Visualising social space: Investigating the use of space and human-animal interaction in Neolithic built environments in the Zagros Mountains and adjacent lowlands.

Thesis submitted in accordance with the requirements of the University of Liverpool for the degree of Doctor in Philosophy by Cecilie Lelek Tvetmarken.

December 2012

Abstract

The Neolithic in the Near East witnessed increased duration of settlements and the emergence of food production. Research has in recent decades become increasingly focused on the social mechanisms that underpinned these developments. There has been considerable debate about the extent to which Neolithic built environments reflect new forms of social relationships, household composition and interaction, and the degree to which these may be linked to new economic practices. Most discussions have, however, focused on the Levantine record as it presents a more comprehensive data set. Despite the increase in fieldwork taking place in the Zagros and adjacent lowlands since the late 1990s, there are still temporal gaps in our understanding of the transition from mobile hunter-gatherer groups to more sedentary communities in this area. Additionally, discussions have tended to focus on the reconstruction of economic strategies, and especially the question of caprine domestication, with little consideration of the social transformations that took place in this area. The main aim of this thesis is therefore to begin to redress this situation by providing a contextualised examination of social practices within Neolithic communities in the central and northern parts of the Zagros Mountains and adjacent lowlands.

The methodology employed in this thesis utilises a computer-based modelling approach that allows us to visualise architectural remains as lived-in spaces by considering how people lived within and utilised the built environment. Various scenarios were modelled to assess the physical affordance of space for human occupancy, different scales of social interactions and activities associated with daily life, human-animal interaction, and potential storage capacities. This facilitated an examination of how the structuring and use of space may reflect the social practices that existed within individual communities.

The modelling has indicated that there was considerable variability in the structuring and use of space within the built environments considered in this thesis, which indicates differing social practices within these communities. Especially interesting is the differences in the spatial configurations between the roughly contemporary level D at Ganj Dareh in the Zagros uplands and the later occupational phases at Nemrik in the lowlands of northern Iraq, which suggests that there were significant differences in the spatial patterning of activities and social practices at these two sites. The modelling has also shown that instead of the increased compartmentalisation purportedly associated with increased household autonomy there appears to be a decrease in internal sub-division throughout the Neolithic in the Zagros. This is accompanied by an increase in the spatial separation of co-resident units and an increased affordance of space for animals within the built environment. The modelling also indicates that there was no substantial increase in storage capacities as all structures examined had the capacity to facilitate storage of enough food and fodder to support the co-resident unit and a small herd of goats.

Acknowledgments

There are many people who have contributed to my thought process throughout the writing of this thesis. First and foremost I would like to express my sincere gratitude to my supervisors, Prof. Douglas Baird and Dr. Matthew Fitzjohn, for their continuous guidance, encouragements, and insights over the past four years. This thesis would not have been possible without their support and advice throughout.

I would also like to offer my thanks to Dr Rachel Pope and Dr Jessica Pearson for their encouragements and discussions on aspects of my research. Special thanks must also go to Rachel Heslop and Samantha Cook for their continuous support and for reading and commenting on various drafts of this thesis. I would also like to thank my friends and colleagues Dr. Nick Taylor, Dr. Corisande Fenwick, Rhw Mitcheson, Nick Wernick, Rosa Campos-Blade, Beliz Tecirli, Rachael Brown, Dr. Holly Miller, Lucy Bennison-Chapman, Francoise Rutland, Ceren Kabukcu, Caroline Middleton, Martina Keller, Tim Wakeford, John Stewart, Nicky Nielsen, Christine Schepens, Banjo Patterson, Rosie Patterson, Joe Skinner, Anke Marsh, Andy Shuttleworth, and Mari Dragland Gjersvoll for their continuous support, advice, stimulating discussions, as well as keeping me sane throughout.

This research was funded by the Duncan Norman Research Scholarship and the Overseas Research Student Award Scheme (ORSAS) Scholarship.

Table of Contents

Appendices

List of Figures in main text

List of Tables in main text

Appendices: List of Figures and Tables

Chapter 1

Introduction

1.1: Introduction

Ever since Gordon Childe postulated that the 'Neolithic Revolution' was the first pivotal economic and cultural transformation in human prehistory (Childe 1941), the origins and establishment of agricultural economies has been a major focus in research on the Neolithic in the Near East (Asouti 2006; Byrd 2005a; Kuijt and Goring-Morris 2002 and references therein). Robert Braidwood's Iraq-Jarmo Project in the Zagros foothills of Iraq, initiated in 1947, was the first interdisciplinary fieldwork project that systematically attempted to investigate the Neolithic period (Braidwood 1973). The project marked the beginning of a new focus in the archaeology of the Near East, which up until then had been primarily concerned with chronological issues and the acquisition of museum pieces (Braidwood 1972: 310; Wright 1971: 447-9). Braidwood subsequently conducted fieldwork in the Kermanshah Valley in central Zagros, western Iran (Braidwood 1960, 1961; Braidwood, Howe and Reed 1961), which stimulated the initiation of other archaeological projects focusing on the Neolithic in the Iranian Zagros (Young 1987: 287), e.g. at Tepe Guran (Meldgaard, Mortensen and Thrane 1963), Ganj Dareh (e.g. Smith 1976, 1990), Hajji Firuz (Voigt 1976, 1983), Ali Kosh (Hole and Flannery 1962, 1967; Hole, Flannery and Neely 1969), and Tepe Abdul Hosein (Pullar 1981, 1990).

There has since been a westward shift in the geographical focus of fieldwork and general research attention. The political circumstances in Iran and Iraq led to a paucity in excavations and surveys conducted there since the 1980s and the area was largely neglected in Western scholarly discussions concerning the Neolithic (Abdi 2001:51;

Kozlowski and Aurenche 2005: 20; Zeder 2009: 14).[1] This situation has started to change with an increase in the number of archaeological projects taking place in Iran since the late 1990s (Azarnoush and Helwing 2005: 189) with local and foreign archaeologists undertaking (often collaborative) projects in various parts of the country (e.g. Darabi and Fazeli 2009; Matthews et al 2010; Potts et al 2005; Potts et al 2009; Tsuneki, Zeidi and Ohnuma 2007; Weeks et al 2006). However, there are still temporal gaps in our knowledge concerning the transition from mobile hunter-gatherer groups to more sedentary communities, especially in the upland zones of the Zagros (Hole 1996: 263-268), and most models aimed at explaining the developments that took place during the Neolithic have been constructed based on more substantial data sets from the Levant (see Asouti 2006 and references therein).

The increased duration of settlements from the Late Epipalaeolithic through the Early Neolithic tends to be viewed as a region-wide phenomenon characterised by a shift from temporary circular or oval hut structures to larger rectangular, often multi-roomed buildings. Plant cultivation and herding of animals began sometime during this period, resulting in increased reliance on domestic crops and animals and an eventual decrease in exploitation of wild resources. Archaeological research was initially concerned with the technological and economic aspects of this transition, especially pinpointing the location and timing of the domestication of plants and animals (Kuijt 2000a). In recent decades attention has turned to the social mechanisms that underpinned the developments that took place (Asouti 2006: 98; Kuijt 2000b, 2000c), focusing on issues such as household composition and organisation, social differentiation, competition, and ritual behaviour (Bender 1978; Byrd 1994, 2000, 2005b; Flannery 1972, 2002; Kuijt 1995, 2000b: vii, 2000c: 311-315, 2000d, 2000e; Watkins 2002: 41; see various contributions in Gebel, Hermansen and Jensen 2002; Kuijt 2000f). Settling down and dwelling within permanent settlements would have affected the ways in which people related to and interacted with each other (Banning 2003: 5; Wilson 1988: 4, 9-10); one of the ways that people manage social relationships within sedentary communities is through the construction of architectural structures, as these spatially mark out and direct social interaction (Marshall 2006: 160). In this sense, the built environment facilitates particular forms of understanding and actions (Boyd 2006: 171). Architecture and the use of space are therefore central features in the investigation of issues such as sedentism, social organisation, community structure, and household composition (e.g. Byrd 2000, 2005b; Flannery 1972; Cutting 2005; Düring 2006; Verhoeven 1999).

Archaeologists have recorded a range of regional variations in vernacular architectural traditions during the Epipalaeolithic and Neolithic. In the Levant structures were circular or oval, some with internal features such as post holes for roof support, hearths, sub-floor burials, and/or shallow stone-filled basins or depressions during the Epipalaeolithic (Goring-Morris and Belfer-Cohen 2008: 244-250). In the subsequent Pre-Pottery Neolithic A (PPNA)

[1] In Iran there were also limitations on work conducted by Iranian archaeologists during the 1980s (Abdi 2001: 51). It was not until the 1990s, when increased funds and new equipment became available that there was an increase in archaeological activities; halted projects were resumed, old sites re-excavated and new projects initiated.

buildings were oval, semi-subterranean, made of stone, *tauf/chineh*[2], or mud bricks, and occasionally had post holes for support posts, internal dividing walls, hearths, limestone slabs with cupholes set into the floor, and external silos (Goring-Morris and Belfer-Cohen 2008: 254; Kuijt and Goring-Morris 2002: 737). During the transition to the Pre-Pottery Neolithic B (PPNB), structures became rectilinear, were made of mud bricks and/or stone with plastered floors and walls, many had multiple internal spaces and some an upper storey (Goring-Morris and Belfer-Cohen 2008: 261; Kuijt and Goring-Morris 2002: 392, 407). In southeast Anatolia and along the western flanks of the Zagros, buildings were circular or oval during the Epipalaeolithic and Early Aceramic Neolithic (e.g. Hallan Çemi, Zawi Chemi, Çayönü, Qermez Dere, and Nemrik) with rectangular and rectilinear structures appearing in the Late Aceramic Neolithic (Peasnall 2000). The PPNB/Late Aceramic Neolithic saw the appearance of a range of architectural traditions specific to certain regions, including 'pier houses' in the central southern Levant (e.g. Beidha, 'Ain Ghazal); 'grill-plan' or 'cell-plan' buildings in southeast Anatolia (e.g. Çayönü, Nevalı Çori); and agglutinated, rectangular structures in central Anatolia (e.g. Aşıklı Höyük, Çatalhöyük) (Banning 2003; Banning and Byrd 1988; Düring 2006). At some sites in Mesopotamia structures became larger and highly compartmentalised from the Later Aceramic Neolithic throughout the Pottery Neolithic (e.g. Bouqras, Sabi Abyad, Tell as-Sawwan) (Banning 2003: 15).

The changes in architecture and use of space observed throughout the Early Neolithic are often linked to changes in economic and social relations within the various communities. Explanatory models emphasise the appearance of the nuclear family household as the primary social and economic unit, increased household autonomy, a lessening of community-wide sharing of resources and increased inward focus of economic production and consumption, the emergence of private property and inheritance, and social crowding (Byrd 1994, 2000, 2005a: 265-268, 2005b; Flannery 1972, 2002; Kuijt 1995, 2000d; Kuijt and Goring-Morris 2002: 420-423; Zeder 2009: 22-24). These social transformations are thought to have resulted in increased social tension and social inequality which people sought to defuse through communal rituals centring on elaborate mortuary rituals or non-domestic buildings (Byrd 1994; Kuijt 1995; 2000e). Flannery (2002: 424-432) has extended this developmental trend to include the appearance of large, internally compartmentalised buildings housing extended families at Late Neolithic settlements in northern Mesopotamia, which he links to increased labour demands exceeding the capacity of the nuclear family. These models are largely functionalist understandings that assume a causal link between economic and social progression and architectural changes. The constructed narratives tend to assume linear trends that equate architectural developments with increasing social

[2] *Tauf/chineh* will be used throughout this thesis to describe the building technique consisting of layering mud by hand: uncompressed slabs of mud (tempered with straw) are piled on top of each other at about one quarter or one sixth of the intended height, then left to dry for two-three days before another layer is built (van Beek 2008: 3). This building technique is still in use in the Near East today (e.g. Kramer 1982: 91; Watson 1979: 119) – *tauf* is the Iraqi term and *chineh* is the Iranian term. The term *pisé* is often erroneously used in the archaeological literature to describe architecture that is in fact layered mud; *pisé* is actually rammed earth, a construction technique consisting of compacting soil by pounding or tamping in wooden or metal forms (van Beek 2008: 3).

complexity (Cutting 2005: 10). They rely heavily on Levantine data sets with little mention of vernacular architectural traditions from other regions, apart from where they provide assumed parallels to Levantine sites.

Even though the Zagros region has gained increased attention since the late 1990s, the focus of research has remained on the reconstruction of subsistence strategies, and in particular the question of caprine domestication (e.g. Hesse 1982; Zeder 1999, 2009; Zeder and Hesse 2000). There has been a lack of consideration of the social strategies within Neolithic communities compared to the Levant and southeast Anatolia, in parts due to the paucity of work and difference in the amount of available evidence. The main aim of this thesis is to begin to redress this imbalance through an analysis of the built environment and use of space within Neolithic settlements in the central and northern parts of the Zagros, and a discussion of the information this may provide concerning social practices within these communities.

There is no standardised methodology for studying architecture in archaeology, even though most approaches tend to overlap to a certain degree (Cutting 2006; Lawrence and Low 1990 and references therein). The various methodologies focus on one or more of the following aspects: architectural form, continuity and standardisation; spatial distribution of activities; patterns of movement within the settlement; the relationship between built and non-built space; and ethnographic analogy (Cutting 2006). There has been an increased recognition within archaeology that buildings were originally lived-in spaces (Fitzjohn 2007; Hemsley 2008; Nevett 2007; Sturt 2007), a point which is often neglected in traditional discussions of the use of settlement space. The methodology employed in this thesis (which is presented in detail in chapter 3) aims to integrate this element into the analysis by assessing the physical affordance of space within built environments for human occupancy, human-animal interactions, and storage. Through contextualised site-specific examinations this thesis asks whether the proposed models (discussed in more detail in chapter 2) are appropriate explanatory tools for understanding the social strategies of Neolithic communities in the central and northern parts of the Zagros and adjacent lowlands.

More importantly, this study allows us to begin to form a picture of the social strategies within Neolithic communities in the Zagros which so far has been lacking – one that does not rely on generalising models. It is not denied that the approaches listed above have provided useful insights and raised some important points concerning social structures within Neolithic communities. However, their concern with similarities in built form ignores much of the diversity that exists in the archaeological record, and masks potential differences in social practices (Hemsley 2008: 305-321). Also, by moving away from broad-scale, linear narratives based on evidence from a region that is significantly different (not only in terms of the physical environment, but also socio-economic developments) it may be possible to start to move towards a more situated understanding of the social transformations that took place in the Zagros, one that incorporates an evaluation of social life within these communities. In order to do this it is necessary to look at how individual built environments in the Zagros may have been occupied and utilised. This question is approached through a consideration of the physical affordance of space for people to conduct everyday activities, and humans and animals to be co-present. More specifically, the methodology used in this thesis aims to answer five interrelated questions:

- What is the affordance of space for co-residency within individual structures?
- What is the affordance of space for co-presence and social interactions within the built environment?
- Are there differences in the nature and scale of domestic activities taking place inside buildings and in external areas?
- Is the built environment designed to include animals, and what are the implications of this for early animal management practices and human-animal relationships?
- Does the built environment afford storage, and what are the social and economic implications of possible storage practices?

Together these questions allow us to evaluate the social structures at individual sites by considering how people related to each other on a daily basis through co-habitation and social interactions focusing on a range of domestic activities. It also allows us to assess economic strategies in terms of possible storage and herding practices. The ways in which the methodology can inform on these issues is elaborated upon in chapter 3.

This thesis focuses on three sites in the central and northern parts of the Zagros, although it is acknowledged that there are sites in the southern part of the Zagros and further east that may be suitable for the scenario modelling undertaken in this thesis. However, as the three main case study sites chosen for examination (i.e. Ganj Dareh, Jarmo, and Hajji Firuz) are already located within a large geographical area it was felt that the inclusion of sites in the southern part of the Zagros would extend the geographical range to a point at which comparison would be complicated and liable to criticism for assuming some degree of relationship in developmental trajectories between settlements spread over such a large geographic area. Additionally, it was decided to focus on the region of the Zagros upon which much of the debate concerning caprine domestication has centred, and in that sense contribute an additional aspect to this discussion. Although Hajji Firuz has not featured in this debate, it is included due to a greater geographical proximity to the other two main case studies, and in order to allow an assessment of potential temporal developments which have been suggested in previous discussions of the social transformations that took place during the Neolithic (discussed in more detail in chapter 2).

1.2: Thesis structure

The next chapter (chapter 2) provides a review of the relevant archaeological information pertaining to the current understanding of the social and economic developments that occurred during the Neolithic. Initially, the ecological, climatic, and geographical setting of the Zagros region is outlined in order to situate these changes within an environmental context. This provides the necessary background information on resource availability and seasonal variations in temperatures and weather conditions that may have had an impact on social and economic strategies in the Zagros (especially at higher elevations where winter conditions can be severe), which is important in building an understanding of the communities inhabiting the area. These seasonal variations may have affected storage practices and herding strategies (e.g. seasonal movement of herds, storage of fodder and so on), and seasonality may have been a factor in the spatial patterning of activities within a settlement (e.g. shelter from snow, rain, wind or sun). The possible impact of seasonal variations in temperature and weather is discussed further in the methodology chapter (chapter 3) and where relevant in the various case studies (chapters 4-7). The next part of chapter 2 provides the background information about the current archaeological understanding of the development of plant cultivation and animal herding in the Levant, southeast Anatolia and the Zagros, and the main material characteristics of various archaeological entities in these areas from the Epipalaeolithic through the Early Neolithic. This review highlights the differing information available for each region, and situates the subsequent discussion of existing approaches to Neolithic architecture and social organisation within an archaeological context. The last section of chapter 2 reviews the existing approaches that have been applied to the interpretation of how Neolithic architecture reflect social organisation, highlighting the focus placed on issues of sedentism, household structures, activity areas, and ritual behaviour. These issues are elaborated upon further in chapter 3 where the methodology that facilitates the discussion of the use of space and structuring of social life within Neolithic built environments in the Zagros is presented.

The next three chapters present the in-depth analyses of the use of space at Ganj Dareh (chapter 4), Jarmo (chapter 5), and Hajji Firuz (chapter 6) in the Zagros Mountains and piedmont using the methodology outlined in chapter 3. As it was decided to focus on the central and northern part of the Zagros, these sites were chosen based on the quality and quantity of the available evidence concerning Neolithic built environments. They offer the most comprehensive (albeit not complete) data sets pertaining to the structuring of space within Neolithic settlements, on which the modelling outlined in chapter 3 depends. Chapter 7 presents four additional case studies: one from the Zagros uplands, one from the lowlands of southwest Iran, and two from the lowlands of northern Iraq. Two of these case studies, Sheikh-e Abad and Ali Kosh, have less information available regarding settlement space than the main case studies. They are included to provide additional perspectives on the Zagros Neolithic, as well as to highlight the potential and limitations of the methodology used in this thesis. Ali Kosh is admittedly located further south than the focus area of this study, but is included because it forms part of the aforementioned discussions concerning caprine domestication due to the fact that it has evidence for a new resource management strategy in the area where a community appears to have moved down from the uplands to the lowland plains (indicating the link between these two areas), bringing with them animals and crops that do not occur naturally in the new environment. The two last case study sites, Nemrik and Magzaliyah, are located in the lowlands of northern Iraq. They are included in order to provide a contrast between the Zagros uplands and adjacent lowlands, and were chosen as they are the two sites for which there is the most information available (i.e. published data) on settlement space from the Early Neolithic in this area.

In the concluding sections at the end of each of the case study chapters the main observations made in the analysis are summarised and compared to the preceding case studies. The key points raised in these sections are discussed in the first part of chapter 8. This forms the basis for the examination of Neolithic social structures in the Zagros and the subsequent evaluation of whether the models discussed in chapter 2 are appropriate frameworks for understanding the developments that occurred during this period. Chapter 9 summarises the main conclusions drawn from this study and suggests possible improvements and future avenues for research.

Chapter 2

Archaeological background

2.1: Introduction

The previous chapter provided a brief history of research and outlined the main aims of this thesis (chapter 1). This chapter outlines the economic and social developments that occurred during the Neolithic in the Near East, focusing on the emergence of plant cultivation and animal herding, how architecture has been used to inform on issues of sedentism, household composition and the use of space, and aspects of ritual behaviour that form part of the current understanding of the social organisation of Neolithic communities. Initially, a summary of the geographical, ecological and climatic setting of the Zagros Mountains and piedmont is provided (section 2.2) in order to situate the changes that took place within an environmental context and to provide background information on resource availability and seasonal differences in climatic conditions that may affect economic and social strategies. Winter conditions, for example, may have had an impact on herding strategies and storage practices, and the use of space may vary according to season due to temperature differences and weather, especially in the upland zones.

The next part of this chapter deals with the development of plant cultivation and animal herding in the Near East. It provides an outline of the current understanding of the economic changes that took place in the Levant and southeast Anatolia (section 2.3.1), and the Zagros (section 2.3.2), and the main material characteristics of various archaeological cultures in each area from the Epipalaeolithic through the Aceramic Neolithic. The chronological terms used in this discussion differ between the areas. There is a variety of terminologies that have been used to describe the archaeological time periods spanning the Neolithic, and an in-depth evaluation of their use falls outside the scope of this thesis. In the Levant the Neolithic is usually divided into the PPNA and PPNB, which is further sub-divided into an Early (EPPNB), Middle (MPPNB), Late (LPPNB), and Final PPNB (FPPNB) phase or sometimes

PPNC (see Byrd 2005a; Kuijt and Goring-Morris 2002: 366-369 and references therein), and the Pottery Neolithic. This terminology was initially defined based on observations made regarding the chipped stone and stratigraphic sub-divisions made by Kathleen Kenyon at Jericho, and has since been refined based on increased information obtained from sites across the southern Levant (Asouti 2006: 91-92; Kuijt 1997). The PPNA-PPNB terminology has often been adopted in discussions of Aceramic Neolithic cultures across the Near East. However, since this chronology is essentially based on lithic types with no or limited presence in the Zagros region, it was felt that it was better to use a chronology based on calibrated radiocarbon dates where available. The dating of the Epipalaeolithic period in the Zagros is problematic and thus some of the dates in sections 2.2.1-2.3.2 are given as uncal bc.

In this thesis the Neolithic is split into two main phases, namely the Aceramic Neolithic and the Pottery Neolithic. These general terms do not have associations with specific materials cultures, but rather indicate the presence or absence of pottery. It is acknowledged that clay vessels have been found at the Aceramic Neolithic site of Ganj Dareh (*c* 8,000 cal BC), yet Pottery Neolithic here refers to the various types of 'soft ware' ceramics that appear around 7,000-6,500 cal BC at sites such as Jarmo and Ali Kosh, both of which have Aceramic and Pottery Neolithic phases of occupation (Dyson 1965; Hole 1987a; Vandiver 1987). The terms Epipalaeolithic, Aceramic Neolithic and Pottery Neolithic are used as chronological indicators only to aid discussion and enable broad temporal comparisons.

The last part of this chapter outlines the ways archaeologists have used architecture (section 2.4) and aspects of ritual behaviour (section 2.5) to try and understand the social aspects of the developments that occurred during the Neolithic. This discussion focuses on the issues of sedentism, household structures and the use of space, social interaction, and ritual behaviour. Certain aspects of these issues, e.g. the ways in which household size have been estimated, types of domestic activities, and the nature of potential storage facilities, are discussed in the methodology chapter.

2.2: Environmental setting

The geographical setting of any area influences the movement of people through the landscape, as well as the distribution of settlements. It provides limitations and possibilities with regards to available natural resources, potential for plant cultivation and animal husbandry, and natural routes of communication, movement and interactions (Hole 1987b: 22). In the Near East the environment is incredibly diverse, ranging from deserts through marshes to snow covered mountains, with a variety of vegetation zones that offer human populations different natural resources. This has resulted in a diverse set of subsistence strategies and ways of life. The Fertile Crescent refers to an area stretching northwards from the Sinai to southeast Turkey and arching southwards down to southern Mesopotamia. Its eastern part includes the Zagros Mountains and foothills in western Iran and eastern Iraq. From the arid plains of the Mesopotamian lowland the landscape rises gradually from the eastern banks of the Tigris River through the steppes of the low piedmont and the rolling, forested foothills to the Zagros Mountains (Wright, McAndrews and van Zeist 1967: 416). The Mountains form part of the Taurus-Zagros arc that extends from southwest Turkey through southeast Turkey and down to the Strait of Hormuz in southwest Iran (Wright 1962: 134). Roughly paralleling the western Iranian border, the Zagros runs from northwest to southeast separating the Mesopotamian lowlands from the high, dry Iranian plateau and consists of a series of long parallel ridges and intermontane valleys of mainly Cretaceous and Tertiary limestones and marls (van Zeist and Bottema 1977: 21). It can be divided into two parallel geological zones, namely the high karstic zone and the folded zones. The high zone forms the highest part of the range with peaks reaching up to about 4,500 meters above sea level, whereas the folded zone occupies the lower parts (up to between 1,380 and 2,500 meters above sea level) along the west and southwest and includes the foothills (Heydari 2007: 654-656). Several rivers cut transversely across the mountain ridges to join the Tigris River, including the Greater Zab, Lesser Zab, Diyala, Karkheh and Karun Rivers (Wright, McAndrews and van Zeist 1967: 420; van Zeist and Bottema 1977: 21). The natural gaps created by these rivers and the structural openings between the folds are the main two factors dictating human movement between the intermontane valleys, and between the Mesopotamian lowlands and the Iranian Plateau and further east. One of these routes is the Khorasan Road, which formed part of the Silk Road, connecting Baghdad to Tehran via Kermanshah and Hamedan in the Central Zagros (Hole 1987b; Wright, McAndrews and van Zeist 1967: 420).

The Zagros region currently enjoys a Mediterranean climate with hot and dry summers, especially at lower altitudes, and winters that are cool and wet at higher elevations and mild and moist in the foothills zone (Wright 1962: 136).[3] Annual precipitation ranges from 250-400 mm in the piedmont to about 1,500 mm in the central part of the high mountains. Most of the precipitation falls between late autumn and spring (often in the form of snow at higher altitudes), and there is almost no rainfall during the summer (Wright 1962: 136-138; Zohary 1963: 5-6). The distribution of rainfall in the Zagros region is influenced by the mountain ridges as they form a barrier to the winter storm tracts coming from the Mediterranean Sea. Precipitation is therefore low in the interior of Iran, especially in the rain shadow of the higher mountains (Wright 1962: 138). The vegetation in the Zagros region can be divided into four broad zones (roughly from west to east): the lowland Mesopotamian steppe; the pistachio-almond forest-steppe (or savanna) of the foothills; the Zagros oak forest; and the steppe of the interior plateau (Zohary 1963). There are few records that deal with the vegetation at elevations above 2,500 meters above sea level, which is the upper limit of the Zagros oak forest at present day. It is believed that juniper steppe-forests extend the woodland areas to

[3] See Appendix A for the mean annual temperatures and precipitation for selected cities in the region today.

an altitude of between 2,500 and 3,000 meters, above which it is likely to be a tree-less, alpine vegetation (van Zeist and Bottema 1977: 24-27).

Palaeoenvironmental studies in the Near East have indicated that the region was colder and drier during the Younger Dryas (*c* 11,000-9,500 cal BC), at the end of which was a period of rapid warming and increased precipitation. Studies of pollen cores from the Mirabad and Zeribar Lakes (at approximately 800 and 1,300 meters above sea level respectively) in the Zagros Mountains suggest that open vegetation dominated by *Chenopodiaceae*, *Artemisia* and *Umbelliferae* prevailed in the area during the Late Pleistocene. This steppe vegetation would have included numerous edible food plants, such as perennial grasses, legumes and tubers, although in low densities (Hillman 1996: 178-181). Some of these species are most likely underrepresented in the pollen record due to their poor pollination (Hillman 1996: 176). Trees, such as *Pistacia*, *Amygdalus*, *Quercus* and *Acer* expanded slowly from the end of the Pleistocene, resulting in forest-steppe vegetation during the Early Holocene. The expansion of the forest-steppe also resulted in an increased density and spread of cereals and legumes (Garrard 1999: 68-70; Hillman 1996: 181-192). The increase in grasses that occurred from *c* 10,000 cal BC, peaking at *c* 8,500 cal BC, appears to correspond with an increase in human settlement of the uplands in the central part of the Zagros, with sites such as Asiab, Ganj Dareh, Sheikh-e Abad and Abdul Hosein being occupied during the 9th millennium cal BC (Matthews 2009a: 8).

The oak woodland expanded more slowly and it was not until about 5,500 years ago that it had established itself (Wright, McAndrews and van Zeist 1967; van Zeist and Bottema 1977). This delayed expansion of trees has often been interpreted as a result of a slow increase in precipitations during the Early Holocene, which implies that conditions were drier than at present (Roberts and Wright 1993: 201). Roberts (2002) has argued for an alternative explanation to the slow spread of trees during this period. He suggests that human landscape management, such as the use of systematic burning to regulate vegetation composition in order to facilitate grazing and possibly dry-land cereal cultivation, played an important role in the delayed establishment of the oak woodland vegetation in Western Zagros and Anatolia (Roberts 2002: 1007-1009).

The expansion of the woodland-steppe during the Early Holocene would also have encouraged increased population of many hunted animal species, e.g. gazelles, onagers, wild sheep and goats, aurochs, and red, roe and fallow deer (Smith 1995: 50-51). In terms of species that were domesticated during the Neolithic, goats typically prefer steep and rocky terrains as they are very adept at climbing, whereas they are left more vulnerable to predators on level ground because of their slow gait. Sheep on the other hand can occupy more undulating habitats as they are good runners, but less suited to rugged, mountainous terrain (Legge 1996: 238; Smith 1995: 54, 57). Wild boars have a wide geographical distribution, thriving in rich, well-watered vegetation such as river valleys and marshy areas. It has been noted that as they constitute only small proportions of the animal bone assemblages from Neolithic sites in the Zagros compared to sites in the northern part of the Fertile Crescent, their distribution may have been more restricted there (Smith 1995: 62-65). The distribution of aurochs extended throughout the entire Fertile Crescent as is evident by auroch bones having been found at sites across the region prior to cattle domestication (Smith 1995: 65-67).

2.3: The development of plant cultivation and animal herding

Over the years studies of plant and animal remains have generated much information concerning the domestication process (Cappers and Bottema 2002; Clutton-Brock and Grigson 1984; Harris 1996a; Harris and Hillman 1989; Price and Gebauer 1995; Ucko and Dimbleby 1969; Zeder et al 2006a; Zohary, Hopf and Weiss 2012). Part of this research has focused on identifying certain physical and morphological characteristics resulting from domestication (e.g. Helbaek 1959; Renfrew 1969; B. D. Smith 1995, 2006; Zeder 2009: 33-34). Subsequent advances in analytical methods and re-evaluation of available data have resulted in more specialised approaches and an increased understanding of domestication that acknowledges the role of human behaviour in this process (Zeder et al 2006b: 1-2). The increase in knowledge has led to the recognition that there were multiple domestication events across the Near East, e.g. wheat in northern and southern Levant, barley in southern Levant and possibly the Zagros (Willcox 2002, 2005), goats in the Zagros highlands (Zeder 1999; Zeder and Hesse 2000), and sheep in the eastern Taurus region (Zeder 2008: 11598; Zeder and Smith 2009: 683).

Research is now no longer primarily focused on finding the earliest domesticates (Harris 1996b: 2); it has been pointed out that the identification of distinct morphological changes is insufficient as markers of domestication as these are only evident in the later phases of the process (Zeder 2008; Zeder and Smith 2009: 685). Attention has now shifted to the earlier stages of plant cultivation and animal herding that preceded domestication. The transition from hunting and gathering to agriculture was potentially a long process that involved changing relationships and interaction between humans and plants and animals (Miller 2002: 85; Zeder 2006, 2008: 11598-11599). As such, morphological changes do not signify the starting point of agricultural development, but are instead indicative of an agricultural economy that is becoming increasingly established (Zeder 2009: 38-39). Even though cereals can *theoretically* display certain morphological characteristics associated with domestication after only a few generations of cultivation (Hillman and Davis 1990a, 1990b), initial cultivation is not easily distinguished from a subsistence strategy of intensified exploitation of wild resources (Hillman 1996: 194). Since the appearance of domestic type cereals was preceded by a period of cultivation when cereals retained their wild type traits, archaeobotanists have started to investigate other lines of evidence. The presence of weeds in archaeological crop assemblages, for example, is believed to be indicative of cultivation since tilling of arable soil creates a favourable environment for certain weedy species (Colledge 2002). Hillman et al (2001) have argued for cereal cultivation during the Epipalaeolithic occupation at Abu Hureyra in the Euphrates Valley, northern Syria, based on the continued use of rye and wheat after the onset of the Younger Dryas, combined with a marked increase of small-seeded legumes, small-grained grasses, and stony-seeded dry-land gromwells. All of these plants, of which the latter three are weeds associated with rainfall cultivation, would have been adversely affected by the deteriorating environmental conditions at that time and would not have been able to grow in the environment around Abu Hureyra without human involvement (Hillman et al 2001: 385-388). The new emphasis on identifying the early stages of cultivation that preceded plant domestication has rightly refocused attention on the role of human behaviour, in particular those associated with landscape management.

There has also been a similar shift in the study of the domestication of animals from focusing on genetic change to the human behaviours that are associated with the process of domestication (Redding 2005). The new skill sets required to successfully manage a herd of animals potentially susceptible to domestication necessitates adjustments in human-animal relationships (Smith 1995: 25-28). It has been proposed that targeted hunting strategies can be distinguished from initial herd management by recording the demographic profile, i.e. the sex-specific age profiles, of faunal assemblages as each strategy will result in distinct kill-off patterns (Hesse 1978, 1982, 1984; Zeder 1999; Zeder and Hesse 2000). This is not entirely unproblematic since most species have different natural demographic patterns. Caprines, for example, will separate into distinct nursery and bachelor herds at different times throughout the year (Reed 1983: 515-516). The possibility remains that any patterning in the bone assemblage could be a reflection of the animals available to hunters and/or a selective hunting strategy rather than initial herd management. Ideally, for demographic profiling to be more conclusive, it should be combined with other lines of investigation, such as changes in species abundance at a site (Reed 1983: 516; Smith 1995: 25-33), and/or the appearance of a species outside of its natural habitat.

The first clearly domestic forms of both plants and animals date to the PPNB (*c* 8,500-6,900 cal BC), with the earliest domesticated plants predating the first morphologically domestic animals by about 1,000 years (Zeder 2009). The view of the Neolithic as an economic revolution (sensu Childe) may, on the one hand, be somewhat misleading as the start of the Neolithic does not mark the beginning of agriculture in terms of a fully agricultural economy reliant on domestic species (Nesbitt 2002: 124). It was a period in which a wide variety of subsistence strategies were employed, all of which were undoubtedly continuations of Epipalaeolithic subsistence economies, and some would eventually result in the appearance of domestic forms of plants and animals.

2.3.1: The Levant and southeast Anatolia

The most substantial body of evidence from the Epipalaeolithic and the Neolithic periods comes from the Levant, and most of the models concerning the origins of agriculture therefore draw on this evidence. Many features of Neolithic communities are said to have developed from the preceding Late Epipalaeolithic period, i.e. the Natufian (*c* 13,000-10,000 cal BC). During the earlier part of the Epipalaeolithic sites were small and occupied for shorter periods of time during the year, with its occupants subsisting on wild plant and animal resources (Byrd 2005a: 253-254). The subsequent Natufian period is characterised by longer duration of residency at sites and subsistence strategies with a more extensive reliance on wild grasses, legumes and nuts, and a more diverse set of game, birds and aquatic resources (Bar-Yosef 1989; Byrd 2005a: 255-257). Other characteristics of the Natufian are the occurrence of possible storage pits and an increase in ground stone implements throughout the period, as well as a wider variety of types of ground stones with a particular focus on pounding (Bar-Yosef 1989; Belfer-Cohen and Bar-Yosef 2000: 21; Wright 1991: 28-31, 2000: 92-98). It is believed that these were especially suitable for the preparation of nuts, legumes, and de-husking of wild cereals (Byrd 2005a: 262-263). In the Late Natufian (*c* 11,000-10,000 cal BC) and subsequent PPNA (*c* 9,700-8,500 cal BC) there was a change in ground stone technology with a new focus on grinding implements more suited for cereal preparation (but see Wright 1991: 31-33; 1994: 240-241 on possible multi-functionality of ground stones). This shift accompanies a greater reliance on cereals, as well as the earliest evidence for cultivation of plants (Byrd 2005a: 262-263). It is possible that the shift from implements for pounding to grinding tools could be a result of changes in food preparation rather than just an increased reliance on cereals (Wright 1991, 1994). PPNA settlements were larger and appear to have been occupied for longer than the Natufian sites, and many were situated in locations where sizeable portions of land could be cleared for cultivation and the water table allowed for more reliable harvests (Kuijt and Goring-Morris 2002: 371-372). The faunal assemblages from PPNA sites indicate that humans maintained a diverse diet with an increase in the consumption of smaller animals such as birds, water fowls, tortoises and lizards (Byrd 2005a: 262-263).

The subsequent PPNB (*c* 8,500-6,900 cal BC) was characterised by larger permanent settlements with more elaborate architecture (Goring-Morris and Belfer-Cohen 2008: 260-265; Kuijt and Goring-Morris 2002: 382-413). It was also the period from which the earliest evidence for domesticated animals (e.g. Horwitz et al 1999; Peters et al 1999; Zeder 2009) and plants (e.g. Garrard 1999; Zeder 2009) comes. Gazelle was the main game animal hunted during the Early Neolithic in the Levant. Other large game, e.g. deer, aurochs, wild goat, wild boar, equids and antelopes, made up a relatively small portion of the diet, whereas smaller game, birds and smaller vertebrates increased in importance from the Natufian onwards (Horwitz et al 1999: 65). During the MPPNB goat replaced gazelle as the main animal consumed at many sites, including Tell Aswad, Tell Ramad, Abu Gosh, and Munhatta

(Horwitz et al 1999: 66; Legge 1996: 253). However, it is not until the LPPNB that domestic goats appear in the archaeological record in the area (Horwitz et al 1999: 69). Sheep appear to be rare in the zooarchaeological record of the southern Levant until the appearance of domestic sheep in the PPNB levels at Tell Aswad and Ghoraife in the Damascus Basin and later at other sites further to the south (Horwitz et al 1999: 66; Legge 1996: 252-255). This has been taken to suggest that sheep were domesticated in the northern part of the Fertile Crescent and brought to the south as domestic stock (Legge 1996: 259). The probable location for their domestication is southeast Anatolia; sheep with demographic profiles suggesting herding have been found at the EPPNB site of Nevalı Çori, southeast Anatolia, and later at MPPNB sites in the Middle Euphrates Basin (Peters et al 1999: 39-40).

Another species probably domesticated in southeast Anatolia is pig (Zeder 2009: 37). Rosenberg et al (1998) have presented a claim for the early occurrence of pig husbandry at Hallan Çemi (10^{th} millennium cal BC), based, in parts, on the reduction of tooth size and the kill-off pattern observed in the bone assemblage. This claim has, however, been disputed as the size of the molars fall within a range also observed in wild specimens, and kill-off patterns similar to that observed at Hallan Çemi have been attested in earlier assemblages of wild boar and in ethnographic accounts of the hunting strategy of certain hunter-gatherer groups (Peters et al 1999: 40-41), namely nest robbing. Redding (2005) maintains that the assemblage indicates that human behaviour and use of pigs at Hallan Çemi change from the early to the late phase of occupation. He (2005: 43-47) argues that he is not so much concerned with whether the pigs are being domesticated in the sense of morphological changes brought on by a consistent practice of management, but rather that the form of pig husbandry at Hallan Çemi constituted one of a multitude of subsistence strategies undertaken during this period – one that ultimately did not last. His main point is that archaeologists need to consider the possibility that the various human subsistence behaviours during the Epipalaeolithic and Neolithic may not necessarily all have led to domestication; domestication should be considered a nonlinear process involving much experimentation, trial and error (Redding 2005: 46-47). The earliest morphological evidence for domesticated pigs comes from the LPPNB levels at Hayaz Höyük and Gürcütepe, southeast Anatolia, and Tell Halula, northern Syria (Peters et al 1999: 41). Domestic pigs are not found in the southern Levant until the LPPNB-FPPNB levels at ‘Ain Ghazal and Atlit Yam (Horowitz et al 1999: 70-71, 77). The last of the four species to be domesticated during the Neolithic was cattle. It is believed that the process of domestication had started by the MPPNB in the Euphrates Valley (Zeder 2009: 37), although domestic cattle is not attested until the LPPNB at sites such as Gürcütepe, Hayaz Tepe, Bouqras, and Ras Shamra (Peters et al 1999: 40).

The earliest occurrence of wild cereals and pulses in the archaeobotanical record of the Levant comes from Middle and Late Palaeolithic cave sites in Northern Israel (60,000-30,000 uncal bc); the earliest assemblage containing multiple species – including wild barley, emmer wheat, lentils, nuts and fruits – was found at the Early Epipalaeolithic site of Ohalo II (*c* 21,000 cal BC) (Garrard 1999: 72-73; Weiss et al 2004). The steady expansion of oak forest and park-steppe woodland during the Early Natufian would have increased the availability of edible plants such as legumes, cereals and nuts (Hillman 1996: 181-192). However, the later part of the Natufian, which coincided with the onset of the Younger Dryas, brought cooler, drier conditions leading to a retraction of the park-steppe woodland belt and the natural habitat of cereals and legumes. It has been argued that this encouraged human cultivation of plants (e.g. Bar-Yosef 2001a: 7; Hillman 1996; Hillman et al 2001: 390; McCorriston and Hole 1991: 48-49). As previously mentioned, Hillman et al (2001) argued for the cultivation of rye and wheat at Abu Hureyra during this period, and the earliest evidence for domestic type rye have been directly dated to the later Epipalaeolithic occupation at the site (Hillman et al 2001: 389-91). Interestingly, rye never appears to have become an important part of cereal cultivation in the Near East during this time; the only other identified domestic type rye comes from Can Hasan III in central Anatolia some 2,000 years later (Garrard 1999: 78; Zeder 2009: 29-30).

The archaeobotanical evidence from the PPNA indicate that two-row barley was exploited throughout the region, whereas the distribution of emmer wheat is concentrated in the southern and central parts of the Levant, einkorn wheat in southern Levant and along the Euphrates, and rye in northern Iraq and Syria (Garrard 1999: 74-76). Most of these species are believed to have been cultivated, although there is no evidence for domesticated cereals during this period (Tanno and Wilcox 2012). There is no evidence for domesticated pulses during the PPNA either, although they have been found in significant quantities at some sites, such as Çayönü (Kislev and Bar-Yosef 1988: 177-178). Lentils are the most common, occurring at sites throughout the region, whereas bitter vetch and pea have been found at sites in the northern part of the Fertile Crescent (Garrard 1999: 76; van Zeist and Bakker-Heeres 1982: 207-209). Other wild plants consumed include pistachio (occurring at sites throughout the region), fig, almond and caper. It should also be noted that the earliest occurrences of wild flax have been recorded at Mureybet and ʻIraq ed-Dubb (Garrard 1999: 76).

By the PPNB domestic forms of two-row barley, emmer wheat and einkorn wheat are found throughout the Fertile Crescent, including at sites in Turkey and western Iran. Naked six-row barley appear slightly later in Syria, Turkey and Iran, and free-threshing wheat in the Levant and Turkey (Garrard 1999: 77-78). This distribution pattern of domestic cereals continued throughout the Neolithic with the exception of naked six-row barley, which does not appear in any assemblages in the Zagros (Garrard 1999: 81). Pulses are also widely distributed with lentils occurring at every site, pea has a wider distribution than before (it is found at a range of sites from Jericho in the Levant to Ganj Dareh in the Zagros), whereas chickpea and bitter vetch appear only in the Levant and Turkey, and broad bean only in the southern Levant (Garrard 1999: 77, 79; Kislev and Bar-Yosef 1988: 177-178). Even though pulses are thought to have been widely cultivated during the PPNB, the evidence for domestication is limited; potentially domesticated pea has been found at Çayönü, broad bean at Yiftahel, and chickpea at Jericho (Garrard 1999: 79; Hopf 1983: 585). Later Neolithic evidence for domestic pulses include lentils at Tell Ramad and Bouqras; pea at Bouqras and other sites in Syria, Turkey and Iraq; bitter vetch at sites in Turkey; and chickpea at Tell Ramad (Garrard 1999: 81; van Zeist and Bakker-Heeres 1982: 207-209). Flax becomes more widely distributed during the PPNB (Garrard 1999: 81), with the possibility of domestic type flax at Jericho (Hopf 1983: 586-587) and later at Tell Ramad (van Zeist and Bakker-Heeres 1982: 206-207). A wide range of nuts and fruits continued to contribute to the diet throughout the Neolithic, including pistachio, fig, almond, caper and grape (Garrard 1999: 77-81).

2.3.2: The Zagros

There are no Epipalaeolithic cultural assemblages in the Zagros paralleling the Natufian in the Levant. Archaeological evidence for human occupation in the area during the Palaeolithic is mainly found in caves and rock shelters, and most of the information available concerns lithics. The Zarzian period has only been documented in any detail at Zarzi cave and Warwasi rock shelter, although Zarzian material has been recorded in surveys (Azarnoush and Helwing 2005; Rosenberg 2003) and other excavations, e.g. at Palegawra and Shanidar Cave B2 (Olszewski 1993: 213, 1994: 83-84). Most of the known Zarzian sites are located in the central Zagros, but lithics described as belonging to the Zarzian tradition have also been reported in the southern Zagros (Rosenberg 2003; Tsuneki, Zeidi and Ohnuma 2007) and the Central Iranian Plateau (Azarnoush and Helwing 2005).

As is the case with the preceding Upper Palaeolithic period in the Zagros, the Baradostian, the Zarzian primarily refers to a lithic tradition first described by Garrod following her excavation at Zarzi cave. It has never been clearly defined by archaeologists – perhaps in part due to the intermittent evidence – and most of our knowledge of this period concerns the lithic industry, in particular the assemblage from Warwasi (Roustaei et al 2004: 692). The Zarzian industry is dominated by blades and bladelets characterised by mainly non-geometric (mostly pointed types), but also geometric microliths (especially scalene triangles, but also quadrilaterals and lunates); notched and denticulated blades and flakes; backed blades and bladelets; burins and microburins; end scrapers, thumbnail scrapers and side scrapers; drills or perforators; and occasional single-shouldered points (Olszewski 1993: 208-209; Rosenberg 2003: 100-101; Smith 1986: 28; Wahida 1981). Additional observations have been made regarding changes in the lithic assemblage from the Zarzian deposits at Warwasi, including scrapers becoming more common than burins, which contrasts the situation in the Baradostian; most of the microliths are non-geometric; geometric microliths, microburins and borers are absent in the earliest Zarzian deposits; and lunates only appear in the latest Zarzian deposits (Olszewski 1993: 210-212, 1994: 86). It is often assumed that the presence of microliths indicate use of composite tools (Tsuneki, Zeidi and Ohnuma 2007: 7), although there is no direct evidence for this from Zarzian sites (Smith 1986: 28). Most of the Zarzian lithics are made from local flint and chert, although small quantities of obsidian have been found at Zarzi, Palegawra and Shanidar in central Zagros (Smith 1986: 28) and, more recently, at TB75, a Late Epipalaeolithic/Early Neolithic site in southern Zagros (Tsuneki, Zeidi and Ohnuma 2007: 7). The presence of obsidian in addition to the occasional shell beads (e.g. *Dentalium* shells at Pa Sangar; Hole 1970: 291; Hole and Flannery 1967: 160) in Zarzian and Late Epipalaeolithic deposits indicate movement of material in the region during this period, although it is not clear what the nature of this movement was.

It is also unclear if the Zarzian industry developed directly out of the preceding Baradostian lithic tradition or not (Hole 1970; Hole and Flannery 1967: 151-160; Olszewski 1993; Smith 1986: 28-29). Nor is there consensus regarding either the beginning, or the duration of this period (Henry and Servello 1974: 23-24; Rosenberg 2003: 100-101), partly due to the lack of firm radiocarbon dates from this region for the period between 25,000 and 13,000 uncal bc. The available dates from the Baradostian deposits in Shanidar and Yafteh caves range between approximately 38,000 to 19,000 uncal bc, although none of the dates after about 25,000 uncal bc is considered to be reliable, and the dates from the Zarzian deposits at Shanidar (*c* 12,000-10,000 cal BC; Aurenche et al 2001) and Palegawra caves range between 13,000 and 10,000 uncal bc (Smith 1986: 27-28). Hole (1970) argued that the Zarzian developed directly out of the Baradostian lithic tradition at about 20,000 BC based on the continuity of certain lithic forms and basic manufacturing technology between the late Baradostian and the Zarzian levels at the site of Pa Sangar in Luristan province, western Iran (Hole and Flannery 1967: 159-160). Through her study of the Warwasi lithics Olszewski (1993: 211) appears to agree with Hole's assessment. However, the inherent problems associated with the entire Palaeolithic sequence in the Zagros due to lack of reliable dates and a less than satisfactory understanding of the development of the lithic traditions (Rosenberg 2003: 100-101) renders this assumption problematic. Another point that remains unclear is whether the gap in occupation observed in most of the Zagros between the Late Baradostian and the Early Zarzian were in fact a reality, or whether it is due to sites not having been found (Smith 1986: 28). Most appear to assume that the colder conditions at the time would have made human occupation, in particular at higher elevations, unfeasible, and that Zarzian sites may be found in the lowland rather than the highland zone (Smith 1986: 28-29). However, recent survey work has apparently established the presence of Zarzian materials on the Central Iranian Plateau (Azarnoush and Helwing 2005: 193) indicating that more work on the Epipalaeolithic is needed.

Studies of the lithic and animal bone assemblages at Zarzian sites are limited, but seem to indicate short-term occupation in caves and rock shelters for hunting purposes, e.g. at Warwasi (Hole and Flannery 1967: 162-165; Olszewski 1993: 214-215). The animal bone assemblages that have been studied seem to suggest that hunting was focused on one or two principal species, e.g. onager at Warwasi (Turnbull 1975) and Palegawra (Turnbull and Reed 1974), and caprines at Shanidar and Zarzi (Smith 1986: 29). Another feature is the appearance of a variety of birds and certain freshwater species, such as clams, crabs and fish (Smith 1986: 29; see also Payne 1981). Also worth noting is the possibility of domestic dog at Palegawra, indicated by a canid jaw with domestic traits (Turnbull and Reed 1974). There is no archaeobotanical evidence for plant foods from the Zarzian, although, based on the presence of rubbing and grinding stones and the possible ‘storage pit’ at Shanidar, it is assumed that certain species, such as pistachio and possibly cereals, were being consumed (Smith 1986: 29-30).

The transition from the Zarzian to the Neolithic also remains somewhat unclear as archaeological evidence pertaining to this period is limited. Only a handful of sites dating to the earliest phase of the Aceramic Neolithic have been excavated, including Zawi Chemi, Karim Shahir, Shanidar B1, and M’lefaat (in the Zagros foothills). The recent work at TB75 and TB130 in the Bolaghi Valley in Fars, southern Zagros (e.g. Tsuneki, Zeidi and Ohnuma 2007), and the series of rock shelters in Vare Zard in Luristan, central Zagros (Roustaei et al 2004: 705), may help shed further light on this transitional period. One of the few sites that has yielded evidence from the earliest Aceramic Neolithic is the early 10th millennium cal BC site of Zawi Chemi in the Shanidar Valley, northern Iraq. The excavators found a roughly circular stone structure, measuring about 2.20 m in diameter, which had been rebuilt three times. None of these structures had any internal features, but ground stones, hearths and pits were found in the outdoor areas to the south and east of the buildings (Solecki 1981: 53). One unusual external feature was the concentration of animal remains, including at least fifteen goat or sheep skulls and the bones of a minimum of seventeen birds of prey, which have been interpreted as signifying some sort of ritual activity (Solecki 1981: 53-54). Studies of the general faunal assemblage indicate a primary reliance on red deer, sheep and goats, with sheep increasing in importance throughout the occupation at the site. Other species included wild boar, fallow and roe deer, wolf, fox, marten, freshwater clam, fish, and birds (Perkins 1964). Perkins (1964) claimed that the sheep at Zawi Chemi had been domesticated based on the large number of sheep compared to goats in an environment he considers more suited to goats, and the high percentage of immature sheep metapodials in the assemblage. This claim has, however, not been universally accepted. Some researchers have criticised the statistic validity of Perkins’ conclusions as the sample size is very small, whereas others have pointed out that the Zawi Chemi occupants may have hunted on the flatlands closer to the river where more sheep and deer would have been available (Reed 1983: 521-524: Zeder 1999: 12-13).

An alternative to Perkin’s claim for domesticated sheep at Zawi Chemi is that the emphasis on young males between two and three years of age – which is apparently younger than that expected for a hunted population, but older than that of a managed herd – is indicative of a hunting strategy aimed at preserving the female breeding stock in the wild population during a time of increasing pressure on local wild herds (Redding 2005: 44; Zeder 2008: 11598, 2009: 37-38). It is also possible that this age profile is representative of the hunting of bachelor herds (Reed 1983: 515-516), especially if seasonal hunting episodes are involved (Legge 1996: 241). At the site of Karim Shahir, thought to be roughly contemporary with Zawi Chemi (no firm dates have been obtained from the site), the preliminary analysis of the animal bones indicate a reliance on a similar range of wild species as at Zawi Chemi and Shanidar B1, including wild sheep and goat, wild boar, deer, gazelle, wolf, marten, fox, birds, and tortoise (Braidwood and Howe 1960: 53). The exact nature of the occupation at Karim Shahir remains unclear as no discernible structural remains were found at the site; the single phase of activity consisted of a wide scatter of river pebbles of varying density and a few pits containing rocks and traces of burning (Howe 1983).

Caprines continue to play an important role in the diet at later Aceramic Neolithic sites in the Zagros highlands. Much research has focused on the place and timing of the domestication of goat and sheep since it is believed to have taken place in the Taurus-Zagros region of southeast Anatolia and western Iran (Zeder 2008, 2009). The earliest evidence for human management of goats comes from the site of Ganj Dareh (*c* 8,000 cal BC) in central Zagros. Occupation at the site appears to have consisted of two main phases. The remains from the earliest phase (level E) consisted of a series of circular or oval pits with traces of burning, but no structural remains, whereas the later levels D-A contained rectilinear and multi-room structures made of mud-brick and *tauf/chineh* containing storage facilities and ground stones set into the floors (Smith 1990). Hoof imprints of sheep or goats on mud-bricks were found in level D (Smith 1970) suggesting that humans and caprines had developed a closer relationship although this in itself does not necessarily imply domestication (Hesse 1982: 411). Hesse (1978, 1984) and Zeder (1999; Zeder and Hesse 2000) have argued that in level D (and subsequent phases of occupation) the inhabitants were herding goats. By comparing the kill-off pattern of goats at Ganj Dareh to the culling patterns of modern domestic herds they have argued that there is a clear focus on sub-adult males and a delayed slaughter of females that is indicative of a herded population (Hesse 1984; Zeder 1999, 2009: 36; Zeder and Hesse 2000). This contrasts the observed pattern in the earliest occupational level at the site (level E) where young animals of both sexes as well as adult females were killed, which is thought to be more consistent with the hunting of nursery herds (Zeder 1999: 15). It is generally accepted that the goats at Ganj Dareh were herded regardless of whether researchers prefer to rely on age and sex specific profiling or size reduction as indicating domestic status (Bar-Yosef and Meadow 1995; Legge 1996: 249-252). It appears that, even if the goats at Ganj Dareh may not have been morphologically domestic, they had come under human control at some point around 8,000 cal BC. The situation at Ganj Dareh contrasts with that found at the nearby and roughly contemporary site of Tepe Asiab where there is no evidence for domestic sheep or goat (Legge 1996: 248-249).

A more clear case of domestic goats comes from the lowland site of Ali Kosh in southwest Iran. The site dates to *c* 7,500-6,000 cal BC with an occupation spanning both the Late Aceramic and Early Pottery Neolithic. The Neolithic sequence at the site has been divided into the Aceramic Bus Mordeh and Ali Kosh phases and the Pottery Neolithic Mohammad Jaffar phase (Hole, Flannery and Neely 1969: 5-49). One of the main aims of the project was to devise a local chronological sequence based on artefacts, and plant and animal remains (Hole, Flannery and Neely 1969: 2-12), which is reflected in the comprehensive zooarchaeological and archaeobotanical reports from the site (Helbaek 1969; Hole, Flannery and Neely 1969). Flannery (Hole, Flannery and Neely 1969: 266-291) has presented a strong argument that the goats at Ali Kosh were domesticated based on morphological change of horn cores observed between the Bus Mordeh and Ali Kosh phases; the high proportion of young animals killed; and the fact that the Deh Luran lies outside of the natural habitat of goats. The latter would in itself give some indication that the goats had been brought there under human control (Zeder 1999: 17). Flannery (Hole, Flannery and Neely 1969: 266-291) also argued for domestic sheep at the site based on the presence of a hornless female skull in the Bus Mordeh phase, and the twisting of some horn cores in the Mohammad Jaffa phase; both are traits commonly associated with domestic sheep. Zeder (1999: 17-22) has pointed out that this conclusion is problematic because although the Ali Kosh sheep are smaller than the upland sheep this could be due to environmental conditions rather than domestication. Additionally, the sample is too small to allow any analysis of slaughter profiles, and hornlessness can occasionally occur in the wild. Nevertheless, even though the issue of domestication of sheep remains uncertain, it is possible that the inhabitants at Ali Kosh undertook some form of sheep management in addition to goat herding. This was supplemented by a reliance on a range of wild species, including onager, gazelle, auroch, fox, various birds, tortoise, lizards, freshwater fish, clams and mussels (Hole, Flannery and Neely 1969: 264-266, 293-330). Domestic goats, and possibly sheep, have also been attested at the roughly contemporary site of Jarmo (*c* 7,500-6,000 cal BC) in the Zagros piedmont, which also has domestic pigs (Flannery 1983; Reed 1960; Stampfli 1983).

The archaeobotanical record from the Zagros is not as extensive as that from the Levant, as botanical materials have not been collected at some of the sites. None of the Zarzian sites have yielded any evidence of edible plants; buckthorn found at Zarzi cave, for example, is poisonous although it may have been used for medicinal purposes or as a dye (Renfrew 1981: 36). The available botanical assemblages from the Aceramic Neolithic indicate a heavy reliance on wild species. Almond and pistachio are particularly common, but wild pulses, such as lentils and pea, occur as well. Other plants that could *potentially* have been collected for human consumption include *Astragalus* (milk vetch), sea club-rush and mustard seeds (Helbaek 1969; Hubbard 1990; Ilkhani 2009; van Zeist et al 1984: 220).

The earliest evidence for domestic type cereal in the Zagros uplands was recovered at Ganj Dareh. Barley – as the only type of cereal found at the site – was found in both wild and domestic form, and it appears to increase in importance throughout the occupation of the settlement (van Zeist et al 1984: 201-211). Even though the inhabitants at Ganj Dareh had begun to cultivate barley, wild plant foods, and in particular pistachio and almond, continued to be important (van Zeist et al 1984: 222). Preliminary analysis of the archaeobotanical assemblage at Sheikh-e Abad (*c* 9,800-7,600 cal BC) show a similar range of exploited plants; pistachio and almond were the most common, with other species including barley (no wheat), and wild lentils and pea (Ilkhani 2009). Analysis of the archaeobotanical assemblages from the recently excavated Chogha Golan (*c* 8,800-7600 cal BC) and Chia Sabz (*c* 8,500-7,600 cal BC)[4] indicate that barley was cultivated at both sites, with other identified species including wheat, lentils, grass pea, and bitter vetch, as well as almond and pistachio (especially at Chia Sabz) (Riehl et al 2012).

Domestic type two-row hulled barley has also been found at Abdul Hosein (no secure dates; it is believed to be later in date than Ganj Dareh, and as it has both Aceramic and Pottery Neolithic phases of occupation it may be roughly contemporary with Jarmo and Ali Kosh), in addition to large quantities of pistachio and almond, but only one wild lentil. Hubbard (1990: 218) also reported having found oat at the site although the significance of this is not clear. The interesting difference from other upland sites is the presence of emmer wheat, and, although Hubbard (1990) was uncertain whether it is wild or domestic type, it is likely to have been cultivated; emmer wheat appears to have been domesticated in southeast Anatolia and northern Levant (Özkan et al 2002; Özkan et al 2005; Willcox 2005; Zeder 2009: 31; Zohary, Hopf and Weiss 2012: 41), and domestic forms have been found at Ali Kosh and Jarmo. At Ali Kosh both wild and domestic forms of wheat and barley have been found: domestic emmer wheat was the main cultivated crop during the Bus Mordeh and Ali Kosh phases, barley appears to become more important during the Mohammad Jaffar phase, whereas both wild and domestic forms of einkorn wheat occur only sparsely (Helbaek 1969: 389-403). Three species of weed (ryegrass, goat-faced grass and wild einkorn) were introduced with the cultivated cereals, indicating that cultivated plants had been brought in from the uplands (Helbaek 1969: 389-391, 412). This complements the observations made regarding domestic goats being brought into the Deh Luran Plain, which together indicate that people had moved down into the lowlands. Other potential cultivars include a few lentils and fragments of possible flax, whereas the identified oats appears to have been weeds (Helbaek 1969: 397-398). Edible wild plants found at the site include pistachio, capers, and milk vetch (Helbaek 1969: 398-399). Domestic and ‘transitional’ types of emmer and einkorn wheat have also been attested at Jarmo, in addition to potentially cultivated barley, and wild lentils, pea and pistachio (Helbaek 1960; Watson 1983).

[4] Located in the Zagros foothills at *c* 479 and 485 meters above sea level respectively.

Figure 2.1: Map of Neolithic sites in the Zagros highlands and adjacent lowlands mentioned in the text.

Thus far this chapter has presented the environmental setting of the Zagros, and outlined the current understanding of the cultural and economic changes that took place in the Levant and southeast Anatolia, and the Zagros from the Epipalaeolithic through the Aceramic Neolithic, focusing on the development of plant cultivation and animal herding, but also including the main material characteristics of various archaeological cultures in each area. What is clear from this review is that the evidence from the Zagros is limited compared to the Levant and thus our understanding of the social and economic changes that occurred from the Epipalaeolithic through the Neolithic is biased towards the Levant. The limited archaeobotanical record from the Epipalaeolithic and Early Neolithic in the Zagros does not allow an in-depth analysis of plant use and the initial stages of cultivation equalling that of the Levant (Riehl et al 2012: 96) where plant cultivation is attested during the PPNA followed by the appearance of domestic type crops in the PPNB. Wild plants, and, in particular, almond and pistachio, dominate the archaeobotanical assemblages from Early Neolithic sites in the Zagros. Cultivation of barley appears to have begun sometime before 8,000 cal BC, indicated by the assemblages from Chogha Golan, Chia Sabz, and Ganj Dareh. Emmer wheat has been attested at Abdul Hosein in the upland zone, and domestic emmer and einkorn wheat at Jarmo in the piedmont and the lowland site of Ali Kosh, which suggests that wheat was probably being cultivated in both the upland and lowland zones of the Zagros by 7,500 cal BC. With regards to animals, caprines played an important role from the earliest part of the Aceramic Neolithic. Human management of goats is first attested at around 8,000 cal BC at Ganj Dareh, with domestic goats, and possibly sheep, appearing around 7,500-7,000 cal BC at Ali Kosh and Jarmo. The remainder of this chapter will outline how archaeologists have used architecture (section 2.4) and ritual behaviour (section 2.5) to try and understand the social aspects of the developments that occurred during the Neolithic.

2.4: Settlements, architecture and households

Built forms reflect specific socio-cultural concerns particular to the culture in which it is found, modified by local responses to various climatic conditions, available materials and construction methods (Rapoport 1969). Architecture forms an important part of our understanding of past societies, as it provides space in which people live and interact with each other, and thus plays a part in structuring everyday life (Fitzjohn 2007). As research on the Neolithic in the Near East has become increasingly focused on the social aspects of the developments that occurred during this period (section 1.1) the use of space within built environments have received more attention. Structural remains have frequently been used to assess the nature of settlements; the basic assumption being that the more complex the architecture the more developed or intricate the social structures. There is an underlying presumption, which is perhaps not explicitly stated, that the nature of architectural remains, sometimes in combination with other data (e.g. estimated size of a settlement, bioarchaeological remains), is suggestive of the nature of the occupation at a site (Braidwood and Howe 1962: 138; Marshall 2006: 156-158). Sites with simple, unsubstantial structures made of mostly perishable materials (e.g. reeds, branches, brush) and/or utilising natural features (e.g. rock shelters, caves), and with few or no internal structural features have been characterised as seasonal or short-term (e.g. Bernbeck 2001: 9-10). In the Zagros circular or oval structures of stone and semi-subterranean pits, often with evidence of an upper structure made of perishable material, are seen as representative of a seasonally mobile population, including the sites of Zawi Chemi (Solecki 1981), Tepe Asiab, and Tepe Sarab (Braidwood 1960, 1961; Braidwood, Howe and Reed 1961). Architecture involving more labour in terms of construction and maintenance, on the other hand, has often been associated with sedentary occupations (e.g. Braidwood and Howe 1962). This includes both circular and rectangular structures built of *tauf*/*chineh*, mud bricks, and/or stone with evidence of renewed plastering or preparation of floors and walls. These buildings also tend to have an increased number of built features associated with storage and food preparation. The rectilinear, internally subdivided *tauf/chineh* and mud slab structures containing several storage facilities (e.g. clay bins and unfired clay vessels) at Ganj Dareh, for example, have been characterised as the remains of a sedentary settlement (Smith 1990). Architecture is thus intrinsically linked with concepts of settlement types (Bailey 2005: 92; McGuire and Schiffer 1983).

The simplistic equation of structural remains, and thus site types, with specific degrees of sedentism or mobility has recently been criticised (Bailey and Whittle 2005: 1-4). Halstead (2005: 38-39) has pointed out that year-long residency at a site does not preclude a significant degree of mobility; some of the inhabitants at a settlement may have been mobile on a range of different temporal scales, from daily to seasonal, and even generational. In general terms, sedentism denotes the transition from a mobile way of life to taking up permanent, year-long residence in a settlement, and has therefore a central position in the understanding of the Neolithic. The use of the concept of sedentism has, however, been questioned for the way it is entangled with prevailing expectations of what Neolithic 'behaviour' is (see various contributions in Bailey, Whittle and Cummings 2005). Perceptions of the Neolithic period centre on the appearance of sedentary communities and the development of agro-pastoral economies, masking the fact that there were multiple social and economic strategies being pursued throughout the region. The excavations at a range of sites across the Zagros highlands and adjacent lowlands attest to the variety of social and economic practices that took place in the region throughout the Neolithic (Bernbeck 2001: 8-10). For example, Jarmo (*c* 7,500-6,000 cal BC) and Hajji Firuz (*c* 6,100-5,700 cal BC) are viewed as sedentary, agricultural villages (Braidwood 1958: 1428; Voigt 1977, 1983: 322-324), whereas Tepe Sarab (*c* 7,000-6,500 cal BC) and Tepe Tula'i (7th millennium cal BC) are considered to have been occupied by pastoralist on a seasonal or short-term basis (Bernbeck 1992; Braidwood 1960: 107; Hole 1974).

Exploring built environments through presuppositions that associate structural forms with degrees of social complexity has limited value as it tends to favour those sites assumed to be more 'advanced', and reduce our understanding of individual communities. This is often the extent to which built environments in the Zagros have featured in discussions concerning Neolithic societies. The architectural changes that occur over time are assumed to reflect wider social and political developments, and apparent similarities in architectural change are often seen as implying similar social and cultural developments (Bailey 2005: 91). The onset of plant cultivation and animal herding is often regarded as a major event signalling the transition from small mobile or semi-mobile hunter-gatherer groups to larger, sedentary food-producing communities. It is clear that these changes did not occur concurrently, nor did all communities adopt an economic strategy that combined the cultivation of plants and herding of animals. Changes in subsistence strategies and sedentism would have had an effect on social relationships and behaviours within these communities, and human groups are likely to approach broadly similar challenges in different manners (Belfer-Cohen and Goring-Morris 2002: 145-146). It is these social strategies that archaeologists seek to understand through studies of built environments.

Architecture is seen as structuring social interaction as the configuration of space dictates movement within and between structures, provides and restricts access to certain areas, and, in many cases, delineates specific activity areas, although the particular use of any spatial configuration may also be flexible (Byrd 2000: 66, 2005b: 119-120; Düring 2006: 31-32). The underlying assumption in most studies concerned with the relationship between built environments and social organisation and behaviour is "[...] that human groups seek to adapt their buildings to their behavioural needs or functional requirements; when the built environment ceases to accommodate behavioural requirements, people seek to correct the problem through construction, renovation, or moving to a different building" (Lawrence and Low 1990: 460). Research concerned with the social aspects of architecture and the use of space often examine these relationships within a domestic context, focusing on the household. In the Near East studies concerned with the development of Neolithic architecture have explored the development and composition of households; establishing the size and composition of households is seen as a first step in understanding the social structure of archaeological communities. Households are often portrayed as autonomous social units characterised by the pooling of economic resources, co-residency, reproduction, and transmission of property between generations (Banning 2003: 12, Byrd 1994: 642-643, 2000: 66; Netting 1993: 59). Some prefer to emphasise the reconstruction of economic pooling (Allison 1999: 4-5) or the aspect of co-residency (Hendon 1996: 47) as more important in defining a household. Underlying many studies is the assumption that households are identifiable with the buildings they inhabit, and that they undertook various domestic functions together, socialised, and shared production, consumption and reproduction. However, "the social boundaries of household units do not necessarily coincide with the physical boundaries of the dwelling itself" (Lawrence and Low 1990: 461). Households are culturally specific (Düring and Marciniak 2006: 166-168), and the term co-resident unit may therefore be more appropriate when discussing the number of people that lived together in a building.

Identifying household structures and how they change over time is seen as a way for archaeologists to gain information about wider social and economic issues within the community as a whole. However, architecture cannot easily be equated with social organisation (Byrd 2000: 66); it should be viewed as a reflection or physical manifestation of human concerns associated with cultural and social relationships. It has been argued that increased sedentism and the emergence of agricultural economies in the Neolithic is indicative of increasingly autonomous households (e.g. Byrd 1994, 2000, 2005a: 266; Flannery: 1972, 2002; Kuijt 2000d). One of the first archaeologists to explicitly focus on changes in household organisation during the Neolithic was Flannery (1972, 1993, 2002). He (1972: 30-33) argued that the circular structures found at Natufian and PPNA sites in the Levant were hut compounds housing polygynous extended households comparable to hunter-gatherer groups in terms of their social organisation. Shared characteristics include only one or two individuals occupying individual structures, and the sharing of food storage and labour tasks. He (1972: 39-42) argued that the architectural development from circular to rectangular architecture indicates that the family gained increased importance as a social unit; the nuclear family household occupying individual rectangular buildings became the primary economic unit. In his opinion the architectural development signals change, not only in the number of residents occupying each structure, but also a shift from shared to private storage with the location of storage facilities moving from external to internal spaces (Flannery 2002: 420-421). These changes reflect developing notions of property and the concept of 'private', especially with regards to the storage of produce, which has implication for the social and economic structure of these communities. The shift in the location of storage facilities indicates a change in social organisation, with risk being assumed on the household rather than the communal level (Flannery 1993: 110-111, 2002: 421). If nuclear family households became the main economic unit then this would allow for the development of economic intensification and differentiation (Flannery 1972: 48-49).

Flannery's model relies heavily on ethnographic studies of the hut compounds of central African horticulturalists and herders (a point he has acknowledged himself; Flannery 2002: 418), which in itself is problematic. His study raises some interesting social and economic questions, but his ethnographic examples are of communities in different social, cultural and economic settings, and it cannot be assumed that the spatial patterning of the hut compounds is the same as the circular structures at Natufian and PPNA sites in the Levant (Banning 1996: 170). Banning (1996: 168-170) has argued that even though there is difference in size between the circular and the later rectilinear structures, these are not as great as some may assume. In his opinion there was little or no change in the structuring of households during the Early Neolithic in the Levant as both circular hut structures and later rectilinear buildings would have had the capacity to house nuclear families (Banning 1996: 178).

Byrd (1994, 2000, 2005b) also disagrees with Flannery, arguing that household compositions remained the same in spite of architectural changes. He (1994: 640-641) believes that the appearance of larger, rectangular structures with increasing compartmentalisation of internal space was due to an increased formalisation in the use of space with domestic activities and storage moving inside buildings. "Architecture fulfills a variety of social demands, organizing, regulating, and delimiting contact between individuals and households" (Byrd 2000: 66), but most importantly, it has the "ability to create public and private space" (Byrd 1994: 644). The changes to rectangular buildings and the increased internal division of space reflect increased autonomy relating to production and consumption, and changes in interaction between households (Byrd 1994: 660). He thus, as Flannery did, emphasises the development of notions of ownership and concepts of 'private', which resulted in increased autonomy. Similarly, Kuijt (2000d) relates the increasing compartmentalisation of internal space to increasing household autonomy and their desire for privacy and control over resources. The difference is that he sees the increasing sub-division of space and increase in building density within settlements as results of population pressure and social stress.

In northern Mesopotamia buildings became large and highly compartmentalised in the later parts of the Pottery Neolithic (Banning 2003: 15-17). Flannery (2002: 424-432) argued, in his revised examination of households, that the large, multi-roomed structures at Late Pottery Neolithic sites such as Hassuna housed extended families. The increased number of household members (twelve to twenty individuals) was a response to increasing labour demands, which exceeded the capacity of the nuclear family, brought on by an intensified, mixed economic strategy that included a range of cultivated crops and an addition of cattle and pigs to the traditional focus on sheep and goats (Flannery 2002: 424). He (2002: 427) argued that even though the extended family may have shared agricultural tasks and some storage and work areas, individual nuclear families were responsible for the preparation and consumption of their own resources, an assumption he based on the presence of multiple hearths, or 'kitchens', within individual structures. In other words, the extended family may have co-habited due to labour demands, but the nuclear family retained some autonomy in terms of consumption activities, and presumably also storage.

These studies incorporate aspects that try to identify the use of space and activity areas, often based on architectural form and movement within the built environment. Identifying the nature of the activities taking place within individual spaces is important when examining how people structured daily life (Cutting 2006: 228). Daily interaction through repeated performance of domestic tasks provides a platform for creating and maintaining social relationships within co-resident groups, as well as between various co-resident units within a community (Yaeger and Canuto 2000). One study concerned with the use of space relating to domestic tasks is Wright's (2000) study of the spatial distribution of activities associated with the preparation and cooking of foods during the Natufian through the PPNB in southern Levant. In it she recorded the spatial distribution of features and artefacts associated with food preparation and cooking, including fire installations (e.g. hearths), pits, bins, and ground stone implements. She argued that food-related activities took place in open areas during the Natufian and PPNA, but that this practice gradually changed from the EPPNB with these activities occurring in increasingly structured open and private spaces (Wright 2000: 92-112). By the LPPNB food preparation and cooking took place in private spaces within highly compartmentalised buildings, which she linked to intensification of production and an increased emphasis on private property (Wright 2000: 112-114). Food-related activities developed from being communal and inclusive activities that fostered social interactions between households, to becoming increasingly 'privatised'. Individual households controlled their own food resources, preparation and storage facilities, and food consumption was focused on individual households (Wright 2000: 117).

An alternative view of Neolithic social relations has been proposed by Pollock and Bernbeck (2010) who argue for a communal mode of production and consumption at the Late Neolithic site of Tol-e Baši in Fars Province, southern Zagros. In his review of the state of research on the Iranian Neolithic over a decade ago, Bernbeck (2001) questioned the applicability of current models of the Neolithic with regards to the Zagros and argued that the variability in the degree of sedentism and mobility and associated life-ways observed at sites in the central Zagros indicated that the social and economic practices that existed in the area were different from the Levant. He (2001: 11-12) suggested that in order to understand the social aspects of Neolithic communities as relating, not only to modes of production, but also the social distribution of products and patterns of consumption and associated ideologies, it is necessary to examine the spatial distribution of artefacts.

Together with Pollock, Bernbeck expanded on his initial suggestions in a discussion of the spatial distribution of artefacts and the use of space at Tol-e Baši. They (2010) argued that social relations within this Neolithic settlement were based on principles of sharing that permeated social life and interactions within the entire community. Social life at Tol-e Baši centred on an ethos of collectivism that was perpetuated through verbal, inter-personal communication, a high degree of social interaction and socialisation, and restricted circulation and consumption of objects and materials (Pollock and Bernbeck 2010: 283-287). Their argument is based on the combination of what they perceive as a low density of artefacts not only in internal spaces compared to external areas, but also across the site; a high degree of curation of objects; a limited range of materials and stylistic expressions; a lack of human and animal figural representations in any media; and a reliance on local materials (apart from a few *dentalium* beads) (Pollock and Bernbeck 2010: 274-278). While their discussion raise some interesting points, much of their argument is based on assumptions concerning the material assemblage that rely too heavily on the *absence* of evidence without a satisfactory discussion of alternative explanations, of which the main ones will be mentioned here.

In their view all social activities and interactions took place in external spaces under constant scrutiny of, and interactions with, others, whereas buildings were used principally for shelter, warmth, and storage with some limited activities occurring in internal spaces during winter (Pollock and Bernbeck 2010: 274-278). They (2010: 274-275) argued that the limited amount of artefacts found in internal spaces was not a result of repeated cleaning, but because few activities took place inside buildings. This they base on the observation that there were spaces within the structures that had ash and other burnt material deposited on the floors (Pollock and Bernbeck 2012: 274). This assertion is problematic as it ignores the possibility that the distribution of refuse only on particular parts of interior surfaces and/or in specific internal spaces may be indicative of patterns of use of space and notions of cleanliness associated with various parts of building interiors – similar, for example, to ‘clean’ and ‘dirty’ areas observed within structures at other Neolithic sites, e.g. Boncuklu Höyük in central Anatolia (Baird 2010, 2012; Baird et al 2011) and Hajji Firuz (see chapter 6) – rather than indicating limited use of building interiors. Additionally, the high degree of curation of objects noted by Pollock and Bernbeck (2010: 276) may indicate that most items would have been removed from buildings for continued use before the structures were abandoned. The presence of 'closing' deposits (Pollock and Bernbeck 2010: 275) further suggests that at least parts of building interiors reflect ritual activities occurring immediately prior to the abandonment of a structure rather than repeated practices taking place during its use-life. Similarly, their argument that most objects found in external spaces were haphazardly discarded where used with no systematic disposal of refuse taking place (and therefore supporting their assumption) because no middens were found within the excavation area (Pollock and Bernbeck 2010: 276) fails to consider the possibility that most of the refuse may have been discarded in specific locations away from, or around, activity areas, on the edges of the settlement, or in specific locations within the settlement. Such practices have been documented in ethnoarchaeological studies (e.g. Watson 1979: 37-39), where they usually occur concurrently with lesser accumulations of refuse found throughout the settlement. Similar practices appear to have taken place at, for example, Jarmo (see chapter 5) and Hajji Firuz (see chapter 6) where there were limited amounts of artefacts found outside of refuse contexts such as pits and midden accumulations. In this respect the low frequency of artefacts may in fact be a result of sampling, although this does not mean that the observed limited range of types of artefacts, style, and material used is not accurate.

While it appears that many of the daily activities and interactions may have taken place in external spaces, their view of buildings as empty shells providing not much beyond shelter is too simplistic. In fact, continuing their argument (albeit perhaps to the extreme) it may be suggested that there would have been few reasons for people to construct *tauf/chineh* architecture since less permanent structures such as tents or pit structures may have provided sufficient shelter. The aforementioned 'closing' deposits indicate that structures were associated with some form of ritual behaviour, potentially relating to and/or performed by the co-resident unit living within them, which may suggest that buildings were not merely shelters for winter habitation. Relating to this, they also fail to consider the structuring of the various social units living within and utilising the individual buildings, as well as how these social groups 'fit' within a community where social life supposedly centred on shared ideas of collectivism. Additionally, while they discuss cooking and consumption practices and the social aspects of these activities at some length (Pollock and Bernbeck 2010: 275-278), they provide no assessment of possible storage practices apart from mentioning that it occurred inside buildings (Pollock and Bernbeck 2010: 274). In spite of these shortcomings, they do provide an interesting discussion of social interaction and an alternate view of the social structure of a Neolithic community that contrast the models put forward based on Levantine data sets.

This section has summarised the main discussions concerned with the social implications of changes in Neolithic architecture. Most studies of Neolithic built environments tend to emphasise broader similarities even though there is a range of regional variations in architecture throughout the region (see section 1.1). Changes in domestic architecture and the use of space are seen as signifying changes in household structure and the ways in which people within Neolithic communities related to each other. The proposed changes include the emergence of co-resident household units (nuclear families) as the primary unit of economic production and consumption, increased household autonomy, a lesser degree of community-wide sharing of resources and economic activities, the emergence of notions of private property and inheritance, increased social crowding, and, by extension, increased social inequality. These discussions have focused on the development that took place in the Levant (see e.g. Düring and Marciniak 2006 and references therein); there are currently no in-depth studies that explicitly deal with social strategies and the role of the household within Neolithic communities in the Zagros equalling those discussed in this section, and most references to sites in this region are as examples only that assume similarity based on built form (e.g. Banning 1996: 75-76, 2003: 6; Byrd 1994: 659). One exception is the discussion of social relations at Tol-e Baši in which Pollock and Bernbeck (2010) argued for a communal mode of production and consumption, and that social relations were based on a communal ethos of sharing that permeated every aspect of social life at the settlement.

2.5: Ritual practices

The changes in social dynamics that occurred during the Epipalaeolithic and Neolithic periods are not only evident in new subsistence strategies and architectural developments; the role of symbolism and ritual has gained increased interest over the last few decades (Watkins 2002: 41).[5] Focus has shifted from principally descriptive approaches emphasising environmental and socioeconomic processes to more intuitive explanations of ritual activities (Jensen, Hermansen and Gebel 2002: 2). Symbolic and ritual behaviour now has an important role in many interpretations concerned with the changes in social organisation of Neolithic communities that occurred during the transition from hunting and gathering to sedentism and agriculture. Ritual, in particular, is viewed as an important part of the strategies aimed at maintaining intra-group relationships within the new social setting of sedentary communities. Issues such as maintaining seemingly social equality in the face of increasing inequality (Kuijt 1996, 2000e, 2002) and defusing social tension associated with increased permanence (Halstead 2005: 38-39) are seen as central motivations for the ritual and symbolic expressions observed in the Neolithic.

In basic terms, rituals are repeated actions that are always carried out in a particular way, and, although this implicitly includes everyday activities, it is commonly linked to religious practices (Garwood et al 1991). Archaeologists have tended to view rituals as distinct from secular activities (Brück 1999: 316); ritual practices are often associated with community interactions that in most cases do not relate to everyday domestic tasks. Objects and features without an apparent function are frequently described as ritual or symbolic, which is

[5] Objects have a symbolic as well as a practical function (Verhoeven 2002a: 6-7), and because symbols are frequently used in rituals the concept of symbolism is intrinsically linked to ritual behaviour (Verhoeven 2002b: 235).

symptomatic of the view that ritual practices reflect belief systems and world-views and their meanings are therefore difficult to ascertain (Verhoeven 2002a: 6, 2002b: 233-234). However, it is because rituals are based in commonly held beliefs that it is important to examine ritual behaviour to gain further insight into the social fabric of past communities (Garwood et al 1991). Additionally, ritual activities may not be conceptually separate from secular practices (Banning 2011; Brück 1999). It has been suggested that the proliferation of symbolism and ritual behaviour observed within Neolithic structures – including the incorporation of animal parts in buildings (e.g. Hallan Çemi, Çatalhöyük, Jerf al-Ahmar), interior decorations such as wall paintings (e.g. Dja'de, Çatalhöyük) and carved pillars (e.g. Göbekli Tepe, Nevalı Cori), and sub-floor burials – may indicate that ritual and secular space was often indistinguishable (Banning 2003: 19-20, 2011).

Ritual and symbolic behaviour exemplified by burial practices and figural representations of humans and animals developed throughout the Neolithic, flourishing especially during the PPNB (Kuijt and Goring-Morris 2002: 418-419). Goring-Morris and Belfer-Cohen (2002: 69) have argued that although certain burial practices and representational art appear during the Epipalaeolithic, the symbolic motifs and associated meanings were probably present prior to their material manifestation in the archaeological record. The proliferation of symbolic and ritual behaviour during the Neolithic is linked to problems associated with the organisation of larger communities in the absence of any explicit social stratification. They (2002: 70-73) argue that Neolithic ritual behaviour was conservative in outlook; it provided a point of reference in the old and familiar during a period when human groups were experiencing new ways of life and had to deal with the social challenges that presented them with. Change was better implemented within 'old' frameworks; if something cannot be rationalised by individuals as being a natural progression or beneficial at some level (i.e. normal or logical), change cannot be successfully implemented. Differentiated social power, for example, cannot be accepted unless it is perceived as normal within the framework of the beliefs and values of the society (Kuijt 2002: 84).

Mortuary practices have received considerable attention in the discussion of ritual practices (e.g. Byrd and Monahan 1995; Kuijt 1996, 2000e, 2002). Burials are commonly found under floors of Neolithic structures across the Near East, and include primary and secondary burials. Secondary mortuary rituals are the intentional removal of certain skeletal parts, e.g. the skull or the long bones, from one location and the subsequent re-deposition of those parts at another location. In the Levant primary burials and secondary removal of skulls, which were later reburied in both internal and external spaces, continued from the Late Natufian through the PPNA (Kuijt and Goring-Morris 2002: 376-377). There was an increase in secondary mortuary rituals during the PPNB in the western and northern parts of the Fertile Crescent, including skull caching, with some of the skulls being plastered and decorated with paint or shells (Kuijt and Goring-Morris 2002: 394-396, 491; Watkins 1990: 342-343, 2010: 627-630). Kuijt (1996, 2000e, 2002) has argued that secondary burial practices were important means by which these communities maintained the illusion of social equality in spite of increasing inequality. These rituals facilitated participation that cross-cut household and kin lines, and provided a community-wide platform for interaction aimed at fostering social cohesion (Kuijt 2000e: 143-149), while also being a source of authority for those individuals or households who organised them (Kuijt 2002: 82). Similarly, it has been suggested that the promotion of an equalitarian ethos through communal and ritual activities is evidenced in PPNB by the non-domestic buildings found at sites such as Beidha, 'Ain Ghazal, Jerf al-Ahmar, Nevalı Çori, Çayönü, and Göbekli Tepe.[6] It has been argued that non-domestic structures and other communal spaces provided a focal point for communal decision-making and ritual activities aimed at defusing social tension caused by the increasingly inward social and economic focus of Neolithic communities (Byrd 1994: 659-661).

Most discussions of ritual and symbolic behaviour tend to focus on the Levant or southeast Anatolia where material manifestations of such practices are ample. The archaeological evidence for symbolism and ritual in the Zagros is limited compared to elsewhere in the Near East, and include burials, clay figurines (e.g. Broman Morales 1990; Voigt 2000), the concentration of caprine skulls and vulture bones at Zawi Chemi (Solecki 1981: 53-54), a pair of sheep skulls found in a sub-floor niche at Ganj Dareh (Smith 1990: 330-33), and five sheep and goat skulls placed on the floor in one of the structures at Sheikh-e Abad (Matthews et al 2010). An interesting point that has been raised with regards to the Zagros is the frequent depiction of domestic animals in figurine form, which may indicate their ritual importance during the Neolithic (Bernbeck 2001, 2003). It may be that the perceived lack of overtly symbolic features in the Zagros compared to the rich records from the Levant and southeast Anatolia is due to the limited data available. The presence of burials, figural representations of humans and animals, and sheep and goats skulls located within buildings indicate that symbolism and ritual behaviour were features of Neolithic communities in the area. There has so far not been a consideration of the ritual aspects of Neolithic communities in the Zagros that equal that of the Levant, southeast Anatolia and northern Mesopotamia. This may be due to the inherent lack of in-depth discussions of the social transformations that occurred in the Zagros during the Neolithic, as well as perhaps a record that contains a lesser degree of material manifestation of ritual practices.

2.6: Summary

This chapter has summarised the evidence for the appearance of plant cultivation and animal herding in the Near East, and outlined the main explanatory models proposed for understanding the social transformations that occurred during the Neolithic. These

[6] Banning (2011) has suggested that we should consider the possibility that ritual and secular space were inseparable during the Neolithic, and that the structures at Göbekli Tepe could in fact be houses.

discussions have tended to focus on the Levant due to the more comprehensive data sets available compared to the Zagros. Despite the increase in archaeological work taking place in the Zagros, there are still temporal gaps in our knowledge concerning the social and economic developments that took place from the Epipalaeolithic through the Neolithic in this area (section 1.1). Recent discussions of the Zagros record are still dominated by reconstructions of subsistence strategies, especially the issue of caprine domestication, often through reconsiderations of old data sets (e.g. Hesse 1978, 1984; Zeder 1999; Zeder and Hesse 2000). Discussions have in a sense picked up where they were left off in the 1980s (section 1.1), and, although aspects of Neolithic social organisation may be tangentially touched upon (e.g. Bernbeck 2001), there is a prevalent lack of explicit, in-depth discussions of the social strategies employed by Zagros communities. One recent exception is the discussion of the social life within the Late Neolithic community at Tol-e Baši by Pollock and Bernbeck (2010), in which they argue that "life in the village was practically and conceptually communal" (Pollock and Bernbeck 2010: 278).

Since the evidence from the Zagros is limited and often preliminary in nature compared to the Levant, most discussions of the transition from mobile hunter-gatherer groups to sedentary, food-producing communities, and the social mechanisms that underpinned this development are based on the Levantine data. The models proposed by Flannery (1972, 2002), Byrd (1994, 2000, 2005b), and Kuijt (2000d, 2000e) are largely functionalist in their view of the social implications of architectural change, and assume a linear progression from the Natufian through the PPNB (Cutting 2005: 10). Space is discussed in terms of function with assumptions based on a standardised set of rules that ignore the actual affordance of space for social interactions and human presence. They have also failed to take into account how animals fit into settlement landscapes. Studies concerned with determining early animal management strategies preceding domestication have become increasingly focused on the role of human behaviour, but still fail to consider how humans and animals co-existed within Neolithic settlements and the implications this has for herding practices and human-animal relationships. The association between caprines and ritual behaviour evidenced at Ganj Dareh (*c* 8,000 cal BC) and Sheikh-e Abad (*c* 7,600 cal BC) and in the frequent occurrence of figurines depicting domestic animals indicate that their role within these communities went beyond the economic function of managed animals. It is therefore important to consider how animals fit into the social space of these settlements.

This thesis presents a study of the built environments at three Neolithic sites in the Zagros uplands and piedmont, and two sites in the adjacent lowlands of northern Iraq that is based on the in-depth examination of the *affordance* of space for human occupancy, different scales of social interactions, human-animal interaction, and potential storage capacities. The structuring of space within these settlements is investigated utilising a computer-based modelling approach – which is outlined in the next chapter – that considers the capacities that these built environments have for accommodating humans and animals, activities associated with daily life, and the nature of economic strategies as relating to, not only plants, but also animal management.

Chapter 3

Methodology

3.1: Introduction

The previous chapter presented an overview of the current understanding of the development of plant cultivation and animal herding, and the main points that have been raised in discussions of Neolithic social structures in the Levant. It was pointed out that there is a lack of explicit discussions of Neolithic social practices in the Zagros that take into account the information that can be gained through studies of settlement space. This chapter presents the methodology that facilitates the examination of the use of space within Neolithic built environments in the Zagros. A computer aided design programme (AutoCAD) will be used in the analysis of the configuration of space at three Neolithic sites in the Zagros, focusing on the affordance of space for human occupancy in terms of co-residency, co-presence, and activity areas, as well as storage practices and human-animal relationships. The approach builds on the methodology developed by Hemsley (2008), although it has been adapted to the issues investigated in this thesis, which includes the role of animals within these communities, and therefore does not include the same stages as her analysis did. Initially, the definition of the various spaces that constitute the built environment and the terminology that will be used throughout this thesis to describe the nature and potential uses of the various spaces is outlined in section 3.2. The next part of this chapter focuses on how AutoCAD is used to explore the structuring and use of space within settlements, including the assumptions made in the modelling (section 3.3). It outlines the ways in which the affordance of space for co-residency (section 3.3.1), social interactions (section 3.3.2), domestic activities (section 3.3.4), animals (section 3.3.5), and storage of foods for human consumption (section 3.4) and fodder (section 3.4.1) are investigated through a visual approach to the built environment.

3.2: Defining spaces within the built environment

In general terms the built environment refers to any space that has been modified by human actions (Lawrence and Low 1990: 454), from buildings and roads to parklands and gardens. It provides the spatial context in which people experience life on a day-to-day basis (Parker Pearson and Richards 1994: 2-6), and therefore forms an important part in understanding the social organisation of past communities. Most of the terminology used in this thesis is as 'neutral' as possible in order to avoid ascribing function to the different spaces within the built environment. Terms that are related to function and laden with modern connotations are avoided. The terms building and structure are used (interchangeably) rather than 'house', because the latter has connotations of dwelling and habitation, and in that sense 'home' (although 'home' does not necessarily mean a 'house'; Parker Pearson and Richards 1994: 5-6). Further to this any individual part of the built environment is referred to as a space, primarily distinguished as either an external or internal space. An internal (or interior) space is any spatially separate part of a building that was roofed and enclosed by walls, some of which may have had ground-level or raised entrances. External spaces are unroofed, or only partially roofed, and are either enclosed (courtyards) or open. Partially roofed external spaces include courtyards with roofed porches, or outdoor working areas that were only partially roofed to provide shelter from the sun, rain, and/or wind.

The various spatial components of the built environment are, initially, defined in terms of their character, i.e. whether spaces are internal or external, open or enclosed, and so on, and how they relate to each other. This makes it possible to examine how the structuring of space within settlements could have accommodated different scales of interactions and the potential use of space without basing the discussion on preconceived assumptions regarding the nature of buildings, the internal configuration of space, and outdoor areas. In other words, arriving at an understanding of the nature and use of settlement space should be through a detailed examination of the dimension and forms of the structures, and the associated affordance of space for co-habitation and co-presence, movement between and access into spaces, as well as access to and spatial attributes of various features (e.g. pits, platforms, bins, and burials) and *in situ* artefact assemblages. Scenario modelling is a major component of this evaluation, and forms part of the identification of the possible use of spaces as living spaces that could have accommodated sleeping, eating, and general socialising, in addition to working and perhaps storage. They are in that sense potentially multi-purpose or multi-functional spaces. Defining potential living spaces is important as it helps determine whether buildings and spaces may have been used for dwelling, and, if so, aids in the assessment of the size of potential co-resident groups. Possible work and storage spaces are those that appear not to have been used for living purposes due to their size, spatial configuration, and/or built features found within them. These spaces may have been multi-functional, although they may have been used for a specific purpose only, such as storage or work.

There are three main definitions of external spaces used in this thesis: open spaces that are not intentionally enclosed and may be quite large in size (e.g. ‘plazas’ or large activity areas); spaces that are partly enclosed such as alleyways between buildings; and spaces that are more or less fully enclosed (although they may have entrances in one or more walls), which may have served as courtyards into which access was restricted and where a range of activities may have taken place depending on season and/or the type of activity. Patterns of use of multi-functional spaces outside buildings have been observed in ethnographic contexts. At the village of Aşvan activities that produce refuse take place outside on verandas and in courtyards during the summer and inside during winter when it is very cold, with verandas and internal spaces being swept several times a day, and courtyards only once a day (Weinstein 1973:274). Other ethnoarchaeological studies have also shown patterns of seasonal use relating to activities, and in particularly those associated with food preparation and cooking, which take place in courtyards, on platforms or porches outside building entrances, or on flat roofs during the summer (Hall, McBride and Riddell 1973: 248; Kramer 1982: 108-111; Watson 1979: 126-159). Courtyards do not necessarily have to be fully enclosed by walls; structures may be intentionally grouped around an open external space to create an open courtyard (e.g. Hall, McBride and Riddell 1973: 247), in which case access may be restricted to those people living in the surrounding buildings in a similar manner to enclosed courtyards.

3.3: Scenario modelling

The methodology employed in this thesis draws on the scenario modelling developed by Hemsley (2008) for her study of the social experience of living within PPNA and PPNB settlements in the Levant. Her work illustrated the insight that may be gained by creating representations of building plans and populating the structures with people and material culture in order to assess the affordance of space. As Hemsley (2008: 336) has pointed out, even populating the built environment with simple two-dimensional representations can be an effective means of conceptualising the physical affordance and size of the various spaces within a settlement.

The first stage of the analysis requires a close reading of the published material, including plans, sections, and photographs, in order to gain an in-depth understanding of the occupation and use of space within each settlement. The published plans used in this thesis are essentially two-dimensional approximations of what the dynamic built environments may have looked like at any one point in time (Düring 2006: 46). Buildings are maintained throughout their use-life (Tringham 2000: 126-127), and some of these episodes of maintenance are perhaps not detectable during excavation (especially in the absence of micromorphological studies) and/or may not be conveyed in published reports. The next step was to scale and digitise the archaeological plans in AutoCAD[7]; the advantage of using a CAD programme when examining built environments is that the models can be structured into levels that may be viewed together or separately. This offers a certain degree of flexibility when analysing space compared to two-dimensional plans as it allows the production of different views of the model that highlight different aspects (Eiteljorg et al 2003). Different colours were used to represent the various construction materials and features (or layers in the CAD model), e.g. walls, fire installations, bins, burials, ground stones, pits, and so on, which makes it possible to visually represent the different parts of the built environment and how they relate to each other (Appendix B, Figure 3.2). The different occupational phases, including reconfigurations of space within individual buildings during their use-life (e.g. the construction of new walls and/or features), was digitised separately to allow an examination of if, and how, the modifications of the built environment may have affected the use of space and the social implications of these structural changes. In some cases part of structures had to be reconstructed during the digitising process. The reasons for and the reliability of these reconstructions are discussed where relevant in the case study chapters (chapter4-7).

In order to conduct the visual modelling of living space, i.e. to 'put people' into the buildings, it was necessary to create model shapes of people representing humans. Two individuals of different height and build were used in order to provide a range of potential occupancy in the modelling. One individual measured 1.70 m and was of slim build (Size A), whereas the other measured 1.60 m and was of a larger build (Size B). Both of the individuals sit within the height range of Neolithic populations; the average adult stature for individuals at Ganj Dareh is 1.58 m for females and 1.71 m for males, whereas the range is 1.55-1.68 m for females and 1.60-1.71 m for males in other Neolithic populations in the Near East (Merrett 2004: table 11.1). The difference in build between the two individuals was chosen in order to explore potential differences in build that may have existed in the past.[8]

After measuring the size of the area occupied by each individual in four different positions – sitting cross-legged, squatting, kneeling (with forward reach), and lying on the side in a slightly crouched position – a range of polygon shapes was created to represent each position in AutoCAD (Appendix B, Figures 3.3-3.4). The statures of the two individuals used in the modelling do not represent the full range of heights and body shapes that would have been present in the past, or those of modern societies, nor do they include children. A child generally occupies a smaller space than an adult, although the size of the space would increase as the child grows, and older children may in fact occupy similar spaces to adults. The composition of a co-resident group and the space required by each member would change throughout the life of the individual, which may be reflected in the spatial

[7] A vector based system where spatial phenomena are represented by points, lines, areas, polygons, and so on (Eiteljorg et al 2003).
[8] The various positions modelled for the Size A individual have similar spatial extents to those of the 1.65 m tall individual in Hemsley's study (Hemsley 2008: Appendix B).

arrangement of internal spaces. Modelling using polygons representing the two different individuals rather than using a single shape that represents the average person provides a range of scenarios and associated values of the potential affordance of space (Hemsley 2008: 83).

The positions that were chosen are those commonly used by people undertaking work or resting within a domestic setting (sitting cross-legged, squatting, kneeling, and lying slightly crouched on the side). There are differences in the ways that people assume these positions (e.g. Molleson 2007: fig. 9.1), but there is a general tendency for people to revert to a preferred position, commonly adopted since childhood (Molleson 2007: 186). Some postures are active whereas others are more passive, which, depending on the type of activity a person is engaged in, may influence the choice of posture. It is, for example, easier to get up from a squatting position than from sitting cross-legged or kneeling. Squatting may therefore be preferred when a certain degree of mobility is desired, whereas a seated or kneeling position may be assumed during activities requiring an individual to be stationary for longer periods of time. Studies of the skeletal material from Abu Hureyra, for example, have indicated that women were kneeling while grinding cereals (Molleson 2007: 191-192).

Each of the modelled positions involves the use of different configurations and amounts of space, and are represented by different polygons; sitting cross-legged and squatting are represented by trapezoids of different sizes, and kneeling is represented by a rectangle, sometimes with a smaller rectangle attached to one of the short sides indicating forward reach (e.g. when grinding). Polygons were modelled along or near to walls and other features, some of which may have provided support for the back, and thus the other side of the polygon represents the direction in which an individual would have been facing. The last modelled position was an individual lying on the side in a slightly crouched position, represented by a hexagon. Sleeping patterns, as with positions assumed during work and interaction while awake, are culturally specific (Williams and Crossley 2008) and co-sleeping is a common feature of non-western societies (Tahhan 2008: 37-38; Yovsi and Keller 2008: 66). As sleeping crouched on the side is a very common sleeping position, especially when co-sleeping and in situations where people sleep close to each other to keep warm, this position was modelled to represent a sleeping individual. It allows an assessment of the maximum numbers of people that can fit into a space, and presents a better way of utilising the internal space in cases where spaces are not perfectly rectilinear. The modelling undertaken in this thesis presents a range of scenarios aimed at answering five basic questions which were outlined in chapter 1. The remainder of this chapter outlines the ways in which the modelling has the potential to answer these questions, and the assumptions that form the basis for the various stages in the analysis.

3.3.1: Modelling co-residency

The first question asks how many people could potentially have co-resided within individual structures. This relates to the issue of the size and structure of Neolithic households, as well as to the use of space within the built environment. Households are usually viewed as "units of social and economic cooperation commonly defined on the basis of a combination of shared residence and the pooling of economic resources" (Düring 2006: 39). An important part of the discussions concerning Neolithic social organisation is the extent to which households were economically autonomous and how this relates to possible incipient hierarchies during the Pre-Pottery Neolithic, and thus understanding the structuring of domestic groups forms a central part of this research (see section 2.4). Architecture and the use of space have provided a framework for archaeologists to examine household structures due to the relationship between spatial and social organisation (Byrd 2005b: 119-120; Hemsley 2008: 62). As was pointed out in section 2.4, this has led to households being identified with individual domestic structures, even though this association is problematic because a household may reside in several buildings and there may be more than one household living in the same structure (Horne 1982, 1988; Lane 1994; Lawrence and Low 1990: 461; Wilk and Rathje 1982: 620). Nevertheless, because households tend to be equated with the structure they inhabit, building size is often seen as indicative of the size of households (e.g. Chang 1958: 303).

Archaeologists have employed a variety of methods for estimating prehistoric populations and households, including skeletal remains, artefact assemblages, food remains, surface scatters, and the number and/or size of rooms and buildings or settlements (see Hassan 1981; Kolb 1985; Schacht 1981 and references therein). However, as Byrd (2005b: 120) points out, discussions of Neolithic households in the Near East have tended to be limited to assertions that they either consisted of nuclear or extended families which have rarely been linked to empirical data. The size and/or form of buildings tend to form the basis for assumptions made regarding the household, which is usually equated with either a nuclear or extended family. A nuclear family[9] is commonly defined as consisting of a married couple (or a widowed individual) and their offspring whereas an extended family consists of a nuclear family and one or more relatives that are not offspring (Hammel and Laslett 1974: 92-3). There are issues, however, associated with equating a household with either of two particular family groupings. Ethnographic and ethno-historic studies have shown that different types of households may co-exist within one community, including single individuals, co-resident siblings or other relatives, nuclear families, extended families, and multiple families[10] (Bagnall and Frier 1994: 53-74; Hammel and Laslett 1974). Assuming that households (equated with a particular family grouping) were the same across an archaeological community based on building size and form is therefore problematic.

[9] A nuclear family may also be referred to as a conjugal or simple family.
[10] A multiple family household is defined as consisting of two or more conjugal families (Hammel and Laslett 1974: 92-93).

With regards to the Near East the studies by Flannery (1972) and Byrd (2000, 2005b) are the only ones that have explicitly tried to reconstruct Neolithic household organisation, both of which used ethnographic analogy and floor area to estimate the size and structure of households. Flannery (1972), following Naroll (1962), used 10 m^2 of roofed dwelling area per person to estimate the number of individuals residing in a structure (see section 2.4). Byrd (2000: 80-85, 2005b: 120-121), on the other hand, believed that Naroll's value was too high to be applicable to prehistoric settlements (Kolb 1985). Instead, Byrd (2000: 82-83, 2005b: 121) preferred to combine Naroll's value with lower floor area values from modern hunter-gatherer groups (e.g. Weissner 1974), although he did not state the specific value that he used. There are issues, however, associated with calculating household size based on roofed dwelling area.

In his influential paper Naroll (1962) argued, based on a cross-cultural study of 18 sedentary societies from different geographical areas[11], that there is a relationship between roofed dwelling area and population, and that an average of 10 m^2 of floor area per person can be used to estimate the population of prehistoric settlements (e.g. Flannery 1972). However, the relationship between dwelling area and population in Naroll's study is non-linear, which means that it is *not* constant, and therefore his value of 10 m^2 is not a good approximation of his own results (Kolb 1985: 583; Schacht 1981: 126; Weissner 1974: 343). There is also a large standard deviation in his sample[12] due to the small sample size (Kolb 1985: 583; Petersen 1975: 232). In fact, "it is apparent that very few persons actually live in situations in which they occupy 10 m^2 of roofed area" (Shea 1985: 594). Despite this, many scholars have in principle agreed that there is a correlation between floor area and population size and provided data from subsequent studies. These show a wide variety in average values across time and space and in different living situations, including 7-10 m^2 per person for Iranian villages (LeBlanc 1971; Kramer 1979, 1982; Watson 1979), 6.12 m^2 per person for Mesoamerican agricultural communities (Kolb 1985), 5.9 m^2 and 10.2 m^2 per person in !Kung camps of ten and 25 people respectively (Weissner 1974), 5.3 m^2 per person in New World multi-family dwellings (Casselberry 1974), around 2.33 m^2 or less per person in a winter camp in Shanidar cave, Iraq (Solecki 1979), and 1.8-3.7 m^2 per person in barracks in military installations (Kardulias 1992).[13] There is also disagreement as to whether the calculated area per individual should only include roofed living spaces (Byrd 2005; LeBlanc 1971), all roofed spaces (Naroll 1962), or total settlement area (Weissner 1974). Therefore, when using either of the above values scholars have not always applied 'like to like'. For example, in his discussion of Neolithic households Byrd (2000, 2005b) combined Naroll's (1962) value, which is based on *all* roofed spaces (including non-living areas and features such as wall bases, stairs, courtyards and so on), with e.g. Weissner's (1974) lower area

[11] Six from North America and Oceania, three from South America, two from Africa, and one from Eurasia.
[12] Ranging from 0.8 m^2 per person to over 20 m^2 per person.
[13] This, in fact, confirms Naroll's idea that the relationship between dwelling space and population is non-linear (Schacht 1981: 127).

value, which is based on total *settlement* area (including internal and external spaces), to estimate numbers of co-residents in roofed *living spaces*.

It has also been argued that the use of habitation space, and therefore the relationship between floor area and population, varies between different types of settlements and dwellings, as well as according to economic and social structures (Baker and Sanders 1972: 160; Casselberry 1974; Kolb 1985: 582; Petersen 1975: 232; Schacht 1981: 128; Weissner 1974). The relationship between the size of buildings and the number of co-residents is, as DeBoer (1985: 592) has noted, "complex, multivariate, and context-dependent". Using floor area to estimate household size not only ignores the cultural variation in attitudes to space (Casselberry 1974: 119; Fletcher 1985; Weissner 1974: 343; see also Gifford 1997: 105-106), but also the variation in household numbers that may exist within the same community (Fletcher 1985: 592). The main problem with estimating household and/or population size based on an average floor area value is, however, that the behavioural rules they imply (e.g. attitudes towards the use of space and personal space requirements) are based on a limited set of cross-cultural studies that may be invalid for the Neolithic (Hemsley 2008: 51; see also Petersen 1975). As Kolb (1985: 582) has noted, using ethnographic analogy becomes increasingly problematic as the temporal and spatial distance between the contemporary and archaeological populations increase, and it is likely that Neolithic societies do not have modern parallels (Hemsley 2008: 51 citing Asouti; Pollock and Bernbeck 2010: 274; see also Bernbeck 2001; Gilbert 1983).

Another method used by archaeologist to estimate population size which is based on the perceived correlation between habitation space and population is to multiply the number of identified households by an estimated average household size (Baker and Sanders 1972: 160; Chamberlain 2006: 127; Hassan 1981: 72-73; Schacht 1981: 125-126). A household is in these cases identified with, for example, a hearth, a building, or a habitation room within in a building complex (Hassan 1981: 72; Schacht 1981: 125). This approach usually equates a household with a nuclear family (Petersen 1975: 232; Schacht 1981: 125 and references therein), which is argued to average between four and five individuals (i.e. a married couple and two to three children) (Bagnall and Frier 1994; Kolb 1985; Hassan 1981: 93). The main problem with this approach is that it requires an estimation of the number of co-residing household members (Petersen 1975: 232; Schacht 1981: 125), which is usually "a guess, perhaps based on a minimally researched ethnographic analogy, and treated as a constant. It must be stressed that there is *no evidence justifying a universal value* for this figure, which should be determined by the nature of the family in, and the transient demographic characteristics of, the target culture" (Schacht 1981: 125, my emphasis; see also Burch 1972). Even if average values appear to be constant there is great variability on either side of the mean. Additionally, non-nuclear family households such as those consisting of extended and multiple families need not be large and complex and may consist of no more than four to six individuals (Burch 1972: 91-92), which would fall within the aforementioned estimated range of an average nuclear family. Thus assuming an average standard size of nuclear or extended families is problematic. The assumed uniformity in household size not only ignores the potential variability in types of households within a community (as it assumes only nuclear families to be present), but also the fact that household size and form varies across time and space (Wilk and Rathje 1982: 631). It should also be noted that many historical records – which form the basis for much of the research that provide data for these 'demographic averages' – indicate that in many pre-modern societies the concept of a 'household' appears to have been poorly conceptualised, and thus the recorded 'household' may not mean the same as modern definitions of a 'household' (e.g. Bagnall and Frier 1994: 57).[14]

It is clear that both the concept of a 'household' and the ways it has been approached in discussions of Neolithic social structures are problematic. This is in large parts because they rely on limited, but highly variable cross-cultural studies that are likely to have little in common with Neolithic societies. The inherent issues associated with defining what constitutes a household relates to the fact that they are culturally specific and that co-residency and the pooling of economic resources do not necessarily overlap (Düring and Marciniak 2006: 168). It is, as Düring (2006: 39) has suggested, "[f]or this reason household studies cannot be reduced to the analysis of buildings (Allison 1999: 4; contra Blanton 1994), but have to include an analysis of the uses to which spaces are put and how these spaces may have related to household groups." Because demographic models and floor area calculations treat buildings as 'empty shells' they provide no information as to the potential use of space. In other words, they do not consider the physical affordance of space in terms of living within and using the built environment, nor do they take into account whether spaces are suited for habitation due to, for example, size, spatial configuration, and built features.

The scenario modelling undertaken in this thesis offers an alternative method for examining the structuring and use of space, which avoids the problems associated with floor area calculations and demographic averages, as well as predetermined notions of which features more accurately defines a 'household'. The first step was to assess the potential for co-residency, which was done by modelling the contextualised (i.e. taking into account the size and shape of spaces, and internal features) maximum capacity for adult individuals to sleep within individual spaces. Modelling the maximum capacity for sleeping makes it possible to estimate the potential size of the co-resident unit in a way that reflects the physical affordance of space for co-habitation. In order to illustrate this, a comparison between the scenario modelling, demographic averages and floor area calculations has been included. Table 3.1 shows the estimated number of co-resident individuals for Structure II_1 at the Late Neolithic site of Hajji Firuz (which is examined in chapter 6), according to floor area calculations, average household size, and the result from the scenario modelling. The building has a roofed floor area of 28 m^2, which includes a living space (S1), a potential work

[14] This is also the case for the concept of the 'family' (see Hammel and Laslett 1974: 91-92).

and storage space (S2), and two small spaces, possibly used for storage, located at one end of S2 (in addition to various internal features such as hearths, a burial cist, and pottery vessels set into the floor). According to Naroll's floor area value (used by Flannery 1972) less than three people would have lived in the building, whereas if we followed Byrd (2000, 2005b) and combine Naroll's value with that proposed by Weissner (1974) there may have been three or four individuals co-residing in this structure. This is at the lower end of, or less than, the average household size proposed in demographic models.

Floor area		Demographic models	Scenario modelling	
Naroll (1962), Flannery (1972): 10 m^2 per person	Weissner (1974): 5.9 m^2 per person	Average household (i.e. nuclear family) size (Hassan 1981; Kolb 1985)	Modelled contextualised maximum capacity for Size A adults to sleep (see chapter 6)	
2.8 persons	4.7 persons	4-5 persons	Living space, S1:	13 persons
			Storage/work space, S2:	7 persons

Table 3.1: Comparison between calculated floor area per person, average household size, and scenario modelling for the early phase of Structure II_1 at Hajji Firuz, which has a 28 m^2 roofed floor area.

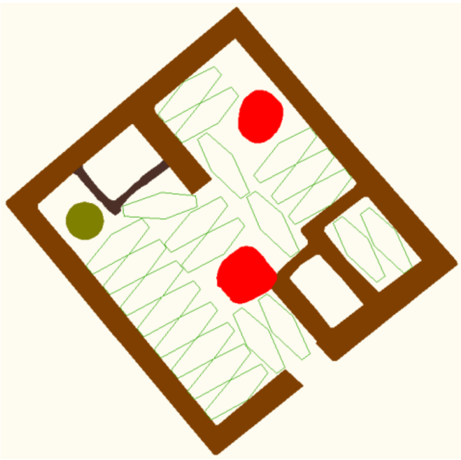


Figure 3.1: Modelled contextualised maximum capacity for sleeping in Structure II_1. Note the limited amount of space available for the two modelled individuals in the smallest space.

The result from the scenario modelling, on the other hand, indicates a greater potential for co-residency. As can be seen in Figure 3.1, the modelling takes into account the spatial layout within the building (including features) and excludes the smaller possible storage spaces (although there were room for two adults to sleep in one of them, this is less likely to have been the case due to the limited amount of space available). When the work and storage space S2 is excluded (as it may not have been used for sleeping purposes), the potential number of co-residing individuals in living space S1 remains greater than suggested by the floor area calculations (two to four individuals) or assumed in demographic averages (four to five individuals). It should, however, be stressed that the maximum capacity modelling is meant to indicate an upper range of potential co-residents, and *not* the actual number of individuals that resided in the building, which is likely to be lower. What the scenario modelling allows us to do is to conceptualise the *potential* occupancy of the building in a more realistic manner than the floor area calculations and demographic averages.

Another aspect of the modelling of the affordance of space for co-residency that differentiates this method from floor area calculations and demographic averages is that it provides a first step in the examination of the use of space. Alongside the modelled affordance of space for co-presence (discussed in section 3.3.2) it contributes information that may allow us to identify potential living spaces, i.e. internal spaces that may have provided, not only basic shelter for sleeping, but also space for social interaction between members of the co-resident unit and potentially guests (e.g. members of other co-resident groups, visitors to the settlement and so on; section 3.2). Contextualised maximum capacity for people sleeping was also modelled for external spaces, and especially courtyards, in order to explore whether outdoor spaces may have served as sleeping areas during the summer months. It has been a common practice in the Middle East to sleep outside in courtyards or on roofs during summer as it can become too hot inside buildings made of mud (Hassan 1973: 45-46; Hall, McBride and Riddell 1973: 248; Kramer 1982: 108-111; Watson 1979: 241-243), and it is possible that this practice occurred during the Neolithic as well.

At this point it is important to stress that the modelling of potential co-residency allows us to explore one aspect of how people may have lived and utilised space within built environments. It is *combined* with the other aspects of the scenario modelling – which explores potential for co-presence (section 3.3.2), activities and social interactions (section 3.3.3), human-animal co-presence (section 3.3.4), and storage potential (sections 3.3.5-3.3.6) – that it may inform on broader social and economic structures within the community and thus allow an evaluation of the degree to which co-residency and economic production and consumption may have overlapped. The methodology employed in this thesis is not, however, meant to provide definitive statements as to 'how it was' in the past; the modelled scenarios represent *potential* uses of space and thus the approach provides a 'tool to think with' (Hemsley 2007: 72).

3.3.2: Modelling co-presence

The second question asks how many people can interact within individual spaces, both internal and external. This was determined by modelling the number of people that could sit cross-legged within individual spaces while maintaining visual contact with at least the majority of those present. The modelled individuals were placed along walls, and any internal features that may be located by walls (e.g. bins, hearths), facing into the space. This scenario enables the opportunity for interaction between those present, as well as offering support for the back, which would not be possible if an individual was facing the wall. Modelling co-presence (in combination with the modelled capacity for co-residence) allows an assessment of the affordance of space for social interaction, and potentially the types of interactions that may have taken place, especially in the absence of *in situ* artefacts and built fixtures. The amount of room 'left over' in each space, i.e. not occupied by a seated individual, may also be informative. Certain spaces may have a lower capacity for co-presence with room for only a few individuals (between one and four), whereas other spaces may be large enough to afford the co-presence of larger groups (over five). There may be no space left for movement associated with sitting down or getting up from a seated position in the former case, and it may be better suited as a work space for domestic activities that only required the presence of one or two people, or possibly storage. Larger spaces with greater affordance for co-presence, on the other hand, may have accommodated non-work related social activities (as well as work), such as eating, entertaining guests, or ritual activities. In such cases there may be a certain amount of space available between the modelled individuals that could have facilitated the placement of objects related to particular activities, such as bowls, plates, and/or baskets in the case of food consumption. Modelling contextualised maximum capacities of co-present individuals therefore inform on the discussions concerning the character and scale of social interactions, i.e. whether the built environment structured social interaction and the number of people that could participate in the different types of activities taking place.

One aspect of behaviour that may have bearing on social interaction is the notion of personal space. Personal space refers to the spatial distance and orientation a person chooses to have during social interaction with others (Gifford 1997: 99; see Hall 1969). However, it is a social construct that is defined based on a set of socially observed notions, and as it depends on the social and cultural contexts (Gifford 1997: 99; Lawson 2001: 101) it is not possible to reconstruct archaeologically. Therefore, when modelling maximum capacities (sitting and lying down) personal space was not taken into account. It should be mentioned that the closer, or more intimate, the relationship between people are, e.g. between family and close friends, the more comfortable they will feel interacting at a closer spatial distance than they do with strangers because it is not perceived as threatening (Madanipour 2003: 26). Thus it is possible that the people inhabiting the structures would have interacted at close distances as they were likely to have close relationships through co-habitation. It will be assumed that the social actors modelled within individual structures are co-residents with close social bonds and the individual personal spaces were, if they existed, not of significance during social interactions not associated with working such as eating or general socialising. The spatial distance between people engaged in work may have been greater due to the spatial requirements of various domestic tasks, and the maximum capacity for co-presence allows us to explore the affordance of space for interactions not involving work.

3.3.3: Activities and social interactions

The third question asks whether there is any observable spatial patterning in the location of domestic activities, and the scale of social interaction taking place in internal and external spaces. A range of domestic activities would have taken place on a daily basis within these built environments, although the precise nature of many of them may not be accurately reconstructed based on the fragmentary evidence that has been preserved. There are issues associated with the identification of particular activities and use of space based on *in situ* artefact assemblages alone as the place where portable artefacts were deposited is likely not the same place as it was originally used (LaMotta and Schiffer 1999; also Kramer 1982; Wright 2000). The continued cleaning of interior floors is a common feature of Neolithic structures (e.g. Matthews 2005), and artefacts found within buildings may relate to activities that occurred immediately prior to the abandonment of a structure rather than being traces of activities repeatedly taking place over a long time. Alternatively, such artefacts may have been deposited as part of ritual behaviours associated with the abandonment of the building (Hodder and Cessford 2004: 32-35; Russell, Martin and Twiss 2009: 107; Watkins 1990: 342-343). It is also important to take into account potential taphonomic processes that may have affected the deposition of artefacts, as well as critically assess how such artefacts are reported in excavation reports and evaluate whether they were in fact deposited where they were used. Certain built features, i.e. features set into the floor, wall, and potentially the roof of structures, are more permanent indications of possible activities. These include bins, pits, various fire installations (e.g. hearths, oven, fire pits, or 'earth ovens'), and ground stone implements fixed into the floor (e.g. mortars, querns) (e.g. Wright 2000). Bins and pits may, for example, have been used for storage and/or refuse disposal (perhaps towards the end of their use-life), whereas fire installations and ground stones are often associated with food processing and cooking. It is, of course, possible that certain features were only built and used during shorter periods of the use-life of the buildings within which they are located.

Manufacturing and craft activities may not leave any *in situ* evidence in the archaeological record as debris from the production of various items (e.g. chipped stone tools, bone objects, beads) may be discarded in secondary locations, e.g. middens and refuse pits. Food processing and cooking is one group of activities that would have taken place on a daily basis (usually occurring several times a day) and may have involved the use of particular features commonly found in the archaeological record. Storage features, ground stone implements, and fire installations would have been used at various stages of food preparation, and these features are often found inside buildings, as well as in external spaces. The identification of such features and their location within the built environment are discussed in each case study. The frequent co-presence through repeated, daily interaction, such as during food preparation, cooking and eating, is important for structuring social relationships within co-resident groups, as well as between various co-resident units within the wider community (Yaeger and Canuto 2000). Identifying the location in which these activities took place therefore has both social and economic implications. It allows us to examine the scale of social interaction and possible number of participants, as well as reconstruct distribution and consumption patterns.

The configuration of built space in terms of the size and shape of internal and external spaces, and the movement within and around structures can provide insights into *possible* uses of space, particularly when evidence of built features is either partial or non-existent. By modelling co-presence, it was possible to assess which activities may have taken place within each space (section 3.3.2). For example, small spaces that did not appear to accommodate social gatherings, i.e. where only between one and four individuals could sit tightly packed together without any room for movement, are assumed to have been used for other purposes, such as storage and/or as working areas. If these small spaces did not contain any built features, the next step was to model one or two people sitting, squatting or kneeling in order to assess whether it was possible for one or two individuals to undertake work in these spaces. This modelling highlighted whether smaller spaces could accommodate one, two, or possibly three individuals, as well as implements potentially used, such as baskets or other containers (e.g. with food), grinding equipment and so on. If spaces were too small for a person to comfortably undertake work in either of these positions (i.e. sitting cross-legged, squatting, kneeling) it may indicate that they were perhaps better suited for storage purposes (e.g. food stuffs, fuel, tools).

In some cases people were also modelled in various positions in larger spaces in order to assess whether the spaces were designed to structure activities and associated interactions in any particular way, e.g. to avoid certain parts of the space due to presence of built features or burials. If there were features associated with, for example, food processing and cooking (e.g. fire installations and ground stones) present then the modelling assessed whether their location would have impacted the access into the space and where people would position themselves not to restrict movement, take advantage of light, and so on. People were in these cases modelled in various positions (usually a combination of sitting cross-legged, squatting and kneeling) along walls, opposite each other, in circles, and/or by particular features as a way of exploring whether the larger spaces accommodated multiple individuals utilising the spaces simultaneously, and, if so, whether their positioning would have impacted the movement through or access into a space or a particular part of the space. This part of the scenario modelling is not meant to represent specific activities, nor imply that the people using the spaces would position themselves exactly as modelled, but rather to provide a tool with which we can start to think about how these spaces *may* have been used and how this may have affected access into and movement within the spaces.

The use of external spaces may highlight differences in the use of space between internal and external areas, as well as potentially shed light on seasonal variation in the use of space. Activities associated with food processing, preparation and cooking may have taken place outside during the warmer months and inside during colder months (section 3.2). In such cases we would expect to see features such as fire installations and perhaps non-portable ground stone implements in both internal and external spaces. Multiple fire installations may also indicate functional differences (McQuitty 1984), especially if there were several types (e.g. hearths, ovens, fire pits, 'earth ovens') present within a settlement. In the village of Aşvan in eastern Anatolia Weinstein (1973: 272-274) recorded four different types of fire installations and their various uses. One of these types was small temporary hearths made by placing stones in a semi-circle and fuel (e.g. dung, twigs, brushes) in the middle. These hearths (constructed in the same general area according to need) were used for boiling large amounts of water for washing clothes and other tasks that could not be done in a closed oven (Weinstein 1973: 273). Another type of temporary fire installation was the slit trenches that measured 0.50 m in width, 2 m in length and 1.50 m in depth. These were used for the preparation of bulgur (boiled in cauldrons above the trenches), after which they were filled in without removing the large quantities of charcoal produced by this activity (Weinstein 1973: 272-273). Additionally, Kramer (1982: 119-123) has noted that at 'Aliabad', in western Iran, hearths located in living rooms were used for keeping warm during the winter, whereas the hearth and/or oven located in the kitchen were used for cooking. It is therefore possible that when there are different types of fire installations present this may relate to a difference in function or seasonal use (see also Seeden 1985).

The seasonal use of spaces highlights the fluid nature of built environments, as do the continuous maintenance of internal floors and walls and the changing configuration of space within a building's use-life. Changes in the size and composition of co-resident groups as members age, leave and die, may also alter the needs and use of space. It is therefore important to keep in mind that the spatial layout of buildings and associated external spaces may only reflect one phase in the use of space (prior to abandonment).

3.3.4: Animals within the built environment

The fourth question asks whether the built environments were designed to include animals. This has implications for aspects of animal management strategies, the development of human-animal relationships, and the use of space within settlements. The issue of caprine domestication is central to our understanding of the Neolithic in the Zagros, and has tended to be the focus of discussions regarding the developments that took place in the region during this period (sections 2.3.2). Most of this discussion has, however, provided limited consideration of the social and economic role of animals beyond the question of whether the caprines were domestic or hunted populations, and there has been a lack of consideration of how animals 'fitted' within the settlement landscape (section 2.8). The presence of animals, as well as various aspects of animal management practices, is usually attested through zooarchaeological, micromorphological and archaeobotanical studies. Management strategies, including penning and herding practices, are often investigated through micromorphology and isotope studies (e.g. Bocherens et al 2001; Henton, Meier-Augenstein and Kemp 2010; Mashkour, Bocherens and Moussa 2005; Matthews 2005; Matthews et al 1997; Pearson et al 2007). However, as most of the sites analysed in this thesis were excavated prior to the 1990s and no micromorphological studies have been conducted, information concerning such issues is not available. It has been argued that parts of the archaeobotanical record from sites with domestic or pre-domestic livestock may in fact come from dung that was burnt as fuel because the processing of plants for human consumption leaves fewer residues than fodder and fuel (Miller 1984a, 1984b), although there are issues associated with identifying charred plant materials as derived from dung (Charles and Bogaard 2005: 95). The utilisation of animal dung for fuel has been attested through micromorphology at several Neolithic sites across the Near East, including Sheikh-e Abad (Matthews 2009b), which indicates that herded animals were kept in pens at least periodically.

One way of providing some insight into aspects of early human-animal relationships and possible penning practices in the absence of evidence from e.g. michromorphological studies is to look at the potential inclusion of animals within the settlement landscape. Ethnographic studies concerned with pastoral economies (including nomadic pastoralists and sedentary communities practicing animal herding as part of a mixed economy) indicate that in societies where households form the basic unit of production and consumption, individual households are responsible for any decisions made concerning the animals, which includes ensuring adequate pasture and providing fodder when pasturage is not available or insufficient, providing water, protecting against predators, providing shelter when needed, treating animals that are injured and ill, and controlling breeding (Beck 1980: 330-331; Cribb 1991: 23-43; Gilbert 1973: 57; Horne 1988: 69). The aspects of animal management strategies that are of interest in the discussion in this section relates to providing protection and shelter, and in some cases also medical treatment.

Most societies engaged in some form of pastoralism will keep their domestic flocks contained within pens, corrals, stables, and/or caves when they are not out on pasture. The degree of control exercised through containment depends on "how close the supervision must be in order to achieve desired conditions of maintenance or produce desired physical qualities among the animals" (Gilbert 1973: 57). Animals are usually kept in pens or stables during nights – although there are examples of herds being pastured at night and penned during the day in summer (e.g. Cribb 1991: 166) – to shelter and protect against weather, predators, theft, and pests (Gilbert 1973: 57, 1983: 110-111; Horne 1988: 70). Even in pastoral communities where herds are allowed to graze freely during the day without the supervision of a herder the animals are still kept penned at night (e.g. Baker and Hoffman 2006: 768). Pens, corrals, and stables are often located within or attached to courtyards or structural compounds (Cribb 1991: 158; Gilbert 1983: 110-111; Horne 1982: 681, 1988: 70, 133; Kramer 1983: 150-151; Solecki 1979; Watson 1979: 129, 160-161), although there are also examples of animals stabled in separate compounds on the outskirts of villages (Horne 1988: 150). Nomadic pastoralists will also keep their herds corralled at night for protection, often in close proximity to their tents or in roofed enclosures attached to more sturdy winter dwellings (Cribb 1991: 96, fig. 6.12, fig. 6.15; Gilbert 1983: 111). Providing protection and shelter through the containment of animals when they are not on pasture also occur in instances where flocks are kept at secondary locations away from the main settlement for varying lengths of the year, such as at winter herding stations in Khar-o Turan, northeast Iran (Horne 1988: 109).

There is a range of herding strategies employed both within individual communities (nomadic through sedentary) and between different pastoral groups, which include allowing flocks to graze freely, hiring a shepherd, and herding your own animals. There are also examples of pastoralists (nomadic as well as sedentary communities) who, due to an imbalance between available labour resources and labour demands, form co-operative herding units to take care of daily herding needs when the size of individual herds are not ideal (Beck 1980: 332; Cribb 1991: 34-39; Horne 1988: 68; Watson 1979: 93-97). The optimal size of a herd that can be managed by one person, frequently accompanied by a dog, tends to fall in the range of between 200 and 400 animals (Beck 1980: 332-333; Cribb 1991: 28; Halstead 1996: 34; Watson 1979: 93-94). In cases where animals are herded in co-operative units, it is usual for individual herds to be kept penned or stabled separately when returned to the settlement or camp, usually in pens or stables located within, or close to, the residence of the household that owns the herd (e.g. Watson 1979: 97; although see Horne 1988 for discussion of dispersed holdings within a settlement).

The containment of domestic animals in pens, corrals, and/or stables (underground and above ground) within sedentary, semi-sedentary and nomadic settlements and camps is a common feature of animal management strategies, and is aimed at providing protection and shelter against a range of external factors. There are examples of societies with strong pastoral elements in which the penning of livestock is an influencing factor on the structural layout of settlements (both sedentary and nomadic camps) (Cribb 1991: 133-166), in some cases this is because people want to keep a 'close eye' on their own herds (Bina and Dyas cited in Cribb 1991: 160). It is therefore possible that such features formed part of the built environment in the past as well – be it within, on the outskirts of, and/or in close proximity to the settlement. There is a wide range of management strategies that have been and are employed by communities that rely either fully or partly on pastoralism, which include herd movement on a wide variety of temporal and spatial scales (see Cribb 1991 and references therein). The modelling of goats within the built environment (in both external and internal spaces) does not attempt to reconstruct these strategies. Instead, it allows us to consider whether the built environment *may* have accommodated the containment of animals and what this may tell us with regards to the potential degrees of control of individual herds or segments of larger (co-operative) herds. The underlying assumption is that if the co-resident unit was the main unit of production and consumption this would include not only agricultural produce (which is often the only product considered within the models discussed in section 2.4 with regards to storage practices), but also pastoral holdings, i.e. animals. Modelling goats within the built environment allows an examination of whether shelter (against weather and potential predators) *may* have been provided within the settlements, such as in courtyards, in some proximity to domestic structures, and/or in specific locations within the built environment, and the *possibility* that individual co-resident groups may have kept their herd close to their place of residence. In this respect it also provides another aspect in the exploration of the potential use of space within the built environments. The potential inclusion of animals therefore forms part of the assessment of economic practices as well as the structuring and use of space within the settlements. It is included to provide one alternative among a range of scenarios explored in the examination of the structuring and use of space. Another part of the assessment of whether individual co-resident groups were also the main units of production and consumption is provided by the modelling of storage capacities – both food for human consumption (section 3.3.5) and animal fodder (section 3.3.6).

It may not be possible to identify pens within the built environment, partly due to the possible use of perishable materials such as wood and brushes to construct pens and corrals. An alternative may be that there were no pens, either because animals were kept outside the settlement, inside enclosed courtyards, or were left to wander around the settlement without any traceable restrictions. In the absence of micromorphological studies to elucidate on this question, a starting point is to assess the affordance of space for animals within the built environment. This was done by modelling goats in the external spaces (both open and enclosed) at each site. Goats were not the only domestic animals at later Neolithic sites, however, since the domestication of goats is thought to have occurred early in the Zagros (section 2.3.2), and due to the importance placed on this economic development, it was decided that it was better to focus this part of the modelling on goats. Additionally, goats can be similar in size to sheep,[15] and thus modelling goats will allow a rough parallel with sheep.

[15] The length (head and body) ranges between 1.20 m and 1.80 m for sheep (Nowak 1999: 1232), whereas the length (head and body) of goats ranges between 1.20 m and 1.60 m (Nowak 1999: 1220).

In order to model the affordance of space for goats it was necessary to establish the length and width of goats and create a representative polygon in AutoCAD (as with the modelling of people). The length of fully grown wild goats (*Capra aegagrus*), including head and body, ranges between 1.20 m and 1.60 m (see Nowak 1999: 1220), whereas various modern wild goat species range between 1 m and 1.80 m (Nowak 1999: 1220-1228). Female goats are generally smaller than males (Nowak 1999: 1220-1228)[16], as are kids and young animals, and there appear to have been a reduction in size of domestic goats (*Capra hircus*) during the later part of the Aceramic and Pottery Neolithic in the Zagros highlands (Zeder 2006b: 202). It was decided that the modelled goat would measure 1.20 m in length, which is at the lower end of the scale for wild goats, since it would potentially off-set any difference in size between females and males in the herded population, as well as the size difference between animals that were not domesticated and those that definitely were. Size of goats are generally given in terms of length of head and body, length of tail, height of withers, weight, and length of horns, with no information available regarding width. In order to create a polygon representing the area occupied by a modelled goat, it was decided to use 0.50 m as an arbitrary width. The goats will thus be modelled as 1.20 x 0.50 m rectangular polygons (Appendix B, Figure 3.5).

There is a range of external factors associated with the housing of animals that can affect their health, including floor, bedding, tethering, temperature, removal of manure, ventilation, dust, and the density of the herd (Hartung 1994: 30-45). As penning of animals is only likely to have occurred during shorter periods of time, i.e. during the night, under adverse weather conditions, and during lambing (Halstead 2006: 50; Watson 1979: 104, 157, 294), the welfare of the animals in terms of space allocation was not taken into consideration when modelling the maximum capacity for goats within individual spaces. The presence of goats was modelled in all external spaces – open areas, enclosed courtyards, and partially enclosed external spaces (potential courtyards), but avoiding features such as hearth, ovens, pits, and so on – as well as in internal spaces with ground level entranceways. In pastoral societies (both nomadic and sedentary) animals that are ill and injured, and/or kids and lambs (especially newborn) are frequently brought into the domestic space while recovering, to protect against the sun and heat and/or snow and cold, and during the night for the first few days after birth (e.g. Hole 2009: 263; Salzman 1972; de Schauensee 1968: 39; Watson 1979: 255). Since the lambing and kidding season may start in January it is possible that newborn animals were brought into the domestic space during the Neolithic, at least for the first few days, to protect against the cold if needed (e.g. at higher elevations). Modelling goats together with people and storage within the domestic space can inform on the *potential* for such practices to have taken place.

[16] Female ibex (*Capra ibex*), for example, are on average only one third the size of males (Nowak 1999: 1223).

3.3.5: Modelling storage

The fifth question asks whether the built environment was designed to include storage of resources and what the potential impact of storage practices on the use of space may have been. Changes in Neolithic domestic architecture have been seen as reflecting a shift from shared to private storage associated with increasingly economically independent household units (section 2.4). Modelling storage capacities allows an assessment of potential storage practices within the Zagros communities. In order to model storage, the average annual calorific requirement of an individual, and how much this would equal in stored resources, was calculated. Humans require energy for a range of bodily functions, including basal metabolism (e.g. cell functions, respiratory and cardiac muscles, and brain functions), ingestion and digestion of food, physical activity, growth, pregnancy, and lactation.[17] Factors such as age, body weight, pregnancy, and level of physical activity will determine the daily energy requirement needed to sustain an individual. Hemsley (2008: 89-90) used an average of 2,500 kcal per person per day as a sensible estimate reflecting the possible energy intake of most non-western populations. This was based on a discussion of nutritional requirements for active individuals by the UN Food and Agriculture Organisation (between 2,800 and 4,000 kcal/person/day)[18], the average energy intake in ten modern hunter-gatherer populations (averaging 2,560 kcal/person/day; see Jenike 2001: table 8.2), and observations made that the energy requirement for adult men conducting physical labour for eight hours per day is between 2,000 and 3,000 kcal/day (see Clark and Haswell 1967: 1-23). Any estimation of daily nutritional requirement for a population should include a range of individuals of different ages and body weights and with different metabolic rates and levels of physical activity, including some that need less energy due to age (i.e. children[19] and aging[20] individuals), and those that required more energy, such as pregnant women.[21] The figure of 2,500 kcal provides a viable average for the entire population “as the higher requirements of pregnant women and a highly active adult and adolescent population are offset by the lower demands of children and aged members of the community” (Hemsley 2008: 90).

The next stage required the calculation of the storage volume needed to provide the annual nutritional requirement for an individual. The calculation of storage volumes considers plant foods only as it is difficult to assess how much meat would have been stored. Even when meat is dried it is usually stored for a shorter period of time[22] than plant foods, which can be stored for longer and thus have a longer use-value than animal products (Soffer 1989: 723-728). Animal herds provide a sort of ‘live storage’ (Flannery 1969; Paine 1972) and a means

[17] See: http://www.fao.org/docrep/007/y5686e/y5686e04.htm#bm04 (accessed on 10/10/2011).
[18] See: http://www.fao.org/docrep/007/y5686e/y5686e07.htm#TopOfPage ; and http://www.fao.org/docrep/007/y5686e/y5686e08.htm#TopOfPage (both accessed on 10/10/2011).
[19] See: http://www.fao.org/docrep/007/y5686e/y5686e06.htm#TopOfPage (accessed on 10/10/2011).
[20] See: http://www.fao.org/docrep/007/y5686e/y5686e09.htm#TopOfPage (accessed on 10/10/2011).
[21] See: http://www.fao.org/docrep/007/y5686e/y5686e0a.htm#TopOfPage (accessed on 10/10/2011).
[22] Though it is possible to store dried meat for more than nine months if it is kept in the right conditions (Cunningham 2011: 138; Soffer 1989: table 1).

to diversify against risk (Halstead 1996: 23-35), and it is less likely that meat would have been stored long-term.

Studies detailing diets in modern hunter-gatherer and sedentary societies highlight the fact that the proportion of consumed plant and animal derived foods depends on a variety of factors, including available resources, wealth, and traditions. In modern agricultural communities in southern and central India, for example, cereals and millet contribute only around 56% of the calorific intake for the wealthiest households and up to 90% in poorer households; comparable proportions were also attested in earlier periods (M. L. Smith 2006: 43-44). In a study of the small-scale agricultural village of Aşvan, Hillman (1973: 228-229) estimated that out of the total calories consumed about 78.5% came from wheat products and 3.5% from legumes. In the only other study that has attempted to model potential storage capacities in Neolithic buildings, Hemsley (2008: 90-94) favoured a high estimate (80%) when assessing the proportion of plant food consumed. Even though this is possibly an over-estimation of the consumption of stored plant resources during the Neolithic, she chose this figure in order to investigate the maximum potential storage requirements of a co-resident unit, and to offset any nutritional differences between more energy dense modern domesticate (for which there are available values) and wild counterparts (Hemsley 2008: 91). There is, however, a notable difference between the diet of communities in the Levant and those in the Zagros. Studies have indicated that the dietary intake of Neolithic populations in the Zagros consisted of a higher percentage of meat than in the Levant where cereals and legumes played a central (albeit changing) role (Schoeningen 1981). If it is assumed that storage of plant resources occurred at Neolithic settlements in the Zagros, it may be suggested that they would have contributed a smaller portion of the stored resources than at Levantine sites.

The archaeobotanical records from various sites in the Zagros indicate a greater reliance on wild species during the Aceramic Neolithic, especially almond and pistachio, but also pulses such as lentil and pea, with domestic barley, wheat and lentils becoming more common during the Pottery Neolithic (section 2.3.2). Depending on the proportion and the type of plant foods that were consumed, the annual requirement in terms of volume would differ. The nutritional values of cereals and legumes are in a similar range with one kilo of grain averaging 3,490 kcal and one kilo of dried lentils providing 3,350 kcal, whereas almonds and pistachio have higher energy content with one kilo averaging 6,000 kcal (Kislev and Bar Yosef 1988: table 1). This means that a larger quantity of grain and lentils would be needed to meet the annual calorific requirement than nuts (Table 3.2).

Proportion of plant food consumed		60% + 25% wastage	70% + 25% wastage	80% + 25% wastage
Annual requirement: kcal per person		684,375	798,437.5	912,500
Grain	Kg grain per person per year	196.10	228.78	261.46
	Bushels	8.00	9.34	10.67
	Storage volume (m^3)	0.28	0.33	0.37
Legumes	Kg legumes per person per year	204.29	238.34	272.39
	Storage volume (m^3)	0.24	0.29	0.33
Nuts	Kg almonds per person per year	114.06	133.07	152.08
	Storage volume (m^3)	0.19	0.22	0.25

Table 3.2: Calculated storage volume for storing the annual calorific requirement for one person if supplied by grains, legumes and nuts.

The calculations in Table 3.2 show the volume needed to store grains, lentils and almonds if they accounted for 60%, 70%, and 80% of the annual calorific intake. An additional 25% was included in the calculations to account for loss due to pests or wastage during food preparations and so on, and seeds kept for sowing next year's crop. One kilo of threshed grain average 24.5 kg per bushel[23] and one bushel equals 0.035 m^3, whereas one kilo of dried lentils average 0.0012 m^3,[24] and one kilo of almond equals 0.0017 m^3.[25] For the purpose of modelling potential storage capacities, it was assumed that 70% of the calorific intake came from plants, which would mean that the annual storage of grain for one person required 0.33 m^3, lentils 0.29 m^3, and almonds 0.22 m^3. 70% is probably an over-estimation, but it allows for dietary variations between sites, and potentially compensates for any differences between volume and energy content in modern day domesticates and the wild and early domestic varieties consumed in the Neolithic. The higher storage volume of 0.33 m^3 required for grains was used in assessing potential storage, although the lower volume of 0.29 m^3 for lentils was used for calculating storage at Ganj Dareh. As mentioned in section 2.3.2, wild species, especially almonds and pistachio, appears to have been more important at the site even though wild and domestic forms of barley were present (van Zeist et al 1984: 201-222). This volume provides a medium between that required for grains and that for almonds, thus allowing for the inclusion of all three plant types.

[23] There are 60 lb or 27.22 kg of wheat per bushel, and 48 lb or 21.77 kg of barley per bushel (http://extension.missouri.edu/publications/DisplayPub.aspx?P=G4020 accessed on 30/10/2011). The average has been chose as it potentially represents a mixture of both crops.
[24] There are 831 kg of whole lentils at 9.2% moisture content per m^3 and 840 kg of husked, split lentils at 6.7% moisture content per m^3 (Bhattacharya et al 2005: 218), averaging 835.5 kg per m^3.
[25] See http://www.onlineconversion.com/weight_volume_cooking.htm (accessed on 30/10/2011).

The discussion of the architecture at each site includes an assessment and identification of potential storage features such as bins, pits, and clay or ceramic vessels. The potential capacities of smaller interior spaces deemed as possible storage spaces due to their size, lack of internal features, and restricted affordance of space for people to be present (sections 3.3.2-3.3.3), was also assessed. In these cases it was assumed that plants were stored directly on the floor up to a height of 0.50 m and 1 m. These calculations should be viewed as minimum estimates as it is likely that the spaces had the potential of being filled to a greater height than 1 m. Plant foods may have been stored in portable containers within these spaces, but this scenario is difficult to calculate as the dimensions and number of such containers, and the way in which they would have been arranged, are impossible to estimate accurately. Calculating storage directly on the floor based on the area between the walls presents a general estimate that is representative of *minimum* storage potential. In cases where no storage features or small potential storage spaces were identified, storage was calculated using modelled on-floor storage containers. These were circular polygons representing 1 m high cylinders containing a volume of 0.33 m^3 or 0.29 m^3 (Appendix B, Figure 3.6).

There is a wide range of solutions that are, and have been used for storage (by sedentary and mobile communities), including built fixtures, such as bins, silos, pits, and platforms, separate storage rooms, and a variety of portable storage containers, e.g. ceramic vessels, baskets, skins, and sacks, which may be kept on the floor, stacked in separate rooms, and hung on the walls or from the ceiling (Cunningham 2011; Seeden 1985: 294-299; Soffer 1989; Weinstein 1973; Watson 1979: 124-126). In many cases only built fixtures, storage rooms, and containers made of durable materials such as clay or stone, may survive in the archaeological record. Archaeologists tend to focus on these types of features and containers when discussing increased storage practices, often ignoring perishable containers, e.g. baskets, skins, sacks and wooden bowls, which are not always preserved. Notable exceptions include discussions of storage practices and organic containers at Çatalhöyük, central Anatolia (e.g. Bogaard et al 2009; Ryan 2011; Twiss et al 2008; Twiss et al 2009). Twisted fibres found at Olaho II (*c* 21,000 cal BC) believed to be from bags or nets (Nadel et al 1994) and basketry from Shanidar Cave (Solecki 1963) indicate the longevity of use of organic containers. Some of the best preserved examples of perishable containers come from the PPNB site of Nahal Hemar, which included fragments of cordage and basketry in a variety of shapes and sizes (Shick 1988), providing extensive information on forms, techniques and materials used. Impressions of basketry and textile bags have been found at some of the sites considered in this thesis (e.g. Adovasio 1975, 1983; Bader 1993a; Voigt 1983: 263-267), which indicates that storage in organic containers probably occurred in the area during the Neolithic. Modelling potential on-floor storage by using simple shapes as representative of containers that for whatever reason have not been preserved allows an assessment of the *potential* affordance of space for storage in the absence of built features. The modelled storage containers are not implied to accurately represent the storage containers that were used (in terms of size and shape), but rather help to *visualise* the potential use of space.

3.3.6: Modelling the storage of fodder

The early management of goats in Zagros introduces the possibility that potential storage practices at Neolithic sites were not necessarily aimed at providing annual supplies of foods for humans – storage facilities may have been used to store fodder for herded animals. Pursuing pastoral strategies means that humans take on responsibility for ensuring the welfare of their livestock (as outlined in section 3.3.4), which include making sure that the animals have access to sufficient pasture and providing fodder when the pasturage is not available or adequate. Whereas nomadic and transhumant pastoralists move with their herds and flocks in order for them to take advantage of a variety of pasturages on a seasonal basis (e.g. Bates 1972; Cribb 1991; Salzman 1972), sedentary communities may devise other solutions in order to ensure that there is enough fodder to feed their herds when pastures are not available. In the event of adverse weather conditions, which in the Zagros may include snow and/or heavy, cold rain, animals may be kept penned or stabled within, or in the immediate vicinity of, the settlement, or possibly in nearby caves (see discussion in section 3.3.4). If animals cannot be taken out on pasture, or if the quality of the pasture is poor and not enough to feed the livestock, such as during drought, the animals may have to be fed stored fodder (Horne 1988: 68-69; Makarewicz 2007: 138; Miller 1984a: 74).

A range of forage resources are, and were in the past, utilised as fodder, including grasses, legumes, cereal grains, leaves and twigs from trees and shrubs, and by-products from cereal processing (e.g. straw, husks), all of which have various nutritional values. Certain plants commonly found in archaeobotanical assemblages, e.g. barley, legumes and by-products from cereal processing, may have been used for animal fodder and not necessarily for human consumption (Charles 1998; Charles and Bogaard 2005; Miller 1984a, 1996; Weinstein 1973: 275). The choice of fodder will in most non-mechanical agro-pastoral and pastoral societies depend on the available forage,[26] but will likely consist of a mixture of different feeds (but see Salzman 1972). Alternatively, animals may be moved by a few individuals to lower or higher altitudes where there are still pasturages available during certain parts of the year, e.g. the winter or summer months respectively. Research employing a range of methods, e.g. isotope studies, dental microwear, and the study of animal dung, have been used to reconstruct past animal diets as a way of investigating animal management strategies and feeding practices (e.g. Charles and Bogaard 2005; Mainland and Halstead 2005) including tracing the movement of nomadic groups with their herds (Mashkour, Bocherens and Moussa 2005). Some researchers have suggested the

[26] In most industrial societies where dairy and meat production is on a larger-scale, costs in association with weight gain and/or increasing milk yield are determining factors in formulating feeding strategies.

possibility that various foddering practices may already have been in place during the Neolithic (Charles and Bogaard 2005; Henton, Meier-Augenstein and Kemp 2010; Makarewicz 2007; Makarewicz and Tuross 2012; Martinoli and Nesbitt 2003; Matthews 2010; Miller 1996). It is possible that foddering was part of animal management strategies in the Zagros, particularly at higher elevations where winter conditions can be harsh, but also during the summer if forage was inadequate as suggested by Miller (1996) for Ali Kosh.

The modelled storage of fodder allows us to explore the *potential* for storage practices to include fodder, which has implications not only for animal management strategies, but also economic practices within these communities. Combined with the modelling of goats within the built environment it may allow us to evaluate possible management strategies relating to ownership of animals as discussed in section 3.3.4 (i.e. in terms of being responsible for animal welfare and ensuring pastoral productivity). Together with the modelling of storage of plant foods for human consumption (section 3.3.5), these two aspects form part of the evaluation of possible economic strategies that takes into account the physical affordance of space for storage and penning practices.

In order to assess the potential affordance of space for storing animal fodder, it was necessary to find the nutritional requirement for animals and the amount of space required to store the fodder. Since goats were used to model the affordance of space for animals within the settlement (section 3.3.4), it was decided to base these calculations on the energy requirement of goats. The nutritional requirement of goats depends on a range of factors, both physiological (e.g. body size, age, pregnancy, lactation, and health) and environmental (e.g. terrain, temperature, humidity, wind velocity, and sunshine), as well as the level of activity (NRC 1981: 2). Following the National Research Council (subcommittee on Goat Nutrition) guidelines the basic maintenance requirement, which includes stable feeding, minimal activity and early pregnancy, ranges from 0.57 to 3.21 Mcal metabolisable energy (ME)[27] per day for goats ranging in weight from 10 to 100 kg[28], with an additional 1.42 Mcal/ME/day required during late pregnancy regardless of the size of the goat (NRC 1981: table 1). The weight of wild *Capra aegagrus* range from 25 kg to 95 kg (Nowak 1999: 1220), with body size and weight potentially being less in domestic goats; the weight of modern *Capra hircus* average 45 kg[29]. In order to represent the weight of pre-domestic and domestic goats, as well as off-set difference between females and males, the median body weight of 50 kg was chosen for the purpose of modelling fodder storage. The maintenance requirement for a 50 kg goat is 1.91 Mcal/ME/day and 3.33 Mcal/ME/day during late pregnancy. These calorific requirements are lower than for animals on pasture due to the difference in activity levels (NRC 1981: 2).

[27] ME is the energy provided by the food when energy lost in faeces, urine and as methane has been taken into account.
[28] Weight gain has not been taken into account as this is primarily a concern of modern day dairy and meat farmers.
[29] See http://animaldiversity.ummz.umich.edu/accounts/Capra_hircus/ (accessed on 17/10/2012).

		50 kg goat; 1.91 Mcal per day			50 kg goat in late pregnancy; 3.33 Mcal per day		
Type of fodder	Average energy content - Mcal per kg fodder	Kg per goat for 90 days	Bushels	Storage volume (m^3)	Kg per goat for 90 days	Bushels	Storage volume (m^3)
Barley	3.107	61.47	2.89	0.10	107.18	5.04	0.18
Legume hay	2.151	88.83	3.26	0.11	159.30	5.85	0.20
Mix of cereal processing by-products, grass hay and legume hay	1.912	99.89	3.67	0.13	174.16	6.40	0.22

Table 3.3: Feed requirements for 50 kg goat and 50 kg pregnant doe for 90 days.

The quantity of fodder needed to meet the daily energy requirement for a goat will depend on the nutritional value of the feed. Grains (e.g. barley and wheat) have higher energy content than hays, whereas by-products from cereal processing (e.g. straw and hulls) have even lower energy contents.[30] The calculated fodder requirements assumes that enough fodder was stored to sustain the herds during winter when temperatures were low and herds may not have been taken out to pasture due to snow or cold rain. Foddering may not have been required for the entirety of the winter, assuming that the animals would have been taken out when pasture was available or the weather allowed it. The calculations in Tables 3.3 and 3.4 are for 90 and 120 days respectively, showing the fodder required for maintenance of a 50 kg goat and a 50 kg doe during late pregnancy when fed on barley, legume hay, and a mixture of cereal by-products and hay (with a predominance of hay). 90 days would cover the period of the year in which snow may potentially have fallen at higher altitudes.[31] It is possible that more fodder was required to sustain the herds during winter, or that more fodder was kept in case of emergency, and thus the amount of fodder required for 120 days was also calculated. The calculations take into account a dry matter (DM)[32] content of 90% for the various forages (as listed by DPI[33]), but no loss of DM during storage.[34]

[30] Average ME/kg dry matter (DM) are as follows: barley and wheat grains contain 3.107 Mcal/ME/kg DM; hay range between 1.912 and 2.390 Mcal/ME/kg DM depending on whether it is legume or grass hays (as well as specie); and straws and hulls from wheat and barley contain 1.195 Mcal/ME/kg DM (http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0016/104641/full-hand-feeding-of-sheep-quantities.pdf accessed on 08/03/2012).
[31] Early December through to early March.
[32] Dry matter content is the component of the feed that contains nutrients minus the moisture content; the moisture content needs to be below 18% before storage to prevent heating and mould developing (http://extension.missouri.edu/p/G4575 accessed on 09/03/2012).
[33] NSW Department of Primary Industries. See: http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0016/104641/full-hand-feeding-of-sheep-quantities.pdf (accessed on 08/03/2012).
[34] See http://extension.missouri.edu/p/G4575 (accessed on 09/03/2012).

		50 kg goat; 1.91 Mcal requirement per day			50 kg goat in late pregnancy; 3.33 Mcal per day		
Type of fodder	Average energy content - Mcal per kg fodder	Kg per goat for 120 days	Bushels	Storage volume (m^3)	Kg per goat for 120 days	Bushels	Storage volume (m^3)
Barley	3.107	81.97	3.85	0.13	142.90	6.72	0.24
Legume hay	2.151	118.44	4.35	0.15	212.40	7.80	0.27
Mix of cereal processing by-products, grass hay and legume hay	1.912	133.19	4.89	0.17	232.21	8.53	0.30

Table 3.4: Feed requirements for 50 kg goat and 50 kg pregnant doe for 120 days.

Feeding goats entirely on cereal grains, even though they are a great source of energy, can be detrimental to their health[35] and it is advised that hay should be the primary fodder with grains only supplementing the diet.[36] Legume hays have higher energy contents than grass hays, with the leafy parts of the legumes being particularly nutritious[37], and leguminous plants, as well as trees and shrubs, are preferred browse for goats. It is possible that most stabled animals would have been fed a mixture of dried grasses, legumes, leaves, twigs and straw, as well as cereal grains, when foddering was required (Miller 1984a, 1984b).[38] The modelled fodder storage was based on legume hay as its energy content provide a medium between grains and the lesser value mixture of cereal by-products and hay, and allows for any difference in hay to grain ratio that may have existed.

Since kidding may occur at any time from January to early May (Nowak 1999: 1221),[39] and because the nutritional requirement increases during the later stages of pregnancy (4-6 weeks), the increased energy requirement may have been reflected in the amount of stored fodder. The amount of fodder required to feed a pregnant doe is almost twice that of a non-pregnant adult animal, and therefore the volume needed to store enough leafy leguminous hay to feed a 50 kg pregnant doe for 90 days (0.20m^3) were used. The fodder requirement for 120 days (0.27 m^3) may be used to compare what impact the different storage requirements may have had in terms of herd size at sites located at high altitudes where

[35] They have high levels of phosphorus, which can cause kidney stones, and low in calcium, which can lead to milk fever in pregnant and lactating does.
[36] See also http://www.sheepandgoat.com/articles/graintruth.html (accessed on 09/03/2012).
[37] See also http://www.ansci.cornell.edu/goats/Resources/GoatArticles/GoatFeeding/FeedingForTwo.pdf (accessed on 09/03/2012) and http://vbs.psu.edu/extension/resources-repository/publications/Eq-Feed%20Quality-06.pdf (accessed on 09/03/2012).
[38] At the village of Malyan, for example, the livestock was fed a mixture of straw from cereals, barley grains and alfalfa (Miller 1984a: 73).
[39] The mating season for goats is August-December and the gestation period is 70-150 days (Nowak 1999: 1221).

winter temperatures were lower for longer and there was a greater possibility of snow and frost than sites at lower altitudes (section 2.2).[40] Storage of fodder was calculated for small potential storage spaces, assuming storage directly on the floor up to a height of 0.50 m and 1 m, as discussed for storage of plant foods (section 3.3.5). In cases where no storage facilities could be identified, on-floor storage containers were modelled as circular polygons, each representing a 1 m high cylinder containing a volume of 0.27 m^3 (Appendix B, Figure 3.6).

3.4: Summary

This chapter has outlined the main components of the modelling that facilitates the examination of the use of space within Neolithic built environments in the Zagros uplands and adjacent lowlands in this thesis. Each case study presented in the next four chapters provides in more detail the practical application of this approach and how informative it is in dealing with variable archaeological and architectural remains. Various scenarios were modelled in order to assess the physical affordance of space for human occupancy, social interaction and animal presence within the settlements, and how potential storage may have impacted on the use of space. A key difference from previous studies is the inclusion of animals in the scenario modelling and the modelling of storage of animal fodder, which allows us to investigate potential animal management strategies and the impact that these may have had on the structuring and use of space in terms of animal co-presence and possible storage practices.

Creating simple two-dimensional shapes representing humans in various positions and modelling the maximum capacities for co-presence, co-habitation, and activities provides the basis for a more contextualised site-specific discussion of the potential use of space. The approach offers a ‘tool to think with’ (Hemsley 2008: 77) with which we can start to conceptualise how the built environments would have afforded different scales of interaction. It allows us to visualise the architectural remains as lived-in spaces (Fitzjohn 2007), and thus facilitates a more in-depth understanding of the nature of human occupancy of Neolithic built environments in the Zagros which so far has been lacking from discussions of the developments that occurred in the region. The various modelled scenarios facilitate a more situated conceptualisation of how space may have been used, which combined may inform on broader social and economic structures within the Neolithic communities. By evaluating the degree to which co-residency and economic production and consumption may have overlapped it is possible to examine the extent to which Neolithic co-resident groups may have been economically autonomous (e.g. Byrd 1994, 2000; Flannery 1972, 2002), or not (e.g. Pollock and Bernbeck 2010). The next chapter presents the first of the three main case

[40] Additionally, snow tends to stay on the ground and affect the availability of pasture for longer than rain.

studies, examining the built environment at Ganj Dareh utilising the approach outlined in this chapter.

Chapter 4

Ganj Dareh

4.1: Introduction

This chapter presents the first of three case studies that examine the structuring of settlement space in Neolithic sites in the Zagros, namely Ganj Dareh in this chapter, and Jarmo and Hajji Firuz in the next two chapters. The Aceramic site of Ganj Dareh (*c* 8,000 cal BC) is of particular interest as it provides some of the earliest evidence for the management of goats (e.g. Hesse 1978, 1984; Zeder 1999; Zeder and Hesse 2000). It therefore presents an ideal opportunity to investigate whether the built environment was designed to afford space for herded animals, and may provide insights into aspects of management strategies in the absence of other lines of evidence, such as micromorphological studies, and human-animal interaction within Neolithic built environments during the earlier stages of goat herding. Initially, an outline of the main features of the site, and the excavation strategies are provided (section 4.2), including the main characteristics of the materials recovered from the site, the occupational phases, and the reconstruction of the diet. Following this is a discussion of the structural remains found at the site, and in particular those that are identified to be best suited for the scenario modelling, as well as any evidence for food-related activities (e.g. ground stones and fire installations), storage practices, and ritual behaviours (e.g. burials) (section 4.3). This provides the basis for the main part of this chapter, the modelling, in which the issues of co-residency and co-presence (sections 4.4.1 and 4.4.5), activity areas and the use of space (sections 4.4.2 and 4.4.4), animals within the built environment (section 4.4.1), and storage (section 4.4.3) are explored.

4.2: The excavations

Ganj Dareh is situated 10 km west of Harsin and 37 km east of Kermanshah in western Iran (approximate co-ordinates: latitude 34° 19' N, longitude 47° 25' E). The site is located at an altitude of about 1,400 m above sea level in a cultivated field in a small, narrow valley surrounded by mountains rising over 2,000 m (Smith 1976: 11). At the time of excavation the site appeared to be roughly circular, measuring approximately 40 m in diameter and covering about 1,300 m^2. Philip Smith and T. Cuyler Young discovered the site and dug a small test pit there during a survey in the summer of 1965 (Smith 1967). Smith went on to conduct four seasons of excavation at the site between 1967 and 1974 on behalf of the University of Montreal and the Archaeological Centre of Iran. No final excavation report has been published to date, only interim excavation reports (Smith 1967, 1968, 1970, 1972, 1974, 1975, 1978, 1983/1984; Smith and Mortensen 1980), a brief summary (Smith 1976) and an article dealing with the architecture at the site (Smith 1990).

The main excavation efforts were concentrated on the central and southern parts of the site, with a smaller trench dug on the western flank of the site connected to the central trench by a long, narrow trench, as well as seven smaller test pits (see Figure 4.1 for trench locations) (Smith 1976: 12). Smith (1976: 11, 1990: 323-324) has estimated that they excavated between one fifth and one quarter of the site, and that there were between 7 and 8 meters of archaeological deposits dating to the Neolithic, with some Iron Age and later disturbances near the surface. The main aim during the first two seasons was to establish the stratigraphic sequence of occupation by opening a trench in the centre of the mound (Smith 1968: 158, 1970: 178-179). Following some initial confusion due to stratigraphic complexities, the excavated deposits were divided into five archaeological levels corresponding to the main phases of architectural activity at the site; each level was assigned a letter from A (latest) to E (earliest) (Smith 1976: 12-13). In the third season they concentrated their efforts on exposing more of the two earliest phases of occupation, levels D and E, and clarifying stratigraphic problems relating to levels A-C (Smith 1972: 166). Additionally, they excavated two trenches extending out from the central trench to the edge of the site – one to the west (measuring 8 x 2 m) and one to the east (measuring 6 x 2 m) – in order to establish the horizontal extent of each archaeological level (Smith 1972: 166-167). In the final season work continued in the main trench with the aim of gaining more information on the architecture in level D, as well as on the transition from level E to level D (Smith 1974: 207, Smith 1975: 179). A smaller trench was excavated, extending out from the narrow 8 x 2 m western trench dug the previous season, in order to expose more of level E (Smith 1974: 207), and seven smaller test pits were dug around the edge of the site in an effort to determine the extent of the archaeological deposits (Smith 1975: 179).

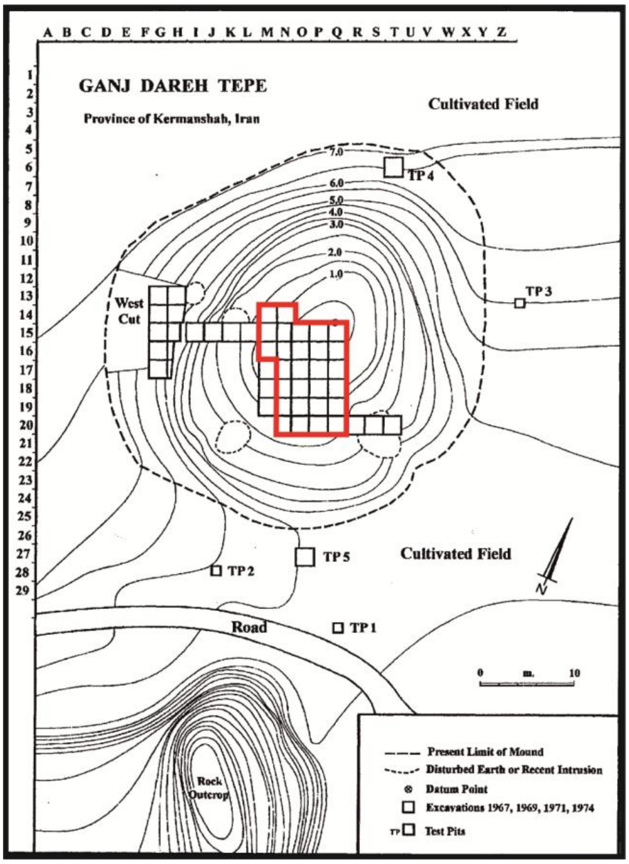


Figure 4.1: Overall site plan of Ganj Dareh showing locations of excavated trenches with the location of the level D remains used for the scenario modelling outlined in red (modified from Merrett 2004: fig. 9.1).

The main occupational phases at Ganj Dareh dates to the Aceramic Neolithic, although pottery was recovered from levels D through A (one sherd, believed to be intrusive, was found in level E), including large clay jars measuring up to 1 m in height, many of which had been sealed to the floors and/or walls with mud (Smith 1968: 159, 1970: 179). A number of the large jars were found more or less intact in the level D structures, some of which had the capacity to hold 100-200 litres (Smith 1976: 16, 1983/1984: 301). They also found sherds of smaller vessels, ranging in shapes from shallow bowls and dishes to small vases (Smith 1976: 16). All of the pottery was simple, made of lightly baked clay, and ranged in colour from brown to blackish (Smith 1983/1984: 301). The pottery was rarely decorated; only a few sherds had small punctuated or crescent-like impressions (Smith 1976: 16, 1975: 179). Clay was also used to make human and animal figurines and a variety of other small items, e.g. cones, discs and spherical objects (Smith 1976: 16). Other artefacts found include a range of ground stones (e.g. mortars, pestles, 'rubbing stones'), chipped stone tools made of flint or chert (no obsidian was found) similar to the assemblages found at other sites in the area (e.g. Tepe Asiab, Tepe Guran), worked bone objects, fragments of polished stone vessels, and beads made of shells (including the marine gastropod *Oliva*) and stone (Smith 1970: 179, 1972: 167, 1974: 207-208, 1975: 179-180, 1976: 17-18).

Studies indicate that during the Neolithic occupation the site was located within a forest-steppe environment, indicated by the presence of *Pistacia*, *Amygdalus*, and *Rhamnus*, as well as the frequent occurrence of leguminous species such as *Astragalus* and *Trigonella* and steppic grass such as *Stipa* in the archaeobotanical record (van Zeist et al 1984: 216-217). Analysis of the botanical remains indicated a heavy reliance on wild species, and in particular pistachio and almond, but also lentils, with other plant foods including wild and domestic type barley and a few peas (van Zeist et al 1984: 219-220). The faunal remains collected at the site included goat, sheep, boar, auroch, gazelle, red deer, hare, fox, and partridge (Smith 1990: 324). The evidence for goat herding in level D has already been discussed (section 2.3.2) and will not be repeated here.

4.3: Summary of the excavation results

There were no structural remains found in the earliest occupational phase, level E, only a series of about thirty large circular or oval pits measuring up to 1.70 m in diameter and 0.50 m in depth (Smith 1975: 179, 1976: 12). Many of the pits were either partly or entirely filled with burnt limestone cobbles, charcoal and ash (Smith 1974: 207, 1976: 12, 1983/1984: 301), and it appears that these may have been used for activities that involved the use of fire. The stratified deposits in a few of the pits indicate that they had been reused, and although the specific functions of the pits remain uncertain (Smith 1974: 207, 1976: 12, 1978: 538), it is possible that they were fire pits or ‘earth ovens’. Interestingly, no ground stone implements were found in level E, which contrasts the abundance of such artefacts in levels D-A. The chipped stone assemblage, on the other hand, remained fairly similar throughout all the occupational phases (Smith 1974: 207, 1975: 179, 1976: 14). Above the level E pits there was an accumulation of up to 0.5 m of dark soil, ashy lenses, and small stone fragments (Smith 1976: 12, 1978: 538).

The subsequent level D was the best preserved phase of occupation at the site, especially in terms of architecture. It consisted of the burnt remains of a series of tightly clustered spaces that had been partly built on top of the accumulation of dark soil above level E and partly dug into it (Smith 1976: 12, 1978: 538). Level C was less well preserved, but appears to have been a continuation of the structures in level D and consisted of a few buildings in the central part of the site, including possible wattle and daub structures (Smith 1976: 12-13, 1978: 538). The structural remains in level B were not as well preserved as those in level D, but more substantial than the preceding level C. Rectangular mud brick and *tauf/chineh* buildings, each with a number of sequential plaster floors, directly overlay the structures in level C (Smith 1968: 159, 1970: 179, 1972: 167, 1976: 13). The remains in the latest occupational phase, level A, were badly disturbed and only fragments of a few buildings and domed oven-like installations remained (Smith 1970: 179, 1972: 167, 1976: 13).

Smith has suggested that level E was the remains of one or more encampments used by semi-nomadic pastoralists and hunters (Smith 1976: 17) based on the lack of architecture and the fact that the site appears to have been occupied on a seasonal basis between spring and autumn, but not during the winter (Smith 1990: 324; see also Hole 1987a: 49). The lack of architecture may not necessarily be a true reflection of the settlement as it is possible that people stayed in tents or structures, perhaps similar in nature to the pit structures encountered at Tepe Asiab or Tepe Sarab (see Braidwood 1960: 107; McDonald 1979: 216-233), located outside the excavated area. If the structures were temporary, they may have been difficult to detect during excavation, due to the nature of the remains, the level of preservation, and/or methods of excavation. Levels D-A, on the other hand, had more substantial architecture and are therefore thought to represent more sedentary occupations of the site. Smith, however, stated that he could not be sure that the habitation was necessarily year-round, and suggests that the population may have moved to lower, and warmer, altitudes during the winter months (Smith 1976: 17). The issue of seasonal or permanent occupation will be explored further in sections 4.4.2 and 4.4.3.

Level D, which was partially destroyed by fire, had the most complete architecture at the site with walls preserved up to 2 m in height (Smith 1970: 179). It is also the level for which there is the most information published, as well as the only one where a plan of some of the excavated buildings is available (Smith 1990: fig. 1). The available plan is of an 8 x 12 m trench, with a 1 x 3 m extension from its western corner, located in the central part of the site (Figure 4.1-4.2). This central area of level D is therefore the focus of the remainder of this chapter. The architecture in level D consisted of mostly rectangular or trapezoidal (although a few were more irregular in plan) spaces that were tightly clustered with no discernible alleys or courtyards between them (Smith 1990: 325). This led Smith (1990: 325) to wonder whether the structural remains may constitute only one building. From the published materials it appears that Smith may have interpreted the larger spaces in the western part of the trench as single storey structures (see Smith 1990: fig. 1), whereas he (1990: 325) suggests that the series of small spaces in the eastern part of the trench formed the basement of a two storey structure with living spaces located above them. This, he (1970: 179, 1972: 166, 1975: 15, 1990: 325) claimed, was evidenced by the impressions of horizontal beams and smaller support poles (possibly made of poplar and/or willow and reeds), and remains of plaster floors above the smaller cubicles. However, the minimal description and depiction of the evidence Smith has interpreted as indicating an upper storey, make it difficult to assess whether the material is in fact from an upper floor, or if it may be collapsed roof material. Lumps of mud with impressions of beams and poles are also cited as being from the roof (Smith 1990: 325), and remnants of floor above the small spaces may, without further information, also have been remains of a flat, mud plastered roof (perhaps serving as an outdoor work area). If this was the case, then it may be that series of small spaces were storage and work spaces for people living in the larger spaces in the western part of the trench. The possibility of an upper floor is considered later in this chapter through a series of reconstructions of possible upper storeys (section 4.4.5).

All of the walls were made of a combination of different construction methods, including *tauf/chineh*, mud bricks (most of them plano-convex), coarse rubble (including fragments of broken bricks) packed with mud and plastered on both faces, and alternating layers (averaging 0.05-0.06 m in thickness) of mud and lime plaster (Smith 1990: 328-330). The latter two construction methods appear not to have been used for load-bearing walls, but rather for supplementary or dividing walls, and buttresses (Smith 1990: 330). Wooden beams, poles and reed had been used as structural support in the construction of the walls, floors and roofs, of which the former two had been coated with layers of fine mud plaster (Smith 1970: 179, 1976: 14-15, 1983/1984: 301, 1990: 324-325). The walls were relatively thin (on average 0.30-0.40 m in width), which would have rendered them poorly suited for load-bearing; it may be that the buttresses, and the tightly clustered spaces, were means to strengthen the buildings structurally (Smith 1990: 325-326). Nevertheless, many walls had slumped and been deformed, which Smith (1990: 326) suggests was due to the downward pressure from the upper storey, and there is evidence for frequent restoration, such as the construction of supplementary supporting walls and the infilling of some of the small cubicles (Smith 1990: 326-328). An interesting feature in many of the walls was the circular or oval openings (around 24 were identified), measuring 0.20-0.40 m in diameter, which had been intentionally made during the construction of the walls (Smith 1970: 179, 1975: 179, 1976: 15, 1990: 330). Many of these openings had been sealed with small conical or larger disc-like clay objects that often had small depressions near the centre (Smith 1990: 330). The function of these so-called portholes is discussed in section 4.4.4.

A variety of grinding equipment, e.g. mortars and pestles, and potential storage features, including bins made of mud slabs, large clay vessels and ‘silos’, were found in the small spaces (Smith 1976: 14, 1990: fig. 1). This led Smith to suggest that these spaces were storage spaces for food stuffs, whereas the upper storeys provided living and working spaces (Smith 1976: 15, 1990: 325). An unusual feature found in one of the small spaces was a pair of sheep skulls that had been set into the plastered walls of a small niche (Smith 1976: 15, 1983/1984: 301, 1990: 330-333). Their symbolic meaning remains unclear, although it should be mentioned that goat and sheep skulls have been found placed on the floor of one of the structures at the Neolithic site of Sheikh-e Abad (Cole 2009; Matthews et al 2010), which is located not far from Ganj Dareh. The inclusion of symbolism and ritual behaviour into domestic spaces appear to be a phenomenon encountered at many Neolithic sites (section 2.5), and the sheep skulls found at Ganj Dareh may be seen as a form of incorporating ritual behaviour into the domestic sphere. It is not implied that the meaning was the same throughout the region, or that such practices stemmed from similar traditions, but rather that the symbolism associated with the skulls may have formed part of the daily lives of the inhabitants at the site.

Another aspect of the ritual behaviour at Ganj Dareh is the burials that were recovered from all of the occupational phases with the majority found in levels E through C (Meiklejohn et al 1992: 85). These occurred under floors, and in so-called 'special' niches (Smith 1990: 333) or sealed burial cubicles (Merrett 2004: 179), and many of the spaces containing burials had, according to Smith (1990: 331), portholes associated with them. For example, the remains of two adults and four children were found buried below the floor in a small space that contained a plastered basin, which was connected to the adjacent space, which contained the sheep skulls, by a porthole (Merrett 2004: 179-180). There is no further information given regarding the precise nature of the remaining interments. The skeletal remains are reported to consist of 69 individuals, 57 of which were *in situ* burials identified during the excavation, and included both males and females from all age groups from fetal to adult (Meiklejohn et al 1992: 88, table 2; Meiklejohn, Lambert and Byrne 1980). Lambert (1979) initially identified six crania that had been intentionally deformed using bandages, however, following a re-examination of the material Meiklejohn et al (1992: 89, table 4) found that all of the 14 preserved crania appeared to have been deformed. Studies of the skeletal remains indicate that the inhabitants were generally healthy (Merrett 2004: 188), and that their diet appear to be consistent with an emphasis on goats and sheep and a lower reliance on cultivated plants than observed at Levantine sites (Schoeningen 1981). A potentially interesting point that should be noted is the high frequency of porotic hyperostosis in adults (approximately 85%), which is usually thought to be related to anaemia either due to iron deficiency in the diet, presence of internal parasites (Merrett 2004: 236-237), or malaria (e.g. Agelarakis 1989). Merrett (2004: 236-237, 244-245) has argued (based on recent clinical trials and ethnographic data suggesting that this is a common occurrence among shepherds) that the anaemia may have been a symptom of an intestinal parasite and/or brucellosis caused by prolonged contact with goats if they were present at the site. If this assessment is correct it may indicate that an increasingly close relationship between humans and animals was developing at the site.

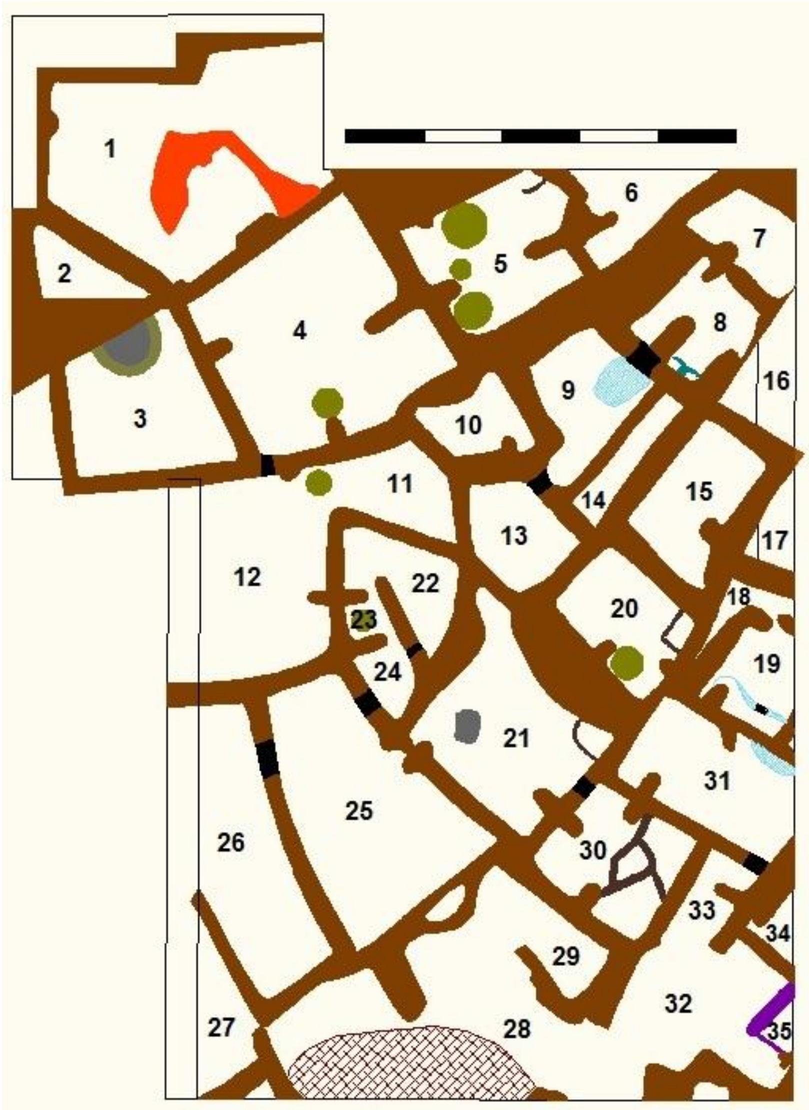


Figure 4.2: Plan of level D at Ganj Dareh with space numbers.

4.4: Modelling scenarios

The remainder of this chapter examines the structuring of built space within the level D settlement at Ganj Dareh, focusing on the size of potential co-resident groups, the types of activities and interactions that may have taken place within the structures, and the potential storage capacities of the internal spaces. It also evaluates whether the built environment was designed to accommodate animals and what this may mean in terms of animal management practices and human-animal relationship at the site. Initially, the potential numbers of people that can be co-present and co-reside in individual spaces are assessed through the modelling of contextualised maximum capacities of Size A and Size B adults sitting cross-legged and sleeping (section 4.4.1). This provides the basis for the subsequent discussion of the potential use of the various spaces, and in particular those which lack internal features and/or *in situ* artefacts (section 4.4.2). Following this is an assessment of the potential storage capacities of various storage facilities and the implications this have for issues of seasonality and the accumulation of resources (section 4.4.3). The final part of this chapter considers the possible routes of movement between, and access into, the various spaces (section 4.4.4) and provides a brief discussion of potential reconstructions of the upper storeys and the modelled affordance of space for co-residency in these spaces (section 4.4.5).

For the purpose of modelling, the various spaces were assigned sequential numbers from 1 through 35 (Figure 4.2), and will be referred to as S followed by the relevant number, i.e. S1, S2 and so on. Some of these were not excavated completely, but as it appears that they formed individual spaces within the built environment, they were assigned separate numbers. S28, S32, S33, and possibly S29, may have been extensions of the same space, but due to the nature of the spatial configuration[41] they were numbered separately. Similarly, S11 may originally have been an extension of S12, but are treated as separate from S12 due to the fact that a large clay vessel appears to have blocked, or at least restricted, access between the two spaces. Additionally, the narrowing of S11 towards the west may indicate an intentional restriction of access into this space.

4.4.1: Contextualised maximum capacity

The maximum numbers of Size A and Size B adults that can sit cross-legged (second and third columns) and sleep (fourth and fifth columns) in the level D spaces are summarised in Table 4.1 (Figure 4.3). Spaces that were too small for people to fit into in either position, as well as those where the majority of the space had not been excavated and it was not possible to reconstruct accurately their original size, are not included. The spaces that were too small are S2, S14, S23 and S24, and those that were incomplete are S16, S17, S18, S34, and S35 (which was also marked as a ‘burial cubicle’ and it is believed that it was used for that purpose only).

[41] There is a potential refuse area in S28; this renders the nature of S28 different from S32 which lies directly to its east. Additionally, the poor preservation of the walls in the area between S28 and 32 makes it difficult to assess whether there had originally been a wall separating the two spaces. Similarly, it is uncertain whether there was originally a wall or a buttress separating S32 and S33. However, as S33 appears to be a more niche-like space extending from S32 towards S31 (albeit with a buttress, thus reducing the amount of space available), it was deemed to be different enough in character from S32 (which has a more irregular plan) to be labelled separately. The wall stump separating S29 from S28 may originally have extended more towards the southern wall of S25 and these two spaces were thus deemed to be sufficiently separate from each other.

	Sitting cross-legged		Sleeping	
Space	**Size A**	**Size B**	**Size A**	**Size B**
S1	8	6	5	4
S3	5	3	3	2
S4	8	8	6	5
S5*	2	2	-	-
S6*	2	1	-	-
S7*	2	1	-	-
S8*	1	1	-	-
S9*	2	1	-	-
S10*	1	1	-	-
S11*	2	1	-	-
S12	9	8	5	4
S13*	2	1	-	-
S15*	3	2	1	1
S19*	1	1	-	-
S20*	3	1	1	-
S21*	4	3	2	2
S22*	2	1	-	-
S25	11	6	5	5
S26	6	6	5	4
S27	4	3	-	-
S28	10	8	n/a	n/a
S29	2	2	n/a	n/a
S30*	2	-	-	-
S31*	4	3	2	2
S32	6	4	n/a	n/a
S33	1	-	n/a	n/a
*These are the small spaces referred to as 'cubicles' or 'small compartments'.				

Table 4.1: Modelled contextualised maximum capacities.

What becomes clear from the modelled maximum capacities is that most of the spaces were too small to allow a person to lie down. The majority of the spaces were also too small for more than one or two individuals to sit cross legged; four of the spaces that were modelled could fit one Size A adult and only three of these had room for a single Size B adult. Nine spaces could fit two Size A adults sitting together, and of these only two had enough room for two Size B adults. The spaces that could only fit one or two individuals were not particularly suited for tasks that required people to sit down, as they would have had to squeeze into the spaces, and in some cases there would not have been much room left for any kind of movement required for sitting down or getting up again. In other words, a ‘polygon person’ can be modelled sitting in the space, but an actual person might have had problems sitting down and getting back up again. All of these spaces, as well as the majority of those that could fit three or four Size A adults, are located in the eastern part of the trench and are those described by Smith as ‘cubicles’ or small compartments forming the ‘basement’ of two storey buildings (Smith 1990: 325). The majority of the spaces where five or more people may have gathered are those that may have been single storey structures located in the western part of the trench. This may support Smith’s assumption that most of the small compartments or ‘cubicles’ were not used as living spaces (Smith 1978: 540, 1990: 325, 333), inasmuch as they were too small for people to sleep in, nor was there enough room for more than one or two individuals to be present at any one time. The potential use of these spaces will be discussed further in the next sections.

With regards to the larger spaces in the western part of the trench, the modelling shows that they would have had the capacity to fit a larger number of people, both sitting cross-legged and sleeping. S4, S12, S25 and S26, in particular, may have functioned as living spaces as they could accommodate between four and six adults sleeping and at least six adults sitting. The presence of a possible kiln and a large mortar with a substantial clay rim in S1 and S3 respectively, may indicate that these spaces may have been used for production and/or food-related activities. This does not, however, preclude their use for habitation purposes as there was room for between two and five adults to sleep in these two spaces, a point that is discussed further in section 4.4.2. The area in the southern part of the trench, which includes S28, S29, S32 and S33, may have accommodated people sleeping, but this is doubtful as it appeared to have been used for refuse disposal. Since the modelling of maximum capacity takes into account the nature of the archaeological deposits in addition to built features, sleeping was not modelled for these spaces.

The tight clustering of spaces would not only have restricted the affordance of space for humans; it does not appear to have accommodated animals despite the fact that Ganj Dareh has some of the earliest evidence for the management of goats in the region (section 2.3.2). There are ethnographic examples of pastoralist communities where goats and sheep are taken into the domestic space in the event of illness, or when there are newborn kids that need close attention (e.g. Watson 1979: 255). Considering the structural layout in the central trench it appears unlikely that animals would have been brought here. Additionally, if access into internal spaces were through the roof (discussed in section 4.4.4) this scenario seems even less likely. It is possible that there was some form of access (from the south) to the refuse area in S28 and the adjacent S32 that may not have required movement through internal spaces or on the roof, which would allow goats to be kept there during night time or adverse weather; modelling animals in S28 and S32 indicate that there was enough space for perhaps ten goats (Figure 4.4). If the excavated structural remains are indicative of the un-excavated parts of the settlement, including the area south of the trench, then there may not have been a point of access into S28, which would render the penning of goats in this space less likely. The site is quite small (approximately 40 m in diameter), and if goats were kept in pens overnight and during times of unfavourable weather the pens may have been in close proximity to the buildings. It is also possible that goats were penned away from the settlement, perhaps in nearby caves. The hoof prints of sheep or goats found on some of the mud bricks in level D (Smith 1970) may suggest that animals were penned in some proximity to the settlement, perhaps close to the area where mud bricks were made.

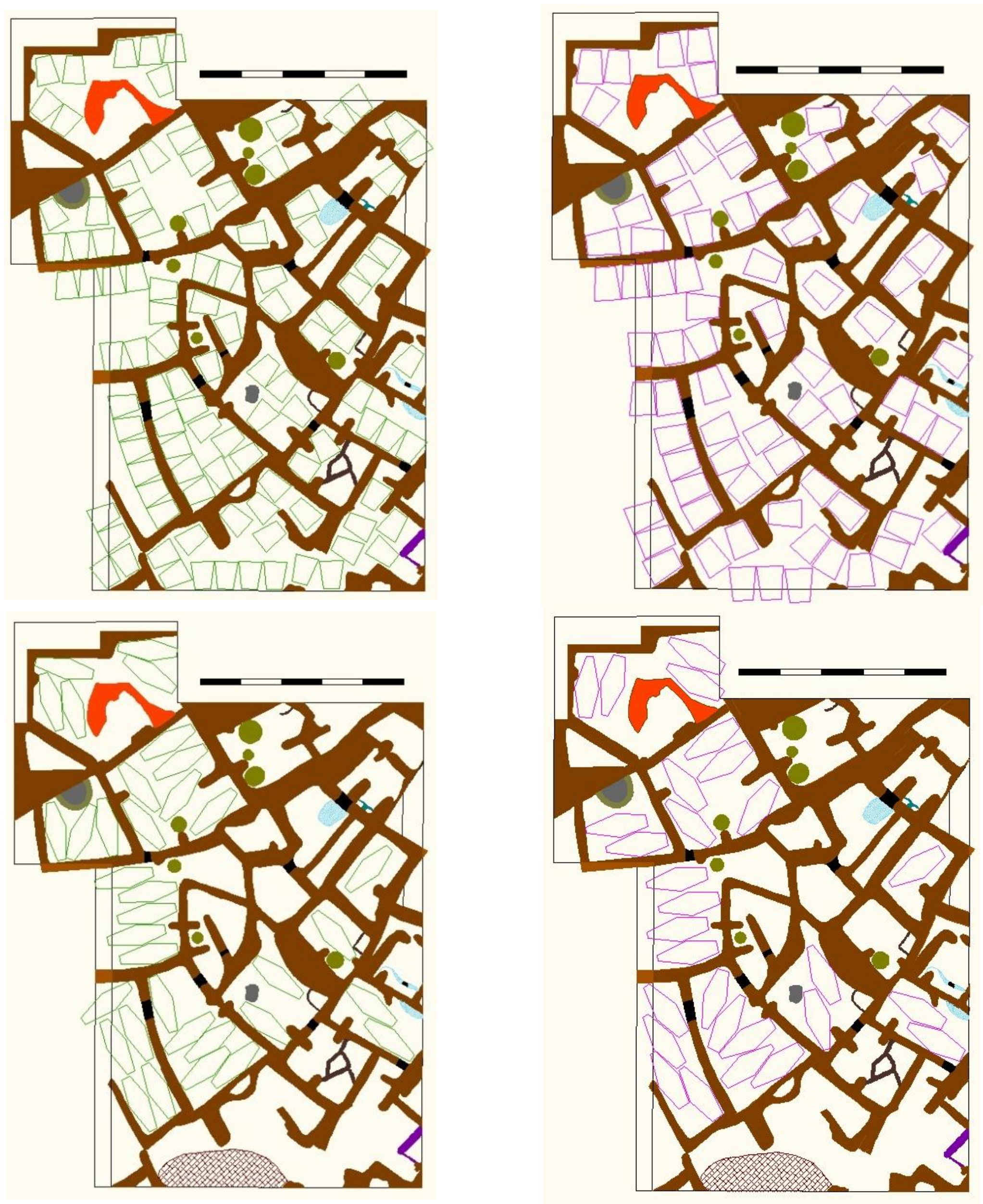


Figure 4.3: Modelled maximum capacities of Size A (left) and Size B (right) adults sitting cross-legged (top) and sleeping (bottom).

It is, of course, possible that there may have been external spaces within the settlement located outside of the excavation trench. As is the case with any archaeological site, it is possible that our understanding of the structuring of the built environment may be altered if the trench had been located elsewhere and/or extended in either direction. The more of a site that is exposed during excavation, the more information about the structuring and use of space will be available to us. If there were external spaces within the settlement at Ganj Dareh (e.g. if S28 extended further south), it is possible that goats could have been brought into the settlement. If this was the case, then it may be that penning animals within these external spaces allowed closer control of the herd (perhaps belonging to particular co-resident units) or segments of the herd, including those animals requiring closer attention during particular period such as newborn kids and animals that were ill or injured, or to separate males from females in order to control breeding schedule. It is also possible that if there were external spaces that these were used for particular food-related or production activities. However, as the available evidence only includes a *potential* external space (S28) these alternatives remain unsubstantiated. The remaining discussion will therefore concern the excavated part of the settlement and assumes that these structural remains are also indicative of the un-excavated part of built environment at the site, with alternative scenarios mentioned where relevant.

Figure 4.4: Modelled capacity for goats in S12 and S28.

4.4.2: Modelled activities

The preparation and cooking of food are often indicated by the presence of fire installations and *in situ* grinding equipment (section 3.3.1). No hearths were found in level D (Merrett 2004: 179), and only one potential oven appears to have been found in the central trench, however, there is little information available concerning the construction or layout of it (such as size, form, opening, chimney and so on). It is located in S1, which is large enough for six to eight people to sit cross legged; it has sufficient room for people to undertake work associated with the use of the oven – assuming that the opening was located in this space. Smith (1974: 207) has mentioned a stone lined kiln or oven in level D that apparently contained the remains of burnt limestone and small fragments of clay. If this is the fire installation in S1, it may perhaps have been used for firing clay objects and in the production of lime plaster, and not for preparation and cooking of food, and this space may therefore have been used primarily for manufacturing activities. It is, of course, possible that S1 served multiple functions, including as a living space, as it was large enough for five Size A adults to sleep and eight Size A adults to sit cross-legged. However, the arrangement of people within the space would perhaps have been awkward for other purposes than undertaking work, and if the possible fire installation was used for manufacturing activities, it may be that these activities produced a certain quantity of waste that rendered the space 'too dirty' for habitation purposes. It is also possible that the oven may have been used for food preparation and cooking instead of, or in addition to, manufacturing activities. Nevertheless, this does not alter the suggestion that S1 may have been better suited for undertaking tasks related to the use of the oven than as a living space.

The lack of fire installations used for cooking, and in particular hearths, is noticeable, and there are at least three alternative locations in which such activities may have taken place. It is possible that cooking took place outside the buildings in an area, or areas, located around (but presumably in close proximity to) the structures; perhaps the fire installations were grouped in a specific location in a similar manner to the fire pits found in level E. This would make the preparation and cooking of food a social activity that could have involved several participants, and was not associated with a need for privacy. It is also possible that hearths and other fire installations were located within the settlement, but in areas outside of the excavated trenches. A third, and related, alternative is that hearths were located in the upper storeys, as have been attested in ethnoarchaeological studies in the Zagros (Kramer 1979: 147-149, 1982: 102-104), which would indicate that cooking may have been a more private activity that involved co-resident groups and/or close kin only. Considering the level of preservation due to the fire, it is curious that no trace of any fire installations apart from the aforementioned possible oven was found. This may indicate that there were no fire installations in the excavated buildings. It is possible that there were practical reasons for not including hearths or ovens in the internal spaces, such as to eliminate smoke from the living spaces. Studies of the skeletal remains indicate that people appear to have had minimal exposure to wood smoke, a situation similar to that observed in modern populations who routinely cook outside (Merrett 2004: 235).

The lack of internal fire installations may also have had an impact on the potential seasonality of the settlement. Due to its location in the Zagros highlands, the difference in temperature between the summer and the winter would have been significant (even if it was warmer than today), and snowfall is a possibility during winter (even if it was drier than today).[42] Mud architecture, including mud brick and *tauf/chineh*, is recognised for its heat retaining and releasing properties making it ideal for keeping the building interior cool during the summer and warm during winter as heat is retained in the walls and released when temperature changes occur (Birkeland 2002: 193; Easton 2005: 152, 158-161; Hassan 1973: 45-49; Moquin 2005: 87, 96-97; Smith 2005: 117, 128). However, because mud can retain heat for a long period of time the temperature inside buildings can become uncomfortable during summer nights, and therefore, to take advantage of the cooler air outside, people in the Middle East and Egypt often sleep on the roofs during the summer months (Hassan 1973: 45-46). If the roofs at Ganj Dareh were flat, they may have provided a sleeping space during the warmer part of the year if the internal spaces became too hot, or, alternatively, people may have slept in tents located around the settlement. In the winter the issue of inside temperatures may have been reversed; even though it is possible that the tightly clustered architecture increased the insulation properties of the mud walls and thus decreased heat loss during winter months (insulating mud walls can minimize rate of heat loss; Smith 2005: 96-97), additional heating may have been required, especially if the amount of sunshine during the day was limited (Moquin 2005: 128). If the architectural configuration provided enough insulation for the colder months, then internal fire installations may not have been necessary. The lack of internal fire installations also raises the question of where cooking took place during the winter when adverse weather and outside temperatures may have prevented it, or made such activities unfeasible. It is possible that the oven in S1, and other ovens or fire installations located elsewhere in the settlement, were used for cooking during the winter. An alternative suggestion is that the community may have moved down to lower altitudes during at least parts of the winter, perhaps to take advantage of winter pastures. If this was the case it would indicate a seasonal pattern of movement based on a particular herding practice favouring pasturage over foddering (although fodder may still have supplemented the grazing). The issue of storage of fodder, as well as food for human consumption, is explored further in section 4.4.3.

Turning back to the issue of food-related activities, there is more information available with regards to ground stone implements than fire installations. Ground stone tools are often associated with the processing of plants, including nuts and cereals, although they may also be used for other purposes, such as grinding pigments or temper, extracting bone marrow, or they may have been multi-functional tools (Wright 1994: 240-242). A range of ground

[42] See Appendix A for annual temperatures and precipitation for nearby Kermanshah.

stone implements were found in level D, including large mortars with clay rims fixed onto the floor or set on raised clay platforms (Smith 1978: 539). For example, a large mortar with a clay rim was placed against the northern wall in S3, and a mortar was set into the floor in the northern part of S21, which indicate that activities associated with their use, e.g., the processing of plants, may have occurred in these two spaces. These spaces may have accommodated at least three or four seated adults each, which would allow for some cooperation and socialising while working. Food processing may have been a social activity that included multiple individuals – although less than cooking activities – or required enough room for people, processing equipment and/or storage (and/or other) containers. There may have been differences between the various food-related activities. Cooking and consumption of food were communal activities that may have taken place in open external areas, whereas food preparation involving the use of ground stone tools may have been less inclusive as it took place in smaller spaces. Smith (1970) mentions that ground stones were found in the small spaces, however, he does not elaborate on context, distribution or whether they were found *in situ* or in the general fill. If the various ground stone implements were found *in situ* then it is possible that they were kept in the spaces where they were used, which would indicate that the some of the 'cubicles' were used as spaces for processing activities. Alternatively, the ground stones may have been stored in some of the small spaces but used in others, or placed there immediately prior to abandonment.

There is a lack of information concerning the distribution of artefacts, and thus it is not possible to incorporate such data into the assessment of the function of spaces. Nevertheless, it is possible to make suggestions based on the size of spaces and the presence of internal fixtures. For example, S4 (adjacent to S1 and S3) is another space that may have facilitated the co-presence of a number of people undertaking a variety of tasks; it has the capacity for up to eight or nine seated adults, or five to six sleeping adults. A large clay vessel was found by the south wall, which indicates that some storage took place in this space, as well as perhaps activities associated with, or utilising, the stored goods, such as food preparation. It is also possible that it served more than one function; it is large enough for people to have gathered for social and/or work purposes, and may have accommodated sleeping while at the same time have room for some storage, perhaps between the buttresses in the southeast corner of the space where it would not have restricted the use of the remaining space in S4. There is no information available regarding the potential use of the other large spaces in the western part of the trench, i.e. S12, S25, and S26[43] (the use of space in S3 has already been discussed). They are large enough for a number of people to be co-present or sleeping, which suggests that there may have been room for a variety of everyday tasks to have occurred while perhaps providing some storage space. The refuse deposits in the western part of S28 indicate that some disposal activities occurred in it. It is possible that the eastern part of S28, the adjacent S32, and perhaps S29 and S33 (which is

[43] S27, which is adjacent to S26 has not been included as only a limited portion of it was excavated and it is not possible to ascertain the nature of this space, e.g. whether it was an internal or external space.

an extension of S32), may have been used for activities that produced a certain amount of debris, e.g. manufacturing activities, and processing of food. If this was the case then it may be that S29, which is partly separated from S28 by a wall, provided storage space for various tools, raw materials, fuel, and/or food that were used in the activities that took place in S28.

The presence of bins (S5, S20, S21, and S30), large clay vessels (S5, S20, and S23) and grinding equipment (the mortar in S21) in the small spaces in the eastern part of the trench indicate that they may have been used for food and storage related activities. People often undertake work while in a squatting or kneeling position; the preferred position may depend on the task performed and/or cultural preferences (section 3.3). These positions involve the use of different configurations of space than when sitting cross-legged and it may be that a person squatting or kneeling could fit into a space where there is not enough room for a person to sit cross-legged. To assess whether different working positions may have allowed people to use the small spaces more easily (i.e. more space would be available for movement of, e.g. arms), the maximum numbers of people that could squat and kneel in these spaces were modelled (Table 4.2).

	Squatting		**Kneeling**	
Space	**Size A**	**Size B**	**Size A**	**Size B**
S5	2	2	2	2
S6	3	1	1*	1*
S7	2	1	1	1
S8	1	-	1	1
S9	2	1	2	2
S10	2	1	1	1
S11	3	1	1	1
S13	4	1	2	1
S15	6	2	3	2
S19	2	1	1*	1
S20	3	1	2	1
S21	6	3	3	3
S22	3	1	2	1
S24	1	-	1	-
S30	2	-	2	1
S31	8	3	4	3

*A minimum number; it is possible that more people could fit into the space, but either the original size is unknown (S6), or it would be no room left in the space for any kind of movement (S19).

Table 4.2: Modelled contextualised maximum capacities of adults squatting and kneeling in the small space.

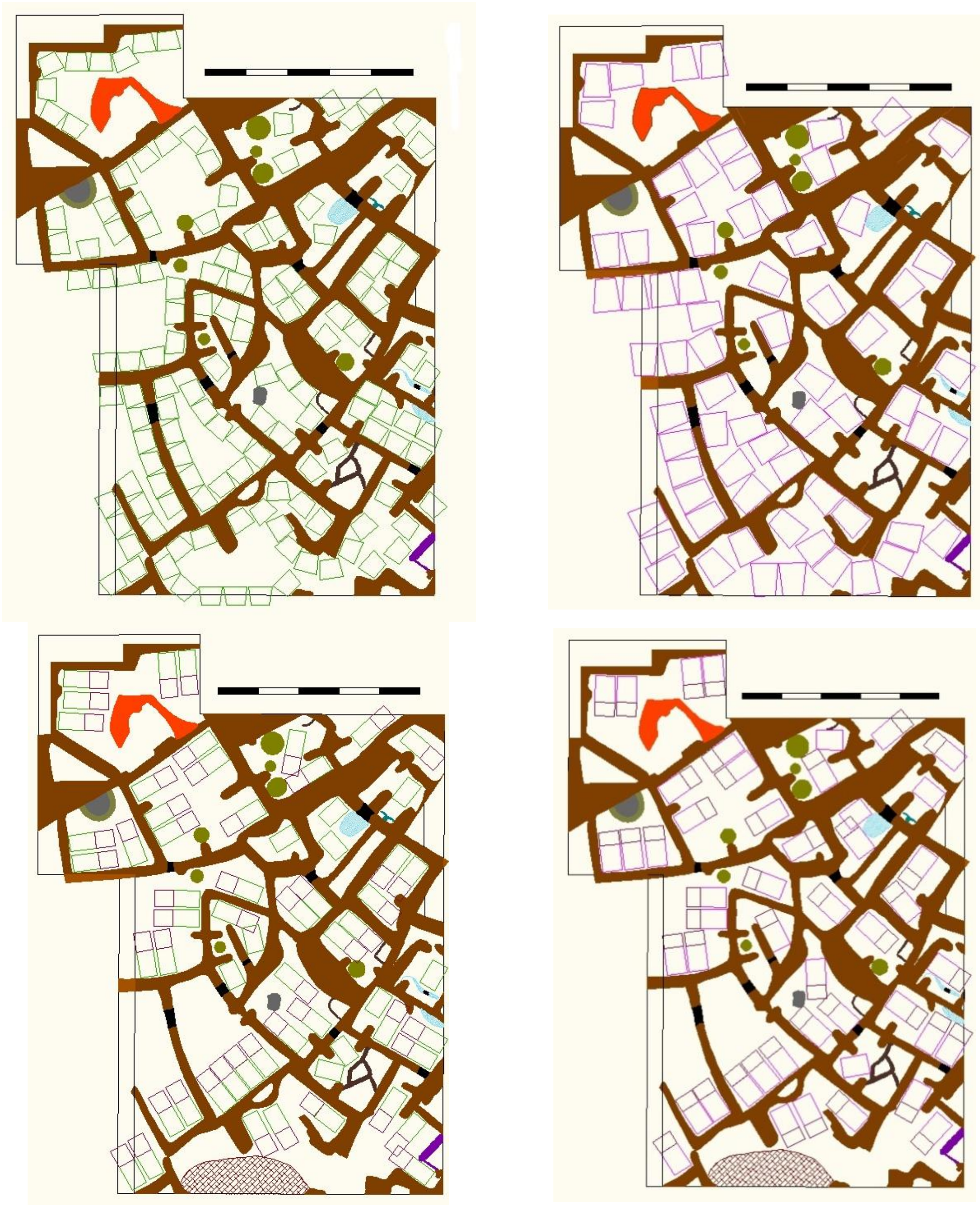


Figure 4.5: Modelled maximum capacities of Size A (left) and Size B (right) adults squatting (top) and kneeling (bottom).

The modelling indicates that even though kneeling requires a different configuration of space than a squatting or seated position, there is not much difference between the numbers of people that can fit into the small spaces when kneeling compared to if they were sitting cross-legged (Figure 4.5). A squatting Size A adult, on the other hand, requires less space than one that is sitting cross-legged, and the majority of the small spaces have the capacity to fit more Size A adults squatting than sitting cross-legged or kneeling. For example, one Size A adult can either kneel or squat in S24, which was one of the spaces that were too small for a person to sit cross-legged. This appears to indicate that people may have performed certain activities in the small spaces while squatting, although it is doubtful whether more than one or two people would have been present at the same time. With regards to Size B adults, there is no difference in the number of people that can sit, squat or kneel in these spaces, and the fact that usually only one, or perhaps two, adults could fit, may suggest that the spaces were too small for larger individuals to comfortably move or undertake activities within them.

As previously mentioned, there is limited information concerning the distribution of artefacts and built features; most of the information regarding internal fixtures comes from their depiction on the plan. There were a plastered depression in S9, a plastered feature on either side of the porthole in S19, and a plastered feature by the north wall in S31. In the absence of information it is difficult to assess their function based on the drawings; it is not known whether the latter two were decorative features or functional. The plastered depression in S9 may have been associated with some sort of food or drink processing or preparation activities, textile production, or it may have been a ritual feature, perhaps associated with the six sub-floor burials (section 4.3) or the sheep skulls in the adjacent S8. Two Size A adults could sit, squat or kneel in this space, and it is possible that some activity associate with the plastered depression may have occurred there. Some of the spaces that contained storage features, such as S5 (three clay vessels and a bin), S20 (a clay vessel and a bin), and S30 (three bins), are large enough to have facilitated some activities associated with the processing of the goods stored in the bins and clay vessels. S5 and S30 may have accommodated two Size A adults sitting, squatting, or kneeling, and S20 had room for three Size A adults in either positions. This suggests that these spaces had the *potential* to accommodate some activities taking place in addition to providing storage space, although perhaps only involving one or two individuals. The use of the small spaces may also have depended on the availability of a light source; it is possible that activities that occurred in these spaces were those that did not require much light or did not take long, such as retrieving stored foods or other items. It is possible that various materials and tools were stored directly on the floor, in organic containers, and/or hung from the ceiling and walls, and that the spaces only provided access to the stored good and were not used as activity areas.

4.4.3: Potential storage capacity

Another suggested use for the small spaces in the eastern part of the trench is storage. The presence of large clay vessels and bins in some of these spaces indicate that storage may have occurred there, and some of the smallest spaces that appears to have been difficult for people to fit into due to their size and shape (e.g. S10) may have been used for storage purposes only. To assess this, and possibly provide an indication of the nature of the occupation of the site in terms of seasonality (section 4.4.2), their *potential* storage capacities were calculated, focusing on the storage of plant foods and fodder. It was assumed that storage may have occurred to ensure access to food for human consumption and/or fodder for herded animals regardless of seasonal fluctuation in resource availability. This is not, however, meant to imply that the weather was unpredictable, apart from the winter months when the amount and nature of the precipitation may have varied from year to year. Calculating storage potential was done to assess the *possibility* that the built environment accommodated *potential* storage needs. The potential storage capacities for the bins and smaller spaces that had no surviving storage facilities or discernible internal features indicating their functions (thus they may have been used for storage) have been calculated (Table 4.3). As discussed in section 3.3.3, the calculated storage capacities are based on storage of legumes[44], although it is acknowledged that since the archaeobotanical remains from Ganj Dareh include wild and domestic type of barley, lentils, pistachio and almond (van Zeist et al 1984), it may be that one, some, or all of these species were stored for later consumption.

Space	Type of facility	Volume: 0.5. m height	Volume: 1 m height
S5	Bin	0.039	0.078
S7	Directly on floor	0.580	1.160
S10	Directly on floor	0.420	0.840
S13	Directly on floor	0.660	0.320
S14	Directly on floor	0.303	0.605
S15	Directly on floor	0.890	1.780
S20	Bin	0.051	0.101
S21	Bin	0.076	0.152
S30	Bin	0.175	0.350
	Bin	0.055	0.110
	Bin	0.220	0.440
Potential capacity for storage (m^3)		3.468	5.936
Number of people that could be supplied by potential storage		11.96	20.47

Table 4.3: Potential storage capacities of bins and some of the smallest spaces.

The calculations show that, depending on the height of the storage facilities – 0.5 m being the lower estimate and 1 m the assumed maximum capacity – the bins and small spaces could supply enough legumes for between twelve and twenty people for a year. It should be mentioned that the bins in S30 survive to over 1 m in height, and may have had a greater storage potential than calculated here. It is also possible that other bins may have been in a similar height range.

44 0.29 m^3 person/annum.

The large clay vessels set into the floors may also have been used for storage, and the calculated potential capacities of the vessels shown on the plan (Figure 4.2) are presented in Table 4.4. Calculations are based on the radius of the vessels as shown on the plan and the assumption that they have a cylindrical shape and a standard height of 0.25 m (left hand column), 0.50 m (middle column), or 1 m (right hand column). These calculations may not be realistic in terms of actual vessel shape and size, but, nevertheless, give an indication of potential volumes and storage capacities. It is also acknowledged that the vessels shown on the plan may not be a true reflection of the actual number of vessels that were in use within these structures at any one time. Smith (1968: 159, 1970: 179, 1976: 16, 1983/1984: 301, 1990: 332) has reported that some of the vessels found were up to 1 m in height and that they ranged in capacity from 70 to 200 litres (0.07 and 0.20 m^3 respectively). Most of the calculations assuming vessel heights of 0.5 m and 1 m fall within this range, and it may be that most of the clay vessels were between 0.50 m and 1 m in height. The calculations show that combined they may have contributed enough plant based calories for between one and four persons for a year depending on vessel capacity.

Space	Potential capacity for storage (m^3) if 0.25 m height	Potential capacity for storage (m^3) if 0.50 m height	Potential capacity for storage (m^3) if 1 m height
S4	0.048	0.095	0.190
S5	0.073	0.145	0.290
	0.033	0.065	0.130
	0.063	0.125	0.250
S12	0.040	0.080	0.160
S20	0.053	0.105	0.210
S23	0.035	0.070	0.140
Total	0.343	0.685	1.370
Number of people that could be supplied by potential storage	1.18	2.36	4.72

Table 4.4: Potential storage capacities of clay vessels.

If it is assumed that all of these bins, spaces and clay vessels were utilised to the capacities listed above, the combined potential storage capacity may have provided a supply of plant food that covered the annual requirements for between thirteen and twenty-five people. Considering that the settlement was located in a resource rich area that had access to a range of plant resources during most of the year, it may not have been necessary to store enough plants to supply each inhabitant for a whole year. If, for example, legumes were stored to provide the supply for 6 months only, then the combined potential storage capacity could have supplied between twenty-six and fifty-one people individuals (0.14 m^3 per person).

These calculations are not intended to imply that the inhabitants at Ganj Dareh utilised all of the potential storage facilities for plant foods, nor that all of the potential facilities listed, especially with regards to the small spaces, were used for the storage of food. It is possible that the smallest spaces with no obvious points of access or internal features were not in use and only functioned as structural support, e.g. S10 and S14. Smith (1990: 326-328) has mentioned that some of the small spaces had at some point been filled in, although he does not specify which ones. Another possibility is that some of the spaces may have been used for storing other materials, such as various implements used in everyday activities, fuel, animal products (e.g. meat, skins), or fodder for animals. The potential capacities for storing animal fodder in the small spaces and bins have been calculated and are presented in Table 4.5; these assume that enough fodder was collected to supply the goats for 90 days and 120 days (section 3.3.4).[45]

Space	Type of facility	Volume: 0.5. m height	Volume: 1 m height
5	**Bin**	0.039	0.078
7	**Directly on floor**	0.580	1.160
10	**Directly on floor**	0.420	0.840
13	**Directly on floor**	0.660	0.320
14	**Directly on floor**	0.303	0.605
15	**Directly on floor**	0.890	1.780
20	**Bin**	0.051	0.101
21	**Bin**	0.076	0.152
30	**Bin**	0.175	0.350
	Bin	0.055	0.110
	Bin	0.220	0.440
Potential capacity for storage (m^3)		3.468	5.936
Number of goats that could be supplied for 90 days by potential storage		17.34	29.68
Number of goats that could be supplied for 120 days by potential storage		12.84	21.99

Table 4.5: Potential storage capacities of bins and some of the smallest spaces.

These calculations show that the bins and small spaces had a combined capacity to hold enough fodder to feed between seventeen and twenty-nine goats for three months, or between thirteen and twenty-two goats for four months. If it is assumed that managed animals would have been taken out to pasture as long as the weather conditions permitted it,

[45] 0.20 m^2 per goat for 90 days and 0.27 m^2 per goat for 120 days.

and that fodder was only supplied when pasturage was limited or not available due to snow or heavy rainfall, then the calculated storage capacity may indicate that a small to medium herd could have been kept at the settlement through the winter. However, if the settlement was occupied all year, then stored resources would have to include food for human consumption as well. Smith (1990: 332) has suggested a possible difference in use between the various storage facilities; the bins and clay vessels were used for storing human food and the smaller spaces was for animal fodder and fuel. If this was the case then the combined storage capacity of the clay vessels and bins could supply between four and nine people for a year (Table 4.6), or, alternatively, between nine and eighteen individuals for six months. The small spaces may have had the capacity to supply fodder for between fourteen and twenty-three goats for 90 days, or ten to seventeen goats for 120 days (Table 4.7).

Space	Type of facility	Volume: 0.5 m height	Volume: 1 m height
S4	Clay vessel	0.095	0.190
S5	Bin	0.039	0.078
	Clay vessel	0.145	0.290
	Clay vessel	0.065	0.130
	Clay vessel	0.125	0.250
S12	Clay vessel	0.080	0.160
S20	Bin	0.051	0.101
	Clay vessel	0.105	0.210
S21	Bin	0.076	0.152
S23	Clay vessel	0.070	0.140
S30	Bin	0.175	0.350
	Bin	0.055	0.110
	Bin	0.220	0.440
Total potential capacity for storage (m^3)		1.301	2.601
Number of people that could be supplied by potential storage		4.48	8.97

Table 4.6: Potential capacities of bins and clay vessels storing food for human consumption.

These calculations suggests that the storage facilities at Ganj Dareh may have had the capacity to supply enough food and fodder to sustain between one and four co-resident groups (each perhaps consisting of three to five individuals), and a goat herd consisting of between ten and twenty-three animals during the late autumn and winter. It is of course possible that stored resources may have sustained more people or animals if less food was stored (i.e. enough to cover a shorter period of time than 180 days), storage in the small spaces was to a greater height than 1 m, storage occurred in more spaces than calculated here, and so on. What it does, however, is illustrate that the built environment had the potential to accommodate year-round occupation at the site in terms of minimising risk during winter (when perhaps less resources were available) through storage.

All calculations presented thus far do not take into account the storage of food in perishable containers, such as baskets, sacks and skins, nor of meat and other animal products. The storage of meat, often dried, is more difficult to assess as the period in which meat is kept before consumption is usually shorter than for plants (section 3.3.3), and the storage volume required may vary according to method of preservation. It is possible that dried meat was stored in the small 'cubicles' or the larger spaces, perhaps hung from the ceiling or kept in containers made of organic materials (no pits have been found[46]). Storage of food – both plants and meat – in perishable containers may have occurred in the small spaces (including those not considered in the above calculations), the large spaces, and/or the spaces in the potential upper storey. The presence of clay vessels and bins in some of the spaces (S4, S5, S20, S23 and S30) may indicate that other items or materials (e.g. food) were also kept in these spaces, but stored in, for example, baskets, skins or sacks. If it is assumed that storage of food occurred within the settlement, it may suggest a need to store plants beyond their natural availability, which may indicate a concern with creating surplus for consumption during periods with less resource availability, e.g. the winter months. However, whether this surplus was stored to support a population that stayed at the settlement all year, or a population that moved to lower elevations during the winter to provide better winter pastures for their herds cannot be ascertained based purely on the presence of storage.

Space	Volume: 0.5 m height	Volume: 1 m height
S7	0.580	1.160
S10	0.420	0.840
S13	0.660	0.320
S14	0.303	0.605
S15	0.890	1.780
Total potential capacity for storage (m^3)	2.853	4.705
Number of goats that could be supplied by potential storage: 90 days	14.26	23.53
Number of goats that could be supplied by potential storage: 120 days	10.56	17.43

Table 4.7: Potential capacities of small spaces for storing animal fodder.

[46] See Soffer (1989) for examples of how pits may be used for storage of meat.

4.4.4: Access and movement between spaces

An aspect that also needs some consideration is that of access into and movement between spaces. The previous discussion of potential activities and storage, especially if they occurred in the smaller spaces in the eastern part of the trench, necessitate availability and access. Some of the larger spaces in the western part of the trench may have had ground level or raised entrances; the original extent of S12, S26, S27 and S28 has not been preserved and/or fully excavated, and thus it remains possible that there were ground level entranceways. Alternatively, it is possible that these spaces were accessed through the roof as has been attested at Neolithic sites elsewhere in the Near East, such as Çatalhöyük in central Anatolia (Cessford 1998; Cutting 2003: 6; Düring 2001: 4; Twiss et al 2008: 43).

The portholes that have been found in some of the walls present another means of access (section 4.3). Smith (1990: 330) was not sure that they were used as conventional entrances, although he is uncertain about their function due to the variability in size and shape and their presence in walls of both the larger and the smaller spaces, as well as in the 'burial cubicles'. It may be, as he has suggested (Smith 1990: 330-331), that they served a variety of functions; they may have provided ventilation, access to contents kept in the smaller spaces, and/or so-called 'peep-holes'. If it is assumed that some of these portholes may have been used as cursory entrances, the question would then be what size a porthole would have had to be for a person to crawl through it. A person that is similar in height and width of shoulders, but with slightly wider hips than the Size A individual used for the scenario modelling can crawl through a hole with a diameter of about 0.33 m (personal observation), and it may be suggested that the portholes that measured ~0.30 m or more in diameter may have provided a means of entering a space for a Size A (or smaller) adult or child. Table 4.8 lists the size of the portholes shown on the plan (Figure 4.2) (there is no further information available concerning any of the other portholes found).

In wall between spaces	S4-S12	S8-S9	S9-S13	S19*	S21-30	S22-S24	S24-S25	S25-S26	S31-S33
Diameter (m)	0.20	0.39	0.25	0.16	0.24	0.13	0.30	0.48	0.29
* The porthole is located in a plastered feature by the southern wall, but there is no indication whether it extended through the wall into S31 or not.									

Table 4.8: Approximate sizes of portholes.

Assuming that the portholes measuring 0.30 m or more may have been cursory entrances, there are three, or perhaps four, portholes that may have provided enough space for a Size A, or smaller, person to crawl through, i.e. between S8 and S9; S24 and S25; S25 and S26; and S31 and S33. The porthole between S8 and S9, however, is located above the plastered depression in S9 and opens up onto the western wall of the niche containing the sheep skulls in S8, and it is thus doubtful whether it would have been used for movement between the two spaces. Instead it is possible that it was there mainly to enable people in S9 to look into S8. The porthole at the other end of S9, which opened up into S13, appears not to have been blocked by any structural features, and may have provided some form of access between these two spaces (perhaps for retrieving goods stored in S13). It may even have been enough space for a small individual (e.g. a child) to have crawled through it if required.

The porthole between S25 and S26, which is the largest one recorded here, presents the most convincing candidate for a possible entrance based on size. Similarly, the porthole between S25 and S24 may have provided access into S24, and if so, possibly also the contents of the clay vessel in S23. There was only a buttress separating S24 from S23, leaving a gap of about 0.16 m between it and the wall through which it would have been possible for an individual to reach. Alternatively, if the buttress did not go all the way up to the ceiling, the content of the vessel may have been reached more easily. The porthole between S22 and S24 may have provided access to contents stored in S22 as it may have been wide enough for an arm to reach through, although this may have necessitated the stored goods to be placed directly by the porthole in S22. If the portholes between S25 and S26, and S24 and S25 were used as entranceways, and the porthole between S22 and S24 provided some form of access into S22 then it is possible that all of these spaces (S22-S26) were part of the same structural unit. If this was the case, then it may have provided living and working spaces for a co-resident unit. S25 and S26 could accommodate up to five adults sleeping each, and eleven and six adults sitting cross-legged respectively. Additionally, activities taking place within S25 and S26 may have involved use of the foods, materials, and/or tools that were stored in S23, S24, and S22.

There are other examples of spaces that may have been functionally linked. For example, it may have been possible for a small person, such as a child, to crawl through the porthole between S21 and S30. The three large bins in the eastern part of S30, combined with the mortar in S21, may suggest that food-related activities taking place in S21 required access to the goods stored in S30. Additionally, the porthole between S31 and S33 may have provided access for a small person, which may indicate that it was possible to enter S31 from S28 through S32-S33. It is also possible that various materials and items may have been passed between these spaces, from one person to another, through the portholes without necessitating someone crawling through them.

All of the portholes listed in Table 4.8 may have provided some form of access between spaces, either as cursory entrances (or ‘crawl holes’), openings that people could reach their arm through to retrieve goods stored in that space, or openings that people passed materials between one another. They may also have allowed people in different spaces to communicate verbally, provided ventilation or lighting (if there was a source of light in one of the connected spaces), or they may have been there only for people to look into certain spaces (e.g. in the case of S8 and S9). Without further evidence, however, these are only suggestions. Nevertheless, it remains clear that even if portholes were points of access, the majority of spaces have no obvious entryways. The larger spaces may have been entered from the roof or through doorways that have not been preserved or are located outside the excavated area. With regards to the small spaces, it is possible that they were accessed from above – through the floor of the spaces above if these were part of a two storey structure or from the roof if they were not. If the former was the case, then the floors of the spaces on the upper floor would have had a considerable number of openings in them. Their placement would, therefore, have had to be considered during construction so as not to be in the way of activities taking place in the upper storey, or reduce the amount of 'usable' or available floor space. If access to the smaller spaces was gained through openings through the above floors, it is possible that these were capped by 'plugs' or covers made of wood or clay when not in use. It is also possible that access into and movement between the smaller spaces were achieved through a combination of openings in the floors (for spaces with no other obvious entrances, e.g. S5, S15 and S20) and the portholes. If there was no upper floor, then the placement of roof entrances may not have been of great concern.

4.4.5: Possible reconstructions of the upper storeys

The final aspect that will be considered in this chapter concerns the possible upper storey that so far has been mentioned only in passing. Smith (1976: 15, 1990: 325) believes the upper storey provided living and working spaces for the inhabitants at Ganj Dareh, although, assuming there was an upper storey, it appears that the upper storey did not cover the entire structure. There is a lack of information concerning the spatial configuration of the upper storey; the remains of the plastered floors above the small spaces and the lumps of mud with impressions of beams and poles are the only evidence referred to in the published reports (Smith 1970: 179, 1972: 166, 1975: 15, 1990: 325). As an experiment a series of four different reconstructions of possible upper storeys were produced and maximum capacities of people sitting cross-legged and sleeping were modelled for each reconstruction. The reconstructions assume that the walls of the upper storeys would largely follow the underlying walls for structural purposes, especially where the lower walls have slumped and/or been reinforced by buttresses or additional walls built alongside the original ones. This would also allow for access from the upper storey into the underlying smaller spaces, and the possibility that the living spaces on the upper floor may, in combination with the smaller spaces they overlay, have constituted individual structural units.

The four reconstructions take into account different possibilities: if all of the internal spaces in the central trench had an upper storey (Figure 4.6); if all of the small spaces in the eastern part of the trench and some of the larger spaces in the northern part had an upper storey (Figure 4.7); and if only the small spaces in the eastern part of the trench had an upper storey. As there are indications that the latter was more likely, two different spatial configurations were reconstructed for this scenario (Figures 4.8-4.9). The reconstructions were based on the assumption that the upper spaces would be larger than those in the lower storey, but that the walls would still be built above underlying ones for structural support. It is not suggested that any of the reconstructions of the upper storeys are accurate; it was done in order to provide an estimate of the affordance of space for co-habitation and co-presence. The modelling indicates that most of the reconstructed upper spaces may have accommodated between four and twenty Size A adults sitting cross-legged, and between two and fifteen Size A adults sleeping. Most of the reconstructions could accommodate an average of four to eight adults sleeping, or six to nine adults sitting cross-legged. Admittedly, most of the reconstructed upper spaces had awkward shapes and would perhaps not have provided ideal spaces for social gatherings, such as for food consumption or general socialising. However, this modelling indicates that these spaces may have served as living spaces (as suggested by Smith) for various co-resident groups, perhaps consisting of between three and eight adults. This is consistent with the modelled affordance of space in the larger spaces in the western part of the trench (section 4.4.1), which may suggest possible co-resident groups of between three and six adults.

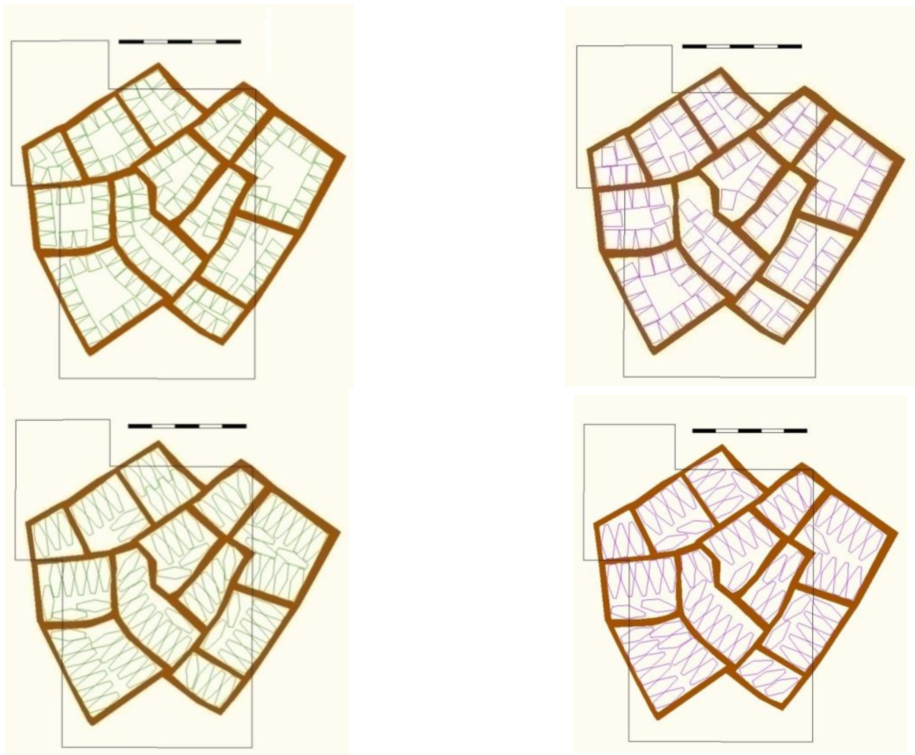


Figure 4.6: First reconstruction of upper storey; modelled maximum capacities of Size A (left) and Size B (right) adults sitting cross-legged (top) and sleeping (bottom).

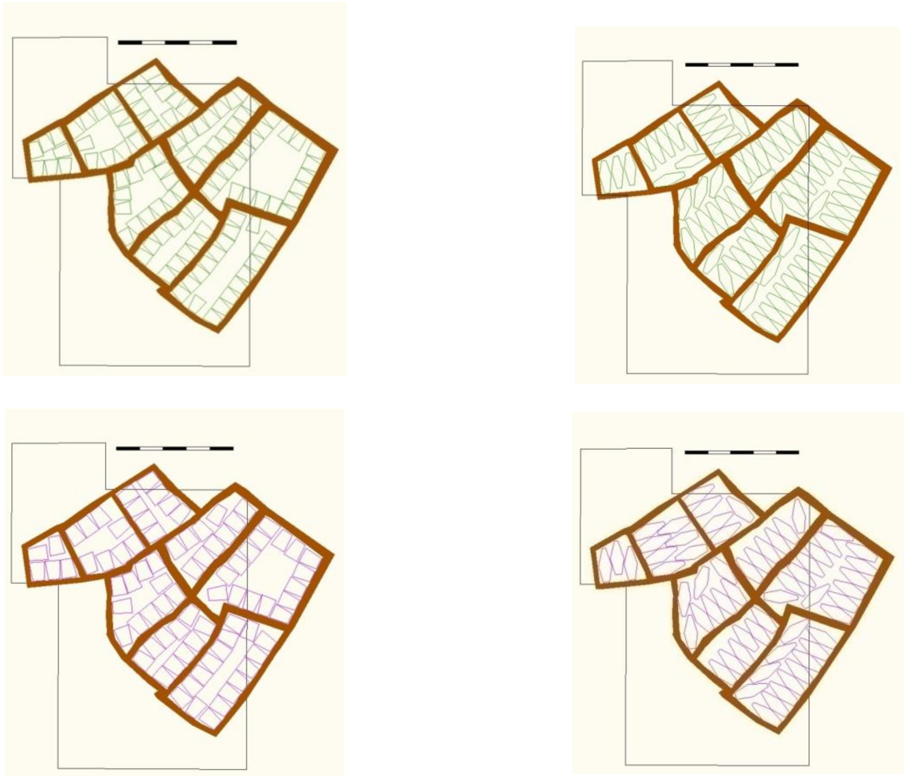


Figure 4.7: Second reconstruction of upper storey; modelled maximum capacities of Size A (left) and Size B (right) adults sitting cross-legged (top) and sleeping (bottom).

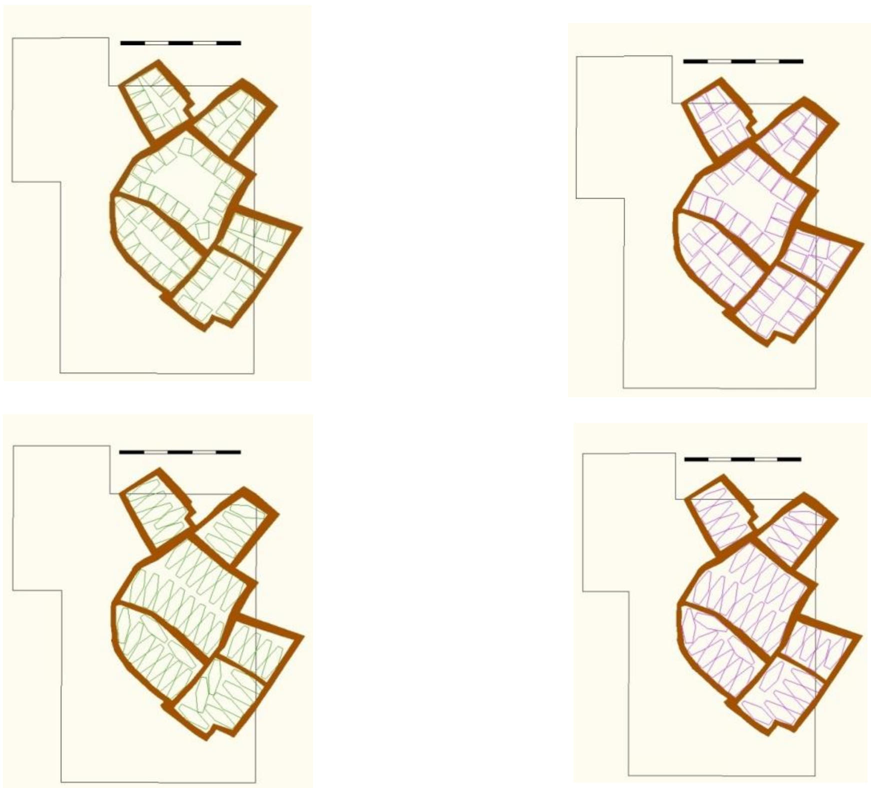


Figure 4.8: Third reconstruction of upper storey; modelled maximum capacities of Size A (left) and Size B (right) adults sitting cross-legged (top) and sleeping (bottom).

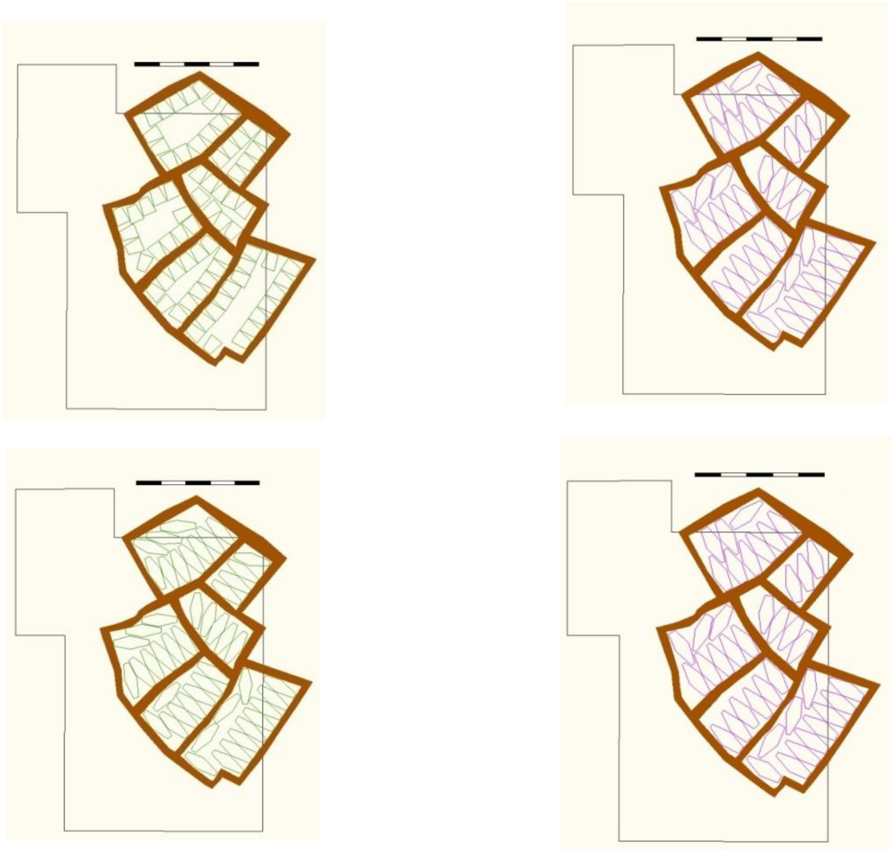


Figure 4.9: Fourth reconstruction of upper storey; modelled maximum capacities of Size A (left) and Size B (right) adults sitting cross-legged (top) and sleeping (bottom).

4.5: Summary

This chapter has examined the built environment at Ganj Dareh, focusing on the size of co-resident groups, the affordance of space for interaction, the use of spaces, possible storage capacities, and the affordance of space for animals. Certain observations were made regarding the potential differentiation in the use of space based on size. The larger spaces in the western part of the trench had room for at least four or five co-present adults, and between three and six co-resident individuals. This indicates that they may have been living spaces as they were large enough to provide shelter and work areas for a number of people. S3 and S4 contained a large clay-rimmed mortar and a clay storage vessel respectively and there was another storage vessel located between S11 and S12, which indicate that food and storage related activities took place in them. It may be that individual living spaces accommodated co-resident groups consisting of three to eight individuals, perhaps nuclear families. This is perhaps also indicated by the four reconstructions of the upper storey, which suggested a similar size range for potential co-resident units (four to eight individuals).

The small spaces could generally only accommodate the co-presence of one or two adults, which indicate that they may have been used for storage and/or activities associated with the stored goods that only required the presence of one or two individuals. It is possible that some of the smallest spaces that did not contain any built features, e.g. S7, S10 and S13, were used for on-floor storage of food stuffs or animal fodder. Spaces that contained storage facilities, including S5, S20 and S30, may have been used for storage of foods and possibly items associated with food processing, such as portable ground stones. It is also possible that some food processing activities utilising the stored goods, which may not require much space or light, and may not have taken much time, also occurred there. Alternatively, the time people spent in these spaces may only have been associated with the deposition and retrieval of stored materials. The mortar in S21 suggests that some food processing activities took place there, and it is possible that these activities may have utilised foods stored in the three bins in S30 as these two spaces were connected by a porthole that may have been large enough for a small individual, e.g. a child or an adolescent, to crawl through. S8 may have been associated with ritual activities, suggested by the sheep skulls in the niche by the southern wall. There was only room for one individual to be present at any one time, indicating that any activity occurring there did not involve any social interaction. Similarly, the use of S9 (connected to S8 by a porthole) would have been restricted to one or two individuals. It may have been a ritual space, although it is equally possible that the plastered basin were used for processing of foods and/or liquids. If the latter was the case then these activities may have utilised food stuffs stored in S13.

It is less clear what function S31 may have had; the nature of the plastered feature by the northern wall is not known, thus it is unclear whether it was functional or associated with ritual activities. The modelling indicates that there was space for up to four seated or kneeling adults, or eight adults squatting, which suggests that the number of possible participants was somewhat restricted. Alternatively, S31 may have been used for storage of materials and tools that were used in S28 and S32; there is a porthole connecting S31 with S32 (through S33) that was large enough to have been used an entrance. The refuse deposits found in S28 indicate that that it may have been used for manufacturing and possibly some food-related activities that perhaps required more space, in addition to refuse disposal.

Access into and between the various spaces may have been achieved through a combination of portholes and openings in the floors (lower storey) and roofs (upper storeys and single-storey structures), although more ‘conventional’ doorways may have existed outside of the excavated area. Based on the available evidence it is difficult to assess whether the built environment consisted of individual, highly agglutinated buildings, or if the series of spaces should be viewed as a single structure with individual living spaces housing small co-resident units that shared storage and work areas. If there were individual buildings and the living spaces were on the upper floor, then the questions would be how many spaces on the upper floor were there in each building? And how many small spaces in the ‘basement’ did each co-resident group have access to? The reconstructed living spaces in the upper storeys overlie between one and seven lower spaces depending on size and spatial configuration. If these living spaces and the spaces they overlie constituted individual structures, then they appear to contain different facilities (depending again on spatial configuration of the upper floor). In the modelled scenarios, some ‘buildings’ would have storage and food processing facilities; some would have storage and ritual spaces; whereas others would only have limited storage facilities that did not have the capacity to supply the annual or six month requirement for the co-resident unit. Additionally, some of the small spaces could be accessed from the larger spaces in the western part of the trench; it was possible to enter S24 from S25, and S31 from S32/33. This appears to counteract any effort to control access into these spaces if individual co-resident groups managed their own production and consumption.

It is also possible that several co-resident groups living in the upper storey shared access into and use of the smaller eastern spaces. Similarly, if there were no upper storey, it is possible that co-resident groups lived in the larger western spaces and shared access into and use of the small eastern spaces. It is, in this scenario, possible that there were living spaces encircling the small spaces. In both scenarios use of the small spaces – for storage or work purposes – was shared between several co-resident groups. It appears that activities associated with food preparation and cooking, and perhaps also eating, took place outside in communal areas, providing a setting for social interaction between co-resident groups. This suggests that production and consumption, and thus any strategy to minimise economic risks, may have been shared within the community. Certain food-related activities, however, occurred inside, indicated by the mortars in S3 and S21. These spaces could accommodate four to five adults at any one time, and thus activities taking place in them may have afforded some co-operation, although on a smaller scale than activities occurring outside. It is possible that the domestic tasks that took place inside individual spaces depended on the type of activity and/or the season. Certain food processing activities that required access to stored goods may have taken place inside, either in the spaces where the food was stored (e.g. S4) or in adjacent spaces (e.g. S21 and S30). Alternatively, most of the domestic activities may have taken place outside – either on roofs and/or in areas adjacent to the structures – during the summer and inside during winter.

The issue of seasonality has been discussed in connection with fire installations and potential storage capacities. The lack of internal fire installations in living spaces (as well as indications of minimal exposure to smoke) may not have been ideal for occupation during the winter. There would have been no source of heating which is likely to have been required as below zero temperatures are possible during the winter, unless the tight clustering of structures provided enough insulation. Additionally, it is questionable if cooking would have taken place in external areas due to snow or rain. It is possible that the oven in S1 (and others located outside the excavation area) served such purposes during the winter. The calculation of potential storage capacities for food for human consumption and animal fodder indicated that the storage facilities may have accommodated year-round occupation for maybe four co-resident units (totalling eighteen individuals) and ten to twenty-three goats. These calculations only take into account on-floor storage in the small spaces, bins, and clay vessels, and do not include on-floor storage in other spaces, which would increase the storage potential. The calculated winter storage (180 days for humans and either 90 or 120 days for goats) may be an over-estimation, and it is therefore possible that there may have been enough stored food and fodder to sustain a larger population – both human and animal – throughout the winter than that calculated here.

With regards to goats, it is interesting to note that the built environment does not appear to have been designed to include them. This may imply that penning occurred outside, although perhaps in close proximity to, the settlement. The hoof imprints found on mud bricks may suggest that they were kept close to the site, perhaps in an area where mud bricks were manufactured. Additionally, the suggestion made by Merrett (2004: 236-237, 244-245) that the high frequency of porotic hyperostosis in adults was a result of an intestinal parasite and/or brucellosis due to prolonged contact with goats indicate, if correct, a certain degree of human-animal interaction even though animals were not included in the settlement.

In summary, the modelling has indicated that even though co-resident groups may have consisted of nuclear families (three to five individuals) they formed part of a larger social unit that co-operated on a range of domestic tasks, and in particular food-related activities, and shared storage facilities and possibly responsibility for herding. Animals appear to have been kept outside, but in some proximity to, the settlement, and most of the human-animal interaction would have occurred outside of the built environment. It also appears that a range of domestic activities occurred in external area around the settlement, suggesting a communal focus for most of the social interaction taking place on a daily basis. This indicates that the models which correlate compartmentalisation of space with economically autonomous nuclear family households (section 2.4) are not applicable to Ganj Dareh. Instead there are different social practices underlying the structuring and use of space at this site which would be overlooked if assumptions were made based on built form alone. The next case study focuses on Jarmo, a site that has often been cited as an example of the architectural development that occurred during the Neolithic (e.g. Banning 2003; Flannery 1972), but has never been investigated on its own terms beyond generalising statements concerning built form. The situated examination of the structuring and use of space at this site allows an assessment of whether there are observable similarities and/or differences in social practices at the site compared to Ganj Dareh, which is discussed in the concluding section of chapter 5.

Chapter 5

Qala'at Jarmo

5.1: Introduction

This chapter presents the second case study examining Neolithic built environments in the Zagros, focusing on Qala'at Jarmo (hereafter referred to as Jarmo) which was occupied from the Late Aceramic Neolithic into the Early Pottery Neolithic (*c* 7,500-6,000 cal BC). It was the first site in the Zagros region to be purposefully excavated as part of a wider strategy aimed at understanding the Neolithic in the Near East, and even though it to some degree lacks the fine-grained documentation of more recent excavations, it provides a more complete record than many of the other, roughly contemporary, sites in the region. The buildings at Jarmo have been described as "houses [that] were small, multi-roomed structures that already had many of the features that we associate with Near Eastern village life" (Banning 2003: 6), and the site is often viewed as an example of the changes in household composition and emerging notions of privacy and property often associated with the move from circular to rectangular, multi-roomed structures (Flannery 1972: 38-44). The first part of this chapter presents an outline of the work that took place at Jarmo, including excavation strategies and methods, as well as the reconstruction of the diet and the occupational phases (section 5.2). Following this is a summary of the architectural remains and associated built features found during the excavations, and in particular those that are identified to be best suited for the scenario modelling (sections 5.3-5.4). The main part of this chapter discusses the results from the modelling, focusing on co-residency and co-presence (sections 5.5.1.1, 5.5.2.1, 5.5.3.1, and 5.5.4.1), the use of space and whether the built environment afforded space for animals (sections 5.5.1.2, 5.5.2.2, 5.5.3.2, and 5.5.4.2), and whether the built environment had the capacity to accommodate storage of food for human consumption and fodder for animals (section 5.6).

5.2: The excavations

Jarmo was excavated by Robert and Linda Braidwood on behalf of the Oriental Institute of the University of Chicago during three seasons between 1948 and 1955 as part of their Iraq-Jarmo project (Braidwood 1954, 1972; Braidwood and Howe 1960: 19-23). The site is located east of Kirkuk, northeast Iraq, on a promontory on the southern bank of the Cham-Gawra wadi in the Chemchemal valley (approximate co-ordinates: latitude 35° 33' N, longitude 44° 57' E) (Braidwood 1983a: 155; Braidwood and Howe 1960: 26). It is situated at an elevation of about 800 m above sea level and covered, at the time of excavation, an area of about 90 x 140 m (Braidwood 1983a: 155; Braidwood and Braidwood 1950: 191; Perkins 1949: 50), although it is possible that as much as one third of its original extent had been lost due to wadi erosion (Wright in Braidwood 1983: 155; Wright in Braidwood and Howe 1960: 27). Studies indicate that the site was probably located in an open steppe-forest environment which had expanded throughout most of the region during the Early Holocene (section 2.2). Botanical remains included domestic emmer wheat and einkorn wheat, wild and 'transitional' forms of wheat (indicating cultivation), wild barley (possibly cultivated), lentils, field peas, blue vetchling and pistachio (Helbaek 1960; Watson 1983). Analysis of the faunal remains indicated a reliance on domestic goats, possibly sheep, and pigs (in the upper levels), and wild species such as onager, gazelle, red deer, roe deer, auroch, wild boar (both upper and lower levels), fox, hare, partridge, tortoise, and freshwater crab (Braidwood and Howe 1960: 47-48; Reed and Braidwood 1960: 172; Flannery 1983; Reed 1960; Stampfli 1983).

Excavations indicated that there were up to 7 meters of archaeological deposits dating to the Neolithic, of which the upper 2.25 m contained pottery (Braidwood and Howe 1960: 39-40). The areas exposed during excavations totalled *c* 1,370 m², including two main trenches (I and II), a step trench and 151 test pits (see Figure 5.1 for trench locations) (Braidwood 1983a: 163-165; Braidwood and Howe 1960: 38-39). During the first two seasons of work efforts were concentrated in trench I (9 x 16 m at its largest) in the western corner of the site, and trench II (17 x 27.50 m at its largest) on the north-central escarpment, as well as step trench A (*c* 3 m wide, with five 'steps'; the first was 1.80 m long and the subsequent four were each about 1.50 m) adjacent to trench II, and four smaller test trenches (trenches B-D were 3 x 4 m and trench III was 5 x 5 m) (Braidwood 1983a: 163-164; Braidwood and Braidwood 1950: 192). In the third season Braidwood thought that the site had been adequately sampled in depth and decided to lay out a 5 x 6 m grid across the site and excavate 2 x 2 m test pits in 151 of the grid squares in order to obtain information on the overall layout of the settlement (Braidwood and Howe 1960: 21). This did not, however, produce the results they had hoped for; there were only scant architectural remains in some of the test pits and they were not able to correlate the stratigraphy from the different soundings (Braidwood 1983a: 164-165; Braidwood and Howe 1960: 39-41).

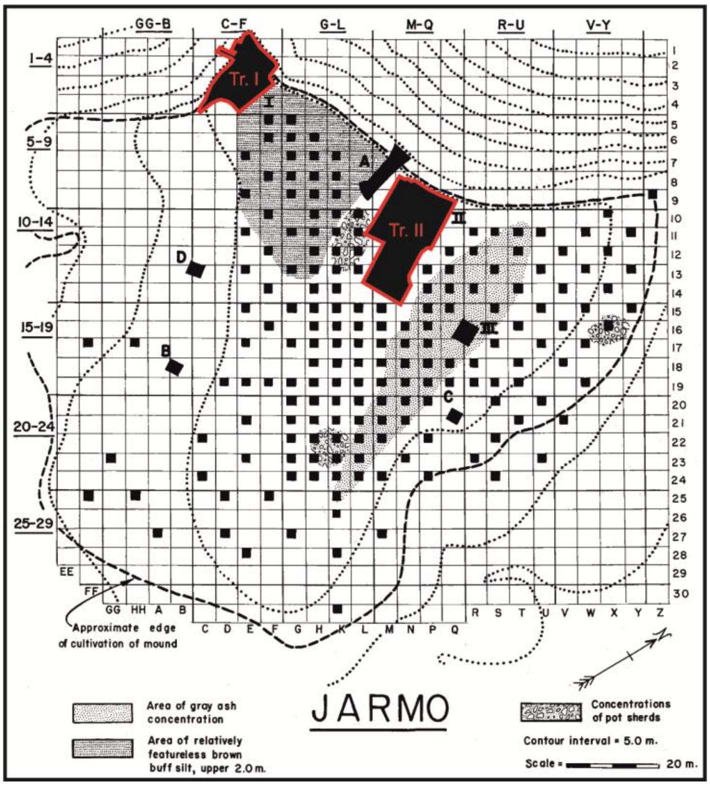


Figure 5.1: Overall site plan of Jarmo showing locations of excavated trenches with the location of trenches I and II outlined in red (modified from Braidwood et al 1983: fig. 6).

The excavations were carried out by trained workmen who first removed about 0.10 m before scraping and sweeping the excavated area to see if there were any architectural features showing up. If this was the case the walls were traced downwards until they were about 0.10 m above the floor and the deposits between the walls were excavated separately (Braidwood and Braidwood 1960: 22). The excavated deposits in each main trench were divided into different archaeological levels; each was assigned a sequential number (1 being the uppermost). Each of these levels generally included a floor or a series of floors with its/their associated architectural remains, secondary features and the deposits surrounding these in a ‘more or less horizontal plane’ within the trench (Braidwood 1983a: 166). Floors were defined as a living surface within or immediately adjacent to a room or a cluster of rooms that appeared to be part of a structure, including any line of compacted earth; any layer of clean packed silt on a reed bedding; any layer of dark or greyish ash; any surface made of paving stones or pebbles; or (if none of the preceding were present) a general level where the architecture, including secondary features, indicated a floor (Braidwood and Braidwood 1960: 22). Based on these parameters the excavators divided the deposits in trenches I and II into 9 and 6 main architectural phases respectively (Braidwood 1983a: 159-160). They were not, however, able to correlate any of the levels from the two trenches, nor link them to the stratigraphy in any of the test pits (Braidwood 1983a: 155). The possible stratigraphic relationship between the two trenches is discussed in more detail in section 5.7.

The excavation method meant that the archaeological deposits were dug as arbitrary units and the excavators did not separate discrete contexts. All of the materials recovered during the excavation were therefore recorded as coming either from a general deposit removed during the exposure of the architecture down to about 0.10 m above the floor, or from the remaining 0.10 m of deposits directly overlying the floor. The recording system thus only denoted the trench number and level, e.g. J-II 3, with the addition of 'fl' for the 0.10 m directly above the floors, e.g. J-II 3fl (Braidwood and Braidwood 1960: 22-23). In the published reports artefacts are only dealt with in terms of main characteristics, and/or grouped together according to level(s). Braidwood observed that very few artefacts were recovered from within structures and that there were areas with midden-like deposits in certain levels (Braidwood 1983a: 158). This may indicate that buildings were kept clean and that refuse disposal took place in certain areas. However, it remains difficult to ascertain the exact locations where individual artefacts or groups of artefacts were found. Even in the case where a plan of the artefact distribution on a specific floor in level 7 in trench I has been provided (Braidwood 1983a: fig. 32), it remains uncertain if the materials were actually lying directly on the floor, or were merely recovered from the 0.10 m fill above it.

These factors complicate any attempt to undertake a fine-grained examination of the spatial distribution of artefacts, or animal and plant remains, at the site, thus it is difficult to define potential activity areas within and around the excavated structures based on *in situ* artefact distributions. There are, however, sufficient architectural remains in some of the archaeological phases to enable an analysis of the type of social interactions and activities that are afforded by the size and structural configuration of the various buildings. The results from the test pits are not included in the following discussion due to the problems associated with the stratigraphy and the lack of, or very scant, structural remains found in them. There is a range of factors that may account for this lack of architecture in the test pits, including poor preservation of *tauf/chineh* walls in the upper deposits (the test pits were not excavated to any great depth), or structural features may have been missed due to the restricted size (and spacing) of the test pits. Alternatively, large parts of the site may have been used for other purposes, such as rubbish disposal or animal penning, and there were therefore no structures in the locations of the test pits. The results from the excavations are presented in the next two sections, focussing on the architectural remains in trench I (section 5.3) and trench II (section 5.4).

5.3: Structural remains in Trench I

Trench I, located at the westernmost corner of the mound, was initially 8 x 10 m, but was expanded to 9 x 16 m due to its location by the escarpment. About 5.50 m of archaeological deposits were excavated, which were divided into nine archaeological levels (numbered 1 through 9; top to bottom) (Braidwood 1983a: 158-159). Only levels 6 and 7 yielded any significant architecture; the structural remains in levels 1 through 5 were limited to a few fragmentary pieces of *tauf/chineh* walls (levels 3-5) and possible stone foundations (levels 1-2) (Braidwood 1983a: 160, figs. 43-45). The remains in level 8 consisted of two *tauf/chineh* walls, one of which had three smaller niches with traces of burning and deposits containing much ash and charcoal, which may have been the remains of temporary hearths. To the west of the walls were clusters of stones, ash and charcoal, as well as numerous artefacts, especially microliths, but no animal bones (Braidwood 1983a: 159, fig. 39). This may have been an outdoor area where a range of manufacturing activities and tasks associated with the use of fire occurred, although the precise nature of these activities remains unclear. There were no structural remains in level 9, only a series of refuse pits and mud coated basins with traces of burning and charcoal rich ash deposits, possibly hearths (Braidwood 1983a: 157-159, fig. 39). The architectural remains in levels 7, 6d-b, and 6a were more complete and appear to show structural continuity. All of the below information pertaining to these levels are from Braidwood (1983a: 158-160, figs. 40-42) and Braidwood and Howe (1960: 38-50).

The structural remains in level 7, although not complete, constitute the earliest comprehensive architecture in trench I, and consisted of *tauf/chineh* walls that made up a series of spaces of varying sizes. Preservation along the escarpment (the northern and western edges of the trench) was especially poor, and the extent of the structural remains in the western and northern parts of the trench is uncertain. There appeared to have been two rectangular spaces, oriented east-west, in the northern part of the trench, of which the eastern one continued into the baulk. The western space, of which approximately 4.40 x 3.20 m was preserved, had a smaller rectangular, compartment-like feature at its eastern wall. Only a limited description of this feature is given in the publications, but it appears to have been the poorly preserved remains of an oven-like installation with a possible opening through the wall into the northeast space. To the south of the two northern spaces were two larger spaces along the eastern edge of the trench flanked to the west by three smaller spaces, oriented north-south. In the central eastern space (*c* 3 x 3 m) there was a foundation for another oven-like installation. There were apparently stones and fragments of reed bedding in the central possible oven, and a fragment of a quern and some reed matting found in the foundation of the northern one. As ovens at the site were frequently located in rooms without reed matting, it may be that the possible ovens in level 7 were constructed during a later phase of use of the structure. It was unclear to the excavators whether the north-south wall separating the two northern spaces was a later addition constructed at the same time as the oven.

The southeast space extended about 4 m from the trench edge to its western wall and its width increased from about 2.40 m in the west to 3.90 m in the east. No reed matting was found in it and the configuration of walls in the later phase of the structure (level 6d-b) indicates that it may have been an at least partially walled external area. South of this space there appears to have been an open external space that had been used for refuse disposal in previous levels as attested by the presence of a large pit. At some point *tauf/chineh* walls had been constructed over the western part of the pit and a fire installation, possibly a hearth, over the eastern part (see Braidwood 1983a: fig. 40). Due to their poor preservation the function of the *tauf/chineh* walls are uncertain, although it is possible that they enclosed a small space (measuring *c* 2 x 1.30 m). To the north of the latter was another small space (*c* 3.10 x 1.20 m) that had reed matting on the floor, on which was found a scatter of bones, horns, antler, stone objects and flint blades. It is possible that manufacturing activities may have taken place there and/or that the space had been used for storage of raw materials. North of this space and adjacent to the central space containing the oven, was another small space (*c* 2.40 x 1.10 m) that appears to have had a ground level doorway in its western wall.

Level 6d-b appears to be a later architectural phase of level 7, in which some modifications had been made. The western wall had been moved further west, thus enlarging the two western spaces; preservation along the escarpment was poor, but it appears that the southern space measured roughly 2.40 x 2.20 m and the northern space 3 x 2.50 m, and both had reed matting preserved on their floors. The two northern spaces were less well preserved than in level 7 and their original layout and size are unknown. The northwest space had reed matting on the floor and an oven-like installation adjacent to the eastern wall, and in the northeast space there was a clay-lined depression with traces of burning that may have been a hearth. There was also an oven-like installation in the central space that had an opening through the east wall. This eastern wall may have been a new addition that decreased the size of the space, now measuring *c* 3 x 1.90 m, and increased the size of the space to the south. In the latter, outside the opening for the oven, was an accumulation of ash and refuse, including snail shells and animal bones, which may have been associated with the use of the fire installation. No traces of reed matting were found on the floor surface, which, combined with the presence of what appeared to be a hearth further south, may suggest that it was an external, at least partially walled, area. The southern wall separated this space from another external area that contained three fire installations, possibly hearths, clustered in the eastern part of this space; two were clay-lined depressions, and the third was larger and paved with flagstones.

The structural configuration in level 6a appears to have consisted of four or five internal spaces, and show change, but also some continuity, from level 6d-b. The central space containing the oven in the preceding phases had in level 6a decreased in size, measuring 2.20 x 1.60 m, and contained no traces of any fire installations, suggesting a change in the function of the space. There was a possible ground level doorway in the southern wall, which may have led into another internal space as suggested by the fragmentary remains of a wall running north-south just west of the possible entrance. The two western spaces appear to have been renewed and remained approximately the same size as in the earlier levels. Traces of reed matting were found on the floor in the southwest space and the baked clay flooring of a possible fire installation by the eastern wall of the northwest space. The latter may indicate that the space may have been unroofed. From this space there was an opening at the northern end of the eastern wall leading into a small space, measuring *c* 0.70 x 1.50 m, which had a ground level entrance in its northern wall leading into a large space to the north. The original size and layout of the northern space is uncertain as the northern part of the space had not been preserved. Fragmentary *tauf/chineh* remains in the northwest part of this space may indicate that there may have been a platform in this area, or part of the space may have been delineated by low 'curbs' or walls. Traces of reed matting on the floor suggest that it may have been an internal space.

5.4: Structural remains in Trench II

Trench II was initially 10 x 20 m, but was expanded to 17 x 27.50 m (due to its location by the escarpment), before decreasing to about 9.50 x 10.50 m at the end of the excavation. About 3.25 m of archaeological deposits were excavated, which were divided into six main archaeological levels (numbered 1 through 6; top to bottom) (Braidwood 1983a: 160). Of these, the lower two levels yielded the most substantial architectural remains. The later architectural phases consist of what appears to be a series of linear stone foundations, which were divided into three main levels (levels 1-3) and the two latest layers have been further sub-divided into two sub-phases each (1 and 1a, and 2 and 2a) (Braidwood 1983a: 162-163, figs. 54-56). A careful study of the published reports, plans, section drawings and photos indicate that the buildings depicted on the plans are not necessarily contemporary. The few remains of *tauf/chineh* walls found in levels 3 and 2 were too fragmentary to yield any useful information, and their relationships to each other as well as the stone foundations are unclear. Most of the structural remains in the southern and central part of the trench designated as level 4 appear to be directly overlying those of level 5 (see Braidwood 1983a: fig. 53). Through a careful study of the published reports and plans it appears that, even though the structural remains have similar alignments, they were separated by varying thickness of different non-structural deposits. It may be that the architectural remains in level 4, which consisted of only a few fragments of *tauf/chineh* walls and part of a stone foundation, were originally similar to the level 5 structures. However, the evidence is too inconclusive and level 4 will not be included in this discussion. Level 6, which is the earliest level excavated in trench II, consisted of an incomplete building made of *tauf/chineh*. Braidwood has suggested that there were at least another 3 m of archaeological deposits below this level (Braidwood 1983a: 160), however, without further excavation, this assumption remains only speculative. The configuration of space in level 5 presents the most complete architecture excavated in this trench and will therefore be the focus of the following discussion, but some consideration will also be given to the structural remains in level 6. All of the below information pertaining to levels 5 and 6 are from Braidwood (1983a: 157-163, figs. 50-51) and Braidwood and Howe (1960: 38-50).

The structural remains in level 6 consist of a series of *tauf/chineh* walls that made up three spaces; two smaller spaces, aligned north-south, appear to have been flanked by a larger space to the west. The northeast space (*c* 1.40 x 1.50 m) appears to have contained no artefacts or any internal fixtures, but Braidwood (1983a: 161) suggested that it may have been used for storage purposes. There might have been a porthole between the two small eastern spaces as the central portion of the wall between these spaces had been 'worn smooth' according to Braidwood (1983a: 161). In the southern part of the southeast space there was a well preserved domed oven made of clay with burnished floors. It was ovoid in plan, had a 'scoop-like' opening through the southern part of the western wall (just above floor level), and a 'chimney' that had been incorporated into the wall above the opening. The southeast space (*c* 2.50 x 1.50 m) also had a slit in its eastern wall with a flat stone sill set into it at about 0.25 m above floor level, which Braidwood (1983a: 161) suggested may have been a ventilation hole for the oven or a window. As the 'chimney' and the opening for the oven were in the western wall and opened into the western space, ventilation may not have been needed in the southeast space. There was also a ground level doorway in the northern part of the west wall, which may have provided ventilation if required, thus the slit in the eastern wall may have been a window or similar feature. The extent and function of the western space remains unclear as the western part had not been preserved. Braidwood (1983a: 161) suggested that it may have been an open courtyard based on the presence of a small stub of wall extending north from the southern wall in front of the opening to the oven which he believed was built to protect the oven from draft. Considering that ovens appear to have opened up into external spaces, and no traces of reed matting were found, which were usually found in internal spaces, this suggestion seems plausible.

The architectural remains in level 5 were the most extensively excavated at the site, and consist of at least two separate structures. Braidwood (1983a: 161) suggested that there may have been three structures based on the criteria that each building would have had an oven-like installation. The southernmost building, which will be referred to as Structure A, consisted of what appears to have been nine separate spaces, of which at least seven were internal. Apart from a linear stone foundation of uncertain function that ran along the exterior of the southern wall, all walls were made of *tauf/chineh*. The eastern rectangular space (*c* 5.25 x 2 m) had at some point been sub-divided; the remains of a *tauf/chineh* wall built on top of the reed matting on the floor was found about 2.10 m from the northern wall. Due to the fragmentary nature of the wall it is not clear whether there had been a ground level doorway providing access between the spaces. Braidwood (1983a: 161) has stated that this wall was subsequently moved further south. It appears that this reconfiguration of space occurred in level 4, which, in the southern part of the trench, appears to have been separated from the remains in level 5 by some difference in elevation. Another structural reconfiguration in level 4 was the movement of the northern wall of this space further north.

In the eastern wall of what was the southeast space in the later phase there was a gap in the wall where two flat stones had been laid down and covered with reed, and since only structural collapse was found above it Braidwood (1983a: 161) suggested that it may have been a doorway. The best preserved example of a doorway was the one found in the southern part of the western wall of the same space. It led into a narrow rectangular space (*c* 0.90 x 2.90 m) that appears to have connected the southeast space with the southwest space. North of this narrow space was a series of four small spaces, none of which had any discernible entrances. The southern two of these four spaces measured about 2 x 1.15 m, whereas the two northern ones were smaller, measuring approximately 1.75 x 1.15 m. The wall dividing the two northern spaces was quite fragmentary and had been built on top of the reed flooring, which indicates that it may have been a later addition. There was also reed matting on the floor in the southeast central space, but not in the southwest central space. An oven-like fire installation was located in the southern part of the latter space, which may explain the lack of reed matting. The possible oven appears to have been constructed in a similar manner to the oven in level 6 with a ‘scoop-like’ opening through the western wall. The size and extent of the two western spaces are uncertain as only parts of the walls extending westward had been preserved. Fragments of reed flooring were found in the northwest space, thus it is possible that it had been at least partially roofed. The southwest space, on the other hand, appears to have been an external, at least partially walled space with a simple, compacted earth floor on which were found numerous fragments of ground stones.

The original layout of the structural remains in the central part of the trench is less clear than for Structure A. There was a separate *tauf/chineh* wall running along the eastern part of the northern wall of Structure A, north of which was a floor consisting of a series of five parallel linear lumps made of *tauf/chineh* and covered with reeds. The floor was flanked by cobble stone foundations to the east, north and west, and immediately north of it was a similar, albeit very fragmented, floor flanked by a cobble stone foundation to the west. It is uncertain whether the two floors represent different spaces within the same structural configuration. Braidwood (1983a: 162) argued, through comparison with Çayönü (southeast Anatolia), that this type of floor construction was intended to make the floor less cold during the winter. There were some fragmentary remains of linear lumps of *tauf/chineh* covered with reeds immediately west of the most complete floor and north of Structure A, which indicate the possibility that this area used to be part of a structure. The remains of an oven-like feature (in the central part of the trench) that had been covered with reeds when it was no longer in use may support this assumption. West of the oven-like feature were the fragmentary remains of two potential spaces (aligned north-south) that had been built after the possible oven was no longer in use and had been covered with reeds. There appeared to have been a ground level entrance in the southern part of the eastern wall of the southern space (*c* 1.75 x 1.40 m), and another ground level doorway in the northern wall of this space led to another space. It is not clear whether the latter was an internal or external space due to the fragmentary remains of the *tauf/chineh* walls in the western part of the trench. The eastern wall extended about 2 m northwards from the south space, and it is therefore possible that the north space would at least have been partly enclosed. It is unclear from the published reports whether the eastern wall had been preserved in its entirety, or if it extended in any directions (northwards or westwards). North of this wall, and extending to the west, is what Braidwood (1983a: 162) described as a 2 m thick L-shaped feature made of 'low-grade, trash filled' *tauf/chineh*. However, without any further information it is not possible to ascertain this, and it is possible that it may have been an area with a higher concentration of architectural collapse rather than a distinctive feature.

In the northern part of the trench, immediately east of the L-shaped accumulation of *tauf/chineh*, there were two small spaces aligned east-west. The western space measured approximately 2 x 1.60 m, whereas the eastern one was only slightly larger, measuring about 2 x 2 m. Apart from the reed flooring there were no discernible features or finds found within the eastern space. In the southern part of the western space a quern had been placed on its end on the floor and in the northwest corner were the remains of an oven-like installation. The reed flooring had been bedded against it and it appeared that the opening for the oven was through the western wall as was the case with the other examples excavated in levels 6-5. To the north of these two spaces there appears to have been an outdoor area containing a pile of refuse with numerous fragments of stone bowls and pestles.

5.5: Modelling scenarios

The remainder of this chapter examines the structuring of built space in levels 7, 6d-b and 6a in trench I, and level 5 in trench II. Due to the nature of preservation of some of the structural remains found in these levels parts of some of the walls were reconstructed during the digitising process (see Appendix B, Figure 3.2 for conventions). These reconstructions were made in cases where walls were only partially preserved but their original extent (thickness and length) could be reasonably reconstructed based on the parts of the walls that had been preserved, the nature of complete walls (e.g. thickness, direction, angle of corners and so on) within the same structural unit, as well as the extent of internal floor surfaces (i.e. reed matting). A consideration of possible structural configurations is discussed in cases where the original extent of walls or other structural remains could not be reconstructed based on the available evidence.

Each level will be discussed separately focusing on the potential size of co-resident groups, the types of activities and interactions that may have taken place within the various spaces, the affordance of space for animals, and the potential storage capacities of internal spaces. For the purpose of modelling, the individual spaces in each level were assigned separate numbers (referred to as S followed a number), which is outlined at the start of each relevant section together with an assessment of access into, and movement between, the various spaces (sections 5.5.1, 5.5.2, 5.5.3, and 5.5.4). Following this, the potential scale of co-residency and co-presence is assessed for each space through the modelling of contextualised maximum capacities of Size A and Size B adults sleeping and sitting cross-legged (sections 5.5.1.1, 5.5.2.1, 5.5.3.1, and 5.5.4.1). This provides the basis for the subsequent discussion concerning possible activity areas and the potential use of the various spaces (sections 5.5.1.2, 5.5.2.2, 5.5.3.2, and 5.5.4.2). As discussed in section 5.2, there was little or no *in situ* artefacts found, and the discussions concerning the spatial patterning of activities therefore rely primarily on the presence of built features and the affordance of space for co-presence. This general scarcity of *in situ* artefacts may be partly due to buildings being kept clean, but perhaps to some degree also the excavation methods (section 5.2). The discussion of the use of space also assesses whether the built environment accommodated the co-presence of animals. The final part of this chapter considers the potential storage capacities of the various internal spaces, which will be assessed for both grains for human consumption and animal fodder (section 5.6).

5.5.1: Trench I, Level 7

The various spaces in level 7 were assigned separate numbers from 1 through 8, which are as follows: the three smaller spaces aligned north-south in the southwest part of the trench are, from south to north, S1, S2 and S3; S4 is the external space in the southeast part of the trench; S5 is the possible courtyard immediately north of S4; S6 is the central space containing an oven; S7 is the northeast space; and S8 is the northwest space containing an oven (Figure 5.2). It is possible that S1 was a southward extension of S2, but due to the poor preservation of the walls this cannot be verified and they were given separate numbers.

It is difficult to assess the movement between the spaces due to the restricted horizontal exposure and the level of preservation. Due to the fragmentary nature of most walls and the fact that their original heights have not been preserved, the possibility of raised doorways, portholes, or access from the roof into some of the spaces cannot be excluded. There was a possible doorway into S3 from the west and a potential entrance into a narrow corridor that may have provided access into S6 from the west (between S3 and S8). It is also possible that there was an opening in the southern part of the eastern wall of S6 as only a small portion of it was excavated in the trench. S2 may have been accessed from S1 and/or S4, although due to the poor preservation it is not possible to assess whether access may have been through a ground level or raised entrance. Parts of S4, S5, and S7 are located outside the trench and most of S8 has been eroded, which makes it possible that access were at ground level from the east into S4, S5 and S7, and from either south, west, or north into S8. It is possible that direct access between most of the spaces in level 7 was not required, although it is equally possible that movement between S5, S6, and S7 occurred in the area to the east of the trench. If S8 was originally entered from the south, then it is possible that access into S3 and S6 was required by individuals also utilising S8. Additionally, it is possible that the architectural remains constituted at least two structural units, perhaps centring on one or more shared spaces, if S1-S3 were part of a different structural unit, possibly extending further west, than S8 and that S5-S7 were connected in the area east of the trench.

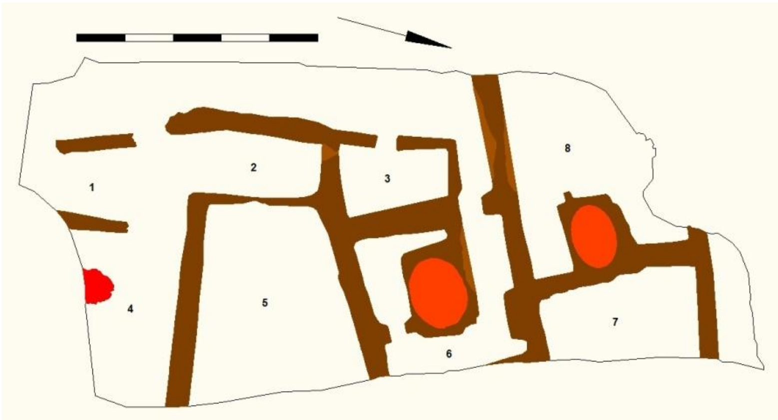


Figure 5.2: Plan of level 7 with space numbers.

5.5.1.1: Contextualised maximum capacity

The maximum number of Size A and Size B adults that can sit cross-legged and sleep in each of the spaces is summarised in Table 5.1 (Figure 5.3). Maximum capacity was not modelled for S6 as the presence of the oven and the space left around it may have precluded it from being a suitable space for people to gather or sleep in, although it is wide enough for one adult (Size A or Size B) to sit cross-legged or lie between the walls and the oven if required. Since only the eastern and western walls of S1 have been preserved, and the extent and form of this space is not known, the number listed in Table 5.1 is the number of adults that could fit in the area between the preserved walls.

S5 was the largest space as it could have accommodated at least fourteen Size A or eleven Size B adults sitting cross-legged and may thus have been used for larger social gatherings if required. Additionally, there was enough room for thirteen Size A or ten Size B adults to sleep, which indicates that it may have provided sleeping space for a number of people during the warmer months since it appears that this space was an at least partially walled courtyard (section 5.3). The smaller spaces, S1, S2 and S3, could accommodate between three and four seated adults, though there would not have been much room left over for any kind of movement, such as that required for sitting down or getting up again. It may be that these spaces were better suited for storage and/or activities involving one or two individuals.

S1 and S3 could only accommodate two adults (Size A and Size B) sleeping, which may support the assumption that they may not have been used as living spaces.

Space	Sitting cross-legged		Sleeping	
	Size A	Size B	Size A	Size B
S1	4	3	2	2
S2	4	3	4	4
S3	4	3	2	2
S4	7	5	6	6
S5	14	11	13	10
S6	-	-	-	-
S7	8	5	6	5
S8	10	8	8	6

Table 5.1: Modelled contextualised maximum capacities for level 7.

S2 had room for up to four adults (Size A and Size B) sleeping, which may indicate its potential use as a living space. However, the scatter of bone, horns, antler, stone objects and flint blades found in S2 may suggest that it was, at some point at least, used for manufacturing purposes and/or storage of, for example, raw materials. Based on the assumption that this space was, at least partly, a work space, the modelling took into account two different scenarios. In the first scenario, people were seated facing each other oriented north-south. This would accommodate more space in front of the individuals if they were working, or, alternatively, provide room for storage in the inner part of the space. If two Size B adults were working in S2 while seated opposite each other, this would leave 0.30-0.35 m on either side of each person and up to 1 m between them. There is enough space for another person between them, but this positioning may not have been conducive to work (or social interaction). Alternatively, four Size A adults could fit into S2 if seated two and two opposite each other at a distance of up to 1.40 m. This would, however, only leave a few centimetres between the people sitting next to each other and between them and the walls. Another two Size A adults could have been seated in S2, but, as was the case with the Size B scenario, this would have resulted in awkward working positions. In the second scenario, people were seated along the eastern wall facing the opposite wall, which may have accommodated work that did not require too much elbow room while still allowing movement along the western wall. Four Size A adults could be seated in this manner (spaced about 0.09 m apart), which would leave 0.45-0.61 m between their knees and the western wall provided they sat with their back against the wall. Alternatively, three Size B adults could sit along the western wall (with about 0.20 m between them), which would leave 0.40-0.47 m between their knees and the opposing wall. These two scenarios indicate that activities occurring in S2 were perhaps restricted to between one and four adults.

The spatial configuration of S3 was not as regular as S2 as the southern wall was wider (*c* 1.53 m) than the northern wall (*c* 0.98 m). If people were sat facing each other, then three Size A adults (two by the southern wall and one by the northern wall) could fit. This arrangement may have allowed the performance of tasks requiring some movement while at the same time not blocking access into and out of the space. Alternatively, four Size A adults could fit seated in various locations: two by the southern wall and two by the eastern wall; three along the eastern wall and one in the southwest corner; or two by the southern wall, one by the eastern wall, and one by the northern wall. In the latter scenario the person seated in the southeast corner would not be able to leave the space without inconveniencing the people sitting next to her/him, whereas the former two scenarios would allow for all four individuals to enter and leave S3. Three Size B adults could also fit into S3, either along the eastern wall, or two by the southern wall and one by the northern wall. The former scenario would have allowed some space between the individuals and movement into and out of the space, whereas the latter would have meant that the two individuals seated by the southern wall would have to sit with their knees pressed against the walls and each other.

The original maximum capacities for S4, S7 and S8 are difficult to ascertain since they were not fully excavated, and thus the numbers listed in the table are those that can fit into the space within the excavation area. S4 appears to have been an external space (section 5.3) that may have accommodated at least seven Size A or five Size B adults sitting cross-legged, or six adults (Size A and Size B) sleeping. As it is possible that S4 extended further south and east, this may indicate that activities that took place in this area (e.g. associated with the use of the hearth) may have involved a number of people. It may also have provided a place for people to sleep during the summer, as was the case with S5. The nature of S7 and S8 are more ambiguous, although it is possible that S8 was an internal space as the later structural phases of this space (i.e. levels 6d-b and 6a) were (section 5.3). It could accommodate at least ten Size A or eight Size B adults sitting cross-legged, or eight Size A or six Size B adults sleeping, which indicates that it may have been a living space. S7 may have been an at least partially enclosed, possibly unroofed space, as it appears to have been an external space in the subsequent structural phase (i.e. level 6d-b). It may be that the opening for the oven located in the eastern part of S8 was through the wall into S7, which, if Braidwood (1983a: 157) is correct in assuming that ovens generally opened up into external spaces, may support the suggestion that S7 was an outdoor area. There was room for at least eight Size A or five Size B adults sitting cross-legged, or six Size A or five Size B adults lying down, and it is possible that it accommodated a range of interactions involving a number of people. It may also have provided a place for people to sleep during the summer, assuming that it was an external space.

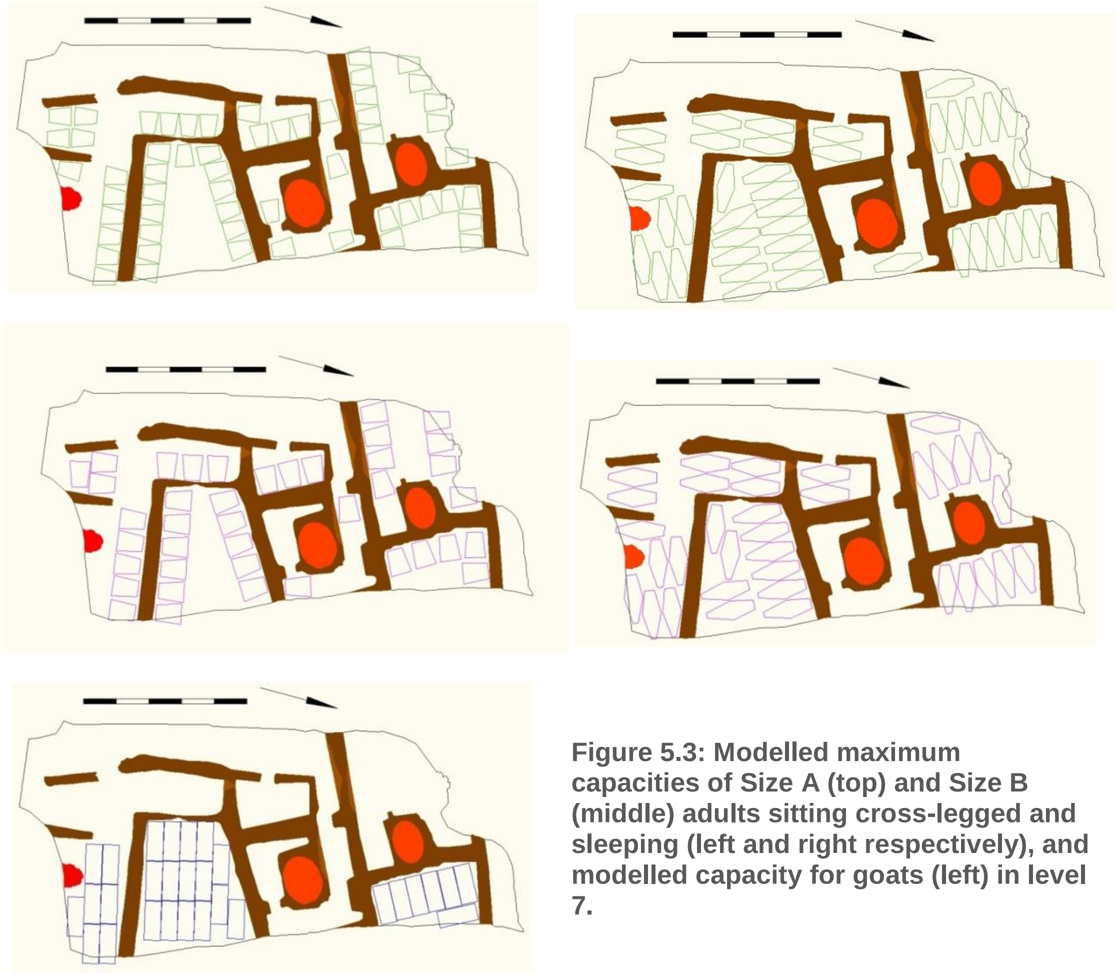


Figure 5.3: Modelled maximum capacities of Size A (top) and Size B (middle) adults sitting cross-legged and sleeping (left and right respectively), and modelled capacity for goats (left) in level 7.

5.5.1.2: The use of space

The location of food-related activities is often indicated by the presence of fire installations and/or ground stone implements (section 3.3.1). The precise use of the ovens found at Jarmo is uncertain, but it is possible that they may have been related to some form of food preparation, such as popping cereal grain husks (Helbaek cited in Braidwood 1983a: 157), extraction of fat or vegetable oils (Zohary cited in Braidwood 1983a: 166), or cooking (as at Aliabad; Kramer 1982: 99-100). Three of the spaces in level 7 contained either a hearth (S4) or an oven (S6 and S8, but opening up into S7), and it is possible that some food-related activities may have taken place in association with these. The discussion of maximum capacities in the previous section indicated that most of the spaces in level 7 were large enough for at least two individuals to have been co-present. In S6, where there is a restricted amount of space between the wall and the oven, there is still enough room to allow access and movement for a Size A or Size B adult. It is possible that certain tasks were performed in this space, possibly related to the use of the oven; two people could have worked positioned at either side of the opening of the oven. Alternatively, if the eastern wall was not a fully enclosing wall and access was possible from the east, three people may have been able to participate.

The oven in S8 is believed to have opened up into the potential courtyard S7 which may have afforded space for a number of individuals to participate in activities related to the use of the oven, either positioned along the northern and southern walls, or in front of the opening to the oven. S8 may have afforded space for a range of domestic activities, including food preparation, eating, and entertaining guests. The oven may also have provided a source of heat during colder periods of the year, and it is possible that S8 was a living space. There were no *in situ* artefacts or other internal fixtures in this space, thus the nature of the activities that may have taken place in it cannot be ascertained. Another fire installation is the hearth in S4, which indicate that activities associated with the preparation and cooking of food may have taken place there. There was room for at least four or five individuals to sit cross-legged, squat or kneel, and there may have been room for more people to be present within the space, especially if it extended further outside of the trench.[47] It was also possible for an adult to sit, squat or kneel between the hearth and the eastern wall of S1, which may have provided a space for someone to cook without obstructing movement in the rest of the space, and the wall may have provided shade against the sun or wind if required. It appears that the three fire installations excavated in this occupational phase were either located in external areas (the hearth in S4), or used in spaces that were not living spaces (the oven in S6 and the oven opening up into S7). It is possible that the smoke from such features, and in particular open hearths, was an undesirable feature that the inhabitants did not want in their living spaces.

S1, S2 and S3, did not contain any items related to food preparation, however, this does not mean that food-related activities could not have take place in them as items such as ground stones may have been removed prior to abandonment, or perhaps stored elsewhere. The full extent of S1 is not known, nor is it certain that the two parallel walls that were preserved constitute the remains of a fully enclosed space. Nevertheless, S1 may have afforded space for one or two working individuals. Alternatively, its location next to S4 may indicate that it was used for storage of, e.g. food stuffs, cooking related items, or fuel, needed for the activities taking place in S4. The potential function of S2 has already been discussed in connection with maximum capacities; it is possible that it was used for manufacturing activities involving one to four individuals, and/or as a storage area, at least in the period immediately prior to the abandonment of the structure. This does not, however, preclude it from having been used as a living space for a smaller co-resident unit.

The discussion regarding maximum capacities in S3 also addressed some issues regarding possible function; the size and spatial configuration of the space put certain constraints on how many people could have been in the space at any one time, as would the presence of

[47] This was not modelled as the space inside the trench could already accommodate a number of people, indicating that several individuals may have been involved in activities taking place there.

any stored items. It may have accommodated up to four working individuals, although if it was used for both storage (e.g. along the walls so as not to block movement) and work (perhaps utilising items and materials stored in it) then it may be that only one, or perhaps two, people could have been present. If it was used for storage, this may have been items or materials used in activities taking place west of S2-S3, or perhaps in S6, although this would necessitate a point of access through the narrow corridor between S3 and S8. There was a limited amount of space around the oven in S6, which suggests restricted storage capacity, if any, and it may be that S2 provided the storage facilities that S6 did not have. S6 may also have been accessed from S5 through an entrance in the eastern wall as it is not known whether this wall fully enclosed S6 or not. It is therefore possible that the use of S6 was related to the activities occurring in S5.

The size of S5 and lack of features may allow for a range of activities to have taken place there as it could accommodate the co-presence of at least fourteen individuals, although it is not possible to ascertain the specific nature of these activities. If it is assumed that it was a courtyard similar in nature to those observed in ethnographic studies from the Zagros region (e.g. Kramer 1982; Watson 1979), it may have been multi-functional, including not only domestic activities, but also general socialising and entertaining guests, storage, and animal penning. The amount of space that was used would therefore depend on the type of activities taking place. For example, people might be seated in a circle when eating and socialising, or along the walls when undertaking work, which would offer support for the back and/or shade from the sun during the summer. If various items or materials were stored in S5 then these may have been placed along the walls or at the inner part of the space so as not to block access or restrict movement, and thus people engaged in various activities would not sit where the stored materials were. It may also have been used to pen animals[48], such as during the night, adverse weather conditions, and/or in lambing season; it was large enough for at least fifteen goats to be kept in it (Figure 5.3). S4 and S7 may also have been used as pens as they had room for a minimum of seven goats each. However, the presence of the hearth in S4 may have made this a less desirable option.

5.5.2: Trench I, Level 6d-b

Some of the wall remains in level 6d-b are quite fragmentary, but the structural configuration appears to include at least seven spaces that were assigned separate numbers from 1 through 7 (Figure 5.4). S1 is the external space in the southern part of the trench (S1 and S4 in level 7); S2 is the southwest space northwest of the western part of S1 (S2 in level 7); S3 is the possible courtyard north of S1 (S5 in level 7); S4 is the central space (S6 in level 7); S5 is the space west of S4 (S3 in level 7); S6 is the northwest space (S8 in level 7); and S7 is the northeast space (S7 in level 7). It is unclear if the western part of S1 was originally a

[48] Even if it was not fully enclosed, a temporary fencing could have been made from, e.g. brushes.

separate space as in level 7 due to the fragmentary nature of the *tauf/chineh* walls, and the entire area is therefore treated as a contiguous space. S2, S4, S5 and S6 have reed flooring which indicates that they were internal spaces, whereas S1, S3 and S7 had simple earthen floors, fire installations, and accumulations of refuse, which suggests that they were external areas.

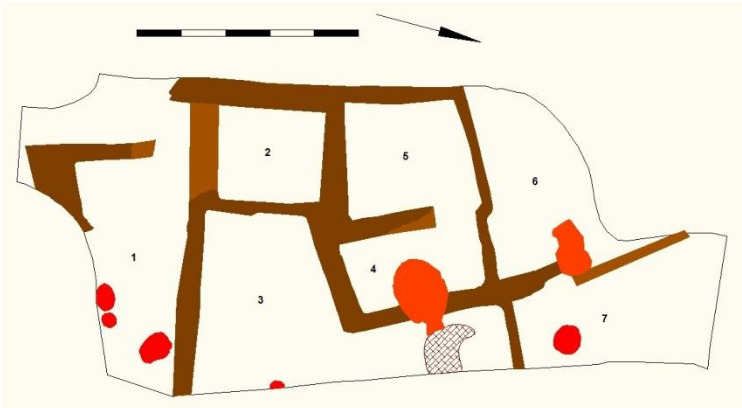


Figure 5.4: Plan of level 6b-d with space numbers.

As with the preceding level 7, there are difficulties associated with determining movement between the various spaces due to the fragmentary nature of the walls. The only clear doorway is in the northern part of the wall separating S4 and S5, which indicates that the two spaces may have been functionally linked. It may have been possible to move from S1 into S2 and on into S5, and maybe further into S6; however, due to the fragmentary nature of the walls separating these spaces this is only a suggestion. As only parts of S3 and S7 are located within the trench, it is possible that these spaces were accessed from the east. Access into S6 and S7 may have been from the north, or from the west into S6, in which case it may be that these two spaces were part of a different structural unit (possibly including spaces originally located to the north of the trench) than S1-S5. It may therefore be suggested that the structural remains in this level originally constituted two buildings that shared walls (between S4-S5 and S6, and S3 and S7), and that different (but perhaps closely related) social units resided in each structure.

5.5.2.1: Contextualised maximum capacity

The maximum numbers of Size A and Size B adults that can sit cross-legged and sleep in the various spaces are summarised in Table 5.2 (Figure 5.5). Maximum capacities for sleeping in S1, S3, S6, and S7 have only taken into account the portions of the spaces located within the trench, and should therefore be regarded as minimum numbers.

Space	Sitting cross-legged		Sleeping	
	Size A	Size B	Size A	Size B
S1	10	9	9	7
S2	10	6	5	4
S3	16	12	15	12
S4	4	4	4	3
S5	12	9	7	6
S6	11	10	8	7
S7	6	5	7	5

Table 5.2: Modelled contextualised maximum capacities for level 6d-b.

Since S1, S3 and S7 extended beyond the excavated area, it is not known whether they were fully or partly enclosed courtyards, or open areas, perhaps apart from S3 which was enclosed on at least three sides. As only limited parts of S1 and S7 were located within the trench it was decided to assess the number of adults that could have sat around the hearths as if engaged in activities associated with their use, as well as along the western wall in S1, rather than model maximum capacities in the same manner as has been done for the other spaces. Both spaces were potentially large enough to allow the co-presence of a number of people; S1 could accommodate at least ten Size A or nine Size B adults sitting, whereas there was room for a minimum of six Size A or five Size B adults sitting in S7. It is possible that these spaces may have been used for sleeping during the summer, as S1 could accommodate nine Size A or seven Size B adults sleeping, and S7 had room for seven Size A or five Size B adults sleeping. The possible courtyard S3 may also have served a similar function during the summer as it afforded space for at least fifteen Size A adults or twelve Size B adults sleeping, perhaps more depending on its original size. In S3 the maximum capacities were modelled for the southern part of the space only, as it is assumed that people would avoid sitting or sleeping in the accumulation of refuse outside the oven. The space may still have accommodates at least sixteen Size A or twelve Size B adults sitting cross-legged, which indicates that the space had room for a range of activities to take place, including food-related activities and social gatherings possibly involving different social units (e.g. when holding meetings, or celebrating various festivities).

The remaining four spaces, S2, S4, S5 and S6, appear to have been internal spaces, and S2, S5, and S6 were all large enough to accommodate the co-presence of a number of people. S2 was the smallest of the three with room for ten Size A or six Size B adults sitting cross-legged, and five Size A or four Size B adults sleeping. This indicates that S2, S5, and S6 had the potential to be living spaces for social units consisting of three to eight individuals. The presence of the oven in S4 would have restricted the amount of people that could have been present in the space at any one time. There was enough room for two adults (Size A and Size B) to sit at either side of the oven, or four Size A or three Size B adults to sleep. However, these scenarios depend on whether S4 was used for storage, and/or if the oven was in use and how much heat it radiated into the space, as it might have been uncomfortable to sit or lie down too close to it.

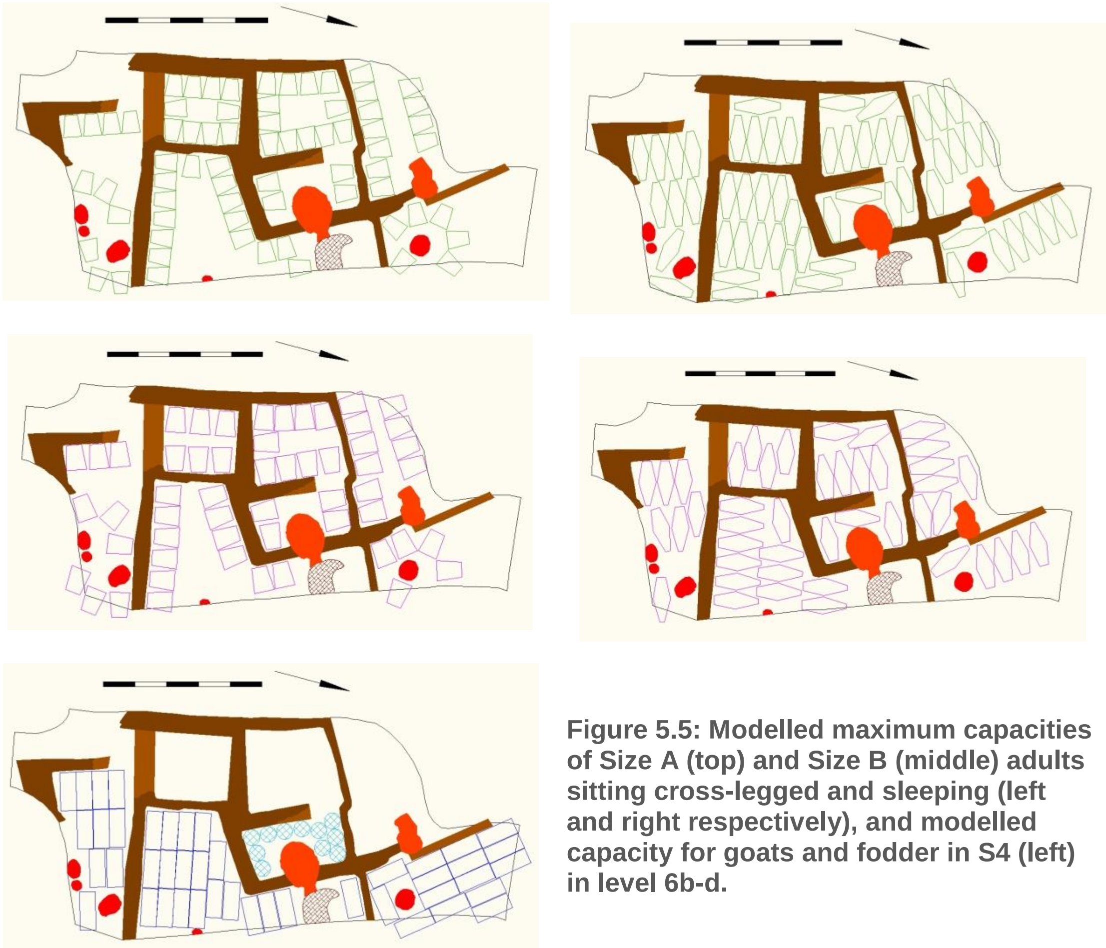


Figure 5.5: Modelled maximum capacities of Size A (top) and Size B (middle) adults sitting cross-legged and sleeping (left and right respectively), and modelled capacity for goats and fodder in S4 (left) in level 6b-d.

5.5.2.2: The use of space

The archaeological remains in level 6d-b offer more evidence for food-related activities than in the preceding level 7; there are seven fire installations, of which two are possible ovens and five are hearths. All of the hearths are located in external spaces (S1, S3 and S7) and the ovens, even though they are located in internal spaces (S4 and S6), open up into external areas (S3 and S7 respectively). This follows the pattern observed in the preceding level 7 where activities associated with the use of fire installations appear to have taken place in external spaces. There is a cluster of three hearths in S1, around which at least six adults would have been able to sit, squat or kneel, with room for at least another three adults if the space extended further south. This indicates that the activities that took place there may have involved a certain degree of co-operation and social interaction. The hearths may also have provided a focal point for social gatherings not related to work, e.g. during and after the consumption of food, perhaps providing a source of heat during cooler evenings in the spring through autumn. The walls in the southwest corner may have provided shade in the day during warmer months, and/or, if it had been partially roofed, some shelter if it rained. Alternatively, it may have been used as a storage area for fuel or implements utilised in S1 (e.g. related to cooking activities). Depending on its original extent the space may have been large enough to accommodate a range of activities taking place at the same time in addition to storage. On the other hand, if S1 did not extend much beyond the excavated area, fewer people may have been able to be present at the same time, in which case the activities taking place there would have been less inclusive and more private.

The other external spaces, S3 and S7, both contain a hearth and had ovens opening up into them. They may originally have been quite large in size compared to the internal spaces, and may have had room for a substantial number of people to be present at any one time. There was space around both hearths for at least three (Size B) or four (Size A) adults to sit, squat or kneel – more if the spaces extended outside the trench. Additionally, the ovens could easily be accessed by one or more individuals without interfering with the use of the hearths. S3 may have accommodated a wide range of activities within an (at least partially) enclosed space, including food preparation and cooking, eating, sleeping during the summer, and storage. The accumulation of ash and other refuse (e.g. animal bones) outside the oven may be related to the use of the oven (e.g. rake out), and may suggest that food preparation and cooking took place in this space. Both S3 and S7 may also have been used for penning animals; there were enough space for at least nineteen goats in S3 and fifteen goats in S7 (Figure 5.5). However, the hearths would in this case have had to be covered to avoid the animals trampling into them, and it is possible that any penning that occurred there was only short-term, such as during kidding and lambing season (section 3.3.4). S1 is perhaps less likely to have been used for penning animals – although there is enough room for ten goats – as it appears to be a well-defined cooking area.

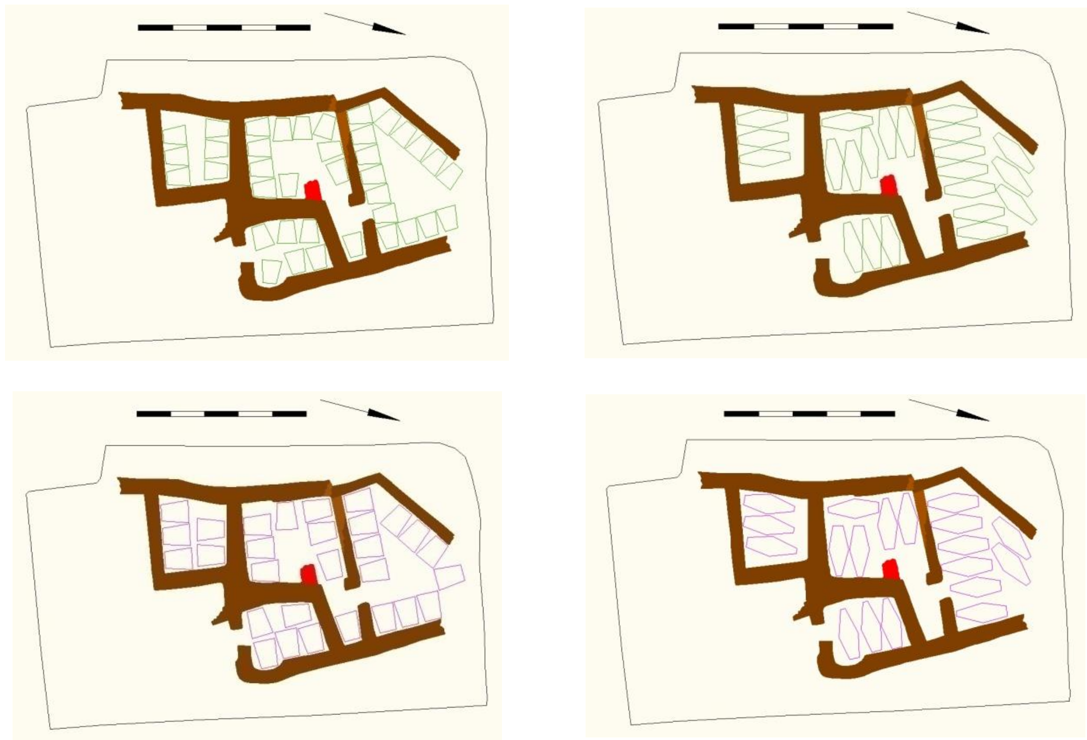
The maximum capacities of S2, S5 and S6 discussed in section 5.5.2.1 indicate that these internal spaces may have accommodated social gatherings and provided sleeping spaces, and in that sense it is possible that they were living spaces. This also indicates that they were large enough to facilitate a range of domestic tasks, including food-related and manufacturing activities. S4 appears less suited for living purposes due to the presence of the oven, and it may be that this space provided storage and/or work space as it could have afforded space for an adult to work comfortably on either side of the oven. It is possible that stored items were placed in the inner part of the space (south of the oven) while the northern end (by the entrance into S5) provided an area for one or two working individuals. This scenario allows for unobstructed movement into and around the space and access to the stored materials.

S2 is also somewhat smaller than S5 and S6, and, although there was room for six (Size B) to ten (Size A) co-present adults, there would not have been much room for movement. If it was a living space, then perhaps only two to four individuals may have resided together in this space. Alternatively, it may have been a work space for particular domestic tasks, such as food-related and/or production activities, or tasks considered to be 'dirty' or that produced a significant quantity of debris (e.g. flint knapping) and needed to be kept separate from living and cooking areas. It may also have been used as a storage space, or a combination of storage and work space as suggested for S4. Additionally, as there is no apparent source of heat it may not have been considered 'suitable' as a general living space. If outdoor areas provided more ideal spaces for spending most of the time during warmer months, internal spaces may have served as living spaces when it was colder. The ovens in S4 and S6, although they open up into external spaces, would have provided some heat, and, in the case of S5, the doorway into S4 may have allowed the distribution of heat from the oven into S5 making it more attractive as a living space. S5 is also larger than S2 with room for at least six adults to sleep and at least seven people to be seated comfortably, and may have accommodated a number of people engaged in a variety of activities (e.g. eating and socialising, sleeping, or working). Similarly, S6, although not fully preserved, appears to have been large enough to allow for a range of activities; at least seven adults could sleep there, a few more could comfortably have gathered there (eating, socialising, or working), and the oven would have provided a source of heat if needed.

5.5.3: Trench I, Level 6a

The structural remains in level 6a are less extensive than in the preceding phases, but appear to have consisted of five spaces, which were assigned separate numbers from 1 through 5 (Figure 5.6). S1 is the southwest space (S2 in level 6d-b); S2 is the southeast space; S3 is the space north of S1 and west of S2 (S5 in level 6d-b); S4 is the small space north of S2 and east of S3; and S5 is the northern space (S6 in level 6d-b). The reed flooring found in S1 and S5 indicate that these were both internal spaces, whereas it is assumed, based on its size, that S2 was also an interior space. It is possible that S3 was an unroofed or partially roofed courtyard due to the presence of a hearth by the eastern wall. If it was not a courtyard, the placement of a heart in an internal space differs from the pattern observed in all the other excavated buildings where hearths are located in external areas (open and enclosed), and ovens opened up into possible courtyards.

There is more evidence regarding access into and movement between the various spaces in level 6a than in the previous levels with three ground level doorways and one possible raised entrance or porthole. The latter (possibly around 0.90 m wide) is located in the western part of the wall separating S1 and S3. At the northern end of the eastern wall in S3 there appears to have been a ground level entrance leading into S4 and one leading from S4 to S5. Another ground level doorway is located in the southern wall of S2, although it is not clear whether it was an entrance into another internal space or an external area as there were no structural remains preserved in this part of the trench apart from the fragmentary remains of a possible wall extending south from the southern wall of S2, immediately west of the doorway. It may be that S2 formed part of a structural unit that originally extended further southwards; there does not appear to have been any direct access between S2 and the other spaces (between which movement was accommodated), which may indicate that they were part of two different structural units in terms of function, or that different social groups resided in each as was suggested for level 6d-b.



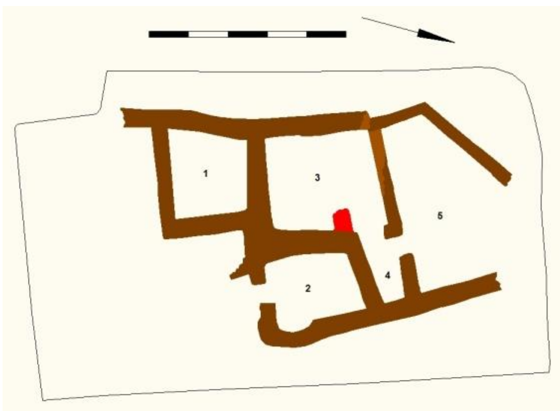


Figure 5.6: Plan of level 6a with numbered spaces (bottom left). Also showing modelled maximum capacities of Size A (top) and Size B (middle) adults sitting cross-legged and sleeping (left and right respectively) in level 6a.

5.5.3.1: Contextualised maximum capacity

The maximum number of Size A and Size B adults that could sit cross-legged and sleep in the various spaces are summarised in Table 5.3. S4 has not been included as it was a small space that appears mainly to have provided access between S3 and S5, and potentially some storage space in the eastern part. There is enough room for one adult (Size A or Size B) to sit in S4, but this would have blocked access between S3 and S5 (Figure 5.6).

Space	Sitting cross-legged		Sleeping	
	Size A	Size B	Size A	Size B
S1	6	5	3	3
S2	6	5	3	3
S3	10	7	6	5
S5	15	11	10	8

Table 5.3: Modelled contextualised maximum capacities for level 6a.

All of the spaces apart from S4 afforded space for at least six Size A or five Size B co-present adults, although if the maximum number of adults were sat in S2, there would not have been much room left for movement, regardless of whether they were only socialising or engaged in any kind of work-related activity. Additionally, S2 could only accommodate three adults (Size A or Size B) sleeping with limited amount of space left over, and it appears that this space may have been more suitable for storage and/or activities involving perhaps between one and three individuals. The same number of adults could sit and sleep in S1, although the layout of the space meant that there would have been more room left over than was the case in S2, and it is possible that S1 may have been used as a living space. S3 and S5 were larger and could accommodate at least five and eight (both Size B) adults sleeping respectively, and may have provided more comfortable arrangements than S1 and S2. There was room for ten Size A or seven Size B adults to sit in S3, and fifteen Size A and eleven Size B adults to sit in S5. This may indicate that these spaces could have accommodated larger social gatherings (e.g. during food consumption, or when entertaining guests) than the other spaces, and it may be that S3 and S5 are more likely to have been living spaces than S1 and S2. If S3 was originally an unroofed courtyard then it is possible that it served as a sleeping space during warmer months and S5 during the winter for one co-resident unit consisting of up to six individuals.

5.5.3.2: The use of space

There is limited evidence available indicating the particular types of activities that may have taken place in the individual spaces; only one possible hearth was found and there is no mention of *in situ* artefacts, and thus the discussion is informed by the size and layout of the various spaces. As mentioned in the preceding section, S2 may have been used for storage purposes, and provided some space for undertaking tasks that involved the materials stored in the space, such as food processing or manufacturing activities. Another possible storage and/or work space is S1, perhaps associated with the activities that took place in S3. Raised entrances (over 1 m above floor level) have been observed in some buildings at the village of Aşvan, which were a means of preventing rodents accessing the produce that was stored in the structures (Weinstein 1973: 272). It is possible that the raised entrance or porthole between S1 and S3 could be an indicator that food was stored in S1, especially considering that all the other entrances in this level were at ground level (see also Braidwood 1983a: 158). If this was the case then it may be that the stored food was processed and cooked, as well as consumed, in S3; the possible hearth in S3 indicates that food preparation and cooking may have taken place there. It is also possible that S1 was a living and/or working space as it could accommodate the co-presence of six adults and a co-resident group consisting of up to three individuals. If it provided a living space for two or three people, it may be that S3 provided a space for social interaction between two social units (i.e. those residing in S1 and S5).

S5 afforded space for at least six adults to sleep, although the potential size of the co-resident group would have depended on the original form and size of the space. Another factor influencing this is the fragmentary *tauf/chineh* remains in the western part of the space, which may be the remains of walls, low curbs, or a platform or bench. However, there is no further information available regarding this possible feature(s) and it is therefore not possible to assess the impact it may have had on the use of space. If these remains were in fact one or more internal feature, it may indicate that certain parts of S5 were differentiated from the rest of the space, perhaps in terms of function, e.g. a bin or a small space used for storage, or a platform for sleeping or craft activities. It is also possible that this ‘feature’ was constructed towards the end of the space’s use-life and may not reflect the use of space in the earlier phase of the structure. S2 appears mainly to have provided access between S3 and S5, but may have been used for some storage in the eastern part. There is enough room for a person (Size A or Size B) to have sat, squatted, or knelt at the eastern end of the space if required, but this would have severely restricted movement associated with, for example, sitting down, or getting back up. A person could also have sat, squatted or knelt in the western part of S4, but this would have blocked movement between S3 and S5.

5.5.4: Trench II, Level 5

The fragmentary nature of the archaeological remains in the northern part of the trench does not allow an accurate reconstruction of the architecture in this area (section 5.4), and the following discussion will focus on Structure A. A few brief observations can, nevertheless, be made regarding some of the remains north of Structure A (Figure 5.7): the possible space immediately north of Structure A afforded space for ten Size A seated or six Size A sleeping adults, and may have been multi-functional, including serving as a living space; the two spaces in the northern part of the trench had room for four Size A adults sitting or two Size A adults sleeping each, and although they may have served as living spaces for two individuals, they were perhaps better suited for work and/or storage purposes; and the two potential spaces in the western part of the trench could accommodate two Size A adults sleeping, or three (northern space) or four (southern space) Size A adults sitting and may perhaps have been work and/or storage spaces. The layout of individual spaces – both in Structure A and those north of it – appear to have been more regular than in the trench I levels, and although different buildings may not have shared walls as in level 6d-b and possibly level 6a, they may still have been clustered together.

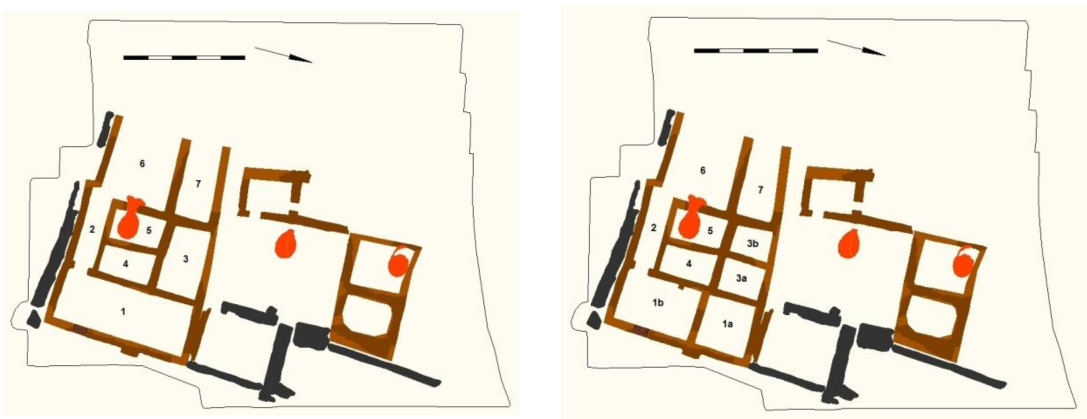


Figure 5.7: Plan of the earliest (left) and latest (right) phase of level 5 with space numbers.

Structure A consisted of seven spaces, numbered 1 through 7, of which two were later sub-divided into smaller spaces (Figure 5.7). S1 is the eastern rectangular space, which was later divided into two separate spaces labelled, from north to south, S1a and S1b; S2 is the narrow corridor running along the southern part of the building; S3 is the central northern space that was later divided into two separate spaces labelled, from east to west, S3a and S3b; S4 is the central space south of S3a; S5 is the space west of S4 and south of S3b; S6 is the southwest space; and S7 is the space north of S6. For S1 and S3 two phases were modelled; before and after the dividing walls were built as the sub-divisions of space may indicate change in function. It appears that S1, S2, S3 and S4 were internal spaces since they had reed floors, a pattern that seems to be recurrent. S5 contained an oven, and although the space does not have a reed floor, it is assumed to have been internal since ovens tend to be located in interior spaces. This oven opened up into S6, which appears to have been a partially enclosed, probably unroofed courtyard with a simple compacted earthen floor on which fragments of numerous grounds stones were found. The nature of S7 is difficult to assess, although the traces of reed matting may suggest it was an internal space. For the purpose of the following discussion, it will be assumed that the northern wall of S7 extended further west, and that it was an at least partially enclosed, roofed space.

With regards to movement between the various spaces in Structure A, there is only one clear ground level doorway, namely between S1 and S2. There are two other possible doorways, one in the southern part of the eastern wall of S1, and one between S2 and S6. This may indicate that movement from S1 to S6 was required on a frequent basis. As none of the walls have survived to any great height, and some of the walls have not been fully preserved, it is possible that there were originally raised entrances and/or portholes. For example, it is possible that there were ground level or raised entrances between S1a and S1b, and S3a and S3b, possibly where the walls have not been preserved. Additionally, there may have been raised doorways or portholes between S3a and S4, S2 and S4, S4 and S5, S3b and S5, and from S6 into S5 through the wall north of the oven. Access from S2 into S5 seems unlikely as the person entering S5 would have had to climb over the oven to gain access to the northern part of the space. Alternatively, access into all of the central spaces (S3-S5) may have been through the roof, or through a combination of roof access and raised entrances.

5.5.4.1: Contextualised maximum capacity

The maximum number of Size A and Size B adults that can sit cross-legged and sleep in the spaces in Structure A has been summarised in Table 5.4 (Figures 5.8-5.9). With regards to S6 and S7, only the space within the reconstructed length of the walls has been taken into account, although it is possible that the original size of these spaces was larger; the modelled capacities should be viewed as possible minimum numbers.

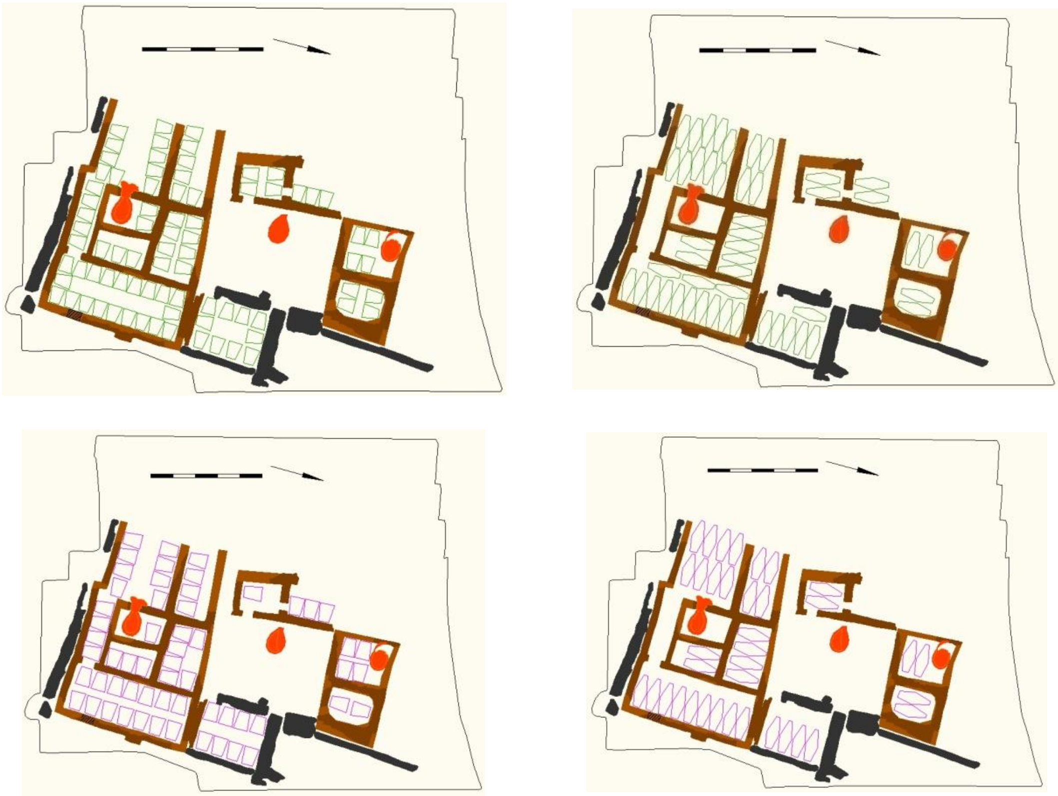
The size and shape of S2, and the entrances at either end of the space, may indicate that it was primarily used for movement between S1 and S6, and perhaps to gain access into S4. It was wide enough for an adult to sit either facing one of the walls or one of the entrances, but either scenario would have blocked movement through the space. This does not preclude S2 from having been used as a work space for one or two individuals, perhaps associated with items kept in S4 if there was an entrance in the wall between these two spaces. There was also room for two adults to sleep in these, although other spaces appear better suited for this purpose.

Space	Sitting cross-legged		Sleeping	
	Size A	Size B	Size A	Size B
S1	20	14	13	9
S1a	8	6	4	4
S1b	11	8	7	6
S2	5	4	2	2
S3	8	6	5	4
S3a	4	2	2	2
S3b	4	2	2	2
S4	3	3	2	2
S5	2	1	1	1
S6	10	8	10	8
S7	6	4	4	4

Table 5.4: Modelled contextualised maximum capacities for level 5.

S1 is the largest internal space in terms of capacity for co-presence and co-residency; there was room for twenty Size A or fourteen Size B adults sitting cross-legged, or thirteen Size A or nine Size B adults sleeping. In the later phase, when S1 had been divided into two separate spaces, S1a could accommodate eight Size A or six Size B adults sitting, or four adults (Size A or Size B) sleeping, whereas S1b had room for eleven Size A or eight Size B adults sitting, or seven Size A or six Size B adults sleeping. This suggests that S1, and later S1a and S1b, may have been living spaces. If people were seated along the walls in either of these spaces there would still have been some space for movement (e.g. to enter or exit the spaces), or to place food for consumption between those present. This indicates possible multi-functionality of these spaces; they may have provided space for interactions associated with eating, entertaining guests, or other social gatherings, as well as work. The later division of this space may relate to changes in the composition of the co-resident group (associated with childbirth and/or marriage), a change in the need for privacy (e.g. separating sleeping space from work area), or it may have been related to the sub-division of S3.

S3 was the second largest internal space with the capacity to accommodate between six (Size B) and eight (Size A) adults sitting cross-legged, or four (Size B) to five (Size A) adults sleeping. However, the modelled maximum capacity would have left very little room for movement, such as that associated with sitting down and getting back up again. It may therefore be suggested that S1 is more likely to have been used for most of the social interactions taking place within the buildings, although it is possible that S3 provided sleeping space for a smaller co-resident unit. If both S1 and S3 were living spaces it is possible that the social group living in the building consisted of two closely related co-resident units (e.g. two generations of the same family) that required some degree of privacy within their shared structure. After the sub-division of S3 in the later phase, there was only room for a maximum of four adults (Size A) sitting or two adults (Size A or Size B) sleeping in 3a and 3b, and it appears less likely that these spaces were used for sleeping or general socialising. If S3 had provided sleeping space for two to four individuals, then it may be suggested that the division of S1 into S1a and S1b could be because this function had been transferred to S1b, perhaps to provide more storage facilities or spatially separated internal working spaces (i.e. S3a and S3b).[49]



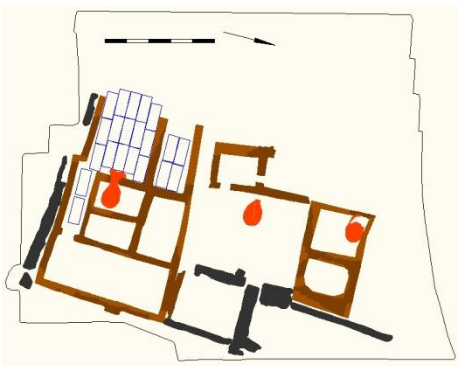


Figure 5.8: Modelled maximum capacities of Size A (top) and Size B (middle) adults sitting cross-legged and sleeping (left and right respectively), and modelled capacity for goats (bottom left) in the earliest phase of level 5.

The restricted number of people that could have been seated in S4 (three Size A or Size B adults) and S5 (two Size A or one Size B adult), may indicate that these spaces were more likely to have been used for storage or work rather than as spaces in which people gathered to socialise. Only two adults (Size A or Size B) could have slept in S4 and only one adult (Size A or Size B) in S5, which may support the suggestion they were storage and/or work

[49] The people who had previously slept in S3 now slept in S1a, and those that slept in S1 now slept in S1b.

spaces. S7 had room for at least six Size A or four Size B adults to sit and four adults (Size A and Size B) to sleep, although, as people would have had to sit with their back against one wall and face the other, possible interactions within this space may have involved work (e.g. food processing of craft activities) rather than general socialising. If it was an unroofed, or only partially roofed space then it may have provided sleeping space for four adults (Size A or Size B) during the summer when outdoor temperatures may have been cooler than indoors. The courtyard S6 may also have provided an outdoor sleeping space during the summer; there was room for ten Size A or eight Size B adults to sleep, possibly more, depending on the original extent of the space. It was also large enough for the same number of adults to sit, which may indicate that it was a multi-functional space as suggested for the courtyards in levels 7-6a. If both S6 and S7 were courtyards used for sleeping during the summer, and S1 and S3 provided sleeping space for two social units during the colder part of the year, then the interior sleeping pattern could have been replicated in external areas as well.

5.5.4.2: The use of space

As with the other levels discussed in this chapter, there is little evidence pertaining to the specific activities that took place in the various spaces in Structure A. The exception is S6 where numerous fragments of ground stones were found, which, combined with the fact that the oven in S5 opens up into it, indicates that S6 may have been a focal point for food-related activities within the structure. S6 afforded space for a range of activities to have taken place concurrently, and it is possible that the space was multi-functional. Four or five adults could easily have knelt, sat or squatted along the walls without blocking movement through S6 or into S2. There is also space for at least two adults to use the oven while other individuals were engaged in the preparation or processing of food (e.g. grinding grains). Alternatively, at least eight adults may be seated in a circle during food consumption or while co-operating on a specific task. The walls may have provided some shelter from the sun and wind if needed, and it is possible that many domestic activities (e.g. food preparation, cooking, manufacturing, and mending of personal and/or household items) took place in S6 as long as the weather permitted. It is also possible that S6 may have provided a space for animals to be kept if required during the night, in the lambing season, and/or in adverse weather (section 3.3.4); the space had room for at least ten goats (Figure 5.8). Two goats (or more if kids) may also have been brought into the transitional space S2 if needed. It is also possible that herded animals were kept elsewhere in the settlement, away from domestic structures; certain areas of the built environment may have consisted of larger, open spaces that could have been used for penning purposes as suggested in section 5.2.

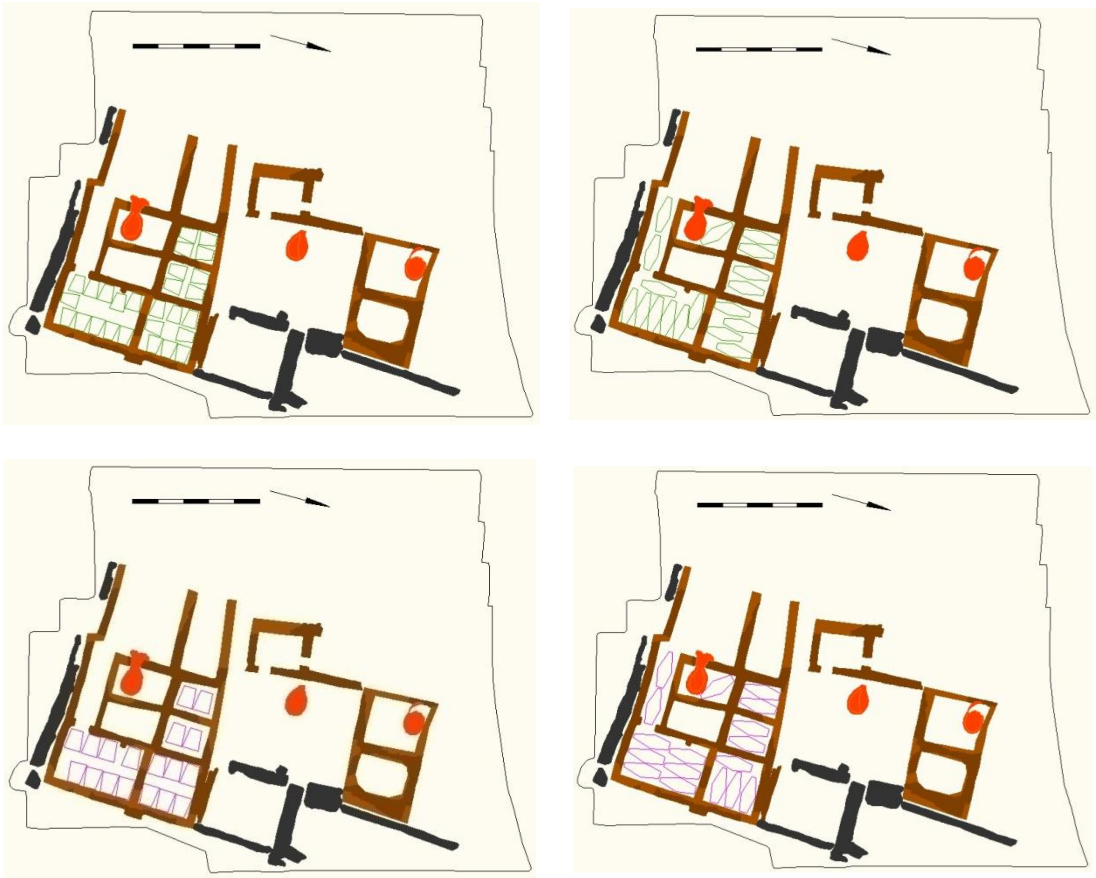


Figure 5.9: Modelled maximum capacities of Size A (top) and Size B (middle) adults sitting cross-legged and sleeping (left and right respectively) for Structure A in the latest phase of level 5.

The presence of ground stones in S6 may indicate that these and other tools were kept in this space when not in use, although it is equally possible that implements used in the activities taking place in S6 were kept in the northern part of S5. The placement of the oven in the southern part of S5 left almost 1 m of space north of it, and it is possible that the remaining space served some other purpose, e.g. storage of equipment and/or as a work space. If S5 was used for storage of materials and equipment utilised in the activities taking place in S6, it may be that there was a raised entrance from S6 into S5. Alternatively, S5 may have provided a space for one or two individuals to work, or its main function may have been to provide access to S4 and S3/S3a. Both of these scenarios may have provided space for some storage, depending on the positioning of the person(s) working there, the location of the entrances, and the quantity and placement of the stored goods. If the only access into S4 and S3/S3b was from S5, and food stuffs were stored in S4 and S3/S3b, then it may indicate that the processing of this food took place in S6, or possibly S5, rather than in any of the other spaces. This would indicate that the ease of access was a concern in the structuring of space.

The use of S4 was restricted to between one and four working adults. However, there were no obvious light sources in the space that would have provided for good working conditions in terms of vision; there was no hearth, and although any opening in the wall may have allowed some light to penetrate, this was most likely very limited. There may have been a hole in the roof for such purposes, and/or for access, but as there is limited information available on the superstructure this cannot be ascertained. It is possible that the space was better suited for storage purposes, or possibly a combination of storage (in the part furthest from the entrance so as not to block access) and work space (closest to the entrance to take advantage of potential light coming in).

S3 may have accommodated smaller gatherings of people, although perhaps no more than four adults rather than the maximum capacity of eight, as well as provided sleeping space for two to four individuals. It is also possible that S3 was used for storage, and/or provided space for some food-related or manufacturing activities similar to the situation suggested for S2 in level 7 (trench I). If it was a work space the issue of lighting may have been a factor, as was discussed for S4. The later sub-division into two more or less equally sized spaces, S3a and S3b, may indicate that it was used for storage at least in this later phase; one or two adults could have undertaken some work in S3a and S3b, although it appears more likely that activities occurred in spaces that afforded more room for movement, and perhaps interaction with others, such as S1, S1b and S6. If the sub-division of S3 was the result of a need for spatially separate storage facilities it may have been to keep different stored goods separately (e.g. food and fodder). Alternatively, less storage space and/or more internal, spatially separate work spaces were needed.

S7 may have been similar in size to S3, although narrower, and the fragments of reed matting found in it may suggest that it was an internal, or at least partially roofed, space. The fact that it was narrower than S3 may have limited its use for social gatherings not associated with work (e.g. eating or holding meetings), as such interactions are assumed to have required a certain degree of face-to-face interaction (sections 3.3.2-3.3.3). It may be suggested that S7 was more suited for storage and/or work-related activities, perhaps involving between one and three individuals seated along the southern wall. The space may also have provided a place to keep animal as four goats could fit into the space, although perhaps only periodically and the space may have served other purposes most of the time.

The largest internal space, S1, may have accommodated a range of domestic activities, as well as sleeping, eating and socialising, and it may be suggested that it was a multi-functional living space. It is also possible that parts of the space were used for storage of various tools, person items, bedding, and so on. Possible storage is likely to have occurred in those parts of the space where the stored goods would not obstruct movement, such as along the walls or in the northern part of the space (away from the entrance). The later sub-division of S1 into a smaller space at the northern end, S1a, and a larger one in the south, S1b, indicates a functional or social need to restructure space. An alternative explanation for this change to the aforementioned changes in the composition of co-resident groups and/or privacy concerns is that it may be that a greater need for the separation of storage from everyday activities had arisen, or that some activities needed to be separated from other everyday tasks.

5.6: Storage capacity

In the preceding discussion concerning the use of space it was suggested that some of the spaces may have been used for storage based on their size, limited potential for co-presence, lack of built features, and a lack of ground level doorways. If these spaces were used for such purposes, the next step is to assess their potential storage capacities based on the assumptions outlined in sections 3.3.3-3.3.4. No features usually associated with storage, such as bins, pits and silos, were found in the levels discussed in this chapter, although impression of textiles and basketry made of reeds on clay and bitumen have been found (Adovasio 1975, 1983) indicating that organic containers were used. The storage calculations were made based on floor area and the assumption that grain and fodder were stored directly on the floor up to a height of 0.50 m and 1 m (Table 5.5). As cultivation of wheat, and possibly barley, occurred at Jarmo (section 5.2) the calculation of stored food for human consumption was based on the annual requirement for grains[50], which differs from Ganj Dareh where these calculations were based on legumes (section 3.3.3).

These calculations show that the various spaces may have held enough grain to supply the annual requirement of between three and sixteen individuals (depending on the height of the stored grain). If these calculations are combined and compared with the number of potential co-residents (number of co-resident Size A adults in living spaces) in each individual level then it becomes clear that there may have been enough storage space to supply each of the co-residents with grain for a year (Table 5.6). There are a number of factors to keep in mind, however, as these numbers are meant to illustrate the *potential* quantity of stored grain and size of co-resident groups. For example, some of the structures have not been fully excavated with parts of the buildings remaining outside the trench, and it may be that not all storage and/or living spaces have been found. Additionally, it is possible that some of the spaces listed as living and/or storages spaces could have been used for other purposes. Storage spaces may have been work spaces used for specific tasks, or may have been used for both storage and work, whereas the potential living spaces may not have been used for such purposes at all, but rather as activity areas for food processing, and/or craft activities

[50] 0.33 m^2 person/annum.

Trench	Level	Space	Potential capacity for storage (m^3) if 0.50 m height	Number of people that could be supplied by potential storage (0.5 m height)	Potential capacity for storage (m^3) if 1 m height	Number of people that could be supplied by potential storage (1 m height)
I	**7**	**S1**	1.300	3.94	2.600	7.88
		S3	1.320	4.00	2.640	8.00
	6d-b	**S2**	2.640	8.00	5.280	16.00
	6a	**S1**	2.000	6.06	4.000	12.12
		S2	1.760	5.33	3.520	10.67
II	**5**	**S1a***	2.100	6.36	4.200	12.73
		S3	2.188	6.63	4.375	13.26
		S3a*	1.006	3.05	2.013	6.10
		S3b*	1.006	3.05	2.013	6.10
		S4	1.150	3.48	2.300	6.97
* Later phase						

Table 5.5: Potential on-floor storage capacities for small spaces.

Trench	Level	Space with potential for co-residency	Number of potential co-residents per space	Total potential number of co-residents (all spaces occupied)	Number of spaces with potential for storage	Total potential storage capacity
I	**7**	**S2**	4	12	2	15.5
		S8	8			
	6d-b	**S5**	7	15	1	16
		S6	8			
	6a	**S3**	6	16	2	22.5
		S5	10			
II	**5 early phase**	**S1**	13	18	1 or 2	7 or 20
		S3	5			
	5 late phase	**S1a**	4	11	3 or 4	19 or 32
		S1b	7			

Table 5.6: Modelled co-residency and storage potential.

There is also the issue of whether the structural remains in levels 7, 6d-b and 6a (trench I) constitute separate buildings (sections 5.5.1, 5.5.2 and 5.5.3), in which case the combined number of potential co-residents may not be accurate. If S7 and S8 in level 7 were part of another structural unit than S1-S6, then the combined storage capacity of S1 and S3 (eight to fifteen people) far exceeds the need of the potential co-resident group (four individuals). Similarly, S6 and S7 in level 6d-b may have been part of another structural unit than S1-S5, in which case the potential storage capacity of S2 may have supplied twice the annual grain requirement for the people residing in S5 (seven individuals). In both cases the storage potential of the possible second structural unit (S7-S8 in level 7 and S6-S7 in level 6d-b) is not known. With regards to level 6a, if S2 is excluded from the calculations, S1 had the capacity to supply twelve individuals, which is enough for the co-resident unit in S3 (six adults) *or* S5 (ten adults), but not both. However, if S3 was a courtyard and was only used for sleeping in the summer, then the potential storage capacity would be enough for the co-resident unit in S5.

In the earlier phase of Structure A (level 5, trench II) the combined potential storage capacity of S3 and S4 (twenty people) may have supplied those living in S1 (up to thirteen people). If, on the other hand, both S1 and S3 were living spaces (up to eighteen individuals) the storage capacity of S4 could not have supplied both social units residing in the building. In the later phase, if both S1a and S1b were living spaces (up to eleven individuals) and only two of S3a, S3b and S4 were storage spaces, there was still enough storage capacity (between twelve and nineteen people) to hold the annual requirement for both social units residing in the building. If only S1b was a living space (up to seven individuals) then either of the smaller spaces would have sufficed as a storage space.

Trench	**Level**	**Space**	**Potential capacity for storage (m3) if 0.50 m height**	**Number of goats that could be supplied by potential storage (0.5 m height)**	**Potential capacity for storage (m3) if 1 m height**	**Number of goats that could be supplied by potential storage (1 m height)**
I	**7**	**S1**	1.300	6.19	2.600	12.38
		S3	1.320	6.29	2.640	12.57
	6d-b	**S2**	2.640	12.57	5.280	25.14
	6a	**S1**	2.000	9.52	4.000	19.05
		S2	1.760	8.38	3.520	16.76
II	**5**	**S1a**	2.100	10.00	4.200	20.00
		S3	2.188	10.42	4.375	20.83
		S3a	1.006	4.79	2.013	9.58
		S3b	1.006	4.79	2.013	9.58
		S4	1.150	5.48	2.300	10.95

Table 5.7: Potential capacities for storing animal fodder (90 days) in small spaces.

If the animal management strategy included storage of fodder for feeding the animals during the winter when temperatures were low and snow or cold rain may have prevented the herd from being taken out on pasture, or to supplement the pasturage, then it is possible that fodder was kept in the small spaces instead of food for human consumption. Table 5.7 lists the potential storage capacities for the small spaces if they were used for storing enough fodder to feed a goat for 90 days.[51] These calculations indicate that each space may have held enough fodder to feed between five and twenty-five goats, and if fodder was stored to a height of 1 m then there would be enough fodder to feed between twenty-five and forty-nine goats per level. It is also possible that if these spaces were all designated storage spaces, they may have been used to store a range of items and materials, including food for human consumption, animal fodder, raw materials, and various tools.

Level	**Co-resident unit**		**Storage capacity; grain for human consumption**		**Storage capacity; animal fodder**	
	Space	**Size of co-resident group**	**Space**	**Number of people supplied by potential storage**	**Space**	**Number of goats supplied by potential storage**
7	S2	4	S1	7.5	S3	13
6d-b	S5	7	S2	16	S4	11
6a	S5	10	S1	12	S2	17
5 early phase	S1	13	S3	13	S4	11.5
5 late phase	S1a and S1b	11	S3a and S3b	12	S4	11.5

Table 5.8: Size of potential co-resident unit and the potential storage capacities for storing food and fodder in each level.

If we consider the potential affordance of space for storing both grain for human consumption and fodder for feeding animals through the winter (Table 5.8) it becomes clear that the individual structural units identified in each level (i.e. excluding S7-S8 in level 7, S6-S7 in level 6d-b, but including S2 in level 6a) had the facilities to store enough food for the potential co-resident unit and fodder for between eleven and seventeen goats. The structure in level 6d-b had the capacity to store twice the annual requirement of the co-resident unit, and it may be that if foods and fodder were stored in various containers (e.g. sacks, baskets) instead of directly on the floor, then there may have been enough room for the storage for both. Alternatively, fodder may have been stored in containers in S4; the modelled on-floor

[51] 90 days (0.20 m^2 per goat) were chosen as Jarmo is at a lower altitude than Ganj Dareh and may therefore have enjoyed better or less harsh winters.

storage of fodder in S4 (see Figure 5.5) indicates that the space afforded storage of fodder for eleven goats.

What all of these calculations illustrate is that these structures have the *potential* to provide facilities for long-term storage of food items (which is most likely to have included plant foods, meat and other animal products) consumed by the people residing in them, as well as providing fodder for domestic herds. It is possible that individual co-resident units may have stored and consumed their own resources and were responsible for the welfare of their own animals. However, it is also possible that any storage was short-term and that many of the small internal spaces were used as work spaces, or for the storage of equipment, fuel, and/on raw materials instead or in addition to food and fodder.

5.7: Summary

This chapter has examined the built environment at Jarmo, focusing on the potential size of co-resident units, the affordance of space for social interaction, human-animal interaction, activity areas and the use of space, and possible storage capacities. Even though there is a lack of *in situ* artefacts (section 5.2), it is possible to make certain general observations based on the presence or absence of fire installations, the nature of floor surfaces, and the affordance of space for co-presence and co-residency. It is possible that the structural remains in levels 7 and 6d-b, and possibly level 6a (all in trench I), constituted different structural units based on the configuration of the architectural remains, movement between individual spaces, and structural continuity. If this was the case then it is possible that multiple structures were grouped together in certain parts of the site, perhaps according to family ties, and that the buildings may have had shared walls (e.g. between S4-S5 and S6, and S3 and S7 in level 6d-b). Similarly, Structure A in level 5 (trench II) was also located in close spatial proximity to other structural units, although they do not appear to have shared walls. Structure A was larger, contained more internal spaces, and appears to have had a more regular layout than the buildings in levels 7-6a (trench I). It is possible that levels 7-6a (trench I) were earlier than level 5 (trench II), which may explain the increased structuring in the layout of the buildings. This suggestion is made based on three observed differences in the archaeological data, although it should be noted that the excavators were not able to correlate the stratigraphy in the two trenches (section 5.2). Firstly, the remains in trench I are at a lower elevation than the remains in trench II; level 6 in trench II is at ~795.40 m and level 6a in trench I is at ~ 793.40 m. Secondly, there appears to be a difference in the stone bowl assemblages in levels 6-9 in trench I, and that collected from levels 1-5 in trench I and levels 1-6 in trench II with changes observed in the size (decreased over time), form (shift from flat base with flaring sides to rounded with vertical sides), material used (shift from marble to sandstone and limestone), and manufacturing techniques (increased thickness, variation in thickness and irregularities in form, and less final polishing of vessels) (McCormick Adams 1983: 211-213). Thirdly, pottery is only present in the upper 2-2.5 m of the site, appearing in level 5 in trench II and level 3 in trench I (McCormick Adams 1983: 215-221, table 2; Matson 1960). It is therefore possible that level 5 (trench II) constitutes a later phase of occupation at Jarmo than levels 7-6a (trench I), which saw an increase in the regularity in the layout of structures as well as certain technological changes, although these changes do not appear to have been accompanied by any major changes in social structures.

The modelled affordance of space for co-residency and co-presence indicate that there were larger internal spaces in levels 7-6a that may have accommodated co-resident groups that were similar in size to the size of the co-resident group suggested for Structure A in level 5. All structural units appear to contain larger living spaces, smaller work and/or storage spaces, and courtyards, with the main difference being the way that the spaces were organised. There is also a similar patterning in the use of space with no internal fire installations; hearths are located in external spaces and ovens, even though they are located in internal spaces, open up into possible courtyards. It is possible that the majority of food processing and cooking occurred in external spaces, although certain food-related activities may also have taken place in internal spaces – either on a daily basis or according to season. The lack of internal fire installations suggests that the cooking took place outside, and it may be that parts of the possible courtyards were roofed to provide shelter when the weather was not favourable (e.g. raining). Some of the ovens were located in potential living spaces (S8 in level 7 and S6 in level 6d-b), or in the space adjacent to the potential living space (S4 in level 6d-b), and may have provided a source of heating during the winter. This differs from the situation at Ganj Dareh, where there appears to be a lack of internal fire installations that could provide heating during the winter.

S3 in level 6a may be the clearest evidence of a fully enclosed courtyard; it is possible that it was an unroofed space due to the presence of a hearth and the lack of reed matting on the floor. If this assessment is correct it would indicate that food preparation and cooking were activities associated with a higher degree of privacy than in the earlier levels. The extent of the other possible courtyards – S5 and S7 in level 7, S3 and S7 in level 6d-b, and S6 in level 5 – could not be established, but it is possible that they were only partially enclosed. If this was the case then the food-related activities that took place in them were associated with a lesser degree of privacy than S3 in level 6a, although they would still have been more secluded and less inclusive that activities taking place in open areas. The size of some of the possible courtyards (S5 in level 7 and S3 in level 6d-b) indicate that they may have provided spaces for activities that involved a larger group of people than the co-resident group. This may suggest that there was a difference in the scale of interactions that took place in internal spaces compared to courtyards. The latter may have provided a space for the co-resident group to interact with individuals from other co-resident units within the community (or potentially visitors). It is also possible that the size of the co-resident units (averaging eight individuals) is over-estimations, and that the co-resident groups consisted of perhaps no more than six individuals. As most of the possible living spaces could afford the co-presence of ten or more adults, they may have accommodated social interactions that included visitors, in which case both internal and external spaces were designed to accommodate social interaction between different social units. It is also possible that there were additional spaces located at the opposite end of the courtyard, i.e. outside the trench. If this was the case then perhaps the courtyards were used by one social unit residing and utilising all spaces centred on the courtyard, perhaps similar to the Iranian villages studied by Kramer (1982) and Watson (1979). Alternatively, there may have been different social units (possibly closely related) residing and using the different clusters of internal spaces, but shared the courtyards and may have co-operated on domestic tasks. Either of these scenarios suggests a less inclusive pattern of domestic activities than at Ganj Dareh, even though certain spaces may have been designed to accommodate interaction between co-resident groups.

The precise nature of the functions of the smaller spaces is not clear. It is possible that some of them provided smaller work areas and other were used for storage, in which case some may have had raised entrances to prevent rodents accessing the stored food, especially if the storage occurred directly on the floor. The calculated potential storage capacities indicate that each structure may have had the capacity to store the annual food requirement for the co-resident group. This suggests that the co-resident groups may have been more economically independent than was the case at Ganj Dareh. It also appears that each building may have had the capacity to supply a herd of between eleven and seventeen goats in addition to food for the co-resident groups. Interestingly, this is within the range of the number of goats that could fit into the possible courtyards. If goats were kept within the courtyards during nights and bad weather, this may suggests closer human-animal interaction within the settlement, and the courtyards may be a result of a herding strategy where individual co-resident groups were responsible for segments of a herd or their own herd. However, the location of hearths within courtyards, some of which may have been located towards the centre of these spaces (e.g. S3 in level 6d-b), may have precluded their use as pens. If this was the case then it is possible that goats – and other domestic animals (possibly sheep, and pig in the later phase of the occupation) – were kept elsewhere within, or outside of the settlement. There are indications that parts of the settlement did not contain any buildings, and it is possible that animals were penned there.

Structure A is often cited as an example of a ‘typical’ Jarmo building (Banning 2004: 6; Braidwood 1983a: 158; Flannery 1972: 41-42). However, the modelling has provided indications that there may have been some degree of variability in the configuration of structural units, especially in the earlier occupational phases in trench I. Buildings were located in close proximity to each other, sometimes sharing walls, and it is possible that structural units were grouped together in different parts of the site, possibly sharing access to and use of courtyard spaces. The spatial closeness of buildings is reminiscent of the situation at Ganj Dareh (although at Ganj Dareh there may have been only one structure), but the spatial patterning of domestic activities at Jarmo suggests that a range of tasks were less inclusive than at Ganj Dareh. There is also evidence that some cooking-related activities may have occurred in more open spaces outside courtyards which afforded space for several social units to interact, though these interactions may have taken place on a less frequent basis. The possible decrease in internal compartmentalisation between Ganj Dareh and Jarmo is interesting as it does not conform to the increasing spatial complexity proposed in most discussions of Neolithic architecture and use of space (section 2.4). This point is revisited in the concluding section of the next chapter, which focuses on the structuring and use of space at Hajji Firuz in the northern part of the Zagros uplands.

Chapter 6

Hajji Firuz

6.1: Introduction

This chapter presents the third case study examining the structuring of space in Neolithic sites in the upland zone of the Zagros region, focusing on the Late Pottery Neolithic settlement at Hajji Firuz (*c* 6,100-5,700 cal BC).[52] The site is one of the earliest investigated Neolithic settlements in the Urmia Basin in the Western Azerbaijan province, northwest Iran. It is also one of the most extensively excavated Neolithic settlements in the Zagros and presents a more detailed data set than the previous two case studies. The site has been described as an egalitarian community where self sufficient households lived in similar buildings and pursued a subsistence strategy that included cereal cultivation, caprine herding, and hunting and gathering (Voigt 1983: 322). It presents an interesting comparison to the previous two case studies where, even though there appears to have been an increased reliance on domestic species, wild resources still played an important part in the subsistence system. It should be noted that studies of strontium levels in human bone from the site have indicated that the diet was similar to that consumed by the Ganj Dareh population, with both containing relatively high amounts of meat (Schoeninger 1981: 81-87). The similarities in the diet between these two sites have been attributed to a traditional emphasis on sheep and goats in the Zagros area (Schoeninger 1981: 86-87).

The first part of this chapter presents an outline of the work that took place at Hajji Firuz, including excavation and sampling strategies, and the architectural phases (section 6.2). This is followed by a summary of the architectural remains and associated built features found during the excavations in each of the identified architectural phases (sections 6.3-

[52] The radiocarbon dates from the Neolithic period at the site are as follows: 6,145 cal BC (possibly phase L), 5,780 cal BC (Structure VI_2, phase D) and 5,798 cal BC (Operation V, Stratum 4, which is probably equivalent to phases E through B) (Lawn 1974: 221-222; Stuckenrath 1963: 90; Voigt 1983: 348-349).

6.3.5). The second part of this chapter discusses the results from the modelling, focusing on co-residency and co-presence (section 6.4.1), the affordance of space for social interactions and the use of space in each level (sections 6.4.2-6.4.2.5), storage (section 6.4.3), and the affordance of space for animals (section 6.4.4).

6.2: The excavations

Hajji Firuz is located about two km southeast of the site of Hasanlu Tepe in the northeast part of the Solduz Valley, south of Lake Urmia (approximate co-ordinates: latitude 37° 01.6' N, longitude 45° 28' E) (Voigt 1983: 7). It is situated at an elevation of about 1,300 m above sea level, on a plain boarded by lower hills to the northeast and east, and mountains with peaks over 2,000 m to the northwest and south (Voigt 1983: 268-269). At the time of excavation the site appeared to be roughly oval in plan and measured approximately 140 x 200 m at the level of the plain, although Voigt (1983: 7) believed that parts of the mound (to the west and northeast) had been removed by later human activity. The mound rose to a height of about 10.30 m above the level of the plain at the time of excavation, with at least another 1.10 m of archaeological deposits below the plain; the water table was reached at 11.40 m below the summit of the mound (Voigt 1983: 7-10, 272-273). Palynological studies of sediment cores from Lake Urmia have indicated that the replacement of the *Pistacia-Quercus* forest-steppe with the Zagros oak woodland started around the time of the Neolithic settlement at Hajji Firuz (Bottema 1986: Djamali et al 2008: 418-419). It has been suggested that *Artemisia* steppe with stands of terebinth and almond may have covered the valley floor, with riparian forests along the rivers and small side valleys during the Neolithic (Voigt 1977: 314-315). There are freshwater lakes along the northern and eastern parts of the Solduz Valley and parts of the valley floor (including the areas around the lakes and along the Gadar River) floods seasonally, often creating swampy areas (Voigt 1983: 270). Irrigation has altered the drainage pattern of the valley floor, potentially affecting the location and size of the swampy and water-logged areas on the plain (Voigt 1983: 272-275), and the valley floor has been covered by alluvial deposits which have also altered the topography of Hajji Firuz.

Studies of the botanical sample, although limited, showed the presence of domestic barley, wheat and lentil, two types of wild pulses (not specified), as well as rye and knotgrass which are possible weeds (Voigt 1983: 275-277). The sample of animal bones was also small (all apart from four specimens were collected during the 1968 excavation), and included domestic goat, sheep, pig, and possibly cattle, and wild species such as red deer, aurochs, wild boar, hare, and various birds (Meadow 1983: table 1). Voigt (1977, 1983) has argued that the subsistence strategy at Hajji Firuz had developed out of earlier agricultural strategies in the Zagros, but adapted to the local environment and with a greater emphasis on herding and increased reliance of stored resources. In her (1977: 341-342) opinion domestic species formed the main part of the subsistence system with hunted animals and wild plants contributing only some seasonal variation to the diet. She (1977: 336-337) suggested that the inhabitants practised “sedentary pastoralism” where the sheep and goat herds were moved around the valley to take advantage of seasonal variation in pasture, which at times may have involved staying away from the settlement for varying lengths of time.

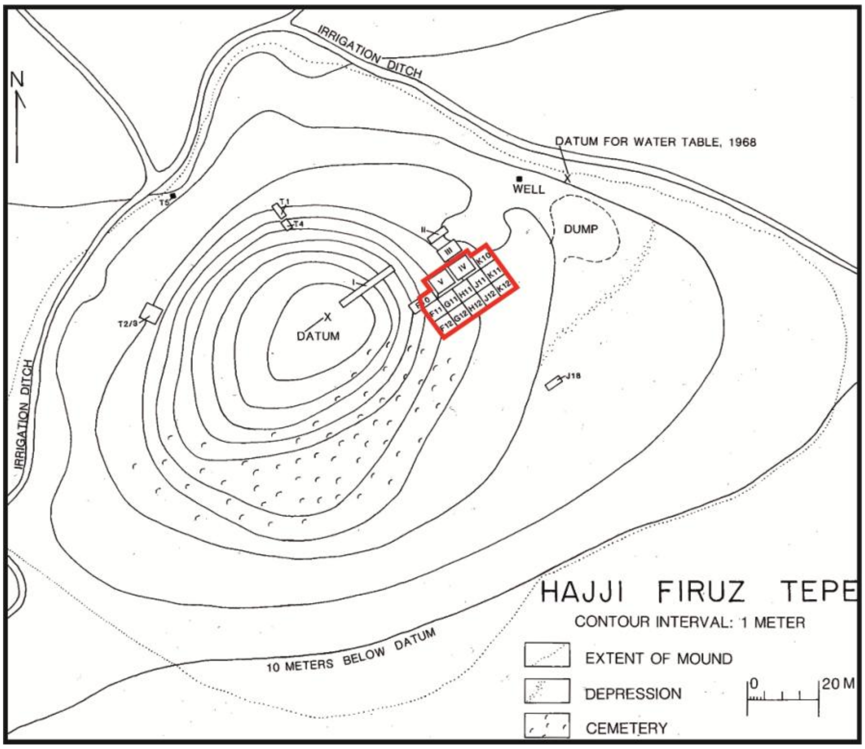


Figure 6.1: Overall site plan showing the locations of the excavated trenches with the trenches from which the structural remains discussed in this chapter outlined in red (modified from Voigt 1983: fig. 5).

The site was first recorded in 1936 by Sir Aurel Stein who collected a small sample of material from the surface of the mound (Stein 1940). Subsequent archaeological work was undertaken during the 1950s and 1960s on behalf of the University of Pennsylvania as part of the Hasanlu Project: Charles Burney excavated two test trenches (Operation I and II; 2.5 x 2.5 m and 2.5 x 6 m respectively) in 1958; a small 4 x 6 m trench (Operation III) was dug during the 1960 season; T. Cuyler Young, Jr. excavated two 5 x 6 m trenches (Operation IV and V) in 1961; and Mary Voigt and Robert Dyson, Jr. co-directed the more extensive excavation season in 1968 (Dyson, Jr. 1983; Dyson, Jr., Muscarella and Voigt 1969; Voigt 1983: 7-11). The area chosen for excavation in 1968 was located on a lower portion on the eastern part of the mound adjacent to the two trenches (Operations IV and V) excavated in 1961 (see Figure 6.1 for trench locations) (Voigt 1983: 13, fig. 5). This area was chosen so that the Neolithic levels could easily be accessed since the later deposits (there were phases of later occupation at the site, dating to the Chalcolithic, Bronze Age, Iron Age through Islamic periods) were quite shallow in this area, and it would be possible to incorporate the data collected in 1961 with the information from the 1968 excavations and use the sections of Operations IV and V to inform on the stratigraphy of the adjacent areas (Voigt 1983: 13, fig. 6). Additionally, four small trenches were excavated in the northwest part of the mound, and a 1 x 3 m trench (to a depth of 11.40 m below the summit when the water table was reached) to the east of the main excavation area in order to investigate the nature of the deposits in those areas of the mound (Voigt 1983: 15-17, fig. 5). The main excavation area (hereafter referred to as the 1968 trench) was initially divided into ten 5 m squares (see Voigt 1983: fig. 6) that were excavated and recorded independently.

Phases	**A_3**	**B**	**C**	**D**	**E**	**F_1**	**F_2**	**G**	**H_1**	**H_2**	**J**	**K_1**	**K_2**	**L**
Structures	I_1		I_2											
	II_1	II_2												
	III													
		IV												
			V											
			VI_1	VI_2										
				VII										
				VIII										
				IX										
				X_1	X_2	X_3								
						XI_1		XI_2						
								XII_1	XII_2					
								XIII						
									XIV_1	XIV_2				
										XV_1	XV_2			
												XVI_1	XVI_2	
											$XVII_1$	$XVII_2$		
													XVIII	

Table 6.1: Architectural sequence at Hajji Firuz.

The excavated Late Neolithic deposits were divided into eleven main phases, each assigned a sequential letter from A (latest) to L (earliest) excluding the letter I, each corresponding to "significant changes in the use of space over time" (Voigt 1983: 18). Sub-phases (the early, late, and, in the case of phase A, middle part of the main phase) were denoted by a subscripted number ($_1$ was the latest) when minor changes in the use of space needed to be distinguished. Phases A through D were excavated in the 1968 trench as well as Operations IV and V, with phases E through L only excavated in the latter two trenches (Voigt 1983: 21-30). Structures were numbered sequentially as encountered during excavation from I (latest) to XVIII (earliest) with a subscripted number ($_1$ being the latest) denoting either different phases of use (e.g. changes in internal features such as hearths), renewal of internal floors that corresponded with significant changes in adjacent exterior areas, or sometimes differentiating between two structures built directly above each other, or with one inside the other (e.g. Structure I_1 and I_2) (Voigt 1983: 21, 36-59). These labels have been retained in this chapter; the architectural sequence is presented in Table 6.1 for reference.

The methods of excavation and recording used at the site were based on techniques developed by British archaeologists (e.g. Mortimer Wheeler and Kathleen Kenyon), and paid particular attention to identifying so-called 'behavioural units' that resulted from specific activities, or recurrence of the same type of activity (i.e. contexts) (Voigt 1983: 11-13). Finds were generally recorded according to area within a square (e.g. a room, a space between structures, a feature, or a deposit consisting of relatively dense refuse) and so-called stratum (i.e. context), with the location of rarer artefacts recorded on plans (Voigt 1983: 13). The artefact assemblage recovered during the various seasons of excavation included ceramic vessels, chipped stone tools, human and animal figurines, various smaller clay objects, bone implements, ground stones, incised stones, a few beads, and imprints of basketry on pottery sherds (Voigt 1983: 95-267). It is perhaps worth noting that the assemblages of chipped and ground stones were limited compared to many other Neolithic sites. For example, only thirty-six ground stone items were found, most of which were recovered from phase A_3, and included twenty-five grinding implements and only two items that may have been used for pounding (Voigt 1983: 245-246). The chipped stone assemblage consisted of a total of only 215 flint and obsidian pieces (obsidian was only fractionally more common), of which just over half were tools and the rest debitage; the tools were generally small with a predominance of short, wide blades (Voigt 1983: 218-241).

The results from the 1961 and 1968 excavations will be presented in the next six sections; initially some general observations regarding building layout, size and construction materials are summarised (section 6.3), before presenting the structural remains in phases L-E (section 6.3.1), phase D (section 6.3.2), phase C (section 6.3.3), phase B (section 6.3.4), and phase A_3 (section 6.3.5). Due to the limited exposure of phases L-E (restricted to Operations IV and V) the structural remains in these phases are discussed together.

6.3: Summary of excavation results

The post-Neolithic deposits in the 1968 trench and Operations IV and V consisted mostly of intercutting pits and burials, and most of the latest Neolithic deposits were heavily disturbed and comprised of structural collapse (phase A_1), and fragmentary pieces of mud brick walls and accumulations of various deposits containing organic material, ash and refuse (phase A_2) (Voigt 1983: 18-21, figs. 8-11). Architectural remains were found in phases A_3-L, and, although these did not always constitute complete structures, some general observations can be made. Structures were freestanding, usually rectangular in plan, and some had a small unroofed space (enclosed by either a rectilinear or curvilinear wall) attached to the eastern wall (Voigt 1983: 31-32). Most of the buildings in phases F-A_3 were built of mud brick apart from Structures I_1 and V, which were made of *tauf/chineh*. The structures in phases L-G were reported to have been constructed of *tauf/chineh*, however, some may in fact have been built of mud brick; when walls initially believed to have been made of *tauf/chineh* dried following prolonged exposure, it became clear that they were actually made of mud bricks (Voigt 1983: 33), a situation also noted at Ganj Dareh (Smith 1990: 329). There was little evidence relating to the upper part of the structures, although wood appears to have been used for roofs and possibly roof support (Voigt 1983: 32). Voigt (1983: 34) suggested that the roofs may have been flat, as was the case in the Solduz Valley and elsewhere in the region; flat roofs are easier to construct and maintain, and they provide space for storage, sorting and drying of food stuffs, and sleeping during the summer months.

Most of the buildings had two shorter internal walls (with a wide entranceway between them) dividing the interior into two more or less equally sized spaces (Voigt 1983: 32). Interior wall faces had been coated with mud and lime plaster, and the walls in Structures II_2 and IV had also been whitewashed and had black pigment applied to its surface (Voigt 1983: 35). The floors were made of clay – either as plaster (some with lime mixed in) or hard-packed clay – and had usually been renewed at least once during the use of the buildings. Voigt (1983: 35) observed that the floor in one of the internal spaces generally had fairly clean and level surfaces, sometimes covered with red ochre, whereas the floor in the other space was usually dirty (i.e. with occupation debris, such as animal bones, ash, burnt debris, and various organic matter, trampled into the floor) and were often irregular and/or sloped. Similar distinctions between ‘clean’ and ‘dirty’ areas have been recorded during more recent excavations at other sites, such as Çatalhöyük and Boncuklu Höyük in central Anatolia. Internal features included bins, burial cists, storage vessels set into the floor, and hearths (Voigt 1983: 32), the location of which sometimes changed during the use of the building (Voigt 1983: 21). In the publication Voigt (1983: 21-94) used the term bin to describe features that were small clay compartments or bins, some of which contained burials (also referred to by Voigt as ossuaries) and some which did not. Most of those that contained burials ranged between 0.10 m and 0.40 m in height (one measured 0.80 m in height), and from the limited description available they appear to have been more like clay cists. These features are therefore referred to as burial cists in this chapter to distinguish them from bins not containing burials as the latter may have been used for storage or other purposes. A range of features were also found in the external areas between structures and in the attached courtyards, including pits (some of which were burnt), hearths, and ovens (Voigt 1983: 59-60). All of the information in the next five sections, pertaining to phases L-A_3, is from Voigt (1976, 1977, 1983); for an overview of the stratigraphic sequence of structures the reader is referred to Table 6.1.

6.3.1: Phases L-E

Phases L through E were only excavated in Operations IV and V, and even though architectural remains were found in all of these phases, information is limited compared to later levels (Figure 6.2). There is not much data available pertaining to phase L because most of the deposits were below the water table at the time of excavation. Fragmentary remains of a wall (Structure XVIII) were found in the southern part of Operation IV, and the remaining deposits appear to have consisted of wall erosion or collapse, interspersed with ashy lenses. The structural remains in phase K were also fragmentary with most of the deposits consisting of layers of clay interspersed with ash. There were two parallel walls running east-west in Operations V (Structure $XVI_{1\text{-}2}$), which had been rebuilt once each, and the southern wall of a potential building ($XVII_2$) extending northwards outside of the trench. The architectural remains in phase J were slightly more substantial, and included the southern wall (in Operation V) and walls visible in the northwest section of Operation IV of a potential building ($XVII_1$), and the northwest portion of Structure XV_2 (in Operation IV). Structure XV_2 was rectilinear in plan (*c* 5.30 m north-south; length unknown) and appears to have been separated into two spaces by two shorter interior walls. The internal wall faces were plastered (renewed two or three times) and the south space had one clay floor. Below the floor in the northwest corner of the south space was a poorly preserved, possibly secondary, adult burial. In the external area south of the structures there were apparently clean clay surfaces that sloped towards the buildings, and in the alleyway between Structures $XVII_1$ and XV_2 there were alternating lenses of clay and ash indicating periodic deposition of refuse.

Phase H was divided into an earlier (H_2) and a later (H_1) phase. In phase H_2 Structure XV_1 was built on top of, and about 0.35 m to the north of, the earlier Structure XV_2; both buildings were rectilinear in plan and had two interior spaces. The later building had three sequential clay floors in the south space, of which the first two were covered with red ochre. Fragmentary wall remains (StructureXVI_2) were found in the section west of Structure XV_2, and the deposits between the two buildings consisted of alternating lenses of clay and refuse, indicating that this area had been used for refuse disposal. The deposits in the external space in Operation V consisted of clay surfaces with no features. In phase H_1 the structural remains visible in the northwest section (Structure XIV_1) appear to have continued, whereas Structure XV_1 had been abandoned and the deposits in this part of the trench consisted of eroding building material and a pit filled with burnt material, ash and pottery sherds dug into it. The corner of a potential structure (XIII) that extended southwards into the baulk was found in the southern corner of Operation V. Immediately north of the latter was another building, Structure XII_2, of which only the central part lay within the excavation area. It appears to have been a rectangular structure (5.90 m wide with a reconstructed length of *c* 7 m) with two internal spaces similar to other buildings found at the site. The structure had a single floor made of hard packed clay and its internal wall faces were plastered with possible traces of red pigment found in some places. A bin containing three small, complete pottery vessels and a shaft straightener was located at the western end of the south space, and two primary child burials were found below the floor by the bin, in the northwest corner of the space.

Figure 6.2: Plan of the structural remains found in phases K_2 through E.

The structural configuration in Operation V continued into phase G with a new floor made of clay, coated with red ochre, in the north space of Structure XII_1 (otherwise this structure was unchanged from its earlier phase Structure XII_2). Parts of another building, Structure XI_2, were found in Operation IV. It appears to have been a rectilinear building with two internal spaces similar to other structures; only the southwest part of the structure was found in plan, with some walls and floors (at least four clean clay floors were recorded) of the northeast part of the building visible in section. A burial cist containing the remains of at least eleven individuals (ten adults and one juvenile have been identified) and some long bones of larger animals were located at the western end of the south space. The burials were apparently all secondary, although a partially articulated skeleton (from the ribs down) was found in the centre of the cist. A range of objects was also found among the bones, including pottery vessels (mostly cups and small jars), spindle whorls and a celt, and red ochre had been sprinkled over the burial area. The cist was constructed at the same time as the building and appears to have been in use until it was abandoned. A series of simple clay floors mixed with significant amounts of debris (probably through trampling) and a possible hearth associated with the earliest floor in the south space, was used to separate the occupation of the building in phase G from the subsequent phase F (designated as Structure XI_1). In the latter phase the last two floors in the south space were made of clay, or a mixture of clay and lime, and apparently kept much cleaner than the floors assigned to the earlier phase.

The use of space in Operation V changed throughout phase F; in phase F_2 it had been an open area consisting of clay eroding from the abandoned Structure XII_1 with a large pit (about 2.40 x 1.40 in plan and *c* 1 m in depth) dug into it. At some point in phase F_1 Structure X_3 was constructed, the northeast corner of which almost abutted Structure XI_1. Only the central part of this building and its northeast corner lay within the two trenches (Operations V and IV respectively) with some walls and floors visible in section. It was rectangular in plan (*c* 6.60 x 7.30 m) with two shorter walls dividing the interior into two separate spaces. Both spaces had a sequence of two floors, each denoting a separate phase; the earliest floors in the two spaces belonged to Structure X_3 in phase F_1 and the second floor in each space to Structure X_2 in phase E. The south space had clay floors mixed with refuse and is believed to have been unroofed, whereas the north space, which was slightly larger in size, had clean clay floors coated with red ochre. In the north space of Structure X_3 a hearth was located against the western part of the eastern dividing wall, and two burial cists had been constructed by the western dividing wall with the eastern of the two extending further east than the wall. The interior of these two cists (the western one measured *c* 1.32 x 1.15 m, and the eastern one *c* 0.92 x 1.19 m) had been coated with a mud plaster, and human bones deposited in them before they were sealed with a clay cap. Two skulls covered in red ochre and a few pottery vessels were found in the western cist (as it was not fully excavated because the western part lay outside the trench, it may have contained more human remains), and the disarticulated bones of at least three adults and one child covered in red ochre, four animal bones (three long bones from a large animal and the jaw of a pig) and a ceramic bowl were found in the eastern cist. There were no features found in the south space apart from what appeared to have been a short wall (running east-west) at its eastern end.

Structure X_2 (the later phase of Structure X_3) continued to be occupied in phase E with some changes to the internal spaces. Two large jars had been set into the floor in the western part of the south space (although they were most likely used sequentially rather than at the same time), and in the north space the second floor was laid over the hearth and the eastern cist, and a new burial cist had been constructed over the western one. It had also been lined with mud plaster, and contained human remains. However, as most of it lay outside the trench the number of individuals has not been reported. The remains of a low, thin wall in the section east of Structures X_3-$_2$ has led Voigt (1983: 52) to suggest that there might have been a small courtyard containing deposits of refuse and burnt material attached to the building on its eastern side. Most of the open areas further east contained compacted clay whereas the areas immediately east of Structure X_2 had patches of burnt clay and thin lenses of ash and refuse, which may indicate that burning events and some refuse disposal took place there.

6.3.2: Phase D

Phase D was the earliest phase excavated in the 1968 trench (albeit only in the central part) and the remains include a range of architectural configurations (some of which were not complete) that differed from the preceding structural remains (Figure 6.3). The corner of what may have been a building (Structure VIII) extending further south and east was found in the eastern part of the trench. In the western part of the trench was a wall (approximately 6.85 m long) running east-west with three smaller spaces at its eastern end (Structure IX) and a possible enclosed, unroofed courtyard (Structure X_1) to the north (located in Operation V). Only the three small western spaces in Structure IX were excavated; most of the northern wall was reconstructed based on information obtained from the section, which indicated that it had been plastered on both sides. Two of the small spaces were located along the north wall (the northeast space will be referred to as S1 and the northwest space as S2) with the third (S3) located south, and adjacent to, S1. S1 measured *c* 0.91 x 0.74m and had thin, sloping clay floors, whereas S2 was smaller (*c* 0.56 x 0.83 m), but as it was not fully excavated no further information is available. S3 was filled with lumps of burnt clay and ash and had traces of burning on its north wall, which led Voigt (1983: 50-51) to suggest it may have been an oven, although this cannot be verified. A domed oven had been built against the south wall of S3; its walls had been preserved to a height of about 0.25-0.30 m, curving towards the top, and its floor sloped down from the back wall towards the south indicating that its opening was to the south. Structure X_1 (north of Structure IX) appears to have been built over the southern part of the earlier Structure X_2; the southern parts of the east and west walls, and the two internal walls of Structure X_2 had been used as foundations for Structure X_1. The nature and slope of the deposits against the eastern wall, consisting of thin lenses of refuse, indicated that this had probably been an unroofed space, which led Voigt (1983: 51) to suggest that it could have been a courtyard attached to Structure IX. No features were found inside the enclosure, or in the external area to the north and northeast of it, but two carinated pits lined with clay and fired *in situ* were found in the section just east of Structure IX.

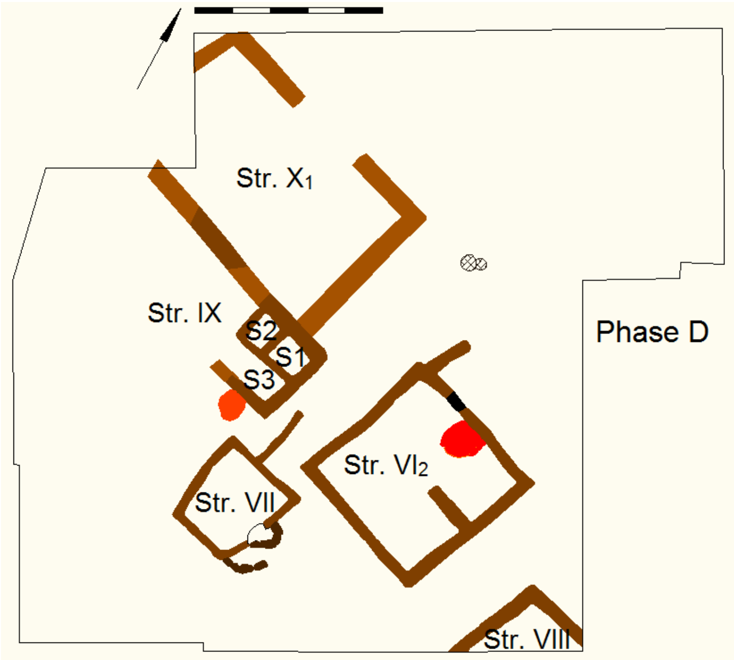


Figure 6.3: Plan of the structural remains found in Phase D.

Two complete buildings, Structures VII and VI_2, were unearthed in the central part of the 1968 trench, in the area between Structures VIII and IX. Both had been built in the later part of phase D and appeared to be different in plan than most other structures excavated at the site. Structure VII was a small rectilinear building (*c* 2.60 x 2.40 m) with a raised doorway in its east wall; the threshold was 0.25 m above the floor. There was a semi-circular line of clay lumps partially blocking the entrance and another curving line of irregular clay lumps (preserved to a height of about 0.15 m) extending northwards from the southeast corner of the building. An external mud brick wall extended northwards for about 1.68 m from the north wall of the building, which appears to have been built before Structure VII and incorporated into the building. It was only partially excavated and its function remains unknown although Voigt (1983: 27) points out that it would have restricted movement between the buildings in the area. The areas on either side of this wall were narrow due to the proximity to Structures VI_2 and IX (to the east and west respectively) and contained lenses of ash and refuse, possibly associated with the use of the domed oven adjacent to Structure IX. Structure VII had a smooth clay floor that had been kept clean, but no features were found in the internal space and the function of this building is unclear.

Structure VI_2 was located immediately northeast of Structure VII, with lenses of refuse and clay deposited between the two buildings. It was square in plan (4.40 x 4.40 m) with an entrance in the western part of the north wall and a short external wall projecting north from the northwest corner of the building, adjacent to the doorway. A short internal wall (*c* 1.30 in length) divided the eastern part of the interior space into two areas, and a hearth had been built against the central part of the north wall. As only the eastern part of Structure VI_2 was excavated there is no further information available regarding the hearth or the use of space in the western part of the building during this phase (the latest occupational phase of this building occurred during the subsequent phase C and the internal layout will be described further in the next section). There are no details given regarding the area north of the internal wall, whereas about 0.20 m of deposits that had been sealed by the second floor in the building, i.e. Structure VI_1, were found on the floor in the area south of the wall. This deposit contained the fragmentary remains of at least four individuals (one adult, one adolescent and two juveniles), as well as animal bones and horn cores (including red deer, goat, sheep and pig), five clay cones, a bone awl, charcoal and burnt clay. The fact that this burial deposit was sealed by the floor of Structure VI_1 may indicate that it belonged to the phase C occupation of the building (Structure VI_1), or was deposited sometime between the two phases.

In the external area immediately adjacent to the west wall of Structure VI_2 was a trough-like depression containing hearths, and over time this depression had been filled with ash and lumps of burnt clay. The deposits in the external area to the east of Structure VI_2, between it and Structure VIII, consisted of large quantities of refuse and ash, and Structure VIII had, after its abandonment, been filled with black refuse deposits. It is possible that these deposits were associated with activities taking place in the external space between Structures VIII, VI_2 and VII; however, as this area was not excavated the precise nature of these activities remains uncertain.

6.3.3: Phase C

Phase C is the phase of occupation for which the most information is available concerning the configuration of space with structures spread across the entire 260 m^2 area excavated (Figure 6.4). Even though only one complete building was excavated, there was enough information to reconstruct a further two structures, and the fragmentary remains of another two potential buildings (Structures I_2 and IV) were also unearthed. Structure IV appears to have been rectilinear in plan and may have had two distinct internal spaces (based on the number and the nature of the floors found in the eastern and western parts of the structure), and Structure I_2 appears to have been rectilinear in plan, possibly with two internal spaces. The northern space had a small internal wall projecting westwards from the east wall and a clay floor. The fragmentary remains of a wall that had been removed by a later pit were visible in section east of Structure I_2, although the nature of this wall is unknown.

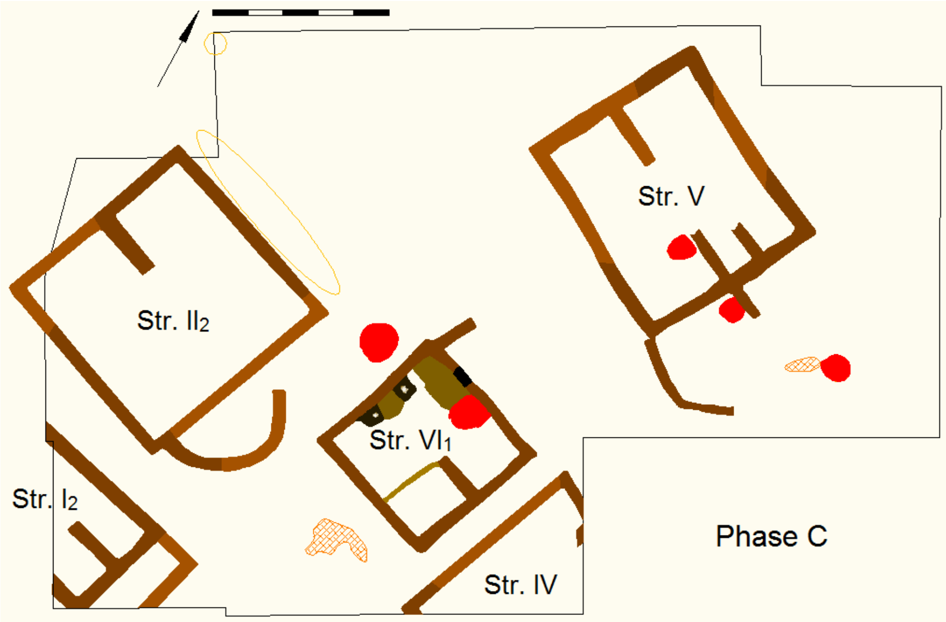


Figure 6.4: Plan of the structural remains found in Phase C.

Structure VI (west of Structure IV) continued to be occupied in this phase; the second floor (made of hard packed clay mixed with refuse) marks the latest phase of occupation and the building is now referred to as Structure VI_1. The general plan remained the same as in the preceding phase D; the building was square with a shorter internal wall dividing the eastern part into two areas, and there was an entrance in the north wall. The door sill was 0.20 m above a platform that extended about 1.50 m from the west wall and *c* 0.85 from the north wall. The central part of the platform was made of mud bricks (0.24 m wide, 0.39 m long and 0.08 m high) whereas the parts to either side of the bricks were made of packed mud. Adjacent to the platform the hearth that was constructed against the north wall during phase D continued to be in use. The area south of the internal wall had been further separated from the rest of the building by the construction of a low clay curb between the south wall and the internal wall, and the floor in this area (which sealed the burial described in section 6.3.2) was more irregular and soft than in the rest of the structure. Built against the central part of the western wall was a feature made of packed mud of unknown function. It was symmetrical and consisted of two 0.16 m high rectangular blocks with a 0.70 m long platform in between. This platform was only about 0.06 m high with a curved edge (maximum width was *c* 0.55 m) that had a low clay rim with a 0.20 m gap in the middle. The two blocks on either side of the platform differed in size, but each had a rectilinear cavity in its top surface that measured between 0.10 and 0.14 in depth and had flat bottoms. Both of the cavities and parts of the surfaces of the blocks had been discoloured by fire. The traces of burning may indicate that fires had at some point been lit on them, perhaps to provide lighting, although its function is uncertain. West of Structure VI_1 was Structure II_2, a large, square building with a possible courtyard attached to its eastern wall. As most of the information about this structure pertains to the latest phase of its occupation in phase B, it will be described in the next section.

The external areas south of Structure VI_1 were almost level with deposits consisting of fairly clean clay surfaces and structural collapse with small quantities of ash and refuse. This area contained a large, irregular and shallow (0.10-0.20 m deep) pit with burnt edges that had been filled with ash and burnt debris, including a clay sealing, large pieces of pottery, and lumps of clay and mud bricks. In the external space immediately west of Structure VI_1 was a circular hearth that had been maintained throughout phase C; the curb encircling the hearth floor had been rebuilt three times and each of the four curbs had at least two floors associated with it. There was an opening in the curb to the south, possibly for raking out the ashes from the hearth. Ash and refuse had accumulated around the heart and in the area along the north wall of Structure II_2, to the west of the hearth. In the latter area there was a series of irregular burnt patches that may have been temporary hearths. This indicates that a range of activities associated with the use of fire took place around Structure II_2. North and east of Structure II_2, especially along the exterior (east) face of the wall of the possible courtyard, the excavators found traces of reed matting, which may have been mats that people sat on when engaged in various activities. Another work area was located northwest of Structure II_2 (at the western end of Operation V), possibly associated with another building situated outside the excavation area. A hearth located on a series of pebbled surfaces was recorded in section, and south of the hearth there was a low wall that Voigt (1983: 26) suggests may have been a courtyard wall.

The remains of another building, Structure V, were found in the northern part of the excavation area. The western end (in Operation IV) had been heavily disturbed by later pits and the central part had been lost due to erosion between excavation seasons, whereas the eastern end (in the 1968 trench) was almost completely preserved at floor level. Structure V was rectangular in plan (*c* 5.50 x 6.50 m) with a shorter internal wall projecting west from the east wall. It is possible that there had originally been another dividing wall at the opposite end of the building as seems to be a recurrent feature of the structures at Hajji Firuz. Even though the southwest part of the building had been removed by a later pit, there was an observable difference between the floors in the southern and the northern parts of the building. The floor in the north space consisted of compacted clay surfaces mixed with refuse, whereas in the south space there was a sequence of two cleaner clay floors. There was a hearth built against the partition wall in the eastern part of the south space which had been renewed at the same time as the floor. In the north space there was a large storage jar set into the floor at the western end and a short internal wall dividing the eastern end into two areas of different width. An unroofed courtyard was attached to the eastern part of the structure; there was a wall curving northwards from the southeast corner of the building and another, shorter wall projected eastwards from the central part of the east wall. The courtyard was entered from the north, and, even though parts of the curving wall had been removed by a later pit, it appears that the entrance was quite wide, measuring at least 1.20 m in width. Inside the courtyard the floor surfaces consisted of lenses of clay mixed with refuse with a patch of gravel by the entrance and a hearth located by the short northern wall.

East of the courtyard, adjacent to its entrance, were a circular hearth and a narrow, oval pit which had burnt sides and was filled with refuse. There were no features found in the external area between Structure V and Structure VI_1 to the south.

6.3.4: Phase B

The structural remains in phase B included the final use and abandonment of Structures II_2 and IV, and the fragmentary remains of a wall located in the northeast corner of the excavation area (Figure 6.5). Immediately north of the latter wall was a hearth, and it is possible that the fragmentary wall was either part of a structure that had not survived, or a wall built to shield the activities taking place around the hearth. There were also some possible fragments of walls visible in the eastern section of Operation IV and the western section of Operation V, indicating that other potential buildings had originally been located in this area, but had not survived. In the western part of Operation V the excavators found parts of a rectangular pit that extended outside of the trench and a carinated pit that was only visible in section. Both of these features had been lined with clay and fired red, and the trench was filled with a loose, ashy deposit.

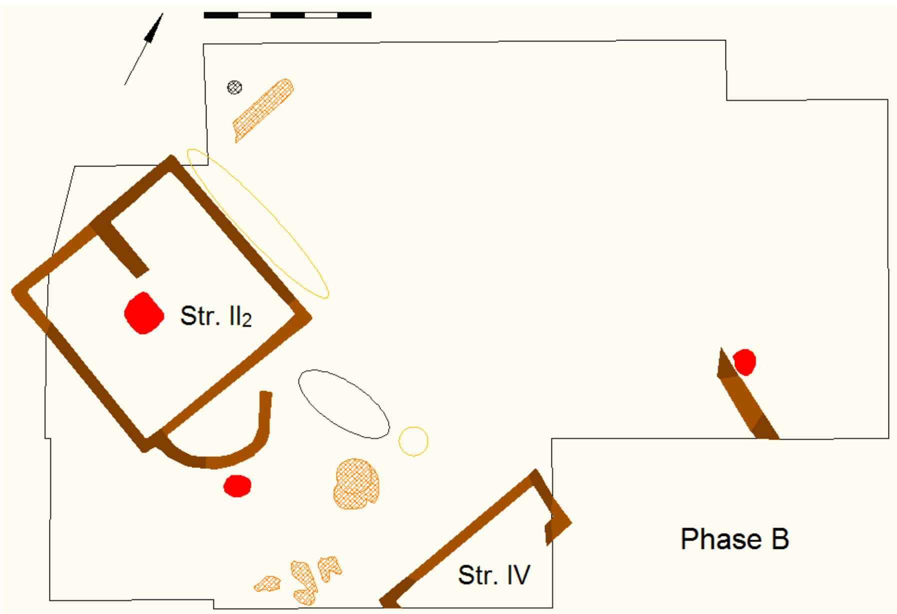


Figure 6.5: Plan of the structural remains found in Phase B.

Structure II_2 was difficult to delineate during excavation, but combined with information from the sections, the building could be reconstructed; it was square in plan (*c* 6.40 x 6.40 m) with a short internal wall projecting east from the west wall. Only four soundings were dug inside the buildings – in the northeast, southeast and northwest corners, and in the central part – and information on the layout of the structure is therefore limited. A sub-rectangular hearth located in the middle of the structure, southeast of the internal wall, was the only feature found. The fragmentary remains of a low mud brick wall curving north from the southeast corner appear to indicate that a small external courtyard was attached to the building. Alternatively, Voigt (1983: 42) also suggest that it could have been built to protect the doorway if it had originally been located in the eastern wall.

The external space between Structures II_2 and IV appears to have been an open area containing a variety of features and large quantities of black, ashy debris with pieces of burnt clay. A series of seven irregular pits of varying size and depth with fired sides were located in this area; some of the pits were cutting others, indicating that they had been dug at different times. The fill of the pits consisted of deposits containing ash, burnt soil and burnt debris, including fragments of animal bones, lumps of clay with reed impressions, mud bricks, pottery sherds, fragments of human and animal figurines, and five clay sealings. An oval hearth that had been renewed at least once was found adjacent to the Structure II_2 courtyard, and a possible oven (missed during excavation due to disturbance by later pits and only recorded in section) was located halfway between Structures II_2 and IV. In the area between the possible oven and Structure II_2 was a series of small, irregular pits filled with refuse. North of Structure II_2 was an open area containing a series of hard surfaces with burnt patches (possibly temporary hearths), especially along the northern wall of Structure II_2 (as in phase C), and lenses of gravel, possibly scattered to reduce the amount of mud forming during wet periods (a practice that has been noted in modern day Iranian villages e.g. Watson 1979: 157, 109, 283-284).

6.3.5: Phase A_3

The architectural remains in Phase A_3 consisted of a row of three structures aligned north-south and separated by alleyways in the western part of the trench, namely Structures I_1, II_1 and III (Figure 6.6). Structure II_1 was the best preserved with an almost complete plan and well preserved internal features. It was rectangular (*c* 5.90 x 6.50 m) with two smaller internal walls that divided the interior into two main spaces (S1 to the south and S2 to the north) and a ground level doorway through the eastern wall leading into S1. There were changes in the location and types of internal features during the occupation of Structure II_1, and the plans used in the scenario modelling (sections 6.4.1 and 6.4.2.5) are that of the structural layout during the earliest phase and the latest phase after which it was abandoned.

S1 was the largest of the internal spaces (by about 0.40 m), and had a level, relatively clean clay floor that had been renewed four times, of which the second had been coated with a red pigment (possibly red ochre). The walls in this space had been plastered and whitewashed, and there were traces of black pigment, thought to be carbon (Winter 1983: 337-338), found in some areas. A hearth was placed by the western end of the short eastern wall separating

S1 and S2; it had been completely rebuilt once, and its floor had been renewed an additional two times. During the earliest phase of Structure II_1 there was a burial cist (*c* 1.34 x 0.34 m) in the northwest corner of S1 and a large storage vessel set into the floor in the southwest corner. In the latest phase the storage vessel was cut down to the same level as the floor, filled with soil and a second burial cist constructed over it. The cists contained disarticulated human remains and had been capped with packed mud giving them the appearance of a platform. It is uncertain, however, whether this was done during the use of the building or at the time of abandonment. The northern cist (*c* 0.20 m high) contained the remains of between eleven and thirteen individuals, two of which were partially articulated (see Voigt1983: figs. 64-65), whereas the rest were secondary burials even though there were some articulated limbs present. Three fragmentary animal bones (including a pig tooth and a sheep or goat mandible), a ceramic cup and a small jar, an oval hand stone, a grinding slab, a polishing stone, a stone palette, and a blade were found among the bones and red ochre had been scattered over the burials. The southern cist was lower (*c* 0.10 m high) and contained the secondary remains of two juveniles, one adult male and one adult female that were more or less complete apart from the placement of the skulls separate from the bodies. Red ochre had been scattered over some of the bones (although not on the juvenile skulls) and a range of objects had been placed in the cist with the bones, including eleven clay whorls, a clay cone, an incised stone, a celt, a flint core, a ceramic cup and a small jar, a stone ball, a polishing stone and a bone scraper, as well as eight fragmentary animal bones (identified as pig, goat, sheep/goat, and possibly wild *Bos*), and lumps of red ochre. These burials are discussed in more detail in section 6.4.1.

In S2 there were two smaller spaces located at the eastern end; the northeast space, S3 (*c* 1.69 x 1.12 m), had a sequence of three irregular, dirty clay floors, and the southeast space, S4 (*c* 1.38 x 0.78 m) had a sequence of five floors, of which the first four were made of clay and grass and the last of clay and gravel. Voigt (1983: 41-42) suggested that S4 was used as an oven, at least during the latest phase because the last floor had been fired red. However, the original construction had not been preserved and this can therefore not be verified. The main part of S2 had a sloping, uneven clay floor that had been renewed at least two times. There was a hearth by the northern wall and a series of storage jars set into the floor by the shorter internal wall in the western part of S2 during the early phase of Structure II_1, which includes the first two floors in S2 and the first four floors in S4. In the latest phase of occupation, which included the latest floor in S2 and the burnt floor in S4, there was a change in the configuration of space in S2; the new floor was laid over the hearth and storage vessels in the western part, and a new hearth was built by S3 at the eastern end of the space. Additionally, a low ridge made of clay was constructed between S1 and S2, emphasising the internal division of space within the building, and there was another low clay curb that extended from the latter ridge towards the hearth in S2.

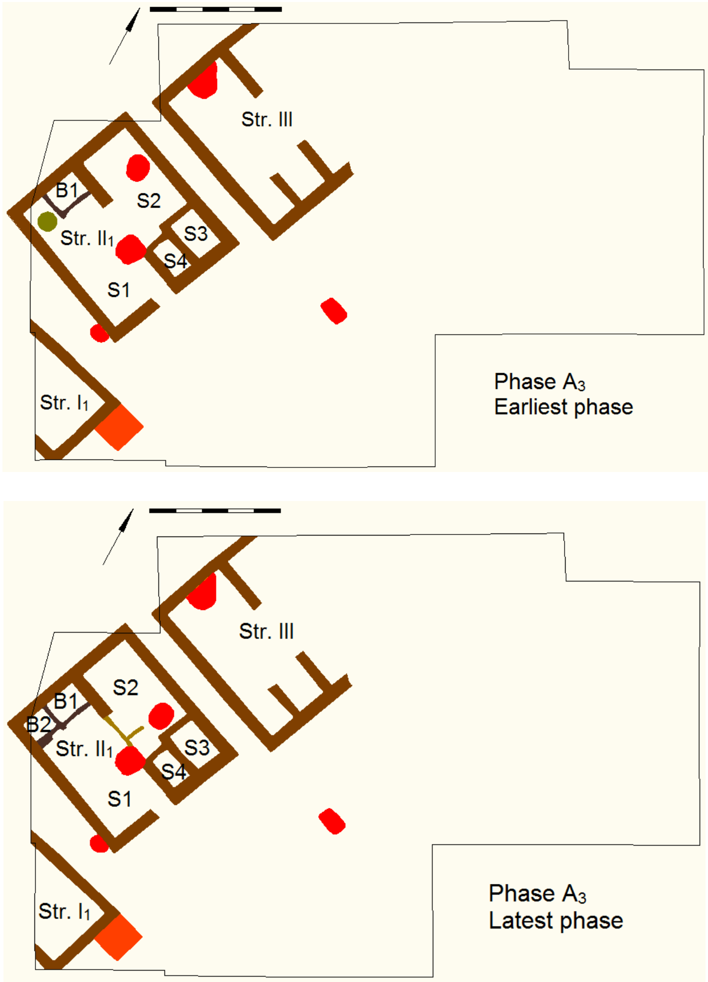


Figure 6.6: Plan of the structural remains found in Phase A$_3$.

The other two structures found in phase A$_3$ were not fully preserved; only the northeast corner of Structure I$_1$ was located within the excavation area, and the northern half of Structure III had been removed by later pits. It appears that Structure III had a similar layout to Structure II$_1$ with at least one internal wall (extending west from the east wall) dividing it into two spaces. It had one clay floor (in both spaces), the internal wall faces had been plastered and whitewashed, and the eastern end of the south space appeared to have been divided into two niches in which there were found sherds from at least one large storage jar. In the western end of the south space there was a 0.20 m thick deposit containing ash, burnt soil, fragments of mostly burnt bone (some of which were human), and complete pottery vessels, which Voigt (1983: 43) suggests may have been the remains of a hearth and associated cooking vessels. Even less is known about Structure I$_1$, but the internal wall faces seem to have been plastered; the floor was irregular and sloped due to the collapse of the underlying Structure I$_2$; three large storage vessels had been set into the floor; and the base of a jar containing the remains of two individuals (an adolescent and a juvenile) were found under the floor.

Three fire installations were found in the external spaces: an oval hearth built against the eastern end of the south wall of Structure II_1; a rectangular hearth located in the area east of Structures II_1 and III; and a domed oven (which had been re-built three times) attached to the eastern wall of Structure I_1. The alleyways that separated the three structures contained alternating lenses of refuse, ash and clay that had been hardened by continuous trampling, indicating that they provided passage, possibly for both humans and animals. Most of the northern part of the excavation area was heavily disturbed by later pits and the configuration of space there is not known. The deposits in the area east of the structures consisted of a series of clay surfaces with refuse accumulated on them, with the amount of debris increasing with the distance from the buildings, whereas the deposit in the area immediately east of Structure III consisted of black organic material interspersed with very thin clay lenses. It is possible that various work related activities, some associated with the use of fire, took place in this area with refuse disposal occurring in and, especially, around it.

6.4: Modelling scenarios

This chapter has so far summarised the structural remains and spatial layout of the excavated part of the Neolithic settlement in each archaeological phase. Voigt (1983: 31-36) has argued that the large structures were all domestic houses that consisted of a ‘clean’ living room and a ‘dirty’ utility room, and that the two smaller structures (Structures VI_{1-2} and VIII) were non-domestic due to their size and the structuring of internal space. This may be the case, but the fragmentary nature of many structures and the variability in buildings plans recorded in phase D could indicate that the architecture at the site may have been more varied than observed in the excavated sample, especially since the excavated area is admittedly limited compared to the original extent of the settlement (as is the case with most excavated sites). It is possible that the variation in architectural form could be related to differences in function, although this may not necessarily mean that they were non-domestic or ‘ritual’ since storage, animal penning, and working (all of which are possible alternative functions) may be considered part of the domestic sphere. The possible function of the phase D buildings is discussed further in sections 6.4.1 and 6.4.2.2.

The remainder of this chapter examines the structuring and use of space in phases J through A_3. Phases K and L have not been included as the structural remains were too fragmentary to yield any information. Due to the level of preservation and later disturbances parts of some of the buildings used in the scenario modelling had to be reconstructed during the digitising process. Following a close reading of the published materials and an evaluation of the reconstructions proposed by Voigt (see Voigt 1976: fig. 25-49, 1983: fig. 14-24, 27-48), it appeared that the latter were fairly reliable, and it was therefore decided that they would form the basis for the reconstructions used in the scenario modelling. The reconstructions were based on the nature of the excavated structural remains such as the thickness and alignment of walls; the angle of wall corners; the extent of internal floors and external surfaces; the extent and structural configuration of internal features (e.g. bins and burial cists); and observations of structural remains made in trench sections, e.g. the alignment, angle and thickness of walls, and the junction between floors and/or external surfaces and walls (e.g. where the former lipped up onto walls). In some cases the preserved parts of a building (in the excavation area and sections) included two diagonally opposite corners (sometimes three corners) and/or parts of the four enclosing walls, e.g. Structures X_{3-2} and V, which enabled a reconstruction of the remaining walls that had been truncated by later activity and/or were located outside the trenches (i.e. the walls could be 'joined up').

Some of the reconstructions were more tentative as only portions of two or three of the outer walls of a building had been preserved and/or recorded in section, and thus their original extent were less clear. With regards to Structure XII_{2-1}, the available evidence allowed a reconstruction of most of the building with the exception of the precise location of its western wall. Since the length of similar structures at the site ranged between 6.40 m and 7.30 m it was decided to place the western wall immediately outside the excavation area, thus giving Structure XII_{2-3} a reconstructed length of *c* 7 m.[53] Based on the available data it is believed that this reconstruction is a reasonable representation of the potential extent of the original building, although it is possible that it extended further westwards. With regards to Structure XI_{2-1}, the preservation of the western part of the building (which included floor surfaces, parts of the western and southern walls and a shorter internal dividing wall) in addition to walls, floor surfaces and a potential fire installation recoded in the northeast and southeast sections provided the basis for the reconstruction of the western part of the structure. The location of a wall and the presence of floor surfaces south of it (observed in the northeast section) indicated that there had been a wall running east-west enclosing an internal space to the south, and this wall was reconstructed to join the western wall. Based on the available evidence it is proposed that the part of the building located west of the aforementioned sections (see outline for Phase F_1 in Figure 6.2) presents a reasonable reconstruction of what this part of the structure may have looked like. The location of the eastern wall, on the other hand, is only hypothetical as it is not possible to accurately assess the eastward extent of the building, although the reconstructed spatial extent of the structure falls within the range observed in similar buildings at the site. The reconstructed Structure XI_{2-1} thus presents an *alternative* of what the buildings may have looked like, although it is possible that the original extent were smaller or larger than the reconstruction. There was even less information available concerning the original extent and layout of Structures XV_{2-1} than for Structure XI_{2-1} and it was felt that any attempt at reconstructing it would not add any significant information to the discussion of the structuring and use of space. Only the western

[53] This also meant that the bin located at the western end of the south space would be similar in size to other bins and burial cists excavated at the site.

parts of these buildings were therefore digitised, although the southern and northern walls were extended slightly further eastwards to indicate minimum extent.

The method of excavation and recording employed at the site and the extensive publications mean that there is more information available than for Ganj Dareh and Jarmo. It is therefore possible to identify activity areas with a higher degree of confidence than in previous chapters, which allows for a more informed discussion of the use of space at the site. Initially, the potential numbers of people that can co-reside and be co-present are assessed through the modelling of maximum capacities of Size A and Size B adults sleeping and sitting cross-legged (section 6.4.1). Following this is a discussion of activity areas and the use of space within buildings and in external areas, and the differences in the scales of interaction taking place in different spaces (sections 6.4.2-6.4.2.5). The final part of this chapter considers the potential storage capacities for individual buildings for both grain for human consumption (section 6.4.3) and animal fodder (section 6.4.4), and provides an assessment of the affordance of space for animals within the built environment (section 6.4.4).

6.4.1: Contextualised maximum capacity

The maximum numbers of Size A and Size B adults that could sit cross-legged and sleep in each of the buildings that were more or less complete, or could be reconstructed, have been summarised in Table 6.2 (Figures 6.7-6.12). Enclosed courtyards, i.e. Structure X_1 and those attached to Structures II_2 and V, are included as they may have provided a space for interaction and sleeping that was spatially separate from the main external areas. No modelling was done when most of the building was located outside the excavation area, or when the original plan of the structure could not be reconstructed. The buildings that were not modelled, and do not feature in the remaining part of this chapter, are those that have been designed as Structures I_1, I_2, IV, VIII, IX, XIII, XIV, XVI_1, XVI_2, XVII, and XVIII in the publication (see Voigt 1983: 26-59).

The modelling shows that most of the buildings afforded space for interactions involving more people than the structures at Ganj Dareh and Jarmo. About twice as many people, or more, could be co-present in individual internal space at Hajji Firuz compared to Jarmo (sections 5.5.1.1-5.5.5.1), and twice or three times as many as in the large spaces at Ganj Dareh (section 4.4.1). The modelled capacity for Structures XV_1 and XV_2 are minimum counts as only about half of the buildings were excavated, and since the maximum capacities modelled for the excavated parts indicated that there was room for at least ten Size A or nine Size B adults sleeping, it is possible that they were similar in size to the other buildings.

Phase	Structure	Space	Sitting		Sleeping	
			Size A	Size B	Size A	Size B
A_3	**II_1 late phase**	**S1**	16	13	12	10
		S2	11	8	7	7
	II_1 early phase	**S1**	16	13	13	11
		S2	12	10	7	7
	III	**north space**	10	9	11	10
		south space	19	17	17	14
C-B	**II_2**	**north space**	21	18	18	14
		south space	21	17	16	15
		courtyard	8	6	5	4
C	**V**	**north space**	19	15	14	9
		south space	18	15	14	13
		courtyard	11	9	8	6
	VI_1	**main space**	14	12	8	8
		SE corner	5	4	2	2
D	**VI_2**	**northern half**	10	9	5	5
		southern half	12	10	9	8
	VII	**single space**	8	6	4	4
	X_1	**courtyard**	25	21	23	20
E	**X_2**	**north space**	23	18	19	16
		south space	21	19	19	16
F_1	**X_3**	**north space**	24	17	17	14
		south space	23	20	19	17
	XI_1	**north space**	25	21	23	20
		south space	20	15	14	13
G	**XI_2**	**north space**	25	19	21	18
		south space	18	15	13	12
	XII_1	**north space**	24	20	18	15
		south space	20	17	16	14
H_1	**XII_2**	**north space**	26	21	18	15
		south space	21	18	17	14
H_2	**XV_1**	**north space**	>15	>13	>10	>9
		south space	>16	>12	>10	>9
J	**XV_2**	**north space**	>15	>13	>10	>9
		south space	>16	>12	>10	>9

Table 6.2: Modelled contextualised maximum capacities.

Structure VII, the smallest building excavated at the site, could accommodate eight Size A or six Size B adults sitting-cross legged and four adults (Size A or Size B) sleeping. Structure

VI_{1-2}, which is larger than Structure VII but smaller than the other buildings, could have accommodated at least fourteen Size A or twelve Size B adults sitting cross-legged, or ten adults (Size A or Size B) sleeping. This indicates that Structure VI_{1-2} had the potential to accommodate a co-resident group that was similar in size to those at Jarmo and some of the individual spaces in the other buildings at Hajji Firuz. It is therefore possible that it may have been a domestic structure (even though features similar to the ones along the western wall have not been found in other buildings), providing a living space for a smaller social unit than other co-resident groups occupying the larger structures.

It is possible that some of the modelled capacities are over-estimations; since many of the structures were not fully excavated due to their location and/or poor preservation, there may originally have been internal features in these buildings (e.g., hearths and bins). The presence and location of features would have had a direct impact on where people positioned themselves and the number of people that could have been present at any one time. Nevertheless, even Structure II_1, which was one of the most complete buildings excavated and contained a range of internal features, was large enough to accommodate almost twenty adults (Size A or Size B) sleeping, or over twenty adults (Size A or Size B) sitting cross-legged. Individually, each internal space may have accommodated a co-resident group similar in size to Structure VI_{1-2} and some of the structures at Jarmo. The fact that the buildings could accommodate interactions involving a large number of people, and provide living space for larger co-resident groups, does not mean that the modelled number of people lived in these buildings. Large internal spaces could be a response to a range of different social requirements, and is most likely the result of a combination of factors. This may include the size of co-resident groups; a greater need for long-term storage (e.g. food for both human and animal consumption); a need for an internal space in which to entertain guests (i.e. an increase in socialisation between co-resident groups taking place within domestic structures); and/or perhaps a greater need for personal space within the co-resident unit.

It may be that the buried population could provide some insights into the size and composition of co-resident groups. Burials generally occurred in cists (Structures II_1, X_{2-3}, and XI_{1-2}), below floors (Structures XII and XV2), or between two floors (Structure VI_{1-2}).[54] Sub-floor burials (only in phases $J\text{-}H_1$) were single inhumations, whereas burials in cists and between floors (phases $G\text{-}A_3$) contained multiple individuals. If it is assumed that the burials containing multiple individuals were members of the same co-resident group that had passed away during the occupation of the building, the burial population may give some indication of the size and composition of the co-resident unit, or at least the part that passed away during the occupation of the building. Based on these assumptions, let us briefly consider the burials found in Structure II_1 as it was the best preserved building and the available

[54] Human remains were also found in Structure III, but it is unclear if the context in which they were found could be considered a burial, and in a jar in Structure I_1, and in Structure IV (in a pit and between two floors), as well as an unexcavated building in Operation III (see Voigt 1983: 79-94).

information about the skeletal remains is more comprehensive than for any of the other burials.

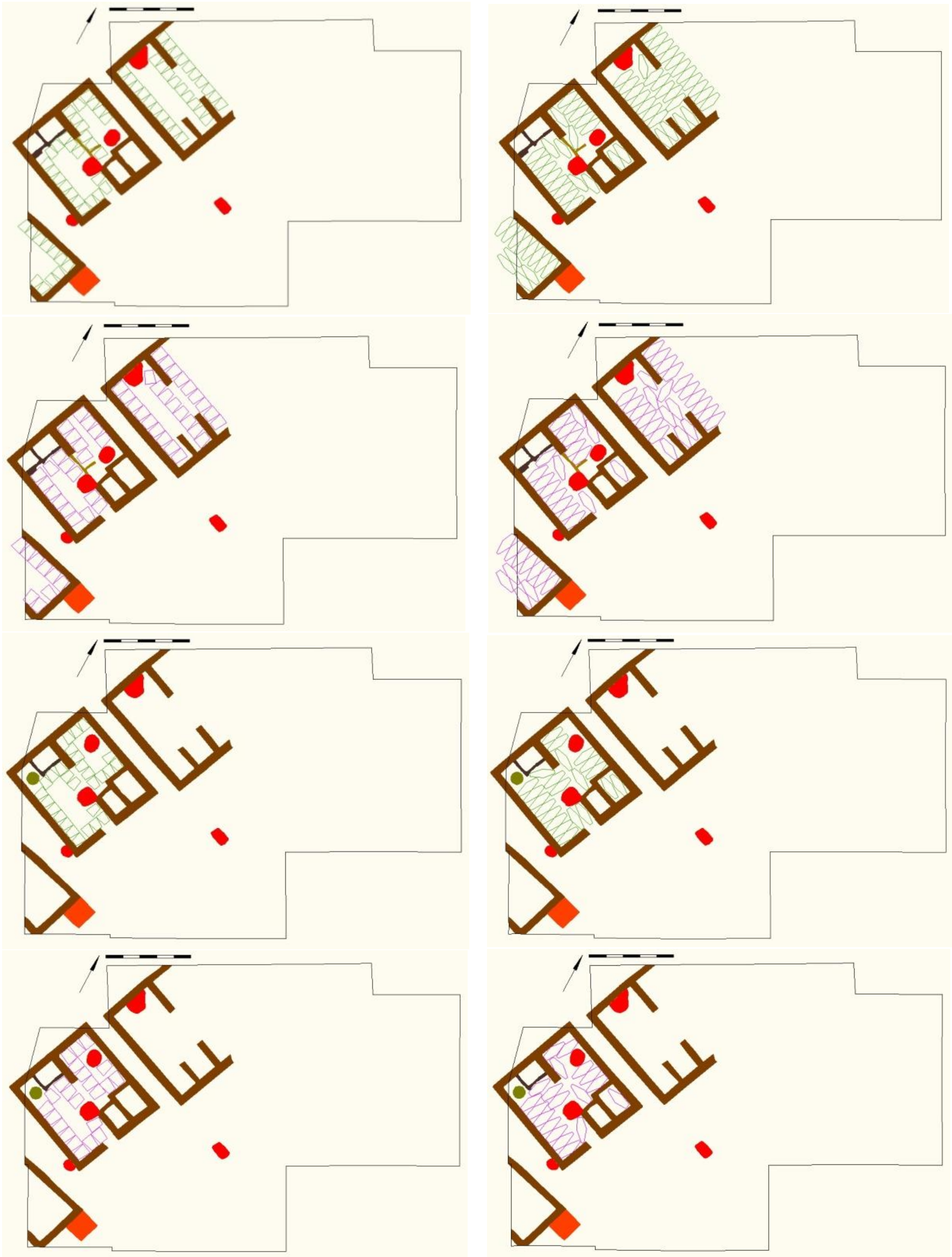


Figure 6.7: Modelled maximum capacities of Size A and Size B adults sitting cross-legged (left) and sleeping (right) in the earliest and latest phases of phase A_3 (top two and bottom two respectively).

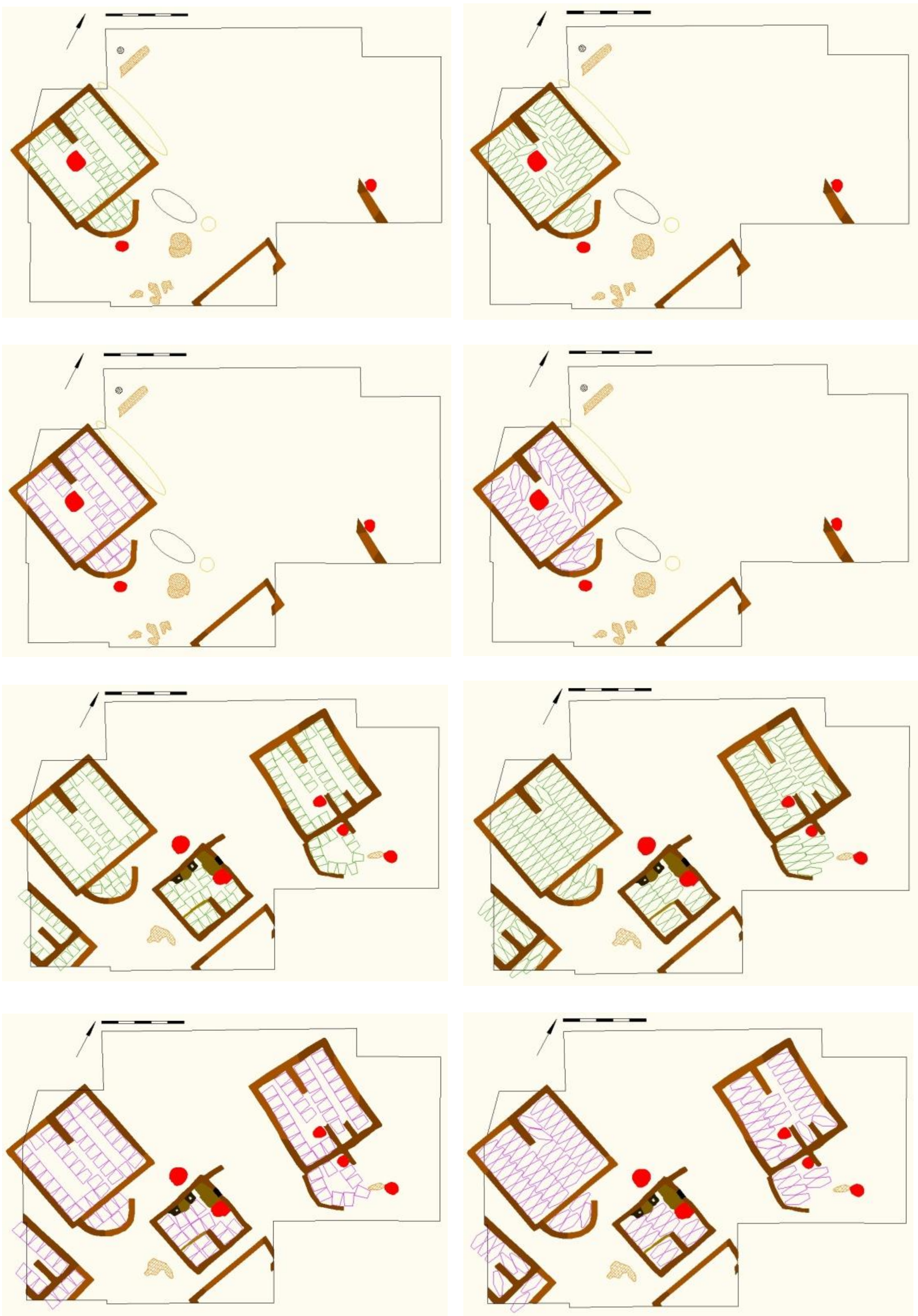


Figure 6.8: Modelled maximum capacities of Size A and Size B adults sitting cross-legged (left) and sleeping (right) in phases B and C (top two and bottom two rows respectively).

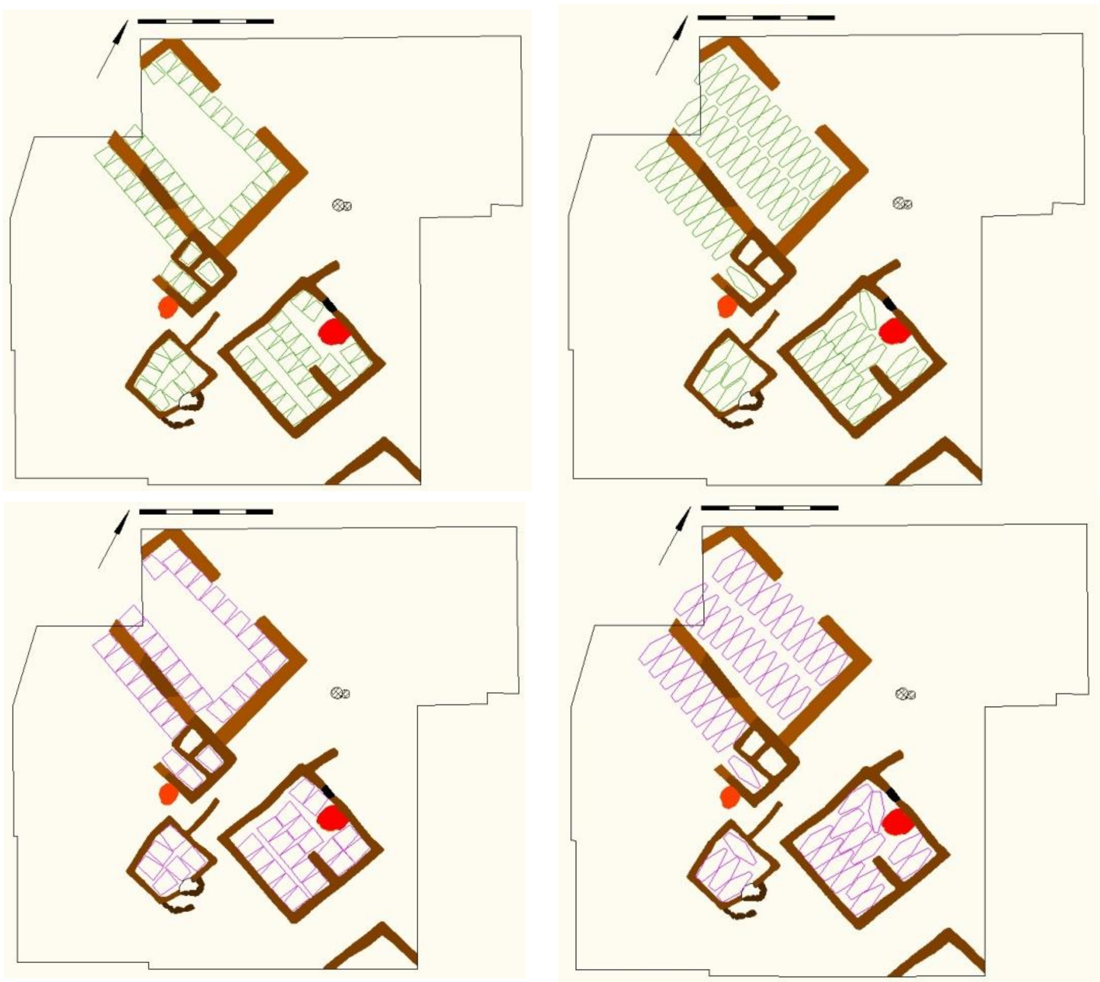


Figure 6.9: Modelled maximum capacities of Size A and Size B adults sitting cross-legged (left) and sleeping (right) in phase D.

There were two cists containing human remains at the western end of S1 in Structure II_1; one was built in the earliest phase (B1) and the other in the latest phase (B2), and both had been capped by mud prior to the abandonment of the building. B1 contained the remains of six, or possibly eight, adults (at least two females and four males), three juveniles and two infants, whereas two adults (one female and one male) and two children (one was an infant or a very young child) were interred in B2 (Voigt 1983: 79-84). The total of eight to ten adults and seven children is within the capacity for co-residency in the building, or perhaps in the potential living space, assuming that children would have required less space and that some of them may not have been alive at the same time, such as the two infants and the two children. Based on the location of the skeletal remains it appears that one of the adults was the first to be interred, followed by a group consisting of an infant, a juvenile and an adult male, and then the remaining four adults, two juveniles and the infant, of which an adult female was the last individual to be placed in the B1. The burials in B2 were possibly later than some, or all, of the ones in B1, although the skull of the adult male was apparently set into the northeast corner of B2 and may have been placed there when the cist was constructed. It is, however, clear that at least the two adults and two children in B2 were interred at some point in the latest phase of the occupation. This illustrates that not all of the individuals that were buried in the cists were alive at the same time. Additionally, the size of the individual co-residents changed during the occupation of the structure as each individual aged (and especially children), and the amount of space each person used probably changed over the years.

It may be suggested that the potential living space, S1, could have accommodated a social unit that originally consisted of a couple with their children, some of which eventually grew up and may have married but continued to live in the building with their spouses (and potentially also their children). Alternatively, the co-resident group may have consisted of two, or perhaps up to four, closely related, couples with their children. In other words two or three generations may have resided in the structures, with some of the younger couples eventually moving into new buildings, perhaps when they had one or more children. Similarly, the burial cist at the western end of the south space in Structure XI_{1-2} contained the remains of at least ten adults and one child, although Voigt (1983: 88-89) suggested that since these identifications are based on skulls only there may originally have been more individuals (especially children). Nevertheless, it may be suggested that the co-resident group was similar in size and composition to the one in Structure II_1. If the number of individuals buried in the building is in fact a reflection of the number of people that lived in there then the number of generations would depend on the length of time that the structure was occupied, which again may depend on the level of maintenance (e.g. Watson 1979: 161). Voigt (1983: 19-20) suggested that the Hajji Firuz buildings were occupied for around thirty years based on the effect of moisture on mud architecture, the wetness of the site and surrounding landscape, and observations made in the modern settlements in the area. If this is an accurate estimation, then the suggestion of two or three generations in the larger building may have been possible.

The smaller Structure VI_{1-2} may have been domestic even though it appeared to be smaller in size and contained a feature not found in any of the other excavated buildings. A burial was found between the two floors in the southeast corner of the structure containing some of the post-cranial remains of at least four individuals, including a young adult, an adolescent and two younger children. If these were the remains of some of the occupants of the building then it is possible that the co-resident group consisted of a couple with their children. Alternatively, the building may have served a non-domestic function, in which case the individuals interred between the floors may have been selected based on other criteria.

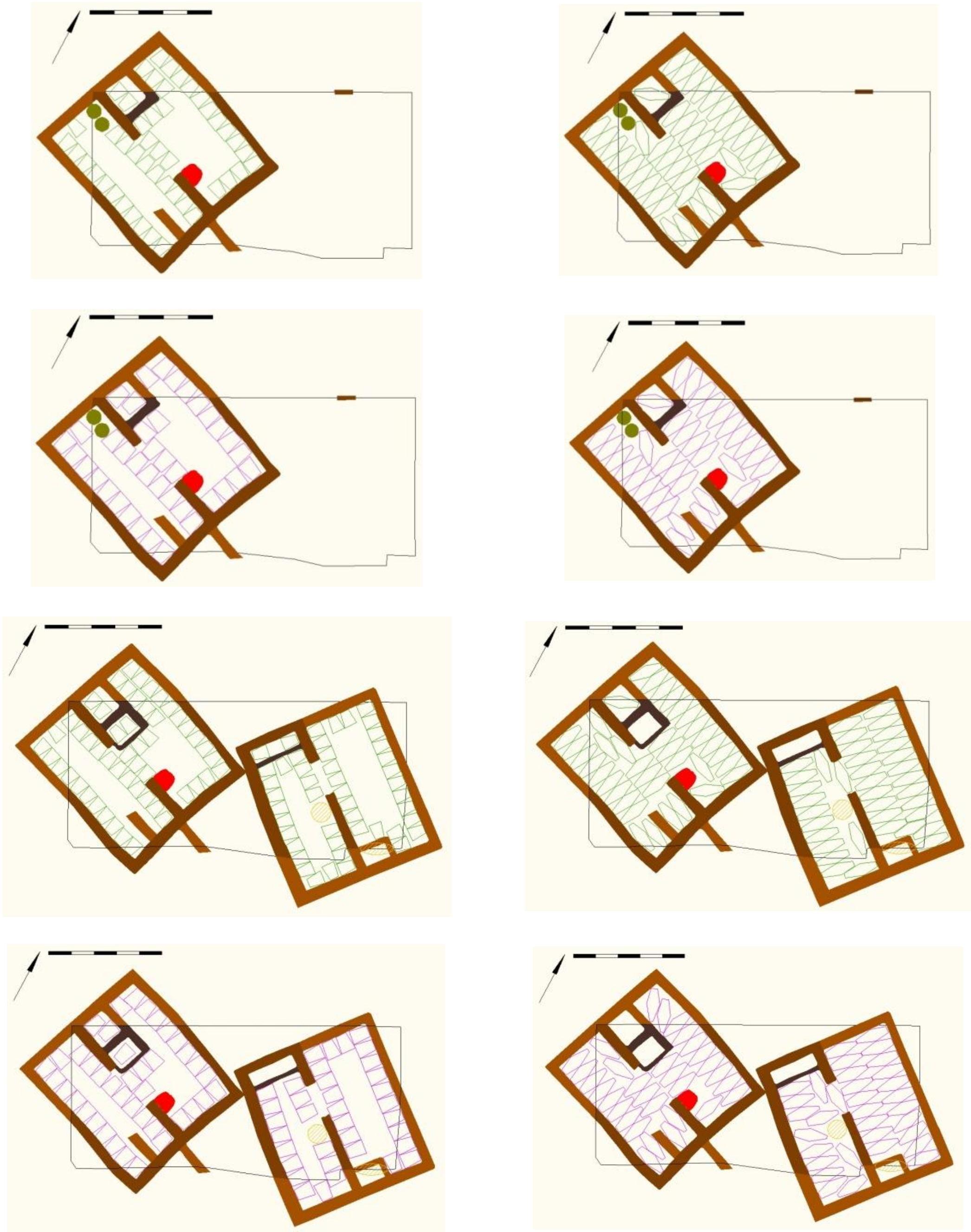


Figure 6.10: Modelled maximum capacities of Size A and Size B adults sitting cross-legged (left) and sleeping (right) in phase E and phase F_1 (top two and bottom two rows respectively).

Figure 6.11: Modelled maximum capacities of Size A and Size B adults sitting cross-legged (left) and sleeping (right) in phase G and phase H_1 (top two and bottom two rows respectively).

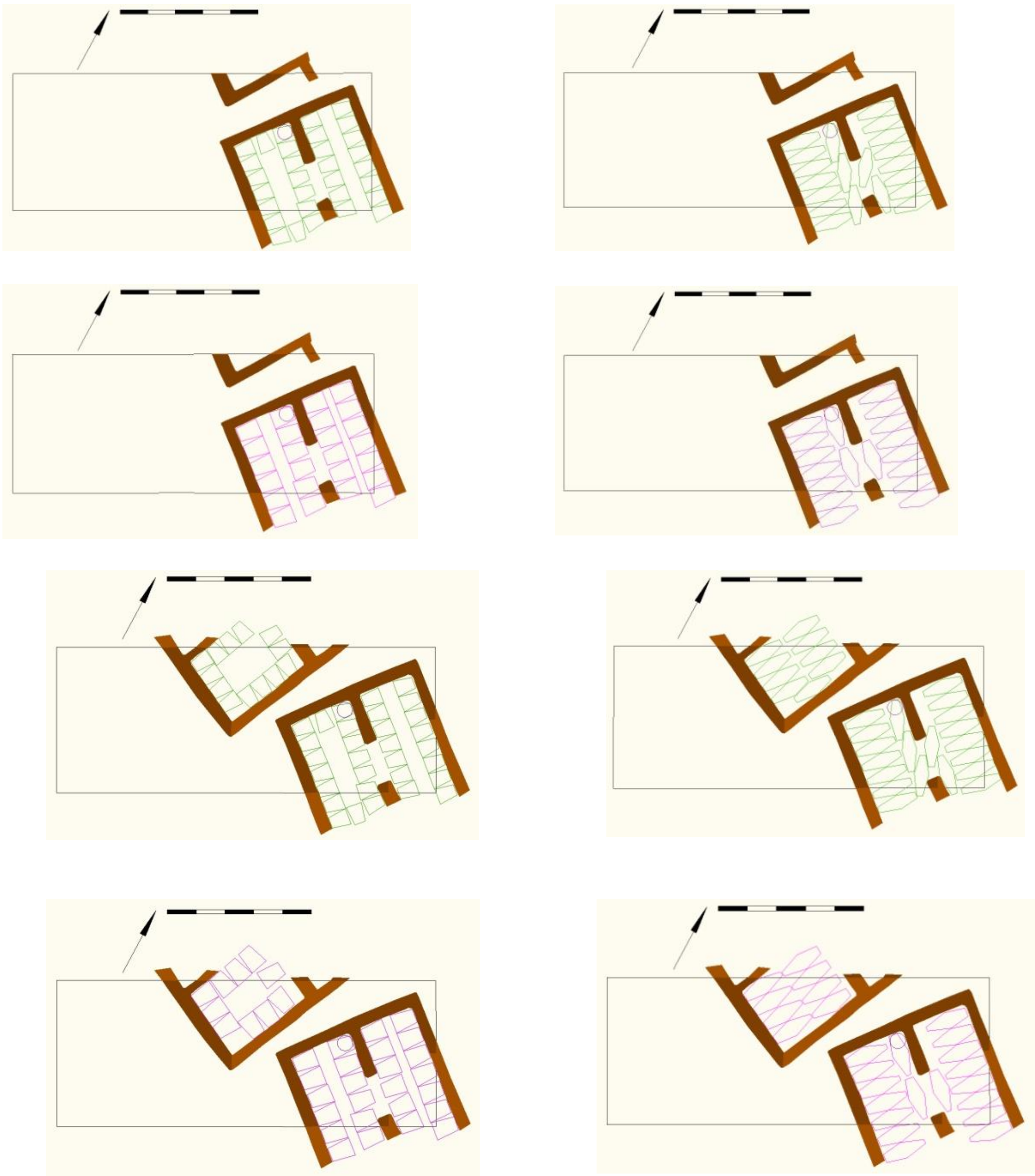


Figure 6.12: Modelled maximum capacities of Size A and Size B adults sitting cross-legged (left) and sleeping (right) in phase H_2 and phase J (top two and bottom two rows respectively).

6.4.2: The use of space

The size of most of the buildings at Hajji Firuz meant that they could have accommodated interaction between a large number of people, as illustrated by the maximum capacities for co-presence and co-habitation discussed in the previous section. This appears to have been the case with external spaces as well, of which there are two types; open areas and enclosed, unroofed spaces, which are here referred to as courtyards. It is possible that the various external spaces could have been used for different purposes as they may have accommodated different scales of interaction; activities taking place in open areas would have the potential to be more inclusive (i.e. involving more members of the community), whereas a courtyard could offer more privacy as the number of participants would be limited and the view into the courtyard may have been restricted. Larger open spaces would also allow for greater interaction between humans and animals within the settlement that may not have been possible at, for example, Ganj Dareh where structures were tightly clustered.

Since it appears that both internal and external spaces could have accommodated a large number of people, as indicated by the maximum capacity modelling, a range of scenarios depicting Size A adults in various positions were modelled within buildings and in external areas (Figures 6.13-6.17). This was done in order to explore the various ways in which the use of space may have affected access into and movement through the different spaces (as discussed in section 3.3.3). In some cases more than one Size A adult were modelled positioned by fire installations and other features (in both internal and external spaces) in order to explore whether it would have been possible for people to co-operate on tasks requiring the use of those features and whether this would have affected the use of the rest of the space. Similarly, Size A adults were modelled in various positions in the smaller and more restricted external spaces, such as courtyards and alleyways, in order to assess the potential utilisation of these spaces as sheltered work areas, as well as patterns of movement within the external spaces. The scenarios shown in Figures 6.13-6.17 are not meant to depict specific activities, nor is it assumed that people would have positioned themselves in the particular ways in which they were modelled. Instead, they were modelled to provide a visual tool to aid in the conceptualisation and discussion of the potential uses of these spaces. It is therefore important to stress that this part of the scenario modelling was included as a ‘tool to think with’, and is not meant to portray a reconstructed reality.

Before examining the potential use of space in each of the phases there are a few assumptions that will be made in the subsequent discussion regarding internal and external features, as well as the use of certain artefacts, that need to be clarified. There appears to have been five different types of fire installations at Hajji Firuz: ovens (fire was contained by a super-structure); permanent hearths (well made and repeatedly renewed; often with a clay curb around a clay floor); temporary hearths (burnt patches, possibly remnants of single burning events); burnt pits (either shallow and irregular, or ovoid and up to 1 m deep); and burnt trenches (long, narrow and relatively deep clay-lined trenches that had been fired) (Voigt 1983: 60). It is possible that different types of fire installations were used for different tasks, or perhaps at different times of the year. The variation in function of the different types of fire installations (e.g. temporary hearths, closed ovens and slit trenches) at Aşvan was discussed in section 3.3.1. It is possible that the burnt patches found in localised areas within the external spaces at Hajji Firuz were similar to the temporary hearths at Aşvan. Voigt (1983: 158) believes that the burnt pits and trenches at Hajji Firuz were not used for cooking, but instead were open kilns where ceramic vessels were fired. This was based on the fact that their sides had been burnt and they were filled with large quantities of ash and lumps of burnt bricks believed to have been used to stabilise pots or shield them from the fuel. This might be true, although it is equally possible that the firing of pottery vessels took place outside of the excavated area, and that these pits and trenches were used for other activities involving the use of fire. Some of them may, for example, have been 'earth ovens'.

A final point regarding the fire installations concerns the occurrence of two hearths within the same building. This has only been recorded in Structure II_1 (and possibly Structure XI_{1-2}), although this may be due to the fragmentary nature of many buildings. It is possible that the two hearths in Structure II_1 served different functions; one for cooking and one for heating when it was cold. This practice has been observed by Kramer (1982; 116-126) at 'Aliabad', western Iran, where buildings usually had a hearth or oven for cooking in the kitchen and a hearth for heating during winter in the living room which would be covered when not in use. It appears that the large buildings were divided into a 'clean', better maintained living space, and a 'dirty' storage and work space (sections 6.3-6.4), including Structure II_1. This may support the suggestion that the two internal hearths could have served different purposes; the hearth in the 'dirty' space, S2, may have been used for cooking whereas the hearth in the 'clean' space, S1, may have been used mainly for warmth during the colder periods and cooking if needed. Alternatively, multiple internal hearths may indicate that there were two different social units inhabiting the building and utilising separate cooking facilities, although in this scenario it may be difficult to assess the rationale behind the difference in their location.

One group of artefacts often associated with food-related activities is ground stones; the majority of those found at Hajji Firuz were used for grinding (e.g. pigments and plant foods), with only a couple of pieces that would have been used for pounding (Voigt 1983: 245). However, none of the ground stones were found *in situ* (Voigt 1983: 298-299) and the precise location of their use can only be suggested. Most of the ground stones were found in the fill of buildings, and although it is possible that they were used in internal spaces, it is equally possible that they were only stored there when not in use, or were deposited in the fill following the abandonment of the structure. Alternatively, the use of ground stones may have occurred both in internal spaces and outside, perhaps depending on the time of the year. Another category of artefacts associated with food-related activities and storage is ceramic vessels. Residue analyses on pottery from Hajji Firuz has established the presence of tartaric acid from grapes and terebinth resin on the interior of a medium sized jar (McGovern et al 1996), and fatty acids from ruminant adipose fats and plant oil on four body sherds (Gregg 2009; Gregg and Slater 2010).[55] These results indicate that some ceramic

[55] Residue analysis of a medium sized collared jar found in the north space of Structure II_1 (see Voigt 1983: fig. 87d) confirmed the presence of tartaric acid, which occurs naturally in large amounts only in grapes, and terebinth resin, which is known to have been used as an additive in medicine and wine in antiquity (McGovern et al 1996). The resin is believed to be from a liquid due to the jar having a narrow neck and it is considered the earliest evidence for grape used in wine, however, as the site lies within the natural range for wild grape it cannot be assumed that it was cultivated (McGovern et al 1996: Miller 2008: 941). Analysis of four pottery sherds, all of which were from the body of vessels that Voigt believed could have been used for dairy products (Gregg 2009), confirmed the presence of fatty acids. One sherd had organic residue from plant oils, indicating that it would have been used to boil cereals or

vessels were probably used for the processing, cooking and storing of meat, plants, and products derived from processing meat and plants, e.g. liquids derived from grapes, oils from oil rich seeds, and grease from meat.

Voigt (1983: 296-305) has discussed the spatial distribution of artefacts found in phases D-A_3 arguing that certain 'artefact clusters' indicate specific activity areas. It remains uncertain, however, whether many of these 'artefact clusters' were actually debris found in refuse contexts or part of fills resulting from general discard accumulated over time rather than debitage or tools deposited where manufacture took place. There is little information given about the type of deposits in which these 'artefact clusters' were found; whether they were deposited together (or close to each other) on a floor or surface, or whether they were merely collected from various parts of a general fill of a buildings (i.e. deposited over time post-abandonment) or in a refuse context (e.g. a midden). It is possible that some of these 'artefact clusters' indicate activity areas, which is discussed where relevant in sections 6.4.2.1-6.4.2.5.

6.4.2.1: Phases J-E

Phases J-E were only excavated in Operations IV and V, and information regarding the configuration of space is therefore very limited compared to the subsequent phases D-A_3 (Figure 6.13). It appears that the external spaces around the buildings were open with no features apart from a possible burnt pit in phase H_1, a large pit in phase F_2, and possible hearths in phase E. The pit in phase F_2 may have been used for refuse disposal (although the deposit in the pit was not recorded; Voigt 1983: 68), whereas the burnt pit in phase H_1 may have been used in activities requiring fire. If this pit was used for cooking, other food-related activities may also have taken place in this area, or, if the pit had been used to fire pottery, it may have been an area where craft activities occurred. The presence of possible temporary hearths in the area immediately east of Structure X_2 in phase E indicate that activities associated with the use of fire, e.g. cooking, took place there periodically. There was a possible courtyard attached to the southeast corner of Structure $X_{2\text{-}3}$ in phases F_1-E which was filled with ash and refuse deposits, indicating that either refuse disposal and/or activities that produced a significant quantity of waste occurred in this space. If it was an activity area, then it may be that only a restricted number of people could have taken part, although it is not possible to assess the potential number of participants.

The alleyways between the buildings in phases J-H_1 were wide enough for one Size A adult to sit cross-legged, kneel, or squat with her/his back against one wall and facing the other,

pulses (e.g. wheat, barley, lentils), or to render or store oil from oil rich seeds (Gregg 2009: 122, 152). Three sherds had residue consistent with degraded animal fats, indicating the continuous use of the vessels for cooking or serving meat, extracting bone marrow, or storing grease (Gregg 2009: 122, 151). Gregg (2009: 151) has, however, argued that the result of the analysis of the sherds has not conclusively ruled out the possibility that they were used for dairy products due to uncertainties associated with the isotopic characterisation of the fatty acids.

although access through these space would either have been blocked or at least restricted. It is possible that the space between Structures XV_1 and XIV_2 (phase H_2) was not a passageway as there may have been a wall extending eastward from Structure XIV_2 which would have blocked access. Nevertheless, both spaces may have provided a sheltered place for people to work if they required a greater degree of privacy, or shade from the sun and/or the wind. High winds are especially prevalent in the area during the autumn (mid September through October), when they also carry large quantities of dust, and spring (late March through May) (Voigt 1977: 310, 1983: 271). It is possible that people engaged in activities outdoors during these times may have worked in sheltered areas such as these alleyways. Alternatively, these spaces may perhaps have been used primarily as passageways (for both humans and animals), and for refuse disposal. The open areas in the western part of the trench in phases J and H_2 and in the eastern part in phases H_1 and E may have allowed the co-presence of a large number of people. Even though it is not possible to ascertain the precise number of potential participants in these spaces, due to the restricted horizontal exposure, the open areas may have accommodated at least similar numbers as the internal spaces. There would, however, not have been the same restrictions on the use of the space in terms of where individuals could position themselves because of the lack of features, and external areas may have provided spaces for interactions between co-resident groups.

There were also few internal features in the buildings, in part be due to poor preservation and/or difficulty in discerning certain features during the excavations. It is possible that features were located in the portions of the structures outside the excavation area. No internal features were found in Structures XV_2 and XV_1 (phases J and H_2 respectively) and the size of the internal spaces may have afforded space for a range of activities and interactions. One factor that may have influenced where people positioned themselves was the location of household items, e.g. storage containers and tools that have not been preserved, or were removed before the buildings were abandoned. It is possible that storage may have occurred at either end of both internal spaces in each structure where the containers would not restrict or block movement within the building. The two earliest floors in the south space in Structure XV_1 were coated with red ochre and may indicate that it was a ‘clean’ space, which may have affected the types of activities that took place there, the number of co-present individuals, and the items (e.g. tools, storage containers, bedding and so on) kept in the space. Another factor that may have influenced where people positioned themselves was the sub-floor burial located in the northwest corner of the south space. If the location of the burial was respected and people avoided positioning themselves and/or equipment and storage containers there, it would have affected the use of space within the building, potentially restricted the amount of space that was used.

Figure 6.13: Modelled activities in phases E-J.

Structures XII_{2-1}, (phases H_1-G), and XI_{2-1} (phases G-F_1) were also large enough to afford space for a range of activities and interaction, possibly involving a large number of people. The internal features that may have influenced the number of co-present individuals and where they positioned themselves are as follows: the bin and the sub-floor burials next to it in the south space in Structure XII_{2-1}; the burial cist in the south space and the possible fire installation in the north space in Structure XI_{2-1}; and the hearth in the south space in Structure XI_2. As was the case with Structures XV_{2-1}, on-floor storage of items that have not been preserved, or were removed, would also have affected where social interaction took place and how many individuals participated. The floor in the north space of Structure XII_1 had apparently been coated with red ochre, indicating it was a ‘clean’ living space, in which case the south space may have been a ‘dirty’ space where storage and many food-related and manufacturing activities occurred. There may have been a change in the use of space in Structure XI_{2-1}; the initial floors in the south space in Structure XI_2 (phase G) had large amounts of debris mixed in, probably through constant trampling and poor cleaning, whereas the last two floors (Structure XI_1, phase F_1) were made of a clay and lime mix and had apparently been kept very clean. Even though there is not much information available for the north space, it is possible that it was a 'clean' space in Structure XI_1 and a 'dirty' space in Structure XI_2. The possible fire installation in the north space and the hearth located in the south space during the earlier phase indicate that food processing and cooking may have taken place there. It may be that there was a need for two fire installations during the earlier occupational phase with the hearth in the 'dirty' space mainly being used for cooking, and the fire installation in the 'clean' space provided a source of heat when it was cold and for cooking when needed. When the use of the two spaces changed in the later phase the fire installation located in the north, now 'dirty' space was still in use whereas the hearth in the south, now 'clean' space was plastered over. It should also be noted that the north space was the larger of the two spaces, and it may be that the rearrangement may be connected to a change in the composition of the co-resident group where less space was required for sleeping and socialising. Alternatively, there may have been an increased need for storage space or internal work space.

Structure X_{3-2}, (phases F_1-E) was one of the largest buildings excavated at the site, and could accommodate more than twenty co-present individuals, and therefore also a range of activities. The two burial cists in the western part of the north space in the early occupational phase and the one in the last occupational phase would have affected the number of people that could have been present at the same time. It may also have influenced the use of the western part of the space as it was narrower than the eastern portion and appears to have been less suited for social gatherings than storage or work purposes. The south space appeared to have been an unroofed courtyard, which, combined with the clean floor with red ochre in the north space, indicate that the north space was the living space. This may indicate that the social unit residing in the building retained the structural form seen in other buildings consisting of two spaces, but decided to have an unroofed, fully enclosed courtyard instead of a roofed 'dirty' internal space. This would have provided them with an external space with a higher degree of privacy than other courtyards at the site. In the last occupational phase (Structure X_2) there were two ceramic vessels set into the floor at the western end of the south space, indicating that storage took place there. The eastern end of the space appeared to have been divided into two smaller areas by a short wall, and, although the function of this wall is not known, it may be that this space was divided to provide two separate storage or working areas. Alternatively, if the entrance had originally been in the eastern wall, thus providing access to the possible courtyard attached to the building, the short wall may have separated the entrance from stored goods or shielded it from a work area. The living space contained a hearth in the early occupational phase (Structure X_3) which suggests that food-related activities may have taken place there. The location of the hearth by the entrance into the courtyard may have been for ventilation purposes, i.e. to reduce the amount of smoke in the internal space. It may also have facilitated interaction between individuals working in both spaces. The hearth was no longer in use in Structure X_2 and it is possible that cooking no longer took place within the building. The temporary hearths in the area immediately east of the building may indicate that cooking now took place in external spaces.

6.4.2.2: Phase D

The structures in phase D (Figure 6.14) differ from those in many of the other phases and include the two smallest buildings excavated at the site (Structures VI_2 and VII) and a large external enclosure (Structure X_1). Structure VII, which was the smallest building, had no internal features and the clean clay floors may indicate that any activities that occurred may not have produced much waste, that it was cleaned regularly, and/or that it was not used for work purposes. It afforded space for up to eight co-present adults, though there would not have been much space left over, and it may be that only four, maybe five, individuals were present. Possible functions may include work space for particular activities, storage (e.g. food stuffs, fuel, tools), or for social gatherings not related to work, e.g. holding meetings. The limited number of people that could have been co-present (and the slightly awkward shape of the building) may indicate that it was perhaps better suited for work involving only two or three individuals, or storage, rather than providing a space for social gatherings.

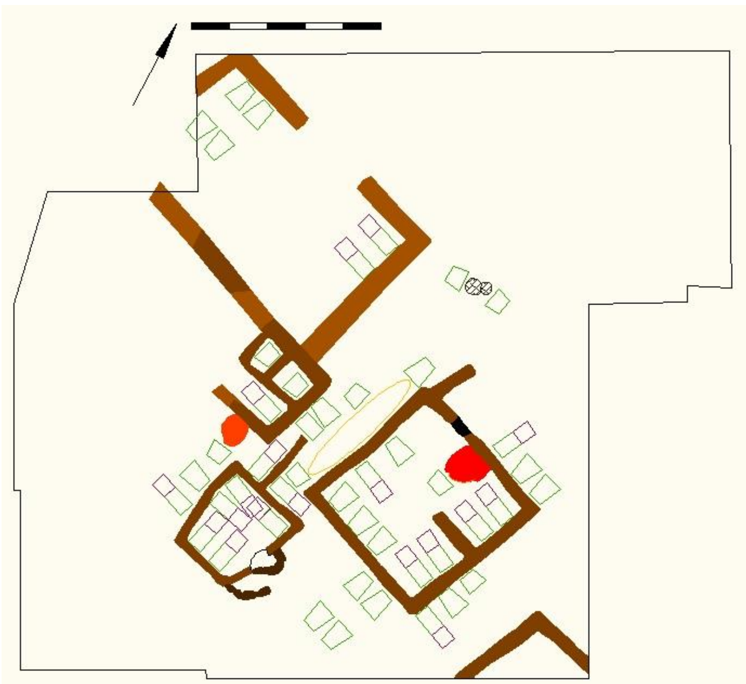


Figure 6.14: Modelled activities in phase D.

Structure VI_2 was the second smallest building excavated at the site. The only internal feature was a hearth by the north wall; however, since only the latest occupational phase (Structure VI_1 in phase C) has been fully documented it is possible that the internal configuration of space was similar to Structure VI_1. The small soundings dug in the areas on either side of the internal wall did not indicate any specific use of these spaces. There was enough room for two Size A adults to sit, squat or kneel in either of these two areas whilst engaged in various food-related and other everyday activities. The hearth indicates that food preparation and cooking may have occurred in the structure, although it is also possible that the hearth was only used for heating if the building was used purely for social gatherings. If food processing and cooking took place there (by and around the hearth), then it may be that the internal wall shielded these activities from parts of the interior space. The platform by the entrance in Structure VI_2 may also have been present in the early phase as its use appears to have been associated with the entrance; the central part of the platform was worn by frequent trampling and it may have been a step constructed to reduce the distance down from the door sill.

The unroofed enclosure Structure X_1 was large enough for a substantial number of people to gather, and its size differentiates it from the other, smaller courtyards excavated at the site. It may have provided a larger outdoor space for social gatherings that involved several co-resident groups, and/or it may have been an enclosed outdoor space used for manufacturing and processing activities that people preferred not to do indoors due to smell and amount of refuse produced (i.e. considered to be untidy or unpleasant) or because a larger amount of space was needed, such as for butchering of animals, processing of skins and hides, flint knapping, threshing and/or winnowing. A range of chipped stone tools possibly associated with the production of items made of shell, stone and wood, as well as debitage from the production of these tools were found in this space. It is not clear, however, if these were collected from general refuse deposits or found together on a surface in a manner suggestive of production activities (section 6.4.2). Another potential use for this space is as an animal pen (Voigt 1983: 307) for keeping goats, sheep, or pigs during the night or in adverse weather conditions (see also section 6.4.4). Two carinated pits were found in the section east of Structure X_1. They resembled ceramic vessels, but were pits that had been lined with clay and fired *in situ*, and although their function is uncertain it is possible that they may have been used for storage and/or refuse disposal as they contained charcoal (at the bottom) and refuse resembling the surrounding deposits. If Structure X_1 was used as an animal pen, at least periodically, these pits may have been used to store fodder that was fed to the animals kept there.

The majority of the external space appears to have been open areas that afforded the co-presence of a large number of people – exceeding the capacity of the buildings – and a range of activities. Features found in the external areas include an oven built against the southern wall of Structure IX and a series of temporary hearths in the depression along the west wall of Structure VI_2. Due to the fragmentary remains of Structure IX it is not possible to ascertain the extent of the external space south and west of the oven and the assessment of the potential number of people that may have participated in activities associated with the use of the oven is only preliminary. There appears to have been room for a person to squat in front of the oven while at least two individuals could be seated and/and kneeling along the western wall of Structure VII, perhaps preparing food that was to be cooked in the oven, even if there had originally been a wall running south from the western end of S3 (Structure IX). Access to this area may have been gained from the south or by walking through the passage created by the wall extending north from Structure VII. The passage was wide enough for a Size A adult to kneel (with forward reach) while working although this would block access through the passage.[56] Similarly, there is enough space for one or two adults to sit, squat and/or kneel on the eastern side of the wall, but this would have block access through the passageway between the wall and Structure VI_2. It is possible that this wall was meant to separate the activities taking place around the oven south of S3 from those taking place further east, or shield them from general view, and in this sense perhaps also limit the number of participants. Alternatively, it may have been a way of limiting thoroughfare when both the oven and the hearths were in use.

A series of temporary hearths was located in a depression (*c* 0.80 m wide) that ran along the western wall of Structure VI_2 (the general location has been indicated on the plan; Figure 6.14), indicating that activities associated with their use, e.g. cooking, took place there. The space between Structure IX and the depression was wide enough for people to sit cross-legged, kneel, and/or squat along the eastern wall of Structure IX. However, this scenario would block movement between the areas to the south and to the north, and other access routes would have had to be used. An alternative route would be on the other side of Structure VI_2, between it and Structure VIII. This passageway was wide enough for a number of people to sit cross-legged, kneel and/or squat with their back against one wall and facing the other without blocking or restricting access. As was suggested in section 6.4.2, sitting along walls while engaged in various activities may have provided a work area that was shaded from the sun and/or wind if needed.

6.4.2.3: Phase C

As was the case with the preceding phases, the structures and outdoor areas in phase C were large and could accommodate a range of activities involving a substantial number of people (Figure 6.15). The available information concerning the Structure II_2 interior is limited and relates to the latest phase of the building (phase B) and it is therefore discussed in section 6.4.2.4, as is the courtyard attached to the southeast corner of the building. Structure VI_1 was the smallest building excavated in this phase, and although the features along the western wall and the platform and the hearth by the north wall may have restricted where people positioned themselves, there was enough room for six Size A adults to work

[56] In this scenario the adult have been modelled as kneeling with forward reach, but the person could potentially have sat cross-legged or squatted depending how he or she was positioned.

comfortably within the structure. This scenario assumes that people would not position themselves in the southeast corner since the burial was located there (which was spatially demarcated by a low clay curb), and that they would sit, squat, or kneel in the northeast part perhaps directly participating in activities associated with the hearth (e.g. preparing and cooking food), and by the southern wall. The structure may have served a non-domestic function, such as providing space for social gatherings (section 6.4), however, the compacted clay floor was mixed with refuse which may indicate that it was not cleaned that often, and/or that activities that produced waste took place there. Additionally, it contained similar features to the larger domestic structures. This may suggest that it was probably a domestic structure, or a building used for certain domestic activities, perhaps shared between different co-resident groups, rather than being a non-domestic or ritual building.

Structure V was large enough to accommodate a large number of co-present individuals, which also suggests that a range of activities involving a number of people may have taken place at the same time. The internal layout is similar to Structure $X_{3\text{-}2}$ (phases F_1-E), although reversed; the south space appears to have been the living space with clean floors and a hearth, whereas the north space was the 'dirty' work and storage space. It had a floor made of hard packed clay mixed with refuse, indicating that a range of domestic tasks (e.g. food processing and manufacturing activities) may have taken place there. There appears to have been a short wall dividing the eastern end and a large ceramic vessel set into the floor in the western part, which suggests storage occurred in this space. The hearth in the 'clean' south space indicates that certain food-related activities, e.g. food preparation and cooking, took place there. The courtyard attached to the southeast corner of Structure V may have provided an additional space for interaction and the performance of everyday activities for the people that resided in the building. It afforded space for at least six working individuals, and the presence of a hearth indicates that food-related activities may have taken place there, perhaps during the summer when it was more pleasant to work outside then inside. If this was the case then it may suggest a seasonal use of internal and external space with most of the food-related activities taking place outside as long as the temperature and weather permitted it, and inside during the winter. Another hearth and a burnt pit were located immediately outside the entrance to the courtyard, in an area that appeared to afford space for the co-presence of a larger number of people. The proximity of these features to the courtyard may indicate that they were used by the co-resident group occupying Structure V. It is possible that the area was partly shielded from view from the south, depending on the original height and extent of the courtyard wall. If this was the case then it may be that a certain degree of privacy was associated with these activities. Alternatively, there may have been other buildings located to the east and north that shared the use of this external space.

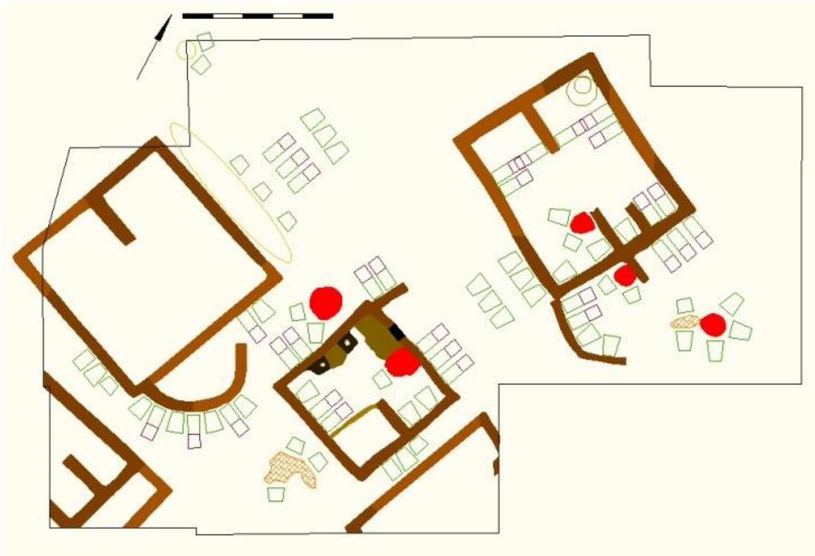


Figure 6.15: Modelled activities in phase C.

Most of the external spaces were large and could accommodate a range of activities simultaneously without restricting movement around the settlement. There were no features between Structures VI_1 and V, although this does not necessarily imply that no activities took place there. The deposits in this area consisted of clay surface with ash and refuse and there was space for a range of activities to have taken place without restricting movement through it, or access into Structure VI_1. The space between Structures IV and VI_1 was very narrow, and although there was room for people to position themselves with their back against one wall and facing the other, this seems unlikely as there would have been limited space for movement and completely blocked access through the alleyway. Large quantities of refuse and ash had been deposited in this passageway, which indicate that, in addition to providing access between the areas to the north and south, refuse from a range of activities was discarded there. Refuse deposits were also found in the space south of Structure VI_1, which may be related to the use of the burnt pit that was located in this area.

The space between Structures I_2 and II_2 was wide enough for a number of individuals to sit cross-legged, kneel, and/or squat along the wall without blocking access. If activities did take place in this space then these did not produce much waste, or the space was cleaned frequently as the deposits contained very little refuse and ash. This also appears to have been the case with the areas east of Structure II_2 and its courtyard, and it may be that most of the refuse disposal and/or manufacturing activities that produces waste were conducted further east where there are more midden deposits. Traces of matting were found to the north and east of Structure II_2, and it is possible that it was an activity area where people sat on mats, possibly for comfort, while working. A number of individuals could have been positioned along the walls without restricting movement between the various external areas and buildings with the exception of the northern part of the eastern wall of Structure II_2. If people were seated in this location the access into the Structure II_2 courtyard may have been blocked, and if people were seated along the western wall of Structure VI_1 at the same time movement between the areas to the north and to the south may have been restricted. The hearth located between Structures II_2 and VI_1 indicates that food-related activities may have occurred there. Additionally, the series of temporary hearths (general area indicated on the plan; Figure 6.15) located along the north wall of Structure II_2 and the hearth located a bit further north, suggest that many activities associated with the use of fire, e.g. food preparation and cooking, took place in this area, perhaps providing a focal point for these activities for a number of co-resident groups.

6.4.2.4: Phase B

There was only one complete structure found in phase B (Figure 6.16), namely the final occupational phase of Structure II_2. The building could have accommodated around twenty co-present individuals in each space, and therefore also a range of interactions and activities. Due to the restricted excavation of its interior spaces, the hearth located in the south space is the only internal feature recorded. This indicates that a range of food-related activities may have taken place in this space. If there had originally been other internal features, such as burial cists and/or storage vessels, this would have affected the number of participants. Attached to the southeast corner of the buildings was an enclosed courtyard, however, the wall appears to have been low and it may be that its function was not to restrict view, but demarcate the space from the surrounding areas. It afforded space for four adults to work comfortably with tasks that did not require too much surrounding space, although this may have blocked access into the courtyard. The deposits in the courtyard did not contain any refuse, and it may be that it was cleaned regularly if activities that produced waster occurred there. This differed from the external space surrounding the courtyard, which contained ash and refuse deposits accumulating from the activities taking place in the area east of Structure II_2. In the latter area were a series of burnt pits, a hearth, a possible oven, and a series of refuse pits. The pits and the deposits containing much black, ashy debris that had accumulated just east of the burnt pits, indicate that this area may have been a focal point for many production activities and possibly also food preparation and cooking.

North of Structure II_2 there was another open area where activities involving the use of fire appear to have taken place as indicated by the presence of a series of temporary hearths along the northern wall of the building and a burnt pit and a burnt trench further north. There was also a carinated pit by the burnt trench, which may have been used for storage or refuse disposal as was suggested for the two examples found in phase D (section 6.4.2.2). In the eastern part of the excavation area was another hearth located by a fragmentary wall. The function of this wall is unclear, but it may have shielded the space containing the hearth and the activities taking place there (e.g. food preparation and cooking) from the open areas to the south. Alternatively, it may have been part of a structure that did not survive. Most of the deposits in the northern part of the excavation area had been heavily disturbed by later pits and the precise structural configuration is not known, although it is possible that the activity area containing the hearth extended further north.

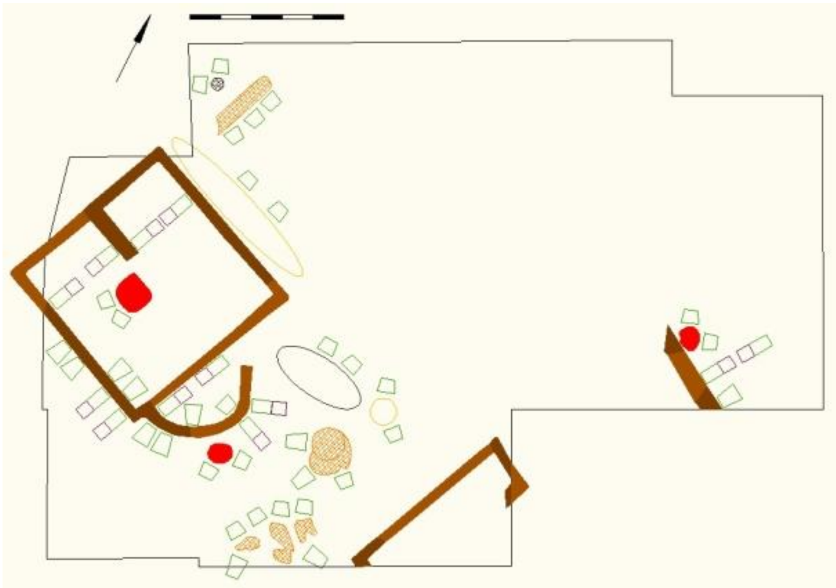


Figure 6.16: Modelled activities in phase B.

6.4.2.5: Phase A_3

Most of the information from this phase comes from the western and southern parts of the excavation area as the northern part was heavily disturbed by later pits (Figure 6.17). There were three fire installations found in the external areas; a hearth located east of Structures II_1 and III; a hearth by the southern wall of Structure II_1; and an oven built against the eastern wall of Structure I_1. Much of the open area east of the buildings contained refuse deposits, which increase in quantity with the distance from the structures. Voigt (1983: 22) suggested that the open space east of the buildings was a work area and that people would discard the waste from activities taking place there (perhaps also refuse cleared from within the structures) along the edges. This seems plausible as the presence of the fire installations indicates that activities associated with their use (e.g. food preparation and cooking, possibly production activities) occurred there. Some refuse was also disposed in the alleyways between the buildings. These ashy deposits had been trampled, which suggests that these alleyways provided passage between the areas to the east and to the west.

The alleyway between Structures II_1 and III was wide enough for people to sit, squat, or kneel whilst working. However, this would have blocked movement through the alleyway, and it may be suggested that it was primarily used to provide access. The alleyway between Structures I_1 and II_1, on the other hand, was wider and may have been used for a range of activities. A number of ground stones, debitage from flint knapping, chipped stone tools, and bone tools possibly used for skin processing were found in this space, which, combined with the hearth by the southeast corner of Structure II_1, indicates that a range of food-related and manufacturing activities took place, if not in the passageway itself, then in the area immediately east of it (assuming that the artefacts were found *in situ* and not collected from general refuse contexts that had accumulated over a longer period of time). There was enough space for people to utilise the hearth at the same time as a number of individuals were seated, knelt, and/or squatted along the south wall of Structure II_1 while working without blocking access through the alleyway. Performing tasks in this space may have provided shelter from the wind or sun if needed, although they may have been less inclusive due to the restriction of space. It is also possible that the majority of activities may have taken place in the open area east of the buildings. The oven by Structure I_1 and the hearth east of Structures II_1 and III indicate that at least some food-related and possibly production activities occurred there. If this was the case then it may be that it provided a setting for social interaction involving members of different co-resident groups.

The maximum capacities discussed in section 6.4.1 show that Structures II_1 and III afforded space for a large number of people to be co-present, which indicate that the buildings could have accommodated a range of activities at the same time. There is more information regarding the structuring of the internal spaces in Structure II_1 (both in the earliest and latest phases) and the remaining discussion therefore focuses on this building.[57] It was entered from the east through a doorway into S1, a space that had whitewashed walls with possible traces of black pigment and a sequence of five clean clay floors, one of which had been coated with red ochre. S2 (entered from S1 through a wide entrance), on the other hand, had a sequence of three sloping, uneven floor surfaces made of hard packed clay that had been mixed with refuse through trampling. The difference in construction and maintenance suggest that there was a functional difference between the two spaces, as has been argued for other buildings at the site. S1 may have been the living space where people ate, socialised, slept, and entertained guests, whereas S2 may have been used for storing the majority of food stuffs and equipment as well as most of the food preparation and cooking. There was a hearth in both S1 and S2, of which the latter changed position in the latest phase of occupation, and in the earliest phase ceramic vessels were set into the floor in both spaces – one in S1 and five in the western part of S2. S1 afforded more space for people to interact and perform various activities; individuals could position themselves anywhere along the southern wall without restricting movement through the building. The removal of the ceramic jar set into the floor and the construction of a second burial cist in the latest phase did not alter the available floor space, although the presence of any on-floor storage in portable containers would have affected the floor space available. The presence of the two burial cists at the western end of S1 suggests that some ritual activities took place there, and since the buried individuals may have been members of the co-resident group, any activity associated with their interment may only have involved the co-resident group.

[57] Additionally, Structure III was badly disturbed by later pits, which means that there is limited information available concerning the layout and structuring of space within this building, and an examination of the evidence would not contribute to the discussion and it will therefore not be considered further.

In S2 there was less space due to the presence of the smaller S3 and S4 at the eastern end, and the hearth and ceramic vessels at the western end. The removal of the ceramic vessels and the moving of the hearth increased the available floor space; nine individuals may have worked comfortably in S2 during the latest phase compared to six in the earliest phase. However, these scenarios do not account for portable storage containers that have since been removed, or were not preserved. It is possible that most of the western end of S2 was used for storage at least during the early phase. The five ceramic vessels set into the floor of S2 were modelled along the western dividing wall although their precise location in relation to each other is not known (Figure 6.17).[58] Their placement along this wall may indicate that storage also occurred along the western wall (including bags hung from the roof or on the wall, and/or containers placed on the floor), in which case the stored goods could be reached by walking around the hearth. If there were no stored goods along the west wall then there would have been space for an individual to work in the northwest corner. It is equally possible that activities only occurred in the space between the hearth and S3-S4 as there would have been room for movement even if there were two or more individuals taking part. The changes made to S2 in the later phase may suggest a need for more floor space either for work purposes or storage. It is possible that the removal of the ceramic vessels set into the floors in both spaces may be because more of the storage in this phase occurred in movable and/or organic containers that have not survived.

The function of S3 and S4 is uncertain. S3 was large enough for two Size A adults to sit cross-legged facing each other and S4 could fit one Size A adult sitting, kneeling or squatting. However, neither of these scenarios would leave much room for movement, and it may be suggested that these spaces were used for storage of food, fuel, fodder, and/or tools. Voigt (1983: 41-42) has suggested that S4 may have been used as an oven in the latest phase as the inside walls had been fired red, and that it was accessed from S2 or the outside through the east wall. If this was the case, then that would mean that the inhabitants in Structure II_1 had two hearths and an oven at their disposal during the final phase of occupation of the building, which would indicate an increased need for fire installations, a further diversification of the function of fire installations, or the need for an oven if the latter served a particular function that differed from the hearth. As mentioned in the discussion concerning the ovens at Jarmo, it is possible that ovens could be used for particular forms of food preparation, such as extracting fat and vegetable oils, the popping of cereal grain husks, or cooking (see section 5.5.1.2) and bread making (e.g. Haaland 2007; Lyons and D'Andrea 2003; Weinstein 1973: 274). It may be that there was a difference in function with hearths possibly used for most of the everyday cooking and boiling, whereas ovens may have been used for baking and the preparation of food that required longer cooking times. The internal hearths may also have provided a source of heat during the colder periods of the year.

[58] The two largest circles in the southwest corner indicate the potential size range for the largest vessel according to the information given for form class 20 (see Voigt: 136, figs. 88-89).

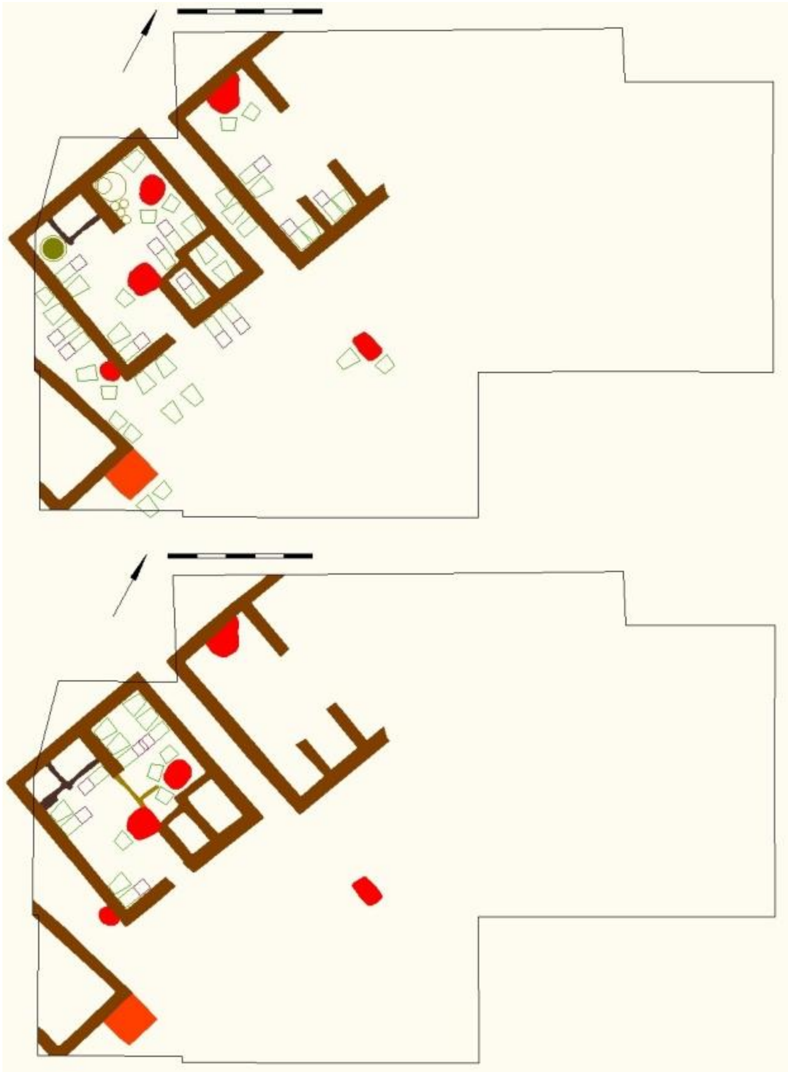


Figure 6.17: Modelled activities in the early (top) and late (bottom) phases of phase A_3.

6.4.3: Modelled potential storage

The large size of most of the internal spaces at Hajji Firuz meant that the buildings afforded space for the co-presence and co-habitation of a large number of people (on average nineteen and fourteen individuals respectively) and allowed for a range of interactions and activities to have taken place concurrently involving a large number of people. Some of the buildings had smaller spaces within them that do not appear to have been suitable for people to be in; they could usually fit one individual sitting cross-legged, kneeling, or squatting, but there would have been very little room left for the individual to move. An alternative use for these small spaces may be storage of food, fodder, fuel, and/or tools. For the purpose of this discussion, it will be assumed that they were used for the storage of grain for human consumption, although it is acknowledged that only the small spaces in Structures II_1 (S3 and S4) and IX (S1 and S2) were preserved as fully enclosed spaces.

The small spaces appear to be located at the eastern end of the ‘dirty’ space within buildings; shorter internal walls extended westwards and divided the eastern end into two smaller areas. Due to poor preservation and because the partition walls were, in most cases, recorded in section only, it is not possible to ascertain whether these areas may have been fully enclosed, or only separated into two ‘niches’. The calculations in Table 6.3 were based on the assumption that all of the small spaces were fully enclosed, and the length of the partition walls as recorded on plan (Voigt 1983: figs. 13-22) have been used as the length for the small spaces. If the spaces were not fully enclosed, it is possible that grain storage may have occurred in, for example, sacks that were stacked on top of each other, and the calculations should be considered as estimations that indicate the potential storage volume.

Level	Structure	Space	Potential capacity for storage (m^3) if 0.50 m height	Number of people that could be supplied by potential storage (0.5 m height)	Potential capacity for storage (m^3) if 1 m height	Number of people that could be supplied by potential storage (1 m height)
A_3	II1	S3	0.946	2.87	1.893	5.74
		S4	0.538	1.63	1.076	3.26
	III	SE corner of south space*	0.788	2.39	1.577	4.78
		NE corner of south space	0.847	2.57	1.694	5.13
C	V	SE corner of north space	0.376	1.14	0.752	2.28
		NE corner of north space	0.610	1.85	1.220	3.70
D	VII	Whole building	1.923	5.83	3.845	11.65
	IX	NW small space	0.235	0.71	0.470	1.43
		NE small space	0.337	1.02	0.673	2.04
E-F_1	X_{2-3}	SE corner of south space**	0.810	2.45	1.620	4.91
		NE corner of south space**	0.721	2.18	1.441	4.37

* A large storage vessel (form 20) may have been placed in this space.
** These two smaller areas may have been part of an unroofed space, and thus calculations are based on the assumption that they were roofed and thus allowing storage directly on the floor.

Table 6.3: Potential storage capacities for small spaces.

Structure VII in phase D has been included as it may have been used for storage due to its small size and lack of internal features. This does not, however, imply that the entire building was used for storage in the same way as the small spaces may have been. In fact, the threshold was only 0.25 m above the internal floor and since the potential storage calculations assumes storage of grain directly on the floor up to 0.50 m and 1 m in height (section 3.3.3), these calculation do not reflect a realistic situation. However, if it was used for storage it is possible that the grain was stored in sacks, or other containers, that were stacked on top of each other), which may have allowed quantities similar to the estimates in the table to be stored in the building.

The calculations indicate that if the small spaces were filled with grain to a height of 0.50 m above the floor they could hold between half the annual requirement for one individual and the annual requirement for almost three individuals. If they were filled to a height of 1 m above the floor the grain in these spaces could supply the annual requirement for between one and a half and five and a half people. Assuming that these spaces were fully enclosed and grain was stored in them, there may have been a raised entrance or porthole allowing access into them, perhaps to prevent rodents from accessing the stored grains (section 5.5.3.2). Another type of built-in feature that may have been used to store grains is the large ceramic jars set into the floors of some of the buildings. The volume of two of these jars (form class 20; Voigt 1983: 286) have been estimated to be 206.4 litres (vessel HF 61-73, Structure I_1) and 244.63 litres (vessel HF 68-239, Structure X_2) (Voigt 1983: table 24). The original capacities for the storage vessels found set into the floor of various other buildings are not known, but if it is assumed that they were similar in size and capacity as the two large vessels for which there are estimates, each may have had the capacity to hold the annual grain requirement for about one and a half people.[59]

The potential built-in storage capacity, including large ceramic vessels and small spaces, for each of the buildings discussed in this chapter is summarised in Table 6.4. It is possible that there were other built-in storage features that due to poor preservation, later disturbances, and/or parts of buildings not having been excavated have not been found. If each phase of a building is counted as a separate structure, then seven of eighteen buildings have built-in storage facilities. Most of these buildings have potential built-in storage capacities that may have supplied the annual grain requirement of between seven and twelve individuals, with five of the buildings falling into the range of nine to twelve people. Structure IX, with storage capacity for three and a half individuals, was only partially preserved, but has been included here because the dimensions of the small spaces have been recorded. Of the six remaining structures, only the small spaces in Structure II_1 are known to have been fully enclosed and one of these, S4, may have been used as an oven in the latest phase of the building. The small spaces in Structures III, V, X_2 and X_3 may not have been enclosed, which would reduce their built-in storage capacity. Large storage vessels set into their floor were only

[59] Since the volume of two of the large ceramic jars have been estimated to be 206.4 litres and 244.63 litres if filled to the rim (Voigt 1983: 286, table 24), it may therefore be reasonable to assume that the large storage vessels with similar forms would have capacities in the range between 205 and 245 litres. 205 litres equals 0.205 m^3 and 245 litres equals 0.245 m^3, which accounts for the annual requirement for 1.55 and 1.86 individuals respectively if 0.33 m^3 is the volume of grain required by one person per year.

found in Structures II_1 early phase, V and X_2, each of which had the potential capacity of supplying the annual grain requirement for one and a half person.

Level	Structure	*In situ* ceramic vessel(s)		Small space potentially used for storage		Number of people that could be supplied by potential built-in storage
		Yes/No	Number	Yes/No	Number	
A_3	II_1 Early	Yes	2	Yes	2	12
	II_1 Late	No	-	Yes	2	9
	III	No	-	Yes	2	10
B	II_2	No	-	No	-	-
C	II_2	No	-	No	-	-
	V	Yes	1	Yes	2	7.5
	VI_1	No	-	No	-	-
D	VI_2	No	-	No	-	-
	VII	No	-	Yes	1	11.5
	IX	No	-	Yes	2	3.5
E	X_2	Yes	2	Yes	2	12
F_1	X_3	No	-	Yes	2	9
	XI_1	No	-	No	-	-
G	XI_2	No	-	No	-	-
	XII_1	No	-	No	-	-
H_1	XII_2	No	-	No	-	-
H_2	XV_1	No	-	No	-	-
J	XV_2	No	-	No	-	-

Table 6.4: Potential built-in storage capacities for buildings discussed in this chapter.

The alternative to built storage features is movable storage containers that were made of perishable materials and/or were removed before the building was abandoned. In order to assess how potential on-floor storage would, if at all, have affected the number of people that may have been present in the building, storage containers were modelled and inserted onto the digitised plans used in the modelling (Figures 6.18-6.20). This exercise showed that the on-floor storage of grain, with each modelled container holding the annual requirement for one person, would have affected the maximum capacity of co-present individuals, although it may not necessarily have affected the number of co-habitants. Since seven individuals were the minimum number of sleeping individuals that may have occupied the living space, the minimum on-floor storage capacity modelled for each of these structures was also seven. Most of the buildings could have accommodated the co-habitation and on-floor storage for at least ten people, although it is acknowledged that this may be due to the lack of built features. If there had originally been internal features (e.g. bins, fire installations) in the structures it would have affected the affordance of space for human occupancy.

Structure VII, which was the smallest building, could accommodate three Size A adults sleeping and storage for two people, or, alternatively, if the structure was purely used for storage, there was enough room for eight on-floor storage containers. The other small building, Structure VI_{1-2}, could accommodate the co-habitation and on-floor storage for five people in the latest phase (Structure VI_1) and at least eight in the earliest phase (Structure VI_2), assuming that the only internal features in the earliest phase were the hearth and the platform below the doorway.

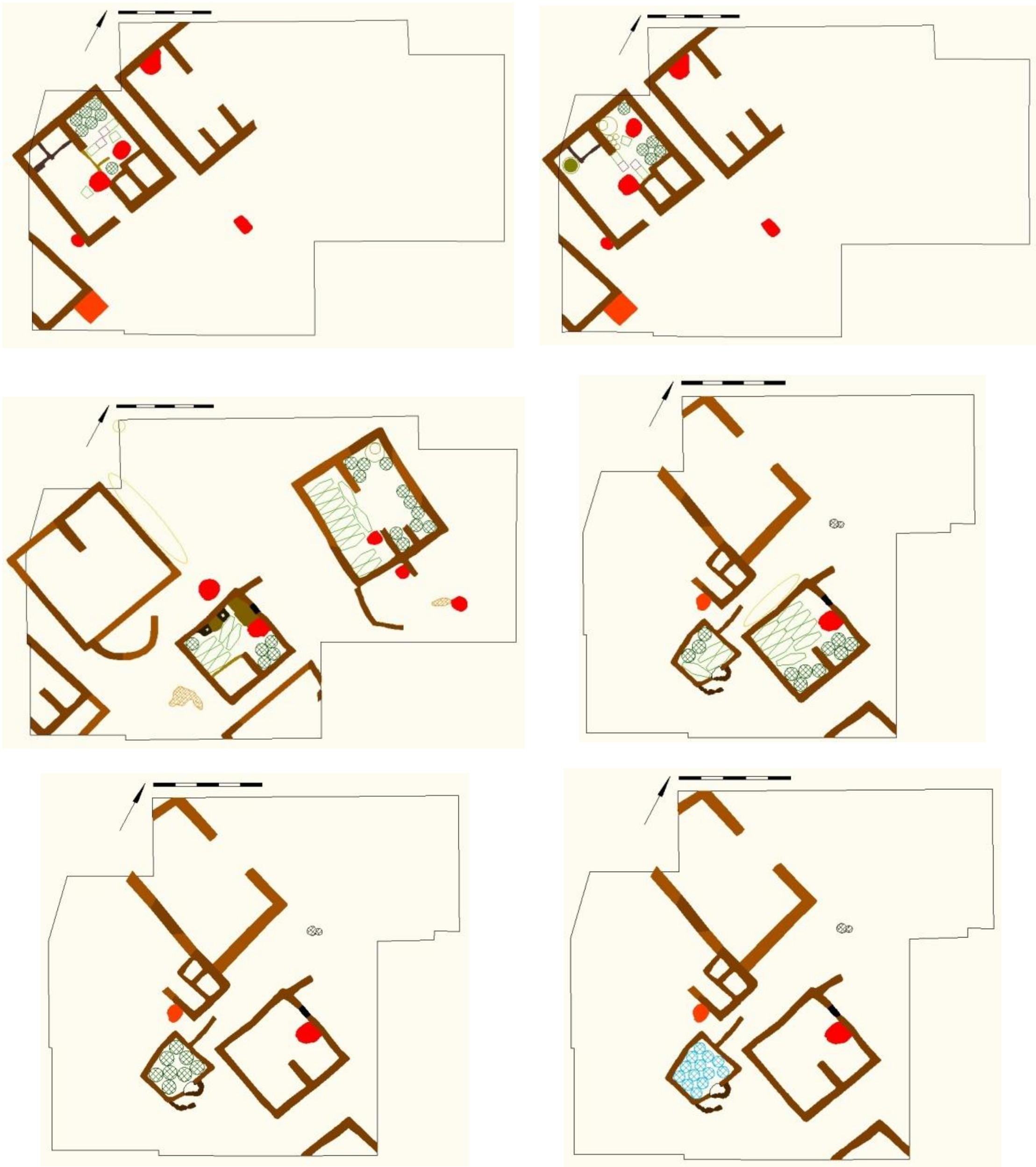


Figure 6.18: Possible configuration of on-floor storage and work space in S2 in Structure II_1, phase A_3 (top), and affordance of space for co-residency and storage in phase C (middle left) and phase D (middle right); and modelled on-floor storage of grain (bottom left) and fodder (bottom right) in Structure VII in phase D.

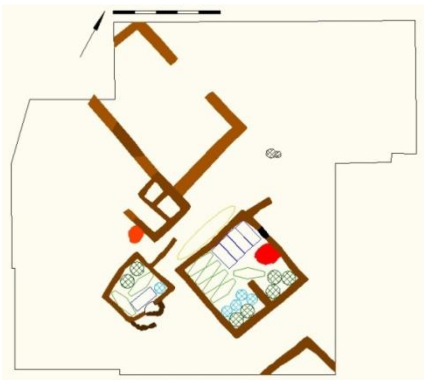


Figure 6.19: Modelled affordance of space for co-residency, storage and goats in the earliest and latest phases of phase A_3 (top right and left respectively), phase B (middle left), phase C (middle right), and phase D (bottom left).

In Structure II_1 the inclusion of on-floor storage, combined with the potential built-in storage facilities, in the modelled scenarios would also have affected the space in which people could have positioned themselves when working. The modelled on-floor storage assumed two things: that most of the food storage occurred in S2 (the ‘dirty’ space) and activities such as eating, socialising and sleeping took place in S1 (the ‘clean’ space’); and that the presence of the hearth in S2 indicates that some cooking took place there during both phases of occupation, and the on-floor storage was modelled in a way that would not obstruct access to, and the use of, the hearth (Figure 6.18). The modelling for the earlier phase includes five on-floor containers, two ceramic vessels containing the annual grain requirement for three individuals, and storage in S3 and S4 for nine people, i.e. a total of seventeen people could be supplied by the potential storage. In the latest phase the modelled storage included seven on-floor storage containers and storage in S3, and perhaps S4 if it was not used as an oven, i.e. a total of twelve or sixteen people could be supplied by the potential storage. This scenario also allow for activities taking part between the on-floor storage containers and the hearth. The movement of the hearth in S2 in the latest phase may have allowed the inhabitants to organise this space in a way that facilitated an increase in work space without affecting the storage capacity. This change in space may also have allowed on-floor storage in most of the western part (more than was modelled) while the space immediately north of the clay curb separating S1 and S2 could have been left unoccupied to allow for activities associated with the hearth, as well as access to S3 and S4.

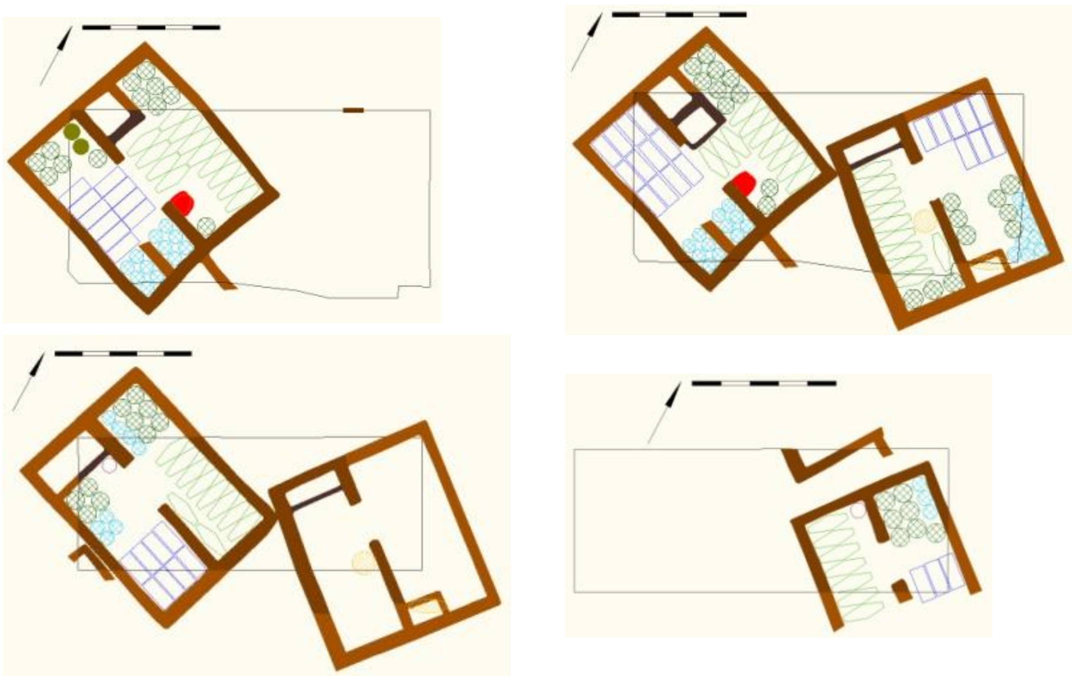


Figure 6.20: Modelled affordance of space for co-residency, storage and goats in phase E (top left), phase F_1 (top right), phase G (bottom left) and phase H_2 (bottom right).

All of the above scenarios only account for the storage of grain and not other food stuffs and liquids (e.g. animal fats, plant oils, meat) for human consumption, nor fuel, various personal items, tools, or animal fodder. The latter will be considered in section 6.4.4. It is possible that short-term storage (e.g. up to six months) of various food stuffs may have been more common than long-term storage (e.g. a year or more) of plants such as cereals and legumes; the settlement was located in an area where there they would have had access to a range of resources, and it is possible that much of the diet involved the consumption of seasonally available resources with potential storage perhaps only intended for consumption during the winter months. Additionally, studies indicate a higher reliance on meat that plant foods (section 6.1), which may suggest that the estimated storage is too high. What these calculations indicate, however, is that the individual buildings at Hajji Firuz had the potential to accommodate food storage for the co-resident unit as was the case at Jarmo (section 5.6).

Level	Structure	Space	Potential capacity for storage (m^3) if 0.50 m height	Number of goats that could be supplied by potential storage (0.5 m height)	Potential capacity for storage (m^3) if 1 m height	Number of goats that could be supplied by potential storage (1 m height)
A_3	II_1	S3	0.946	4.73	1.893	9.46
		S4	0.538	2.69	1.076	5.38
	III	SE corner of south space*	0.788	3.94	1.577	7.88
		NE corner of south space	0.847	4.24	1.694	8.47
C	V	SE corner of north space	0.376	1.88	0.752	3.76
		NE corner of north space	0.610	3.05	1.220	6.10
D	VII	Whole building	1.923	9.61	3.845	19.23
	IX	S1	0.337	1.68	0.673	3.37
		S2	0.235	1.18	0.470	2.35
E-F_1	X_{2-3}	SE corner of south space**	0.810	4.05	1.620	8.10
		NE corner of south space**	0.721	3.60	1.441	7.21

* A large storage vessel (form 20) may have been placed in this space.
** These two smaller areas (at the eastern end of the south space) may have been part of an unroofed space, and thus calculations are based on the assumption that they were roofed and thus allowing storage directly on the floor.

Table 6.5: Potential capacities of small spaces for storing animal fodder.

6.4.4: What about animals?

If domestic animals were not taken out to pasture during the winter and/or adverse weather conditions (e.g. snow and heavy rain[60]), but kept penned within the settlement they would have to have been fed with stored fodder. It was suggested earlier that the carinated pits found in some of the external spaces may have been used for the storage of fodder (section 6.4.2.2). No dimensions are available for these pits and calculations of their storage potential cannot be performed. It is possible that if the small spaces inside buildings were used for storage, they may have contained animal fodder rather than food for human consumption, which may have been stored in on-floor storage containers in the 'dirty' spaces. The potential storage capacity for the small spaces (again assuming that they were enclosed) and

[60] The main precipitation in the area is likely to have fallen in winter and spring (i.e. November through May) as is the case today, and although most of it may have been in the form of rain, it is possible that snow could have fallen in January and February, which are the coldest months (Voigt 1977: 310, 1983: 271).

Structure VII are presented in Table 6.5. If we disregard Structure IX, which was not fully preserved, and Structure VII, these calculations indicate that the small spaces could hold enough fodder to feed between two and nine and a half goats each. Three of the buildings (Structures II_1, III and X_{2-3}) had storage capacities to supply between fourteen and sixteen goats, whereas Structure V had enough for nine or ten goats. It may be suggested that if these spaces were used for the storage of animal fodder for the herd of the co-resident group, then their respective herds may have consisted of on average perhaps twelve animals, which is similar to Jarmo. If this was the case, and if individual co-resident groups stored their own food within the building they lived in, it may indicate that they managed their own economic resources.

The large, open spaces at Hajji Firuz may have afforded an increased scale of interaction between humans and animals within the settlement; the size of the outdoor areas within the settlement may have provided large spaces where animals could be kept when not at pasture. It is possible that pens made of wood, brushes, or other materials that have not left any visible traces in the archaeological record (or were not detected during excavation) were erected in some of the open spaces that contained no features. In order to assess the potential capacity for animals within the built environment goats were modelled in the external areas, but avoiding features such as fire installations and pits; the result of this modelling has been summarised in Table 6.6 (Figure 6.21). It was suggested earlier that Structure X_1 in phase D may have been used as an enclosure for animals when needed (section 6.4.2.2). If this was the case, it is possible that there was a need to keep animals within the settlement albeit spatially separate from the human areas, perhaps to prevent them wandering into the activity areas (those that contained features such as hearth and/or burnt pits). The modelling indicates that at least thirty-five goats could fit into this space, a number that far exceeds the enclosed courtyards at Jarmo. If the calculated storage capacity, which indicated that individual co-resident groups could store enough fodder for about twelve goats, is indicative of average herd size, and if Structure X_1 was used as an animal pen, it may be suggested that a number of co-resident groups penned their animals together. This would then indicate that herding responsibilities were shared between different, but perhaps related, social units.

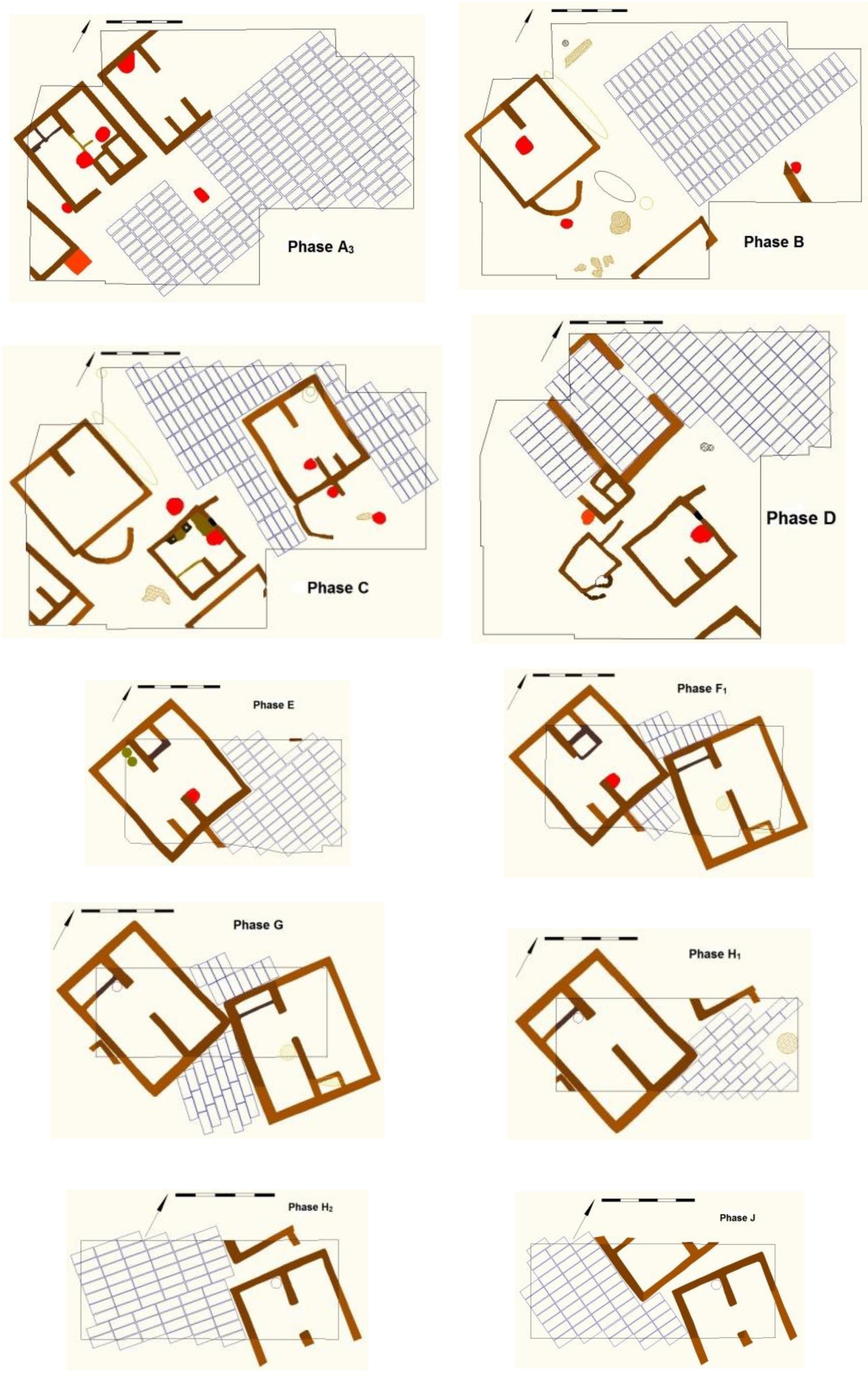


Figure 6.21: Modelled affordance of space for goats in external areas.

At Ganj Dareh there appeared to be little, if any, space within the settlement to keep animals due to the tight clustering of structures, possibly indicating a communal herding strategy, whereas there were more spaces, most of which appear to have been enclosed courtyards, within the built environment at Jarmo where animals may have been kept. It is also possible that herds were kept together elsewhere in the settlement. The built environment at Hajji Firuz appears to have afforded closer interaction between humans and animals than Ganj Dareh and perhaps Jarmo. This does not, however, imply that herded animals were necessarily kept within the settlement, or at least the part of the settlement that has been excavated, but rather the increased *potential* compared to Ganj Dareh and Jarmo.

Phase	Area/space	Number of goats
A_3	Outdoor area, N part of trench	> 216
B	Outdoor area, N part of excavation area	> 144
C	Outdoor area, S and W of Structure V	> 86
	Outdoor areas, N of Structure V, Operation IV	> 40
D	Enclosed courtyard, Structure X_1	35
	Structure IX, potential space west of S1, S2 and S3	18
	Outdoor area, N part of excavation area	> 75
E	Outdoor area, Operation IV	> 61
F_1	Outdoor area, N of buildings	> 13
	External space, possibly partly enclosed, S of buildings	> 9
G	Outdoor area, N of buildings	> 11
	Outdoor area, S of buildings	> 23
H_1	Outdoor area, Operation IV	> 32
H_2	Outdoor area, Operation V	> 60
J	Outdoor area, Operation V	> 48

Table 6.6: Modelled capacities for goats in external spaces.

It is also possible that a few goats may have been brought inside the buildings or kept in the smaller courtyards attached to some of the structures, including animals that were ill or injured, or newborn and young goat kids and lambs (section 3.3.2). The buildings are generally large enough to have accommodated the co-habitation of at least seven individuals and the storage of their annual grain requirement in addition to a minimum of four adult goats and enough fodder to feed these animals for ninety days (Figures 6.19-6.20). This may indicate that animals could have been brought inside if needed, potentially kept in the 'dirty' spaces so as not to damage the carefully made floors in the living spaces, although this may have required a temporary pen to be erected if this space was also used for food storage so that the animals could not get to it (especially those that have been weaned).

6.5: Summary

This chapter has examined the built environment at Hajji Firuz, focusing on the potential size and composition of co-resident groups, the different scales of interaction afforded by different types of spaces, the use of space and activity areas, the affordance of space for animals and possible storage capacities. The Neolithic settlement at Hajji Firuz presents a different built environment than at Ganj Dareh and Jarmo, with larger buildings, less compartmentalisation of internal space, and more open external areas within the settlement itself. It was suggested that co-residential units may have consisted of two or three generations of the same family (section 6.4.1), totalling between seven and fifteen individuals. The composition of co-resident groups would have changed throughout the use-life of the building as people aged, got married and died. For example, the burials in Structure II_1 contained a total of eight or ten adults and seven children, and if it is assumed that these were members of the co-resident group living in the building, those that passed away included infants, children, young adults and older individuals, or, in other words, the parents and their children at various stages in their life. Ritual activities associated with their interment may only have involved members of the co-resident group, and perhaps relatives residing elsewhere. The modelled affordance of space for co-presence indicates that up to sixteen to twenty-five adults may have participated in activities taking place in most of the individual spaces. This exceeds the capacity for co-residency and may suggest that individuals not living in the building could have participated in activities inside the buildings, which may have included activities centred on food consumption and ritual activities.

Evidence suggests that the two internal spaces in the larger buildings were functionally different with one space apparently more carefully constructed, maintained and cleaned than the other. These 'clean' spaces had plastered floors that, sometimes coated with ochre, and some also had plastered walls with traces of possible decorations, whereas the 'dirty' space had floors made of compacted clay that were often uneven and/or sloping. 'Clean' space were cleaned regularly, possibly once or several times per day, whereas refuse had been mixed into the floor surfaces, perhaps through continues trampling and less frequent cleaning, in the 'dirty' space. The difference in construction and maintenance suggest that the 'dirty' spaces were used for storage and most activities that produced refuse, perhaps when these could not take place outside, and that the 'clean' spaces were living spaces where people slept, ate, and socialised. It is possible that some everyday activities also occurred in the living space, e.g. food preparation and repairs of personal items and other implements; however, the space would have been thoroughly cleaned afterwards. The differentiation of spaces within buildings was therefore not defined by fully enclosing walls as may have been the case at Ganj Dareh and Jarmo, but rather through visual clues such as low clay curbs and the difference in construction and maintenance of floors and walls (which sometimes included painting).

Voigt (1983: 31-36) argued that buildings at the site conform to a set principle where the large, rectangular buildings with two internal spaces were domestic structures with a 'living room' and a 'utility room', and that the smaller structures were non-domestic. Whether the buildings can be distinguished as residential and non-residential may not be as straight forward as Voigt assumes, and it is possible that a wider range of architectural forms existed within the settlement, as is perhaps indicated by the structural remains in phase D (section 6.4). Architectural form and size may be linked to differentiation in function, thought the scenario modelling has indicated that even Structures VI_{1-2} and VII that have been described as 'atypical' and as 'serving non-domestic functions' due to their size, form, and internal features (Voigt 1983: 32) may have served as living spaces. In particular, Structure VI_{1-2} may have been a residential structure as it afforded space for at least fourteen co-present individuals and a co-resident group consisting of up to eight individuals (in the latest phase, not including the southeast corner with the burial). This is close to the suggested size of co-resident groups in the larger buildings, and indicates that it could have served as a residence for a smaller social unit. Additionally, the structure contained a hearth, indicating that food preparation and cooking may have taken place there. Based on the modelled affordance of space for co-presence these, and other, activities may have involved similar numbers of people as the larger buildings. This suggests that some of the smaller buildings may have been domestic structures as they provided shelter and a place to undertake everyday domestic activities, and contained features associated with these tasks. The variation in size may indicate a difference in the needs of the co-resident groups, and that if a larger portion of the settlement was excavated, then it may be possible to assess this suggestion. Structure VII, on the other hand, appears not to be a domestic building, although what it was used for remains unclear. It had clean clay floors, which indicates that it was cleaned regularly, and no internal features. Suggestions include a storage structure, perhaps for more communal storage, or as a meeting space for members from different co-resident groups. The modelling suggests that the size and shape may have limited the number of co-present individuals, which suggests that it may have been better suited for work involving only two or three participants, or storage, rather than providing a space for social gatherings.

The external areas appear to have afforded different scales of interaction than the internal spaces as more people could have been involved in activities occurring outside than inside buildings. Various craft and food-related activities apparently took place in specific external spaces as indicated by the concentration of features such as fire installations and pits in certain areas in phases D-A_3, often associated with accumulations of ash and refuse deposited along the edges of the spaces or in pits. There is also evidence that activities associated food preparation and cooking occurred inside structures, which suggests that a range of everyday activities took place both within buildings and in outdoor areas, perhaps depending on season and/or the amount of refuse produced. The situation may have been similar to that observed at Aşvan where activities that produce refuse took place outside on verandas or in courtyards during the warmer parts of the year and indoors only in winter

(Weinstein 1973: 274). It is also possible that the location where a specific activity occurred differed based on the nature of the task. For example, manufacturing activities and initial food processing may have occurred mainly in external spaces, and food preparation, cooking and eating inside buildings. The internal spaces would have provided a more private setting for social interaction if this was desired, whereas the external areas perhaps allowed for more extensive interaction between co-resident groups. There are also differences in the nature of the various external spaces, with courtyards and alleyways offering more private, less inclusive spaces in which to undertake various activities than the more open areas. If most of the domestic tasks occurred outside as long as the weather permitted it, it may be possible that the more spatially restricted spaces (e.g. courtyards) offered the privacy usually afforded by internal spaces. The built environment not only accommodated different scales of social interactions, perhaps depending on the nature of the activity, but also provided people with the choice to interact socially while working.

The large outdoor areas may also have accommodated closer interaction between humans and animals than was the case at Ganj Dareh and Jarmo. There were parts of the external spaces that may have provided areas for penning domestic animals, or they may have been allowed to wander around the settlement. It is possible that the large enclosure Structure X_1 may periodically have provided a space to pen animals, in which case different co-resident groups may have kept their animals together. The modelling also suggested that buildings may have accommodated animals that were ill, injured, or newborn being brought inside, perhaps at night and/or if it was very cold, if needed without it affecting the amount of space used by the co-resident groups. Even though these practices may not have occurred, the built environment had a greater potential for closer, and perhaps more frequent, interaction between humans and animals than Ganj Dareh and possibly Jarmo. It is possible that the small courtyards indicate that some areas within the settlement were enclosed to prevent animals trampling them, or, if they were located by the entrance as suggested by Voigt (1983: 32), they may have been built to prevent animals entering the domestic spaces. Both scenarios indicate that animals were present within the settlement.

One of the suggested functions of the ‘dirty’ spaces is that it provided storage space (in addition to being a work area) for the co-resident unit. Some of the buildings had ceramic storage vessels set into the floors of the ‘dirty’ spaces, although storage vessels have also been found set into the floors of the ‘clean’ living spaces (e.g. Structure II_1). Additionally, it has been suggested that the smaller spaces at the eastern end of the ‘dirty’ space S2 in Structure II_1 (S3 and S4) may have provided storage facilities. ‘Dirty’ spaces in other buildings may have had similar small spaces, or at least areas that were partitioned off, that may have been used for storage. Calculations of storage capacities for ceramic vessels and small spaces combined with modelled on-floor storage containers indicate that buildings had the capacity to store enough food for the co-resident groups living in them. If the small spaces were used for storing animal fodder then they may have supplied feed for a herd averaging twelve animals. If storage of food for human consumption and fodder occurred concurrently, then the herd size might have been smaller. It is possible that food may have been stored for consumption over a shorter period of time (perhaps only enough to cover a six, or possibly nine, month period) rather than the annual requirement. Nevertheless, these calculations indicate that buildings were large enough for the co-resident group to store food and fodder, and thus may have been economically independent.

The most noticeable differences in the structuring of space between Hajji Firuz and Ganj Dareh and Jarmo are the increased spatial separation of co-resident units, the decreased compartmentalisation of internal space, and the possible inclusion of animals within the built environment. The modelling indicates that there may have been an increase in the size of co-resident groups (possibly extended families), though the number of people involved in domestic activities may have been similar to Jarmo if the suggestion that more than one co-resident group shared access to and use of courtyards is correct. The three case studies examined thus far have shown variability in the structuring and use of space indicative of differing social practices. The next chapter presents four additional case studies, namely Sheikh-e Abad in the Zagros uplands, Ali Kosh in the lowlands of southwest Iran, and Nemrik and Magzaliyah in the lowlands of northern Iraq. The first two sites are roughly contemporary with Ganj Dareh and Jarmo, and while Ali Kosh is not located in the highlands it presents a community that appears to have had links with the upland zone. These two sites provide an opportunity to investigate the structuring and use of space at sites from which there is limited evidence, and thus highlights some of the advantages of the visualisation modelling. The two lowland sites offer data from settlements located in different ecological zones, and provide the basis for the assessment of whether there may have been similarities and/or differences in the social practices within and between these two regions, which is discussed in chapter 8.

Chapter 7

Sheikh-e Abad, Ali Kosh, Nemrik and Magzaliyah

7.1: Introduction

The previous three chapters presented the in-depth examinations of the structuring and use of space at Ganj Dareh, Jarmo and Hajji Firuz. These three sites provide the most comprehensive data sets pertaining to Neolithic built environments in the Zagros, with publications that include plans and sufficient information to evaluate the occupational sequences and structural remains depicted on the plans. There have been excavations at other Neolithic sites in the Zagros Mountains and adjacent lowlands, including (but not limited to) Zawi Chemi, Karim Shahir, Tepe Asiab, Sheikh-e Abad, Chia Sabz, Tappeh Jani, Abdul Hosein, Tepe Guran, Shimshara, Tepe Sarab, Ali Kosh, Chagha Sefid, Tol-e Nurabad, and Tall-e Mushki. However, many of the sites lack comprehensive publications and the size of the excavated areas at many of the sites are limited with few or fragmentary structural remains, which restricts the potential for conducting informed analyses of the built environments at these sites. Tepe Abdul Hosein, for example, has a final publication (Pullar 1990, see also Goff and Pullar 1970; Pullar 1981), but the excavations did not produce sufficient structural remains to allow an informed analysis of the built environment.

The first part of this chapter examines the potential information that may be gained from sites with limited evidence, focusing on Sheikh-e Abad (section 7.2.1) in the upland area in the central part of the Zagros Mountains and Ali Kosh (section 7.2.2) in the lowlands of southwest Iran. Ali Kosh is one of the few sites for which there is a final publication (Hole, Flannery and Neely 1969), and the results from the investigations at Sheikh-e Abad are in the process of being published (Matthews, Mohamadifar and Matthews in press). They were selected because the architectural remains at these two sites present two of the more ‘complete’ examples of Neolithic built environments in the Zagros area that are broadly contemporary with the sites examined in the previous three chapters. They were included in this chapter to evaluate the information that may be gained (beyond generalising statements about the construction material and techniques, and built forms) through visualisation modelling in cases where there is limited evidence, as well as to highlight some of the difficulties associated with incomplete remains.

The second part of this chapter examines the built environments at Nemrik (sections 7.3.1-7.3.1.2) and Magzaliyah in northern Iraq (sections 7.3.2-7.3.2.2). These sites are located at lower-lying altitudes than most of the settlements discussed in this thesis – although in proximity to mountains and/or foothills – and provide data from settlements located in different environments than those in the upland zones of the Zagros. They therefore allow an assessment of similarities and differences in the structuring and use of space within different regions. These sites were chosen based on the amount of information available concerning the built environment and because they are roughly contemporary with some of the upland sites. Additionally, there appears to be different economic strategies at the two sites; the inhabitants at Nemrik relied on wild resources, whereas herded caprines and cultivated plants formed part of the subsistence strategy at Magzaliyah.

7.2: The Zagros Mountains and lowlands of southwest Iran

This section presents a discussion of the results from the modelling of Sheikh-e Abad and Ali Kosh. Sheikh-e Abad is an interesting site for exploring aspects of symbolism and ritual behaviour in the Neolithic of the Zagros associated with sheep and goats. Additionally, when a more complete analysis of the animal bone assemblage from the site is undertaken, it may contribute to our knowledge of the development of caprine herding in this region. The current evidence from Ganj Dareh indicates that goats had come under human management sometime around 8,000 cal BC (section 2.4.2). One of the issues considered here is whether there are any observable similarities and/or differences between Sheikh-e Abad and Ganj Dareh with regards to the potential inclusion of animals into the built environment. The sites appear to be roughly contemporary, located in similar environments within the same region in the central Zagros, and the subsistence strategy at both sites may have included herding of goats (although this has yet to be established for Sheikh-e Abad). The lowland site of Ali Kosh has the potential to provide interesting insights into a settlement that relied on domestic species brought in from the upland zone (plants and animals) in addition to locally available resources, as this implies new strategies for managing subsistence resources. Ali Kosh is roughly contemporary with, and has a similar economic strategy (i.e. reliance on domestic species as well as hunting and collecting) to, Jarmo.

7.2.1: Sheikh-e Abad

Sheikh-e Abad is an Aceramic Neolithic site (*c* 9,800-7,600 cal BC)[61] located 35 km north of Ganj Dareh and 38 km northeast of Kermanshah in Kermanshah Province, western Iran (approximate co-ordinates: latitude 34º36` N, longitude 47º16` E) (Matthews 2009a: 7). The site is situated at an elevation of 1,425 m above sea level on a fertile alluvial plain surrounded by mountains rising up to 2,400-3,000 m, and covered, at the time of excavation, an area of around 1 ha with approximately 10 m of archaeological deposits (Matthews et al 2010). Preliminary analyses of various environmental data indicate that the inhabitants at the site would have had access to a range of ecological zones, e.g. plains, wetlands and mountains (Matthews et al 2009: 12; Matthews 2009a: 7-10). The botanical remains include barley, pistachio, almond, lentil, pea, sea club-rush, and *Astragalus* (Ilkhani 2009), and the faunal assemblage indicates a predominance of goats and perhaps sheep (whether they were domesticated have not been established), with other identified species including deer, hare, birds, tortoise, and possibly freshwater crab (Cole 2009). One season of excavation has so far been completed at the site, and information concerning architecture and the use of space is somewhat limited (Matthews et al 2009; Matthews et al 2010).[62] Structural remains were only found in the main trench on top of the mound (see Figure 7.1 for trench location) and consisted of two structural units (here referred to as Structure 1 and Structure 2) separated a by a narrow, possibly external space (Figure 7.2).

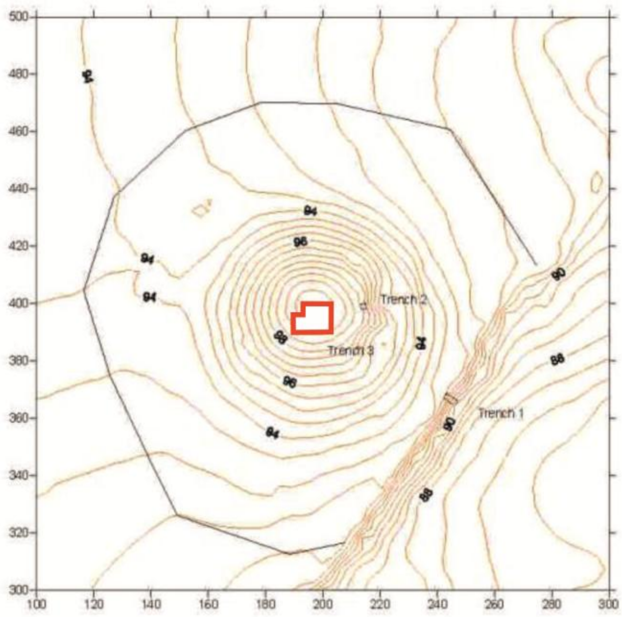


Figure 7.1: Overall site plan of Sheikh-e Abad showing location of the main trench outlined in red (modified from Matthews et al 2009: fig. 3.6).

[61] Only three radiocarbon dates (from earliest to latest deposits) 9,810±60 cal BC (Trench 1), 7,960±60 cal BC (Trench 2), 7,590±40 cal BC (Trench 3, Structure 2) are available from the site (see Matthews et al 2010). There was also some later activity at the site; three burials (probably Late Parthian in date) and two pits disturbed the uppermost Neolithic deposits (Matthews et al 2009: 15, 42-44).

[62] Excavations were conducted in a step-trench at the southeast edge of the mound (1), a trench halfway up the eastern slope (2), and a 10 x 10 m trench with a 6 x 3 m extension (covering a total of118 m^2) at the top of the mound (3) (Matthews et al 2010).

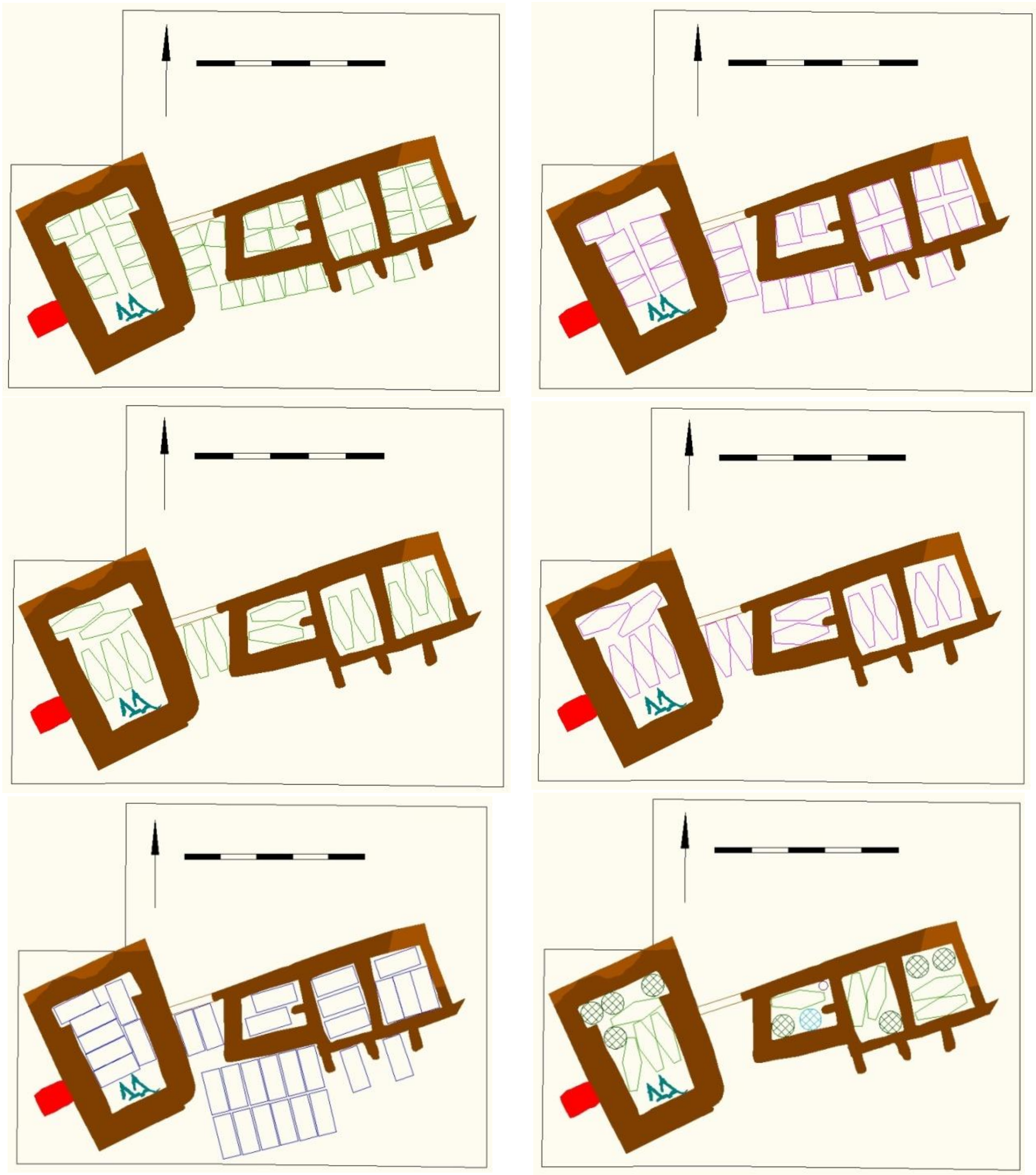


Figure 7.2: Modelled maximum capacities of Size A and Size B adults sitting cross-legged (top) and sleeping (middle); affordance of space for goats (bottom left); and modelled co-residency and storage (bottom right) at Sheikh-e Abad. The northeast corner of the eastern space in Structure 1 had been removed by a recent robber's pit and was reconstructed during the digitising process based on observations in the section of the pit.

Structure 1, located in the eastern part of the trench, consisted of a series of small, rectangular spaces (oriented southwest-northeast) made of *tauf/chineh* that had three short walls projecting southwards from their southern wall (Matthews et al 2009: 44-48). There were fragmentary remains of walls in the southern part of the trench; however, these were only observed on the surface and not excavated, though it has been suggested that they may have been constructed later than Structure 1 (Matthews et al 2009: 44). The external space to the north of Structure 1 consisted of thick layers of compacted clayey material, possibly packing, interspersed with thinner lenses of ashy deposits sloping downwards to the northeast (Matthews et al 2009: 54-58).

In terms of the affordance of space for co-presence, the eastern space (*c* 1.60 x 1.60 m) in Structure 1 was large enough for six Size A or four Size B adults to sit cross-legged, the central space (*c* 1.14 x 1.58 m) could accommodate four adults (Size A or Size B), and the western space (*c* 1.76 x 1.22 m) had room for four Size A or two Size B adults (Figure 7.2). With regards to their potential for co-residency, the eastern space could accommodate three Size A or two Size B adults sleeping, whereas only two adults (either Size A or Size B) could fit in each of the remaining two spaces (Figure 7.2). This indicates that even though the spaces were small, they may have provided shelter for at least two individuals if needed, and had the *potential* to be living spaces. It is also possible that they were used for storage, or as work spaces for particular food-related or manufacturing activities. If it is assumed that they were storage spaces, and that grain for human consumption was stored in them (directly on the floor to a height of 0.5 m or 1 m), then they had the combined capacity to provide the annual grain requirement for between ten and nineteen people. Alternatively, if fodder was stored in them there may have been enough for sixteen to thirty-two goats for 90 days or twelve to twenty-four goats for 120 days (Table 7.1).

Space in structure	**Potential capacity for storage (m^3)**		**Number of people that could be supplied by potential storage**		**Number of goats that could be supplied by potential storage for 90 days**		**Number of goats that could be supplied by potential storage for 120 days**	
	0.5 m height	1 m height	0.5 m height	1 m height	0.5 m height	1 m height	0.5 m height	1 m height
Western	1.074	2.147	3.25	6.51	5.37	10.74	3.98	7.95
Central	0.901	1.801	2.73	5.46	4.50	9.01	3.34	6.67
Eastern	1.280	2.560	3.88	7.76	6.40	12.80	4.74	9.48

Table 7.1: Potential storage capacities, Sheikh-e Abad.

Preliminary studies of micromorphological samples by Wendy Matthews have attested the periodic deposition of herbivore and possibly omnivore dung in the eastern space in Structure 1, which has led her to suggest that it may have been used as a small internal pen, especially during the winter months (Matthews: 2009b: 98). To test the possible use of these spaces as pens, the maximum capacities for goats were modelled in each of the spaces (Figure 7.2): four goats could fit into the east space, three in the central space and one in the western space. It is therefore possible that these spaces could have been used as pens, perhaps for newborn kids, or animals that were ill or injured. However, it is equally possible that at least the eastern space was used for storage of dung fuel and not as a pen. Additionally, the child burial found below the floor in the northwest corner of the western space (Matthews et al 2009: 48) indicates that it may not have been used as a pen. The occurrence of both burnt and non-burnt dung in various deposits at the site indicates that goats were under management strategies that included penning and collection of dung for use as fuel (Matthews 2009b). Traces of periodic deposition of non-burnt herbivore dung on possible external surfaces south of Structure 1 have been attested in the preliminary micromorphological study (Matthews 2009b: 91), which may suggest that goats were brought into the settlement. However, as this area was not excavated it is not possible to ascertain whether this was the result of periodic movement of animals through the space and that they were penned elsewhere, or if goats were penned there recurrently.

Structure 2 (west of Structure 1) was a rectangular building made of mud brick and *tauf/chineh* with a T-shaped interior, west of which there was a possible external space containing a fire installation (Matthews et al 2009: 49-50). By the wall at the southern end of Structure 2 there was a feature consisting of five goat and sheep skulls that were placed facing into the space. Four goat skulls (*Capra aegagrus*) were placed in two rows of two (traces of ochre were found on one of the skulls at the front), with the skull of a possible wild sheep placed behind them by the wall (Cole 2009). This feature suggests that goats and sheep may have played a role in the symbolic and ritual behaviour at the site, perhaps similar to Ganj Dareh where two sheep skulls were set into a niche in one of the small cubicles (section 4.3). The key difference in the use of sheep and goats in ritual practices between these two sites is the hidden, more restricted nature of the sheep skulls at Ganj Dareh. These had been placed in a small space that could only accommodate a single individual, whereas the goat and sheep skulls at Sheikh-e Abad were located in a space where there was room for more people. If these installations were associated with certain ritual activities then such activities may have been more inclusive at Sheikh-e Abad than at Ganj Dareh.

Structure 2 may not necessarily have been a purely ritual space – although this remains a possibility – as it is large enough to accommodate a co-resident group consisting of parents and their children; there is room for up to nine Size A or seven Size B adults sitting cross-legged, or five adults (Size A or Size B) sleeping (Figure 7.2). The limited excavation at the site prevents any conclusions to be drawn regarding the layout of the settlement, or the potential existence of functionally different structures. It is possible that the smaller spaces were used for specific domestic tasks, e.g. food-related and/or craft activities, storage (e.g. food, fodder, fuel), and/or periodic penning, which may indicate a separation of storage and some work from the habitation spaces with only minimal storage (e.g. personal items, bedding and so on) occurring in the spaces where people lived. Without excavating a larger area of the settlement it is not possible to ascertain if domestic spaces (Structure 2) were kept separate from storage and/or work spaces (Structure 1), or whether there were separate spaces for ritual activities associated with sheep and goat skulls (Structure 2) and the smaller spaces (Structure 1) were part of a larger domestic structure that was internally compartmentalised as at Ganj Dareh.

In summary, there may have been a difference between larger living spaces that included visual elements of symbolic and ritual behaviour, and smaller work and/or storage areas. There is a lack of *in situ* evidence indicating particular activity areas, apart from the possible fire installation in what may have been an external space east of Structure 2. This indicates that some food-related activities took place outside buildings, and it may be that certain tasks related to food preparation and cooking were social activities that may have involved members of different co-resident groups. The number of people that could be involved would depend on whether the external space was an open area or an enclosed courtyard. It is also not possible to assess the amount and overall structuring of external space within the settlement, although it is possible that there may have been an increased affordance of space for animals compared to Ganj Dareh. The presence of dung in micromorphological samples indicates that animals were penned and dung collected for use as fuel. The precise locations of the pens are currently open to interpretation, although they would probably have been kept away from areas where food preparation and cooking occurred, e.g. the space east of Structure 2. With regards to the affordance of space for co-residency, the internal spaces may have accommodated small co-resident groups (possibly nuclear families), perhaps similar to Ganj Dareh, especially when compared to Jarmo and Hajji Firuz. It is possible that the small spaces, if they were used for storage, or as work spaces, and/or pens, were part of a communal economic strategy similar to Ganj Dareh where storage and herding practices appears to have been shared between several co-resident units. This, however, can only be investigated through further excavations at the site.

7.2.2: Ali Kosh

Ali Kosh is a Late Aceramic-Early Pottery Neolithic site (*c* 7,500-6,900 cal BC) located in the southeast part of the semi-arid Deh Luran plain (elevations between 100 and 500 m above sea level) in Khuzestan province, southwest Iran (approximate co-ordinates: latitude 32° 33' N, longitude 47° 19' E) (Hole, Flannery and Neely 1969: 10-22), which is a different environmental setting than the other sites discussed in this thesis so far. The upper part of the Deh Luran plains currently receives 200-300 mm of annual precipitation, probably more during the Early Holocene, which is enough to support dry farming (Hole 1987a: 33; Hole, Flannery and Neely 1969: 16-22). At the time of excavation (1961-1963) the site was roughly circular in shape, measuring about 135 m in diameter with about 7 m of archaeological deposits, of which *c* 4 m were above the level of the plain (Hole, Flannery and Neely 1969: 29). The excavated deposits were divided into three main phases (earliest to latest); Bus Mordeh (Aceramic), Ali Kosh (Aceramic), and Mohammad Jaffar (Pottery), which were each further divided into two sub-phases (Hole, Flannery and Neely 1969: 5-49).[63] The significance of the site lies mostly in the fact that the inhabitants were herding domestic goats, and possibly managing sheep (although whether the sheep were domestic or wild remains debated; section 2.4.2). Since the Deh Luran plain lies outside the natural range of wild goats and sheep (Zeder 2009: 36), their presence at Ali Kosh implies a new management strategy in which these animals had been brought into a new environment. New strategies associated with the cultivation of plants are also attested at the site. In addition to the cultivated wild and domestic forms of wheat and barley, Helbaek identified three species of weedy grasses (goat-faced grass, ryegrass and wild einkorn) that were not indigenous to the area and had been introduced together with the cultivated crops into the lowlands from the upland zone of the Zagros (Helbaek 1969: 389-391, 412; see section 2.4.2).

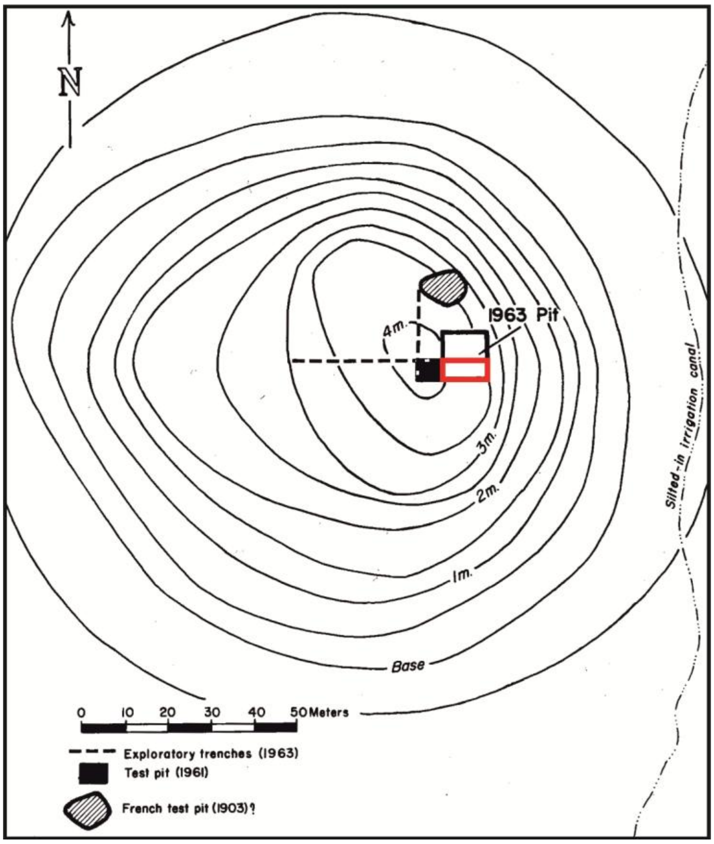


Figure 7.3: Overall site plan for Ali Kosh showing the locations of the excavated trenches with the trench in which the Bus Mordeh and Ali Kosh phase remains discussed in this chapter outlined in red (modified from Hole, Flannery and Neely 1969: fig. 4).

Information regarding the spatial configuration of the Neolithic settlement is limited (no complete buildings were found) due in large parts to the small size of the excavated area

[63] The sub-phases were numbered as follows (early-late): Bus Mordeh – C_2 and C_1; Ali Kosh – B_2 and B_1; and Mohammad Jaffar – A_2 and A_1.

(see Figure 7.3 for trench locations) (Hole 1987a: 34).[64] The results can be summarised as follows: the remains of a few small rectangular spaces made of mud slabs with compacted earthen floors were found in the Bus Mordeh phases; fragmentary remains of plaster coated *tauf/chineh* walls and parts of what appear to be two mud brick buildings were found in association with various fire installations in the Ali Kosh phases; and fragmentary remains of mud brick walls and parts of stone foundations in the Muhammad Jaffar phases (Hole, Flannery and Neely 1969: 34-49). Only two of the published plans will be considered here as they constitute the most comprehensive (if such a word can be used) information on the architecture; one from the Bus Mordeh phase and one from the Ali Kosh phase. As none of these structural remains constitute complete buildings, the digitising process included a greater degree of structural reconstructions than for the other sites considered in this thesis. The rationale behind these reconstructed will be outlined where relevant in the following discussion.

In the earliest Bus Mordeh phase there were three, or possibly four, small spaces in the western part of the excavation area (Hole, Flannery and Neely 1969: 34-36). Figure 7.4 shows the reconstructed extent of this structural configuration used in the modelling. The southeast space was the only one which could be reconstructed to its original extent since only the southeast corner was located outside the trench, whereas the reconstruction of the other spaces presents one *possibility* of what the building *may* have looked like. The eastern and western walls of the northeast space were extended so that the entrance was located approximately in the middle of the eastern wall, although it is equally possible that the space were originally smaller or larger than its reconstructed size. However, considering the size of the southeast space it was assumed that the northeast space was within a similar size range. With regards to the northwest space, its southern extent was known, and since it appeared to be a small space the reconstructed northern wall was placed immediately outside the trench (also the northern wall was not visible in the trench section and the space could therefore not be smaller than the reconstruction). The *potential* southwest space was reconstructed by extending the western wall of the northwest space and the wall extending westwards from the southern wall of the southeast space. It should, however, be noted that based on the available information it is uncertain whether this was a fully enclosed space. Nevertheless, the reconstruction was included to assess the potential use of this area in case it had been enclosed.

The smallest space measured 1.00 x 1.20 m and only one or two adults (Size A or Size B) could sit cross-legged in it, depending on the original length of the space (Figure 7.4). One adult (Size A or Size B) could also lie down in this space, although this may not have been particularly comfortable due to the small size of the space. This indicates that the space was

[64] Excavation was conducted in a 3 x 5 m test pit, a 1 x 20 m exploratory trench running north-south, a 1 x 40 m exploratory trench running east-west, and a 10 x 10 m trench next to the test pit (Hole, Flannery and Neely 1969: 29-33). The 10 x 10 m trench was excavated down to the bottom of the Mohammad Jaffar phase, after which it was reduced to a 4 x 10 m trench.

perhaps better suited for storage purposes, as suggested by the excavators (Hole, Flannery and Neely 1969: 34), or as an enclosed work space where only one individual would be present at any one time. If it is assumed that it was a storage space and it was filled to a height of 0.5 m (0.622 m^3) it could have supplied the annual grain requirement for one and a half people, or the quarterly fodder requirement for three goats. Alternatively, if it was filled to a height of 1 m (1.245 m^3) it could hold the annual grain requirement for three people, or the quarterly fodder requirement for six goats. It is also possible that it may have been used as a storage space for fuel, raw materials, tools, or other household items.

Space	Sitting cross-legged		Sleeping		Goats
	Size A	Size B	Size A	Size B	
Northeast	12	8	7	6	7
Northwest	1-2	1-2	1	1	1
Southeast	8	6	5	5	6
Southwest	5	4	3	2	3

Table 7.2: Modelled contextualised maximum capacities, Bus Mordeh phase.

The two spaces located immediately east of the small space were larger: the southweast space measured *c* 2.50 x 2.00 m, whereas the northeast space, which had a doorway leading to the external area to the east, may have been slightly larger (original extent unknown). There may have been another space in the southwest corner of the trench, though it is unclear whether it was an internal or external area. The southeast space had a wide entrance in its western wall and a wall projecting westwards from its southwest corner indicating that the space in the southwest corner of the trench may have been at least partially enclosed. Table 7.2 lists the modelled maximum capacities for each of the four spaces, including a reconstruction of the southwest space (Figure 7.4). The two eastern spaces may have been large enough to accommodate up to twelve Size A or eight Size B adults sitting cross-legged, and around five adults (Size A or Size B) sleeping, or three adults co-residing with enough room for on-floor storage of their annual grain requirement (Figure 7.4). This indicates that these two spaces may have been large enough to be living spaces. Alternatively, if they were (perhaps periodically) used as animal pens there would have been room for six or seven goats (Figure 7.4).

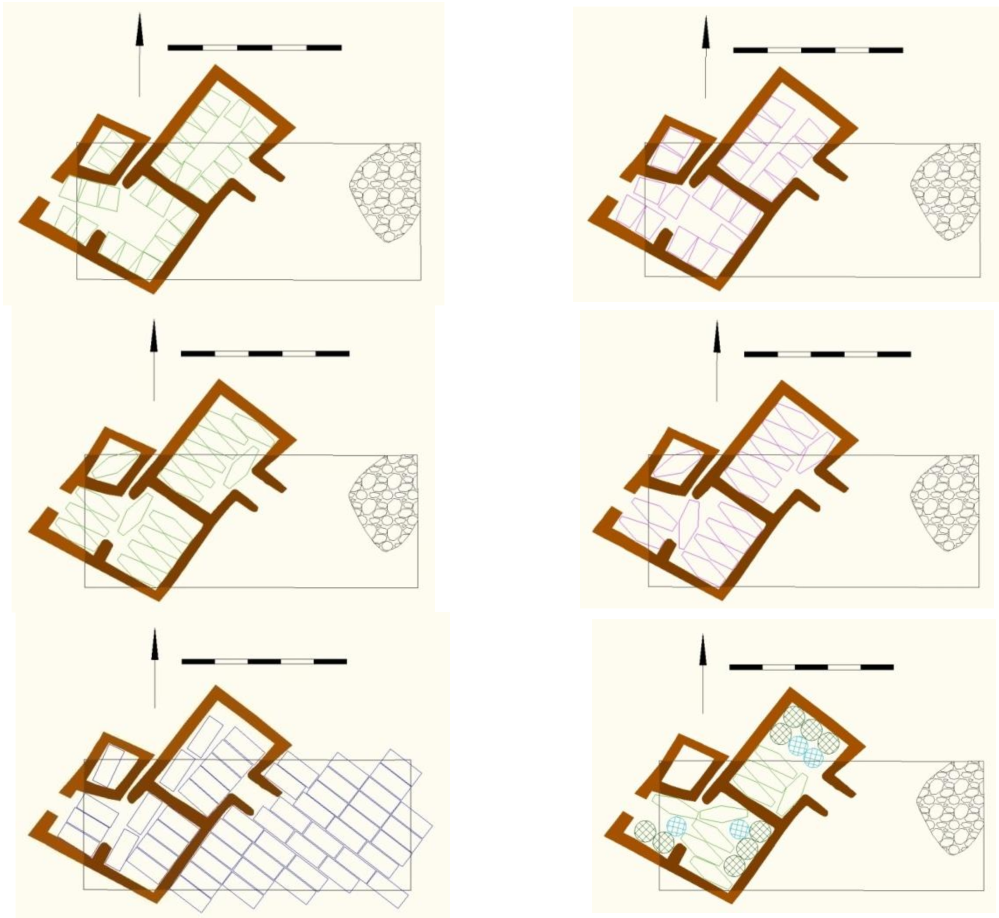


Figure 7.4: Modelled maximum capacities of Size A and Size B adults sitting cross-legged (top) and sleeping (middle); affordance of space for goats (bottom left); and modelled co-residency and storage (bottom right) in the Bus Mordeh phase.

There were no fire installations or other features found in any of the spaces, indicating that activities that required the use of fire, such as food preparation and cooking, took place elsewhere. In the external space in the eastern part of the trench there were refuse deposits containing a substantial amount of ash and charred plant remains, a concentration of chipped stone debris in the southeast part, and a pavement of pebbles in the northeast corner. The midden deposits indicate that refuse disposal and possibly lithics manufacturing took place in this area, which, in addition to the lack of internal features, may suggest that many domestic activities took place outside. A small skull of a hornless sheep was found resting on the floor in the northeast corner of the southeast spaces (Hole, Flannery and Neely 1969: 34, 278-281). If this sheep skull had been intentionally placed in the space and it was associated with some form of ritual behaviour (as at Ganj Dareh and Sheikh-e Abad), then the ritual activities may have involved a similar number of individuals as at Sheikh-e Abad.

In the subsequent Ali Kosh phase the partial remains of two structures separated by an alleyway were found. The narrow alleyway measured 0.30-0.50 m in width and contained large quantities of animal bones (up to 0.50 m in height), and it may have been used for refuse disposal (in particular associated with butchering, food preparation, and eating) rather than providing passage between the eastern and western areas. Figure 7.5 shows the reconstruction of the possible extent of the excavated spaces that was used in the modelling. The northern building consisted of at least three spaces, and the southern structure contained two spaces. All of the spaces appear to have been fairly large, although it is acknowledged that the reconstructions presented here are hypothetical. The southern structure was reconstructed by mirroring the walls excavated within the trench. This was based on the following assumptions: that the spaces were rectangular or rectilinear; that the southern wall would have been roughly parallel to the northern wall; and, as there were no walls visible in section (apart from the wall extending southwards from the northeast corner), that the southern wall would have been located outside of the trench. With regards to the northern structure, the western space could be reasonably accurately reconstructed based on the available information, although the entrance in the western part of its northern wall is only hypothetical as is the reconstructed northwest space. The reconstruction of these spaces was (as was the case with the southern structure) done by mirroring the southern walls, and based on the following assumptions: that the spaces were rectangular or rectilinear; the northern wall would have been roughly parallel to the southern wall; the northern and eastern wall was located outside the trench as they were not visible in section with the exception of the northern wall of the western space; and that the oven found in the southeast corner of the trench was located by the wall and not by an entrance or the corner of the building (thus also providing a partially shielded work area), and the eastern wall was therefore reconstructed slightly further eastwards than the oven. The circumference of each of the ovens in the external areas was reconstructed based on their curvatures. It is acknowledged that both structures may originally have been smaller or larger than the reconstructions used in the modelling. The reconstructions provide one alternative of what the *possible* structural configuration may have looked like, and allow an initial assessment of the structuring and use of space in this phase, especially in the absence of complete architectural units.

The modelled maximum capacities of the various spaces (as reconstructed) are summarised in Table 7.3. If the reconstructions are roughly accurate, the modelling indicates that they may have been used for habitation purposes, including sleeping, eating, socialising, and engaging in various everyday activities. Individual spaces had the capacity to accommodate between five and eleven adults (Size A) sleeping, and between nine and sixteen adults (Size A) sitting cross-legged. It may be suggested that each internal space afforded space for an average of nine co-resident individuals, and the buildings may have accommodated over twenty individuals each. The affordance of space for co-residency and co-presence during this phase at Ali Kosh is greater than at Jarmo, perhaps similar to Hajji Firuz. However, without more information, including a greater horizontal exposure, it is not possible to assess the structuring of space within buildings in terms of differentiation in the use of individual spaces.

Modelled maximum capacities for goats were also included to enable an assessment of whether these spaces had the potential to serve as pens if needed (Figure 7.5), though it is possible that the presence of sub-floor burials (six in the northern structure and one in the southern structure) may indicate that they were used as living spaces rather than as animal pens or storage facilities. All of the spaces had the potential to accommodate a larger number of goats compared to the structures at Sheikh-e Abad and Ganj Dareh, and it is possible that the built environment at Ali Kosh afforded a greater degree of human-animal interaction than at these earlier sites.

Structure	Space	Sitting cross-legged		Sleeping		Goats
		Size A	Size B	Size A	Size B	
South	Western	13	11	11	9	11
	Eastern	14	12	11	9	11
North	Eastern	16	12	11	10	12
	Central	14	11	9	7	10
	Northwest	9	8	5	4	6
	Southwest	10	5	5	5	5

Table 7.3: Modelled contextualised maximum capacities, Ali Kosh phase.

The excavators found numerous ground stone implements and other stone tools in the external space west of the buildings and along the interior walls of both of the structures. Even though many of these artefacts may have been placed there subsequent, or immediately prior, to the abandonment of the buildings, it is possible that various activities in which these implements were utilised, e.g. food preparation, crushing of pigments and so on, took place both in the internal and external spaces. Additionally, two partially preserved ovens were found in the external areas; one by the western wall of the northern structure and one in the southeast corner of the trench. Combined this evidence suggests that food preparation and cooking occurred in the external spaces. This may also indicate that goats were perhaps kept away from these areas, as has been suggested for the other sites.

It is not possible to ascertain whether the external spaces were open areas or enclosed courtyards due to the limited horizontal exposure, and it is therefore not possible to assess the number of people that may have been present at any one time. If these spaces were enclosed then they would have afforded a certain degree of privacy, which would indicate that food-related activities were restricted to the co-resident group, or groups, with access to the courtyard, similar perhaps to Jarmo. However, if these spaces were open areas then a larger number of people could have been present at any one time and the activities taking place there may have involved members of different co-resident groups. The entrance in the western wall of the southern building suggests that the residents in this structure utilised the western external area, but it is not know whether other structures had direct access to this outdoor space or whether it was a courtyard associated with the southern structure only.

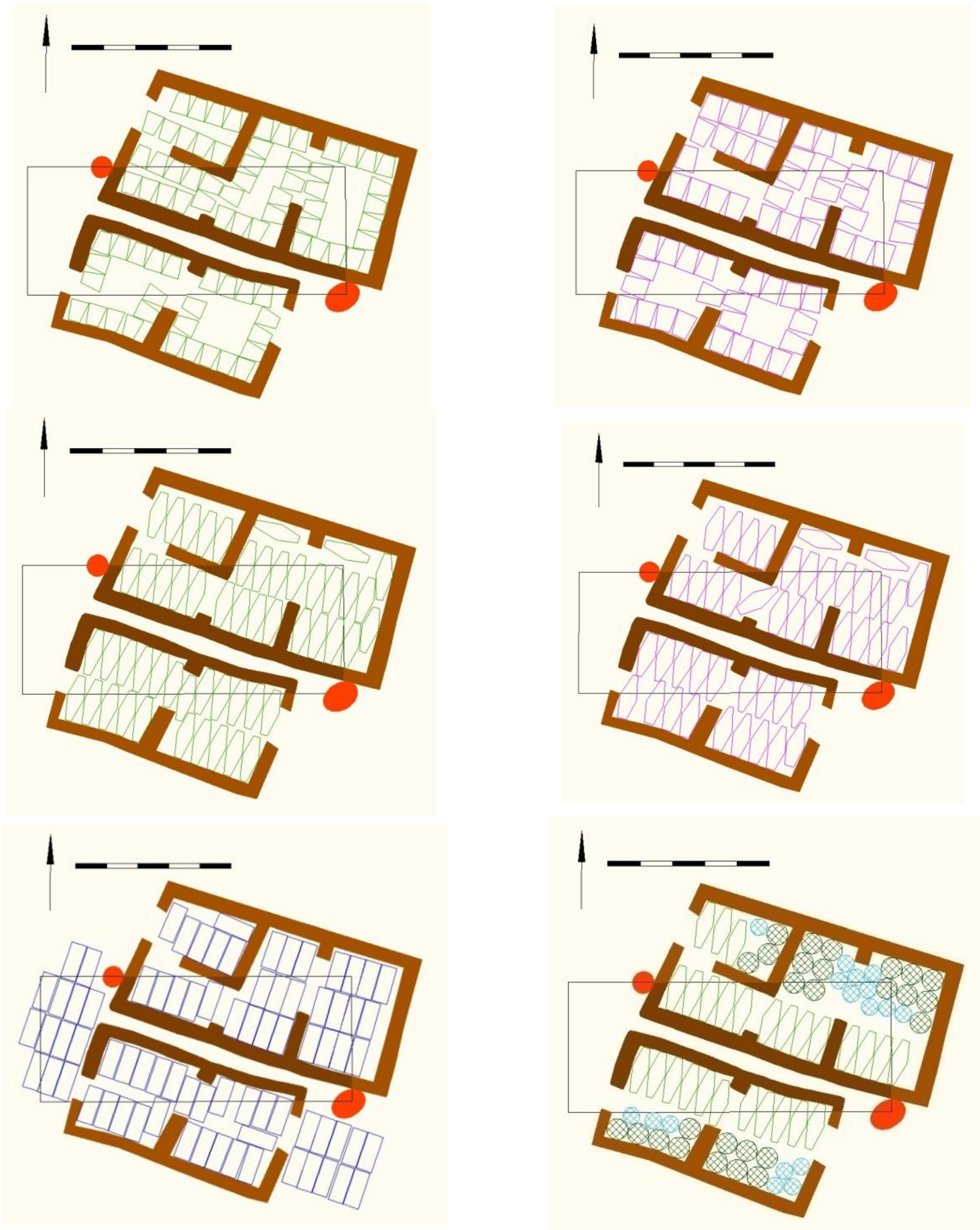


Figure 7.5: Modelled maximum capacities of Size A and Size B adults sitting cross-legged (top) and sleeping (middle); affordance of space for goats (bottom left); and modelled co-residency and storage (bottom right) in the Ali Kosh phase.

7.3: The lowlands of northern Iraq

This thesis has so far focused on the Neolithic sites located in the upland zones of the Zagros for which there is enough data available concerning the built environments. The remainder of this chapter focuses on Nemrik (sections 7.3.1-7.3.1.2) and Magzaliyah (sections 7.3.2-7.3.2.2) in the lowlands of northern Iraq. Their inclusion is not meant to imply that the Zagros highlands and the Mesopotamian lowlands are culturally linked, or the same during the Neolithic. They are included to allow a preliminary assessment of potential similarities and differences in the structuring and use of space, and social practices between two different ecological areas between which there may have been some contact as attested by similar characteristics in material assemblages (although the nature of this contact is not dealt with here as it falls outside the scope of this thesis). These two sites were chosen for their locations at lower lying altitudes (although in proximity to mountains and/or foothills); their subsistence economies, which appear to be different at each site with one community relying on wild resources (Nemrik) whereas herded caprines were part of the subsistence strategy at the other (Magzaliyah); and the amount of available information, which includes published plans. The discussion focuses on the issues of co-residency and co-presence, activity areas and the use of space, and human-animal interaction.

7.3.1: Nemrik 9

The Aceramic Neolithic[65] site of Nemrik (*c* 9,800-8,200 cal BC) was excavated by Stefan Kozłowski on behalf of the Polish Centre of Mediterranean Archaeology at Warsaw University as part of a wider salvage project conducted by the Polish Mission in Iraq in the Eski Mosul area (due to the construction of the Mosul Dam) under the auspices of the Iraqi State Organisation of Antiquities in Baghdad (Daszewski 1990: 5-6; Kozłowski 1990a: 7). It is located about 55 km northwest of Mosul, northern Iraq, on a terrace between two wadis about halfway between the outlying ridges of the Kurdish Mountains and the Tigris Valley at an elevation of 340-345 m above sea level (approximate co-ordinates: latitude 36° 43’ N, longitude 42° 51’ E) (Kozłowski 1989: 25, 1990b: 23, 2002: 19; Kozłowski and Szymczak 1990: 348). Studies indicate that during the Neolithic period Nemrik was located within a steppe-parkland with strands of deciduous trees dotted around the landscape, and strands of mixed oak forests covering the nearby mountain slopes (Kozłowski and Szymczak 1990: 348). The botanical assemblage was small, but included bitter vetch, lentils, wild grasses, pistachio, and cereals, although it is not certain whether they were domestic or wild (M. Nesbitt cited in Kozłowski 2002: 89-90; Nesbitt 1992), and charcoal from tamarisk, ash, poplar, willow, *Pistacia*, and walnut (R. Gale cited in Kozłowski 2002: 90).

[65] One pottery sherd was found in the phases IV-V deposits; it was probably intrusive.

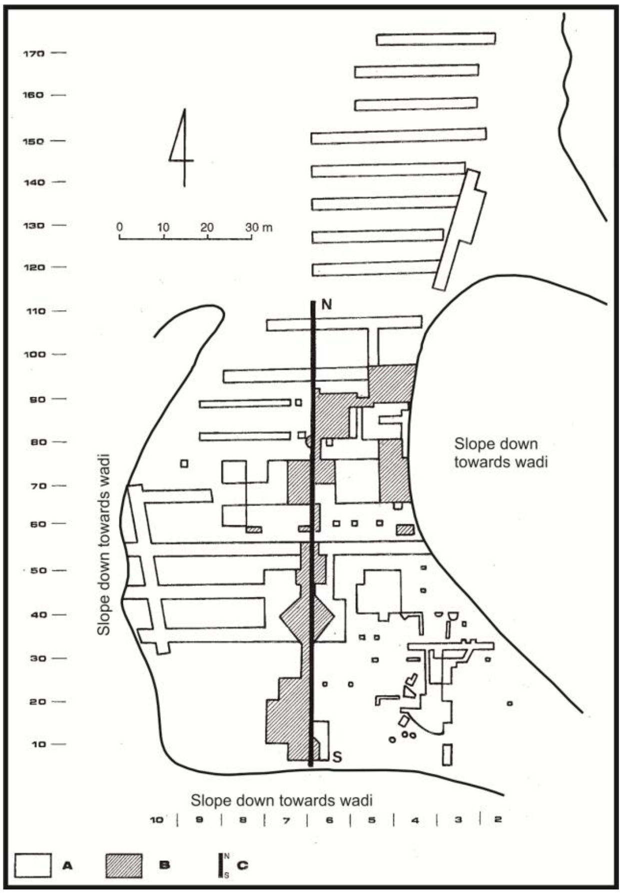


Figure 7.6: Overall site plan of Nemrik showing the location of the excavated trenches. The white trenches (A on the bottom left key) are shallow trenches, the shaded trenches (B on the bottom left key) are deep trenches, and the black trench (C on the bottom left key) is the 80 m long N-S trench (modified from Kozłowski 2000: fig. 7).

A large quantity of faunal remains were recovered, but since there was no zooarchaeologist on the field team and they could not afford to ship the entire assemblage, only about 20-30% of it was sent back to Poland for analysis (Kozłowski in Lasota-Moskalewska 1994: 5-6). The analysis of this reduced assemblage, of which only 80% could be identified, indicates a predominance of gazelle (and other antelopes), with other identified species including aurochs, wild boar, equids, red deer, buffalo, jackal, beaver, badger, wild sheep, wild goat, hare, fox, tortoise, fish, freshwater crab and various birds (Bocheński and Nogalski 1994; Kozłowski 1989: 30, 2002: 90-92; Lasota-Moskalewska 1990, 1994). Lasota-Moskalewska (1994) reported that domesticated sheep, goat, pig and cattle were present at the site with cattle being the most common, whereas both wild and domestic sheep and goats only account for a small part of the assemblage (Kozłowski 2002: 91). However, as Conolly et al (2011: 543) has pointed out, the published identifications of domestic animals are problematic because of the early dates from the site, which is earlier than other sites with attested domesticates in the Tigris-Zagros region, and the assemblage should therefore be reassessed. Additionally, most of the analysed material came from the uppermost deposits

(Peasnall 2000: 420), including the majority of bones identified as domestic (Kozłowski 2002: 91; Lasota-Moskalewska 1994), and it may be that some of the material was intrusive. Later activity and erosion associated with the Mittani and Middle Assyrian settlements had disturbed the upper levels of the Neolithic settlement, especially in the southern and central parts of the site (Kozłowski 2002: 19), and post-Neolithic pottery sherds were found scattered on the surface north of this later settlement (Kozłowski 1990b: 24). Based on the early date of the identified domesticates compared to other sites in the Tigris-Zagros region; the predominance of wild species and the emphasis on gazelle; the occurrence of both wild and domestic varieties and in particular aurochs (as well as the small quantity of sheep, goats, and wild boar/pig); the potential for later, intrusive material; and the inherent problems associated with ascertaining the early stages of domestication (especially considering the early date of the site) it appears reasonable to question the validity of the identification and support the sentiment expressed by Conolly et al that the material needs to be reassessed.[66] For the purpose of this discussion it will be assumed that animals were not domesticated, although certain pre-domestication interaction between animals and humans may have taken place.

Following its discovery during a survey and two weeks of exploratory work where they collected surface material and dug test pits in 1985 (Kozłowski 1990b: 11-14),[67] larger-scale excavations were initiated in 1986 and continued for five seasons (Kozłowski 1990b: 15-16, 2002). At the time of excavation the site covered about 1.8 ha, although it is assumed that a large portion of the original site had been lost due to erosion and later activities (Kozłowski 1990b: 23, 2002: 19). The site was divided into a 10 x 10 m grid which was further subdivided into quadrants, and the archaeological deposits dug in 0.10-0.15 m arbitrary spits; all of the recording was done according to grid square, quadrant, and spit (Kozłowski 2002: 20-21). Excavation took place in a series of trenches laid out across the site, including an 80 m long trench running north-south across the centre of the site (to provide information on stratigraphy), a number of narrow trenches that transversed the site east-west, a series of smaller test pits, and a number of larger trenches of varying depth and size (see Figure 7.6 for trench locations) (Kozłowski 2002: 20-23, fig. 8), some of which were dug using a bulldozer (Kozłowski 2002: 41).[68] The exact depth of the archaeological deposits has not been specified, but it appears that the trenches were dug to a depth of between 0.10 and around 2 m (Kozłowski 2002: 20).[69] A sequence of seven occupational phases, numbered I (earliest), II, IIIa, IIIb, IVa, IVb and V (latest), was identified based on the sequence of construction and abandonment of excavated buildings (Kozłowski 2002: 22, table 1). These

[66] Additionally, the site does not feature in discussions concerning the domestication of animals (e.g. Zeder 2008, 2009), which, due to its early date, appears odd.
[67] Early Neolithic occupation was documented at Nemrik 9 and 10 through a series of surveys along the Tigris; Nemrik 10 lay a short distance to the southwest of Nemrik 9 and may originally have been part of the Nemrik 9 settlement (Kozłowski 2002: 19).
[68] Kozłowski has not stated the exact number and location of all trenches (see Kozłowski 1989, 1990c, 1994, 1999, 2002; Kozłowski and Szymczak 1989, 1990), and thus this is based on the plan of the trenches in Kozłowski 2002 (fig. 8).
[69] Kozłowski has not confirmed the maximum depth of the archaeological deposits, although it appears from some of the section drawings (see Kozłowski 2002: figs. 8-9) that some trenches were dug to a depth of more than 2 m.

phases were associated with two so-called "principal stratigraphic complexes", each of which consisted of a sequence of occupational deposits. The early 'complex' included the so-called layer K, which was divided into 'sub-layers' K_0, K_1, and K_2, and structure KL, and the late 'complex' consisted of the so-called layer KM, which was divided into three 'sub-layers', i.e. KM_Z, KM_Y, and KM_X (Kozłowski 2002: 20-26, table 1). The stratigraphic relationship between the occupational phases, 'stratigraphic complexes', and structures are summarised in Table 7.4 (information from Kozłowski 1990c, 2002).

Occupational phase	**"Stratigraphic complex"**	**Description of 'layer'**	**Excavated structures**
I	K_0	0.1-0.2 m layer of charcoal and ashes on natural clay.	1B (dug into natural clay)
	K_1	0.3-0.7 m layer of brown deposit containing numerous flint tools, stone and bone objects, stone sculptures, and animal bones.	
II	KL	Sequence of up to four clay surfaces, each 2-3 cm thick (although one was 15 cm thick); seals K_1; only eastern part of the site; up to 0.8 m.	4B, 6, 8B, 9A
	K_2	Layer similar in character to K_1.	7A
IIIa	None specified	Buildings dug into K_2 and sealed by KM_Z.	7, 9, 11, 12, possibly 10
			8A1, 15, 16
IIIb			1A, 2A, 4A, 8A, 19
IVa	KM_Z	Sequence of perhaps three stone pavements in the external space; made of pebbles set into clay.	Possibly 4
IVb	KM_Y	Fourth stone pavement in the external space. Cemetery found in southern part of site.	1, 4, 8
V	KM_X	Last stone pavement in the external space. Large, oval refuse pit in the outdoor area in the southern part of the site.	2, 3, 5, 13, 14

Table 7.4: Stratigraphy at Nemrik.

The material assemblages do not appear to change in character throughout the occupation of the site, and in particular the lithic industry (mostly made from local flint), which is referred to as Nemrikian (see Kozłowski 1999: 39-51; Kozłowski and Szymczak 1989), appears to have remained more or less the same throughout (Kozłowski 2002: 49-67; Kozłowski and Szymczak 1989). Other finds include ground stone implements (for grinding and pounding; e.g. querns, grinding stones, mortars, pestles); stone axes; fragments of stone vessels; various clay objects, including animal and human figurines, and tokens; beads and pendants of stone, shell (all *Unio tigridis*), and clay; bone tools (e.g. awls, points, needles, possibly fish hooks); incised bone objects; objects believed to be needles made of black stone; and three pieces of copper (Kozłowski 2002: 69-87). One of the best known groups of artefacts from the site (apart from the chipped stone industry) is the twenty-nine zoomorphic stone sculptures representing the heads of various birds, mammals and a snake. They were all made of local pebbles and include complete examples, fragments of broken sculptures, and statuettes in different stages of manufacture (Kozłowski 2002: 77-80).

7.3.1.1: The built environment

Most of the buildings at Nemrik were large, semi-subterranean, oval or circular mud brick structures with plastered walls and floors (usually made of clay). There were also a few smaller buildings (e.g. Structures 3, 6 and 10), some that were built of *tauf/chineh* (e.g. Structures 3 and 6), some that were built above ground (e.g. Structures 3, 9A and 14), and some structures in phase V that were sub-rectangular (e.g. Structures 2, 5, 13 and 14) (Kozłowski 2002: 27-28; Kozłowski and Kempisty 1990: 358-359). The size of buildings appears to have increased over time, especially in phases IV and V, although there were smaller buildings both in the earlier and latest phases (Kozłowski 2002: 27).[70] Internal features included benches and platforms between 5 and 30 cm in height; post sockets and/or pillars (the latter in phases IV and V) possibly for roof support; oval or circular pits, some with stone slabs laid on top; ground stones set into the floor; and low walls or partitions dividing the internal space (phases IV and V) (Kozłowski 2002: 28-30). There were no clear fire installations found inside buildings, although there were three pits that may have been used as temporary hearths: a shallow horseshoe shaped pit lined with stones and filled with ash and charcoal in Structure 2A (Kozłowski 2002: 30, fig. 14); a small clay-lined pit with traces of burning that was filled with charcoal, ash and lumps of clay in Structure 1B (Kempisty 1992: 22); and a small pit containing large quantities of burnt material in Structure 1A (Kempisty 1992: 28-30). Only Structure 9 appears to have had a doorway, and Kozłowski (2002: 28-30) suggested that most of the buildings may have been entered through the roof by a ladder or wooden steps. Burials occurred below floors in buildings, often grouped together in the eastern part of the structures, and in external areas. The majority of the burials were single, flexed, primary inhumations, although there were also multiple burials and a few skull burials (Kozłowski 2002: 37-38). A few of the burials contained grave goods (mostly in sub-floor burials), which included ground stone implements such as querns, mortars, pestles, and stone balls (perforated and non-perforated); hammerstones and polished axes; clay tokens; bone objects; chipped stone implements[71]; and stone and shell

[70] Most of the smaller to medium sized structures were found in the earlier phases of occupation (phases I through IIIa) with the exception of Structure 3 in phase V.
[71] Two arrowheads were apparently found embedded in the skull of one of the skeletons found in Structure 2A, and the location of arrowheads in close proximity to various part of the skeletons in graves 5, 11 and 33 has led to the suggestion that these individuals did not die of natural causes (Kozłowski 2002: 40).

beads (Kozłowski 2002: 39-40). Twelve adult burials were found grouped together in the southwest part of the site (south of Structure 8) in phase IVb, which led the excavators to suggest that it was a cemetery (Kozłowski 2002: 38-39, fig. 20).

A total of 27 buildings were excavated, some of which had been built on top of earlier ones, though it appears that some time had passed between the abandonment of one structure and the construction of the next one (see Table 7.4).[72] Due to the large number of buildings and since most were similar in size and construction with only some variation in internal features, six buildings were selected for the modelling as they were thought to represent the various architectural forms at the site. These were selected based on the amount of available information, which had to include a published plan that could be 'deciphered' in case of limited information. The amount of available information is variable (in some cases no description is given apart from the type of construction material and general size category) with a bias towards the larger structures. Structures 1B (phase I), 1A (phase IIIb) and 1 (phase IVb) were chosen because they represented a sequence of buildings that had been built on top of each other, and there is more information available than for most other structures (see Kozłowski 1990c); Structure 2 (phase V) was selected because it had a sub-rectangular plan which only occurred in the latest phase; Structure 10 (phase IIIa) was chosen due to its small size; and Structure 3 (phase V) due to its medium size and lack of internal features.[73]

Structure 1B was a semi-subterranean building with an irregular, circular plan (*c* 5.60 m north-south); most of the eastern part of the building had been removed by the overlying Structure 1A (Kempisty 1992: 18-19; Kozłowski and Kempisty 1990: 352). The walls of the pit (which had been dug into the natural clay) had not been lined with bricks or *tauf/chineh* as was the case in the other buildings, nor had the floor, which sloped down towards the centre, been plastered. Most of the northern and eastern parts of the interior were taken up by three large pits, one of which was truncated by a later pit. Other internal features included a small pit and a small possible fire pit in the southwest part of the structure, and a number of sub-floor burials in the eastern part of the building (Borkowski 1992; Kempisty 1992: 18-22; Kozłowski and Kempisty 1990: 352).[74]

Structures 1A and 1 were semi-subterranean, circular mud brick buildings which were similar in size (the north-south and east-west dimensions were 6.90 x 6.30 m and 7.35 x 6.75 m respectively) and had certain similarities in the structuring of internal space. For example, Structure 1A had four post sockets – two in the northern part and two in the southern part – the positions of which were more or less replicated by the four pillars (made of marl) in

[72] The buildings built in the same location are denoted by the same number followed by a separate letter, and include (from earliest to latest) the following: 1B-1A-1; 2A-2; 4B-4A-4; 7A-7; 8B-8A1-8A-8; and 9A-9.
[73] It is acknowledged that none of the buildings in phase II are represented in this sample, but they were not included for the following reasons: there is no plan available for Structure 4B; and Structure 6, even though it is small, it is slightly larger than Structure 10 which was chosen as it represented the smallest end of the scale in terms of building size. Additionally, Structure 2A, a medium sized building for which there is information available, was not included as there are some aspects of the published plan that are unclear (Kozłowski 2002: fig. 14).
[74] One of the burials truncated one of the large pits; see Kempisty 1992: fig 6.

Structure 1 (Kempisty 1992: 31). The floor and internal wall in Structure 1A were plastered, and internal features, most of which were located in the southern part of the building, included pits (containing e.g. chipped stone and ground stones), platforms (one along the northern wall and two in the southern part of the building), and benches associated with the platforms in the southern part of the building (Kempisty 1992: 22-31; Kozłowski and Kempisty 1990: 353-354). Twelve sub-floor burials containing about twenty-five individuals were found in the eastern part of the building (Kozłowski 2002: 37, tables 3-4, fig. 19). Structure 1A had been burnt (the floor had traces of burning and the building was filled with burnt debris from the roof) and the internal features and spatial distribution of some artefacts had been preserved. A concentration of flint was found on the floor in the eastern part of the building, extending north from the southeast platform, together with a cache of ('several dozen') flint bladelets (Kozłowski and Szymczak 1992), and there was a stone slab resting against the western wall (Kempisty 1992: 30; Mazurowski 1992: 102). The flint scatter consisted of 1,054 pieces (including around 100 tools; see Kozłowski and Szymczak 1992), and appears to have been the *in situ* remains of flint knapping activities. It is possible that this particular area was used for the production of chipped stone tools – at least immediately prior to the burning event. If this was the case then it may be that the cache of flint bladelets was associated with these activities, i.e. products from the flint knapping. The function of the stone slab, on the other hand, is not known (but see Mazurowski 1992: 102-103), and it may have been placed against the wall immediately prior to the burning of the structure. It is possible that most of the items that were kept in the building during its occupation had been removed prior to its destruction and the artefacts that were recovered may have been intentionally placed there, and/or the assemblage is not representative of all of the activities that took place within the structure. The excavators found stone balls, ground stones, flint objects, clay tokens, and a black stone 'needle' within the burnt, collapsed material from the roof, and they believed these items had originally been placed on the roof at the time of the fire (Kozłowski 2002: 30-33).[75] If this was the case, it is possible that the roof was used for storage of various tools, perhaps used outside, and/or as an activity area.

Structure 1 was less well preserved, and it is not known whether the floor and walls were plastered, although the plaster with traces of yellow paint found on the pillars (Kempisty 1992: 31) may indicate that the floors and/or walls had also been plastered, if not painted. The only internal feature, apart from the aforementioned pillars, was a mud brick wall running east-west on the north side of, and along, the southern pillars that separated the southern part of the internal space from the rest of the structure (Kempisty 1992: 32). The artefacts recovered from within the building included a flint scatter (consisting of 840 pieces) on the floor south of the southeast pillar (Kozłowski 2002: 32), and twenty-five ground stone objects and fragments of stone axes on the floor (locations not specified) (Mazurowski 1992: 105). This led Kozłowski (2002: 35) to suggest that Structure 1 was used for storage of stone objects and may never have been inhabited, although in the previous paragraph he stated

[75] Other buildings excavated at Nemrik that had been burned are Structures 2A, 4, and 9A (Kozłowski 2002: 30-31).

that the building may originally have been intended to be a dwelling. Discounting habitation based solely on the presence of a number of stone artefacts is not convincing, although it is of course possible that part of the structure was used for such purposes, and/or that it served as a storage facility immediately prior to abandonment (although it is assumed that stored goods may have had some value and would have been removed before abandonment).

Structure 2 was a large, sub-rectangular mud brick building (*c* 7.30 x 5.80 m) that had pillars set into the northwest and northeast corners of the wall, and four pillars in the internal space (two in the northern part and two in the southwest part) (Kozłowski 2002: 28-29, fig. 15; Kozłowski and Kempisty 1990: 358, fig. 6). There was a low internal wall built of marl and mud brick between the two southern pillars, separating the southern end from the rest of the interior, similar to Structure 1 (Kozłowski 2002: 29-30). The floor was made of clay and had traces of red paint on it, and traces of black, red and yellow paint were also found on the walls (Kozłowski and Kempisty 1990: 359). There were apparently "[s]traight walls abutting house 2 on the north, forming perhaps part of its enclosure (?)" (Kozłowski 2002: 43). However, there are no details given regarding the number of walls, their dimensions, form, or precise location, and it is not possible to accurately evaluate their function or impact on the use of space.

Structure 3 was a medium-sized, circular *tauf/chineh* building (*c* 4.20 m in diameter) with a simple clay floor, containing no internal fixtures, but numerous stone querns, a stone slab, and a sculpture of a bird's head (Kozłowski 2002: 28, fig. 13; Kozłowski and Kempisty 1990: 356). Kozłowski (2002: 35) suggested that Structure 3 may have been a storage building (due to the numerous stone objects), which was later turned into a tomb. The latter appears to be based on the fact that a skeleton was found in the fill (no burials below the floor), which indicates that the deceased was interred there at some point after the abandonment of the structure. It may be that this individual was deliberately interred within Structure 3, perhaps as a sort of 'closing' deposit, although it is equally possible that the individual was buried there after the building had been abandoned for some time and therefore not necessarily intentionally associated with the structure. As burials occur in external areas it may be that the burial in the Structure 3 fill is part of this tradition. For example, 'several dozen' burials were found between buildings in phases II through V (Kozłowski 2002: 37) and a group of twelve inhumations was found in the southern part of the site in phase IVb (Kozłowski 2002: 38-39).

Structure 10 was a small, circular *tauf/chineh* building (*c* 2.30 m in diameter) containing a pit, two sub-floor burials in the southern part of the building, and a number of ground stone implements (Kozłowski 2002: fig. 13; Kozłowski and Kempisty 1990: 355). Kozłowski (2002: 39) suggested that the building was a "family tomb" based on its small size, simple floor, and the two sub-floor burials containing grave goods, which included sixteen stone objects that had been intentionally broken, 'a necklace of pebbles', two perforated stone balls, a mortar, six pestles, a flint arrowhead, and three pebbles with traces of use wear. A similar suggestion was made for Structure 6, which was also a small *tauf/chineh* building that contained two sub-floor adult burials (at opposite ends of the building). The argument that the smaller buildings were tombs is mainly based on their size, the presence of sub-floor burials, and a lack of internal features that are perceived to be indicative of dwelling. However, the modelling has indicated that these structures were large enough to accommodate habitation, although for smaller co-resident groups than the larger buildings (discussed in section 7.3.1.2). Additionally, sub-floor burials have been found in several of the larger structures, including those that Kozłowski believed were dwellings. Internal features are in many cases indicative of the types of activities that took place in internal spaces and the lack of fixtures does not necessarily mean that people did not live in the buildings, but rather that the activities associated with these features did not occur there. The argument that these smaller structures were tombs is therefore not convincing, although it is possible that they were used for storage, and/or as work spaces (perhaps communal) rather than as dwellings.

There is not much information available for phase I regarding settlement layout as only a limited area was excavated; it included Structure 1B and (external?) deposits containing ash and charcoal (possibly refuse deposits). In phase II the external space in the central part of the settlement consisted of prepared clay surfaces (renewed up to four times in some places) apparently without features and with buildings located at the edge of the prepared surface (Kozłowski 2002: 45). In phase IIIa all of the buildings were found in the western part of the site, whereas in phase IIIb there appears to have been a shift in the location of structures towards the east (Kozłowski 2002: 44-45). The external area was paved with pebbles in phase IVa and remained so throughout phases IVb and V (Kozłowski 2002: 23-24, 41-44, fig. 24), and there is some evidence indicating that a range of activities took place outdoor (Figure 7.7). In phases IVa and IVb ground stones had been set into the pavement in the central part of the settlement (Kozłowski 2002: 43-44, fig. 24), which indicates that food-related activities occurred in the area between Structures 1 and 4 (northern part of the site) and Structure 8 (southern part of the site). Two mortars were also found in the pavement in the southwest part of the site (Kozłowski 2002: 44), which suggest that it may have been another activity area. A concentration of knapping debris, ground stone implements, and unfinished and broken stone statuettes was found in the area between Structures 1 and 4 (spaced *c* 10 m apart) in phase IVb (Kozłowski 2002: 44, fig. 23), indicating that manufacturing and craft activities occurred there. Kozłowski (2002: 44) refers to this area as a ‘workshop’ and the central area containing ground stones as an ‘industrial zone’, however, they are probably better described as communal activity areas as Kozłowski’s terms has connotations of production activities on a larger scale.

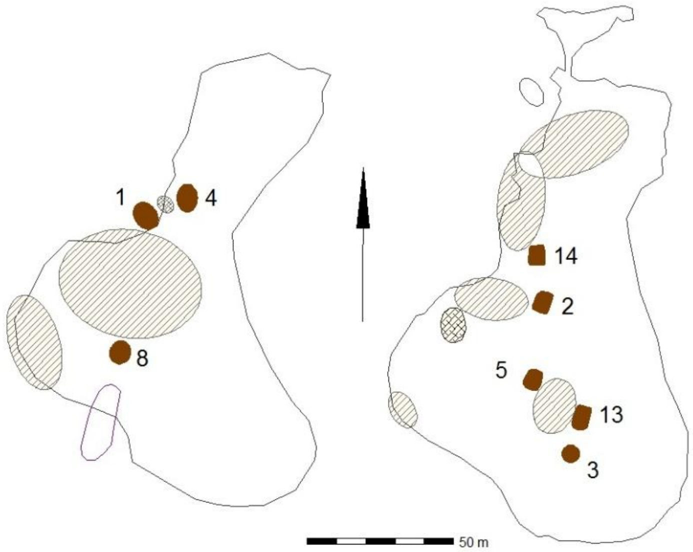


Figure 7.7: Settlement layout in phases IVb and V (left and right respectively) showing buildings(with structure numbers), outline of pavement, areas containing ground stones (striped areas), the refuse pit in phase V, and the external burial area in phase IVb (purple outline).

There is more information available concerning the settlement layout in phase V, which may be summarised as follows: the buildings were located in the eastern part of the site (spaced at a distance of 10 to 20 m); a fire installation (1.50 m in diameter)[76] and numerous mortars and querns were set into the pavement in the northern part (north of the buildings); a large quantity of ground stones and a pit lined with pebbles were set into the pavement in the central part (west of the buildings); a large, oval refuse pit (10 m at its widest) was located at the western edge of the settlement; and there were more ground stones set into the pavement between the buildings located in the southern part (Structures 3, 5 and 13) (Kozłowski 2002: 41-43, fig. 24). A few mortars and other grounds stones were also found set into the pavement at the western, southern and southeast edge of the site (areas heavily disturbed by later activities and erosion) indicating that the external activity areas probably extended further in these directions (Kozłowski 2002: 42-43). Kozłowski (2002: 41-43) again refers to the activity areas as 'industrial zones' which he distinguishes from the 'habitation zone'. However, there may not have been such as clear separation between habitation and work areas, as indicated by the presence of ground stones between Structures 3, 5 and 13 in the southern part of the settlement (see Kozłowski 2002: fig. 24), as well as the fact that a range of activities took place inside buildings. It is more likely that space was structured according to the type of activities taking place, and/or perhaps the people that participated in these activities. For example, the ground stones between Structures 3, 5 and 13 may have been used by the co-resident groups in those buildings, whereas those in the western part of the site (and the large refuse pit) may have been a more communal activity area.

[76] Kozłowski (2002: 42) has not provided any description of this fire installation only stated that it was 'a big fire place', and it could be a large fire pit as the other potential fire installations found at the site were smaller pits.

7.3.1.2: The structuring and use of space

This section presents a discussion of the results of the visualisation modelling. Initially, the size of each building was assessed in terms of their capacities for co-habitation and co-presence by modelling the maximum number of Size A and Size B adults that could sit cross-legged and sleep, which is summarised in Table 7.5 (Figures 7.8-7.13). The sub-floor burials, portable ground stones, and the pit in Structure 10 were not included when modelling maximum capacities in order to assess the affordance of space based on its size. This also allows an assessment of how the pit and ground stones would affect the use of space. It is possible that the location of the burial was respected and people avoided positioning themselves there (Figure 7.13), which would have reduced the number of co-present individuals.

	Sitting		**Sleeping**	
Building	**Size A**	**Size B**	**Size A**	**Size B**
1B	16	12	14	12
1A	34	26	30	26
1	43	35	35	29
2	51	37	39	31
3	17	13	18	16
10	6	5	4	4

Table 7.5: Modelled contextualised maximum capacities at Nemrik.

Most of the buildings at Nemrik afforded space for large co-resident units; the largest buildings (Structures 1A, 1 and 2) could accommodate a minimum of thirty Size A or twenty-six Size B adults sleeping. Even Structure 1B, where the amount of usable space was restricted due to the pits along the walls, could accommodate twelve co-resident adults (Size B), and Structure 3 had room for at least sixteen adults (Size B). Due to the size of the buildings, it was decided to assess the impact that storage might have had on the potential capacity for co-residency (Figures 7.8-7.13) as building size has often been linked to increased economic autonomy of households (section 2.4). There is very limited evidence for storage facilities. The only group of artefacts found that may have been used to contain smaller quantities of, for example, food, liquids, and pigments, is the stone vessels (Kozłowski 2002: 76, plate CXXXVII). However, if they were used for this purpose (for which there is no evidence), the stone vessels were too small to have met the need even for short-term storage of food and liquids for the inhabitants. It may be that the pits found inside the buildings could have been used for storage, with refuse deposited in them prior to the abandonment of the buildings. It is also possible that storage may have involved the use of organic containers (e.g. baskets, sacks, and skins), and storage capacities were therefore assess by modelling on-floor containers (section 3.3.3). If on-floor storage capacities are included in the assessment of potential co-residency, then Structures 1B and 3 could have accommodated ten and eleven adults respectively and their stored annual grain requirements (Figures 7.8 and 7.12), whereas the three large buildings, Structures 1A, 1 and 2, had room for at least eighteen co-resident adults in each building in addition to stored resources (Figures 7.9-7.11).

Structure 10 (the smallest building) could only accommodate four adults (Size A or Size B) sleeping, or six Size A or five Size B adults sitting cross-legged, albeit this would have meant a somewhat awkward seating arrangement (Figure 7.13). It may be that this building was a storage and/or working space for between one and three individuals. However, its size does not preclude it from having been a domestic structure as there was room for three adults to sleep and on-floor storage of their annual grain requirement with some space left over (Figure 7.13). It may, therefore, have served as a residence for two or three adults, or two adults and one or two children. Storage of animal fodder has not been included in the modelling as the identification of domestic animals at the site is doubtful and the animal bone assemblage is in need of re-evaluation (section 7.3.1), which may indicate that people were not herding animals. If there were herded animals at the site and the fodder storage occurred, then there would be enough space in Structures 1B and 3 to store fodder for six goats in addition to about 8 co-residents and their grain requirement, and even more space for fodder in Structures 1A, 1 and 2 if the numbers of modelled co-residents and storage were reduced. This indicates that many of the buildings had the capacity to accommodate a large number of co-residents, storage of resources and various tools, the gathering of a large number of people, as well as a range of domestic activities.

It is possible that the large buildings provided shelter for more than the modelled eighteen adults and their stored resources. If eighteen or more individuals resided in the same structure then this may indicate that co-resident units consisted of extended families or multiple families. As the general size of most buildings could have accommodated large groups of people, the factor limiting the number of co-present individuals would have been internal features. The types (e.g. platform, bench, pit), frequency, location, and size (including height or depth) of internal fixtures would have dictated movement and positioning of people within the buildings.[77] It is possible that even though the buildings had the capacity to accommodate the co-habitation or co-presence of large numbers of people, a smaller group may have resided in them, and the building size was a reflection of other concerns.

[77] It is acknowledged that some of the buildings that have not been included in this modelling (see Kozłowski 2002: figs. 14-16), such as Structures 2A and 5, had more platforms and/or pits which may have reduced the potential number of co-residents, as well as the potential storage capacity.

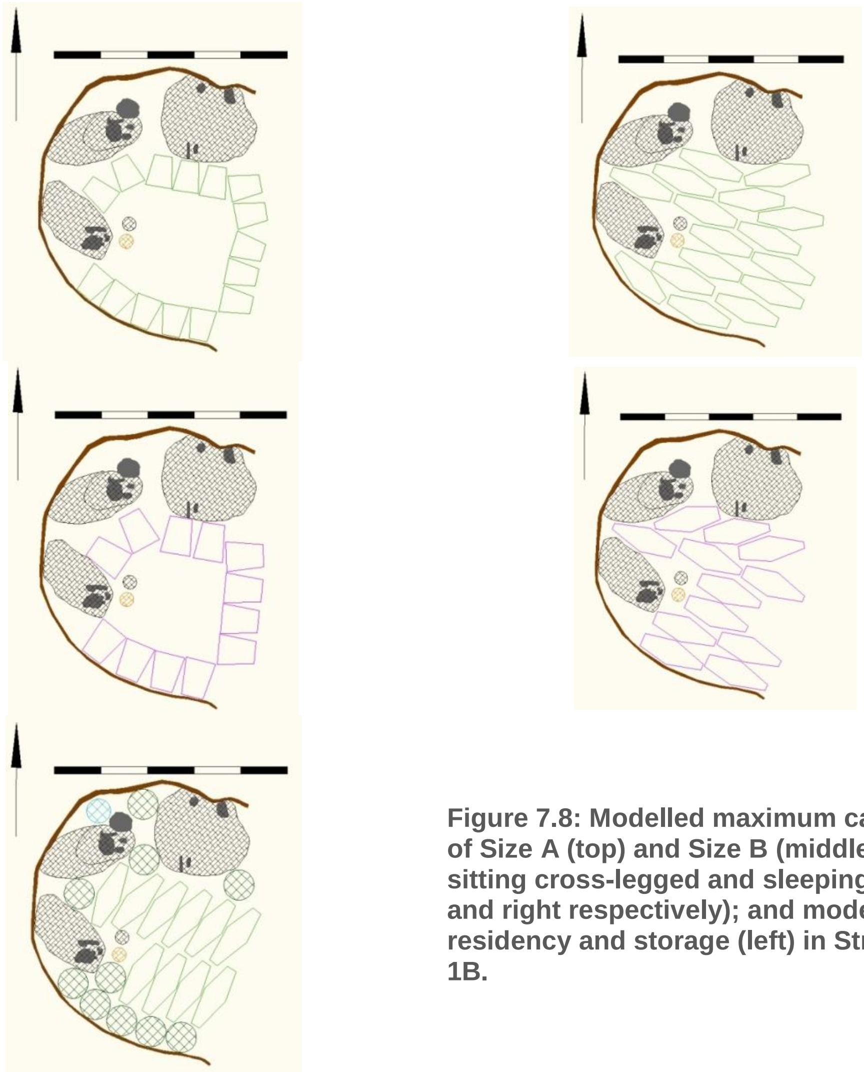


Figure 7.8: Modelled maximum capacities of Size A (top) and Size B (middle) adults sitting cross-legged and sleeping (left and right respectively); and modelled co-residency and storage (left) in Structure 1B.

It is possible that the use of internal space was structured around specific activities, i.e. the activities that occurred inside structures took place in specific areas that were not used for sleeping, and that this was reflected in the size of structures. Evidence indicates that there were some differentiation of space between the southern and northern parts of buildings, most notably in phases IV and V. The partitions in Structures 1 and 2 separated the southern end of the buildings from the rest of the interior, and there appears to be a general tendency, albeit with exceptions, to locate most of the platforms and other features in the southern part of buildings in these later phases (e.g. Structures 1A, 4 and 8). This may indicate a generalised structuring of internal space into what may have been different functional zones, i.e. different tasks may have taken place in different parts of the building, with features such as platforms or low partitions providing 'visual clues'.

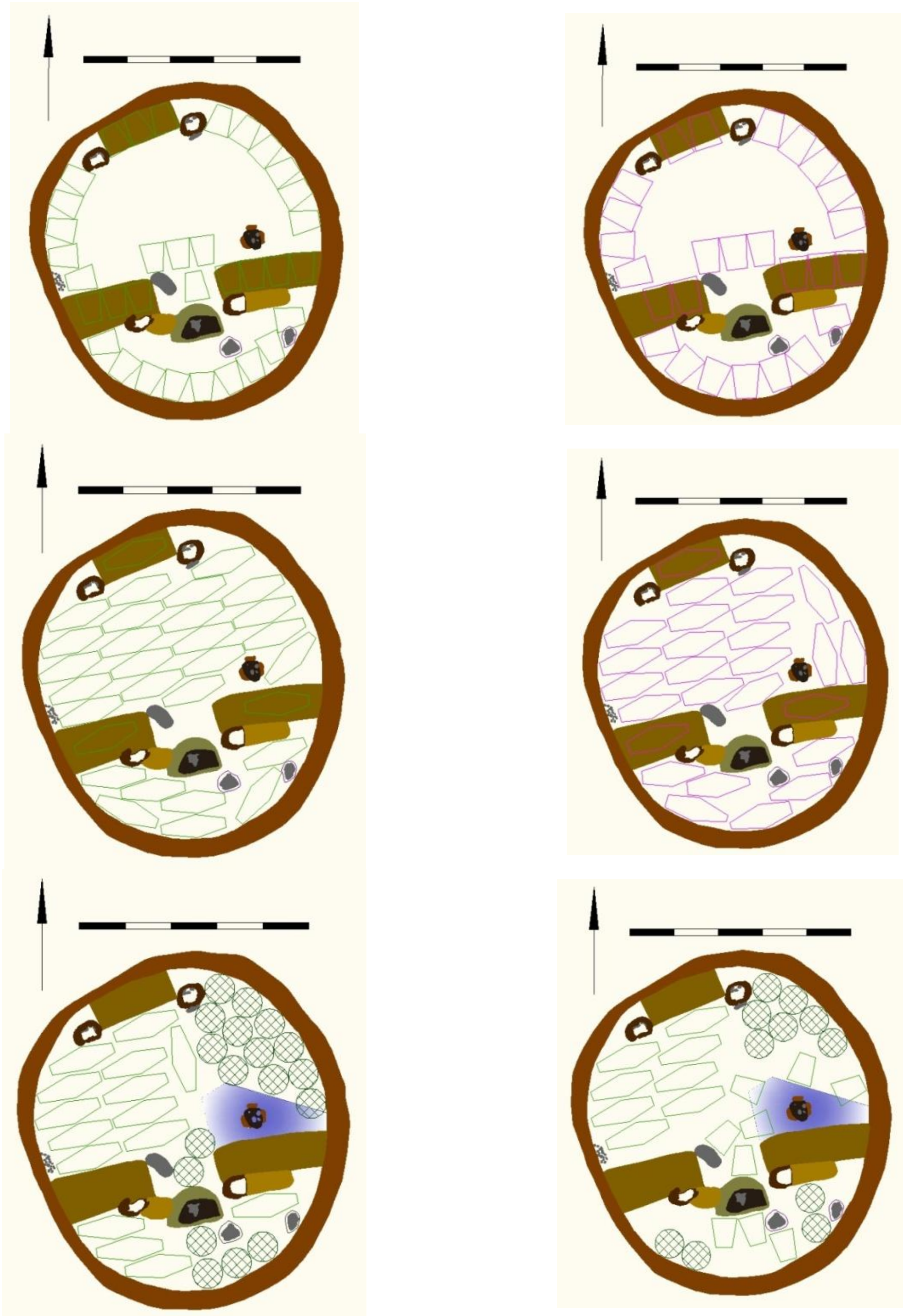


Figure 7.9: Modelled maximum capacities of Size A and Size B adults sitting cross-legged (top) and sleeping (middle); modelled co-residency and storage (bottom left); and the impact on co-residency and storage if activity areas were not used for storage or sleeping (right) in Structure 1A.

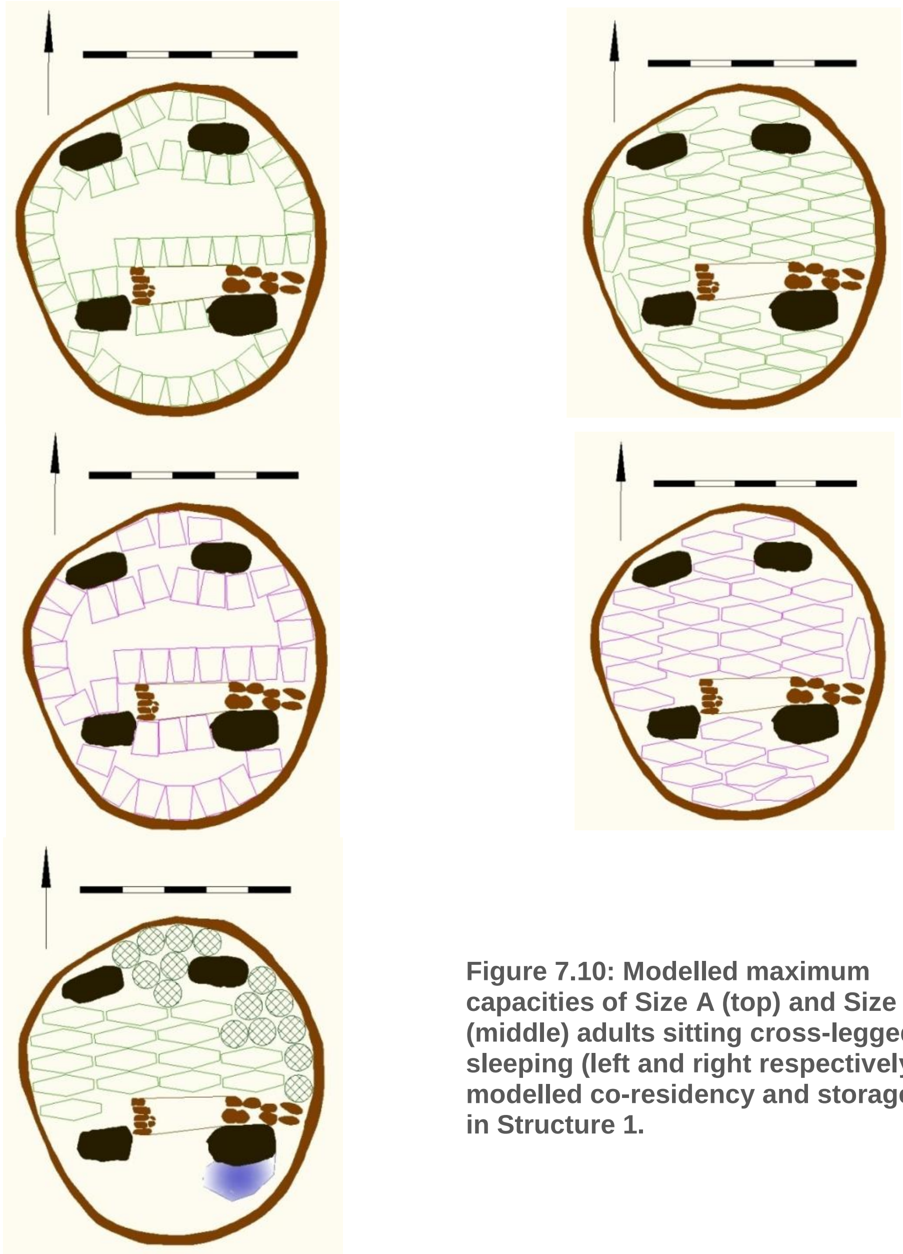


Figure 7.10: Modelled maximum capacities of Size A (top) and Size B (middle) adults sitting cross-legged and sleeping (left and right respectively), and modelled co-residency and storage (left) in Structure 1.

Floors were generally kept clean, but some *in situ* artefacts were recovered from some of the buildings (especially those that had been burnt), including concentrations of chipped stone debitage (e.g. Structures 1, 1A, 2A, 8; see Kozłowski 2002: fig. 18), caches of flint tools (e.g. Structure 1A), portable ground stone implements (all buildings), ground stones set into floors (e.g. Structures 1A, 1B, 2A, 4, 4A, and 8), tokens and bone objects (e.g. awls), and pits filled with objects of bone and flint, ground stones and clay tokens. These *in situ* assemblages provide clues to the types of activities that may have taken place inside buildings, such as the manufacturing of chipped stone tools (flint scatters) and other household items (e.g. bone objects, beads), processing of food and/or pigments (using the ground stones), perhaps working with hides (using bone awls), and so on. It is possible that these artefacts do not reflect the use of space throughout the use-life of a building, but rather activities that occurred immediately prior to abandonment, or they may have been deposited in secondary locations as part of ritual practices associated with the abandonment of the building (section 3.3.3). The nature of the publications makes it difficult to assess whether all the artefacts were found in primary locations, although, for the purpose of this discussion, it will be assumed that some of them were.

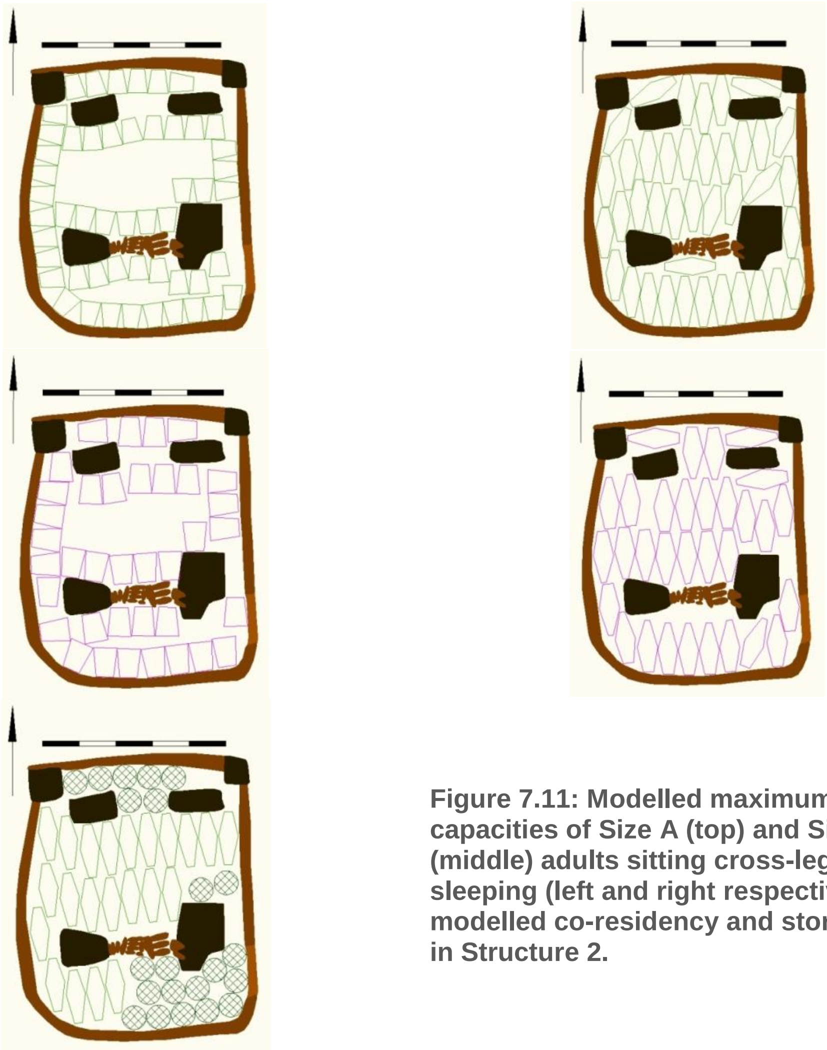
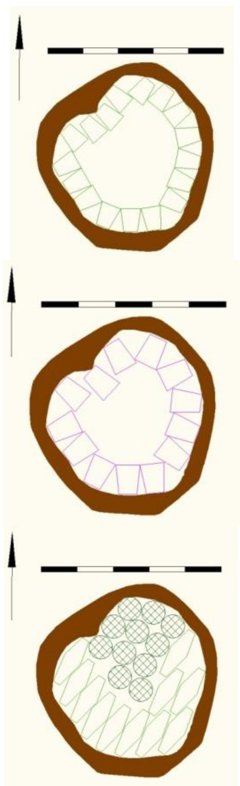


Figure 7.11: Modelled maximum capacities of Size A (top) and Size B (middle) adults sitting cross-legged and sleeping (left and right respectively), and modelled co-residency and storage (left) in Structure 2.

The ground stones found on the floor in Structures 3 and 10 include querns, mortars, and pestles, and may indicate that activities associated with their use, e.g. food processing, took place there, or that they were stored there when not in use (unless the objects were placed the immediately prior to abandonment and are not related to the use of the buildings). There is more evidence available for the larger buildings considered here, namely Structures 1B, 1A, 1 and 2. Querns and mortars were set into the floors of Structures 1B and 1A, and a range of portable ground stone implements (e.g. mortars, pestles, and stone slabs) were found on the floors in all four buildings. This indicates that a range of activities, e.g. processing of food and pigments, may have taken place in these structures. There are also indications that some ground stones were used in manufacturing and craft activities, e.g. polishing stones (Mazurowski 1990, 1992), stone slabs with traces of ochre (Kozłowski 2002:

72), and stone slabs with small, shallow depressions that appear to be drill holes (Kozłowski 2002: 72, plates CXXV-CXXVI; Mazurowski 1992: figs. 53-55) possibly used in the production of perforated stone objects, e.g. beads. Examples were found on the floors in Structures 1A and 2 (Mazurowski 1992: 97-104), and an elongated, flat stone plate with four possible drill holes was found set into the top of the pit by the eastern end of the southwest platform in Structure 1A. In Structure 1B (the earliest excavated at the site) the activities taking place appears to have been concentrated in the northwest half of the building, i.e. the large pits, ground stones, and the small possible fire pit were all located in this area. It is possible that the artefacts found within the material from the collapsed roof of Structure 1A were originally kept on the roof, as suggested by Kozłowski (2002: 30-31), which may indicate that roofs were flat and used as an activity area for domestic activities, or as storage areas, both of which are common today in many Near Eastern countries (e.g. Hall, McBride and Riddell 1973; Kamp 2000). It may also have provided a sleeping space during warmer months. In this sense the roof may have provided an additional work space associated with the building that was perhaps separate from the more communal space.



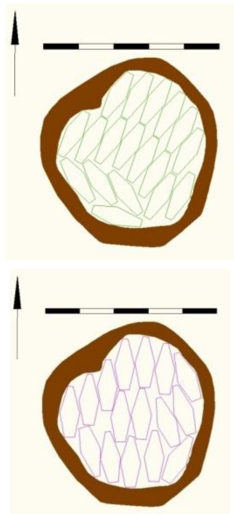


Figure 7.12: Modelled maximum capacities of Size A (top) and Size B (middle) adults sitting cross-legged and sleeping (left and right respectively); and modelled co-residency and storage (left) in Structure 3.

In order to evaluate what impact the distribution of artefacts and features may have had on the occupancy of the buildings, co-residency and storage were modelled together with activities for Structure 1A (Figure 7.9), which has the most evidence for the use of space. This was done by modelling Size A adults engaged in various activities (utilising/seated by various built features, and around the flint scatter)[78] in the southern and eastern parts of the structure, and Size A adults sleeping in the northwest part of the building where no fixtures or *in situ* artefact have been reported. The modelling was based on the assumption that people would not sleep on top of, or too close to, working areas where debris from various tasks sometimes may have accumulated (e.g. knapping debitage). Areas with a high concentration of features (e.g. pits) may also have been avoided since tools associated with the use of these features may have been stored there for easy access during work. On-floor storage containers were modelled where they would not restrict access or movement within the building, and avoiding the concentration of chipped stone scatter and built features. The modelling show that the building could accommodate at least eight adults and their stored annual grain requirements while at the same time have separate activity areas (and perhaps space for tool storage) that were not used for sleeping or grain storage. The platforms were not included in this scenario, but if they were used for sleeping they had room for one Size A adult each (or two smaller individuals on either of the southern platforms); the structure could accommodate these eleven adults and the storage of their annual grain requirement. It is equally possible that the platforms served other functions, such as elevated working spaces for one or two individuals undertaking specific tasks, seating areas for at least three Size adults sitting cross-legged during social gatherings, and/or they may have been used as storage spaces.

In Structure 1 there was a flint knapping area located south of the partition wall (the smallest part of the internal space), which may suggest that there was a need to separate this activity from some of the other interactions that took place inside the building, perhaps to minimise the spread of refuse. It is possible that the southern area was used for other manufacturing activities and that the northern part of the structure provided the living space. No *in situ* artefacts or built features were found in the northern part and it is not possible to ascertain what activities may have occurred there. If the northern part was used as a living space and the southern part was a work area, then the northern part had the capacity to accommodate fifteen co-resident adults and the on-floor storage of their annual grain requirement (Figure 7.10).

A range of everyday activities appears to have taken place in the external areas, including food processing and cooking and perhaps some craft activities. The concentration of knapping debris and unfinished stone sculptures found between Structures 1 and 4 in phase IVb may indicate that the production of chipped stone tools and other stone objects occurred there. The lack of fire installations in internal spaces – only two or three potential fire pits have been found (Structures 1B, 1A and 2A) – suggests that most activities associated with the use of fire, such as the preparation and cooking of food, took place in external areas. In phase V a large fire installation, measuring 1.5 m in diameter (possibly an 'earth oven'), was

[78] People engaged in activities were modelled sitting cross-legged as this position utilises more space than kneeling and squatting.

found in the external space in the north-central part of the site, in an area where there were also numerous mortars and querns set into the pavement (Kozłowski 2002: 42). This suggests that the processing and cooking of food were social activities that took place in open external areas and may have involved members of different co-resident units.

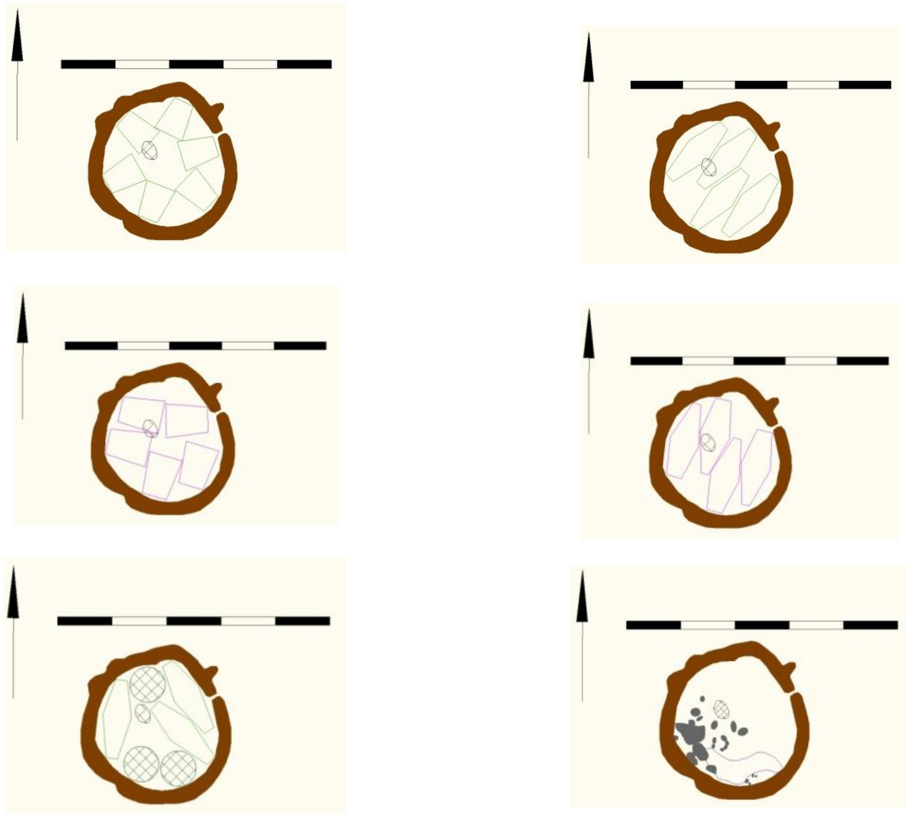


Figure 7.13: Modelled maximum capacities of Size A (top) and Size B (middle) adults sitting cross-legged and sleeping (left and right respectively); and modelled co-residency and storage (left) in Structure 10. The bottom right plan shows the location of the burials and the portable ground stones found within the building.

The evidence thus indicates that domestic tasks, such as food processing and cooking, and manufacturing activities, took place both in external, communal areas and inside buildings in more private settings, perhaps depending on the weather or the nature of the tasks being performed (e.g. certain craft activities, perhaps associated with making personal objects, may have taken place inside). The size of the structures indicates that these activities could still have involved a substantial number of people, and it may be that most domestic tasks were social activities that either provided settings for community-wide interactions, or may have involved members from more than one co-resident unit. Similarly, it is possible that the concept of privacy associated with individual co-resident groups may not have been particularly pronounced, and that co-operation and sharing (both in terms of resources and work) across the community as a whole were more prevalent.

The modelling indicates that individual buildings had the capacity to store food for the residents, which also appears to be the case at the other sites discussed in this thesis. The difference is that storage may have had less impact on interior activity areas at Nemrik than other sites due to the size and the clear ‘zonation’ of internal spaces. At Hajji Firuz, for example, the modelled on-floor storage would have reduced the number of people that could participate in activities in the ‘dirty’ space (section 6.4.3). The social nature of most activities at Nemrik, including food processing and cooking, may suggest that resources were shared within the community, or between particular co-resident groups. Smaller buildings (i.e. Structures 6 and 10) may have served as storage facilities as suggested by Kozłowski (2002: 35), although he believes they were used for the storage of ground stones and building materials rather than food. It is possible that these buildings provided space for communal storage, e.g. for tools used in external areas (e.g. portable ground stones, hunting equipment, items used to work hides), food and fuel used in communal cooking activities, products considered ‘dirty’ or ‘smelly’ (e.g. dung used for fuel, although this would necessitate penning of animals and is perhaps less likely) and not suitable for bringing into the habitation space, and/or materials and products that required more space than was available in the dwelling (e.g. meat that was drying, skins and hides being processed). If food was stored in communal spaces, then there may have been minimal storage occurring in the buildings where people lived and storage would not have impacted the number of co-residents or the use of these spaces.

One of the differences between Nemrik and the other settlements discussed in this thesis is the fact that animals may not have been herded (section 7.3.1). Even if the community at Nemrik was pursuing some early form of animal management, the herds are most likely to have been small as indicated by the predominance of wild species (compared to the portion identified as domestic) and in particular gazelle. If it is assumed that some early form of animal management was taking place, part of which would require keeping the animals penned (as part of a strategy to create dependency), a few observations can be made. The large size of the external areas would have allowed for animals to be kept within the settlement, in which case it is possible that they were penned in specific areas, maybe at the outskirts or away from activity areas (e.g. where ground stones had been set into the pavement), so that they would not disturb, or leave their dung in areas where, for example, food preparation and cooking took place. If animals were penned at site (during the night, adverse weather, or in the case of illness) it would have allowed people to collect dung for fuel. However, the lack of fire installations, midden areas, and micromorphological studies, makes it impossible to assess this scenario. In phase V (which has the best information regarding settlement layout) there are several places where animals could have been penned; there was space for at least six hundred goats to be kept in the northern (north of the northern activity area), southeast (east of Structures 3 and 13) and southern (between Structure 5, the large refuse pit and the southwest activity area) parts of the site, totalling at least 1,800 goats (Figure 7.14). It is acknowledged that cattle, pigs and sheep (the other animals that are purported to be domestic at the site) are different in size than goats, however, the quantity of goats that could have been kept within the settlement far exceeds the potential size of any early domestic herds and therefore suggest that there was enough space even for larger herds of cattle. This contrasts the situation observed at Ganj Dareh (and perhaps to a certain degree Sheikh-e Abad and Jarmo) where the built environment does not appear to accommodate animals, which is interesting as it has evidence for early management of goats. At Hajji Firuz, which has a more established economic strategy reliant on herded animals, there appears to be more space provided for animals within the settlement, similar to Nemrik. The buildings at Nemrik do not appear to be particularly suited for accommodating animals as the structures were often dug down between one and two meters below ground level which would have made it awkward for animals to be brought into the interior space. This differs from the structures at Ali Kosh and Hajji Firuz, where ground level entrances would have provided easier access for animals if they were kept inside during illness or immediately subsequent to birth (section 3.3.2). It appears that the buildings at Nemrik are design to provide space for human activities and habitation, but not to include animals, whereas the outdoor areas have the potential to include animals. Whether herding formed part of the subsistence strategy remains uncertain, and there is a case to be made that the faunal material, and especially the identification of domestic species, should be reassessed (section 7.3.1).

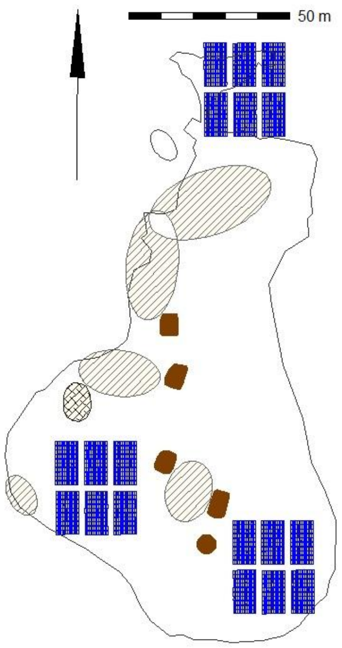


Figure 7.14: The Phase V occupation with modelled affordance of space for goats. Each block of blue represents 100 goats (due to scale individual goats do not show up).

7.3.2: Magzaliyah

The Late Aceramic Neolithic site of Magzaliyah (late 8th-late 7th millennia cal BC)[79] is located about 7.5 km northwest of the site of Yarim Tepe on the right bank of the Abra River on one of the hilly flanks of the Jebel Sinjar Mountains in Ninawa Governorate, northern Iraq (approximate co-ordinates: latitude 36° 23' N, longitude 42° 19' E) (Bader 1993a: 8). It was excavated between 1977 and 1980 by the Soviet archaeological expedition (Institute of Archaeology, Academy of Science, USSR) under the direction of Nikolai Ottovich Bader as part of the twelve seasons of work the Soviet team conducted on the Sinjar Plain (Bader 1993a, 1993b; Munchaev 1993).[80] The site is situated in a semi-arid zone, about 1 km north of the junction between the uplands and the plain at an elevation of about 450 m above sea level, in an area consisting of rocky limestone outcrops that are not particularly suited to cultivation; at the time of excavation cultivated plots alternated with pastures that extended up the mountain slopes (Bader 1993a: 8, 1993b: 64; Merpert, Munchaev, and Bader 1981a: 29). The Sinjar region has hot and dry summers and relatively short and moderate winters with an annual precipitation averaging about 350 mm, most of which occurs during the winter (Bader 1993a: 39). Palynological studies indicate that the environment was more favourable during the Neolithic than currently with vegetation consisting of sparse xerophytic wooded areas and savannas, and strands of oak forests interspersed with steppe flora on the slopes of the Sinjar Mountains (Bader 1993a: 39 citing E. M. Zelikson). Botanical remains collected from the site include domestic wheat (*T. monococcum* and *T. dicoccum*) and barley (*H. vulgare distichum*), wild oat and flax, as well as lentils, vetch and *Adonis* (Bader 1993a: 39; Merpert, Munchaev, and Bader 1981b: 62; Miller 1991: 142)[81], and the faunal assemblage indicated a reliance on wild species (60% of assemblage) such as fallow deer, wild goat and sheep, wild ass, aurochs and wild boar, as well as herded sheep and goats (40% of assemblage).

At the time of excavation the site covered an area of about 4,500 m^2 with about 8.20 m of archaeological deposits, all of which dates to the Aceramic Neolithic (Bader 1993a: 25, 1993b: 64; Merpert, Munchaev, and Bader 1981a: 29). The original extent of the Neolithic settlement is not known due to erosion and modern activities (Bader 1993a: 8, 25), but the excavators estimated that it may have been up to 1 ha (Maisels 1993: 110; Merpert, Munchaev and Bader 1981a: 29). The areas exposed during excavations totalled about 625 m^2 (excavations took place in 5 x 5 m squares separated by 0.5 m baulks), including the main trench at the on top of the mound (375 m^2), two smaller trenches (one on the lower slopes at the northern edge and one on the western slopes), and a 15 m step trench (see Figure 7.15 for trench locations) (Bader 1993a: 9, 25-26). A sequence of 15 archaeological

[79] Only two radiocarbon dates are available: 7,068-6,707 cal BC and 6,440-6,245 cal BC, both from level 10.
[80] N. Merpert and N. O. Bader conducted a preliminary survey of the group of six mounds known collectively as Yarim Tepe in 1968, with long-term work commencing in 1969 and taking place over 12 seasons until 1980. The team located around 50 sites during extensive surveys of the Sinjar Plain with the main excavation efforts concentrated on Yarim Tepe I, II and III, and work also taking place at Magzaliyah, Tell Sotto and Kültepe (Munchaev 1993).
[81] It is not specified whether the lentils and vetch found were wild or domestic varieties.

levels was identified by the excavators, each assigned a number (1 being the uppermost) corresponding to a separate phase of architectural activity (Bader 1993a: 9, 26).[82] These levels were further grouped into four main phases of occupation defined by episodes of substantial rebuilding: the first phase (levels 15-9), which represents the earliest settlement at the site, were only excavated in the lower trench at the northern edge of the mound; the second phase (levels 8-5) marks a change in the general layout of the settlement; in the third phase (levels 4-3) the settlement appears to have been enclosed by a substantial wall; and the fourth phase (levels 2-1) which again sees changes in the settlement plan, including a decrease in size and a discontinuation of the enclosing wall (Bader 1993a: 27-28, 1993b: 64-65). There are, however, no apparent stratigraphic breaks in the occupation of the site, and the material culture remains more or less the same throughout. The artefact assemblages include chipped stone implements of obsidian and flint[83], ground stones (made of basalt), fragments of stone vessels, bone objects (e.g. awls, needles, polishers), clay figurines and other clay objects, stone beads, pendants and bracelets, fragments of gypsum vessels, two pieces of copper ore and one copper awl[84], and numerous fragments of plaster and bitumen with basketry impression (Bader 1993a: 13-23, 34-37; Merpert, Munchaev, and Bader 1981a: 30, 1981b: 62).

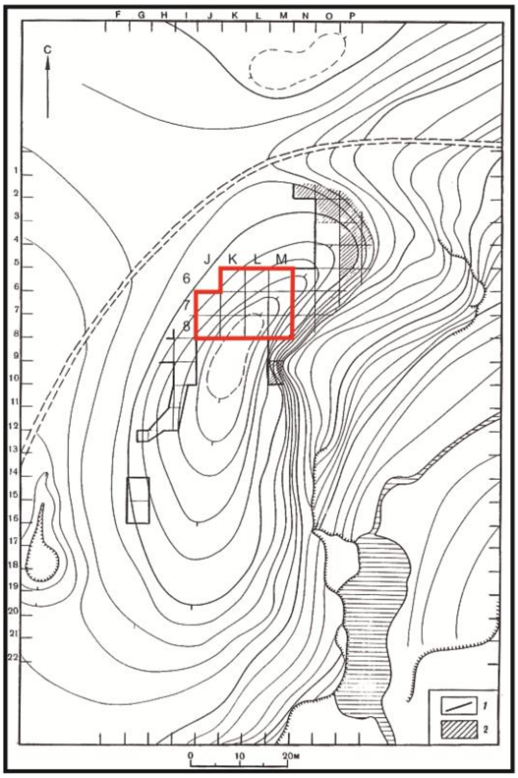


Figure 7.15: Overall site plan of Magzaliyah showing the location of the excavated trenches (black boxes) with the location of the structural remains used in the scenario modelling outlined in red (modified from Bader 1993a: fig. 2.1). Structure A is located in grid squares K6, L6, M6, J7, K7, L7, M7, J8, K8, and L8; and Structure B is located in grid squares K7, L7, M7, K8, L8, and M8.

[82] Bader (1993a: 9) has stated that there was at least an additional architectural level at the top of the mound that remained unexcavated; the excavation started at about 0.60 m below the summit.

[83] Obsidian tools predominate over flint tools throughout all the architectural levels with a slight increase in the percentage of flint tools towards the end of the occupation of the settlement. There is a higher frequency of flint debitage compared to obsidian, which may indicate that obsidian was brought to the settlement as prepared flakes and cores.

[84] The copper awl was found in a context sealed by Structure 19 in level 3. Chemical analysis has indicated that the copper came from Talmesi in central Iran (Bader 1993a: 37).

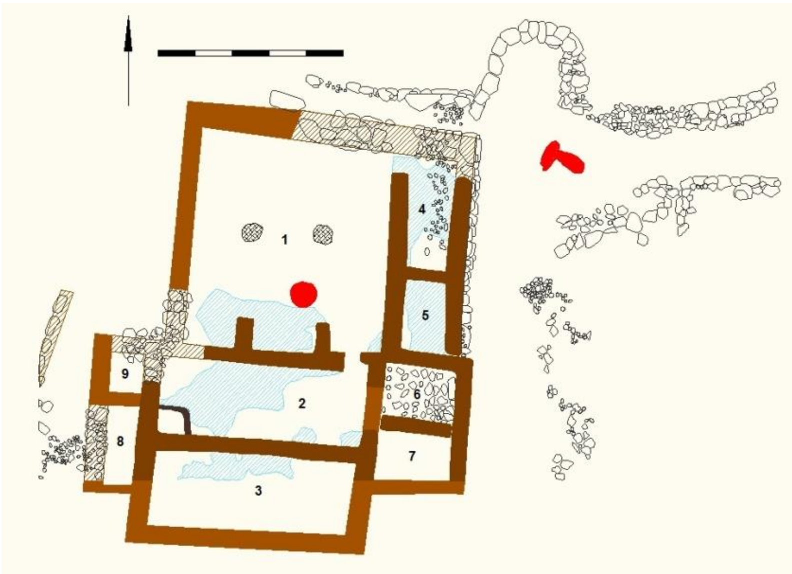
7.3.2.1: The Architecture

Most of the data from the excavations is only briefly summarised in the available reports (Bader 1993a, 1993b; Merpert, Munchaev and Bader 1981a, 1981b; Munchaev 1993), and there is little information regarding individual buildings, the layout of the settlement in the various levels (no site plans), and whether any *in situ* artefacts were found. It is therefore difficult to reconstruct the organization and use of internal and external spaces, as well as the general settlement layout in any of the levels. The architecture at Magzaliyah consisted of large, multi-roomed rectangular or rectilinear *tauf/chineh* structures built on stone foundations that were up to 0.60-0.70 m wide and 0.40-0.60 m high (Bader 1993a: 9, 1993b: 65; Merpert, Munchaev, and Bader 1981a: 30, 1981b: 60). Floors were made of stone slabs covered with clay and coated in gypsum plaster, and the interior walls were also coated in gypsum plaster (Bader 1993a: 12; Merpert, Munchaev, and Bader 1981b: 61). Munchaev (1993: 250) mentioned that the alleyways between buildings had been coated with gypsum plaster, although there is no further information given regarding this. Internal features included benches; niches; plastered basins (perhaps for holding liquid or grain); storage facilities in the form of bins, plastered pits, or niches; hearths (at least in two structures); and ovens (at least in two structures in the earlier levels) (Bader 1993a: 13, 16, 31-32). External features apparently included “hearths, rectangular ovens, storage pits, plaster vessels embedded in the grounds, and other household-related installations” (Munchaev 1993: 250). Very few of the built features (internal and external) have been described in any detail, and it is sometimes difficult to assess their function beyond generalising statements (e.g. the plastered basins, “household-related installations”).

In the earliest levels there were both small, single-roomed rectangular structures in addition to larger buildings (Bader 1993b: 65).[85] One of the buildings contained a large oven with a floor made of gravel which had its opening through the wall to the outside, and, although it is not specified whether it was located in a small, single-roomed or larger structure, it appears that the former may have been the case (Bader 1993b: 65). Another large, rectangular oven (measuring 0.8 x 1.8 m at its base) filled with large quantities of ash, charcoal and fire-cracked rocks and showing trace of intense burning was found in level 15 (Bader 1993a: 12-13; Merpert, Munchaev, and Bader 1981a: 30). There were also large, deep oval hearths found in the external spaces close to the structures that were filled with ash and stones (Bader 1993b: 65). It is possible that these may have been ‘earth ovens’ rather than hearths as they were large and deep, though due to the lack of information this cannot be ascertained. In the third phase the settlement covered about 1,500 m^2 and apparently consisted of eight to ten larger, multi-roomed, rectangular buildings that were encircled by a massive wall, of which about 60 m were unearthed during the excavations (Bader 1993b: 65-66, figs. 2.17-2.18). The wall was up to 1.8 m in height and constructed of different sized

[85] Only two larger structures, buildings 205 and 206, are mentioned in the report although their form and layout are not elaborated upon (see Bader 1993b: 65).

stones, apparently using a variety of techniques, although these have not been elaborated upon (Bader 1993b: 66). It had a gate in the western part and a horseshoe-shaped projection that the excavators suggest may have been a small tower in the northern part (Bader 1993b: 65-66; Merpert, Munchaev, and Bader 1981b: 61). Eight burials (five adults, an adolescent, a child and an infant) were found in pits that were 0.4-0.5 m deep and lined with flat limestone slabs below the floors in four buildings; these were all primary, flexed inhumations, and only one of the burials contained grave good in the form of a single a stone bead (Bader 1993b: 66).



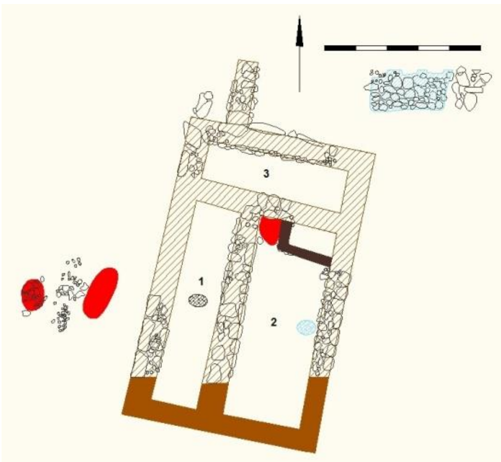


Figure 7.16: Structure A (top) and Structure B (left) with space numbers.

Due to the limited information available, the remaining discussion focuses on the two structures for which there are plans (Bader 1993a: figs. 2.3-2.4, fig. 2.19), here referred to as Structure A (Bader 1993a: figs.2.3-2.4) and Structure B (Bader 1993a: fig. 2.19). Structure A appears to have been a rectilinear, multi-roomed structure (measuring at least 9.80 m N-S and at least 10.20 m E-W), containing at least nine spaces of different sizes: a large northwest space (with two shorter walls extending northwards from the southern wall for about 0.80 m, creating three ‘alcoves’ at the southern end of this space) with two smaller spaces to the south and a row of four spaces (oriented north-south) to the east, and two small spaces to the west (Figure 7.16). The largest space contained a fire installation[86] and two pits, and the space south of it had a storage bin in its southwest corner (Bader 1993a: 32, figs. 2.3-2.4).[87] There appears to have been a 0.5 m wide ground level entrance between the northwest space and the northeast space, and possibly one from the northwest space into the space south of it.

Structure B was large (of which 8.4 x 5.8 m was excavated), rectangular and had at least three internal spaces. The building extended southwards outside the excavation area and Bader (1993a: 29-30) speculated that there might have been another internal space located at the southern end of the structure. Two rectangular spaces (oriented north-south) made up the southern part of the building; the southwest space (S1) measured *c* 5.3 x 1.4 m and the southeast space (S2) *c* 5.3 x 2.3 m. The third space (S3), oriented east-west, measured 4.4 x 1.4 m and adjoined S1-S2 to the north. A storage container constructed of small stones covered in gypsum plaster was located in the northeast corner of S2 next to the remains of a hearth filled with charcoal and ash (in the northwest corner) (Bader 1993a: 29-30). Bader (1993a: 31) also mentioned a series of three sequential oval depressions plastered with gypsum (the largest measuring 0.60 x 0.48 m and 0.25 m in depth) located by the eastern wall of S2. However, as their locations have not been specified on the plan their placement in Figure 7.16 is tentative. A storage pit measuring 0.6 x 0.4 m (depth not given), which had been dug down from the floor and lined with gypsum plaster, was found in the central part of S1 (Bader 1993a: 31). Again, the pit has not been included on the plan and therefore its location in Figure 7.16 is tentative.[88] North of the structure the excavators found the fragmentary remains of another building, and in the external space west of the building were an oval hearth and a fire pit or ‘earth oven’ (Bader 1993a: 30).

Bader (1993a: 32) also described two buildings (levels 3 and 2; no plan available), one directly overlaying the other, with similar layouts to Structure B, i.e. two rectangular spaces oriented north-south adjoined to the north by a rectangular space oriented east-west. The southwest space of the level 3 building was the largest (5 x 1.8 m), it contained a hearth and a potential storage facility (as S2 in Structure B), and there was a doorway located in its southern wall. It is possible that S2 in Structure B also had an entrance in its southern wall, although this cannot be verified as the southern part of the building was not excavated.

---

[86] Described as an oven, but represented on the plan as a hearth or a fire pit.

[87] There are some issues with regards to this buildings related to the level it was found in. On the plans it is labelled as level 13, however, in the northern part of the plan there is depicted what may be part of the encircling wall in levels 4-3 as described by Bader (1993a: 32, 1993b: 65-66), and it appears to fit the description of a building in level 4 (Bader 1992a: 32-34). Additionally, Bader (1993b) later appears to have reversed the numbering of the levels (with 1 being the oldest), as well as referring to 16 levels (which includes the uppermost level not excavated), and it may be that the plan of Structure A was mislabelled in the publication. If so, Structure A would have been found in level 4 (i.e. the third occupational phase), which would fit with the interpretation of the stone wall depicted in the northern part of the plan being the enclosing wall, as well as the description given by Bader (1993a: 32-34) of the level 4 building. However, to avoid confusion, the discussion in section 8.3.2.2 will only deal with the internal spaces as represented on the plan without speculating which level it was found in.

[88] The gypsum basin and the storage pit have been included as they would have impacted on the use of space and therefore on the discussion in section 8.3.2.2.

7.3.2.2: The structuring and use of space

This section presents a discussion of the structuring and use of space in Structures A and B with some consideration given to the external areas where information is available, focusing on the affordance of space for co-residency and co-presence, activity areas, storage and the potential inclusion of animals within the settlement. For the purpose of this discussion the spaces in Structure A were numbered as follows: the northwest space (the largest) is S1; S2 is the space south of S1; S3 is the space south of S2; S4 is the northeast space; S5 is the spaces south of S4; S6 is the space south of S5; S7 is the space south of S6; S8 is the potential southwest space; and S9 is the potential space north of S8 and west of S2 (Figure 7.16). The numbering of internal space in Structure B has already been stated in section 7.3.2.1. It should at this point be mentioned that some of the walls in Structure A and Structure B were reconstructed as part of the digitising process. As was the case with the other reconstructions, these were also based on the nature of the preserved structural remains, such as the alignment and thickness of walls, angle of corners, the location and configuration of internal features such as bins and hearths, and the extent of internal plaster floors. With regards to Structure A the reconstructed extent of S3 is an approximation of the size of S2, and is the only hypothetical part of this reconstruction. As for Structure B, it extended southwards outside of the excavation area and thus its original extent is not known. It was decided to place the reconstructed southern wall immediately outside of the trench, and it is therefore possible that the building was originally larger than suggested in the reconstruction.

Structure	**Space**	**Sitting**		**Sleeping**	
		Size A	**Size B**	**Size A**	**Size B**
A	**S1**	28	25	31	26
	S2	17	15	13	10
	S3	18	16	13	9
	S4	5	4	4	3
	S5	3	3	2	2
	S6	6	4	2	2
	S7	4	3	2	2
	S8	3	2	1	1
	S9	1	1	-	-
B	**S1**	16-20*	7-9*	7-8*	7-8*
	S2	19-20**	15-17**	12-14**	10-13**
	S3	9	7	6	5

*Depends on location of the storage pit (see section 7.3.2.1).
**Depends on location of the gypsum plastered depression (see section 7.3.2.1).

Table 7.6: Modelled contextualised maximum capacities at Magzaliyah.

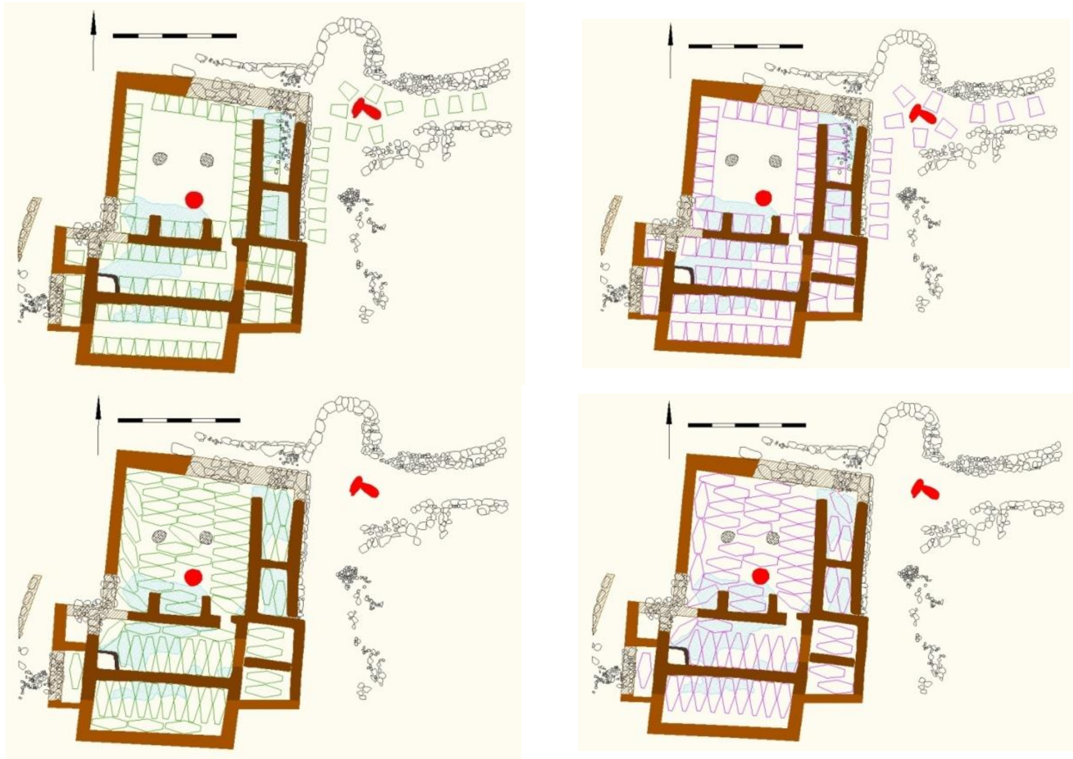


Figure 7.17: Modelled maximum capacities of Size A (left) and Size B (right) adults sitting cross-legged (top) and sleeping (bottom) in Structure A.

Initially, the maximum capacities of Size A and Size B adults that could sit cross-legged and sleep were modelled for both buildings, the result of which is presented in Table 7.6 (Figures 7.17-7.18). In Structure A, S1 and S2, and S3, if the reconstruction is roughly accurate, could have accommodated a large number of people. The eastern row of smaller spaces (S4-S7) had room for between three and six adults sitting cross-legged, or two adults sleeping in S5-S6 and four adults in S4. As people would have had to be seated either along one wall facing the other (S4-S5) or opposite each other without much room left for movement (S6-S7), they appear to have been better suited for storage or work involving one or two individuals than as living spaces. None of the publications mention whether any *in situ* artefacts were found in these spaces, and it is therefore not possible to ascertain their precise function. It is possible that the lack of ground level doorways into S5 and S6 indicates that they were accessed through raised entrances or portholes. If this was the case, then it may be that they were used for storage of food (e.g. grains) and the raised entrances were means to prevent rodents from accessing the food, as was suggested for some of the internal spaces at Jarmo (section 5.5.3.2). Similarly, the ground level doorway between S1 and S4 may indicate that food was not stored in this space, and/or that easy access between these two spaces was required on a more frequent basis. It is possible that S4 was used as a storage space for materials used in the activities taking place in S1, such as tools, raw material, or fuel. The fire installation in S1 indicates that food-related activities may have occurred there, and the pits (there is no description of their fills) may have been used for storage of, for example, grain. Alternatively, they may have been used for refuse disposal associated the activities taking place in S1, such as manufacturing of chipped stone tools, bone objects, beads and so on. S8 and S9 were the two smallest spaces in Structure A; S9 was too small for anyone to sleep in it and there was only room for one adult (Size A or Size B) to sit cross-legged, whereas three Size A or two Size B adults could sit, or one adult (Size A or Size B) sleep in S8. However, if people were to sit (or lie down in the case of S8) in either of these spaces there would not have been any room left for any kind of movement, such as that associated with sitting down or getting back up again. These spaces therefore appear to have been better suited for storage of food, raw materials, household equipment, fuel, or perhaps fodder.

The three spaces in Structure B could accommodate the co-residency and co-presence of a number of people. S2 was the largest space with room for at least ten co-resident adults, whereas S1 had room for at least seven adults and S3 for at least five adults. The potential maximum capacities for S1 and S2 depend, in parts, on the location of the aforementioned storage pit and plastered depression respectively. Since the exact locations of these features have not been denoted on the plans (section 7.3.2.1), the maximum capacities listed in Table 7.6 are given as ranges and their approximate locations have been indicated in Figures 7.16-7.18. S2 was the widest space and appears to have been better suited for social gatherings, which may suggest that it served as the main living space. If people were to gather in S1 and S3 they would have to sit along one wall facing the other in S3 whereas they may have been able to sit opposite each other in parts of S1, although they would be seated knees against knees. In S1 there was more room (up to 1 m between people if they sat along the east and west walls), and the space appears better suited for interactions associated with eating, entertaining guests and so on, as well as during everyday work. It is possible that S1 and S3 were storage and/or work spaces; the storage pit in S1 indicates that at least some storage took place there (e.g. grain). However, there is no mentioning of any *in situ* artefacts having been found, as was the case with the spaces in Structure A, and the precise nature of activities cannot be ascertained.

The internal spaces with capacities to accommodate the co-presence of larger numbers of people, e.g. S1 and S2 in Structure A, and S2 in Structure B, may have provided space for a range of social interactions, including entertaining guests and eating, as well as many everyday activities, e.g. preparing and cooking food, and manufacturing and repairing household items (e.g. chipped stone tools, bone objects, clothing, basketry). Information relating to specific domestic tasks is limited, and mostly concerns activities associated with fire installations. There is a possible hearth in S1 in Structure A and two hearths in the external space northeast of the building, whereas in Structure B there is a hearth located in S2, and a hearth and a fire pit in the outdoor area west of the building. This indicates that food-related activities took place both inside structures and in external areas between buildings, and may have been associated with interactions involving individual co-resident groups only as well as members from several social units. The internal hearths in both buildings are located in the spaces with the greatest capacity for co-presence and co-residency, which may suggest that they provided a focus for social activity within the buildings. These spaces are also large enough to accommodate a number of visitors, which is different from the internal spaces at most of the sites in the Zagros apart from perhaps Hajji Firuz.

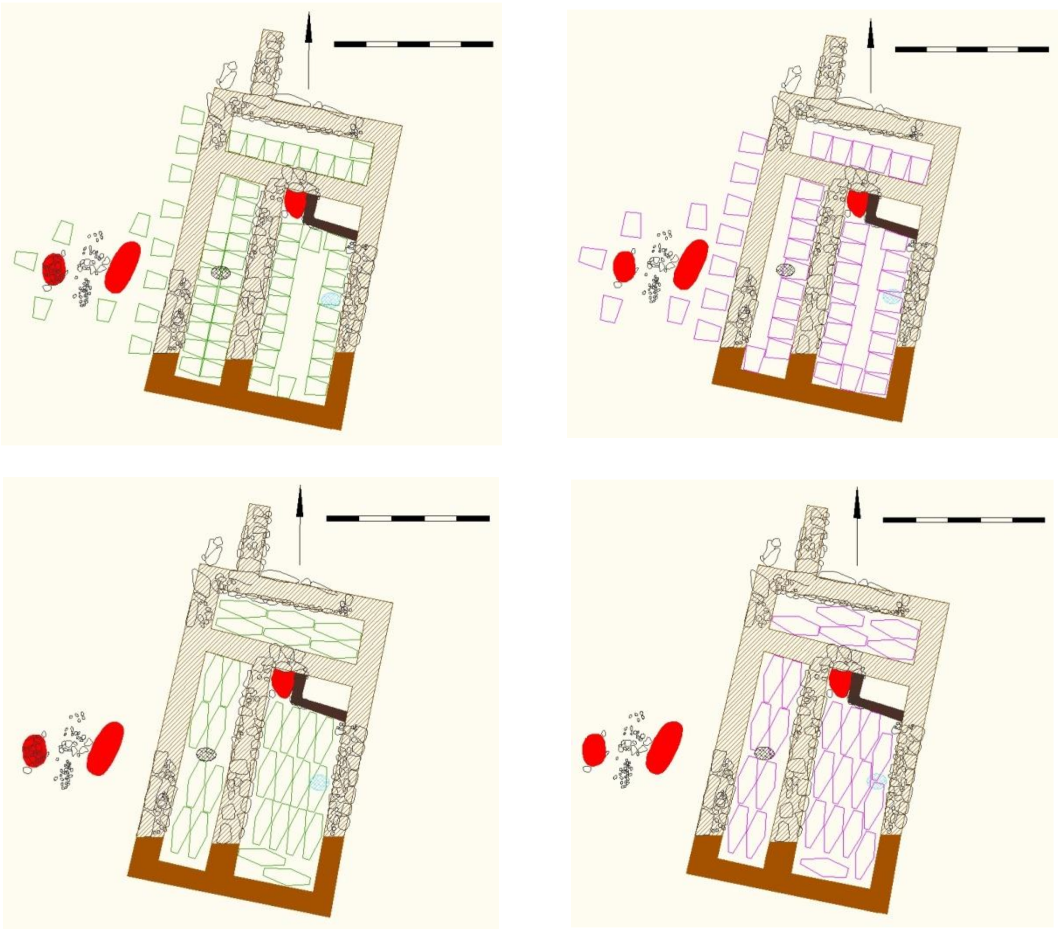


Figure 7.18: Modelled maximum capacities of Size A (left) and Size B (right) adults sitting cross-legged (top) and sleeping (bottom) in Structure B.

There is no mentioning of artefacts found on any of the floors in any of the buildings, which may indicate that they were kept clean. This does not, however, mean that activities that produce refuse, such as production activities or processing of food, did not take place in internal spaces, only that they were cleaned regularly. The few spaces containing built features are large enough to accommodate a number of individuals sitting, kneeling or squatting while undertaking various domestic tasks. Activities also took place in external areas and it may be that a range of everyday tasks provided settings for interactions both within and between different co-resident groups. The external spaces apparently contained many features associated with domestic activities (section 7.3.2.1), including fire installations, storage pits and plaster vessels set into the ground (although no further information regarding size or form is given). Some of these features have only been referred to as “household-related installations” without providing further information, thus it is possible that they included ground stones (either portable or set into the ground). This suggests that external areas were locations for many everyday activities, including various manufacturing and food-related activities. There is no information available regarding the size and spatial configuration of external areas (e.g. the spatial distribution of buildings, patterns of movement within the settlement), and it is therefore not possible to ascertain the number of people that may have interacted in the various outdoor spaces. Nevertheless, it is possible to assess *potential* numbers based on a few assumptions. If it is assumed that there were no other features located in the external space west of Structure B apart from the fire installations, there would have been room for at least thirteen adults to be seated in the part of the space that was excavated. This indicates that the space may have accommodated large numbers of people, especially since the individuals were modelled seated some distance apart (Figure 7.18). The external space around Structure A, on the other hand, is more difficult to assess as it is uncertain whether the stone foundations east of the building depicted on the plan are contemporary with Structure A (Figure 7.17). This area may have accommodated similar numbers of people as the area west of Structure B, although if the stone foundations are roughly contemporary with the building then movement through the space may have been restricted or blocked depending on where people positioned themselves. There is no information available concerning the external spaces west of Structure A and east of Structure B and they were therefore not modelled, although it is possible that they were similar in size to the other outdoor areas. Alternatively, they may have been passageways that were not used as work spaces.

With regards to the herded animals, there is space for thirty-one goats east of Structure A, and twenty-one goats in the space west of Structure B (Figure 7.19). However, if food processing and cooking occurred in these areas, the animals may not have been allowed too close to the cooking and “household-related” installations, which would have reduced the number of animals that could have been present. It is difficult to assess whether there was space for the herded sheep and goats in the areas west of Structure A and east of Structure B since the extent and layout of these spaces are not known. If they were open areas containing no features or buildings, then there may have been space for a larger number of goats; twelve goats were modelled west of Structure A and sixty east of Structure B. Even though the original settlement layout is not clear, it does not appear that the built environment afforded as much space for animals as at Hajji Firuz or Nemrik. The buildings, on the other hand, may have afforded space for animals unlike Nemrik. If the structures were accessed through ground level doorways (section 7.3.2.1), then it is possible (due to the size of many internal spaces) that some animals may have been brought into the structures if needed, e.g. during illness or immediately after birth, or that animals were penned inside some of the spaces (although there is no evidence for this). The built environment therefore appears to be similar to Jarmo, and perhaps Ali Kosh with some potential affordance of space for animals in external areas (which would be clarified with more available data from Magzaliyah and a larger horizontal exposure at Jarmo), but also has similarities to Hajji Firuz with the potential inclusion of animals in internal spaces.

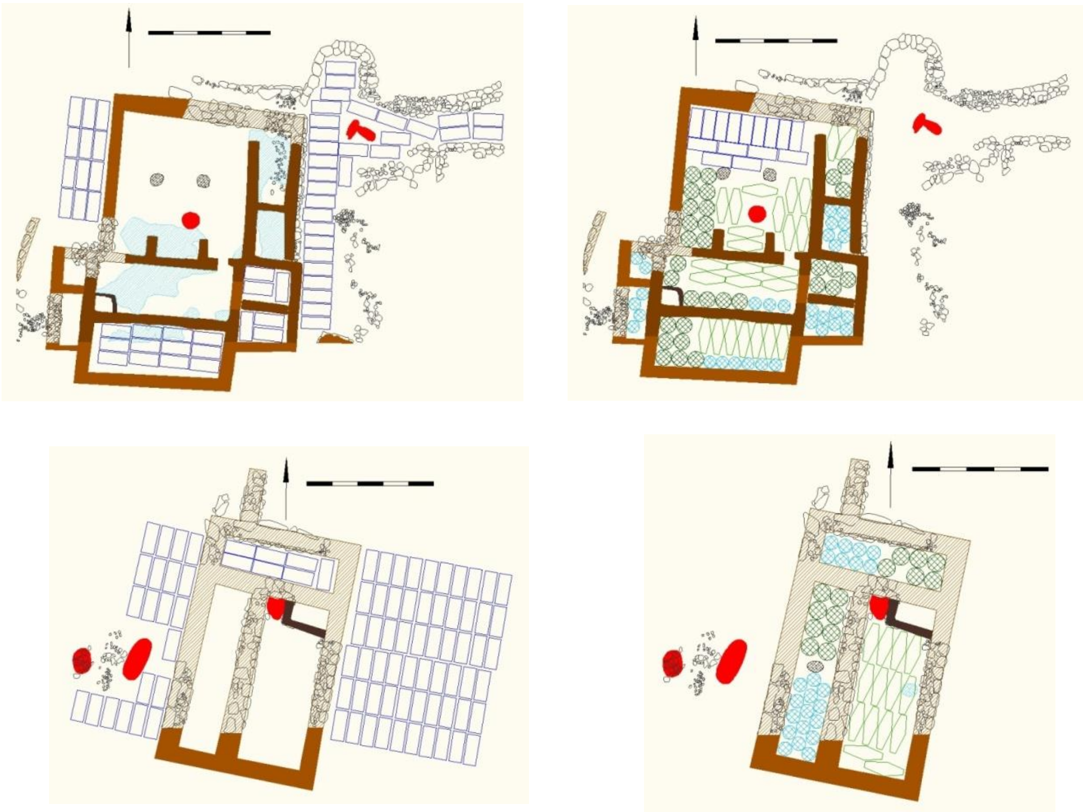


Figure 7.19: Modelled capacity for goats (left), and co-residency and storage (right) in Structure A (top) and Structure B (bottom).

It is possible that the smaller spaces along the eastern side of Structure A (S4-S7) were storage spaces (e.g. for food, fuel or household items), or work areas for specific tasks that needed to be kept separate from other activities due to, for example, smell, noise, or the quantity of waste produced. Another possibility is that the smaller spaces were used for storage; the potential storage capacities for the spaces that do not appear to have ground level doorways (S5-9), as well as the bins and pits found within Structures A and B, have been calculated and are presented in Table 7.7. The calculations assume storage directly on the floor in the small spaces filled to a height of 0.5 m and 1 m, and that the spaces were fully enclosed with a raised entrance (or access gained through the roof). Similarly, the calculated volumes of the pit and the bins are to a height of 0.50 m and 1m to indicate *potential* capacity as the actual dimensions are not known.

If it is assumed that all of the small spaces in Structure A listed in Table 7.7 were used for storage, they had the combined capacity (depending on height of stored grain or fodder) to hold the annual grain requirement for between fifteen and thirty-one individuals, or fodder for between twenty-five and fifty-one goats. Depending on the original storage volume (determined by height), the bin in S2 in Structure A could hold the annual requirement for between half and one person if filled with grain, or between one and two goats if fodder was stored in it. When comparing the potential storage capacities to the potential number of co-residents in Structure A, it appears that the building afforded space for a large number of co-residents in addition to storage of their annual grain requirement and fodder for a number of goats. If, for example, S5-S7 were used for grain storage and S8-S9 for fodder, there may have been enough storage capacity for almost twenty-three people and thirteen and a half goats (see also Figure 7.19). The combined capacity for co-residency of S2 and S3 is twenty-six adults, which is within the range of the calculated storage capacity.

Structure	Space	Potential capacity for storage (m^3) if 0.50 m height	Number of people that could be supplied by potential storage	Number of goats that could be supplied for 90 days by potential storage	Potential capacity for storage (m^3) if 1 m height	Number of people that could be supplied by potential storage	Number of goats that could be supplied for 90 days by potential storage
A	**S2; bin in SW corner**	0.230	0.70	1.15	0.461	1.40	2.30
	S5	1.125	3.41	5.63	2.250	6.82	11.25
	S6	1.387	4.20	6.94	2.774	8.41	13.87
	S7	1.270	3.85	6.35	2.540	7.70	12.70
	S8	0.856	2.59	4.28	1.712	5.19	8.56
	S9	0.487	1.48	2.43	0.974	2.95	4.87
B	**S1; storage pit**	0.120	0.36	0.60	0.240	0.73	1.20
	S2; bin in NE corner	0.544	1.65	2.72	1.088	3.30	5.44

Table 7.7: Potential storage capacities of small spaces, bins and pits.

Structure B had less permanent storage facilities: combined the bin and pit could have supplied the annual grain requirement for between two and four people, or the quarterly fodder requirement for between three and six and a half goats. It is possible that storage of food and/or fodder occurred in various organic containers, e.g. baskets, skins, and sacks, placed on the floor, and potential on-floor storage was therefore modelled (Figure 7.19) The modelling indicates that the internal spaces could have afforded storage of enough grain to feed those people living in the building in addition to fodder for over twenty goats.

7.4: Summary

The first part of this chapter examined the built environments at Sheikh-e Abad in the upland zone of the Zagros Mountains and Ali Kosh in the lowland plains of southwest Iran. It was shown that even though it is not possible to make an in-depth assessment of the built environments at these two sites comparable to the previous three case studies, it is possible to make some observations concerning the structuring of space in terms of affordance of space for co-presence and human-animal interaction. The structural remains excavated at Sheikh-e Abad consisted of a row of three small spaces, Structure 1, and a larger rectangular structure with a T-shaped internal space, Structure 2. An installation containing four goat skulls and a sheep skull located in Structure 2 may indicate an association between sheep and goats and ritual behaviour at the site. The modelling indicates that this structure may have served as a living space for a smaller social unit such as a family, and it is possible that it was a domestic space. This would indicate that ritual behaviour associated with sheep and goats may have been integrated into the domestic space at the site, which is similar to Ganj Dareh where two sheep skulls were placed in a niche in one of the small spaces. The difference between the two sites is that at Ganj Dareh the installation was more hidden and any ritual activity taking place within the space would have been restricted to one person, whereas at Sheikh-e Abad such activities could have involved up to nine individuals and were therefore more inclusive. It is interesting to note that the importance of sheep and goats in ritual activities occurred concurrently with the early stages of goat herding at Ganj Dareh. The built environment at Ganj Dareh was not, however, designed to include animals. At Sheikh-e Abad the excavated spaces do not appear to have been designed to include animals, although penning practices occurred as attested by the presence of dung in some of the deposits. It may be that goats were kept outside the settlement as at Ganj Dareh, although it is possible that they were brought into some of the external spaces. However, the limited information regarding overall settlement layout does not allow any conclusions to be drawn. If goats were kept outside the settlement it is possible that herding was a shared task, perhaps between several co-resident units or the community as a whole as may have been the case at Ganj Dareh.

At Ali Kosh the situation appears to have been somewhat different: the larger external spaces may indicate an increased affordance of space for animals and an increased degree of human-animal interaction within the settlement. The internal spaces also become larger over time compared to both Sheikh-e Abad and Ganj Dareh. In the Bush Mordeh phase the internal spaces may have accommodated between five and seven co-resident individuals, whereas this increase to nine or ten in the Ali Kosh phase, which is similar to the suggested size of co-resident groups in the later phases at Jarmo. The use of space at Ali Kosh (both phases) may have been similar to both Sheikh-e Abad and Jarmo. There is an apparent lack of internal features, with fire installations located in external spaces in the Ali Kosh phase as at Sheikh-e Abad and Jarmo, and possibly Ganj Dareh, which indicates that food preparation and cooking occurred outside. Ground stones were found both in internal and external spaces in the Ali Kosh phase, and, although they may have been placed there immediately prior to the abandonment of the buildings, it is equally possible that they were used in both spaces. This may also have been the situation at Jarmo, although ground stones were only reported from one courtyard. It is possible that Ali Kosh shared some similarities with all three sites mentioned, perhaps more so with Jarmo where the built environment appears to have had an increased affordance of space for animals; internal spaces may have accommodated slightly larger co-resident groups, or, alternatively, a wider range of activities; and food preparation and cooking occurred in external spaces, some of which may have been partly or fully enclosed and others that may have been open spaces.

The second part of this chapter examined the built environments at two lowland sites in northern Iraq, namely Nemrik and Magzaliyah, focusing on the affordance of space for human occupancy, human-animal interaction, storage and the use of space. The built environment at Nemrik consisted of mainly large, semi-subterranean, oval or circular buildings with large, open external spaces which had been paved in the later phases of occupation. There were also smaller buildings at the site, some of which may have been used for communal storage of tools, raw material, food, fuel, and so on. Alternatively, it is possible that they provided shelter for smaller co-resident units consisting of two or three adults, or a couple and one or two children (e.g. Structure 10). The medium sized buildings (e.g. Structure 3) may have accommodated a larger co-resident group consisting of perhaps eight individuals, similar to some of the internal spaces at Ali Kosh and Jarmo. The large buildings, on the other hand, may have afforded space for more than thirty co-residents, which is similar to the buildings at Hajji Firuz (if both internal spaces are included). However, it was suggested that the size of the buildings may also be a reflection of the internal ‘zonation’, i.e. the spaces were divided into different functional areas, rather than the size of the co-resident unit only. In other words, the buildings were designed to include a range of activities and interactions, each of which may have been performed in different parts of the buildings.

Most of the activities that took place inside structures appear to have been manufacturing and craft activities with little evidence for food preparation and cooking occurring inside. Instead certain parts of the external spaces contain ground stones set into the pavement and fire installations, which suggests that most of the food-related activities took place outside in communal areas and probably included members of different co-resident units, possibly the entire community, as at Ganj Dareh and maybe Sheikh-e Abad. There is also evidence suggesting that certain manufacturing activities, e.g. the production of stone sculptures and chipped stone tools, may have taken place outside in specific areas. It is possible that there was little difference in the types of manufacturing activities that took place inside and outside structures as evidence seems to indicate that production of stone objects took place both in internal and external areas. It may be that manufacturing and craft activities took place inside buildings during cooler periods, when it rained, and/or when it was too hot outside to work comfortably outside. The thermal properties of mud architecture (see section 4.4.2), perhaps aided by the fact that the structures were semi-subterranean, would have ensured a cooler interior during the summer.

One of the differences between Nemrik and the other sites discussed in this thesis is the fact that the population appeared to have relied on wild resources with no herding of animals. There is, however, a greater potential for including animals within the built environment due to the open, spread-out layout of the settlement which is even greater than at Hajji Firuz. At Magzaliyah, on the other hand, there appears to be less affordance of space for animals than Nemrik, but more than at Ganj Dareh, Sheikh-e Abad, and possibly Jarmo. The population at the site herded both sheep and goats, and the modelling indicates that the built environment afforded space for animals. If animals were kept within the settlement, then they might have been penned to prevent them wandering over or into various “household-related installations” that were located in the external spaces. The modelling also indicates that animals could have been brought into buildings if it was needed due to injury or illness. Buildings may also have had the capacity to include storage of fodder should that be required during periods of drought or adverse weather.

With regards to the affordance of space for co-residency, the modelling indicates that potential living spaces could accommodate on average thirteen individuals, which is similar to level 5 at Jarmo (trench II) and the suggested size of the co-resident groups in the largest buildings at Hajji Firuz. The internal spaces at Magzaliyah were smaller than at Nemrik, but larger than at Sheikh-e Abad and Ganj Dareh, and would have accommodated interactions on a similar scale to some of the internal spaces at Hajji Firuz, and perhaps also Jarmo and Ali Kosh. There is evidence for domestic activities taking place inside and outside buildings, with fire installations found in both internal and external spaces, indicating that food preparation and cooking may have involved either one co-resident group (inside buildings) or members from several social units (in external areas). It is also possible that the location where these activities occurred might have depended on the temperature and weather. If the preferred location for food-related activities was more private spaces, e.g. internal spaces, then it may be that economic activities were associated with individual co-resident groups. The modelled storage capacities for the buildings indicate that they could have accommodated storage of food for the co-resident group as well as fodder for a number of goats, which may support the suggestion that the co-resident unit may have been more economically independent than at Ganj Dareh and Nemrik where economic activities and resources appears to have been shared.

The discussion in this chapter has highlighted the variability in the social practices as reflected in the structuring and use of space at these four sites. The main points raised in each of the case studies presented in this thesis are discussed and compared in the next chapter. It will also consider the social and practical implications of the conclusions drawn from the modelling, and how, or if, the evidence fit within the proposed frameworks discussed in chapter 2.

Chapter 8

The structuring of space in Neolithic settlements

8.1: Introduction

Discussions of Neolithic social structures have often focused on the extent to which households (often equated with the nuclear family) were either economically autonomous (e.g. Byrd 1994, 2000; Flannery 1972, 2002; Kuijt 2000d) or not (e.g. Pollock and Bernbeck 2010). These discussions have, to varying degrees, considered how households, the spatial patterning of activities, social interactions, and storage practices relate to various aspects of Neolithic social and economic structures. The potential relationship between the structuring and use of space and the social and economic structures of the communities at each of the case study sites have in this thesis been examined through a scenario modelling approach, which focused on the issues of co-residency, domestic activities and social interactions, and potential storage practices and affordance of space for animals. This chapter brings together the main points raised in the discussions in the previous four chapters and considers the social and practical implications of the conclusions drawn from the modelling. This provides the basis for the evaluation of how, or if, the evidence from the Zagros relates to the issues and ideas that have been raised in the discussions of Neolithic social strategies outlined in chapter 2.

Explanatory models tend to be aimed at explaining broader-scale temporal and geographical patterning and it is often assumed that these are applicable to sites across the Near East. However, since these models have been constructed based on Levantine data sets they may not be particularly applicable to the Zagros region, and the discussion in this chapter questions the validity of utilising these approaches in order to understand social strategies existing across the Near East. In this sense it agrees with Hemsley (2008) who argued that these models not only mask the variability in social practices that existed within the Levant, but they also fit the data poorly. This point will be discussed further at the end of this chapter. The discussion in this chapter provides a basis from which we can start to form a picture of the social environment in Neolithic settlements in the Zagros uplands and adjacent lowlands.

8.2: The structuring of social space

As outlined in section 2.4 the structuring and use of space within built environments have provided the basis for much of the debate concerning Neolithic social strategies. Most of these discussions have, however, focused on settlements in the Levant with little consideration of evidence from other regions, apart from where they provide assumed parallels with the Levantine data. Changes in architectural configurations throughout the Neolithic have in the Levant been linked to changes in modes of production and consumption, and increasingly autonomous nuclear family households (e.g. Byrd 1994, 2000; Flannery 1972, 2002). The basic assumption is that sedentism and agriculture provided the necessary foundations for increasingly complex socio-economic systems (Byrd 1994: 639). Architectural characteristics often cited as indicative of increasing household autonomy include increasingly compartmentalised internal space, and a shift in the location of storage and domestic activities from external spaces to inside buildings (Byrd 1994: 640-641, 2000: 79-80; Flannery 1972, 2002: 418). Restriction of visibility and access into structures separated communal space from private household space, and internal compartmentalisation was an extension of this by which access into certain parts of the building was controlled (Byrd 1994: 640; Kuijt 2000d: 95-96). It has also been suggested that the increased inward economic and social focus resulted in increasing social tension and inequality which people sought to defuse through communal ritual activities promoting community cohesion taking place in non-residential buildings (Byrd 1994), or centring on elaborate mortuary rituals (Kuijt 1995, 2000e). In the contrasting view of the Neolithic proposed by Pollock and Bernbeck (2010) they argue for a communal mode of production and consumption at Tol-e Baši based on the assertion that more or less all of the domestic activities and social interactions occurred in communal (external) spaces. The degree to which co-residency and economic production and consumption may have overlapped is therefore central to our understanding of the structuring of Neolithic societies (sections 2.4 and 3.3.1).

This thesis has, thus far, provided a consideration of this issue through an examination of the physical affordance of space for human occupancy at a range of sites in the central and northern parts of the Zagros and adjacent lowlands. In particular, it has focused on the potential size of co-resident units, the spatial patterning of domestic activities and scale of social interactions, possible storage practices, and the affordance of space for animals. The remainder of this chapter will compare the results from the modelling (summarised in Tables

8.1-8.5) and discuss them in relation to issues raised in the models of Neolithic social strategies outlined in chapter 2 (summarised above).

Site	Phase	Structures	Internal features
Ganj Dareh (~8,000 cal BC)	Level D	Series of highly agglutinated spaces; Possibly only one structure.	Ground stone implements; Storage bins and clay vessels; One possible oven
Sheikh-e Abad (*c* 8,000-7,600 cal BC)	Latest phase	A rectangular structure with T-shaped interior and a series of three smaller rectangular space	Installation containing four goat skull and one sheep skull; One sub-floor burial in one of the small spaces.
Jarmo (*c* 7,500-6,000 cal BC)	Early phase (levels 7 through 6a, Trench I)	Rectilinear structures; Potentially one or two structural units sharing some walls; Structural units possibly centring on shared courtyard spaces	Ovens located in internal spaces but opening up into courtyards; Reed matting on internal floor surfaces.
	Later phase (level 5, Trench II)	Rectilinear buildings that were spatially separate from neighbouring building even though these were located close together.	Oven located in internal space but opening up into courtyard; Reed matting on internal floor surface.
Hajji Firuz (*c* 6,100-5,700)	Phases J-A3	Free-standing rectangular structures with a 'clean' living space and a 'dirty' work/storage space	'Clean'/Living spaces: some had painted walls and floors, most of the burials (particularly those in cists), usually hearth by entrance to 'dirty' space. 'Dirty' spaces: most ceramic vessels set into the floors, some had short dividing wall or small storage spaces, sometimes hearths.
	Phases D-C	Smaller, free-standing, square structure with one internal space; Small, free-standing, rectilinear structure with one internal space	Hearth, burial between floors and a feature of unknown function in square structure; No feature in the small, rectilinear building.
Ali Kosh (*c* 7,500-6,900 cal BC)	Bus Mordeh phase	Small, multi-roomed rectilinear structure	No internal features; One possible storage space.
	Ali Kosh phase	Potentially larger, multi-roomed structures	Sub-floor burials; Ground stone implements found placed on the floors.
Nemrik (*c* 9,800-8,200 cal BC)	Throughout	Small, medium and large semi-subterranean circular or oval buildings	Internal 'zonation' with features usually found in S part of buildings; Features include pillars, post sockets, low internal walls, benches, platforms, pits, and sub-floor burials; On-floor artefacts include flint scatters and various ground stone implements.
	Latest phase	Large, sub-rectangular, semi-subterranean buildings	Internal 'zonation'; Features include pillars and low internal walls.
Magzaliyah (~7,000 cal BC)	3rd phase	Free-standing rectangular building with three internal spaces; Large rectilinear, multi-roomed building	Storage bins; Hearths; Plastered basins.

Table 8.1: Summary of architectural forms and internal features at each site.

The built environments examined in this thesis attest to the variety of built forms and social practices that existed in the Zagros uplands and adjacent lowlands; from the tightly clustered, highly compartmentalised structure at Ganj Dareh to the free-standing buildings with more open plans at Hajji Firuz in the Zagros uplands, and the large, circular structures at Nemrik and internally sub-divided buildings at Magzaliyah in the lowlands of northern Iraq. As a reference the architectural forms and internal features found within buildings at each site has been summarised in Table 8.1.

In some instances it was difficult to assess whether the available architectural remains constituted one or more structural units. For example, the nature of the tightly clustered and highly compartmentalised architecture at Ganj Dareh makes it difficult to assess whether the remains consisted of individual buildings or should be viewed as the same structure (section 4.5). Agglutinated buildings are often separated based on features such as shared outer walls (making 'double' walls due to the tight clustering of some spaces), and internal spaces that are interconnected and below one roof (e.g. Cutting 2006; Düring 2006). At Ganj Dareh the only potential 'double' walls are around parts of S5 and S6 (although this may be for structural reasons rather than indicating two separate buildings) and access into and movement between spaces are unclear (section 4.4.4). Similarly, identifying individual buildings in the earlier phase at Jarmo was not straight forward either. It is possible that there were two different structural units in levels 7 and 6d-b (sections 5.6-5.7), and that buildings may have been located together in certain areas of the site, possibly centring on shared external spaces such as courtyards.

The difficulty in defining individual structures at these sites highlights some of the problems associated with models that assume particular household structures (i.e. a specific family grouping) based on built forms. This is because these approaches tend to equate a household with the building in which they reside, as have been the case in most of the previous discussions of Neolithic household structures in the Near East (e.g. Banning 1996; Byrd 1994, 2000, 2005b; Flannery 1972, 2002). Explaining Neolithic social structures in terms of well-defined households is problematic. It may be that the traditional view of a household as a social unit that lives together and shares economic production and consumption are not entirely appropriate (see sections 2.4 and 3.3.1). Perhaps it is more appropriate to discuss these communities as co-resident units and co-operating activity groups (see Kadowaki 2006). The following discussion will therefore consider the issue of co-residency before moving on to the spatial patterning of activities and the degree to which these two aspects may have overlapped.

In order to avoid the problems associated with the empirically weak methods employed in previous discussions of household structures, such as floor area calculations and demographic averages, it was decided to focus on the modelled capacities for co-presence and co-residency in order to identify possible living spaces and the potential number of co-resident individuals (section 3.3.1). Modelling co-residency and co-presence takes into consideration the size, form and spatial layout of internal spaces and thus provides a more situated assessment of the spatial affordances for people to live and gather within structures which previous approaches have not. The result of the modelled capacity for co-residency has been summarised in Table 8.2. In the previous chapters, co-residency and co-presence were discussed in terms of modelled maximum capacities, however, as it is possible that these structures were not used to their maximum capacities, the discussion in this chapter considers suggested ranges of numbers of co-residents in individual living spaces at each site (which, of course, would have been dependent on the sleeping patterns of the inhabitants and any portable materials that may have been kept in the living spaces during their use).

Site	Phase/ Level/ Buildings	Suggested range of possible co-resident individuals
Ganj Dareh	Level D	2-4*
Sheikh-e Abad	Latest level	2-5
Jarmo	Early phase	2-5
	Late phase	5-10
Hajji Firuz	Large buildings	5-15[#]
	Structure VI_{1-2}	2-5
Ali Kosh	Bus Mordeh phase	2-4
	Ali Kosh phase	4-8
Nemrik	Large buildings	10-18
	Medium buildings	5-10
	Small buildings	2-4
Magzaliyah	Both buildings	5-10

* Depending on the original extent of the large spaces that extended beyond the trench. If there were an upper storey with living spaces, these may potentially have been larger than those found within the trench. However, it is unclear whether there had in fact been an upper storey or not.
[#] Several of the building interiors had not been fully preserved and/or excavated, thus it is not completely clear how the original internal layout of some of these structures may have affected the potential number of co-resident individuals.

Table 8.2: Suggested ranges of possible co-resident individuals in potential living spaces and/or domestic structures.

At Ganj Dareh, Sheikh-e Abad, and at least in the earlier occupational phases at Jarmo and Ali Kosh, the modelled affordance of space for human occupancy indicate that individual co-resident groups may have consisted of two to four or five individuals. The early sites in the Iraqi lowlands, on the other hand, had greater capacities and may have provided space for perhaps five to ten or more individuals. This is similar to the modelled affordance for co-residency in the larger structures at Hajji Firuz. It is important to note, however, that Structure VI_{1-2} at Hajji Firuz afforded space for between two and five co-resident individuals, which raises the possibility that there were more than one type of co-resident group at the site (see also discussion in 3.3.1). A consideration of the burial population in Structure VI_{1-2} and one of the larger buildings (Structure II_1), in which it was assumed that those individuals buried in a structure were part of the co-resident unit, appears to support this suggestion (section 6.4.1). The possibility of different co-resident groups (or types of households) co-existing within the same community has thus far not been considered in discussion of Neolithic households as these tend to assume that households consisted of nuclear *or* extended families.

At this point is may be appropriate to return to the models proposed by Byrd (2000, 2005b) and Flannery (1972) and compare the ranges of co-resident units suggested by the scenario modelling with floor area calculations, which they use to estimate household size (section 3.3.1). The estimated size of co-resident units using these two approaches are compared for selected living spaces and/or buildings at Ganj Dareh, Jarmo, and Hajji Firuz in Table 8.3. This comparison illustrates that using floor area calculations could potentially lead to an under-estimation of potential co-residency – both when including all roofed floor area (as Flannery 1972) as well as living space only (as Byrd 2005b) – as the actual affordance of space for human occupancy is conceptualised more efficiently through the scenario modelling. It is possible that using floor area values and/or equating built form with a particular social grouping (e.g. nuclear family) will mask potential variability in types of co-residential groups, such as may have existed at, for example, Hajji Firuz. Additionally, using floor area values to estimate co-residency provides no information as to the potential use of space or the identification of possible living spaces, which in the case of Ganj Dareh may lead to assertions that living spaces were located on an upper floor (e.g. Smith 1990) for which the evidence is not wholly convincing (see discussion in chapter 4).

Site	Roofed floor area	Naroll (1962), Flannery (1972): 10 m2 per person	Weissner (1974): 5.9 m2 per person	Suggested range of co-residents based on scenario modelling
Potential living space S25 at Ganj Dareh^	5.13 m^2	0.5 persons	0.8 persons	2-4 persons
Living space S1 in Structure A, Level 5 (Trench II) at Jarmo*	10.5 m^2	1.05 persons	1.77 persons	5-10 persons
Structure A, Level 5 (Trench II) at Jarmo[#]	30.5 m^2	3.05 persons	5.2 persons	5-10 persons
Structure VI_{1-2} at Hajji Firuz	19.5 m^2	1.95 persons	3.3 persons	2-5 persons
Structure II_1 at Hajji Firuz	28 m^2	2.8 persons	4.7 persons	5-13 persons

^ Due to the difficulty in identifying individual structural units at Ganj Dareh, estimating the size of the co-resident unit(s) based on all roofed floor area is problematic.
* Following Byrd's (2000, 2005b) focus on living spaces.
[#] Following Flannery's (1972) focus on all roofed spaces.

Table 8.3: Comparison of methods for estimating size of co-resident units.

The ranges of potential co-resident individuals indicated by the modelling (Table 8.2) suggests that there may not have been a correlation between built form and the size of co-resident groups as suggested by Flannery (1972, 2002). There were potentially larger co-resident groups (perhaps consisting of extended and/or multiple families) at Jarmo and Hajji Firuz in the uplands as well as both sites in the Iraqi lowlands, all of which have different structural traditions. At the same time there may have been smaller co-resident units (potentially nuclear families) at all of the upland sites, including Jarmo and Hajji Firuz, as well as at Ali Kosh. This also undermines the assertion that household structures remained the same throughout the Early Neolithic, i.e. consisted of nuclear families, regardless of built form (Banning 1996; Byrd 1994, 2000, 2005b), and that extended family households only appeared during the Late Neolithic in Mesopotamia (Flannery 2002). One potential trend at the upland sites is what appears to be an increasing spatial separation of co-residential units (although this would need further investigation at other contemporary sites in the area, a point which is discussed in chapter 9). The structural configuration at Ganj Dareh suggests that co-resident units may have lived in individual living rooms within the same building. Similarly, the spatial proximity between different structural units at Jarmo, especially in the early phase, is akin to the structural configuration at Ganj Dareh, even though they are not as tightly clustered. At Hajji Firuz, on the other hand, there is a greater spatial separation of structural units, and by extension co-resident groups.

The modelling has highlighted a range of differences in the spatial patterning of activities and social practices at individual sites (summarised in Table 8.4). For example, the latest occupational phase at Nemrik and level D at Ganj Dareh (possibly also Sheikh-e Abad) are separated by perhaps only a couple of hundred years, but show very different spatial configurations and use of space which are indicative of different social practices. At Ganj Dareh several co-resident units may have formed larger activity groups that undertook a range of domestic tasks together and shared responsibility for herding and storage of food and fodder. A similar practice can be seen at Jarmo, although involving fewer co-resident groups. The difference between these two sites is that while particular domestic tasks may have been conducted in spaces that allowed limited participation at Ganj Dareh, many food-related (and possibly manufacturing) activities were performed in more public settings, whereas at Jarmo most domestic tasks appears to have occurred in courtyards shielded from general view of the wider community, although possibly not from other co-resident groups that shared access into these spaces, at least in the earlier occupational phases.

Similar to Ganj Dareh, a range of food-related tasks at Nemrik (including cooking) took place outside in open communal spaces and may have involved several co-resident groups. The potential size of the co-resident units was larger than any of the co-resident groups at Ganj Dareh, Sheik-e Abad and the early phases at Jarmo and Ali Kosh. Another difference is the fact that a range of manufacturing activities may have occurred inside individual buildings, indicated by the ‘zonation’ of internal space. The distinction between food-related and manufacturing activities in terms of location may indicate that several co-resident units co-operated on subsistence activities, but undertook some craft activities individually. At Hajji Firuz, and possibly the earlier site of Magzaliyah, on the other hand, it may be that individual co-resident units were also the main activity groups, both for food-related and manufacturing activities. The size of the co-resident groups may have consisted of extended or multiple families (perhaps between one and three nuclear families), and in this sense the activity groups may perhaps be similar in size to those at Jarmo. The spatial patterning of built features and artefacts associated with food-related activities were found in both internal and external spaces at Hajji Firuz and Magzaliyah, as well as the later phase at Ali Kosh, whereas most of the evidence for manufacturing activities occurred in external areas at Hajji Firuz.

Site	**Initial food processing and preparation**			**Later stages of food preparation and cooking**			**Craft and manufacturing activities**	
	Internal space	External space		Internal space	External space		Internal space	External space
		Courtyard	Open		Courtyard	Open		
Ganj Dareh	✓	?*	✓	?	?*	✓	?	?
Sheikh-e Abad	-	-	-	?	-	?	-	-
Jarmo	?	✓	?	?	✓	✓	✓	?
Hajji Firuz	✓	✓	✓	✓	✓	✓	?	✓
Ali Kosh: BM	-	-	✓	-	?	?	-	✓
Ali Kosh: AK	✓	?*	✓	-	?*	✓	-	-
Nemrik	?	-	✓	?	-	✓	✓	✓
Magzaliyah	✓	?*	✓	✓	?*	✓	?	?

✓ Activities took place in this space.
? Activities may have taken place in this space.
- Unclear where these activities occurred, or not applicable as this type of space was not found in excavation.
* Unclear whether the external space was enclosed or open, thus ✓ in 'open' column and ? in 'courtyard' column.

Table 8.4: Summary of the location of food-related and manufacturing activities at each site.

It is possible that the location of domestic activities at Magzaliyah and Hajji Firuz (and possibly the later phase at Ali Kosh) may have depended on the season (i.e. outside during summer and inside during winter section 6.5). The different locations would also have provided the inhabitants with the choice of whether to socialise with members from other co-resident groups during work or not, which may be different from Ganj Dareh and Nemrik (and possibly Jarmo) where the spatial patterning of activities may have been related more to the type of domestic tasks. Neither of these scenarios fit into the suggested shift in location of domestic activities from communal to increasingly private spaces (Byrd 1994, 2000; Flannery 1972; 2002), nor do they suggest that all activities and social interactions occurred in external, communal spaces (e.g. Pollock and Bernbeck 2010). Additionally, the association between internal compartmentalisation and increased autonomy of nuclear family households may not necessarily be as simple as suggested by Byrd (1994, 2000) and Flannery (1972, 2002). Highly compartmentalised internal space is evidenced early in the Neolithic sequence at Ganj Dareh where use of a number of internal spaces may have been shared between several co-resident groups. Instead, buildings appear to have become *less* internally compartmentalised over time in the upland zone.

Another aspect of the proposed increase in household autonomy is the accumulation of resource surplus indicated by the presence of storage facilities within buildings (Kuijt 2009). The accumulation of resources is viewed as dependent on increasingly intensive cultivation of certain crops, and in particular grains. In the Zagros, however, there appears to have been a greater emphasis on animals rather than plant resources, not only attested by the high proportion of meat in the diet (Schoening 1981) and continued reliance on wild resources, but also the early evidence for animal herding (e.g. Hesse 1978, 1982; Zeder and Hesse 2000), and possibly the development of nomadic pastoralism during the Chalcolithic (e.g. Abdi 2002, 2003), if not earlier. In pastoral societies herds represent storage of live resources that can be accumulated over time and transferred between generations, and status and wealth are based on the number of animals owned (Abdi 2002: 46; Barth 1961; Borgerhoff Mulder et al 2010; Cutting 2006: 98; Ingold 1980: 144-145, 1983: 563-564; Salzman 1999). Resource accumulation based on ownership of animals is difficult to identify in the archaeological record compared to storage of plant crops. Certain aspects of the built environment may potentially suggest whether herds *may* have been managed by individual social units or the community as a whole. As animals come under human management a relationship is created where people assume responsibility for the welfare of the animal in order to ensure reproduction (sections 3.3.4 and 3.3.6).[89] This includes providing shelter if needed (e.g. in pens, stables, caves and so on), protection from predators, care during illness and injury, and ensuring access to water and feed if pasturage is not available or of poor quality (Beck 1980: 330-331; Cribb 1991: 23-43; Gilbert 1973: 57; Horne 1988: 69). The increased focus on animal welfare that accompanies animal management strategies may, therefore, be evident in penning and storage practices. It is possible that closer control and ownership of herds by individual social units may have resulted in the penning of animals within, or close to, the domestic structure (in stables, courtyards, temporary pens; e.g. Kramer 1979; Salzman 1972; Watson 1983), and/or storage of fodder within buildings in addition to food for human consumption (see discussion in sections 3.3.4 and 3.3.6).

[89] See Redding (1981) for discussion of the aims and strategies in subsistence herding of sheep and goats, which is dependent on whether they are kept for meat, wool and/or dairy production.

Site	Storage Capacity		Animals within settlement
	Food	Fodder	
Ganj Dareh	✓	✓	Possibly not
Sheikh-e Abad	✓	✓	Potentially in external spaces
Jarmo	✓	✓	Potentially in courtyards and/or open areas
Hajji Firuz	✓	✓	Potentially both in open areas and enclosure
Ali Kosh	✓	✓	Potentially in external areas
Nemrik	✓	-	Probably not, although there is space for animals
Magzaliyah	✓	✓	Potentially in external areas

✓ Capacity to supply food for co-resident unit and fodder for a number of goats.
- Storage of fodder probably did not occur (although there was capacity for it).

Table 8.5: Potential storage capacity and affordance of space for animals within each settlement.

Discussions of Neolithic economic strategies have thus far tended to focus on storage of plant foods for human consumption without considering pastoral resources beyond the question of whether animals were domestic or not (section 3.3.4). However, because of the importance of pastoral practices within communities in the Zagros (see section 2.3.2) it is important to include this aspect into the examination of the social and economic structures of Neolithic societies. In order to investigate the potential economic autonomy of co-resident groups this thesis has, therefore, considered not only the affordance of space for storage of food for human consumption, but also the capacity for storage of fodder as well as the affordance of space for animals within the built environments (summarised in Table 8.5). Since the latter two aspects have important implications for animal management strategies in terms of herd protection and ensuring pastoral productivity (as discussed in sections 3.3.4 and 3.3.6), it is necessary to consider their potential impact on the structuring of space within the Neolithic settlements. The modelling of the affordance of space for animals within built environments in combination with the modelled capacity for storage of fodder have allowed an evaluation of whether individual co-resident units may have been responsible for the welfare of their own herds or segments of larger herds (through containment and provision of fodder when needed; see discussion in sections 3.3.4 and 3.3.6). In other words, it has allowed an examination of the pastoral aspects of Neolithic economies which has so far been lacking in the discussion of Neolithic social and economic practices (outlined in section 2.4).

The modelling indicated that all of the structures considered in this thesis had the potential to accommodate enough storage to feed the co-resident unit without necessarily restricting the amount of available space for habitation or domestic activities. If we were to determine the degree of economic and social autonomy of a co-resident group based on the capacity for storage and domestic activities to occur inside buildings (e.g. Byrd 1994, 2000: Flannery 1972, 2002; Kuijt 2000d; Pollock and Bernbeck 2010; Wright 2000) then this was equally possible for all of the sites considered in this thesis. There also appears to have been enough space within buildings to supply fodder throughout the winter months for small herds of goats (in addition to food), perhaps consistent with small-scale village-based pastoralism. Interestingly, even though it is possible that storage practices at all of the sites comprised both food and fodder, it appears that animals were not included into the settlement at Ganj Dareh which has evidence for early goat herding. In fact, the inclusion of animals into the built environments seems only to have been a feature of later Neolithic settlements where animal management may have been more established as an economic strategy and included several species, i.e. at Magzaliyah, Hajji Firuz, and potentially Ali Kosh and Jarmo. This increased affordance of space may indicate that the built environments offered the opportunity for animals to be penned close to individual buildings, potentially allowing closer control through containment on the part of individual co-resident units (see discussion in section 3.3.4). It may be that the appearance of smaller courtyards located by potential entrances at Hajji Firuz – which is not attested at any of the other sites – was a means to prevent animals entering the domestic space, and thus indicate their inclusion into the settlement landscape. The increased affordance of space for animals seems to be a feature of communities with increased spatial separation of social units, and it is possible that this is linked to increased economic autonomy on the part of the co-resident unit at e.g. Hajji Firuz, or the activity group at Jarmo (penning may have occurred in courtyards, which may have been shared between two or more co-resident groups).

Evidence of ritual behaviour in the Zagros is limited compared to other areas, and there is no compelling evidence indicating social differentiation (Abdi 2002: 120; Bernbeck 2003). There are no large non-domestic structures found at any of the sites (section 2.5), and burials are not especially elaborate and generally contain little, if any, grave goods. At Jarmo, for example, the only human remains that were recovered came from the upper two levels, and most of these are believed to be the results of accidental deaths rather than proper burials (Braidwood 1983b: 427). Evidence for ritual and symbolic behaviour also include the installations consisting of sheep and goat skulls at Ganj Dareh and Sheikh-e Abad, and potentially clay figurines (e.g. Broman Morales 1983, 1990; Voigt 2000). It has been suggested that "[t]he interest in portraying domestic animals points to the ritual/symbolic importance of herded species" (Bernbeck 2003: 672; see also Bernbeck 2010). This ritual association with livestock may also be evident in the inclusion of bones from domestic (and wild) animals in burials at Hajji Firuz (section 6.3.1-6.3). The ritual activities associated with the installations at Ganj Dareh and Sheikh-e Abad appear to have been small-scale and potentially related to individual co-resident groups due to the small size of the spaces in which they were located. It may be that symbolism associated with the sheep skulls at Ganj Dareh did not require the installation to be seen, similar perhaps to the sub-floor burials where the knowledge of the location may have been the main factor. Similarly, participation in ritual activities associated with burials may have been restricted to only one or two individuals (Ganj Dareh) or individual co-resident groups (e.g. Hajji Firuz), and do not seem to include much visual symbolism.

At this point it seems appropriate to consider the most salient points made by Hemsley (2008) in her examination of PPNA and PPNB built environments in the Levant as the methodology employed in this thesis builds on her work.[90] By examining the structuring of space within settlements and modelling the physical affordance of space for human occupancy she was able to demonstrate that there was considerable variability in how PPNA built environments structured social interactions and daily life despite similarities in built forms and patterns of residency within individual communities (Hemsley 2008: 191-192, 307-309). Variability in the structuring and use of internal spaces was also noted at PPNB settlements with formal similarities in architecture, although there were observable similarities within particular regions within the Levant (Hemsley 2008: 309-327). This led Hemsley (2008: 309-314, 326) to suggest that the EPPNB saw the emergence of small-scale regional traditions and identities rather than a standardisation in architectural practices across the Levant. She (2008: 327-328) also argued that there was no convincing evidence indicating increasing economic autonomy of households through the Aceramic Neolithic as "modelled occupancy and storage has shown that, if we determine household economic autonomy through the capacities of interior spaces to accommodate resources and activities out of sight of the neighbours, then this was *equally possible and variable* for PPNA houses as for those of the LPPNB" (Hemsley 2008: 327, my emphasis). These observations echo some of the points discussed in this chapter, namely the variability in built form and structuring of space within settlement across the Zagros region and the lack of noticeable increase in internal storage capacities over time. One difference between the two studies (beyond geographical region and differences in architectural traditions) is the amount of available data. Even though Hemsley focused on four main case studies, she was able to incorporate basic analysis of several other PPNA-PPNB sites, and thus elucidate patterns in the data that may indicate temporal trends. It is clear that the incorporation of information from more sites in the Zagros would present an opportunity to further investigate the main points raised in the discussion in this chapter and allow an evaluation of possible temporal

[90] It should be noted that her approach focused on the affordance of space for co-presence, co-residency and storage (although using two different modelled individuals, and a higher annual requirement of grain per person – which was in fact incorrectly calculated – than in this thesis) combined with a three-dimensional investigation of the sensuous experience of inhabiting the various built environments.

trends within this region (such as the possible increase in spatial separation of co-resident groups). This point is discussed further in the next chapter, which summarises the main conclusions drawn from this study and proposes future avenues of research.

In summary, it appears that the models proposed by Flannery (1972, 1993, 2002), Byrd (1994, 2000), and Kuijt (1995, 2000d, 2000e) do not provide satisfactory frameworks for trying to understand the Neolithic in the Zagros. These models assume linear trends in architectural and socio-economic developments when in fact there is much variability in structural configurations, use of space, and social practices throughout the Zagros and adjacent lowlands. This, in itself, indicates that there is a need for situated site-specific investigations of social strategies in the Zagros and adjacent lowlands. The alternative view proposed by Pollock and Bernbeck (2010) for Tol-e Baši also appears to provide an ill-fitting model for understanding Neolithic social structures in this region. The variability in social practices at the sites investigated here confirms that these areas should be viewed on their own terms instead of applying models that do not fit. This is not to deny the important contributions made by these models to our understanding of how architecture and the use of space can inform our understanding of social strategies. Instead, it is suggested that by examining the particulars of individual sites we can start to build a more informed understanding of the social transformations that took place in the regions within which they are located.

Chapter 9

Conclusions

9.1: Investigating social strategies in the Zagros Neolithic

The main aim of this thesis has been to provide a contextualised discussion of social strategies within Neolithic communities in the Zagros. Research on the Neolithic of the Near East has become increasingly focused on the social aspects of the transition from mobile hunter-gatherer groups to sedentary, food-producing communities. Most discussions have, however, centred on the developments that occurred in the Levant, due in large parts to the more extensive evidence available from this region (sections 2.4-2.6). Despite increased focus on the wider Zagros region in the last decade, discourse has remained concerned with understanding the economic strategies and material expressions of the Neolithic in this area. There has been a lack of explicit discussions of social practices within Neolithic communities in the Zagros compared to studies dealing with this period in other areas.

Discussions of architecture and the structuring of settlement space have emphasised the increasing autonomy of nuclear family households and the assumed increase in social tension resulting from the social transformations occurring as a result of sedentary practices and population growth (sections 2.4-2.6). The models proposed by Flannery (1972, 1993, 2002), Byrd (1994, 2000) and Kuijt (1995, 2000d, 2000e) are largely functionalist and assume linear trends in which the development of architectural forms are indicative of increasingly complex socio-economic systems (Cutting 2005: 10). They are generally aimed at explaining broader-scale temporal and geographical patterning and in doing so they ignore the variability in architectural traditions and social strategies that may exist within and between different regions. In fact, the built environments examined in this thesis attest to the differences in the organisation and use of space that existed within the wider Zagros region. What these models have done is to provide insights into the ways in which the structuring of space within built environments may inform on questions relating to social organisation. This thesis has incorporated these observations within a methodology that takes into account the physical affordance of space for a range of human behaviours.

The modelling has indicated that there is no noticeable increase in storage capacities over time; in fact, all buildings examined may have facilitated storage of food and fodder that supported the co-resident group and a small herd of goats (sections 8.2). Additionally, internal compartmentalisation, which has been linked to increased economic autonomy (Byrd 1994; Kuijt 2000d), appears early in the Zagros sequence. The capacity to accumulate resources therefore does not appear to increase over time; the main difference between the upland sites seems to be an increase in the spatial separation of co-resident groups (section 8.2). Co-resident units at earlier sites in the uplands may have consisted of nuclear families that may have formed part of larger co-operating activity groups sharing responsibility for economic and domestic tasks. The size of the co-resident groups may have increased over time to include two or three generations of the same family (section 8.2, Table 8.2). Towards the end of the Neolithic, the co-resident unit may also have become the main activity group, possibly economically independent from other co-resident units. The increased capacity for animals within sites also suggests an increase in the control of segments of herds on the part of the co-resident unit (section 8.2, Table 8.5). These developments appear, however, to be accompanied by a greater choice of where to perform domestic activities (inside or outside; courtyard or open area) and an increase in the number of potential participants (larger internal spaces and open external spaces). This is different from the suggested shift in location of domestic activities and storage proposed for the Levant (Byrd 1994, 2000; Flannery 1972; Wright 2000), which indicates substantial differences in social practices between the two regions. It is also different from the almost exclusive focus on external areas suggested for Tol-e Baši (Pollock and Bernbeck 2010). In the lowlands of northern Iraq, there may have been a slight decrease in the number of potential co-residents, although co-resident units may still have consisted of extended or multiple families. As with the upland sites there were no noticeable changes in storage capacities, although the evidence suggests differences in the spatial patterning of activities; this possibly indicates that the co-resident unit had become the main activity group.

9.2: Future avenues of research

The methodology employed in this thesis draws on the scenario modelling developed by Hemsley (2008), although it was adapted to the issues investigated in this thesis and therefore did not include the same stages as her analysis. It has facilitated a discussion of human occupancy that considers how people and animals fit into the settlement landscape. The modelled affordance of space for seated and sleeping individuals of two different statures (section 3.3) provided a standard method for assessing the potential range of co-residents and the number of people that could have gathered and interacted within individual spaces which can be applied to a range of different built environments. Combined with the modelled storage of food for human consumption and fodder it has also been possible to examine the impact of potential storage practices on the use of space and the structuring of domestic activities. This thesis has also assessed the affordance of space for animals within the built environment as a means to investigate human-animal interactions, and whether the development of pastoral strategies may have influenced the structuring of settlement space. Together, the modelled scenarios allow us to examine a range of social and economic aspects of past communities through a consideration of how humans (and animals) may have dwelt within the built environments.

There are various ways in which this research can be continued in the future. Even though the methodology employed in this thesis allows a preliminary assessment of the use of space in the absence of complete architectural remains, the more comprehensive data sets will, of course, produce a greater understanding of local variability, as well as potential regional trends. The most basic way to improve our understanding of the structuring and use of space within a settlement is to increase the amount of data collected during excavations. Many projects concentrate their excavation efforts on smaller areas, often due to time constraints or limited funding and personnel. Even though such small-scale excavations can yield valuable information on chronological issues, subsistence strategies, and material culture through the collection of various artefacts and ecofacts, architectural remains are in most cases incomplete or fragmentary. The methodology used in this thesis relies on the availability of archaeological information concerning the structuring and use of both internal *and* external spaces. To achieve a greater understanding of overall settlement layout it is necessary to conduct open area excavations in which a larger portion of a site is exposed. For example, the renewed excavations at the PPNA site of WF16 in southern Jordan were specifically aimed at investigating the settlement structure and use of space through the excavation of a large open area (40 x 15 m) (Finlayson et al 2009; Finlayson et al 2008; Finlayson et al 2009). This strategy revealed the diversity of structures – in terms of size, internal features, occupational fills, and function – that were present, which included a small storage building, a workshop, and a large communal structure (Finlayson et al 2011). If the excavations had been confined to a smaller area, this diversity would not have been detected and our understanding of the structuring and use of space would probably have been inaccurate. Increasing the horizontal exposure at all of the sites examined in this thesis, especially at Jarmo, Sheikh-e Abad and Ali Kosh, would enable a more informed assessment of general settlement layout and the structuring of space, which would help to clarify uncertainties regarding the identification of individual structural units and the nature of external spaces.

Excavations should ideally combine a range of micro and macro-scale approaches aimed at recovering information on daily life within individual settlements. Conducting use-wear studies on a range of implements, such as ground stones, chipped stone tools and bone objects from various sites in the Zagros region would contribute to our understanding of the utilisation of various artefact assemblages. Combining this data with a more in-depth recording – and reporting – of artefact distribution should allow a more informed analysis of the spatial patterning of activities within the built environment. Including techniques that look at the micro-scale traces of activities and human behaviour, such as micromorphology and geochemistry, in the assessment and modelling of built environments would greatly improve our understanding of the use of space, as well as herding practices. Micromorphology can provide invaluable information regarding site formation processes and the use of space that is difficult to distinguish during excavation (Matthews et al 1997). At Çatalhöyük, for example, micromorphological studies, sometimes combined with geochemical analyses, have provided important evidence for the use of space within buildings that were kept remarkably clean, and established recurring patterns of deposition and activities within middens, including the use of particular midden areas as animal pens (e.g. Matthews 2005; Shillito, Matthews and Almond 2008; Shillito et al 2011). The latter would be especially valuable to combine with modelled affordance of space for goats in order to investigate herding practices and herd size. It would also be useful to be able to include information on animal management strategies and human diet from isotope studies as this would allow us to more accurately reconstruct various economic strategies. Analyses of isotope signatures in human and animal bones and teeth have been used to investigate aspects of herding and foddering practices (e.g. Bocherens et al 2001; Henton, Meier-Augenstein and Kemp 2010; Makarewicz 2007; Mashkour, Bocherens and Moussa 2005; Pearson et al 2007), and human diet and patterns of residency and mobility (e.g. Montgomery, Budd and Evans 2000; Richards and Pearson 2005; Schoeninger 1981). Including such information would provide a more informed basis on which to model storage capacities (e.g. whether to include fodder) and animal presence within settlements, as well as provide information on possible seasonal patterns of movement within the wider landscape.

One way of expanding on the scenario modelling employed in this thesis is to include three-dimensional modelling of space (using CAD or other 3D modelling software). Modelling in three dimensions would allow an examination of the sensory aspects of built environments (e.g. vision, light, wind and so on) and how such factors may have affected not only the utilisation of built space, but also the sensuous experiences associated with living within and moving through these built environments (though this is not the place to engage in a lengthy discussion of the pros and cons of phenomenological approaches). Constructing three-dimensional models would allow a more detailed and visually explicit consideration of, for example, light levels within internal spaces (an issue briefly discussed in connection with the smaller internal spaces at Jarmo and Ganj Dareh); the extent to which buildings, courtyards and other external features may have provided shade and/or shelter from the sun, wind and other environmental factors, and in that way created possible locations for a range of activities; and how architecture and other features (e.g. walls) may have impacted the sensuous experiences of moving through the built environment. It would permit an exploration of how spatial organisation within the settlements affected movement between various external areas (including courtyards, alleyways, roofs, and specific activity areas), the scale of interactions, and degrees of privacy afforded by different spaces, as well as potential uses of roof spaces. Three-dimensional modelling may also be used as a tool to explore building interiors and help us think about how ceiling heights, spatial extent of internal features, the location of entrances, portholes and windows, and so on may have affected the sensuous experiences of moving, interacting and living within them. The level D structure at Ganj Dareh (which is preserved up to a height of 2 m) would be particularly interesting in this regard as it would add a new perspective and may help shed some light on aspects of movement and interaction which are unclear from the scenario modelling. In many cases architectural remains are (unfortunately) not preserved to a height (or extent) that allows for an accurate reconstruction of the upper parts of buildings, including roof, placements of windows, portholes or raised entrances, though it may still be possible to reconstruct different three-dimensional models that explore a range of *potential* scenarios.

This study, although detailed, only presents the investigation of seven sites covering a 3,000-4,000 year period and a large geographical area. Even if the discussion in this thesis is limited to a few case studies that are temporally and spatially separate – although admittedly so are the Levantine sites on which most models of social organisation are based – it presents a step towards a broader understanding of the social strategies employed in the area during the Neolithic. As "[t]he modelling process is [...] a very simple, and widely applicable, way to explore potentialities of spaces without having to resort to applying ethnographically derived patterning" (Hemsley 2008: 335) this methodology can easily be applied to other sites. Applying this approach to more sites within the Zagros uplands and adjacent lowlands would allow for a more detailed comparison of the structuring and use of space within broadly contemporary settlements. This would facilitate a more in-depth understanding of potential similarities and differences in built environments and social practices between upland and lowland communities.

The variability in social practices observed at broadly contemporary sites in these two areas, such as Nemrik and Ganj Dareh, is something that would be worthwhile exploring further. It would also be interesting to investigate the affordance of space and spatial patterning of activities within built environments at Late Epipalaeolithic-Early Neolithic sites that are thought to be more ephemeral camp sites, e.g. Zawi Chemi, Asiab and Sarab. This would allow us to gain insights into the ways in which the use of space was structured in smaller, perhaps more mobile communities and help us explore the range of social and economic strategies that existed within the Zagros. Extending the visualisation modelling to other sites within the Zagros and adjacent regions would allow us to compare the structuring and use of space within settlements in different areas. This would allow us to explore possible temporal trends within and between regions and, ultimately, gain a more situated understanding of social practices within Neolithic communities in the Zagros Mountains and adjacent lowlands.

Appendix A

Figure 2.2: Neolithic sites mentioned in the text.

Figure 2.3: Palaeolithic and Epipalaeolithic sites mentioned in the text.

City	Altitude		Jan	Feb	Mar	Apr	May	Jun
Urmia, NW Iran	1,332 m a.s.l	Max	2.6	4.8	10.4	16.8	22.2	27.5
		Min	-6.1	-4.8	-0.1	5.2	9.1	12.9
Tabriz, NW Iran	1,351 m a.s.l.	Max	1.2	3.8	10.1	16.5	22.5	28.6
		Min	-6.6	-4.5	0.3	5.7	10.6	15.2
Hamedan, W Iran	1,850 m a.s.l.	Max	2	4.3	11.5	18.1	23.8	30.9
		Min	-10.5	-8.2	-2.1	2.7	6.4	9.8
Kermanshah, W Iran	1,322 m a.s.l	Max	6.5	8.9	14.3	19.7	25.8	33.3
		Min	-4.2	-2.8	1.2	5.1	8.3	11.4
Sulaymaniyah, NE Iraq	882 m a.s.l.	Max	7.9	10.3	15.4	20.8	28.3	35.1
		Min	-0.2	1.1	5.1	9.7	14.5	20.3
Kirkuk, NE Iraq	354 m a.s.l.	Max	13.8	15.7	20.1	26.3	33.7	39.8
		Min	4.5	5.7	9	13.8	19.6	24.5
Mosul, NE Iraq	260 m a.s.l.	Max	12.4	14.8	19.3	25.2	32.7	39.2
		Min	2.2	3.4	6.8	11.2	16.2	21.3
Dezful, SW Iran	143 m a.s.l.	Max	17.2	19.6	24.1	30	37.5	43.7
		Min	5.3	6.8	10	14.7	20.5	23.8
Ahwaz, SW Iran	17 m a.s.l.	Max	17.3	20.3	25.3	31.8	39	44.3
		Min	6.5	8.2	11.8	16.7	22.2	25.1

*****Climatological information is based on monthly averages for the 30-year period 1961-1990.
** Climatological information is based on monthly averages for the 33-year period 1976-2008.

Figure 2.1:
Mean annual temperatures (°C) recorded for a selection of cities in the Zagros Mountains and adjacent lowlands.

(Sources: http://worldweather.wmo.int/ [accessed 18/10/2012]; http://www.hko.gov.hk/wxinfo/climat/world/eng/asia/westasia/dezful_e.htm [accessed 18/10/2012]; http://www.worldweatheronline.com/Sulaymaniyah-weather-averages/As-Sulaymaniyah/IQ.aspx [accessed 18/10/2012]).

City	Altitude		Jul	Aug	Sept	Oct	Nov	Dec
Urmia, NW Iran	1,332 m a.s.l	Max	31.2	31	27.1	20.1	12.2	5.7
		Min	16.6	15.9	11.5	6.6	1.4	-3.2
Tabriz, NW Iran	1,351 m a.s.l.	Max	32.9	32.3	28.2	19.9	12.1	4.9
		Min	19.6	19	14.3	8	2.1	-3
Hamedan, W Iran	1,850 m a.s.l.	Max	34.9	34.2	29.7	21.9	13.7	5.9
		Min	13.9	12.8	7	2.5	-2.1	-6.6
Kermanshah, W Iran	1,322 m a.s.l	Max	37.8	37	32.5	25	16.7	9.7
		Min	16.1	15.4	10.6	6.4	1.8	-1.6
Sulaymaniyah, NE Iraq	882 m a.s.l.	Max	38.7	38.9	34.7	28.1	18.7	11.1
		Min	23.8	24.1	19.1	14	7.6	2.3
Kirkuk, NE Iraq	354 m a.s.l.	Max	43.2	42.8	38.7	31.4	22.6	15.8
		Min	27.5	27.1	23.2	18.1	11.2	6.3
Mosul, NE Iraq	260 m a.s.l.	Max	42.9	42.6	38.1	30.6	21.1	14.1
		Min	25	24.2	19.1	13.5	7.2	3.8
Dezful, SW Iran	143 m a.s.l.	Max	46	44.9	41.7	34.8	26.2	19.3
		Min	26.2	25.5	21.1	16.2	10.8	6.8
Ahwaz, SW Iran	17 m a.s.l.	Max	46.2	45.3	42.5	35.6	26.5	19.4
		Min	27.3	26.5	22.6	17.9	12.3	7.7

*****Climatological information is based on monthly averages for the 30-year period 1961-1990.
** Climatological information is based on monthly averages for the 33-year period 1976-2008.

Figure 2.1 (continued):
Mean annual temperatures (°C) recorded for a selection of cities in the Zagros Mountains and adjacent lowlands.

(Sources: http://worldweather.wmo.int/ [accessed 18/10/2012]; http://www.hko.gov.hk/wxinfo/climat/world/eng/asia/westasia/dezful_e.htm [accessed 18/10/2012]; http://www.worldweatheronline.com/Sulaymaniyah-weather-averages/As-Sulaymaniyah/IQ.aspx [accessed 18/10/2012]).

City	Altitude	Jan	Feb	Mar	Apr	May	Jun
Urmia, NW Iran	1,332 m a.s.l	30.2	33.2	52.3	62.0	45.6	14.2
Tabriz, NW Iran	1,351 m a.s.l.	25.8	25.3	47.0	53.6	41.9	18.1
Hamedan, W Iran	1,850 m a.s.l.	46.3	43.6	49.4	49.8	37.8	3.7
Kermanshah, W Iran	1,322 m a.s.l	67.1	62.9	88.9	69.9	33.7	0.5
Kirkuk, NE Iraq	354 m a.s.l.	68.3	66.7	57.3	44.1	13.4	0.1
Mosul, NE Iraq	260 m a.s.l.	62.1	62.7	63.2	44.1	15.2	1.1
Ahwaz, SW Iran	17 m a.s.l.	52.8	32.1	27.3	15.7	6.7	0.6
*Climatological information is based on monthly averages for the 30-year period 1961-1990. ** Climatological information is based on monthly averages for the 33-year period 1976-2008.							

Figure 2.2:
Mean annual precipitation (mm) recorded for a selection of cities in the Zagros Mountains and adjacent lowlands.
Includes rain and snow.

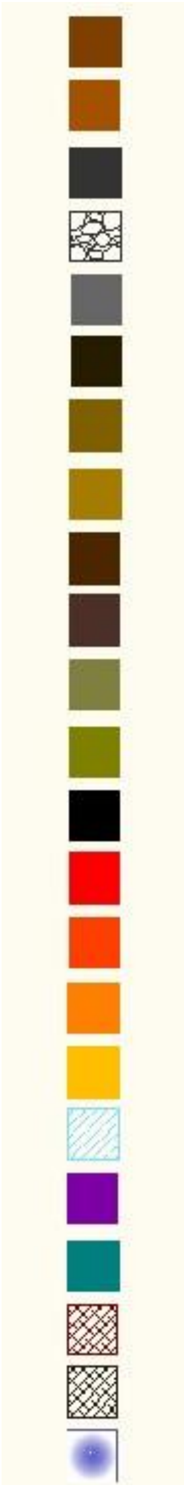
(Sources: http://worldweather.wmo.int/ [accessed 18/10/2012];
http://www.hko.gov.hk/wxinfo/climat/world/eng/asia/westasia/dezful_e.htm [accessed 18/10/2012];
http://www.worldweatheronline.com/Sulaymaniyah-weather-averages/As-Sulaymaniyah/IQ.aspx [accessed 18/10/2012])

City	Altitude	Jul	Aug	Sept	Oct	Nov	Dec
Urmia, NW Iran	1,332 m a.s.l	5.5	2.1	4.4	21.8	40.0	29.7
Tabriz, NW Iran	1,351 m a.s.l.	3.2	4.4	9.4	28.4	28.0	26.0
Hamedan, W Iran	1,850 m a.s.l.	2.0	1.8	0.8	20.7	26.9	40.9
Kermanshah, W Iran	1,322 m a.s.l	0.3	0.3	1.3	29.2	54.3	70.3
Kirkuk, NE Iraq	354 m a.s.l.	0.2	0.0	0.7	12.4	39.1	59.0
Mosul, NE Iraq	260 m a.s.l.	0.2	0.0	0.3	11.8	45.0	57.9
Ahwaz, SW Iran	17 m a.s.l.	0.1	0.0	0.1	8.3	31.9	52.9
*Climatological information is based on monthly averages for the 30-year period 1961-1990. ** Climatological information is based on monthly averages for the 33-year period 1976-2008.							

Figure 2.2 (continued):
Mean annual precipitation (mm) recorded for a selection of cities in the Zagros Mountains and adjacent lowlands.
Includes rain and snow.

(Sources: http://worldweather.wmo.int/ [accessed 18/10/2012];
http://www.hko.gov.hk/wxinfo/climat/world/eng/asia/westasia/dezful_e.htm [accessed 18/10/2012];
http://www.worldweatheronline.com/Sulaymaniyah-weather-averages/As-Sulaymaniyah/IQ.aspx [accessed 18/10/2012])

Appendix B



Wall

Possible wall

Stone wall

Pebble pavement

Ground stone

Marl pillar or *tauf/chineh* blocks

Platform

Bench or low clay curb

Clay lumps or post socket

Bin or clay burial cist

Clay rim

Clay vessel

Entranceway or port hole

Hearth

Oven

Burnt pit or trench

Location of temporary hearths or possible fire installation

Plaster

Location of sub-floor burial

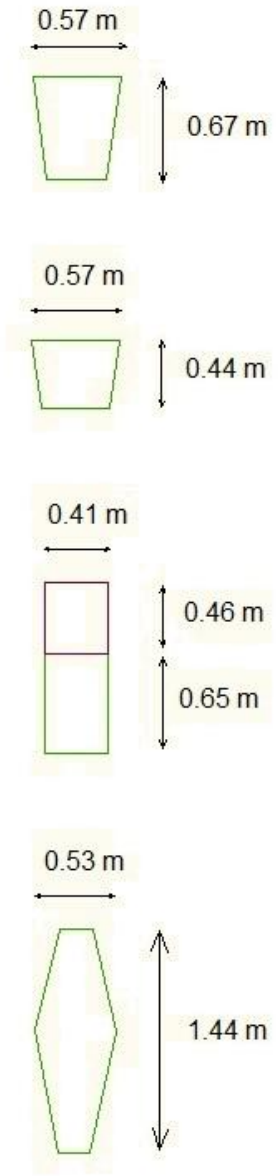
Sheep or goat skull installation

Refuse deposit

Pit

Flint scatter

Figure 3.2: Conventions used in the modelling.



Sitting

Squatting

Kneeling (large rectangle) with forward reach (small rectangle)

Sleeping (lying on the side in a slightly crouched position)

Figure 3.3: Polygons and measurements for the Size A adult.

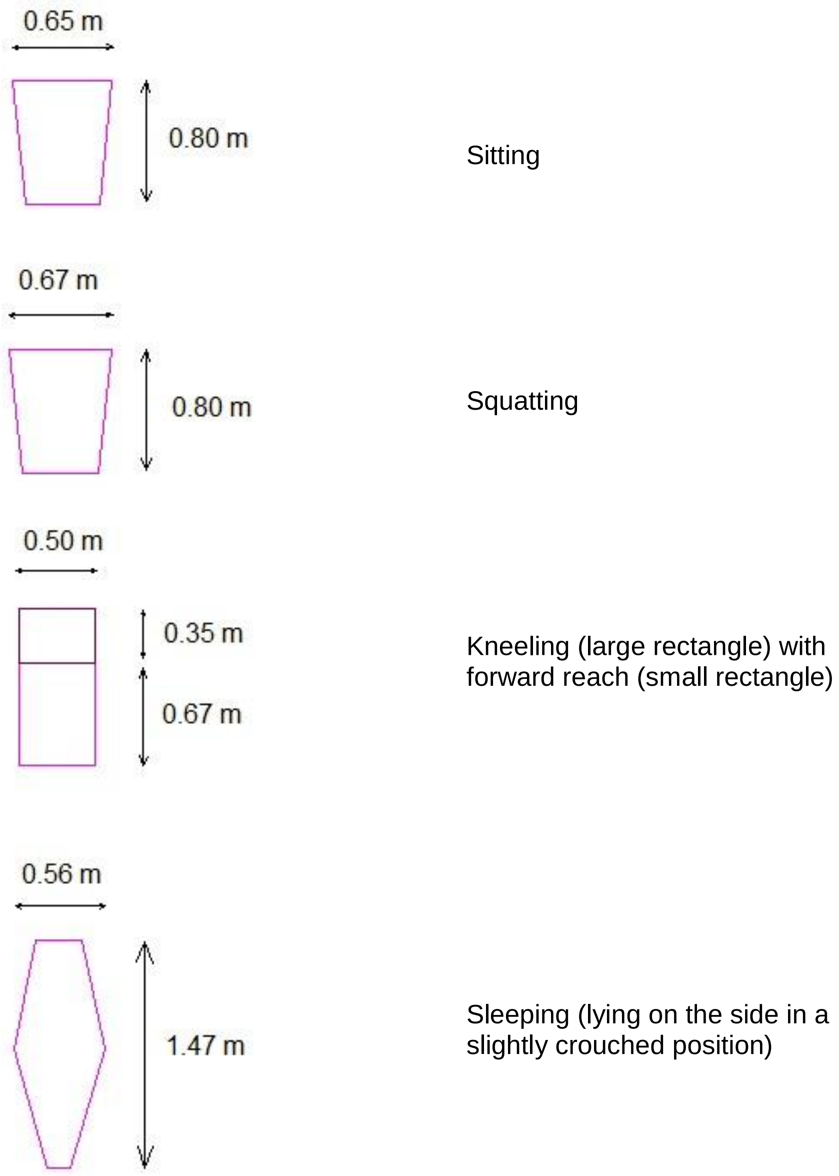


Figure 3.4: Polygons and measurements for the Size B adult.

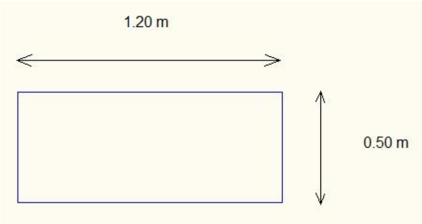
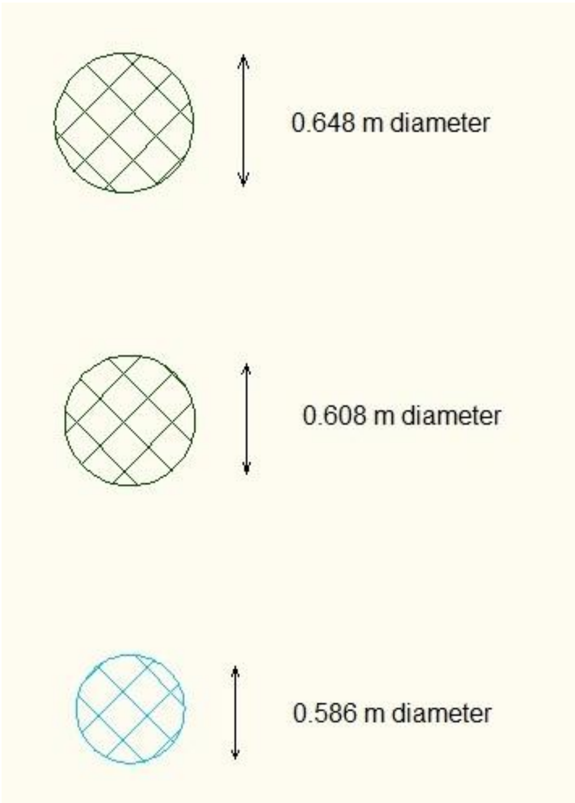


Figure 3.5: Polygon and measurements for the modelled goat.



0.33 m^2 storage container for grain

0.29 m^2 storage container for legumes

0.27 m^2 storage container for fodder

Figure 3.6: Polygons and measurements for storage containers.

Bibliography

Abdi, K. 2001. Nationalism, Politics, and the Development of Archaeology in Iran. *American Journal of Archaeology* 105, pp 51-76

Abdi, K. 2002. *Strategies of Herding: Pastoralism in the Middle Chalcolithic Period of the West Central Zagros Mountains.* Unpublished PhD thesis, University of Michigan

Abdi, K. 2003. The Early Development of Pastoralism in the Central Zagros Mountains. *Journal of World Prehistory* 17 (4), pp 395-447

Adovasio, J. M. 1975. The Textile and Basketry Impressions from Jarmo. *Paléorient* 3, pp 223-230

Adovasio, J. M. 1983. Notes on the Textile and Basketry Impressions from Jarmo. In: L. S. Braidwood, R. J. Braidwood, B. Howe, C. A. Reed, and P. J. Watson (eds) *Prehistoric Archaeology Along the Zagros Flanks.* Chicago: The Oriental Institute of the University of Chicago, pp 425-426

Agelarakis, A. 1989. *The Paleopathological Evidence, Indicators of Stress, of the Shanidar Proto-Neolithic and the Ganj Dareh early Neolithic Human Skeletal Collections.* Unpublished PhD thesis, Columbia University

Alcock, D. and Bell, A. for NSW Department of Primary Industries. 2007. *Full Hand Feeding of Sheep – Quantities.* [online] Available from: http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0016/104641/full-hand-feeding-of-sheep-quantities.pdf [Accessed on 08/03/2012]

Allison, P.M. 1999. Introduction. In: P. M. Allison (ed) 1999. *The Archaeology of Household Activities.* London and New York: Routledge, pp 1-18

Asouti, E. 2006. Beyond the Pre-Pottery Neolithic B Interaction Sphere. *Journal of World Prehistory* 20, pp 87-126

Aurenche, O., Galet, P., Régagnon-Caroline, E. and Evin, J. 2001. Proto-Neolithic and Neolithic Cultures in the Middle East – The Birth of Agriculture, Livestock Raising, and Ceramics: A Calibrated 14C Chronology 12,500-5,500 cal BC. *Radiocarbon* 43 (3), pp 1191-1202

Azarnoush, M. and Helwing, B. 2005. Recent Archaeological Work in Iran – Prehistory to Iron Age. *Archäologische Mitteilungen aus Iran und Turan* 37, pp 189-246

Bader, N. O. 1993a. Tell Maghzaliyah: An Early Neolithic Site in Northern Iraq. In: N. Yoffee and J. J. Clark (eds) *Early Stages in the Evolution of Mesopotamian Civilization. Soviet Excavations in Northern Iraq.* Tucson and London: The University of Arizona Press, pp 7-40

Bader, N. O. 1993b. Summary of the Earliest Agriculturalists of Northern Mesopotamia (1989). In: N. Yoffee and J. J. Clark (eds) *Early Stages in the Evolution of Mesopotamian Civilization. Soviet Excavations in Northern Iraq.* Tucson and London: The University of Arizona Press, pp 63-71

Bagnall, R. S. and Frier, B. W. 1994. *The Demography of Roman Egypt.* Cambridge: Cambridge University Press

Bailey, D. 2005. Beyond the Meaning of Neolithic Houses: Specific Objects and Serial Repetition. In: D. Bailey, A. Whittle and V. Cummings (eds) *(Un)settling the Neolithic.* Oxford: Oxbow Books, pp 90-97

Bailey, D. and Whittle, A. 2005. Unsettling the Neolithic: Breaking down Concepts, Boundaries and Origins. In: D. Bailey, A. Whittle and V. Cummings (eds) *(Un)settling the Neolithic.* Oxford: Oxbow Books, pp 1-7

Bailey, D. Whittle, A. and Cummings, V. (eds) 2005. *(Un)settling the Neolithic.* Oxford: Oxbow Books

Baird, D. 2012. The Boncuklu Project: Investigating the Beginnings of Agriculture, Sedentism and Herding in Central Anatolia. *Anatolian Studies* 16, pp 11-12

Baird, D. 2012. The Boncuklu Project: the spread of Farming and the Antecedents of Çatalhöyük. *Heritage Turkey* 2, pp 16-18

Baird, D., Bar-Yosef, O., Baysal, A. and Fairbairn, A. 2011. The First Farmers of Central Anatolia: the Boncuklu Project. *Heritage Turkey* 1, pp 15-16

Baker, L. W. and Hoffman, M. T. 2006. Managing Variability: Herding Strategies in Communal Rangelands of Semiarid Namaqualand, South Africa. *Human Ecology* 34, pp 765-784

Baker, P. T. and Sanders, W. T. 1972. Demographic Studies in Anthropology. *Annual Review of Anthropology* 1, pp 151-178

Banning, E. B. 1996. Houses, Compounds and Mansions in the Prehistoric Near East. In: G. Coupland and E. B. Banning (eds) *People Who Lived in Big Houses: Archaeological Perspectives on Large Domestic Structures.* Madison: Prehistory Press, pp 165-185

Banning, E. B. 2003. Housing Neolithic Farmers. *Near Eastern Archaeology* 66, pp 4-21

Banning, E. B. 2011. So Fair a House: Göbekli Tepe and the Identification of Temples in the Pre-Pottery Neolithic in the Near East. *Current Anthropology* 52 (5), pp 619-660

Banning, E. B. and Byrd, B. F. 1988. Southern Levantine Pier Houses: Intersite Architectural Patterning during the Pre-Pottery Neolithic B. *Paléorient* 14 (1), pp 65-72

Bar-Yosef, O. 1989a. The Natufian Culture in the Levant, Threshold to the Origins of Agriculture. *Evolutionary Anthropology* 6, pp 159-177

Bar-Yosef, O. 2001a. From Sedentary Foragers to Village Hierarchies: The Emergence of Social Institutions. In: W. G. Runciman (ed) *The Origin of Human Social Institutions.* Oxford: Oxford University Press, pp 1-38

Bar-Yosef, O. and Meadow, R. H. 1995. The Origins of Agriculture in the Near East. In: T. D. Price and A. B. Gebauer (eds) *Last Hunters – First Farmers. New Perspectives on the Prehistoric Transition to Agriculture.* Santa Fe: School of American Research Press, pp 39-94

Barth, F. 1961. *Nomads of South Persia. The Basseri Tribe of the Khamseh Confederacy.* Boston: Little, Brown and Company

Bates, D. G. 1972. Differential Access to Pasture in a Nomadic Society: The Yöruk of Southeastern Turkey. *Journal of Asian and African Studies* 7, pp 48-59

Beck, L. 1980. Herd Owners and Hired Shepherds: The Qashqa'i of Iran. *Ethnology* 19 (3), pp 327-351

van Beek, G. W. 2008. *Glorious Mud! Ancient and Contemporary Earthen Design and Construction in North Africa, Western Europe, the Near East, and Southwest Asia.* Washington D. C.: Smithsonian Institution Scholarly Press

Belfer-Cohen, A. and Bar-Yosef, O. 2000. Early Sedentism in the Near East: A Bumpy Ride to Village Life. In: I. Kuijt (ed) *Life in Neolithic Farming Communities. Social Organisation, Identity, and Differentiation.* New York: Kluwer Academic Press, pp 19-37

Belfer-Cohen, A. and Goring-Morris, N. 2002. Recent Developments in Near Eastern Neolithic Research. *Paleorient* 28 (2), pp 143-148

Bender, B. 1978. Gatherer-Hunter to Farmer: A Social Perspective. *World Archaeology* 10 (2), pp 204-222

Bernbeck, R. 1992. Migratory Patterns in Early Nomadism: A Reconsideration of Tepe Tula'i. *Paléorient* 18 (1), pp 77-88

Bernbeck, R. 2001. Forschungsperspektiven für das Iranische Neolithikum. *Archäologische Mitteilungen aus Iran und Turan* 33, pp 1-18

Bernbeck, R. 2003. Review of 'Formation Processes of the First Developed Societies in the Zagros and the Northern Mesopotamian Plain' by Francesca Balossi Restelli. *Journal of the American Oriental Society* 123 (3), pp 672-673

Bhattacharya, S., Narasimha, H. V. and Bhattacharya, S. 2005. The Moisture Dependent Physical and Mechanical Properties of Whole Lentil Pulse and Split Cotyledon. *International Journal of Food Science and Technology* 40, pp 213-221

Birkeland, J. 2002. *Design for Sustainability, A Sourcebook of Integrated Eco-Logical Solutions*. London: Earthscan Publications Ltd

Blanton, R. E. 1994. *Houses and Households: a Comparative Study.* New York and London: Plenum Press

Bocheński, Z. and Nogalski, S. 1994. Preliminary Identification of the Early Holocene Bird Remains from Nemrik, Iraq, and Their Environmental Implications. In: A. Lasota-Moskalewska (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq. Volume 4: Animal Remains.* Warsaw: Wydawnictwa Uniwersytetu Warszawskiego, pp 53-63

Bocherens, H., Mashkour, M., Billiou, D., Pelle, E. and Mariotti, A. 2001. A New Approach for Studying Prehistorical Herd Management in Arid Areas: Intra-Tooth Isotopic Analyses of Archaeological Caprine from Iran. *Comptes Rendus de l'Académie des Sciences-Series IIA-Earth and Planetary Science* 332 (1), pp 67-74

Bogaard, A., Charles, M., Twiss, K. C., Fairbairn, A., Yalman, N., Filipović, D., Demirergi, G. A., Ertuğ, F., Russell, N. and Henecke, J. 2009. Private Pantries and Sharing Food at Neolithic Çatalhöyük, Central Anatolia. *Antiquity* 83 (321), pp 449-668

Borgerhoff Mulder, M., Fazzio, I., Irons, W., McElreath, R. L., Bowles, S., Bell, A., Hertz, T. and Hazzah, L. 2010. Pastoralism and Wealth Inequality. Revisiting an Old Question. *Current Anthropology* 51 (1), pp 35-48

Borkowski, W. 1992. Graves. In: S. K. Kozłowski (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq. Vol. 2: House No 1/1A/1B.* Warsaw: Wydawnictwa Uniwersytetu, pp 35-42

Bottema, S. 1986. A late Quaternary Pollen Diagram from lLake Urmia (Northwestern Iran). *Review of Palaeobotany and Palynology* 47, pp 241-261

Braidwood, L. S., Braidwood, R. J., Howe, B., Reed, C. A. and Watson, P. J. (eds) 1983a. *Prehistoric Archaeology along the Zagros Flanks.* Chicago: The Oriental Institute of the University of Chicago

Braidwood, R. J. 1954. From Cave to Village in Iraq. *Agricultural History* 28, pp 41-43

Braidwood, R. J. 1958. Near Eastern Prehistory. The Swing from Food-Collecting Cultures to Village-Farming Communities is Still Imperfectly Understood. *Science* 127, pp 1419-1430

Braidwood, R. J. 1960. Seeking the World's First Farmers in Persian Kurdistan: a Full-Scale Investigation of Prehistoric Sites Near Kermanshah. *The Illustrated London News* October 22, pp 695-697

Braidwood, R. J. 1961. The Iranian Prehistoric Project 1959-1960. *Iranica Antiqua* 1, pp 3-7

Braidwood, R. J. 1972. Prehistoric Investigations in Southwestern Asia. *Proceedings of the American Philosophical Society* 116, pp 310-320

Braidwood, R. J. 1973. Greetings. *Paléorient* 1, pp 7-10

Braidwood, R. J. 1983a. The Site of Jarmo and Its Architectural Remains. In: L. S. Braidwood, R. J. Braidwood, B. Howe, C. A. Reed, and P. J. Watson (eds) *Prehistoric Archaeology Along the Zagros Flanks.* Chicago: The Oriental Institute of the University of Chicago, pp 155-207

Braidwood, R. J. 1983b. The Jarmo Dead. In: L. S. Braidwood, R. J. Braidwood, B. Howe, C. A. Reed, and P. J. Watson (eds) *Prehistoric Archaeology Along the Zagros Flanks.* Chicago: The Oriental Institute of the University of Chicago, pp 427-429

Braidwood, R. J. and Braidwood, L. S. 1950. Jarmo: A Village of Early Farmers in Iraq. *Antiquity* 24, pp 189-195

Braidwood, R. J. and Braidwood, L. S. 1960 *Excavations in the Plain of Antioch I. The Earlier Assemblages, Phases A-J.* Chicago: The University of Chicago Press

Braidwood, R. J. and Howe, B. 1960. *Prehistoric Investigations in Iraqi Kurdistan.* Chicago: The University of Chicago Press

Braidwood, R. J. and Howe, B. 1962. Southwestern Asia beyond the Lands of the Mediterranean Littoral. In: R. J. Braidwood and G. R. Willey (eds) *Courses toward Urban Life.* Edinburgh: Edinburgh University Press, pp 132-146

Braidwood, R. J., Howe, B. and Reed, C. A. 1961. The Iranian Prehistoric Project. *Science* 133, pp 2008-2010

Broman Morales, V. 1983. Jarmo Figurines and Other Clay Objects. In: L. S. Braidwood, R. J. Braidwood, B. Howe, C. A. Reed, and P. J. Watson (eds) *Prehistoric Archaeology Along the Zagros Flanks.* Chicago: The Oriental Institute of the University of Chicago, pp 369-423

Broman Morales, V. 1990. *Figurines and Other Clay Objects from Sarab and Çayönü.* Chicago: The Oriental Institute of the University of Chicago

Brück, J. 1999. Ritual and Rationality: Some Problems of Interpretation in European Archaeology. *European Journal of Archaeology* 2 (3), pp 313-344

Burch, T. K. 1972. Some Demographic Determinants of Average Household Size: An Analytical Approach. In: P. Laslett (ed) *Household and Family in Past Times.* Cambridge: Cambridge University Press, pp 91-102

Byrd, B. F. 1994. Public and Private, Domestic and Corporate: the Emergence of the South West Asian Village. *American Antiquity* 59 (4), pp 639-666

Byrd, B. F. 2000. Households in Transition. Neolithic Social Organisation within Southwest Asia. In: I. Kuijt (ed) *Life in Neolithic Farming Communities. Social Organisation, Identity, and Differentiation.* New York: Kluwer Academic Press, pp 63-98

Byrd, B. F. 2005a. Reassessing the Emergence of Village Life in the Near East. *Journal of Archaeological Research* 13 (3), pp 231-290

Byrd, B. F. 2005b. *Early Village Life at Beidha, Jordan: Neolithic Spatial Organization and Vernacular Architecture.* Oxford: Oxford University Press

Byrd, B. F. and Monahan, C. M. 1995. Death, Mortuary Ritual, and Natufian Social Structure. *Journal of Anthropological Archaeology* 14, pp 251-287

Cappers, R. T. J. and Bottema, S. (eds) 2002. *The Dawn of Farming in the Near East.* Berlin: Ex Oriente

Casselberry, S. E. 1974. Further Refinement of Formulae for Determining Population from Floor Area. *World Archaeology* 6 (1), pp 117-122

Cessford, C. 1998. The Excavation of the North Area 1998. *Çatalhöyük 1998 Archive Report.* http://www.catalhoyuk.com/archive_reports/1998/ar98_03.html

Chamberlain, A. T. 2006. *Demography in Archaeology.* Cambridge: Cambridge University Press

Chang, K.-C. 1958. Study of the Neolithic Social Grouping: Examples from the New World. *American Anthropologist* 60, pp 298-334

Charles, M. 1998. Fodder from Dung: the Recognition and Interpretation of Dung-Derived Plant Material from Archaeological Sites. *Environmental Archaeology* 1, pp 111-122

Charles, M. and Bogaard, A. 2005. Identifying Livestock Diet from Charred Plant Remains. In: J. Davies, M. Fabiš, I. Mainland, M. Richards and R. Thomas (eds) *Diet and Health in Past Animal Populations. Current Research and Future Directions.* Oxford: Oxbow Books, pp 93-103

Childe, G. V. 1941. *Man Makes Himself.* London: Watts & Co

Clark, C. and Haswell, M. 1967. *The Economics of Subsistence Agriculture.* London: Macmillian

Clutton-Brock, J. and Grigson, C. (eds) 1984. *Animals and Archaeology: 3. Early herders and Their Flocks.* Oxford: B. A. R. International Series 202

Cole, G. 2009. Archaeozoology. In: *Excavations at Tappeh Sheikh-e Abad and Tappeh Jani, Kermanshah Province. CZAP 2008 Season Report.* Unpublished Archive Report, pp 138-178

Colledge, S. 2002. Identifying Pre-Domestication Cultivation in the Archaeobotanical Record Using Multivariate Analysis: Presenting the Case for Quantification. In: R. T. J. Cappers and S. Bottema (eds) *The Dawn of Farming in the Near East.* Berlin: Ex Oriente, pp 141-152

Conolly, J., Colledge, S., Dobney, K., Vigne, J.-D., Peters, J., Stopp, B., Maning, K. and Shennan, S. 2011. Meta-Analysis of Zooarchaeological Data from SW Asia and SE Europe Provides Insight into the Origins and Spread of Animal Husbandry. *Journal of Archaeological Science* 38, pp 538-545

Cribb, R. 1991. *Nomads in Archaeology.* Cambridge: Cambridge University Press

Cunningham, P. 2011. Caching Your Savings: The Use of Small-Scale Storage in European Prehistory. *Journal of Anthropological Archaeology* 30, pp 135-144

Cutting, M. 2003. The Use of Spatial Analysis to Study Prehistoric Settlement Architecture. *Oxford Journal of Archaeology* 22 (1), pp 1-21

Cutting, M. 2005. *The Neolithic and Early Chalcolithic Farmers of Central and Southwestern Anatolia. Houshold, Community and the Changing Uses of Space.* Oxford: B.A.R. International Series 1435

Cutting, M. 2006. More than One Way to Study a Building: Approaches to Prehistoric Households and Settlement Space. *Oxford Journal of Archaeology* 25 (3), pp 225-246

Darabi, H. and Fazeli, H. 2009. The Neolithic of the Mehran Plain: An Introduction. *Antiquity* 83 (322) [online project gallery] Available from: http://www.antiquity.ac.uk/projgall/darabi322/ [Accessed on 10/09/2010]

Daszewski, W. A. 1990. Preface. In: S. K. Kozłowski (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq.(General Report – Seasons 1985-1986).* Warsaw: Wydawnictwa Uniwersytetu Warszawskiego, pp 5-6

DeBoer, W. 1985. Comments. *Current Anthropology* 26 (5), pp 591-592

Djamali, M., de Beaulieu, J.-L., Shah-Hosseini, M., Andrieu-Ponel, V., Ponel, P., Amini, A., Akhani, H., Leroy, S. A. G., Stevens, L., Lahijani, H. and Brewer, S. 2008. A Late Pleistocene Long Pollen Record from Lake Urmia, NW Iran. *Quaternary Research* 69, pp 413-420

Düring, B. S. 2001. Social Dimensions in the Architecture of Neolithic Çatalhöyük. *Anatolian Studies* 51, pp 1-18

Düring, B. S. 2006. *Constructing Communities. Clustered Neighbourhood Settlements of the Central Anatolian Neolithic, ca. 8500-5500 cal BC.* Istanbul: Nederlands Historisch-Archaeologisch Instituut

Düring, B. S. and Marciniak, A. 2006. Households and Communities in the Central Anatolian Neolithic. *Archaeological Dialogues* 12 (2), pp 165-187

Dyson, Jr., R. H. 1965. Problems in the Relative Chronology of Iran, 6000-2000 B.C. in: R. W. Ehrich (ed) *Chronologies in Old World Archaeology.* Chicago and London: The University of Chicago Press, pp 215-256

Dyson, Jr, R. H. 1983. Introduction. The Genesis of the Hasanlu Project. In: M. M. Voigt *Hajji Firuz Tepe, Iran: The Neolithic Settlement.* Philadelphia: The University Museum, University of Pennsylvania, pp xxv-xxviii

Dyson, Jr. R. H., Muscarella, O. W. and Voigt. M. M. 1969. Hasanlu Project 1968: Hajji Firuz, Dinkha Tepe, Se Girdan, Qalatgah. *Iran* 7, pp 179-81

Easton, D. 2005. Rammed Earth. In: E. Lynne and C. Adams (eds) *Alternative Construction. Contemporary Natural Building Methods.* New York: John Wiley & Sons, pp 151-173

Eiteljorg II, H., Fernie, K., Huggett, J. and Robinson, D. 2003. *CAD: A Guide to Good Practice.* Oxford: Oxbow Books

FAO. 2001. *Human Energy Requirements. Report of a Joint FAO/WHO/UNU Expert Consultation.* FAO Food and Nutrition Technical Report Series 1 [online] Available from: http://www.fao.org/docrep/007/y5686e/y5686e00.htm#Contents [Accessed on 10/10/2011]

Finlayson, B., Mithern, S., al-Najjar, M., Jenkins, E. and Smith, S. 2009. New Excavations at WF16, a Pre-Pottery Neolithic A site in Southern Jordan. *Antiquity* 83 (319) [online project gallery] Available from: http://www.antiquity.ac.uk/projgall/finlayson319/ [Accessed on 20/10/2012]

Finlayson, B., Mithern, S., al-Najjar, M., Smith, S. and Jenkins, E. 2008. New Excavations at the Pre-Pottery Neolithic Site of Wadi Faynan 16. *Bulletin of the Council for British Research in the Levant* 3, pp 60-61

Finlayson, B., Mithern, S., al-Najjar, M., Smith, S. and Jenkins, E. 2009. Excavations at Wadi Faynan 16, a Pre-Pottery Neolithic Site A in Southern Jordan. *Bulletin of the Council for British Research in the Levant* 4, pp 50-51

Finlayson, B., Mithern, S., al-Najjar, M., Smith, S. Maričević, D., Pankhurst, N. and Yeomans, L. 2011. Architecture, Sedentism, and Social Complexity at Pre-Pottery Neolithic A WF16, Southern Jordan. *PNAS* 108 (20), pp 8183-8188

Fitzjohn, M. 2007. Searching for the Domestic: Investigations of the Built Environment in Iron Age and Archaic Sicily. In: R. Westgate, N. Fisher and J. Whitley (eds) *Building Communities: House, Settlement and Society in the Aegean and Beyond. Proceedings of a Conference Held at Cardiff University, 17-21 April 2001.* London: The British School at Athens, pp 201-204

Flannery, K. V. 1969. Origins and Ecological Effects of Early Domestication in Iran and the Near East. In: P. J. Ucko and G. W. Dimbleby (eds) *The Domestication and Exploitation of Plants and Animals.* London: Gerald Duckworth & Co, pp 73-100

Flannery, K. V. 1972. The Origins of the Village as a Settlement Type in Mesoamerica and the Near East: A Comparative Study. In: P. J. Ucko, R. Tringham and G. W. Dimbleby (eds) *Man, Settlement and Urbanism.* London: Duckworth, pp 23-53

Flannery, K. V. 1983. Early Pig Domestication in the Fertile Crescent. A Retrospective Look. In: T. C. Young, P. E. L. Smith and P. Mortensen (eds) *The Hilly Flanks and Beyond. Essays on the Prehistory of Southwestern Asia Presented to Robert J. Braidwood, November 15, 1982.* Chicago: The Oriental Institute of the University of Chicago, pp 163-188

Flannery, K. V. 1993. Will the Real Model Please Stand Up: Comment of Saidel's 'Round House or Square'. *Journal of Mediterranean Archaeology* 6 (1), pp 109-117

Flannery, K. V. 2002. The Origins of the Village Revisited: From Nuclear to Extended Households. *American Antiquity* 67, pp 417-433

Fletcher, R. 1985. Comments. *Current Anthropology* 26 (5), pp 592-593

Garrard, A. 1999. Charting the Emergence of Cereal and Pulse Domestication in South-west Asia. *Environmental Archaeology* 4, pp 67-86

Garwood, P, Jennings, D., Skeates, R. and Toms, J. 1991. Preface. In: P. Garwood, D. Jennings, R. Skeates and J. Toms (eds) *Sacred and Profane. Proceedings of a Conference on Archaeology, Ritual and Religion, Oxford, 1989.* Oxford: The Oxford Committee for Archaeology, pp v-x

Gebel, H. G. K., Hermansen, B. D. and Jensen, C. H. (eds) 2002. *Magic Practices and Ritual in the Near Eastern Neolithic. (Proceedings of a Workshop Held at the 2nd International Congress on the Archaeology of the Ancient Near East (ICAANE), Copenhagen University, May 2000).* Berlin: Ex Oriente

Gifford, R. 1997. *Environmental Psychology. Principles and Practice.* Boston: Allyn and Bacon (2nd Edition)

Gilbert, A. S. 1973. Modern Nomads and Prehistoric Pastoralists: The Limits of Analogy. *Archaeology* 4, pp 53-71

Gilbert, A. S. 1983. On the Origins of Specialized Nomadic Pastoralism in Western Iran. *World Archaeology* 15 (1), pp 105-119

Goff, C. and Pullar, J. 1970. Tepe Abdul Hosein. *Iran* 8, pp 199-200

Goring-Morris, A. N. and Belfer-Cohen, A. 2002. Symbolic Behaviour from the Epipalaeolithic and Early Neolithic of the Near East: Preliminary Observations on Continuity and Change. In: H. G. K. Gebel, B. D. Hermansen and C. H. Jensen (eds) *Magic Practices and Ritual in the Near Eastern Neolithic. (Proceedings of a Workshop Held at the 2nd International Congress on the Archaeology of the Ancient Near East (ICAANE), Copenhagen University, May 2000).* Berlin: Ex Oriente, pp 67-79

Goring-Morris, A. N. and Belfer-Cohen, A. 2008. A Roof Over One's Head: Developments in Near Eastern Residential Architecture Across the Epipalaeolithic-Neolithic Transition. In: J.-P. Bocquet-Appel and O. Bar-Yosef (eds) *The Neolithic Demographic Transition and its Consequences.* Dordrecht: Springer-Science and Business Media B. V., pp 239-286

Gregg, M. W. 2009. *Organic Residue Analysis and the Earliest Uses of Pottery in the Ancient Middle East.* Unpublished PhD thesis, University of Toronto

Gregg, M. W. and Slater, G. F. 2010. A New Method for Extraction, Isolation and Transesterification of Free Fatty Acids from Archaeological Pottery. *Archaeometry* 52 (5), pp 833-854

Haaland, R. 2007. Porridge and Pot, Bread and Oven: Food Ways and Symbolism in Africa and the Near East from the Neolithic to the Present. *Cambridge Archaeological Journal* 17 (2), pp 165-182

Hall, E. T. 1969. *The Hidden Dimension.* New York: Doubleday & Co

Hall, G., McBride, S. and Riddell, A. 1973. Architectural Study. *Anatolian Studies* 23, pp 245-269

Halstead, P. 1996. Pastoralism or Household Herding? Problems of Scale and Specialization in Early Greek Animal Husbandry. *World Archaeology* 28 (1), pp 20-42

Halstead, P. 2005. Resettling the Neolithic: Faunal Evidence for Seasons of Consumption and Residence at Neolithic Sites in Greece. In: D. Bailey, A. Whittle and V. Cummings (eds) *(Un)settling the Neolithic.* Oxford: Oxbow Books, pp 38-50

Halstead, P. 2006. Sheep in the Garden: The Integration of Crop and Livestock Husbandry in Early Farming Regimes of Greece and Southern Europe. In: D. Serjeantson and D. Field (eds) *Animals in the Neolithic of Britain and Europe.* Oxford: Oxbow Books, pp 42-55

Hammel, E. A. and Laslett, P. 1974. Comparing Household Structure over Time and between Cultures. *Comparative Studies in Society and History* 16 (1), pp 73-109

Harris, D. R. (ed) 1996a. *The Origins and Spread of Agriculture and Pastoralism in Eurasia.* London: UCL Press

Harris, D. R. and Hillman, G. (eds) 1989. *Foraging and Farming: The Evolution of Plant Exploitation.* London: Unwin Hyman

Hartung, J. 1994. Environment and Animal Health. In: C. M. Wathes and D. R. Charles (eds) *Livestock Housing*. Oxford: CAB International, pp 25-48

Hassan, F. 1973. *Architecture for the Poor: An Experiment in Rural Egypt.* Chicago: University of Chicago Press

Hassan, F. A. 1981. *Demographic Archaeology.* New York and London: Academic Press

Helbaek, H. 1959. Domestication of Food Plants in the Old World. *Science* 130, pp 365-372

Helbaek, H. 1960. The Paleoethnobotany of the Near East and Europe. In: R. J. Braidwood and B. Howe (eds) *Prehistoric Investigations in Iraqi Kurdistan.* Chicago: The University of Chicago Press, pp 99-118

Helbaek, H. 1969. Plant Collecting, Dry-Farming, and Irrigation Agriculture in Prehistoric Deh Luran. In: F. Hole, K. V. Flannery and J. A. Neely (eds) *Prehistory and Human Ecology of the Deh Luran Plain. An Early Village Sequence from Khuzestan, Iran.* Ann Arbor: Memoirs of the Museum of Anthropology, University of Michigan Number 1, pp 383-426

Hemsley, S. 2008. *The Implications of Early Village Architectures: The Sensuous Geographies and Social Experience of the Near Eastern PPNA and PPNB Built Environments*. Unpublished PhD thesis, University of Liverpool

Hendon, J. 1996. Archaeological Approaches to the Organisation of Domestic Labour: Household Practices and Domestic Relations. In: *Annual Review of Anthropology* 25, 45-61

Henning, J. C. and Wheaton, H. N. for University of Missouri Extension 1993. *G4575. Making and Storing Quality Hay.* [online] Available from: http://extension.missouri.edu/p/G4575 [Accessed on 09/03/2012]

Henton, E., Meier-Augenstein, W. and Kemp, H. F. 2010. The Use of Oxygen Isotopes in Sheep Molars to Investigate Past Herding Practices at the Neolithic Settlement of Çatalhöyük, Central Anatolia. *Archaeometry* 52 (3), pp 429-449

Henry, D. O. and Servello, A. F. 1974. Compendium of Carbon-14 Determinations Derived from Near Eastern Prehistoric Deposits. *Paléorient* 2 (1), pp 19-44

Hesse, B. 1978. *Evidence for Husbandry from the Early Neolithic Site of Ganj Dareh in Western Iran.* Unpublished PhD thesis, Columbia University

Hesse, B. 1982. Slaughter Patterns and Domestication: The Beginnings of Pastoralism in Western Iran. *Man* 17 (3), pp 403-417

Hesse, B. 1984. These Are Our Goats: The Origins of Herding in West Central Iran. In: J. Clutton-Brock and C. Grigson (eds) *Animals and Archaeology: 3. Early herders and Their Flocks.* Oxford: B. A. R. International Series 202, pp 243-264

Heydari, S. 2007. The Impact of Geology and Geomorphology on Cave and Rockshelter Archaeological Site Formation, Preservation, and Distribution in the Zagros Mountains of Iran. *Geoarchaeology* 22 (6), pp 653-669

Hillman, G. C. 1996. Late Pleistocene Changes in Wild Plant-Foods Available to Hunter-Gatherers of the Northern Fertile Crescent: Possible Preludes to Cereal Cultivation. In: D. R. Harris (ed) *The Origins and Spread of Agriculture and Pastoralism in Eurasia.* London: UCL Press, pp 159-203

Hillman, G. C. and Davies, M. S. 1990a. Domestication Rates in Wild-Type Wheats and Barley under Primitive Cultivation. *Biological Journal of the Linnean Society* 39, pp 39-78

Hillman, G. C. and Davies, M. S. 1990b. Domestication Rates in Wild Wheats and Barley under Primitive Cultivation, and Their Archaeological Implications. *Journal of World Prehistory* 4:2, pp 157-222

Hillman, G., Hedges, R., Moore, A., Colledge, S. and Pettitt, P. 2001. New Evidence of Lateglacial Cereal Cultivation at Abu Hureyra on the Euphrates. *The Holocene* 11 (4), pp 383-393

Hodder, I. and Cessford, C. 2004. Daily Practice and Social Memory at Çatalhöyük. *American Antiquity* 69 (1), pp 17-40

Hole, F. 1970. The Palaeolithic Culture Sequence in Western Iran. In: J. Filip (ed) *Actes du VII^e^ Congrès International des Sciences Préhistoriques et Protohistoriques, Prague, 21-27 août 1966.* Prague: Institut d'Archeologie de l'Academie Tchecoslovaque des Sciences à Prague, pp 286-292

Hole, F. 1974. Tepe Tula'i, an early campsite in Khuzistan, Iran. *Paléorient* 2 (2), pp 219-242

Hole, F. 1987a. Archaeology of the Village Period. In: F. Hole (ed) *The Archaeology of Western Iran. Settlement and Society from Prehistory to the Islamic Conquest.* Washington DC and London: Smithsonian Institution Press, pp 29-78

Hole, F. 1987b. Themes and Problems in Iranian Archaeology. In: F. Hole (ed) *The Archaeology of Western Iran. Settlement and Society from Prehistory to the Islamic Conquest.* Washington DC and London: Smithsonian Institution Press, pp 19-27

Hole, F. 1987c. Settlement and Society in the Village Period. In: F. Hole (ed) *The Archaeology of Western Iran. Settlement and Society from Prehistory to the Islamic Conquest.* Washington DC and London: Smithsonian Institution Press, pp 79-105

Hole, F. 1996. The Context of Caprine Domestication in the Zagros Region. In: D. R. Harris (ed) *The Origins and Spread of Agriculture and Pastoralism in Eurasia.* London: UCL Press, pp 263-281

Hole, F. 2009. Pastoral Mobility as an Adaptation. In: J. Szuchman (ed) *Nomads, Tribes, and the State in the Ancient Near East. Cross-Disciplinary Perspectives.* Chicago: The Oriental Institute of the University of Chicago, pp 261-283

Hole, F. and Flannery, K. V. 1962. Excavations at Ali Kosh, Iran, 1961. *Iranica Antiqua* 2, pp 97-148

Hole, F. and Flannery, K. V. 1967. The Prehistory of Southwestern Iran: A Preliminary Report. *Proceedings of the Prehistoric Society* 33, pp 147-206

Hole, F., Flannery, K. V. and Neely, J. A. 1969. *Prehistory and Human Ecology of the Deh Luran Plain. An Early Village Sequence from Khuzestan, Iran.* Ann Arbor: Memoirs of the Museum of Anthropology, University of Michigan Number 1

Hopf, M. 1983. Jericho Plant Remains. In: K. M. Kenyon and T. A. Holland (eds) *Excavation at Jericho. Volume V.* London: British School of Archaeology in Jerusalem, pp 576-621

Horne, L. 1982. The Household in Space. Dispersed Holdings in an Iranian Village. *American Behavioral Scientist* 25 (6), pp 677-685

Horne, L. C. 1988. *The Spatial Organisation of Rural Settlement in Khar o Tauran, Iran: An Ethnoarchaeological Case Study.* Unpublished PhD Thesis, University of Pennsylvania

Horwitz, L. K., Tchernov, E., Ducos, P., Becker, C., von den Driesch, A., Martin, L. and Garrard, A. 1999. Animal Domestication in the Southern Levant. *Paléorient* 25 (2), pp 63-80

Howe, B. 1983. Karim Shahir. In: L. S. Braidwood, R. J. Braidwood, B. Howe, C. A. Reed, and P. J. Watson (eds) *Prehistoric Archaeology Along the Zagros Flanks.* Chicago: The Oriental Institute of the University of Chicago, pp 23-154

Hubbard, R. 1990. Archaeobotany of Abdul Hosein. The Carbonised Seeds from Tepe Abdul Hosein: Results of Preliminary Analyses. In: J. Pullar (with contributions by A. Hastings, R. Hubbard and G. Willcox) *Tepe Abdul Hosein. A Neolithic Site in Western Iran, Excavations 1978.* Oxford: B.A.R. International Series 563

Ilkhani, H. 2009. Archaeobotany. *Excavations at Tappeh Sheikh-e Abad and Tappeh Jani, Kermanshah Province. CZAP 2008 Season Report.* Unpublished Archive Report, pp 179-182

Ingold, T. 1980. *Hunters, Pastoralists and Ranchers. Reindeer Economies and their Transformation.* Cambridge: Cambridge University Press

Ingold, T. 1983. The Significance of Storage in Hunting Societies. *Man* 18 (3), pp 553-571

Jenike, M. 2001. Nutritional Ecology: Diet, Physical Activity and Body Size. In: C. Panter-Brick, R. Layton and P. Rowley-Conwy (eds) *Hunter Gatherers: An Interdisciplinary Perspective.* Cambridge: Cambridge University Press, 205-238

Jensen, C. H., Hermansen, B. D. and Gebel, H. G. K. 2002. Editors' Foreword. In: H. G. K. Gebel, B. D. Hermansen and C. H. Jensen (eds) *Magic Practices and Ritual in the Near Eastern Neolithic. (Proceedings of a Workshop Held at the 2nd International Congress on the Archaeology of the Ancient Near East (ICAANE), Copenhagen University, May 2000).* Berlin: Ex Oriente, pp 1-3

Kadowaki, S. 2006. Ground-Stone Tools and Implications for the Use of Space and social Relations at 'Ain Abu Nukhayla, a PPNB Settlement in Southern Jordan. In: E. B. Banning and M. Chazan (eds) *Domesticating Space. Construction, Community, and Cosmology in the Late Prehistoric Near East.* Berlin: Ex Oriente, pp 53-64

Kamp, K. 2000. From Village to Tell. Household Ethnoarchaeology in Syria. *Near Eastern Archaeology* 63 (2), pp84-93

Kardulias, P. N. 1992. Estimating Population at Ancient Military Sites: The Use of Historical and Contemporary Analogy. *American Antiquity* 57 (2), pp 276-287

Kempisty, A. 1992. Architecture. In: S. K. Kozłowski (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq. Vol. 2: House No 1/1A/1B.* Warsaw: Wydawnictwa Uniwersytetu, pp 13-34

Kent, S. (ed) 1990. *Domestic Architecture and the Use of Space. An Interdisciplinary Cross-Cultural Study.* Cambridge: Cambridge University Press

Kislev, M. E. and Bar-Yosef, O. 1988. The Legumes: The Earliest Domesticated Plants in the Near East? *Current Anthropology* 29 (1), pp 175-179

Kozłowski, S. K. 1989. Nemrik 9, a PPN Neolithic Site in Northern Iraq. *Paléorient* 15 (1), pp 25-31

Kolb, C. C. 1985. Demographic Estimates in Archaeology: Contributions from Ethnoarchaeology on Mesoamerican Peasants. *Current Anthropology* 26 (5), pp 581-599

Kozłowski, S. K. 1990a. Introduction. In: S. K. Kozłowski (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq (General Report – Seasons 1985-1986).* Warsaw: Wydawnictwa Uniwersytetu Warszawskiego, pp 7

Kozłowski, S. K. 1990b. The Site and Excavations. In: S. K. Kozłowski (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq (General Report – Seasons 1985-1986).* Warsaw: Wydawnictwa Uniwersytetu Warszawskiego, pp 9-43

Kozłowski, S. K. (ed) 1990c. *Nemrik 9. Pre-Pottery Neolithic Site in Iraq (General Report – Seasons 1985-1986).* Warsaw: Wydawnictwa Uniwersytetu Warszawskiego

Kozłowski, S. K. 1994. Chipped Neolithic Industries at the Eastern Wing of the Fertile Crescent. In: H. G. Gebel and S. K. Kozłowski (eds) *Neolithic Chipped Stone Industries of the Fertile Crescent. Proceedings of the First Workshop on PPN Chipped Lithic Industries.* Berlin: Ex Oriente, pp 143-171

Kozłowski, S. K. 1999. *The Eastern Wing of the Fertile Crescent. Late Prehistory of Greater Mesopotamian Lithic Industries.* Oxford: BAR International Series 760

Kozłowski, S. K. 2002. *Nemrik. An Aceramic Village in Northern Iraq.* Warsaw: Instytut Archeologii UW

Kozłowski, S. K. and Aurenche, O. 2005. *Territories, Boundaries and Cultures in the Neolithic Near East.* Oxford: B.A.R. International Series 1362

Kozłowski, S. K. and Kempisty, A. 1990. Architecture of the Pre-Pottery Neolithic Settlement in Nemrik, Iraq. *World Archaeology* 21 (3), pp 348-362

Kozłowski, S. K. and Szymczak, K. 1989. Flint Industry from House 1/1A/1B at the PPN Site in Nemrik 9, Northern Iraq. *Paléorient* 15 (1), pp 32-42

Kozłowski, S. K. and Szymczak, K. 1990. Architecture of the Pre-Pottery Neolithic Settlement in Nemrik, Iraq. *World Archaeology* 21 (3), pp 348-362

Kozłowski, S. K. and Szymczak, K. 1992. Flint Industry. In: S. K. Kozłowski (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq. Vol. 2: House No 1/1A/1B.* Warsaw: Wydawnictwa Uniwersytetu, pp 43-79

Kramer, C. 1979. An Archaeological View of a Contemporary Kurdish Village: Domestic Architecture, Household Size, and Wealth. In: C. Kramer (ed) *Ethnoarchaeology. Implications of ethnography for Archaeology.* New York: Columbia University Press, pp 139-163

Kramer, C. 1982. *Village Ethnoarchaeology: Rural Iran in Archaeological Perspective.* New York: Academic Press

Kuijt, I. 1995. *New Perspectives on Old Territories: Ritual Practices and the Emergence of Social Complexity in the Levantine Neolithic.* Unpublished PhD thesis, Harvard University

Kuijt, I. 1996. Negotiating Equality through Ritual: A Consideration of Late Natufian and Prepottery Neolithic A Period Mortuary Practices. *Journal of Anthropological Archaeology* 15, pp 313-336

Kuijt, I. 1997. Trying to Fit Round Houses into Square Holes: Re-examining the Timing of the South-Central Levantine Pre-Pottery Neolithic A and Pre-Pottery Neolithic B Cultural Transition. In: H. G. K. Gebel, Z. Kafafi and G. O. Rollefson (eds) *The Prehistory of Jordan: Perspectives from 1997.* Berlin: Ex Oriente, pp 193-202

Kuijt, I. 2000a. Life in Neolithic Farming Communities: An Introduction. In: I. Kuijt (ed) *Life in Neolithic Farming Communities. Social Organisation, Identity, and Differentiation.* New York: Kluwer Academic Press, pp 3-13

Kuijt, I. 2000b. Preface. In: I. Kuijt (ed) *Life in Neolithic Farming Communities. Social Organisation, Identity, and Differentiation.* New York: Kluwer Academic Press, pp vii-ix

Kuijt, I. 2000c. Near Eastern Neolithic Research. Directions and Trends. In: I. Kuijt (ed) *Life in Neolithic Farming Communities. Social Organisation, Identity, and Differentiation.* New York: Kluwer Academic Press, pp 311-322

Kuijt, I. 2000d. People and Space in Early Agricultural Villages: Exploring Daily Lives, Community Size, and Architecture in the Late Pre-Pottery Neolithic. *Journal of Anthropological Archaeology* 19, pp 75-102

Kuijt, I. 2000e. Keeping the Peace: Ritual, Skull Caching, and Community Integration in the Levantine Neolithic. In: I. Kuijt (ed) *Life in Neolithic Farming Communities. Social Organisation, Identity, and Differentiation.* New York: Kluwer Academic Press, pp 137-164

Kuijt, I. (ed) 2000f. *Life in Neolithic Farming Communities. Social Organisation, Identity, and Differentiation.* New York: Kluwer Academic Press

Kuijt, I. 2002. Reflections on Ritual and the Transmission of Authority in the Pre-Pottery Neolithic of the Southern Levant. In: H. G. K. Gebel, B. D. Hermansen and C. H. Jensen (eds) *Magic Practices and Ritual in the Near Eastern Neolithic. (Proceedings of a Workshop Held at the 2nd International Congress on the Archaeology of the Ancient Near East (ICAANE), Copenhagen University, May 2000).* Berlin: Ex Oriente, pp 81-90

Kuijt, I. 2009. What Do We Really Know About Food Storage, Surplus, and Feasting in Preagricultural Communities. *Current Anthropology* 50 (5), pp 641-644

Kuijt, I. and Goring-Morris, N. 2002. Foraging, Farming, and Social Complexity in the Pre-Pottery Neolithic of the Southern Levant: A Review and Synthesis. *Journal of World Prehistory* 16 (4), pp 361-440

Lambert, P. J. 1979. Early Neolithic Cranial Deformation at Ganj Dareh Tepe, Iran. *Canadian Review of Physical Anthropology* 1 (2), pp 51-54

LaMotta, V. M. and Schiffer, M. 1999. Formation Processes of House Floor Assemblages. In: P. M. Allison (ed) *The Archaeology of Household Activities.* London and New York: Routledge, pp 19-29

Lane, P. J. 1994. The Temporal Structuring of Settlement Space Among the Dogon of Mali: An Ethnoarchaeological Study. In: M. Parker Pearson and C. Richards (eds) *Architecture and Order: Approaches to Social Space.* London and New York: Routledge, pp 196-216

Lasota-Moskalewska, A. 1990.Preliminary Archaeozoological Investigation of Animal Remains from Site Nemrik 9 in Iraq. In: S. K. Kozłowski (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq (General Report – Seasons 1985-1986).* Warsaw: Wydawnictwa Uniwersytetu Warszawskiego, pp 185-208

Lasota-Moskalewska, A. 1994. Animal Remains from Nemrik, a Pre-Pottery Neolithic Site in Iraq. In: A. Lasota-Moskalewska (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq. Volume 4: Animal Remains.* Warsaw: Wydawnictwa Uniwersytetu Warszawskiego, pp 5-52

Lawn, B. 1974. University of Pennsylvania Radiocarbon Dates XVII. *Radiocarbon* 16 (2), pp 219-237

Lawrence, D. L. and Low, S. M. 1990. The Built Environment and Spatial Form. *Annual Review of Anthropology* 19, pp 453-505

Lawson, B. 2001. *The Language of Space.* Oxford: Architectural Press

LeBlanc, S. 1971. An Addition to Naroll's Suggested Floor Area and settlement Population Relationship. *American Antiquity* 36 (2), pp 210-211

Legge, T. 1996. The Beginning of Caprine Domestication in Southwest Asia. In: In: D.R. Harris (ed) *The Origins and Spread of Agriculture and Pastoralism in Eurasia.* London: UCL Press, pp 238-262

Lyons, D. and D'Andrea, A. C. 2003. Griddles, Ovens, and Agricultural Origins: An Ethnoarchaeological Study of Bread Baking in highland Ethiopia. *American Anthropologist* 105 (3), pp 515-530

Madanipour, A. 2003. *Public and Private Spaces of the City.* London and New York: Routledge

Mainland, I. and Halstead, P. 2005. The Diet and Management of Domestic Sheep and Goats at Neolithic Makriyalos. In: J. Davies, M. Fabiš, I. Mainland, M. Richards and R.

Thomas (eds) *Diet and Health in Past Animal Populations. Current Research and Future Directions.* Oxford: Oxbow Books, pp 104-112

Maisels, C. K. 1993. *The Emergence of Civilization. From Hunting and Gathering to Agriculture, Cities, and States in the Near East.* London: Routledge

Makarewicz, C. A. 2007. *Evolution of Foddering Practices in the Southern Levantine Pre-Pottery Neolithic.* Unpublished PhD thesis, Harvard University

Makarewicz, C. and Tuross, N. 2012. Finding Fodder and Tracking Transhumance: Isotopic Detection of Goat Domestication Process in the Near East. *Current Anthropology* 53 (4), pp 495-505

Marshall, Y. 2006. Introduction: Adopting a Sedentary Lifeway. *World Archaeology* 38 (2), pp153-163

Martinoli, D. and Nesbitt, M. 2003. Plant Stores at Pottery Neolithic Höyücek, Southwest Turkey. *Anatolian Studies* 53, pp 17-32

Mashkour, M., Bocherens, H. and Moussa, I. 2005. Long Distance Movement of Sheep and Goats of Bakhtiari Nomads Tracked with Intra-Tooth Variations of Stable Isotopes (^{13}C and ^{18}O). In: J. Davies, M. Fabiš, I. Mainland, M. Richards and R. Thomas (eds) *Diet and Health in Past Animal Populations. Current Research and Future Directions.* Oxford: Oxbow Books, pp 113-124

Matson, F. R. 1960. Specialized Ceramic Studies and Radioactive-Carbon Techniques. In: R. J. Braidwood and B. Howe (eds) *Prehistoric Investigations in Iraqi Kurdistan.* Chicago: The University of Chicago Press, pp 63-70

Matthews, R., Mohamadifar , Y. and Matthews, W. (eds) In Press. *The earliest Neolithic of Iran: the Central Zagros archaeological project 2008 excavations at Sheikh-e Abad and Jani.* Oxford: British Institute of Persian Studies and Oxbow Books

Matthews, R., Mohamadifar, Y., Matthews, W., Astin, T., Cole, G., Darabi, H., Daryaei, M., Lelek Tvetmarken, C., Shillito, L. M. and Taylor, H. 2009. Excavations, Surface Collection, and Geophysics at Tappeh Sheikh-e Abad. In: *Excavations at Tappeh Sheikh-e Abad and Tappeh Jani, Kermanshah Province. CZAP 2008 Season Report.* Unpublished Archive Report, pp 12-61

Matthews, R. Mohamadifar, Y., Matthews, W. and Motarjem, A. 2010. Investigating the Early Neolithic of western Iran: the Central Zagros Archaeological Project (CZAP). *Antiquity* 84 (323) [online project gallery] Available from: http://antiquity.ac.uk/projgall/matthews323/ [Accessed on 20/12/2010]

Matthews, W. 2005. Micromorphological and Microstratigraphic Traces of Uses and Concepts of Space. In: I. Hodder (ed) *Inhabiting Çatalhöyük: Reports from the 1995-1999 Seasons.* Cambridge: McDonalds Institute for Archaeological Reearch and British Institute of Archaeology at Ankara, pp 355-398

Matthews, W. 2009a. Geography, Palaeoclimate and Palaeoenvironment. In: *Excavations at Tappeh Sheikh-e Abad and Tappeh Jani, Kermanshah Province. CZAP 2008 Season Report.* Unpublished Archive Report, pp 7-11

Matthews, W. 2009b. Micromorphology. In: *Excavations at Tappeh Sheikh-e Abad and Tappeh Jani, Kermanshah Province. CZAP 2008 Season Report.* Unpublished Archive Report, pp 77-115

Matthews, W. 2010. Geoarchaeology and Taphonomy of Plant Remains in Early Urban Environments in the Ancient Near East. *Quaternary International* 214 (1-2), pp 98-113

Matthews, W. French, C. A. I., Lawrence, T., Cutler, D. F. and Jones, M. K. 1997. Microstratigraphic Traces of Site Formation Processes and Human Activities. *World Archaeology* 29 (2), pp 281-308

Mazurowski, R. F. 1990. Ground Stone Industry. In: S. K. Kozłowski (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq (General Report – Seasons 1985-1986).* Warsaw: Wydawnictwa Uniwersytetu Warszawskiego, pp 105-139

Mazurowski, R. F. 1992. Ground Stone Artifacts. In: S. K. Kozłowski (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq. Vol. 2: House No 1/1A/1B.* Warsaw: Wydawnictwa Uniwersytetu, pp 81-106

McCormick Adams, R. 1983. The jarmo Stone and Pottery Vessel industries. In: L. S. Braidwood, R. J. Braidwood, B. Howe, C. A. Reed, and P. J. Watson (eds) *Prehistoric Archaeology Along the Zagros Flanks.* Chicago: The Oriental Institute of the University of Chicago, pp 209-232

McCorriston, J. and Hole, F. 1991. The Ecology of Seasonal Stress and the Origins of Agriculture in the Near East. *American Anthropologist* 93 (1), pp 46-69

McDonald, M. M. A. 1979. *An Examination of Mid-Holocene Settlement Patterns in the Central Zagros Region of Western Iran.* Unpublished PhD thesis, University of Toronto

McGuire, R. H. and Schiffer, M. B. 1983. A Theory of Architectural Design. *Journal of Anthropological Archaeology* 2, pp 227-303

McGovern, P. E., Glusker, D. L., Exner, L. J. and Voigt, M. M. 1996. Neolithic Resinated Wine. *Nature* 381, pp 480-481

McQuitty, A. 1984. An Ethnographic and Archaeological Study of Clay Ovens in Jordan. *Annual of the Department of Antiquities* 28, pp 259-267

Meadow, R. H. 1983. The Vertebrate Faunal Remains from Hasanlu Period X at Hajji Firuz. In: M. M. Voigt *Hajji Firuz Tepe, Iran: The Neolithic Settlement.* Philadelphia: The University Museum, University of Pennsylvania, pp 369-420

Meiklejohn, C., Agelarakis, A., Akkermans, P. A., Smith, P. E. L. and Solecki, R. 1992. Artificial Cranial Deformation in the Proto-Neolithic and Neolithic Near East and Its Possible Origin: Evidence from Four Sites. *Paléorient* 18 (2), pp 83-97

Meiklejohn, C., Lambert, P. and Byrne, C. 1980. Demography and Pathology of the Ganj Dareh Population: Early Neolithic in Iran. *American Journal of Physical Anthropology* 52, pp 255

Meldgaard, J., Mortensen, P. and Thrane, H. 1963. Excavations at Tepe Guran, Luristan. Preliminary Report of the Danish Archaeological Expedition to Iran 1963. *Acta Archaeologica* 34, pp 97-133

Merpert, N. I., Munchaev, R. M. and Bader, N. O. 1981a. Investigations of the Soviet Expedition in Northern Iraq 1976. *Sumer* 37, pp 22-54

Merpert, N. I., Munchaev, R. M. and Bader, N. O. 1981b. Soviet Expedition's Surveys in the Sinjar Valley. *Sumer* 37, pp 55-95

Merrett, D. C. 2004. *Bioarchaeology in Early Neolithic Iran: Assessment of Health Status and Subsistence Strategy.* Unpublished PhD thesis, University of Manitoba

Miller, N. F. 1984a. The Use of Dung as Fuel: an Ethnographic Example and an Archaeological Application. *Paleorient* 10 (2), pp71-79

Miller, N. 1984b. The Interpretation of Some Carbonized Cereal Remains as Remnants of Dung Cake Fuel. *Bulletin on Sumerian Agriculture* 1, pp 45-47

Miller, N. F. 1991. The Near East. In: W. van Zeist, K. Wasylikowa and K.-E. Behre (eds) *Progress in Old World Palaeoethnobotany: A Retrospective View on the Occasion of 20 Years of the International Workgroup for Palaeoethnobotany.* Rotterdam: A. A. Balkema, pp 133-160

Miller, N. F. 1996. Seed Eaters of the Ancient Near East: Human or Herbivore? *Current Anthropology* 37 (3), pp 521-528

Miller, N. F. 2002. Tracing the Development of the Agropastoral Economy in Southeastern Anatolia and Northern Syria. In: R. T. J. Cappers and S. Bottema (eds) *The Dawn of Farming in the Near East.* Berlin: Ex Oriente, pp 85-94

Miller, N. F. 2008. Sweeter than Wine? The Use of the Grape in Early Western Asia. *Antiquity* 82, pp 937-946

Molleson, T. 2007. Bones of Work at the Origins of Labour. In: S. Hamilton, R. D. Whitehouse and K. I. Wright (eds) *Archaeology and Women. Ancient and Modern Issues.* Walnut Creek: Left Coast Press Inc, pp 185-198

Montgomery, J., Budd, P. and Evans, J. 2000. Reconstructing Lifetime Movement of Ancient People: A Neolithic Case Study from Southern England. *European Journal of Archaeology* 3 (3), pp 370-385

Moquin, M. 2005. Cob. In: E. Lynne and C. Adams (eds) *Alternative Construction. Contemporary Natural Building Methods.* New York: John Wiley & Sons, pp 117-150

Munchaev, R. M. 1993. Some Problems in the Archaeology of Mesopotamia in Light of Recent Research by the Soviet Expedition to Iraq. In: N. Yoffee and J. J. Clark (eds) *Early*

Stages in the Evolution of Mesopotamian Civilization. Soviet Excavations in Northern Iraq. Tucson and London: The University of Arizona Press, pp 249-255

Murphy, W. J. for University of Missouri Extension 1993. *G4020. Tables for Weights and Measurement: Crops.* [online] Available from: http://extension.missouri.edu/publications/DisplayPub.aspx?P=G4020 [Accessed on 30/10/2011]

Nadel, D., Danin, A., Werker, E., Schick, T., Kislev, M. E. and Stewart, K. 1994. 19,000-Year-Old Twisted Fibres from Ohalo II. *Current Anthropology* 35 (40), pp 451-458

Naroll, R. 1962. Floor Area and Settlement Size. *American Antiquity* 27 (4), pp 587-589

National Research Council (U.S). Subcommittee on Goat Nutrition. 1981. *Nutrient Requirements of Goats: Angora, Dairy and Meat Goats in Temperate and Tropical Countries.* Washington D.C.: National Academy Press

Nesbitt, M. 1992. A Preliminary Note on the Charred Plant Remains. In: S. K. Kozłowski (ed) *Nemrik 9. Pre-Pottery Neolithic Site in Iraq. Vol. 2: House No 1/1A/1B.* Warsaw: Wydawnictwa Uniwersytetu, pp 127

Nesbitt, M. 2002. When and Where Did Domesticated Cereals First Occur in Southwest Asia. In: R. T. J. Cappers and S. Bottema (eds) *The Dawn of Farming in the Near East.* Berlin: Ex Oriente, pp 113-132

Netting, R. McC. 1993. *Smallholders, Householders. Farm Families and the Ecology of Intensive, Sustainable Agriculture.* Stanford: Stanford University Press

Nevett, L. 2007. Greek Houses as a Source for Social Relations. In: R. Westgate, N. Fisher and J. Whitley (eds) *Building Communities. House, Settlement and Society in the Aegean and Beyond. Proceedings of a Conference Held at Cardiff University, 17-21 2001.* London: British School at Athens, pp 5-10

Nowak, R. M. 1999. *Walker's Mammals of the World. Volume II.* Baltimore: The John Hopkins University Press

Olszewski, D. I. 1993. The Zarzian Occupation at Warwasi Rockshelter, Iran. In: D. I. Olszewski and H. L. Dibble (eds) *The Paleolithic Prehistory of the Zagros-Taurus.* Philadelphia: The University Museum Monograph 83, pp 207-217

Olszewski, D. I. 1994. The Late Epipaleolithic Chipped Stone “Heritage” in Early Aceramic Neolithic Assemblages in the Northern Fertile Crescent. In: H. G. Gebel and S. K Kozłowski (eds) *Neolithic Chipped Stone Industries of the Fertile Crescent. Proceedings of the First Workshop on PPN Chipped Lithic Industries.* Berlin: Ex Oriente, pp 83-90

Özkan, H., Brandolini, A., Schäfer-Pregl, R. and Salamini, F. 2002. AFLP Analysis of a Collection of Tetraploid Wheats Indicates the Origin of Emmer and Hard Wheat Domestication in Southeast Turkey. *Molecular Biology and Evolution* 19 (10), pp 1797-1801

Özkan, H., Brandolini, A., Pozzi, C., Effgen, S., Wunder, J. and Salamini, F. 2005. A Reconsideration of the Domestication Geography of Tetraploid Wheats. *Theoretical and Applied Genetics* 110 (7), pp 1052-1060

Paine, R. 1972. The herd Management of Lapp Reindeer Pastoralists. *Journal of Asian and African Studies* 7, pp 76-87

Parker Pearson, M. and Richards, C. 1994. Ordering the World: Perceptions of Architecture, Space and Time. In: M. Parker Pearson and C. Richards (eds) *Architecture and Order: Approaches to Social Space.* London and New York: Routledge, pp 1-37

Payne, S. 1981. Appendix 3: The Animal Bones. *Proceedings of the Prehistoric Society* 47, pp 36-37

Peasnall, B. L. 2000. *The Round House Horizon along the Taurus-Zagros Arc: A Synthesis of Recent Excavations of Late Epipaleolithic and Early Aceramic Sites in Southeast Anatolia and Northern Iraq.* Unpublished PhD thesis, University of Philadelphia

Perkins, A. 1949. Archaeological News. The Near East. *American Journal of Archaeology* 53 (1), pp 36-57

Perkins, Jr., D. 1964. Prehistoric Fauna from Shanidar, Iraq. *Science* 144, pp 1565-1566

Petersen, W. 1975. A Demographer's View of Prehistoric Demography. *Current Anthropology* 16 (2), pp 227-245

Pearson, J. A., Buitenhuis, H., Hedges, R. E. M., Martin, L., Russell, N. And Twiss, K. C. 2007. New Light on Early Caprine Herding Strategies from Isotope Analysis: A Case Study from Neolithic Anatolia. *Journal of Archaeological Science* 34, pp 2170-2179

Peters, J., Helmer, D., von den Driesch, A. and Saña Sengui, M. 1999. Early Animal Husbandry in the Northern Levant. *Paléorient* 25 (2), pp27-48

Pollock, S. and Bernbeck, R. 2010. Neolithic Worlds at Toll-e Baši. In: S. Pollock, R. Bernbeck and K. Abdi (eds) *The 2003 Excavations at Tol-e Baši, Iran: Social Life in a Neolithic Village.* Mainz: Verlag Philipp von Zabern, pp 274-287

Potts, D. T., Roustaei, K., Alamdari, K., Alizadeh, K., Asgari Chaverdi, A., Khosrowzadeh, A., Niakan, L., Petrie, C. A., Seyedin, M., Weeks, L. R., McCall, B. and Zaidi, M. 2005. Eight Thousand Years of History in Fars Province, Iran. *Near Eastern Archaeology* 68 (3), pp 84-92

Potts, D. T., Roustaei, K. Petrie, C. A. and Weeks, L. R. (eds) 2009. *The Mamasani Archaeological Project. Stage One. A Report on the First Two Seasons of the ICAR-University of Sydney Expedition to the Mamasani District, Fars Province, Iran.* Oxford: B.A.R International Series 2044

Price, T. D. and Gebauer, A. B. (eds) 1995. *Last Hunters – First Farmers. New Perspectives on the Prehistoric Transition to Agriculture.* Santa Fe: School of American Research Press

Pullar, J. 1981. Tepe Abdul Hosein. *Iran* 19, pp 179

Pullar, J. 1990. *Tepe Abdul Hosein. A Neolithic Site in Western Iran, Excavations 1978.* Oxford: B.A.R. Series

Rapoport, A. 1969. *House Form and Culture.* Englewood Cliffs, NJ: Prentice-Hall

Redding, Jr., R. W. 1981. *Decision Making in Subsistence Herding of Sheep and Goats in the Middle East.* Unpublished PhD Thesis, the University of Michigan

Redding, R. W. 2005. Breaking the Mould: a Consideration of Variation in the Evolution of Animal Domestication. In: J.-D. Vigne, J. Peters and D. Helmer (eds) *The First Steps of Animal Domestication. New Archaeological Approaches.* Oxford: Oxbow Books, pp 41-48

Reed, C. A. 1960. A Review of the Archaeological Evidence on Animal Domestication in the Prehistoric Near East. In: R. J. Braidwood and B. Howe (eds) *Prehistoric Investigations in Iraqi Kurdistan.* Chicago: The University of Chicago Press, pp 119-145

Reed, C. A. 1983. Archaeozoological Studies in the Near East. A Short History (1960-1980). In: L. S. Braidwood, R. J. Braidwood, B. Howe, C. A. Reed and P. J. Watson (eds) 1983. *Prehistoric Archaeology along the Zagros Flanks.* Chicago: The Oriental Institute of the University of Chicago, pp 511-536

Reed, C. A. and Braidwood, R. J. 1960. Towards the Reconjstruction of the Environemtnal Sequence of Northeastern Iraq. In: R. J. Braidwood and B. Howe (eds) *Prehistoric Investigations in Iraqi Kurdistan.* Chicago: The University of Chicago Press, pp 163-173

Renfrew, J. M. 1969. The Archaeological Evidence for the Domestication of Plants: Methods and Problems. In: P. J. Ucko and G. W. Dimbleby (eds) *The Domestication and Exploitation of Plants and Animals.* London: Gerald Duckworth & Co, pp 147-172

Renfrew, J. M. 1981. Appendix 2: Seed Remains. *Proceedings of the Prehistoric Society* 47, pp 36

Richards, M. P. and Pearson, J. A. Stable Isotope Evidence of Diet at Çatalhöyük. In: I. Hodder (ed) *Inhabiting Çatalhöyük: Reports from the 1995-1999 Seasons.* Cambridge: McDonalds Institute for Archaeological Reearch and British Institute of Archaeology at Ankara, pp 313-321

Riehl, S., Benz, M., Conrad, N. J., Darabi, H., Deckers, K., Fazeli Nashli, H., Zeidi-Kulehparacheh, M. 2012. Plant Use in the Pre-Pottery Neolithic Sites in the Northern and Eastern Fertile Crescent: A Preliminary Report. *Vegetation History and Archaeobotany* 21 (2), pp95-106

Roberts, N. 2002. Did Prehistoric Landscape Management Retard the Post-Glacial Spread of Woodland in Southwest Asia? *Antiquity* 76, 1002-1010

Roberts, N. and Wright, Jr., H. E. 1993. Vegetational, Lake-Level, and Climatic History of the near East and Southwest Asia. In: H. E. Wright, Jr., J. E. Kutzbach, T. Webb III, W. F.

Ruddiman, F. A. Street-Perrott and P. J. Bartlein (eds) *Global Climates Since the Last Glacial Maximum.* Minneapolis and London: University of Minnesota Press, pp194-220

Rosenberg, M. 2003. The Epipaleolithic in the Marvdasht. In: N.F. Miller and K. Abdi (eds) *Yeki Bud, Yeki Nabud. Essays on the Archaeology of Iran in Honor of William M. Sumner.* Los Angeles: The Cotsen Institute of Archaeology, University of California, pp 98-108

Rosenberg, M., Nesbitt, R., Redding, R. W. and Peasnall, B. L. 1998. Hallan Çemi, Pig Husbandry, and Post-Pleistocene Adaptations along the Taurus-Zagros Arc (Turkey). *Paléorient* 24 (1), pp 25-41

Roustaei, K., Vahdati Nasab, H., Biglari, F., Heydari, S., Clark, G. A. and Lindly, M. 2004. Recent Palaeolithic Surveys in Luristan. *Current Anthropology* 45 (5), pp 692-707

Russell, N., Martin, L. and Twiss, K. C. 2009. Building Memories: Commemorative Deposits at Çatalhöyük. *Anthropozoologica* 44 (1), pp 103-125

Ryan, P. 2011. Plants as Material Culture in the Near Eastern Neolithic: Perspectives from the Silica Skelton Artifactual Remains at Çatalhöyük. *Journal of Anthropological Archaeology* 30, pp 292-305

Salzman, P. C. 1972. Multi-Resource Nomadism in Iranian Baluchistan. *Journal of Asian and African Studies* 7, pp 60-68

Salzman, P. C. 1999. Is Inequality Universal? *Current Anthropology* 40 (1), pp 31-61

van Saun, R. J. 2010. *Dairy Goat Nutrition: Feeding for Two. (How to Properly Feed a Goat and Her Rumen).* [online] Available from: http://www.ansci.cornell.edu/goats/Resources/GoatArticles/GoatFeeding/FeedingForTwo.pdf [Accessed on09/03/2012]

van Saun, R. J. 2012. *Forage Quality and Feeding the Horse.* [online] Available from: http://vbs.psu.edu/extension/resources-repository/publications/Eq-Feed%20Quality-06.pdf [Accessed on 09/03/2012]

de Schauensee, M. 1968. Portable Architecture. *Expedition* 10 (3), pp 32-39

Schoenian, S. for University of Maryland Extension. 2007. *The Truth about Grain: Feeding Grain to Small Ruminants.* [online] Available from: http://www.sheepandgoat.com/articles/graintruth.html [Accessed on09/03/2012]

Schoeninger, M. J. 1981. The Agricultural "Revolution": Its Effect on Human Diet in Prehistoric Iran and Israel. *Paléorient* 7 (1), pp73-91

Seeden, H. 1985. Aspects of Prehistory in the Present World: Observations Gathered in Syrian Villages from 1980 to 1985. *World Archaeology* 17 (2), pp 289-303

Schacht, R. M. 1981. Estimating Past Population Trends. *Annual Review of Anthropology* 10, pp 119-140

Shea, D. 1985. Comments. *Current Anthropology* 26 (5), pp 594

Shick, T. 1988. Nahal Hemar Cave: Cordage, Basketry and Fabrics. *Atiqot* 18, pp 31-43

Shillito, L.-M., Matthews, W., and Almond, J. M. 2008. Investigating Midden Formation Processes and Cultural Activities at Neolithic Çatalhöyük, Turkey. *Antiquity* 82 (317) [online project gallery] Available from: http://www.antiquity.ac.uk/Projgall/shillito/ [Accessed on 20/11/2012]

Shillito, L.-M., Matthews, W., Almond, J. M. and Bull, I. D. 2011. The Microstratigraphy of Middens: Capturing Daily Life in Rubbish at Neolithic Çatalhöyük, Turkey. *Antiquity* 85, pp 1024-1038

Smith, B. D. 1995. *The Emergence of Agriculture.* New York: Scientific American Library

Smith, B. D. 2006. Documenting Domestic Plants in the Archaeological Record. In: M. A. Zeder, D. G. Bradley, E. Emshwiller and B. D. Smith (eds) *Documenting Domestication. New Genetic and Archaeological Paradigms.* Berkeley: University of California Press, pp 15-24

Smith, M. 2005. Adobe. In: E. Lynne and C. Adams (eds) *Alternative Construction. Contemporary Natural Building Methods.* New York: John Wiley & Sons, pp 87-116

Smith, M. L. 2006. How Ancient Agriculturalists Managed Yield Fluctuations through Crop Selection and Reliance on Wild Plants: An Example from Central India. *Economic Botany* 60 (1), pp 39-48

Smith, P. E. L. 1967. Ghar-i Khar and Ganj-i Dareh. *Iran* 5, pp 138-139

Smith, P. E. L. 1968. Ganj Dareh Tepe. *Iran* 6, pp 158-160

Smith, P. E. L. 1970 Ganj Dareh Tepe. *Iran* 8, pp 178-180

Smith, P. E. L. 1972. Ganj Dareh Tepe. *Iran* 10, pp 165-168

Smith, P. E. L. 1974. Ganj Dareh Tepe. *Paléorient* 2 (1), pp 207-109

Smith, P. E. L. 1975. Ganj Dareh Tepe. *Iran* 13, pp 178-180

Smith, P. E. L. 1976. Reflections on Four Seasons of Excavations at Ganj Dareh. In: F. Bagherzadeh (ed) *Proceedings of the IVth Annual Symposium on Archaeological Research in Iran.* Tehran: The Iranian Centre for Archaeological Research, pp 11-22

Smith, P. E. L. 1978. An Interim Report on Ganj Dareh Tepe, Iran. *American Journal of Archaeology* 82 (4), pp 537-540

Smith, P. E. L. 1983/1984. Ganj Dareh: An Early Neolithic Site in Iran. *Archiv für Orientforschung* 29-30, pp 300-302

Smith, P. E. L. 1986. *Palaeolithic Archaeology in Iran.* Philadelphia: University of Pennsylvania

Smith, P. E. L. 1990. Architectural Innovation and Experimentation at Ganj Dareh, Iran. *World Archaeology* 21 (3), pp 323-335

Smith, P. E. L. and Mortensen, P. 1980. Three New “Early Neolithic” Sites in Western Iran. *Current Anthropology* 21, pp 511-512

Soffer, O. 1989. Storage, Sedentism and the Eurasian Palaeolithic Record. *Antiquity* 63, pp 719-732

Solecki, R. S. 1963. Prehistory in Shanidar Valley, Northern Iraq. *Science* 139 (3551), pp 179-193

Solecki, R. S. 1979. Contemporary Kurdish Winter-Time Inhabitants of Shanidar Cave, Iraq. *World Archaeology* 10 (3), pp 318-330

Solecki, R. L. 1981. *An Early Village Site at Zawi Chemi Shanidar.* Malibu: Udena Publications

Stampfli, H. R. 1983. The Fauna of Jarmo with Notes on Animal Bones from Matarrah, the ‘Amuq, and Karim Shahir. In: L. S. Braidwood, R. J. Braidwood, B. Howe, C. A. Reed, and P. J. Watson (eds) *Prehistoric Archaeology Along the Zagros Flanks.* Chicago: The Oriental Institute of the University of Chicago, pp 431-483

Stein, A. 1940. *Old Routes of Western Iran. Narrative of an Archaeological Journey Carried Out and Recorded.* London: Macmillian and Co

Stuckenrath, Jr., R. 1963. University of Pennsylvania Radiocarbon Dates VI. *Radiocarbon* 5, pp 82-103

Sturt, F. 2007. Structured Thoughts; CGI and Reconstruction of a Chalcolithic Structure. In: M. Fitzjohn (ed) *Uplands of Ancient Sicily and Calabria. The Archaeology of Landscape Revisited.* London: Accordia Research Institute, pp 81-98

Tahhan, D. A. 2008. Depth and Space in Sleep: Intimacy, Touch and the Body in Japanese Co-sleeping Rituals. *Body & Society* 14 (4), pp 37-56

Tanno, K. And Willcox, G. 2012. Distinguishing Wild and Domestic Wheat and Barely Spikelets from Early Holocene Sites in the Near East. *Vegetation History and Archaeobotany* 21 (2), pp 107-115

Tringham, R. 2000. The Continuous House. A View from the Deep Past. In: R. A. Joyce and S. D. Gillespie (eds) *Beyond Kinship. Social and Material Reproduction in House Society.* Philadelphia: University of Pennsylvania Press, pp 115-134

Tsuneki, A., Zeidi, M. and Ohnuma, K. 2007. Proto-Neolithic Caves in the Bolahgi Valley, South Iran. *Iran* 45, pp 1-22

Turnbull, P. F. 1975. The Mammalian Fauna of Warwasi Rock Shelter, West-Central Iran. *Fieldiana: Geology* 33 (8), pp 141-155

Turnbull, P. F. and Reed, C. A. 1974.The Fauna from the Terminal Pleistocene of Palegawra Cave, a Zarzian Occupation Site in Northeastern Iraq. *Fieldiana: Anthropology* 63 (3), pp 81-146

Twiss, K. C., Bogaard, A., Bogdan, D., Carter, C., Charles, M. P., Farid, S., Russell, N., Stevanović, M., Yalman, E. N. and Yeomans, L. 2008. Arson or Accident? The Burning of a Neolithic House at Çatalhöyük, Turkey. *Journal of Field Archaeology* 33, pp 41-57

Twiss, K. C., Bogaard, A., Charles, M., Henecke, J., Russell, N., Martin, L. and Jones, G. 2009. Plants and Animals Together: Interpreting Organic Remains from Building 52 at Çatalhöyük. *Current Anthropology* 50 (6), pp 885-895

Ucko, P. J. and Dimbleby, G. W. (eds) 1969. *The Domestication and Exploitation of Plants and Animals.* London: Gerald Duckworth & Co

Mileski, A. for University of Michigan, Museum of Zoology. 2004. *Capra hircus.* [online] Available from: http://animaldiversity.ummz.umich.edu/accounts/Capra_hircus/ [Accessed on 17/10/2012]

Verhoeven, M. 1999. *An Archaeological Ethnography of a Neolithic Community. Space, Place and Social Relations in the Burnt Village at Tell Sabi Abyad, Syria.* Istanbul: Nederlands Historisch-Archaeologisch Instituut

Verhoeven, M. 2002a. Rituals and Its Investigation in Prehistory. In: H. G. K. Gebel, B. D. Hermansen and C. H. Jensen (eds) *Magic Practices and Ritual in the Near Eastern Neolithic. (Proceedings of a Workshop Held at the 2nd International Congress on the Archaeology of the Ancient Near East (ICAANE), Copenhagen University, May 2000).* Berlin: Ex Oriente, pp 5-40

Verhoeven, M. 2002b. Ritual and Ideology in the Pre-Pottery Neolithic B of the Levant and Southeast Anatolia. *Cambridge Archaeological Journal* 12 (2), pp 233-258

Voigt, M. M. 1976. *Hajji Firuz Tepe: An Economic Reconstruction of a Sixth Millennium Community in Western Iran.* Unpublished PhD thesis, University of Pennsylvania

Voigt, M. M. 1977. The Subsistence Economy of a Sixth Millennium Village in the Ushnu-Solduz Valley. In: L. D. Levine and T. Cuyler Young (eds) *Mountains and Lowlands: Essays in the Archaeology of Greater Mesopotamia.* Malibu: Udena Publications, pp 307-346

Voigt, M. M. 1983. *Hajji Firuz Tepe, Iran: The Neolithic Settlement.* Philadelphia: The University Museum, University of Pennsylvania

Voigt, M. M. 2000. Çatalhöyük in Context: Ritual at Early Neolithic Sites in Central and Eastern Turkey. In: I. Kuijt (ed) *Life in Neolithic Farming Communities. Social Organisation, Identity, and Differentiation.* New York: Kluwer Academic Press, pp 253-293

Wahida, G. 1981. The Re-Excavation of Zarzi, 1971. *Proceedings of the Prehistoric Society* 47, pp 19-40

Watkins, T. 1990. The Origins of House and Home? *World Archaeology* 21 (3), pp 336-347

Watkins, T. 2002. Memes, Memeplexes and the Emergence of Religion in the Neolithic. In: H. G. K. Gebel, B. D. Hermansen and C. H. Jensen (eds) *Magic Practices and Ritual in the Near Eastern Neolithic. (Proceedings of a Workshop Held at the 2nd International Congress on the Archaeology of the Ancient Near East (ICAANE), Copenhagen University, May 2000).* Berlin: Ex Oriente, pp 41-47

Watkins, T. 2010. New Light on Neolithic Revolution in South-West Asia. *Antiquity* 84, pp 621-634

Watson, P. J. 1979. *Archaeological Ethnography in Western Iran.* Tucson: The University of Arizona Press

Watson, P. J. 1983. A Note on the Jarmo Plants. In: L. S. Braidwood, R. J. Braidwood, B. Howe, C. A. Reed, and P. J. Watson (eds) *Prehistoric Archaeology Along the Zagros Flanks.* Chicago: The Oriental Institute of the University of Chicago, pp 501-503

Weeks, L., Alizadeh, K., Niakan, L., Alamdari, K., Zeidi, M., Khosrowzadeh, A. and McCall, B. 2006. The Neolithic Settlement of Highland SW Iran: New Evidence from the Mamasani District. *Iran* 44, pp 1-31

Weinstein, M. 1973. Household Structures and Activities. *Anatolian Studies* 23, pp 271-276

Weiss, E., Koslev, M. E., Simchoni, O. and Nadel, D. 2004. Small-Grained Wild Grasses as Staple Food at the 23,000-Year-Old Site of Ohalo II, Israel. *Economic Botany* 58 (1 Supplement), pp 125-134

Weissner, P. 1974. A Functional Estimator of Population from Floor Area. *American Antiquity* 39 (2), pp 343-350

Wilk, R. R. and Rathje, W. L. 1982. Household Archaeology. *American Behavioural Scientist* 25 (6), pp 617-639

Willcox, G. 2002. Geographical Variation in Major Cereal Components and Evidence for Independent Domestication Events in the Western Asia. In: R. T. J. Cappers and S. Bottema (eds) *The Dawn of Farming in the Near East.* Berlin: Ex Oriente, pp 133–140

Willcox, G. 2005. The Distribution, Natural Habitats and Availability of Wild Cereals in Relation to Their Domestication in the Near East: Multiple Events, Multiple Centres. *Vegetation History and Archaeobotany* 14 (4), pp 534-541

Williams, S. J. and Crossly, N. 2008. Introduction: Sleeping Bodies. *Body & Society* 14 (1), pp 1-13

Wilson, P. J. 1988.*The Domestication of the Human Species.* New Haven: Yale University

Winter, J. 1983. Investigation of Plaster and Related Samples. In: M. M. Voigt *Hajji Firuz Tepe, Iran: The Neolithic Settlement.* Philadelphia: The University Museum, University of Pennsylvania, pp 337-338 (Appendix A)

Wright, G. A. 1971. Origins of Food Production in Southwestern Asia: A Survey of Ideas. *Current Anthropology* 12, pp 447-477

Wright, H. E. 1962. Pleictocene Glaciation in Kurdistan. *Eiszeitalter und Gegenwart* 12, pp 131-164

Wright, H. E., McAndrews, J. H. and van Zeist, W. 1967. Modern Pollen Rain in Western Iran and Its Relation to Plant Geography and Quaternary Vegetational History. *Journal of Ecology* 55 (2), pp 415-443

Wright, K. I. 1991. The Origins and development of ground stone assemblages in Late Pleistocene Southwest Asia. *Paléorient* 17 (1), pp 19-45

Wright, K. I. 1994. Ground-Stone Tools and Hunter-Gatherer Subsistence in Southwest Asia: Implications for the Transition to Farming. *American Antiquity* 59 (2), pp 238-263

Wright, K. I. 2000. The Social Origins of Cooking and Dining in Early Villages of Western Asia. *Proceedings of the Prehistoric Society* 66, pp 89-121

Yaeger, J. and Canuto, M. A. 2000. Introducing an Archaeology of Community. In: M. A. Canuto and J. Yaeger (eds) *The Archaeology of Communities. A New World Perspective.* London and new York: Routledge, pp 1-15

Young, T. C. 1987. Archaeology. Pre-median: History and Method of Research. In: E. Yarshater (ed) *Encyclopaedia Iranica.* Volume II London and New York: Routledge & Kegan Paul, pp 281-288

Yovsi, R. D. and Keller, H. 2008. The Architecture of Cosleeping Among Wage-Earning and Subsistence Farming Cameroonian Nso Families. *Ethos* 35 (1), pp 65-84

Zeder, M. A. 1999. Animal Domestication in the Zagros: A Review of Past and Current Research. *Paléorient* 25 (2), pp 11-25

Zeder, M. A. 2006a. A Critical Assessment of Markers of Initial Domestication in Goats (*Capra hircus*). In: M. A. Zeder, D. G. Bradley, E. Emshwiller and B. D. Smith (eds) *Documenting Domestication. New Genetic and Archaeological Paradigms.* Berkeley: University of California Press, pp 181-208

Zeder, M. A. 2006b. Central Questions in the Domestication of Plants and Animals. *Evolutionary Anthropology* 15, pp 105-117

Zeder, M. A. 2008. Domestication and Early Agriculture in the Mediterranean Basin: Origins, Diffusion, and Impact. *PNAS* 105 (33), pp 11597-11604

Zeder, M. A. 2009. The Neolithic Macro-(R)evolution: Macroevolutionary Theory and the Study of Cultural Change. *Journal of Archaeological Research* 17 (1), pp 1-63

Zeder, M. A., Bradley, D. G., Emshwiller, E. and Smith, B. D. (eds) 2006a. *Documenting Domestication. New Genetic and Archaeological Paradigms.* Berkeley: University of California Press

Zeder, M. A., Bradley, D. G., Emshwiller, E. and Smith, B. D. 2006b. Documenting Domestication. Bringing Together Plants, Animals, Archaeology, and Genetics. In: M. A. Zeder, D. G. Bradley, E. Emshwiller and B. D. Smith (eds) *Documenting Domestication. New Genetic and Archaeological Paradigms.* Berkeley: University of California Press, pp 1-12

Zeder, M. A. and Hesse, B. 2000. The Initial Domestication of Goats (Capra hircus) in the Zagros Mountains 10,000 Years Ago. *Science* 287, pp 2254-2257

Zeder, M. A. and Smith, B. D. 2009. A Conversation on Agricultural Origins. Talking Past Each Other in a Crowded Room. *Current Anthropology* 50 (5), pp 681-691

Zohary, M. 1963. On the Geobotanical Structure of Iran. *Bulletin of the Research Council of Israel* 11D (Supplement), pp 1-113

Zohary, D., Hopf, M. and Weiss, E. 2012. *Domestication of Plants in the Old World.* 4th edition. Oxford: Oxford University Press

van Zeist, W. and Bakker-Heeres, J. A. H. 1982. Archaeobotanical Studies in the Levant. I. Neolithic Sites in the Damascus Basin: Aswad, Ghoraifé, Ramad. *Palaeohistoria* 24, pp 156-256

van Zeist, W. and Bottema, S. 1977. Palynological Investigations in Western Iran. *Paleohistoria* 19, pp 19-85

van Zeist, W., Smith, P. E. L., Palfenier-Veyter, R. M., Suwijn, M. and Casparie, W. A. 1984. An Archaeobotanical Study of Ganj Dareh Tepe, Iran. *Palaeohistoria* 26, pp 201-224