CONSTRUCTING URBANISM
Relating the Construction of Architecture to the Process of Urbanization in the Middle Bronze Age Southern Levant

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Thesis Submitted to University College London for the Degree of Doctor of Philosophy

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JANUARY 2013
I, Robert S. Homsher confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.
ABSTRACT

In this thesis, I seek a framework for understanding urbanization during the early Middle Bronze Age in the southern Levant by identifying and investigating patterns in the archaeological record during the transition from non-urban society and culture to a system of urbanism. The broad focus of my research is how urbanization occurred during this period, by specifically addressing three questions: (1) how were urban settlements built, in terms of materials and building practices? (2) what was the energetic cost of building cities, and how was this construction organized, in terms of resources and labour? and (3) how does this process of construction relate to the overall organizational processes of urbanization? I investigate patterns in the process of construction during this period by detailing architectural innovations throughout the region within their chronological and stratigraphic contexts. My methods include compiling databases of the dimensions of different aspects of architecture at a number of sites, as well as a detailed sampling and geoarchaeological analysis of mud-bricks at three case-study sites (Dan, Megiddo and Pella).

By analysing bricks and reconstructing the process of their manufacture and use, I address the energetic cost of building cities, and how construction was organized, in terms of resources and labour. By highlighting the chaîne opératoire of urban construction, I indicate the key socio-economic mechanisms in practice during urbanization and identify degrees of social organization through labour and material resources. Patterns of labour management and modes of production provide a window into social processes otherwise difficult to perceive, including possible power structures and discrete social entities. Taken together with other aspects of technological innovation during this period, architecture allows for a discussion of urbanization as a process of developing social complexity that is based on patterns of standardization measureable through the archaeological record.
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ACKNOWLEDGMENTS

There are more people than I can possibly acknowledge for their roles as incredible friends, colleagues, teachers and mentors, all of whom have encouraged and supported me through my graduate studies. I am very grateful to the Institute of Archaeology at UCL for fostering a unique environment in which I was able to learn from and collaborate with brilliant people dealing with all manner of archaeological disciplines. More than any other person, I am extremely grateful for my primary doctoral supervisor, Professor Arlene Rosen, who diligently helped me turn my ideas into tangible research, and dedicated a considerable amount of time in doing so. With Arlene’s keen guidance and optimistic attitude, this whole process has been as constructive and enjoyable as I can imagine. I would also like to express my gratitude to my secondary supervisors, Professor Elizabeth Graham and Dr. Katherine Wright, for providing much needed perspectives toward my research.

For funding and support for some of my research, I thank the Institute of Archaeology, the GRSSC and Graduate School at UCL. My long-term involvement with Megiddo comes from the support of Tel Aviv University and The Megiddo Expedition, especially directors Israel Finkelstein, David Ussishkin and Eric Cline, whom I must thank for their commitment to my research and permission to take samples from the site. For my sampling at Pella I owe my sincere thanks to Stephen Bourke and the Pella Excavations for aid and permission to take photos and samples, and David Thomas for sending me additional samples for analysis. Likewise, I owe David Ilan my gratitude for his generosity in helping me acquire samples from Dan and permission to take photos. Furthermore, my brick analysis was only possible with the kind allowances from the Department of Antiquities, Jordan, and the Israel Antiquities Authority to export my samples for analysis in the UK.

I have been fortunate to have good family and friends to support, commiserate with, and distract me from my work. I offer my sincerest gratitude to all the loving and supportive members of my family, without whom I never would have made it this far. Jonny, thanks for letting me complain about my work and for encouraging me to get out of the flat from time to time. For sheltering me in my final desperate months, I cannot possibly express my gratitude to Dom and Ian, and Adi and Bart.

Finally, thank you, Melissa, for your love, support, and for teaching me what is truly important in life.
1. INTRODUCTION

The first episode of urbanism in the Levant began and ended in the Early Bronze Age (EB, ca. 3100 – 2300 B.C.E.) and, after a general hiatus of urban settlement that lasted for nearly four centuries, the beginning of the Middle Bronze Age (MB) again witnessed the development of complex society manifested in a prominent return to urbanism. This MB episode of urbanism was characterized by the florescence of monumental architecture in the Bronze Age Levant, with cities constructed on an unprecedented scale. These settlements were surrounded by imposing fortifications, and the monumental character of architecture has generally been considered the hallmark of the period (e.g. Dever 1987; Ilan 1995a, 297; Mazar 1990, 174). The marked shift from small-scale villages and pastoral-nomadic populations towards monumental construction at new and re-occupied settlements during this period was accompanied by new architectural innovations—especially in fortifications—as well as new strategies for urban planning and settlement expansion. The nature of this social transformation and the material culture it produced has evoked considerable interest in the period among modern scholars, particularly with enticing theories suggesting mass-migrations and widespread military conflict. Questions driving much of the scholarship over the past century have centred on how and why these settlements were built, by what labour-force and under whose control. These questions remain inadequately answered despite prior attempts that unfortunately operated under outdated theoretical paradigms and relied too heavily on historical and biblical interpretation.

Many studies have gone into detail describing general patterns of MB urban architecture (e.g. Burke 2008; Herzog 1997; Kempinski 1992a, 1992b; McLaren 2003; Wright 1985) and patterns of settlement (e.g. Cohen 2002; Kotter 1986; Ilan 1995a; Maier 2010; Stager 2001, 2002), focusing primarily on the physical manifestations of urbanism. However, there has been a discouraging lack of comparatively better explanatory approaches accounting for developing social complexity and conceptualizing urbanization as a social transformation. Comparatively better approaches towards aspects of socio-cultural development have been undertaken in the study of EB urbanization (e.g. Chesson & Philip 2003; Esse 1991; Finkelstein & Gophna 1993; Joffe 1991; Kempinski 1978; Levy & Holl 1988; Levy et al. 2002; Marfoe 1979; Miroshchedji 1989; Portugali & Gophna 1993; Stager 1985). Yet, despite this research, urbanization in the MB is often consequently treated with
an almost deterministic or cyclical attitude framing it as mere re-urbanization (e.g. Greenberg 2002, 3).

The possible impetus of MB urbanization has remained a matter of limited speculation based on interpretations dating from scholarship of the early- to mid-twentieth century, which was influenced by culture-historical perspectives on history. The earliest stages of archaeological theory explaining urbanization in the Levant generally revolved around progressive notions of social evolution and assumed diffusion of complexity from neighbouring civilizations (e.g. Childe 1950). These scholarly perspectives resulted in prevailing theories that the fall of EB and rise of MB culture resulted from Egyptian influence (e.g. Albright 1922; 1928; 1935; Mazar 1968) and/or immigrating populations from northern Syria (e.g. Kenyon 1957; 1966). In particular, many scholars (e.g. Albright 1922; 1935; Dever 1985; Kaplan 1975; Kenyon 1966; Parr 1968; Wright 1968; Yadin 1955; 1963) speculated the exogenous origins for the earthen ramparts that characterize most MB urban sites, pointing to Indo-Europeans, Amorites and/or Hyksos. Kenyon postulated that the beginnings of the MB could be attributed to an influx of population from the north, bringing with it a distinct material culture. Finding a likely historical candidate from contemporary Mesopotamian texts, Kenyon (1966, 33) hypothesised that the “Amorites” (or “Amurru”) had entered Canaan at the end of the EB, as identified through changes in ceramic styles and nomadic culture from EB IV through MB I. Kenyon’s ideas became adopted and supported by others, such as Albright (1965), Wright (1962), and Dever et al. (1970), thus establishing the so-called “Amorite Hypothesis” as the accepted explanation for the origins of the MB culture for years to come, and the term “Amorite” became a catch-all designation to include any number of regional and ethnic identities (Ilan 1995a, 301; Kamp & Yoffee 1980).

Later research (e.g. Gerstenblith 1983; Dever 1987; Weinstein 1975) began to take new interest in the origins and cultural development of the MB especially in light of ceramic typologies, reassessing previous notions of Egyptian presence in Canaan. Although migrations from Syria have continued to dominate many theories regarding the beginning of the MB, some work has pointed towards more indigenous origins of cultural development (e.g. Gerstenblith 1983; Tubb 1983), including Falconer and Savage’s (1995, 55) suggestion that MB urban centres developed out of a “rural complexity” rather than from external forces. Perhaps the most widely-referenced work on the MB is Ilan’s (1995a) overview of the period, in which he offers a balanced viewpoint acknowledging both internal and external forces behind urbanization:

The forces of culture change in Canaan in the Middle Bronze Age were, as they almost always are, a complex combination of exogenous and endogenous factors, with different inputs asserting themselves to varying extents at different times and in
different parts of the land . . . Certainly, individuals and groups of people with foreign origins can be detected in the archaeological record using defined criteria., while certain other developments—political integration and the evolution of fortifications for example—can be attributed to more local factors such as peer-polity interaction (Ilan 1995a, 297).

While to some degree early diffusionist sentiments have prevailed in the academic literature until today, potential exists for research to investigate urbanization in light of more critical social theory focused on understanding developing social complexity. A key avenue that may be explored to re-evaluate urbanization is the socio-economic organization of major construction projects alongside the many aspects of specialized craft production and technological innovation during the MB that are becoming increasingly apparent from modern research.

This study is not directly concerned with addressing why urbanization occurred, from a causal perspective, though this is certainly an intriguing and closely connected issue. Instead, the broad focus of my research is how urbanization occurred, by specifically addressing the following three questions: (1) how were urban settlements built, in terms of materials and building practices? (2) what was the cost of building the MB city, and how was this construction organized, in terms of resources and labour? and (3) how does this process of construction relate to the overall processes of urbanization? A comprehensive investigation and explanation of MB urbanization is too vast a topic to address in a single study, therefore my research endeavours to conceptualize one aspect of the overall process of MB urbanization in detail by investigating the process of construction during this period of social transformation. Some of the organizational processes that are involved in urban construction may be grounded in the archaeological record by investigating architecture, broadly, and more specifically analysing manufactured materials used in architecture, namely sundried mud-bricks.

Monumental architecture of the MB reflects a fairly unified cultural tradition shared by a region that was organized according to various social entities that have yet to be fully determined from archaeological perspectives. Based on the existence of broadly shared architectural traditions, the potential exists to investigate the degrees of standardized building practices within individual sites and between multiple sites, as well as discuss the overall scale of labour utilized in construction projects. At the same time, deviation from consistent construction patterns may suggest that different practices were employed during the urban construction process, therefore indicating various modes of organization and decision making in MB society.

A primary source of information abundantly available in the archaeological record to detect such patterns is the mud-brick. Mud-bricks are one of the most ubiquitous objects encountered in archaeological excavation yet, as commonplace and mundane as these
objects may seem, by analysing them it is possible to identify valuable information regarding their manufacture, and the ways in which builders used bricks in structures help to reflect construction strategies among and within sites. As human artefacts, mud-bricks reflect choices made by builders regarding source material, composition, size and final use within structures. These aspects of construction enable research into modes of specialized mass production as a means toward understanding some of the organizational principles within urbanization. The implications of mud-brick manufacture and usage also extend beyond the physical borders of a structure or settlement, since most of the raw material used in brick manufacture derives from the surrounding landscape. Therefore, mud-brick production is able to provide a window into human interaction with the broader landscape over time, and hold potential for reconstructing local agricultural ecology (Rosen 1986, 75), all of which aids us in reconstructing the greater system of urbanism.

Very generally speaking, mud-bricks within a single site are made using similar materials, to similar norms. Significant deviation from the general composition or dimensions of bricks at a single site may be indicative of a particular strategy or different types of labour organization. Brick-makers are most likely to have cast their bricks using their own moulds of similar dimensions in order to produce similar sized bricks for building walls of regular dimensions. Since brick-makers most likely used the same sets of moulds to produce bricks en masse, one should expect bricks to be of similar dimensions, having been formed by the same moulds. If there is great variation among the dimensions of bricks at one site, then bricks might have been manufactured by different brick-makers, from different materials (according to size-dependent constraints) or for different architectural purposes. Possible explanations for this variability could be rapid construction or perhaps less standardized brick manufacture spread over a greater number of smaller groups of labourers. One of the chief methods employed in this study is compiling a database of brick dimensions from throughout the Bronze Age Levant in order to determine any important patterns of standardization or variation regionally and diachronically. At a higher resolution, bricks sampled systematically from case-study sites are analysed according to dimensions and composition in order to identify patterns within sites.

By analysing bricks and reconstructing the process of their manufacture and use, it may be feasible to address questions regarding MB construction, specifically the cost of building the MB city, and how construction was organized, in terms of resources and labour. It is possible to quantify the construction of monumental architecture by its cost, in terms of labour, which provides a useful tool in reconstructing a key aspect of overall urbanization. Costs of construction may be calculated through (1) detailed reconstruction of the rates of labour for specific tasks related to brick manufacture (2) applied to estimated volumes of architecture, principally fortifications. By quantifying urban construction, it is possible to
conceptualize the scale of this physical aspect of urbanization, and identify types and degrees of social organization through labour and material resources.

Finally, in order to progress beyond merely discussing the physical manifestation of urbanization—namely the constructed urban settlement—and address the social aspects of this process, I investigate the socio-economic implications of the patterns interpreted from construction. The extent to which the process of construction illuminates our understanding of the social organization and agency of urbanization derives from identifying patterns of labour management and modes of production. These patterns provide a window into social processes otherwise difficult to perceive, including possible power structures, discrete social entities, and the nature and scale of the population and economy. By highlighting the chaîne opératoire of urban construction, I will indicate the existence of key socio-economic mechanisms in practice during urbanization. Considering the large scale of construction, I suggest that the process of construction may have facilitated and consolidated a number of important socio-economic processes occurring at large during urbanization. Thus, I will discuss whether urban construction may not have been merely a product of urbanization, but also an essential means to actualizing urbanism, both physically and socially.

BACKGROUND

Urbanization

The MB of the Levant, particularly the southern Levant, has been the subject of many general studies (e.g. Akkermans & Schwartz 2003; Bietak 2002a; Broshi & Gophna 1986; Cohen 2002; Dever 1985; 1987; 1997; Doumet-Serhal 2008; Falconer 1994; 2001; Fritz 1995; Gerstenblith 1983; Greenberg 2002; Herzog 1997; Ilan 1995a; Kempinski 1991; 1992b; Kenyon 1973; Kotter 1986; Maeir 2002; 2010; Magness-Gardiner 1997; Mazar 1990; Oren 1997a; Wapnish & Hesse 1988; Yasur-Landa et al. 2008). Despite their many contributions to knowledge about the MB, many of these studies have remained essentially descriptive in their approaches to social processes, ultimately recycling much of the same basic information from sites. A notable exception is Greenberg (2002), who applies social theory to the processes of urbanization during the Bronze Age, using the Hula Valley as a case study. Similarly, Herzog (1997) provides a background of theory and methods for urban archaeology (pp. 1-16) and succinctly discusses different approaches in light of the archaeological material he surveys through the volume (pp. 259-78). Although these studies serve as a useful background for entering a discussion regarding MB urbanization, it is necessary to look more broadly at the concept of urbanization.

Defining and discussing urban settlement and its social function have been topics of interest to a diversity of disciplines (e.g. anthropology, archaeology, architecture, art history,
economics, geography, history, sociology), among which the problem of defining the “city” has been addressed using wide-ranging approaches (cf. Carter 1983, 1-17; Clarke 1979, 436; Eisenstadt & Shachar 1987, 21-60; Wheatley 1972, 601ff). This study considers urbanization to be a complex, longue durée process that should be explained, not merely described as has been commonly done in academic literature, especially in the ancient Levant. Architectural elements of ancient cities (e.g. fortifications, monumental public architecture, streets) are designated as urban in form and contribute to urban function; yet such a designation ultimately fails to explain the processes by which the elements develop, or the dynamic system in which they function (cf. Wheatley 1972). For the sake of clarity in the present study, the following simplified definitions and distinctions will suffice.

The adjective “urban” describes centralized orientation (e.g. population, resources, ideology), an anthropogenically constituted spatial environment (i.e. formed by architecture and/or modified landscape), and certain social, political and economic functions. Urban activities and institutions affect a large hinterland outside of a central settlement (Smith 2001, 291), and the complex processes and systems that may be described as urban extend beyond the walls of a city. “Urban economy”, for example, applies to a structure incorporating the settlement, its hinterland and far-reaching networks of connection with other urban entities and various sorts of markets. “Urbanism” describes the process by which urban elements function and interact by providing a nexus for specialized networks of social, economic and political relationships, while maintaining a symbiotic relationship with a centre’s hinterland and external connections. Consequently, “urbanization” is the diachronic process of transformation from a non-urban system to urbanism, including (in no specific order): the migration of rural population (and accompanying resources) to a centre; the physical construction of that centre; the development of complex social power relations; and the aggregation of functionally-related institutions over time.

My research will focus only on the specific part of the process of urbanization in which an urban centre or city is constructed, and I acknowledge that there were a number of possible prime-movers (e.g. economic competition, prosperity, surplus, demographic stress, conflict) in action beforehand, which provided the impetus for urban construction. To borrow cultural evolutionary terms (e.g. Flannery 1972), I assume the development of a level of segregation (i.e. the existence of decision-making elites and/or groups), and rather focus on centralization through modes of production and the organization of labour. The most significant sense in which the present study seeks to conceptualize urbanization in ancient society is through the archaeologically visible built environment which, in turn, provides inferential value for the less visible social aspects of urbanization.

Some of the early steps toward systematically explaining Levantine urbanization include Kempinski’s (1978) study of the rise of EB urbanism, largely criticized for using
outdated anthropologic theory (cf. Dever 1981; Marfoe 1980), followed by Stager (1985), who discusses the foundations of EB economy and Egyptian contact with southern Canaan. As Greenberg (2002, 3) notes, the “historicist” (e.g. Esse 1991; Finkelstein & Gophna 1993) and “neo-evolutionary” (e.g. Joffe 1991; Miroschedji 1989) approaches that emerged following Stager’s work essentially view the process of EB urbanization as “secondary” rather than “pristine”, meaning that some of its characteristics probably derived from previously existing ideas of state-formation and urbanization primarily from exogenous sources.

A study by Portugali and Gophna (1993) represents an alternative approach in which urbanization arises from disjunctive evolution resulting from crisis or collapse (cf. Finkelstein 1995; Herzog 1997, 259ff). Marfoe (1979) provided an influential model for the evolution and devolution of social formations based on the notion of a pastoral-urban continuum. In this model, small-scale social organization has the advantage of being flexible enough to oscillate between different modes of subsistence, yet larger-scale organization may only be maintained under optimal conditions that are predominantly predicated by an ideology and/or power of centralization. In his discussion on the study of urbanism, Herzog (1997, 2-7) summarizes the state of research by presenting four different categories of approaches that have been implemented in scholarly literature: (1) ideal-type dichotomies, (2) evolution, (3) regional integration and (4) power-relations. Herzog ultimately prefers viewing the city as a “container of power” (after Giddens 1984, 262), emphasizing the role of institutional centrality as a trigger for social complexity, insisting that the spatial analysis of architecture may demonstrate power-relations within a settlement. He therefore analyses the city plan—and changes to the plan—in order to understand social organization and delineate socio-economic processes. The strength of this approach is the use of an abundant type of archaeological data, namely architecture, in order to discuss social dynamics. However, despite the potential of this approach, the ability to conduct systematic spatial analysis within settlements is hindered by the amount of exposure of archaeological remains at most sites, and Herzog relies too heavily on architectural reconstructions.

Although the predominantly mono-causal explanations that have prevailed in scholarship have their unique strengths, they are somewhat limited in their ability to address the broader context of complex socio-cultural interactions and change. The question of the origins and evolution of urban society has been explained by single factors such as surplus or other stress “prime-movers”, yet multi-variant approaches should be used to address change in complex systems.
Architecture

Many studies have addressed architectural typologies, technologies and styles during the Bronze Age throughout the ancient Near East, and this is often done on a relatively small scale in individual site reports. A few studies have undertaken systematic comparative approaches toward the topic of architecture, and sometimes building materials, on a regional scale in: Mesopotamia (Moorey 1994), Egypt (Clarke & Engelback 1990 [1930]; Hesse 1971; Kemp 2000; Spencer 1979), Anatolia (Naumann 1971) and the Levant (Barrois 1939; Herzog 1997; Kempinski 1991; Kempinski & Reich 1992; Stern 2001; Wright 1985; 2000a; 2005a; 2009). These studies are valuable for identifying important features, understanding settlement layouts and tracing patterns of change over time.

Wright (2000) is a foundational work surveying the historical background of technologies involved with construction across a number of periods and regions, and deals with these technologies by topic in subsequent volumes (2005; 2009) according to materials and construction practices, respectively. In a more geographically defined volume, and of particular value to the present study, Wright (1985) provides a detailed survey of building practices in southern Syria and Palestine. Among the most relevant topics included in his study, Wright discusses: elements of design, units of measure, architectural forms and types, urban fortifications, mud-brick construction, wall types and functions, and construction methods. Two studies with information relevant to the MB of the southern Levant are Herzog (1997) and Kempinski and Reich (1992), both of which are comprehensive volumes surveying sites in Palestine by period, noting architectural elements and discussing particular patterns. A more recent work dealing with architectural development in Minoan Crete is McEnroe (2010), which provides helpful insight into contemporary developments elsewhere in the eastern Mediterranean.

Among the various types of architecture from any urban MB site, a relatively large amount of information derives from fortifications. The fact that such a high portion of excavated architecture relates to fortifications should come as little surprise due to: (1) their high volume in comparison to any other type of architecture; (2) the particularly large size of most MB fortifications in comparison with other periods; and (3) their (often visible) prominence along the perimeter of most settlements. Such prevalence and usual ease of access has drawn the attention of archaeologists at the majority of excavated sites. Therefore, a number of studies have catalogued and typologically described various features relating specifically to fortification more than other types of MB architecture. One major feature of fortifications relatively unique to the MB, yet ubiquitous among sites throughout the Levant, is the so-called earthen rampart, which has been the subject of discussion in a number of studies (e.g. Burke 2008, 48-59; Bunimovitz 1992; Finkelstein 1992; Herzog
1997, 115-35; Ilan 1995a, 316-7; Kaplan 1975; Kempinski 1992a; Mazar 1990, 198-205; Parr 1968; Singer 1983; Stager 1991; Wright 1968). Some studies have undertaken further steps in understanding these earthworks by analyzing the materials from which they were constructed, paying particular attention to building strategies (Bullard 1970; Cremaschi et al. 2002; Lavee et al. 1993; Pennells 1983).

Two recent works have contributed significantly to the subject of MB fortifications in the southern Levant. McLaren (2003) provides a very useful synthesis of MB fortification architecture in Jordan, in which he defines and details features from many sites, focusing on Rukeis and Pella as detailed case studies. In this volume, McLaren covers the background and development of fortifications in the greater Levantine region and discusses specific features as part of a comparative study covering sites from throughout the Levant.

The most notable contribution to be made specifically to MB fortifications and building practices is Aaron Burke’s (2008) study on the evolution of MB fortification strategies in the Levant. In this volume, Burke discusses warfare and defensive architecture within the context of the period and provides a comprehensive catalogue of sites and their architecture from northern Mesopotamia, the Levant and Egypt. One of the primary purposes of the study is to understand the socio-economic impact of constructing fortifications, specifically earthen ramparts and fortification walls. Burke builds on other relevant studies, most of which address similar questions but are specific to certain sites (e.g. Biran 1990, 65; 1994, 71; Finkelstein 1992, 208ff; Herzog 1989, 32; Mazar 1997a, 250; Oren 1997b, 257; Zettler 1997, 170f, n. 42). Based on such studies in conjunction with his own volumetric estimates of architecture and rates of labour, Burke suggests construction rates and labour consumption for building fortifications, and presents a few scenarios for this process.

Burke’s study undoubtedly provides an important foundation for my present research and has certainly helped shape my research questions, some of which arose from critical observations of his work. Despite the contribution he makes to quantifying MB construction, some of Burke’s conclusions are problematic. Relying too heavily on historic Mesopotamian parallels, Burke assumes an unrealistic level of socio-political complexity for the early MB Levant, ultimately concluding that the construction of fortifications was carried out by (in his order of likelihood): (1) the army, (2) corvée labourers and (3) hired labourers (2008, 143). The major flaw in this conclusion lies in the fact that before urbanization occurred, and during its nascent state, there probably would not have been any such socio-political entities large or powerful enough to have a standing army, command corvée labour or hire hundreds of labourers in such a manner as in contemporary Mesopotamia. As indicated by the Execration Texts, urbanism in the MB Levant seems to have developed out of tribal units (Bunimovitz 1992, 227), which was doubtless a very
different set of socio-economic conditions from the complex bureaucracies of Mesopotamia. Burke’s study suffers considerably from the fact that it focuses on MB fortification architecture in isolation from other major socio-cultural developments during the period, and therefore lacks crucial contextual insight. No study thus far has fully utilized the available archaeological record in order to systematically address how construction and labour were managed and organized, according to what patterns, and in what ways the process of construction might have related to the socio-economic system during the urbanization process of the early MB.

Bricks

Earth, in its various forms, is one of the oldest building materials utilized by humans and has certainly been the most widespread building material throughout the world, even into modern periods. Earthen construction occurs in a number of forms, according to varying terminologies, including: wattle-and-daub, layered mud, rammed earth (or terre pisé), mud brick and mud ball (cf. Van Beek & Van Beek 2008, 2-4). A term frequently employed to cover all manner of mud used in construction is adobe, which is a Spanish word derived from the Arabic at-tob, literally meaning “the mud” and generally referring to mud in an architectural sense. Many individuals prefer “adobe” as a technological term rather than mud (e.g. Politis 1993; 1999; Houben & Guillaud 1994; McHenry 1984). However, I prefer using the term “mud” (meaning the mixture of earthen sediment with water and potentially other materials), simply because it aligns most consistently with the literature regarding the Bronze Age Levant in order to avoid confusion. Technically speaking, this study is concerned primarily with the form-moulded (or mould-made) mud-bricks that were commonly used in the Near East beginning around the Chalcolithic Period, succeeding the use of hand-moulded bricks of various types that appear to have been used from the Epipaleolithic Period (Van Beek & Van Beek 2008, 7ff; Kenyon 1981, 18, 225, 675-76). Although the full archaeological potential of mud-brick study has been greatly neglected in the past (Reich 1992, 7), some progress has been made in recent years.

Studies concerned with earthen materials used in architecture have been informative with regard to technological practicalities involved with mud-brick manufacture and use in many different contexts (e.g. Houben & Guillaud 1994; Keefe 2005; McHenry 1984; Norton 1997). Van Beek and Van Beek (2008) provide an overview of many types of mud-related architecture across a variety of geographic areas and chronological periods, demonstrating the wide diversity of architectural potential using earthen materials. The most useful contributions from this volume include: terminology (pp. 2-4), a discussion of inherent advantages of earthen architecture (pp. 19-39), a discussion concerning raw materials and manufacture of bricks (pp. 129-58), and construction techniques using mud-brick (pp. 258-
Hasan Fathy’s (1969; 1973) informative account of rediscovering traditional building practices using mud-brick in recent Egypt provides considerable insight into many practicalities, such as the planning and building process, as well as the advantages and disadvantages of certain architectural designs and elements. Among the most informative details are the appendices, in which Fathy provides detailed costs and estimates for labour and material and the rates at which tasks might be completed (1969, 251ff). Politis (1993; 1999) provides a broad-ranging study of the use of adobe in the Jordan Rift Valley, covering prehistoric to contemporary practices. In addition to Politis’ primary contribution of ethnoarchaeological data concerning brick manufacture and use, he also combines a number of analyses and observations (i.e. particle-size analysis, tests of the compression strength, mineralogy and impressions of grain/vegetal matter).

In terms of the manufacture and use of mud-brick in the ancient Near East, there have been a number of general studies that provide a basis for further research (e.g. Barrois 1939; Clark & Engelbach 1990; Delougaz 1933; Emery 2009; Freisem et al. 2011; Glueck 1940; Kemp 2000; McHenry 1994; Nims 1950; Oates 1990; Reich 1992; Sauvage 1998; Schaub 2007; Spencer 1979), but only a limited number of studies that involve systematic analysis of particular sets of material. Schaub (2007) briefly discusses the social organization that might be required to build the mid-brick town walls that emerged in EB I-II in the southern Levant, estimating the number of bricks that might have gone into such construction. Moorey (1994, 302-9) provides a general description of the process of mud-brick manufacture and the basic composition of bricks, and makes some observations regarding the emergence and development of bricks over time in Mesopotamia. Kemp (2002) provides similar details regarding mud-bricks in Egypt, going into more detail concerning sediment composition by discussing the results from studies done by French (1981; 1984) at East Karnak and Amarna, and likewise discussing the dimensions of bricks based on Hesse (1970; 1971) and Spencer (1979). In addition to discussing brick dimensions in ancient Egypt, Spencer (1979) provides a number of technical details regarding mud-brick architecture, with a useful catalogue of brick bonding techniques. Although interest in brick dimensions has been demonstrated by these studies in Egypt, only certain early excavators were careful to catalogue the dimensions of mud-bricks in the Levant (e.g. Petrie 1931; Schumacher 1908, 29ff; Sellin & Watzinger 1913).

A few studies have endeavoured to analyze mud-bricks using various types of micromorphological, XRF or XRD techniques in order to identify brick compositions, types and potential sources for material. An example of micromorphological analysis of mud-brick is Goldberg’s (1979; 2004) analysis of brick and potential source material from Lachish. Although Goldberg implements a viable analytical method for describing the composition and possible source of the sediment used bricks, since he only analyzes one
whole brick and another brick fragment his sample does not account for the variety of bricks at a given site. Nodarou et al. (2008) undertake a fairly comprehensive set of mineralogical and chemical techniques of analysis of bricks from Bronze Age Crete, suggesting interesting anthropological implications, yet the archaeological and architectural contexts of the bricks do not factor greatly in the discussion. Similar techniques have been used in Egypt by Emery and Morgenstein (2007) at El Hibeh, where they were able to identify two geochemical groups of bricks, and by Morgenstein and Redmount (1998) at Tell el-Muqdam, where they identified four types of bricks derived from two geochemical sources. Although these studies provide useful conclusions regarding brick composition and potential patterns of manufacture, since the immediate archaeological contexts and architectural function of the bricks sampled do not factor into the discussion, these studies fail to address the anthropological significance of the process of manufacture and construction, the implications this process might have on society, and what patterns within this process can tell us about social development.

The foremost analysis of mud-bricks from archaeological contexts is Rosen’s (1986) study, in which she tests the variability of brick composition at Lachish (with additional comparisons from Batashi and Qasile) by analysing brick samples from different contexts. After comparing brick samples with modern sediments from the surrounding environment, Rosen divides the brick material into different groups of source types (1986, 76-77): (a) colluvium from the hill slope on the plain surrounding the site, (b) tell colluvium from the plain at the base of the site, (c) wadi alluvium, (d) occupational debris from the tell itself, and (f) loess. The archaeological exposures at Lachish from which Rosen was able to sample ranged from Level VIII (MB II) to Level II (Iron Age) and consisted of various types of structures. From these structures, she took representative samples of homogeneous and heterogeneous in-situ bricks within walls. Analysis of the samples includes grain-size percentages, mean grain size and sorting, and qualitative description of the sediment composition. Based on the patterns that emerged from the results of her analysis, Rosen discusses potential implications of energy expenditure for different types of architecture and demonstrates the wealth of information that may be derived from bricks. Rosen’s study serves as a major foundation for my current research, especially regarding the method used for my analysis of mud-brick composition.

CONTRIBUTION

In addition to providing an up-to-date synthesis of general information regarding the MB southern Levant and Bronze Age building practices, my research makes a number of original contributions to the field of Bronze Age Near Eastern archaeology, and beyond. As
part of the research for this study, I have compiled databases of metric data from many sites throughout the Levant, covering multiple periods of the Bronze Age, including the dimensions of mud-bricks and structures (see Appendix 2). I introduce a field method for sampling mud-bricks, as well as analytical methods for assessing bricks according to both their dimensions and composition. The data derived from my case studies provide a systematic set of mud-brick data that is capable of addressing anthropological questions regarding the organization of labour during construction projects. From these data, I identify meaningful patterns and offer interpretations of key organizational aspects of the process of construction, with both site-specific and regional implications. As a compliment to these data, I also contribute a thorough examination of the rates of labour and other constraining factors for mud-brick construction based on historical texts, ethnographic studies and experimental archaeology, which enable refined reconstructions of the construction process.

Perhaps the most important original contribution of this study is my discussion of bricks, architecture and urbanization within the context of technological innovation by assessing mud-bricks according to standardization as a measure of specialized production in order to conceptualize and interpret social complexity. As far as I am aware, this is the first study attempting to discuss architecture and its construction in terms of modes of production, which is usually reserved for other classes of artefacts, such as ceramics. Taken together with other aspects of technological innovation during this period (e.g. ceramics, metallurgy, textiles), architecture allows for a discussion of MB urbanization as a process of developing social complexity that is based on patterns of social organization measureable through the archaeological record.

Of course, since this study is the first to apply many of these methods to such sets of data and overall anthropological questions, much of the content of the present work should be considered as preliminary. What follows is the succinct attempt to apply my research methods to the question of MB urbanization and articulate some significant results and implications for the field of study.
STRUCTURE OF THE STUDY

In order to situate the study in its appropriate context, Chapters 2 through 5 provide necessary background information regarding the MB and aspects of urbanization during the period. Chapter 2 introduces the broad context of the southern Levant during the MB, including an overview of the geography of the Levant, chronological divisions and terminology, and settlement patterns during the early MB. Chapter 3 describes building materials and practices during the MB, with a particular focus on raw materials, mud-brick manufacture, mud-brick architecture and units of measurement. Chapter 4 details the different types of architecture attested during the MB, including the many elements of fortifications, public and private structures, and urban planning. Focusing on more specific contexts, Chapter 5 reviews the early MB architecture and settlement layouts of 13 sites (including the three case studies) that are representative of all the regions (and most sub-regions) in the southern Levant that are relevant for discussing urbanization in the early MB, providing spatial and temporal contexts for the overview of material in the previous chapters.

The second half of the study presents my analytical methods and datasets, summarizes the analysis of the data and enters theoretical discussion regarding MB urbanization in light of the results. Chapter 6 describes the metric and geoarchaeological analytical methods I carried out, and explains the sampling procedure for the case studies. Chapters 7 and 8 discuss the results of the analyses and the patterns derived from them, offering some preliminary interpretations. Chapter 9 goes into detail regarding the process of construction, providing rates of labour for different tasks associated with manufacturing architecture, and ultimately estimates the costs of construction for the case studies using architectural energetics. Finally, Chapter 10 provides the major discussion of MB urbanization as developing social complexity in light of technological innovation, standardization and specialized production. In this chapter, I consider architectural data from the study alongside other cultural aspects of the early MB in order to highlight the prevalence of technological innovation as part of urbanization and its contribution towards social complexity as seen through modes of production and standardization.

The appendices in Volume 2 include all the relevant data from my study, and are organized into two main appendices. Appendix 1 contains all of the data regarding the samples and analyses for the case studies. Appendix 2 contains all of the metric architectural data, including mud-bricks (2.1), widths of walls (2.2) and dimensions of architecture (2.3). These appendices consist of detailed tables and charts, results of analytical procedures for the case studies, and statistical descriptions of the data.
2. CONTEXT OF THE STUDY

In order to contextualize the research questions of my study, it is important to summarize the most relevant aspects of geography and chronology pertaining to the specific areas of research, as well as highlight socio-cultural developments regarding settlement patterns and material culture. The geography of the Levant, the chronology of the Bronze Age and phases of MB developments suffer from convoluted terminologies that are often used uncritically and/or interchangeably. Therefore, this chapter clarifies the meaning and use of the terms and divisions as they are employed in the present study, and synthesizes key aspects of the period from the most recent scholarship.

GEOGRAPHY AND GEOLOGY

Stretching along the eastern shoreline of the Mediterranean Sea, the Levant is generally a patchwork of small regions defined by minor topographic barriers. Yet, in very general terms, the Levant is greatly shaped by a macro-scale geological feature known as the Great Rift Valley, which runs parallel to the sea along with laterally segmented mountain ranges that are further dissected by seasonal wadis.

Figure 1. Google map of the eastern Mediterranean, with an approximation of the southern Levant outlined in red.

The northern Levant consists of a coastal plain in the west, mountain ranges bordering the west of the Great Rift Valley and inland steppe to the east. Fertile areas in the north include valleys fed by the Orontes River, which derives from the Lebanon. To the east lies the Syrian Plateau, consisting mostly of desert (e.g. Homs, Hamad and Palmyra Deserts) with mountain transects (i.e. Jabal ar Ruwaq, Jabal Abu Rujmayn, Jabal Bishri) and bordered by the
Euphrates River to the north and east. Further south, the Beq’a Valley forms part of the Great Rift Valley, bordered by the Anti-Lebanon and Lebanon Mountains to the east and west, respectively. The Hauran Plains merge with the Damascene east of the Anti-Lebanon Mountains while the Lebanon Mountains rise dramatically, descending westward to the Coastal Plain.

In the southern Levant, the Great Rift Valley creates a division resulting in the Cisjordan (essentially Israel-Palestine, see Orni & Efrat 1973) in the west and the Transjordan (i.e. Jordan) in the east. The Cisjordan may be further subdivided into three roughly longitudinal strips: the Coastal Plain(s), the Highlands and the Jordan (Rift) Valley (cf. Orni & Efrat 1973, 5ff). West of the Jordan Valley, the Central Highlands rise and fall southward to the Negev Desert and westward to the Shephelah, an area of rolling hills. The highlands also continue northwest, forming the Carmel Ridge that extends to the Coastal Plain with a patchwork of inland valleys in the north. Eastward from the Jordan Valley, the Jordanian Plateau runs parallel to the valley and highlands to the west, and is characterised by wadis and rolling hills beyond which lie desert to the east and south, and the Hauran Plains to the northeast.

Since this study deals with the southern Levant, the following description will provide an overview of the three distinct sub-regions that feature most prominently in later discussion: the Coastal Plain, the Jordan Valley and the Jezreel Valley.

The Southern Levant

The Coastal Plain

The Coastal Plain borders the Mediterranean Sea and is interrupted in only two places, resulting in a common division between the Northern and Southern Coastal Plains. The distribution of coastline along much of the southern Levant allowed for important maritime interaction with the Eastern Mediterranean world, and provided easy land-based travel along the plain as an alternative to the highlands further inland. Many streams transect the Coastal Plain, flowing from the hills to the east, and there is ample groundwater. Generally speaking, sandstone (kurkar) ridges tend to run along the shore, helping prevent ingress of sands into the plains. The Northern Coastal Plain (and southern Levant) terminates at Rosh ha-Niqra, a cape with high cliffs, and continues southward until it becomes interrupted by the cape of Mount Carmel. From north to south the plain consists of the Akko Plain and the Haifa Bay. The sediments consist of alternating calcareous sandstone, red loam (hamra), dark clay, and un-cemented sand (Sivan et al. 1999, 280). The Southern Coastal Plain is mostly wider than its northern counterpart (Orni & Efrat 1973, 35) and consists of the Sharon, Judean Coast, Philistian Plain and Negev Coast. Between the shoreline and inland plain lie intermittent belts of sand dunes that are broader in the south.
and almost non-existent in the north. Sandstone ridges rise further inland beyond the sand dunes, with the fertile soils of the inland plains stretching to the hills in the east.

Figure 2. Maps of the Coastal Plain (left), Highlands (centre) and Jordan Valley (right) in the Cisjordan of the southern Levant, adapted from Orni and Efrat (1964, Figs. 20, 27, 41).

The Jordan Valley

The Jordan Valley is typically divided into three main parts with further subdivisions: (1) the Upper Jordan Valley, including the Hula Valley, Rosh Pinna Sill and Jordan Gorge; (2) the Central Jordan Valley, including the Kinnarot Valley (in which are Lake Kinneret and the Yarmuk River) and Beth Shean Valley; and (3) the Lower Jordan Valley, which extends to the Dead Sea. Of greatest importance to the following discussion are the Hula and Beth Shean Valleys.

The Hula Valley (or Basin) is demarcated by the mountains surrounding it: (1) the Naftili in the west, (2) the Herman Massif on the northeast and (3) the Golan Plateau to the east. To the north and south the Great Rift Valley continues into the Metulla Hills and Rosh Pinna Sill, respectively. The area is fed by abundant water sources and since prehistoric times the basin has experienced various degrees of swampy conditions that have considerably affected settlement and agricultural strategies (Greenberg 2002, 11-23). The
northern extent of the valley provides a key inland transportation route to inner Syria and beyond.

The Beth Shean Valley runs horizontally across both sides of the Jordan River from Gesher in the north to Wadi Malih in the south (see Nir 1989). Clear geographic, environmental and cultural similarities exist on both sides of the Jordan River, and contrary to modern political boundaries, there is little reason to suppose that it imposed any sort of border during the Bronze Age (Maeir 2010, 20). The eastern geographic boundary of the Beth Shean Valley is clearly defined by the Hills of Gilead, however the western boundary remains fairly ambiguous since it is contiguous with Harod Valley, beyond which lies the Jezreel Valley. Nonetheless, the Harod Valley is narrow (possibly much narrower in antiquity) and formed by the base of the Gilboa Mountains, providing a topographic, albeit somewhat arbitrary, boundary. The connection with the Jezreel Valley, beyond which lies the Haifa Bay, provides the only viable access to the coastal sphere of interaction for the Jordan Valley. The Beth Shean Valley is rich in water sources, receiving several tributaries and having many springs (with high salinity, however, rendering their usefulness for irrigation negligible [Maeir 2010, 27]).

The Jezreel Valley

The Jezreel Valley lies between the Central Highlands to the south and the hilly Galilee to the north. The valley itself is roughly triangular, surrounded by: (1) the foot of the Nazareth Ridge in the northeast; (2) the low Shefar’am Hills in the northwest; (3) the Carmel Ridge and the Menashe Region to the west; (4) the Irron Hills of Samaria to the south; and (5) the edge of the Gilboa to the east. The north-western end of the Jezreel Valley is connected to the Northern Coastal Plain by the Zebulon Valley, and its south-eastern end is connected to the Beth Shean Valley by the Harod Valley. The elevation in the centre of the valley is about 100 m above sea level, grading to sea level in the west and dropping to 200 m below sea level in the east as it approaches the Jordan Valley via the Harod Valley. The flat alluvial plain within the Jezreel Valley has often been referred to as the Esdraelon Plain, through which the Qishon flows from its source at Gilboa to its outlet in the Haifa Bay. The Jezreel Valley serves as an important transportation route connecting the Northern Coastal Plain to the Jordan Valley, bisecting the hills that dominate the topography of the region. In addition to connecting a number of sub regions, the valley also formed a crucial segment of the ancient transportation highway that ran along the eastern Mediterranean coast, but was forced inland via the Jezreel Valley due to the Carmel. Later known as the Via Maris, this transportation route connected Egypt with the Levant, Mesopotamia and Anatolia.
Environment

The southern Levant is situated at a transition zone between the extreme desert areas of the Saharan type in the southern Mediterranean and Arabian Peninsula to the east, and the relatively more moderate Mediterranean zone in the north. Boundaries between arid and moist areas within the southern Levant are influenced greatly by the diverse topography that, in turn, influences local climatic conditions. The high levels of climatic diversity result in many varieties of flora and vegetation within a rather small geographic area (Danin 1995, 24). The soil types throughout the southern Levant likewise reflect climatic variations and localized effects of topography and bedrock. Deriving from late Quaternary geomorphological processes, the main mesomorphic soils of this region include: terra rossas, rendzinas, brown Mediterranean (e.g. Luvisols, Phaeozems) soils, protogrumusols (i.e. Cambisols, Lithosols), grumusols (i.e. Vertisols), hamras (i.e. Luvisols) and sandy (i.e. Arenosols) soils (Shapiro 2006, 1170f). In moderate hilly areas that characterize much of the center and north, non-calcic terra rossa soils occur on calcareous parent material and brown Mediterranean soils on basalts; in low plateaus and plains, vertisols, red sandy loams (hamra), and dark brown soils occur (Goldberg 1995, 40). Geomorphologically, the majority of sediments in areas of MB settlement derive from alluvial and colluvial processes, and relate to alternating dry-erosional and wet-aggregating episodes from the late-Pleistocene and early Holocene (cf. Rosen 2006; Goldberg 1994; Issar et al. 1992). Most of the temperate ecological/agricultural zones in the southern Levant are rainfall dependent. As with the natural environment, the climate of the Coastal Plain and Jezreel Valley belongs to that of the Mediterranean, which may be characterized by a rather short, mild and rainy winter, and a long, warm and dry summer (Horowitz 1979, 28). The Mediterranean climate witnesses annual rainfall in the range of 400-1200 mm, with Coastal Plain of the southern Levant lying within a narrower range of 400-700 mm and the Jezreel Valley nearer the range of 500-800 mm (Horowitz 1979, 22, 28). The Jordan Valley covers an area of diverse geographic and environmental settings, from an almost sub-alpine zone (the Hermon Massif) in the north to a fully arid zone in the south, and bordering various environmental zones with shifting boundaries (Maeir 2010, 15, 18). These climatic conditions may also generally apply to the second millennium B.C.E., which was similar to the present day (Kotter 1986, 80ff; Maeir 2010, 25; cf. Migowski et al. 2006; Schilman et al. 2002). This varied landscape of the southern Levant provided environmental niches that could support a range of subsistence crops. However, quite unlike the irrigation-fed agricultural zones in neighbouring Mesopotamia and Egypt, the Levant was more heavily impacted by periodic droughts. An exception to this trend may have been the North and Central Jordan Valley which, as Maeir (2010, 15) notes, stands out as one of the few zones
in the region with potential irrigation-based agriculture. Without the hydraulic regimes of
the early EB, which enabled some floodwater farming from rich wadi alluvium (Rosen
1991; 1997), MB agriculture was essentially based on dry-farming. With less predictability
and productivity involved in dry-farming compared to irrigation, and fairly restricted total
arable land (as compared to the northern Levant), urban societies in the MB must have had
effective strategies to cope with the high demands of agricultural intensification required by
a sizeable population.

“Canaan” and “Canaanite”

As a geographic designation, the “southern Levant” suggests a part of a greater
whole, namely the Levant. This relationship is certainly accurate, geographically, and also
possibly appropriate in a cultural sense. However, the southern Levant is also a distinct
region, both geographically and culturally, to which a number of specific designations may
apply at different scales and according to chronological periods. The term “Canaan” is an
acceptable geographical description of the area of study (e.g. Ilan 1995a, 297), since it has a
generic inclusive meaning that is also distinct to the entire area; furthermore, the term both
predates and supersedes more politically or religiously sensitive terms (e.g. Palestine, Israel,
Jordan, the Holy Land). Also, “Canaanite” seems to be an appropriate generic term for the
culture and people inhabiting this area during the Bronze Age periods. Thus, where
appropriate, the terms Canaan and Canaanite will be used in this study in addition to more
general or specific terms.

BRONZE AGE CHRONOLOGY

Relative Chronology

Bronze Age chronology in the Levant broadly follows the generic conventional
division of Early Bronze Age, Middle Bronze Age and Late Bronze Age (LB), all of which
covers a span of roughly two millennia from the end of the fourth millennium B.C.E. until
the end of the second millennium B.C.E. This tripartite division includes further sub-
divisions, some of which are generally standard across the Levant and others that are more
specific to sub-regions or sites. It is important to bear in mind that any such chronological
divisions are based on our best understandings of the relative chronology of cultural
assemblages, and are ultimately artificial designations created and used by archaeologists for
reference. Ancient populations certainly would not have been conscious of whichever of our
periods in which they lived, and the beginning or end of any particular chronological
division cannot be viewed as a determining factor in social change. Therefore, in
approaching the chronology of the MB of the Levant, it is essential to realise that our
resolution and understanding of cultural phenomena are limited at best, which means we should exercise a degree of caution when making claims about social transformations. Furthermore, we should observe that the stratigraphic and relative chronological interpretations from sites may be dubious at times, yet the views of the primary excavators must be accepted in most cases, pending further revaluation.

The chronological terminology for the MB, and the period directly preceding it, particularly in the southern Levant, has been a matter of confusion in recent decades and therefore requires a brief explanation. Most of the confusion began with Albright (1933), who used both “EB IV” and “MB I” as terms for roughly the same period of time, but for two separate cultural identifications; following this, the distinctly MB period then received the designation of “MB II”. Later scholars (e.g. Dever 1980; Kenyon 1973) suggested the use of “Intermediate Bronze Age” (IB), highlighting it as a distinct period while also implying a level of both continuity and discontinuity with the EB and MB. Following the scheme most commonly used in recent scholarship, the terminology adopted in the present study is that of MB I, II and III (traditional MB IIA, IIB and IIC). I view the MB as a socio-cultural phenomenon different from the preceding period, which will be referred to as the IB (e.g. Ilan 1995a, 297; Dever 1987, 149-50; Gerstenblith 1983, 2-3; Gophna 2009). Although the chronological divisions and terminology used by authors may vary, all references and citations from other works in this study will be adapted (as much as possible) to conform to this chronological scheme.

<table>
<thead>
<tr>
<th>Southern Levant (Current)</th>
<th>Approx. Dates (B.C.E.)</th>
<th>Southern Levant (Traditional)</th>
<th>Northern Levant</th>
<th>Egypt</th>
<th>Mesopotamia</th>
</tr>
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<tbody>
<tr>
<td>IB</td>
<td>2400/2300 – 1920</td>
<td>MB I, EB IV or IB</td>
<td>EB IV</td>
<td>First Intermediate Period</td>
<td>Isin-Larsa</td>
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<td>1920 – 1750</td>
<td>MB IIA</td>
<td>MB Ia</td>
<td>12th Dynasty</td>
<td>(S) Old Babylonian</td>
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<tr>
<td>MB II</td>
<td>1750 – 1600</td>
<td>MB IIB</td>
<td>MB Ia</td>
<td>13th Dynasty</td>
<td>(N) Old Assyrian</td>
</tr>
<tr>
<td>MB III</td>
<td>1600 – 1530/1470</td>
<td>MB IIC</td>
<td>MB Iib</td>
<td>Second Intermediate Period</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Chronological terminology for the MB Levant and adjacent regions, based on the low chronology (after Bietak 2002b; Bietak & Höflmayer 2007; cf. Maeir 2010, 127-29; Marcus 2010). The terminology used in this study is in the left column. Note that since the absolute dates correspond to the divisions specific to the southern Levant, the corresponding designations for other regions are approximate.

The chronological focus of this study is from MB I through the MB I/II transition, during which period of time urbanization essentially began in most regions of the southern Levant. The research questions regarding patterns of organization and construction are
significant for nascent urbanization, because they apply most significantly to a society under transformation rather than one already in a state of urbanism. The value of asking questions of the earliest stage of urbanization is in an attempt to explain how urbanization might have occurred in the first place. After the earliest phases of urbanization, an urban system and social complexity existed, from which a different set of social processes developed and to which different research questions may apply.

The long stratigraphic sequences of many urban centres of the MB provide the backbone of a local relative chronological sequence, to which other short-lived contexts may be related (Marcus 2002, 95). The construction of local sequences is based on ceramic assemblages from many sites. These sequences are greatly aided by the widespread phenomenon of intramural burials during the MB (Ilan 1995b; Gerstenblith 1983; Hallote 2001), providing both a stratigraphic link with occupational sequences and key assemblages for establishing ceramic typological sequences (Marcus 2002, 95). At present, perhaps the most important relative ceramic sequence for the MB I – MB I/II comes from Tel Aphek, where a four-phase scheme has been derived from excavation (Beck 2000; Cohen 2002; Kochavi & Yadin 2002; Yadin 2009). This sequence at Aphek has superseded that at Megiddo which, despite attempts to refine MB stratigraphy (Kenyon 1958; 1969; Dunayevsky & Kempinski 1973; Gerstenblith 1983; Kempinski 1989; Hallote 2001), poses many stratigraphic challenges to interpreting any confident ceramic sequence. The MB I material from Tel Ifshar promises to help refine both relative and absolute chronology of this period. Excavations at Ifshar have discovered a provisional eight architectural phases (Paley & Porat 1993; 1997) with rich ceramic assemblages from non-mortuary contexts (Marcus 2002, 96; Marcus et al. 2008a; 2008b). Finally, the most recent major contribution to the regional ceramic sequence is Maeir’s (2010) comprehensive study of the MB material of the Jordan Valley.

**Absolute Chronology**

In lieu of its own historical sequence, the absolute chronology of the MB Levant has relied heavily on parallels with Egypt in the past (Weinstein 1992). These parallels include the excavations at Tell el-Daba (Bietak 1991; 1997), the presence of Levantine Painted Ware ceramics in Egypt (Arnold et al. 1995; Bagh 1998; 2000; 2003; Czerny 1998; Tubb 1983) and Egyptian imports in the Levant (Paley & Porat 1993; 1997; Marcus et al. 2008a; Weinstein 1992). The dates for chronological divisions used in this study follow the “Synchronization of Civilizations in the Eastern Mediterranean in the Second Millennium B.C.” (SCIEM 2000) research initiative (Bietak 2002a; 2002b; 2003; 2007) low (or “ultralow”) chronology as a general guideline. The effort of the SCIEM 2000 has been to synchronize chronology, both relative and absolute, of the Second Millennium B.C.E.
throughout the Eastern Mediterranean world (Bietak 2000b), particularly focusing on the Levant and Egypt (e.g. Kitchen 2000; 2007), but also accounting for Mesopotamian synchronization with the Levant (e.g. Gasche et al. 1998).

Until recently, the standard accepted date for the beginning of the MB in the southern Levant was toward the early part of the 20th century B.C.E. (e.g. Dever 1997). However, the Low Chronology argues for a later onset toward the very end of the 20th and/or early 19th centuries B.C.E. (Bietak 2002b, 40-42). Maeir (2010, 127-28) presents a number of arguments for the preferred dating of the beginning of the MB in the southern Levant to the second half of the 20th century B.C.E.:

1) The \(^{14}\)C dates available from early MB sites (e.g. Gesher, Pella, Tell el-Hayyat) in the Jordan Valley (cf. Marcus 2010, 247), and elsewhere in the southern Levant (Marcus 2003; Marcus et al. 2008a; 2008b) indicate that the earliest phase of the MB dates to the second half of the 20th century B.C.E.

2) As generally accepted, the beginning of the 12th Dynasty should be placed in the early 20th century B.C.E. (e.g., Kitchen 1996; von Beckerath 1997). Based on the dating of the sherds of Levantine painted ware (LPW) found in the fills under the temple at Izbet Rushdi (dated to the reign of Sesostris III, ca. early/mid 19th century), as well as multiple strata containing LPW at Tell el-Daba, it seems that during the 20th century B.C.E., the MB I had already begun in the southern Levant and Syria (Bagh 2000; 2003; Bietak 1997; Marcus et al. 2008a; 2008b; Weinstein 1996, 59).

3) Recent results of \(^{14}\)C dates from early MB levels at Tell el-Daba may tentatively belong to the 20th century B.C.E., much earlier than previously accepted (Bruins 2007; cf. Bietak & Höflmayer 2007).

4) Relevant \(^{14}\)C dates from Syria, such as the EB IV/MB I transition in the mid-20th century B.C.E. at Tell Selenkahiye (van Loon 1992) and around 2000 B.C.E. at Qatna (Morandi Bonacossi 2008, 61–63).

Likewise, based on \(^{14}\)C data and relative chronological indicators from Egypt, Marcus (2003; et al. 2008a, 213-16; 2010, 247) suggests that the beginning of MB settlement in the Jordan Valley and Coastal Plain were largely contemporaneous around the end of the 20th century B.C.E. (cf. Bourke 2006, 243-44). \(^{14}\)C data from Phases 5 and 4 at Tell el-Hayyat suggest dates of the latter half of the 20th century followed by the 19th century, respectively, which are also consistent with samples from Pella (Marcus 2010, 247f).

The MB I/II transition is often treated as a sub-period since a number of developments appear to occur during this time (cf. Cohen 2002; Epstein 1974; Ilan 1991; Maeir 1997). This was a burgeoning period for urbanization activity at settlements throughout the coastal plains and inland valleys, and is often looked to as the phase when
full-blown “classic” MB culture appears and is incorporated throughout the region. Important chronological connections regarding the beginning of the MB II have been made recently. First, 13th Dynasty sealings were found in the Ashkelon moat deposits (Stager 2002; Bietak et al. 2008), paralleling datable material at Tell el-Daba demonstrating that the MB II commenced in the 13th Dynasty in Egypt (e.g. Kitchen 1996). Second, Kuniholm (1993; et al. 1996) suggests that timbers from the destruction of the Sarikaya Palace at Aşemhöyük (in which were seal impressions of Šamši-Adad I in Assyria) were felled in 1752 B.C.E. Since Šamši-Adad I overlapped with Hammurabi’s reign (1728 – 1686 B.C.E. according to the Low Mesopotamian Chronology [e.g. Gasque et al. 1998]) by only a few years, and there was a connection between Hazor and Mari during the time of Šamši-Adad I and Hammurabi, it seems that none of these elements could have occurred before the MB I/II transition (Maeir 2010, 128; contra Manning et al. 2001, 2534; Wossink 2009, 28). Therefore, the period of MB I/II transition probably belongs no earlier than the mid-18th century B.C.E., and possibly later. Details regarding dates for the subsequent MB II period need not be discussed here, since by the early-middle of MB II urbanism had already become a widespread phenomenon across the region.

**SUMMARY OF MB SETTLEMENT PATTERNS AND DEVELOPMENTS**

Naturally, the primary source of archaeological evidence for what may be considered urbanization derives from settlements, in terms of their distribution, size and architectural make-up. The trajectory of urbanization comprises the development of social complexity over time, which would seem to be a linear progression easily measureable in the archaeological record. Although this progression does seem to be apparent in aspects of the MB, new complex properties emerge from many interactions that are nonlinear and complex as suggested by complexity theory (e.g. Adams 2001; Bentley & Maschner 2008). Such interactions are not necessarily predictable (or easily interpreted by archaeologists) based on the independent study of individual phenomena. Therefore, a certain caution should be exercised when attempting to reconstruct the many socio-cultural components comprised in the process of MB urbanization, particularly the complex interactions of many agents giving way to a number of emergent properties in society. This section summarizes the archaeological evidence reagarding general settlement patterns and major socio-cultural developments during the early second millennium B.C.E., followed by a brief discussion.

As a brief note, a measure of caution should be exercised regarding settlement survey data in the southern Levant. The majority of survey data derive from surface sherd scatter, which may be extremely misrepresentative of sites due to postdepositional taphonomy. Furthermore, the geomorphology of the region has resulted in major denudation
of hillslopes and aggradation of low-lying areas. Therefore, the settlement data may be very skewed, with many of the smaller settlements in the most important areas for the study of MB urbanization (i.e. lowlands) possibly buried under metres of alluvium, and sherds transported far from their point of origin. However, until the use of more advanced survey techniques are implemented on a systematic, widespread basis, the present settlement data must suffice for this study.

The dawn of a new era of socio-political organization and settlement patterns in Canaan appears to have begun very gradually from the turn of the second millennium B.C.E., during which time nascent urban settlements began to emerge from the milieu of small, semi-sedentary communities throughout the region. With settlement activity gradually building momentum over the following centuries, the southern Levant transformed into an urban society and landscape. On the scale of material culture, this transformation involved many changes from the preceding period, such as: (1) monumental architecture; (2) huge earthworks and fortifications at many sites; (3) increased international interconnectivity and exchange; (4) metal tools and weapons made mostly of bronze rather than copper; (5) the appearance of scarab seals; and (6) intramural burials. In order to fully appreciate these phenomena relating to MB urbanization, and understand this process from its inchoate nature, we should discuss it in light of the preceding period, as Dever (1997, 287) suggests.

Intermediate Bronze Age

The IB/EB IV period has received attention by scholars in recent decades (e.g. Bunimovitz & Greenberg 2004; Chapman 2009; Covello-Paran 2009; Dever 1992; 2003; Falconer 1994; Finkelstein 1989; Gophna 2009; Greenberg 2002; Long 2003; Morandi Bonacossi 2009; Palumbo 1990; 2001; Parr 2009; Pinnock 2009; Prag 1974; 1985; 2009; Richard & Long 2009). After the collapse of urbanism towards the end of EB III (ca. 2400-2300 B.C.E.) and the abandonment of intense occupation at nearly all urban sites, new settlement patterns emerged throughout the region. This period parallels the First Intermediate Period in Egypt, during which socio-political decentralization occurred alongside general disruption of the traditional exchange networks between Egypt, the Syro-Lebanese coast and the southern Levant. At the same time, political instabilities in late third millennium Mesopotamia may have contributed to the rise of inland Syria as a centre of inter-regional trade (Greenberg 2002, 120; Larson 1987).

The IB transformation in the southern Levant resulted in settlement in rural and marginal environmental zones characterized by small, unfortified, single-period dwellings that seem to have used mixed subsistence and economic strategies—basically combinations of dry farming and pastoralism (Dever 1997, 287; Prag 2009, 81-2). As Chapman (2009, 5)
suggests, these settlements may in fact be the “rural” remnant of the EB system. Finkelstein (1989, 135-36) argues for the importance of marginal nomadic/semi-nomadic pastoral groups for understanding this period, stressing autonomous productive strategies without agricultural surplus. He went on to suggest trade as a major factor encouraging the sedentarization of pastoral groups, but stressed the difficulty in distinguishing between agriculturalists practicing pastoralism and pastoralists practicing agriculture based on archaeological evidence (Finkelstein 1995, 99). Palumbo (2001, 260) summarizes the main characteristics of the culture during this period of “rural interlude” in the southern Levant as follows: (1) the prevailing economy was comprised of domestic modes of production; (2) there was no large-scale international trade; (3) regional trade was limited to a few specialized production centres; (4) settlement was dispersed and characterized by mobility in some marginal areas and sedentism in others; and (5) there was a strong tendency towards regionalization of cultural traits. With his model of “diversified levels of specialization”, Palumbo (1990, 130f; 2001, 237) argues that the EB-MB transition can be explained in terms of adaptations (e.g. settlement, production strategies) to changing physical and political conditions as a rural response to urban collapse.

Although limited IB material has been discovered at sites previously occupied in the EB (e.g. Dan, Hazor, Jericho, Megiddo, Beth-Shean, Beth Yerah), it would seem that these resemble unfortified villages rather than urban centres (Mazar 1990, 153-54), lacking continuity with the EB (Maer 2010, 134). Nonetheless, it appears that there may have been some continuity of urban settlement at some sites in Transjordan, such as the fortified site of Khirbet Iskandar (Richard & Long 2007; 2009), but this seems to be an exception to the norm. Greenberg (2002, 121) suggests that during this period individuals in the areas where EB cities had once existed were self-consciously post-urban, or possibly even anti-urban, and therefore drew physical connections with urban areas. Therefore, although settlement activity during this intermediate period was not urban, per se, the population still may have experienced ideological ties with former urban sites. This perspective, and the concept of the city in the mentality of the Canaanite population, may have important implications for the later rise of urbanization during the MB.

Complex society seems to have continued for the most part in areas of the northern Levant during this period, where cultural characteristics associated with MB urbanism appear to have begun earlier than in the south. As urban settlement in the southern Levant went into a prolonged socio-economic disintegration, many sites in the northern Levant thrived and underwent a realignment of society (Greenberg 2002, 120). Yet, the corridors of interaction between the northern and southern Levant had not ceased entirely with the collapse of urbanism in the south. Instead, they may have shifted their orientation between the urban core in inland Syria and the rural-pastoral margin of the south. Important
components of this interaction include the following evidence from the south: (1) adoption of Syrian drinking customs; (2) adoption of warrior-burial paraphernalia (Philip 1995; Doumet-Serhal 2010, 118); and (3) importation of tin-bronzes (Greenberg 2002, 120; Maier 2010, 138-39; Prag 2009, 87). This interaction may suggest that despite being socially and economically fragmented, southern Levantine society did not entirely revert to pre-urban structures, but looked toward urban Syria for modes of rank differentiation (Greenberg 2002, 121).

An important aspect of the urban settlements in the northern Levant during this period that factors greatly in the subsequent urbanization in the south is the proliferation of sites with earthen ramparts. Burke (2008, 80) suggests that this innovation may have resulted from the introduction of the battering ram in northern Syria and Mesopotamia, as attested in the Ebla archive. Despite uncertainty concerning the original function of earthen ramparts, the evidence suggests that these architectural features were being employed at sites around the turn of the second millennium B.C.E. in the northern Levant along the Euphrates. This observation serves as background to the transmission and innovation of rampart settlements throughout Canaan during the following centuries, and likewise indicates that the physical nature of MB urbanization probably derived from a pre-existing notion of the city that may have prevailed the south even during a non-urban period.

Middle Bronze I

After the First Intermediate Period, Middle Kingdom Egypt resumed widespread interactions across the Eastern Mediterranean world, and re-established itself as a major military power. Already early in the 12th Dynasty Egypt renewed its link with centres like Byblos, which became stronger than ever, and unprecedented settlement of an Asiatic population occurred in the Nile Delta, demonstrating the revival of Egyptian international activity (Bietak 1997, 97-100; Holladay 1997; Marcus 2007, 160-76). The earliest evidence of MB I cultural material in the southern Levant is somewhat limited and mostly derives from burial assemblages and small-scale settlements. Some of these contexts appear to be sedentary in nature, but should not yet be considered urban at this stage (Ilan 1995a, 301). The earliest settlement activity belonging to the MB appears to have been located along the most interactive nodes of communication through the landscape along the coastal plains and inland lowlands, typically near springs (e.g. Broshi & Gophna 1986) and areas rich in fertile soil for dry farming or localized irrigation (Ilan 1995a, 301). These settlement areas, which in many ways differed from the core areas of EB urbanism, were possibly more linked to coastal influence and interaction than their predecessors (Greenberg 2002, 108).

To some extent, it seems that early MB culture may have some continuity with the preceding local IB culture, which may suggest local trajectories toward urbanization (cf.
Greenberg (2002, 108) argues that international trade only gained momentum at the end of MB I, after an urban infrastructure existed to cope with it (cf. Kamp & Yoffee 1980, 99). However, although a truly reciprocal exchange network as seen in the later MB might require an urban infrastructure, this does not preclude the existence of earlier interactions by which external parties were interested in exchangeable commodities from the southern Levant. Furthermore, there seems to be evidence that some sites (e.g. Ashkelon, Akko, Ifshar) in the southern Levant were participating in international exchange to some degree from early-mid MB I (Marcus 2007, 171-75; Nigro 1998, 272ff). As Greenberg (2002, 105) puts it, the early MB I should be viewed as a gradual sedentarization of transhumant groups who came into contact with political and economic centres in the northern Levant, which had long been urban, and something began to draw Canaan from the bleak margins into the more volatile periphery of the Syrian centres. The reason why this urbanizing influence affected the southern Levant only at this moment in time, while it had not done so for an extended period beforehand, must have had to do with certain catalysts. The underlying impetus for urbanization probably resulted from a combination of at least two major factors: (1) the general influence of inter-regional exchange generating socio-economic disequilibrium that spread across the IB/MB I southern Levant; and (2) the possible migration of varied groups from the north, such as colonizers from the Syrian periphery and/or nomadic populations (e.g. Amorites; cf. Dever 1977). Despite whatever external influence existed, the urbanization of the southern Levant that occurs over the course of the MB must be seen as the transformation of Canaanite society, involving the agency of a predominantly indigenous Canaanite population.

Over the course of the MB I, increasingly sedentary occupation becomes apparent along the Coastal Plain, Jezreel Valley and Jordan Valley. Contrary to earlier views that MB I settlement began only along the Coastal Plain and subsequently spread to the Jordan Valley (e.g. Cohen 2002), it appears that early MB I settlement activity also occurred in the Jordan Valley (Maeir 2010, 175). The earliest signs of settlement activity of an urban nature in the Central Jordan Valley may be observed at Pella and Tell el-Hayyat, both of which demonstrate evidence of temples during early stages of the MB I. Pella also demonstrates the first evidence for sizeable fortifications dating from mid-MB I (Bourke 2006), earlier in the period than previously considered (e.g. Magness-Gardiner 1997, 315). Likewise, in the Northern Jordan Valley, Tel Dan began emerging as an important site with a fortification wall dating to mid-MB I (Ilan pers. comm.). As noted by Maeir (2010, 141) the background for the initial stages of urbanization in the Jordan Valley is of importance, since it would appear that this region was affected by intensive contacts with the outside world through inland trade networks. This observation is important in light of traditional speculation that MB urbanization had more to do with maritime spheres of interaction and coastal settlement.
early in the period (e.g. Marcus 1998; 2007; Stager 2001; 2002). As soon as contacts commenced in the MB I, signs appear in the archaeological record demonstrating Syrian-related influences and evidence of substantial trade.

Regarding MB I settlement patterns, Cohen (2002) suggests a settlement sequence for sites throughout the southern Levant based on ceramic typologies from the four-phase MB I – MB I/II sequence at Tel Aphek. Using this four-fold sequence as the basis of all settlement in the region is certainly problematic, especially considering the great amount of sub-regional variability in ceramic typologies. However, this study proves useful for loosely conceptualizing the relative sequences of strata at certain sites, and for discussing site distribution and characteristics during the early MB. Cohen’s phases are as follows:

- Phase 1: Ifshar and Aphek (possibly Akko and Ashkelon).
- Phase 2: Dan, Sumeiriya, Akko, Nami, Habonim, Megiddo, Burga, Zeror, el-Hayyat, Ain Zurekiyeh, Jerishe and Ashkelon.
  - Phases 2-3: Kabri, Bira, Par, Me’amer, Dor (south), Mevorakh, Pella, Nahshonim, Hashomer, Bat Yam, Yavne-Yam, Nahal Soreq, Gezer and Revadim.
- Phase 3: Nahariya, Poleg, Shechem, Rishon Lezion and Beit Mirsim.
  - Phases 3-4: Yoqne’am, Jerusalem, Gat-Galon and Lachish.
- Phase 4: Hazor, Qashsish, En Hofez, Esur, Bethel, Jericho, Mazkeret Batya and el-Hesi.

Phases 1-2 demonstrate the earliest MB I sites settled in the lowlands, particularly the coastal plains. Phase 3 reveals the first highland settlement, with sites still predominantly in the lowlands. By Phase 4 the distribution of settlements had become widespread across a variety of terrain. In light of more recent revisions of chronological sequences in the Jordan Valley (e.g. Maeir 2010), Cohen’s phases should be reevaluated, and taken with a great measure of caution; nonetheless, the phases offered by this division prove useful (if arbitrary) in referring to relative sequences in MB I.

One of the key characteristics of the sites settled in the MB I is the gradual construction of major earthworks, particularly freestanding ramparts. Cohen (2002, Figs. 14, 25) identifies sites that were fortified during their respective phases in MB I, demonstrating the same spatial distribution of development as the phases of settlement activity at large:
- Phase 1: Ifshar and Aphek
- Phase 2: Dan, Akko, Megiddo, Burga, Zeror, Ain Zurekiyeh, Jerishe and Ashkelon
  - Phases 2-3: Kabri, Mevorakh
- Phase 3: Poleg and Beit Mirsim
  - Phases 3-4: Yoqne’am and Jerusalem
- Phase 4: Qashish

Figure 3. Map of key MB settlements in Canaan (after Ilan 1995a, Fig. 1).
Burke (2008, 80) suggests that the MB I phase in “rampart evolution” is characterized “less by innovation than by the southward spread of rampart architecture, the refinement of rampart construction techniques, and the adaptation of ramparts to the defences of previously occupied settlements.” Although the origin of the freestanding rampart should be attributed to earlier centuries in the northern Levant, the innovation of such style and technology as implemented in the southern Levant cannot be simply reduced to diffusion from Syria, as Burke seems to imply. Rather, there was a complex set of shifting socio-cultural norms and values during this period of urban transformation that would have defined the “ideal-type” urban settlement that go much deeper than the merely defensive function of this architecture (e.g. Bunivoitz 1992; Finkelstein 1992; Greenberg 2002, 108; Herzog 1997, 132-33; Uziel 2010).

Although architectural details regarding earthworks will be discussed below, it is important to note the apparent types of ramparts as they pertain to patterns of settlement activity. The largest new settlements established in MB I were built with freestanding ramparts (e.g. Dan, Kabri, Akko) typical of the northern Levant (e.g. Ebla, Qatna, Tuqan, Alalakh, Byblos). However, settlements established over sites with previous occupation typically constructed supplemental ramparts, which modified the sides of the tell (e.g. Aphek Vd, Jericho IVa-b, Megiddo XIII, Poleg, Zurekiyeh). As Burke (2008, 80) demonstrates, most sites during the MB I phase were elliptical in their layout, with rectilinear plans beginning to develop mainly later in the period. Of course, the layouts of earthworks, both freestanding and supplementary, varied place to place according to the site contours and topography.

Middle Bronze I/II Transition

The transition between MB I and MB II ushered in the zenith of “classic” MB culture and settlement, as well as regional incorporation into the MB cultural koine (Maeir 2010, 145; Burke 2008, 160). A key characteristic of MB I/II was the peak of innovation in rampart construction in the southern Levant. This phase fully introduced the construction of rectilinear earthen ramparts (i.e. Yadin’s [1955] “fortified camps”; Herzog’s [1997, 118f] “Large Rampart Cities”), which were built at some of the largest sites and become a hallmark feature of the MB urban landscape. Such rampart cities appear to have been established relatively simultaneously in the northern (e.g. Qatna, Sefinat-Nouh, Bosra, Deir Khabiye) and southern (e.g. Dan XI, Hazor XVII, Yavneh-Yam, Timnah XII-XI, Nagila XI, Lachish, Jemmeh, Haror, el-‘Ajjul, Malhata [Per. B], Masos, Irbid) Levant. Although evidence exists that some sites (e.g. Dan, Hazor, Timnah, Kabri) belonging to this phenomenon had MB I occupation prior to this phase of construction, many sites appear to
be either newly founded (e.g. Yavneh-Yam). Older sites expanded the size of settlement and reinforced the slopes of the tell by using combinations of earthwork construction techniques (Herzog’s [1997, 135, 163] “extended cities”). The Lower City of Hazor added 58 ha (enclosed) to an already existing 10 ha mound, and an estimated 60 ha were enclosed by the ramparts at Ashkelon (Herzog 1997, 115). The massive scale of earthen ramparts themselves, and the expansive area enclosed by them at many sites implies the probability of a high degree of centralized planning and social organization in early MB society. This phase of development also saw the abandonment of prior construction techniques at the sites of Dan, Akko and Ashkelon, where “Syrian-style” mud-brick arched gates constructed in an earlier phase of MB I may have been intentionally blocked up: “These gates embody a new architectural technique maladapted to a wetter environment and quickly abandoned. Better alternative materials—lumber and stone—were readily available” (Ilan 1995a, 300-1).

Recent survey of the western Galilee (in the Northern Coastal Plain) by the Kabri Archaeological Project (Yasur-Landau et al. 2008) provides a close look at settlement fluctuations on a sub-regional scale. In the northern portion of this plain, which was dominated by Tel Kabri, the survey found no material corresponding to Cohen’s Phase 1, rather: “intensive settlement both on tells and in rural sites, as well as the founding of new cemeteries, is evident starting in the intermediate phases (Phases 2-3) of the MB I” (Yasur-Landau et al. 2008, 8). The settlement landscape during this phase appears to consist of villages scattered fairly evenly over the area, with some larger (yet still small) settlements at Tell el-Sumeiriya, Tel Achziv and Tel Kabri, with the exceptional small coastal cultic site of Nahariya, which may demonstrate continuity from the IB (Yasur-Landau et al. 2008, 8; Dothan 1993a). In the southern portion of the plain, which was dominated by Tel Akko, more settlement activity appears to have occurred in Phase 2, as demonstrated by pottery already postdating the construction of the rampart at Akko (Yasur-Landau et al. 2008, 9; Raban 1991, Fig. 9). By the end of MB I into the MB I/II transition, a sharp change in settlement patterns becomes evident by the appearance of a large fortified centre at Kabri (with monumental architecture, including freestanding ramparts) and secondary fortified centres at Tel Achziv, Tel ‘Avdon, and Mezad ‘En Tamir, accompanied by a process of nucleation and the disappearance of many small rural sites (Yasur-Landau et al. 2008, 10, 19).

Settlement activity in the Hula Valley seems to demonstrate patterns similar to the Northern Coastal Plain. As Greenberg (2002, 106) observes, a three-tiered urban settlement system existed by the end of MB I, consisting of: (1) sites of 10 ha or more (Dan, Abel, and probably Hazor); (2) sites of 2-3 ha (Tel Na’amah, Tell el-Mallaha, and possibly Wadi Qasab); and (3) sites of 0.5-1 ha. By this time, the earthen rampart and triple-arched gate had been constructed at Tel Dan and the site likely served as a central place for a larger
network of exchange with the north and settlement throughout the valley (Greenberg 2002, 106). During the MB I/II transition, Hazor greatly expands and rises to supremacy over the Hula Valley, if not the majority of the Jordan Valley (Maeir 2010, 144f; Greenberg 2002, 107). The rapid rise of both Hazor and Kabri at this same time seeks some explanation. Yasur-Landau et al. (2008, 3, 19) suggest that in both cases competition with an already urbanized MB I centre (i.e. Dan for Hazor, Akko for Kabri) sparked a very fast trajectory towards urbanization (their “truncated trajectory”). These very rapid settlement trajectories appear to be exceptional cases for MB Canaan (although possibly also Ashkelon [e.g. Stager 2001; 2002]), and probably relate to their respective geographic proximities to coastal and inland access to the northern Levantine sphere of interaction.

**Middle Bronze II-III**

Following the transition to MB II, increasing numbers of sites of various sizes and distributions were established throughout the southern Levantine landscape. Especially characteristic of this phase is what appears to be the earliest settlement development in the highland areas. MB I sites in the highlands were relatively rare yet, by the MB II, small settlements were scattered throughout the central highlands, with high concentrations in the north and west (Finkelstein 1993; 1988-1989). Later in the MB III, while a number of sites were abandoned others (e.g. Shechem, Jerusalem, Bethel) apparently became important centres (cf. Finkelstein 1993).

During the MB II-III, the construction of earthen ramparts appears to be primarily in order to extend the size of settlements. Sites in the highlands (e.g. Shechem XIX, el-Far’ah [N] VC, Shiloh VII, Beth-El, Hebron, Beit Mirsim E-D) were either newly constructed or renovated with supplemental ramparts in a manner comparable to that of tells in low-lying areas during the MB I/II phase. The proliferation of different-sized and distributed sites throughout the region suggests possible socio-economic expansion, and possibly political consolidation occurring at this time (Maeir 2010, 177). Monumental architecture is a hallmark of MB II-III, and consists of massive and often elaborate fortifications (including ramparts, gates and towers) at most sites, and temples and palaces (or large public buildings) discovered at some. One new innovation in earthen ramparts during the latter part of the MB was the construction of substantial stone revetment walls at the base of ramparts using of cyclopean masonry. As Burke (2008, 82) notes, although earlier examples of revetment walls using such masonry exist (e.g. Hazor and Ebla), revetment walls were not a regular part of rampart construction until MB III.

Also during the MB II, the predominance of regional centres begins to appear in different areas: (1) Hazor in the Northern Jordan Valley; (2) Pella in the Central Jordan Valley; (3) Jericho in the Southern Jordan Valley; (4) Kabri in the Northern Coastal Plain;
(5) Ashkelon in the Southern Coastal Plain; and (6) Megiddo in the Jezreel Valley (though Tel Shimron may have eventually eclipsed Megiddo’s authority over the northern extent of the valley). Hazor unquestionably dominated the Northern Jordan Valley, if not a greater territory, and stands as a prime example of interregional connectivity, as demonstrated by its MB II correspondence with Mari (Maeir 2010, 177). A distribution of subsidiary sites may suggest a ranked settlement hierarchy, and/or possibly a heterarchical relationship among sites and socio-political entities.

**Interpreting Settlement Patterns**

The picture of the development of settlement patterns in Canaan during the MB reveals a growing urban (and possibly rural) population and ever-increasing social complexity and interconnectivity, all of which is accompanied by a shift in settlement types from small villages scattered around the landscape to urban centres. The settlement process of the early MB suggests that of urbanization occurred over a fairly extended period of time. As Greenberg (2002, 107) observes, the stratigraphy of sites such as Tel Na’ama and Tel Dan (each yielding three or four MB I strata) indicates the apparently slow pace of resettlement in the Hula Valley (also Tel Ifshar on the Coastal Plain). This slow pace, or gradual trajectory towards increased urban settlement, seems to have occurred at certain sites that became important centres in the MB (see Chapter 5). Nonetheless, it appears that the strata belonging to many sites do not demonstrate the linear continuum of increased urbanization that one might expect from gradual urbanization. Rather, many urban sites established in MB I/II lack evidence of earlier MB development, or else demonstrate quantum leaps in settlement size and complexity from one stratum to the next (e.g. Hazor, Kabri). Therefore, the urban transformation from IB to MB appears to have been a gradual process on a regional scale, whereas there may have been more rapid developments on a site-specific scale.

Various attempts have been made to classify MB settlements according to size, rank and/or function. Burke (2008, 113-16, 122-25) suggests that settlement terms from LB Ugaritic texts provide an appropriate framework for the classification of Levantine Bronze Age settlements, as follows:

1) Large fortified towns
2) Secondary fortified towns
3) Unfortified villages
4) Fortresses
5) Military watchtowers
6) Rural agricultural estates
Although this type of settlement hierarchy may have some relevance for interpreting LB (and perhaps late MB) Canaanite society, it makes too many military inferences, and it seems highly unlikely that such rigidly planned regional organizational principles were implemented in the early MB. Furthermore, contrary to Burke’s argument (2008, 122), there is insufficient data to suggest the existence of defensive networks—organized as districts—that were centred around politically-affiliated settlements. This superficial application of Old Babylonian and Ugaritic settlement patterns and site-types relies entirely on tenuously related historical sources and fails to account for the development of urbanism in the southern Levant.

In terms of settlement hierarchy from the MB II onward, Kotter (1986) has presented the following breakdown of sites in the southern Levant: (1) large urban centres (ca. 8 to 70 ha, 5%), (2) medium-sized settlements (ca. 3 to 8 ha, 10%) and (3) villages and hamlets (ca. 0.2 to 3 ha, 85%). The pattern suggested by this distribution of settlements has often become identified with “city-states”, and one which Dever (1987, 153) suggests is especially characteristic of a “highly urban culture” in the late MB. Although this suggestion may be true to some extent, using the settlement patterns alone is an oversimplified approach toward understanding the multi-faceted complexities of urbanism and the development of settlement patterns.

Sites in the Jordan Valley were well-situated for inland contact with Syria (via the northern extension of the Great Rift Valley), the Jordanian Plateau and Arabian trade networks to the southeast. Likewise, the Jezreel Valley was uniquely situated between coastal and inland exchange routes, facilitating a key connection between the two. This explains the prominence of sites such as Pella and Megiddo already early in the period, since their locations served as dynamic confluences of maritime and inland exchange systems. Knapp identifies strategic sites along settlement networks as “gateways”:

Gateway communities usually emerge along a “frontier”, often between areas of different types of production, and in response to intensified trade or growing population. Located along “natural corridors” of trade and communication, and at critical junctures between areas of high (agricultural, craft) productivity or at least of seasonal availability of scarce resources, gateway communities serve to provide a variety of commodities in demand at a minimal transportation cost (1989, 145).

Accordingly, Pella and Akko provide key examples of gateway communities involved in the flow of essential and exotic goods along a settlement network traversing the Northern Coastal Plain, Jezreel Valley and Central Jordan Valley (Fig. 4). These gateways would interact in systems of exchange on essentially two scales: (1) local exchange systems; and (2) between the local and greater interregional exchange systems of the eastern Mediterranean and western Asia (Knapp 1989, 145).
Adopting the concept of gateways, Ilan (1995a, 305) proposes the following spatial distribution of power in the mid-MB I:

1) Regional centres and gateways
2) Sub-regional centres and/or loci of specialist production or service (e.g. cult)
3) Village
4) Farmstead

The level of complexity increased markedly in MB II-III, particularly resulting from intensified urban settlement and an economy becoming oriented by a system of urbanism. Therefore, based on geographical location, rank-size distributions, and evidence for exchange and production, Ilan (1995a, 305) proposes the spatial distribution of power during the peak of MB II-III as:
1) First-order gateways (primarily Hazor and Tell el-Dab’a)
2) Second-order gateways (e.g. Ashkelon, Kabri, Pella)
3) Third-order gateways (e.g. Masos, Dan, Jericho, Dor, Jaffa)
4) Regional centres (e.g. Megiddo, Beth Shean, Shimron, Shechem, Gezer)
5) Sub-regional centres and/or locus of specialist production (e.g. el-Hayyat, Afula, Kittan)
6) Village
7) Farmstead or hamlet

As Maeir (2010, 113) suggests, Ilan’s use of second- and third-order gateways reduces the significance of what a gateway site should signify, and not every site situated on the boundary of a political unit can be termed a gateway. Rather, some of these second- and third-order sites may simply be more centrally located within a settlement network, and do not function in the same way as a gateway. Ilan’s MB II list should be amended to include Ashkelon, Kabri and Pella as first-order gateways in Canaan, and Tell el-Dab’a as a gateway for Egypt, not Canaan.

According to the power structure implied in these settlement hierarchies, the largest order settlements were the most complex and dominated their surrounding countryside, resulting in a social structure polarized between the urban-based elite and the subordinate peasantry on the social periphery (Ilan 1995a, 305-6; cf. Marfoe 1979). The extent to which the socio-economic power structure of the MB was a matter of kin-based bureaucracies (e.g. LB according to the Amarna letters) or private enterprise (e.g. Old Assyrian or Old Babylonian states) remains unclear. Nonetheless, as Ilan (1995a, 306) observes from a goods standpoint, some evidence shows a fairly segmented system of procurement and production, suggesting local autonomy throughout the rural hinterland (e.g. Schwartz & Falconer 1994). Although ordered typologies of settlements as demonstrated above aid us in conceptualizing aspects of settlements, they are ultimately artificial and offer little value for explaining social processes beyond conjectured hierarchies.

It may be more fruitful to approach early MB settlement patterns in terms of economy and interconnectivity, considering the horizontal relationships among sites rather than vertical political organization, which may be contrived from later political development. Settlement patterns during the beginning of the period appear to be oriented according to spheres of interaction, both externally (e.g. eastern Mediterranean, Levant, western Asia) and internally (e.g. southern Levant, Canaanite sub-regions). Along the Coastal Plain, maritime interaction would have been profoundly important. Presumably, harbours were situated on various types of marine formations, such as: offshore islands, promontories, lagoons, bays and navigable rivers (Marcus 2007, 164; Raban 1985). Despite such features being difficult to identify due to coastal morphology, Marcus (2007, 164) suggests, “the maritime relations or orientation of a particular site should not be precluded
simply because it is currently located on a haven-less open shore, e.g., Ashkelon, or some distance from the shore up a now less-than-navigable river, e.g., Ugarit or Tel Kabri.”

Furthermore, sites throughout the Coastal Plain appear to be oriented along water drainages, prompting Ilan’s (1995a, 302) interpretation of “drainage-defined polities”, or a network of settlement purposefully arranged between maritime and inland nodes of interaction.

According to this arrangement, sites situated along the coast probably provided access to Mediterranean maritime exchange, and large inland sites functioned more as central places with access to hinterland resources. Thus, the two complementary settlement types, and a chain of smaller sites in between, are conceived as belonging to one polity or economic system. The concept of drainage-defined polities with an emphasis on latitudinal, as opposed to longitudinal, movement highlights the importance of economic interaction in the socio-cultural transformation during the early MB on the Coastal Plain.

Adhering to the concept of “dendritic networks” (e.g. Smith 1976, 34-36) Cohen (2002, 123) suggests that the most powerful centre of any settlement system would be located at one end of the network rather than in the middle. According to this settlement system, lower-level centres are associated with centres of only one level higher, in a very linear progression of hierarchal, or vertical, settlement organization (Cohen 2002, 24). Furthermore, development along the east-west wadi systems could facilitate communication and the movement of materials from the interior hinterland to the coastal sites, serving to reinforce the initial settlement pattern (Cohen 2002, 123). Implied in the dendritic system is a certain distribution of economic power and political status, both of which would be concentrated towards one end of a system which, in the case of the Coastal Plain, would be the large coastal sites. The coastal end of the network interacts with the greater system of international exchange, while the sites scattered along the network decrease in both size and power the further they are away from the centre of economic control (Cohen 2002, 127).

Stager’s (2001; 2002) “port power” theory highlights the importance of long-distance maritime trade together with competitive market forces driving MB urbanization and dictating settlement patterns. The basis of this theory derives from the high amount of imported ceramics and Egyptian sealings from the MB I sequence at Ashkelon, mirrored by the number of Canaanite imports at Tell el-Dab’a, and the evidence for maritime exchange in the eastern Mediterranean suggested by the Execration texts. The theory conceptualizes settlements of various orders as “markets”, all of which are connected to seaports, the highest-order market. Stager (2002, 360) argues the sequence of development begins with the establishment of a trade route, then markets situated on this trade route, followed by subsidiary markets developing around the main market(s). Market forces drive this socio-economic system by focusing resources along “funnel-shaped catchments” from the hinterland to the Mediterranean seaports and, presumably, the organization of settlements
follows this trajectory both in distribution and hierarchy. Accordingly, it is the market demand and economic network that penetrate and connect diverse ethnic, cultural and political communities exerting minimal effort (Stager 2002, 361). Rather than being wielded by an overarching political or military force, power in this system was exercised through economic ties throughout a heterogeneous network: “Nevertheless, the relationships within this diverse network of trade were hierarchal, with most of the power and the profits being realized by the export-import merchants, usually an oligarchy, who exercised indirect economic power through the integrated and hierarchical system of market exchange” (Stager 2002, 361). Therefore, power was achieved and yielded by those taking advantage of inequalities between supply (hinterland) and demand (international exchange). Although Stager narrates a compelling story, particularly based on Ashkelon, he neglects the incentive this system would offer the vast majority of agents in the hinterland supplying the basic commodities to the market.

A more elaborate sequence of development for this “port power” system may be the following: (1) eastern Mediterranean maritime activity brings an external interest to the Canaanite coast in order to obtain natural resources; (2) trade relations develop around native Canaanite settlements, establishing “markets” along the Coastal Plain; (3) as part of international interaction, and in turn for exporting domestic goods, valuable commodities are imported to Canaan; (4) socio-economic networks grow in order to obtain ever more raw materials for export; (5) craft specialization produces both local goods for export and prestige items crafted from imported materials; (6) urban centres are constructed to facilitate specialization, serve as nodes for exchange, and create a system in which resources are centrally managed; and (7) urban institutions provide cult, security and access to exchange, all of which facilitate further power relations. Of course, this system need not be limited to maritime activity along the Coastal Plain and immediate hinterlands. Additionally, the Jordan Valley serves as an example of a settlement system engaged in an inland network of exchange in which similar processes occurred, and the Jezreel Valley is strategically situated between both inland and coastal spheres of interaction.

**Discussion**

The major developments early in the MB summarized above demonstrate increased social complexity on the basis of the emergence of urban settlements, standard architectural features and apparent settlement networks. The increasingly larger scales of urban settlements together with the gradual standardization of monumental architecture indicate a concomitant physical manifestation of social interaction resulting in emergent complex properties. Since the distribution of settlements appears to be oriented toward exchange networks rather than political hierarchies during this stage of the second millennium B.C.E.,
the transformative process of MB urbanization lends itself to multivariant and heterarchical interactions of agency, as highlighted by complex systems theory. As Bentley and Maschner observe: “Complex open systems, not at equilibrium, are said to exhibit emergent properties, which are overall patterns greater than the sum of the parts, such that the system may act coherently without domination by a central source” (Bentley & Maschner 2008, 246; cf. Holland 1998). In addition to settlement activity, a number of complimentary developments contribute to the overall emerging complexity during MB urbanization, namely technological innovation and standardization observable in the material culture of this period. The role of urban construction and specialized production in developing social complexity is discussed in following chapters. Nonetheless, it is important to note the significance of interaction as a major aspect of MB urbanization, as suggested by the dendritic or drainage-defined networks, the market economy of Stager’s port-power theory, and the chiefly non-central agency highlighted by complex systems theory.

**SUMMARY**

Over the course of roughly a century and a half during the MB I, the semi-sedentary inhabitants of the southern Levant gradually transformed into an urban society, seemingly more complex than its EB predecessors. This process of urbanization occurred as former sites were resettled and others were newly established throughout the geographic patchwork of coastal plains and inland valleys. The settlement patterns appear to be predominantly oriented toward trade and interconnectivity, particularly organized along major transportation routes linking sub-regions and/or hinterlands together. At one or both ends of such settlement networks, there may have been gateway or market centres that served as nodes connecting the entire network to a much greater international system of trade. Although the term “port-power” (Stager 2001; 2002) may not be entirely appropriate to describe this settlement pattern and socio-economic system—or only describe it partially—the strength of its approach toward the MB is the combination of a theory of market systems with a dendritic organizational structure.

The following chapters provide increasingly detailed information regarding building materials, architectural patterns and construction strategies during this period of urbanization. Moving from general overviews to data from specific case studies, the discussion will highlight the chaînes opératoire of urban construction as it elucidates the extent to which technological innovation and standardization shape the organizational structure of major aspects of the urbanization process.
3. **Middle Bronze Age Building Practices**

The architecture of the MB is perhaps the most striking aspect of the material culture of the period. Urbanization in the early second millennium B.C.E. ushered in a wave of monumental architecture, massive fortifications and new innovations in architectural design and technology as sites became settled throughout regions of the southern Levant. This chapter provides definitions of terms and an overview of the building materials and practices common to this period in order to highlight their roles in architecture, which will be discussed in the following chapters with regard to specific case studies. Building practices of the MB are foundational for conceptualizing the process of construction and understanding key organizational patterns in society, which will be discussed in later chapters.

**Building Materials**

The raw materials used in architecture during the MB are essentially no different from other periods in the region until relatively modern times. The building materials most readily available in certain areas are not necessarily the ones best suited for ideal aesthetic or for constructing every parts of a structure. Nonetheless, a combination of the most available materials is almost always used in most types of architecture to good effect. As Reich (1992, 1) observes, there may be some preference for mud-brick or stone according to region, simply due to an abundance of one material over the other. Yet, during the Bronze Age the majority of architecture was constructed using mostly mud-brick with un-worked stone foundations.

Using the most basic earthen materials, and perhaps a few beams of timber, one could construct essentially any of the structures known from the MB Levant, as well as throughout the ancient Near East. Unlike timber, which would often need to be transported (or imported) from further away, or stone, which would sometimes need to be quarried and hewn, earthen sediments occur in natural abundance in the immediate proximities of settlement. With only minor modification, mud mixtures made predominantly from such sediments could be manufactured both quickly and cheaply, requiring limited skill. Mud mixtures are extremely versatile and may be easily form-moulded (e.g. bricks), affixed to a frame (wattle and daub), piled up or compressed (*terre pisé*, cf. Wright 2005a, 87f). If appropriate precautions are undertaken to keep earthen architecture dry (i.e. mud-plaster...
maintained on walls), then this material may remain durable and strong for great lengths of time.

In general, Bronze Age structures in the Levant had foundations of stone (generally fieldstones, but sometimes hewn) that were partially laid in trenches below and continuing some courses above ground level. On top of such foundations the walls were constructed using mud-bricks. This appears to be the case for most utilitarian and domestic dwellings that were presumably constructed employing the least amount of cost, in terms of material and labour. Monumental public buildings often demonstrate constructional techniques and materials varying from the domestic or defensive sphere, since their sometimes more elaborate design or exotic materials might require more craftsmanship and labour, or materials from further afield. Nonetheless, the basic architectural principle of stone foundations and brick superstructures applies to nearly all MB architecture.

**Raw materials**

*Sediment*

The composition of sediment can vary considerably depending on geological factors resulting in its formation and deposition. In basic terms, sediments are a collection of rock, mineral and organic particles that have been moved from their original source and re-deposited elsewhere by forces such as water, wind, gravity and tectonic activity (cf. Goldberg & Macphail 2006). Unfortunately, some literature concerning Near Eastern archaeology uses the terms soil and sediment interchangeably, or simply use soil indiscriminately; however, the important distinction should be observed. Soils are a specific type of sediment, consisting of a mixture of inorganic and organic material developed *in-situ* through the weathering and alteration of rocks and sediments by physical, chemical and biological processes. In an archaeological context, ancient soils (paleosols) are often studied as they relate to agriculture. The term sediment, rather than soil, is preferred in this study for the raw material used in construction, since it is technically correct and inclusive of a variety of earthen materials. The non-organic particles comprising sediment range in size and are grouped into three different size categories, from large to small: sand, silt and clay. The different combinations of these particle sizes in sediments result in different physical properties. The variability among sediment properties was taken into account by ancient builders who would seek out sediments appropriate for their needs, or often augment sediments by mixing them with other materials, as with manufacturing mud-bricks (see below).

Most of the depositional mass of tells derives from sediments used for purposes of construction, usually in the form of mud-bricks, fills or earthworks. Earthen “fills” were commonly used in all archaeological periods to raise floor levels and even out surfaces.
Although such fills might consist of so-called “virgin” sediments transported to the site from natural deposits offsite, occupational debris was commonly recycled directly from the site where it was used to good effect, at minimal labour expense. Likewise, unaltered sediments were employed in the construction of the earthworks characteristic of the MB. Sediments were also used in great quantities for the manufacture of mud-bricks, which constituted the vast majority of standing architecture. Regardless of their intended use, sediments of various geological derivations exist in natural abundance throughout the region for the needs of construction (less so in the highlands, but still adequately present in most areas).

**Stone**

Outcrops of bedrock may be found on the surface in many places across the landscape, providing easy access to stone. Most of the southern Levant consists of varieties of limestone, yet many areas in the north and east contain basalt, with lesser quantities of sandstone (e.g. kurkar) and other material found elsewhere. Formed under diverse geological conditions, limestone may exist in various degrees of hardness, colour, texture and composition (Reich 1992, 1). Some varieties of limestone are very hard, and difficult to quarry, whereas others belong to the chalky end of the spectrum (e.g. nari) and are easily quarried and worked. Due to its abundance in most places and its versatile extant, limestone could be used in nearly every architectural situation requiring stone. Basalt could also be used for generic building purposes, especially in areas where it is naturally abundant. However, basalt may be distinguished from limestone by its hardness, porosity and black colour, as well as its resistance to heat, weathering and water (Reich 1992, 2). Due to these unique properties, basalt was commonly preferred over other types of stone for grinding and crushing implements, as well as particular architectural features, such as door sockets/pivots, steps or thresholds, and drainage channels. Perhaps due to it aesthetic contrast to limestone and mud-brick, basalt was often used for orthostats, stelae and moveable cultic furniture (Reich 1992, 2).

Stone masonry techniques during the MB were relatively straightforward, using mostly undressed fieldstones to assemble a few courses of foundation for mud-brick superstructures. Fieldstones are simply loose surface rocks collected from the vicinity of a site, often resulting in an assortment of sizes, shapes and geological properties. Assembling fieldstones in construction usually involved: (1) laying them in rough courses of similar size, with smaller stones infilling voids; or (2) fitting stones together in a polygonal arrangement to minimize voids. The faces of walls were built as straight and flush as possible without having to shape the stones and, in many cases, the interior (i.e. core) comprised a “rubble fill” of small pebbles. Dressed stones were not particularly common during the MB, yet roughly-hewn stones are attested in some monumental architecture (e.g. Aphek, Ashkelon,
Beth Shemesh, Hazor, Keisan, Jerusalem, Nahariya). Ashlar masonry, which involved square-hewn stones that were quarried and dressed to standard measurements, was rare in the MB and did not become common until the Iron Age.

Timber

Timber was used in fairly low quantities by comparison with other building materials, but its uses can include: (1) spanning spaces to support roofs and additional storeys, (2) as free-standing columns, or (3) horizontally placed within walls (especially as lintels over openings) to relieve tensile stress on bricks (e.g. Kemp 2000, 90). Wood is an optimum, all-purpose building material, especially since its strength remains quite constant when subjected to stresses of different sorts, particularly tension (Wright 2005a, 17). Because of its excellent qualities, timber would have been preferred for many architectural functions. Yet, the limited regions in the Levant in which it was abundant during the MB (i.e. Lebanon and, to a lesser extent, northern Canaan) where likely under very high demand by the greater region (especially Egypt), which resulted in a limited and costly supply in most places. Therefore, it appears that timber was used sparingly in architectural contexts where it was most needed for its tensile strength. Since the preservation of wood is generally very poor in the Levant, it remains difficult to assess patterns of timber usage in MB construction.

Reeds and brushwood

A final category of raw materials worth noting consists of reeds and types of small wood or vegetal matter. As Moorey (1994, 355) notes, reeds and brushwood were likely used for floors, ceilings and sometimes within walls. The use of straw as temper in mud-bricks is widely known (discussed below), but Moorey suggests that a similar strategy may have been employed in Mesopotamia between certain courses of bricks when laid in a wall: “The practice of putting reeds or reed mats on the ground before bricks were laid or between old wall stumps and the rebuilt upper levels is . . . [widespread] by the second millennium” (1994, 361-62). While this practice is certainly possible, the main evidence for the use of these materials relates to roofs and floors. Often layers of laminated macro-phytoliths encountered in excavation, result from collapsed floors and roofs consisting of all sorts of organic materials even visible to the naked eye.

BUILDING PRACTICES

Mud-bricks

In contrast with raw building materials, mud-bricks are purposefully manufactured artefacts that are designed to function in an architectural context. As such, the chaînes
The compositional analysis of the raw sediment used in brick manufacture varies in quality of composition by the amount of sand, silt, clay, organic matter and carbonates incorporated in it (Rosen 1986, 75). Carbonates serve to harden bricks and may be obtained from ashy occupational material, whereas sand, gravels and microartifacts (e.g. small pottery sherds, bones) serve as a sort of skeletal frame to which the fine-grained plasters cling (Rosen 1986, 75). Sand also helps to limit the amount of cracking due to both the shrinkage that occurs during initial drying, as well as the expansion that results from relative amounts of moisture at other times. Excessive amounts of sand, however, may result in weak, crumbly bricks, as demonstrated by Fathy (1973, 225-26). Clay serves as the most essential component in sun-dried mud-bricks by making bricks dense, acting as a binder and increasing resistance to water erosion. However, too much clay is detrimental to brick composition, since it may cause the bricks to shrink and crack in the dry heat (Rosen 1986, 76).

Tempering (or stabilizing) materials vastly improve the tensile strength of bricks. These stabilizers also bind and chemically strengthen the clay in bricks by adding humic acids (Kemp 2000, 82; Rosen 1986, 76). Straw (ancient Egyptian ḏḥ, Arabic ṭibn), and sometimes chaff, has been the universally preferred type of temper used throughout the Near East; whenever this is not a readily available commodity, alternatives may include: chopped grasses or weeds, tree bark and potsherds (Van Beek & Van Beek 2008, 135). Hillman (1984, 127-28) appropriately distinguishes between various classes of vegetal temper according to their derivation from the process of winnowing and course-sieving cereals, highlighting their commonly-assigned different uses: (1) “fragmented light straw” (ṭibn) is probably the type of vegetal temper most commonly used in mud-bricks; (2) “medium-coarse winnowed straw” (zerrak) features more commonly in mud-plaster or is used as fuel; and (3) “chaff”, which results from a later step during cereal processing, may be used for bricks or plaster. In any case, these fibers serve a number of key functions: (1) they hinder cracking upon drying by distributing tension throughout the bulk of the brick; (2) they accelerate drying by improving outward drainage of moisture to the surface of the brick; (3) they significantly reduce the bulk density of the brick, lightening its weight and reducing its thermal conductivity; and (4) most importantly, they increase the tensile strength of the brick, which is one of its inherent disadvantages (Houben & Guillaud 1994, 82). The necessity of temper may vary depending on the quality of the sediment, yet straw was almost always used in MB bricks in the Levant (cf. Nims 1950, 25-26).
Manufacture

Making form-moulded sun-dried mud-bricks requires little specialized technical knowledge, meaning that any individual in the ancient world would have been roughly familiar with the practice, but certain individuals in communities were most adept at the process (Delougaz 1933, 6-7). A modern ethnographic account from Egypt illustrates the basic process of brick-making that has remained relatively unchanged for millennia:

The brickmaker, called țawwâb in Arabic, searches for a deposit of Nile mud of a suitable consistency for his purpose . . . [he has] learnt to make his own mixtures of mud and sand . . . and clears as large and flat a space as possible. His assistants dig up the mud and put it into a smallish hole in the ground . . . where water is added to it until it has the consistency of a very thick paste. The mixing is done with the aid of a cultivator’s hoe . . . the feet assisting in the operation. If [straw] (tībn) is available, it is mixed in varying quantities with the mud paste; if there is no tībn the bricks are made without it, but sand is often added with good effect. Having thoroughly mixed up the paste, an assistant takes a round of oval mat . . . made of strips of palm leaf . . . having handles on either side, and, having dusted it over with fine dry mud to prevent sticking, he puts as much of the paste on it as he can carry and leaves it beside the brickmaker. The brickmaker squats down, holding an oblong wooden mould fitted with a handle . . . the mould being of the size of the bricks he wishes to ‘strike’ (darab). Having filled the mould with the mud paste, the brickmaker scrapes off the surplus and lifts off the mould, leaving a sticky mud brick, just sufficiently hard to retain its form. He continues ‘striking’ a series of such bricks, one alongside the other, until all his available space is filled. The bricks must then be left to dry until they are hard enough to be stacked and a new series made (Clarke & Engelbach 1990 [1930], 208-9).

Clark and Engelbach (1990, 7) argue that this method was identical in ancient Egypt except for the mud being carried in pots instead of on mats. Egyptian depictions of brickmaking that are roughly contemporary with the MB include: (1) a wall painting in the mid-18th Dynasty tomb of Rekhmira (TT100; Fig. 5); (2) a possible 12th Dynasty example at Deir el-Bersha (Newberry 1895, Pls. XXIV, XXV; Klebs 1922, 118); and (3) wooden models from the early Middle Kingdom (Petrie 1890, 26, pl. IX23; David 1986, pl. 18; Clarke & Engelbach 1990 [1930], fig. 263e; Weinstein 1973, 98-9, 232, 296, 419). The basic principles involved in brick-making observed from Egypt and other regions (e.g. Anatolia, Mesopotamia, North Africa) may also be applied to the Levant, and consist of these basic steps: (1) clearing a large, open space for the bricks to be dried; (2) finding and digging up appropriate sediment; (3) mixing the sediment with water and tempering material; (4) putting the mud into wooden moulds and scraping off the excess; and (5) after a batch of bricks is made, leaving the bricks to dry for about a week, turning them on alternating sides and stacked. Fathy (1969, 118; cf. Politis 1999) describes allowing the brick admixture to sit for up to 48 hours in order to allow the straw to rot or “ferment”, thereby inducing acids
that make the bricks stronger and less absorbent than hastily made ones, as well as creating more homogeneity of texture throughout the bricks.

Figure 5. 18th Dynasty captives making bricks in Egypt (after Newberry 1900, Pl. XXI)

Location for the brick-making process basically depends on sediment, water and open space. Taken together, these three constraints provide a strategic challenge for cost-efficient manufacture of bricks on a large scale. Sediments may have derived from nearby “mud extraction pits”, which are known from Mesopotamia (e.g. Old Babylonian yarrum), and may have been identified by archaeological survey (Wilkinson 2003, 109-11). However, such survey methods have not been effectively implemented in the southern Levant. Unlike the natural taphonomy in other regions, the high amount of alluvial aggradation in the low-lying areas in the southern Levant during the millennia following the MB may render pits or depressions such as these undetectable using available survey techniques. In relatively modern Mesopotamia, brickfields were commonly in or adjacent to a cultivated field beside a canal or river (Moorey 1994, 305). Since most urban MB sites in Canaan incorporated or were located immediately adjacent to springs or rivers, the manufacture of bricks probably occurred very near the springs wherever there was enough space for drying. In this case, there would be plenty of water to fulfil the required proportion of about one part water to three parts sediment by volume for the brick admixture (Wright 2005a, 107). An additional constraining factor is the time it takes for the bricks to dry properly before becoming stackable (for further drying), which may take a week or so (Wright 1985, 352). During this period of drying, a brickfield would be unable to produce more bricks until new space becomes available for drying, and the overall surface area utilized for drying could be multiple hectares (see Chapter 9). In the Levant and northern Mesopotamia, this process would have to be confined to the dry season in order to facilitate the drying of the bricks.
A further crucial constraint in brick manufacture is tempering material, namely straw, which vastly improves the strength of dried bricks, yet also aids the manufacture process by making the admixture less sticky and more workable. In Fathy’s (1969, 118) construction of the village of New Gourna in Egypt, he employed a ratio 45 lbs (20.4 kg) of straw to 1 m³ sediment (itself a mixture of 1:1/3 sediment from the immediate vicinity to sand), which was mixed with water and left to soak and ferment for 48 hours. Others suggest fairly similar amount of temper, such as 2.5% straw by weight (Keefe 2005, 58), a ratio of one part straw to three parts sediment (Politis 1999), and 100 bricks requiring a minimum ca. 60 kg straw (Oates 1990, 389). Despite the substantial amount required for brick manufacture, straw would not always be readily available throughout the year, being only widely available following harvest (Kemp 2000, 82). Therefore, in the Levant, where bricks can only be made in the dry season, the availability of straw creates a significant constraint. Furthermore, until the modern period straw was a commodity used for many purposes beyond brick-making, particularly animal fodder and fuel, adding to the seasonal constraint of availability. A possible alternative may have been manure (Clarke & Engelbach 1990 [1930], 208), yet in much of the Near East, manure may be more valuable for applications such as fuel, fertilizer or, sometimes, in mud plaster (Van Beek & Van Beek 2008, 135).
With regard to the resulting sun-dried brick, the importance of the brick mould should not be undervalued in terms of the technological aspects of brick form in architecture, and its implications for understanding standardization. Wright describes the brick mould as: “a small wooden frame which stands behind towering monuments, massive city walls and in some cases every building great and small within them” (2005a, 99). The form-moulded brick is a building material of specific design and dimension comparable to dressed stone, with a bearing strength not markedly less than that of limestone (Wright 2005a, 99). Moulds used to form bricks consisted of essentially basic wooden frames of one or many linearly arranged partitions, with or without handles (Fig. 8). Information regarding ancient brick moulds derives from (after Wright 2005a, 100): (1) actual survival of moulds from Egypt and Canaan (Petrie 1938, Pl. II, fig. 1; Schumacher 1908, 12, XLIIb); (2) ancient representations from Egypt; (3) ancient literary references from Mesopotamia; (4) traces left on moulded bricks; and (5) modern analogies.

The number of bricks produced by a brick-maker and assistants, or brick-making “team”, may be quite high (see Chapter 9), and since a single group of brick-makers may manufacture thousands of bricks from their own set of moulds, many large sections of
buildings were constructed with bricks of the same dimensions. The extent to which there may be uniformity in brick dimensions across an entire site may have to do with the degree of overall centralization, meaning that the more centralized the management of labour and planning of architecture, the more likely that all the brickmaking teams are using standard-sized brick moulds. However, such uniformity is not always observed in architecture of the Bronze Age Levant, perhaps suggesting the employment of many groups of brick-makers at the same time, producing different bricks that were used in the same structure (e.g. Delougaz 1933, 6-7). These issues of standardization will be discussed further below (Chapter 10) as it pertains to the social processes behind MB urbanization.

Brick Walls

The strength of a mud-brick wall greatly depends on two factors: the quality of the brick manufacture and the expertise of construction. Although mud-brick has negligible tensile strength, its compressive strength is fully adequate for any ancient building (Wright 1985: 408). The main agent in mud-brick decay is water (Rosen 1986, 10), thus the durability of a mud-brick wall depends on it remaining dry throughout. Even from the stage of construction, bricks must be as dry as possible, and mortar must be allowed to try to some extent between courses. Rainwater mechanically erodes mud-brick in a number of ways, requiring mud-plaster treatments on the external faces of the wall as a primary defence. Likewise, stone foundations serve to raise the lowest courses of bricks above the ground level, thereby preventing erosion of the base of the wall by moving water, as well as reducing the amount of water absorbed into the wall from below through capillary action (e.g. Rosen 1986, 11). Without such precautions, the external exposures of a wall will erode, and cleavage planes may develop as a result of moisture in the core. In order to minimize joint stress, and therefore maximize overall wall strength, bricks were arranged in bonding patterns that stagger the potentially weak joints between bricks along alternating courses, dispersing stress equally through the entire wall (Fig. 9). Brick bonding techniques in the Levant were basic and variable, usually consisting of a running bond (each course offset by half a brick length) (cf. Spencer 1979, 116). In order to anchor the extremities to the core of a wall, rectangular bricks were often incorporated along the edges arranged as alternating headers and stretchers in different combinations.
Mud mortar

The composition of mortar is also crucial for structural integrity: if it is stronger than the brick, the brick will tend to break in the setting, but if it is much weaker than the brick, then the joints constitute a weakness (Wright 1985, 409). Mortar in the Bronze Age generally consisted of a similar composition to the bricks and was almost always used along horizontal joints (between courses) and sometimes between vertical joints. On average, the amount of mortar used in MB Levantine walls contributed to ca. 13 per cent of the total volume of the structure, which makes this aspect of construction quite significant. With regard to mortar manufacture, the material may not differ from the bricks whatsoever, being derived from the very same process. In this case, a portion of brick admixture might be reserved for mortar, which would have to be taken, still wet, to the site of building and used immediately. Alternatively, mortar material may derive from recycled tell deposits near the location of building, whereby the individuals laying bricks in a wall would most probably continually mix fresh mortar as they went from the easily accessible occupational sediments. Each of these options have potential advantages, and will be discussed below (Chapter 8) in light of evidence from the case studies.

Kemp (2000, 92) observes that, at least in Egypt, bricks within the core of walls might be laid without any mortar at all within very thick walls. The possible advantage of laying bricks without mortar inside a wall is faster construction by eliminating the need to wait for mortar to dry sufficiently before laying a new course of bricks. This would also
reduce the amount of overall labour spent on constructing a wall, as well as requiring less mortar, which adds up to a significant volume of the wall (and proportion of labour and materials for its manufacture). However, laying bricks without mortar within the wall, yet still using it on external bricks, would result in less internal volume, creating a dip in the middle that would place extra stress on all the brick joints throughout the wall.

*Mud plaster*

Mud plaster is the final key component to constructing a mud-brick wall. The mud mixture used for plaster can be the same as both bricks and mortar, yet it often consists of slightly finer sediment with fewer inclusions, which helps it adhere to the face of a wall. The temper used may also be finer chaff rather than thick straw, and of higher quantities than required in brick and mortar to prevent cracking (Wright 2005a, 94). After the bricks are laid in a wall, and the mortar dries sufficiently, the fresh mixture of mud plaster is spread over the interior and exterior faces of the wall in successive coats. Moorey (1994, 329) observes in modern practice that the plaster is applied in two coats, the first having more straw and clay, and the second being as fine and thin as possible. Mud plaster functions in three major respects: (1) it adheres to the bricks and mortar, which it supplements in binding the bricks together and increasing structural stability; (2) it serves as a barrier to prevent moisture (also: plants, insects, animals) from penetrating the wall and causing permanent degradation in the core; and (3) it provides an aesthetically-pleasing smooth surface rather than exposed bricks, which may be mottled, uneven and irregularly bonded. The importance of these functional aspects, particularly the former two, requires regular (potentially annual) maintenance to prevent any damage from occurring to the wall. As long as a mud-brick wall remains dry and protected from external damage, it might remain standing indefinitely. Unfortunately, the lack of preservation makes it difficult to determine the extent to which plastered surfaces were decorated, but evidence of wall and floor frescoes from a few limited MB II sites (e.g. Tel Kabri, Alalakh, Tell el-Daba, Qatna) demonstrate that such practices were employed in at least some situations (cf. Brysbaert 2008; Bietak 2007; Cline & Yasur-Landau 2007; Niemeier & Niemeier 1998; 2002; Pfälzner 2008).

**Units of measurement**

Despite the extent of excavation in the Levant, little systematic research has been undertaken regarding systems of measurement in Bronze Age architecture besides general, observational measurements. Yet, evidence from Mesopotamia and Egypt make it clear that standard units of measurement existed and were quite commonly practiced in architecture and craft production (Wright 1985, 118ff). The most relevant unit of measurement for the present study is the “cubit”, which was a basic linear measure derived from the length of a
person’s forearm, from the elbow to the tip of the outstretched middle finger, ca. 50 cm. As such, the cubit was a readily available corporeal unit of reference in the many measurements of bricks, walls and doorways, and was probably the basis of further proportional ratios. Material evidence (e.g. measuring rods, yardsticks) survives for the convention of the cubit being used in Mesopotamia and Egypt, demonstrating an early standardization of measurement from the beginning of urban development (Wright 1985, 88). By New Kingdom Egypt, the normal cubit (ca. 52 cm) existed alongside a slightly shorter cubit (ca. 45 cm) and, based on the later biblical mention in Ezekiel (e.g. 40:5; 43:13), there existed a common short cubit as well as a sacred long cubit in Canaan in the first millennium B.C.E. (Wright 1985, 118-19). Particularly for bricks in the Classical period, Vitruvius (II: VIII, 9-10) distinguishes between the pentadoron of 5 palms for public works and the tetradoron of 4 palms for private construction. Subdivisions of the cubit are well demonstrated in Egypt through calibrated measuring rods that agree with later biblical reference, as Wright explains: “the system being 4 fingers to the palm and 6 palms (24 fingers) to the common shorter cubit and 7 palms (28 fingers) to the long Royal cubit” (1985, 119).

The most abundant material available in the archaeological context to observe metric practices is the mud-brick, since bricks may be manufactured “to fit”, being form-moulded to particular dimensions so they may be used effectively in walls. Generally, it seems that bricks used in public architecture are larger than their domestic counterparts, which may also be observable in Egypt (Clark & Engelbach 1990, 209), even into classical times (Vitruvius II, 8, 9-10). There are examples of exceptionally large bricks being used in MB city walls, ca. 0.7 m (e.g. Beit Mirmim [Albright 1938, 38], Hadidi [Dornemann 1979, 144], Pella [McLaren 2003, 17], Timnah [Mazar 1997b, 39-40]) to 1 m (Megiddo [Schumacher 1908, 27]) long, probably in order to anchor the external face of the wall to the core, which seems to be the case at Megiddo. Kemp (2000, 87) suggests an overall preference for large bricks in light of the fact that they result in less mortar throughout a wall, thus reducing shrinkage of the wall during drying, and their greater surface area enables surer bonding and thus greater strength than smaller bricks.

Overall, bricks in the Bronze Age Levant appear to be larger than those in Egypt and Mesopotamia (see Chapter 7), suggesting a preference towards efficiency in manufacture. Nonetheless, the size of bricks in the Levant probably greatly relates to the availability of appropriate raw materials best suited for ideal brick manufacture. Whereas sediments in Egypt and Mesopotamia tend to have high amounts of clay, and must be greatly tempered by sand and straw, the various sediments throughout the Levant tend to have more even distributions of particle sizes, making the sediments naturally suited for brick manufacture with little necessary alteration. Therefore, it is possible that it was easier to make higher quality bricks in the Levant, translating to the ability to produce larger bricks. The strength
of a brick greatly depends on its size. The larger a brick is in any way, the greater its own mass undermines its tensile strength, therefore basic material constraints limit the practical size of bricks manufactured on a large scale.

Further constraints to brick size include an optimum weight for transporting bricks, probably with a preference for transporting multiple small ones over a single, less-manageable brick, and longer drying time for large bricks. The bricks found in the Levant occur in both the rectangular form, which is essentially Egyptian, as well as the square form, which is most common in Mesopotamia. However, upon closer examination, Levantine bricks appear have very little in common with the dimensions of bricks in Egypt, which are smaller and more rectangular (cf. Hesse 1970; 1971; Kemp 2000, 84-88; Spencer 1979, 147-48). Levantine bricks have slightly more in common with Mesopotamian bricks (cf. Powell 1982; Robson 1999, 58-67), but they are thicker and there are clearly major differences between sun-dried and kiln-fired bricks.

Brick dimensions of the MB Levant unfortunately have not been recorded or published in any systematic way. Therefore, despite efforts to study chronological or regional typologies based on brick dimensions (e.g. Albright 1938; Schumacher 1908), results have remained elusive (Naumann 1971, 50). Where measurements are published it is often difficult to determine their exact context and if the values relate to bricks that are typical or exceptional within their context and whether or not the values are averages of multiple bricks. Upon initial observation of the available brick dimensions from the MB, it seems that measurements vary widely, yet basic systematic statistical analysis of these dimensions reveals broad patterns (Chapter 7). Studies on brick dimension in Egypt (Hesse 1970; 1971; Kemp 2000, 84-88; Spencer 1979, 147-48) have attempted to elucidate patterns at sites by plotting sets of measurements representing such data as coefficients of correlation between length and breadth and standard deviation. Based on their results, these studies argue that analysing the dimensions of bricks to the nearest millimetre is unrealistic. Likewise, as Wright (1985, 357) argues, the resolution of precision when interpreting these measurements should be fairly approximate, within a range of a few centimetres, since the approximate nature of brick dimensions arises inherently from the imprecision of using natural (i.e. corporeal) standards of measurement, as well as the roughness of moulding and subsequent shrinkage of bricks. One worker’s cubit may be a few centimetres different from a worker elsewhere, yet despite the possible disparity in measurement in absolute terms, the principle of the cubit (or other units) should still apply. Therefore, it is essential to look for broad patterns and high-frequency ranges of measurements that may correlate to conceptually standardized units in the MB (see Chapter 7).

My database of mud-brick dimensions I have compiled draws mainly from numerous excavation reports and some personal observation. Based on careful analysis of
brick dimensions, some important observations may be made, such as the roughly standard units based on the cubit and its subdivisions. The detailed results of these analyses and their implications will be further discussed in Chapters 7 - 10.

Beyond the actual units of measurement observable in bricks, a fruitful approach for identifying important patterns in overall construction derives from inferring proportional ratios. This concept was highlighted by Schumacher (1908, 27ff) during his excavations at Megiddo, and Wright (1985, 356-8) has subsequently focused on it in his discussion concerning bricks throughout the Levant. As Wright notes:

Manifestly the dimensions of some bricks are determined by a scheme of simple arithmetic proportions between length and breadth (and to some degree the thickness can be brought into the relation). According to this system the basic dimension should be a standard unit of measure, foot or cubit etc., and the other dimension a simple multiple or fraction of this (1985, 356).

As applied to bricks, proportional ratios correspond to the inferred relationship of length to width to height. An example of a rectangular brick is 6:3:1, where the length is 66 cm, the width is 33 cm and the height is 11 cm. In the case of a square brick of 4:1, the dimensions of the brick might be 43 x 43 x 11 cm. Both examples demonstrate proportions based on multiples of a unit akin to the “palm”, here ca. 11 cm, which frequently occur in multiples of three (i.e. “foot”), four (i.e. “short cubit”) and five (i.e. “common cubit”). Wright elaborates on the idea that a system of proportional relationships may also have been incorporated in the design of certain buildings:

The [Megaron] Temples of Megiddo XV, although not centralised in design, are in external dimensions virtually square (i.e. not reckoning the side chamber) being ca. 17.50 m x 17.50 m. These three temples appear to show a very considerable concern for harmony of proportions in simple arithmetic ratios of 2:3:4 e.g. cella (ca. 13.5 m x 9.0 m) = internally 3 x 2, overall temple externally 4 x 4. The Migdol Temple of Shechem equally may show an attempt to harmonise proportions—both the internal dimension of the cella (ca. 13.5 m x 11.0 m) and the overall external dimensions of the temple (ca. 26.3 m x 21.2 m) could be rationalised at about the same ratio, in the vicinity of 6:5 or 5:4. Certainly this ration can be seen in the overall proportions of some Bronze Age city gates e.g. the Area H Gate at Hazor (ca. 20 m x 16 m) and the East Gate at Shechem (ca. 17.2 m x 14 m) (1985, 125). Although there may be some validity to this concept, caution must be exercised when attempting to infer such proportions based on excavation reports, which may not represent truly accurate measurements and may already be shaped by some degree of interpretation. Nonetheless, attempting to identify proportional relationships among the dimensions of architectural units may yield patterns helpful for interpreting constructional strategies and standardization in the MB.
SUMMARY

The implications of standardized units of measurement during this period present the possibility of high degrees of constructional organization and overall standardization, which may be deeply rooted in the impetus and nature of urbanization in the MB, as opposed to other periods. Furthermore, since the Levant seems to demonstrate certain norms different from neighbouring regions (e.g. brick dimensions), it would seem that most aspect of urban architectural innovation during this period did not derive directly from exogenous sources, but must be explained by more complex approaches towards social theory. One of the great potentials in assessing the metric patterns in architecture is identifying key organizational principles in processes of production during construction, such as the scale and intensity of specialized activity. The broad patterns of standard architectural practices (Chapter 4) and detailed patterns mud-brick manufacture (Chapters 7 - 9) will be discussed together with other classes of cultural material regarding organizational principles of production during MB urbanization.
4. MIDDLE BRONZE AGE ARCHITECTURE

As I discussed in the previous chapter, Bronze Age builders made effective use of readily available raw materials in different ways in order to construct various types of buildings. The most ubiquitous building unit was the mud-brick, which was strategically used for its high-efficiency function in walls, potential durability and general ease of manufacture. Stone, timber and various vegetal matter were also used where mud-bricks could not suffice. In this chapter I will describe the greater architectural context of these building materials in the MB urban settlement by detailing the form and—to a certain extent—the function of certain types of common architecture. Furthermore, the following descriptions being to highlight the many architectural aspects unique to the MB and how they contribute to our understanding of urban planning during this period.

FORTIFICATIONS

A number of architectural elements can be discussed under the heading of “fortifications”, including earthen ramparts, curtain walls, towers and gates. There is no lack of literature concerning MB fortifications, which results mainly from the sheer size and prominence of such architecture, often standing out from all other periods of occupation represented at sites. Excavations have commonly investigated the edges of tells with the intention of transecting the MB fortifications, which are easily encountered under most circumstances. Even upon surface survey of a site, the MB earthworks are readily apparent, if not more specific fortification elements, such as towers or gates. Due to their generally good state of preservation, some aspect of the fortifications has been investigated at nearly all excavated MB urban sites in the southern Levant. Therefore, fortification architecture is the most widely available source of data for any discussions regarding MB architecture and urbanization. Although such fortifications are certainly not exclusive to this one period in Canaan, they appear to have been employed to some degree at most, if not all, urban sites in the MB. In fact, features such as earthen ramparts are so common that they are considered to be the hallmark of the MB (e.g. Dever 1987; Mazar 1990, 174).

Subsequent to their pervasiveness in the available archaeological record, MB fortifications have drawn considerable attention, especially by scholars who seem inspired by monumental scale of construction and inferred military function. For archaeologists, the monumentality and assumed defensive functional aspects of MB fortifications seem to
characterize MB society and the florescence of Canaanite culture, being perhaps the clearest manifestation of a presumably highly organized socio-political structure during the period (e.g. Oren 1997a, 256). The emphasis scholars place on fortifications during this period results especially from the fact that there is almost nothing on a comparable physical scale apparent from the EB or IB in the southern Levant except, perhaps, for Yarmuth (de Miroschedji 1999). Based on the evident defensive nature of fortifications (e.g. Burke 2008; Kaplan 1975; McLaren 2003; Parr 1968; Wright 1968), the milieu of the early second millennium B.C.E. is often cast in the light of conflict, evoking notions of invasions, siege warfare and militaristic politics. Unfortunately, the military function of fortifications has dominated scholarly assumptions about the practical and ideological purpose of such architecture, overshadowing its potential value for understanding Canaanite society more broadly. Most discussions regarding MB architecture have been simplistic or have even diverted attention away from potentially more fruitful theories that might apply to the development of social complexity during early stages of urbanism. Referring to certain types of architecture (e.g. earthworks, walls, towers, gates) as “fortifications” implies a primarily defensive function (Mazar 1997a, 250) and carries with it militaristic connotations. That these architectural features functioned in a defensive sense should not really be in question; however, it is crucial to highlight the other functions of fortification architecture in order to explore implications for MB society, as some have emphasized (e.g. Bunimovitz 1992; Finkelstein 1992; Uziel 2011).

In one very basic sense, the same structural properties that would have made these architectural elements effective against siege attack likewise function in a more utilitarian way by providing significant structural support for other massive monumental architecture around often topographically challenging areas (e.g. Herzog 1997). Thus, the term “fortification” may also apply to a system of strengthening or supporting architecture and spaces around a settlement, having nothing to do with an explicit military function. Down to their building materials, architectural elements can often serve both structural and military functions. Even mud-bricks may be interpreted as serving a defensive function, since they could have absorbed shock evenly—cushioning the impact of projectiles and battering rams—whereas stones could be more easily jarred out of place, destabilizing a wall (cf. Wright 1985, 176). Nonetheless, sun-dried mud-bricks were primarily used for their efficient value in construction, as well as their physical properties lending to structural integrity. The many nuanced functions of architectural elements and their constitutive materials should not be overlooked, as they were probably not lost on ancient Canaanite builders. Therefore, the following architectural features listed under the present heading of fortifications should be considered to have multiple functions, both independently and as
part of a greater architectural system, and their potential social functions will be further discussed in Chapters 9 and 10.

**Earthworks**

The major earthworks surrounding the perimeter of settlements equated with the MB have come to be identified as “ramparts”, and possibly remain the single most impressive extant feature of any site. The history of research relating to ramparts in the southern Levant mirrors the study of the MB in many ways, and therefore deserves a brief survey. Ramparts were first identified as a type of fortification by Petrie, based on his excavations of Tell el-Yehudiyyeh in the eastern Nile Delta. Petrie (1906) was also the first to attribute the ramparts to the Hyksos, referring to them as a great work of the mysterious “Shepherd Kings” or “Hyksos” —an idea that was further elaborated by Albright (1935), who interpreted them as closed encampments mainly protecting the horse-drawn chariots for which the Hyksos were known (a glorified car-park, as it were). Kenyon (1952) generally agreed with this theory, and proposed that the sloping ramparts were also a measure intended to defend against attacking chariots. Yadin (1955) suggested an alternative explanation, that earthen ramparts, or “fortified camps”, were rather constructed in order to counteract a new technological innovation in Bronze Age warfare, the battering-ram. In one of the first comprehensive surveys of ramparts, Parr (1968) attempted to disassociate the phenomenon from the Hyksos, and argued for their natural cultural development from the practice of consolidating and reinforcing the slopes of previously occupied mounds of the EB.

In a departure from the prevailing views of earthworks at the time, Wright (1968) focused rather on their architectural aspects, suggesting a non-military function for the glacis as a protection of earthworks against erosion. In a comprehensive investigation of ramparts, Kaplan (1975) sought their origin in the construction of levees of the ancient irrigation canals of Mesopotamia, specifically Ur III, and considered both civic and military functions for them. More recently, Dever (1985) called for a re-evaluation of the MB earthworks within their socio-political context rather than just as a technological development based on formal and functional considerations. However, returning to Hyksos-related theories, Dever argued that the “fortified city-states of Palestine” may be seen as “base-camps from which to launch Asiatic campaigns into Egypt, as well as “back-up systems” in case these were repelled” (1985, 73). Focusing again on their militaristic aspects, Stager (1991) suggested that ramparts reflected a fortification technique designed to counter a besieger’s tactic of tunnelling below and undermining walls, known as “sapping”.

In an important turn away from the linear militaristic interpretations, Finkelstein (1992) and Bunimovitz (1992) challenged the assumption that earthen ramparts were intended solely as defensive fortifications. Rather, they suggested interpreting ramparts as
non-military earthworks, focusing on the social function and implications of their construction. To this end, Finkelstein (1992, 206) argues for alternative terminology from ramparts or fortifications, preferring “public stone- and earthworks”. Likewise, Herzog (1997, 118; 1989) attempts to explain the phenomenon on technical and economic grounds, citing the various forms and functions of ramparts, and arguing that defence should not be the only consideration in defining a city’s form.

Most recently, Burke’s (2008) study covers the subject of MB ramparts, going into considerable detail on their construction and discussing the many typological distinctions that may be made for such earthworks throughout the Levant. Yet, despite being a major contribution towards a typological understanding of MB earthworks, Burke’s discussion and conclusions regarding earthwork construction and function remain grounded only in their military nature. In a refreshing divergence from their military function, Uziel (2010; 2011) suggests an integrative interpretation towards ramparts, highlighting them as important symbolic structures that strongly affect the MB landscape.

For the present discussion, an earthen rampart may be generally defined as: (1) a mass of earthen material with a slope on one or both of its sides; (2) surrounding all or part of a site; (3) having an earthen or stone core anchoring its layers of fill; (4) supported by any number and type of reinforcing walls (e.g. core walls, internal retainers, revetments); and (5) sometimes having a fosse, or dry ditch, at its base. While earthen ramparts all share common architectural principles—essentially the integration of earthen embankments and supporting features—their form may vary according to a number of factors. As Herzog (1997, 118) notes, the enormous size of most of the sites having earthen ramparts precludes the possibility of sufficient exposure on a wide enough scale to fully assess them in comprehensive detail, and where ramparts have been systematically investigated at sites, there appears to be considerable variation in their construction around the site (e.g. Dan). Aside from their size, the most remarkable aspect of earthen ramparts is their durability, which appears to result from the strategic engineering that went into their construction. The following description of earthen ramparts aims to summarize the current corpus of knowledge pertaining to such earthworks based on available excavation data.

A number of typological distinctions have been applied to earthen ramparts, but there are essentially two main types: freestanding and supplementary. The difference between these two types is predominantly morphological, yet also functional in terms of building options at particular sites. Building options were based primarily on site topography, previous architectural elements and overall settlement planning strategies. Both types of ramparts were of significant dimensions, with the average height above the surrounding plain being ca. 10 m, and the width of freestanding ramparts reaching as much as ca. 90 m at Hazor (Burke 2008, 50). According to Burke (2008, 50), the slopes of both
Freestanding and supplemental ramparts appear to be an average of ca. 30°, yet some may have been as steep as 45° before the effects of erosion (cf. O’Neal et al. 2005; Rosen 1986).

Figure 10. Kaplan’s examples of rampart types, as demonstrated in cross-section: (1) a wall rampart, Tel Poleg; (2) “glacis” (i.e. rampart) attached to base of wall, Tel Gerisa; (3) freestanding rampart, Hazor; (4) freestanding rampart, wall and glacis, Tel Nagila; (5) freestanding rampart and glacis, Yavne-Yam; (6) freestanding rampart, glacis and wall, Jericho; and (7) freestanding rampart or city wall, Tel Dan (after Kaplan 1975, Figs. 1-7).

Freestanding ramparts

The freestanding rampart may be defined as an artificial earthen embankment having slopes on its interior and exterior sides, therefore giving it a triangular or trapezoidal cross-section. The internal construction of ramparts generally consists of a stone or dense earthen internal core that provides stability and serves as an anchor for the layers of fill. It is very possible in many cases that the cores of such ramparts were re-used walls from previous phases of settlement (e.g. Dan, Hazor, Megiddo). This type of rampart is sometimes easy to identify at sites because it often results in the formation of “crater” tells, resulting from subsequent occupational strata accumulating upward against the inner slopes of the rampart and sloping downward toward the centre of the settlement. Freestanding ramparts were often constructed where topography was open and relatively flat, and where previous occupation was limited in extent. As such, ramparts could be laid out according to a systematic plan, rather than adapting to spatial constraints (Burke 2008, 49). The largest settlements (Herzog’s [1997, 163] “large rampart cities”) featured freestanding ramparts, and
their layouts were essentially either elliptical (e.g. Achziv, Akko, Ashkelon, Kabri) or rectilinear (e.g. Dan, Haror, Hazor, Lachish, Masos, Nagila, Timnah, Yavneh-Yam). The limited evidence for “core-wall” or freestanding ramparts in Transjordan during the MB contrasts with other regions of the Levant (McLaren 2003, 37), which is highly unusual considering the transmission of most other innovations typical of the period.

Supplementary ramparts

The supplementary rampart (Kaplan’s [1975, 1] “wall rampart”) consists of a single external embankment typically abutting and/or supporting some combination of natural topographic features, tell slope or architecture. Kaplan (1975, 2) describes this type of earthwork as “a girdle of earth” deposited in front of a city wall as a form of protection against the natural forces of erosion or enemy attempts to undermine it. This construction apparently achieved the same purposes as freestanding ramparts, but only on the exterior slope of a site. The supplemental nature of this construction required less overall construction and effort than the freestanding rampart, yet produced a similar result. Although such ramparts were usually more modest in size than freestanding ramparts, they were built using the same fundamental techniques and their slopes were equally steep (Burke 2008, 50). In some cases, both freestanding and supplementary elements were combined at a single site—especially at Herzog’s (1997, 163) “extended cities”. Reoccupied EB tells or greatly expanded MB I settlements were probably extended in size in order to cope with monumental architecture and demographic expansion wherever the existing area of settlement became inadequate. As a resulting compromise, a site could be considerably enlarged by earthworks laid all around it (e.g. Jericho) or on one side (e.g. Shechem) (Herzog 1997, 163).

Parts of a rampart

Beyond the general morphological typologies of freestanding and supplementary ramparts, the more specific construction techniques and constituent elements within these earthworks may vary considerably. Although a general construction strategy seems to have existed across the region, adaptations occurred based on available local building materials and specific engineering challenges at different sites. The four most frequently attested elements identified among earthen ramparts are: (1) a glacis, (2) various walls, (3) a fosse, and (4) strategic internal fill.

Glacis

Among the corpus of literature regarding earthen ramparts, the terms “rampart” and “glacis” have often been used interchangeably; however, an important distinction should be maintained between the two. Wright defines the technical military term derived from
French (glacis) as “the outermost element in a fully developed system, where beyond the counterscarp wall some of the earth excavated from the ditch was piled up to increase the protection given the escarp wall” (1968, 1). In this sense, a sloping rampart could be considered a glacis. However, as Kaplan (1975, 3) initially observed, the term glacis should be applied specifically to the surface of the slope itself, not necessarily to the entire earthwork forming the slope. Herzog (1997, 135) carries this distinction further by defining a glacis as a separate earthwork component, either natural or artificial, that is applied to the slope of an embankment, mound, or rampart, in order to protect it from erosion. Although not using the term glacis, Wright appropriately commented on its primary function as providing protection against natural weathering, particularly from erosion arising from the drainage of storm-water: “This cuts out deep gullies in the side of a tell with startling rapidity . . . the plastering of the slope is not a defensive measure in the military sense—it is defensive against the forces of nature, not those of man” (1968, 17). As with other features relating to ramparts, the construction of the glacis may have varied at different points around a site, potentially due to strategic defence against prevailing climatic patterns on one side of the site or other (cf. Rosen 1986, 25ff). Taking all these aspects under consideration, I propose the following appropriate definition for a glacis: an intentionally prepared coating applied to the surface of a slope in order to prevent its erosion and reinforce the internal fill of an earthen rampart.

The glacis essentially consists of durable and weather-resistant materials, such as those listed by Burke (2008, 55): stones (e.g. Ashkelon, Beit Mirsim, Burga, Far’ah North, Haror, Hazor [upper tell], Hebron); crushed or chipped stone (e.g. Dan, Gerisa, Gezer, Jaffa, Jericho, Nagila, Shiloh, Yavneh-Yam); gravel (e.g. Malhata, Masos, Megiddo); mud-bricks (e.g. Akko, Ashkelon, Gerisa, Jericho, Poran); mud plaster (e.g. Haror); terre pisé or “packed earth” (e.g. Gerisa, Jaffa); and clay (e.g. Beth-El, Shiloh, Ta’anach). It should be noted, however, that the glacis identified at many sites (and their materials) are actually the result of misinterpretation. As mentioned above, the terminology of rampart and glacis have often been used interchangeably, and mud-brick walls have also been grouped with these and other fortification elements, being inclusively mislabelled as “ramparts” or “glacis”. The muddied waters make it difficult to discern actual patterns, yet one basic clarification may be provided here. Mud-bricks would not have been used in the construction of earthworks, unless as part of a fill that was derived from occupational debris, or if the earthworks cover earlier brick walls. At sites where mud-bricks have been interpreted as being part of earthworks, they are in fact either walls (e.g. Jericho) or happen to result from secondary deposition, probably collapsed from a wall onto the rampart (e.g. Mevorakh). Contrary to Burke’s (2008, 55-56) notion that bricks are weather-resistant and preferred in
wetter areas, the reality is quite the opposite—exposed sun-dried mud-bricks on a slope would erode quickly and be counter-productive to stabilizing the rampart.

Walls

Three types of walls may be associated with the construction of earthen ramparts, not including any type of city wall, which is an independent architectural element. These various walls incorporated in ramparts provide different aspects of reinforcement and stability.

The cores that are found particularly in freestanding ramparts provide a solid anchor for the surrounding fill. Although these cores are referred to as “core walls”, they may or may not be walls in a true architectural sense. As Burke (2008, 54) suggests, a core wall may also have provided a solid foundation for the construction of a city wall crowning the rampart. However, such a relation lacks sufficient evidence and, in most cases, the core wall does not reach the full preserved height of the rampart. Core walls generally consist of medium- to large-sized fieldstones and occasionally mud-bricks. In the latter case, however, the core was probably an earlier wall buried under the rampart, yet still functioning as a core.

Internal retaining walls, also usually built of fieldstones, were buried within a rampart’s fill and are generally only a few courses high as well as short in length. These walls seem to have functioned as stabilizers, anchoring the sloping fill of the rampart to the natural topography. Of all the wall types, the use of retaining walls was particularly varied, and greatly depended on the support needs at different points within a rampart. Again, it is very likely that many such walls were, in fact, earlier walls that become incorporated inside earthworks.

Whereas core and retaining walls were used inside ramparts, revetment walls were an exterior feature built at the foot of the rampart’s slope. Being the outermost built feature of the earthwork, revetment walls were usually well-constructed and very often quite thick and tall, sometimes having a battered surface or cyclopean masonry on their exterior. These walls appear to reinforce the earthen fill of the rampart and protect the base from erosive activity that could cause undercutting and therefore accelerate down-wearing.

Fosse

A fosse is essentially a dry ditch, or moat, excavated at the foot of an earthen rampart, and could serve many complimentary functions. For defensive purposes, a fosse may expose an enemy’s approach towards a site (as a counterscarp) and distance them from defensive fortification (the main escarpment). Likewise, a fosse increases the net height of the ramparts in relation to the immediate surrounding plain. As an obvious benefit for the construction process, the excavation of a fosse provided the source of much of the earthen
fill for a rampart. An additional benefit is channelling water away from the base of a rampart, protecting it from erosion, and possibly even serving as a water reservoir for short periods of time. In some cases, the fosse may have been intended to serve as an actual water moat, such as at Achziv, where the fosse on the eastern (inland) portion of the tell joined two river beds which, combined with the sea on its western edge, effectively surrounded the entire site with water (Prausnitz 1975, 202-3).

Internal fill

The earthen fill of a rampart is the main constitutive element of its construction and usually consists of alternating layers of various types of sediment (e.g. clay, silt, sand, gravel), occupational debris (e.g. mud-brick detritus, ash) and chipped or crushed stone (e.g. huwwar, kurkar, travertine), all of which could be obtained locally. Ramparts may often be dated (terminus post quem) based on finds in the fill from previous occupational activity at a site. The various materials were sometimes laid in sequential layers in what may be referred to as the “sandwich” technique (e.g. Burke 2008, 51), with the layers sometimes interleaved to help bind the materials together for extra stability (Fig. 11). Examples of the sandwich technique include (McLaren 2003, 38): MB I Kabri and Dan; MB II Jemmah; MB II-III Jericho and Lachish; and MB III Gezer. The primary purpose for the alternating layers of fill was most likely to facilitate drainage through the earthwork (Pennells 1983), because without sufficient drainage capability it would simply erode (cf. Dothan 1976, 5-7; Geva 1982, 18).

Figure 11. Schematic section of rampart (“Glacis 8012”) in Field I, Gezer, demonstrating the construction technique of alternating layers of fill (after Dever et al. 1970, Plan 2).
Likewise, Lavee et al. (1993, 298-99) have more recently expounded this idea based on granulometric study of the sediments in the rampart at Shiloh. The study indentified five main materials in the Shiloh rampart fill (Lavee et al. 1993, 297-98):

1) A layer at the base of yellowish-grey material (dolomitic marl with a *rendiza*-type microfabric) containing MB II sherds and a lower sub-layer (1A) of mud-brown (*terra rosa*) reaching ca. 80 cm to bedrock, in which no sherds were found.

2) A grey ash layer ca. 0.2-0.3 m thick.

3) A long “lens”, ca. 0.9 m thick, consisting of thin sub-layers formed alternately of reddish-brown earth (*terra rosa* with many argillans) and a friable white material.

4) A crumbly white material (dolomite) containing many small stones. The predominant element of the fill, this layer appeared along the entire length of the rampart and varied from 0.7-1.8 m in thickness.

5) A muddy-brown soil (*terra rosa*) that comprises the surface of the rampart (i.e. the glacis), with “white “fingers” of Layer 4 penetrating into it”.

Based on micromorphological and granulometric analyses of samples taken from each layer, Lavee et al. (1993, 299) concluded that the most important parameter that differs between the layers is clay content, based upon which the layers were divided into two groups:

1) The silt-loamy layers (1, 1A, 2 and 4) which are characterized by relatively porous material and better drainage conditions.

2) The clayey layers (1B, 3 and 5) which are more compact, heavy and stable, and less permeable.

Therefore, the alternation of porous layers (facilitating drainage) and denser layers (offering more structural support) ensures that the rampart remains strong, stable and unsusceptible to internal erosion. Such intentional construction techniques used for earthen ramparts suggests considerable knowledge regarding the mechanical properties of earthen materials,
and demonstrates the capacity for planning and implementing architectural design on a large scale during the MB.

**City walls**

Bronze Age city walls are technically a “curtain” meaning, in general architectural terms, a screen or barrier not intended to support a roof, and/or a stretch of wall connecting more massive features of fortification (e.g. tower, gate) (Wright 1985, 176). Furthermore, it is important to acknowledge that although city walls enclose the perimeter of a site, they may not have been solely defensive in nature, since they also serve as a retaining or terracing walls. Such walls were generally built with strong stone foundations supporting mud-brick superstructures, and could be solid or of a casemate construction. EB city walls were quite massive (reaching ca. 8 - 15 m wide), sometimes built in unbonded sections with many variations, and generally along continuous traces. MB walls, on the other hand, were much slighter and regular than EB walls, demonstrating more developed and standardized architectural technology by incorporating elements, such as buttresses.

Herzog (1997, 132-33) contends that there are no instances in which a city wall was discovered in conjunction with freestanding earthen ramparts (cf. Finkelstein 1992; Kaplan 1975), rather suggesting that earthworks function alone as more cost-effective construction than walls for delineating settlement. In his own counterargument, however, he questions the purpose of heavily fortified city gates incorporated in the ramparts if they could simply be avoided by traversing the earthworks. As Burke (2008, 59) argues, although the various aspects of earthworks were integral to the fortifications of settlements throughout the MB Levant, without actual walls, sloped embankments would not have constituted an improvement on EB fortifications, which did feature walls. Despite Herzog’s argument to the contrary, evidence does exist for city walls in conjunction with earthworks (e.g. Dan, Jericho, Megiddo, Shechem). At sites with no evidence of walls, the walls have probably eroded, or were subsequently removed by later occupational activity.

Since the upper portions of MB city walls have not been persevered, we may only speculate as to the possible defensive features that may have been incorporated along the crest to protect defenders from enemy projectiles (while also allowing them to fire projectiles of their own). Egyptian and Mesopotamian representations demonstrate crenellations (i.e. battlements, merlons, apertures), and Buhen (on the Egyptian Second Cataract [cf. Emery et al. 1979]) provides at least one contemporary parallel for loopholes, or firing platforms and holes for archers (e.g. Wright 1985, 177). A rare iconographic example of fortifications from the MB comes from Beni Hasan, showing the vertical elevation of a city wall under siege (Yadin 1963, 21). Based on particularly Egyptian parallels, Burke (2008, 60f) suggests that the height of fortification walls might have been
ca. 10-15 m. However, there is no direct evidence to suggest walls of such height in the Levant. The tallest preserved mud-brick walls in the region of Canaan derive from Pella and Dan, at 6 m and 7 m, respectively (see Chapter 5). MB Canaanite walls might have had two or more storeys and probably only reached a maximum height of 6-10 m of brick superstructure, on top of substantial foundations (ca. 2.5 m according to Burke [2008, 60]).

It is important to note that the widths of MB walls, particularly early in the period, are much narrower than those of the EB. Although widths of city walls may vary, some general observations may be made. Based on 32 MB sites in the Levant, the mean width is ca. 3.2 m with a standard deviation of only 2 m, whereas 16 EB sites demonstrate a mean width of ca. 5 m with a 3 m standard deviation (See Appendix 2).

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Table 2. Examples of sites showing evidence for different features mentioned in the text belonging to fortifications.

The foundations of city walls were set on stone, earlier architecture (e.g. EB walls), bedrock or some combination of the above. City walls with stone foundations and brick superstructures are known from such sites as: Korucutepe and Tilmen Höyük in Anatolia; Mumbaqt, Carchemish, Kannas, Hadidi, Tuqan and Nebi Mend in Syria; and Aphek, Ain Zurekiyeh, Megiddo, Jericho, Hazor and Shechem in the southern Levant (McLaren 2003, 27). Generally, the trace (line) of city walls are continuous (i.e. straight or curved), but some segments may have jogged or indented traces (McLaren’s [2003, 28-29] “sawtooth”). From a structural standpoint, the straighter and more regular a wall is the less lateral support it has,
which is one advantage to jogged or indented traces, since the wall helps provide some perpendicular support for itself. MB walls were typically continuous, explaining the very common use of buttresses (salients) incrementally built into the external (and sometimes internal) face of the wall, providing lateral stability. Between every trace of city wall, there would generally be a more massive structure, such as a tower.

**Single trace walls**

Single trace, solid walls were first commonly used in the EB at a number of sites throughout the Near East, and this type of wall continued to be the most common during the MB, occurring at such sites as: Boğazköy in Anatolia; Carchemish in Syria; Buhen in Egypt; and Akko, Batash, el-Hammam, Kabri, el-Milh, Megiddo, Nagila, Poleg, Yavneh Yam and Zeror in the southern Levant (McLaren 2003, 27). Single trace walls form the curtain around settlements, and have a very straightforward design as a thick wall sometimes featuring salients and jogged or indented traces.

**Casemate walls**

Another form of wall construction employed in MB Canaan was the casemate. Casemate walls incorporate adjoining architecture along the interior face of the curtain wall, providing additional structural support, as well as the potential for multi-purpose structures within the casemate. The structures adjoining the curtain wall might serve any number of functions, particularly as storage, based on the number of storage jars found in such rooms (e.g. Shiloh, Dothan) (Burke 2008, 63). The total construction could result in an architectural unit a couple metres wider than a single trace city wall, and with the potential to be filled with earth or rubble, casemates could offer multi-functional yet robust fortification. Casemate city walls belonging to the MB exist at such sites as: MB I Beycesultan, Karahöyük and Nebi Mend; MB II-III Alalakh, Carchemish, Boğazköy, Hazor and Far’ah (S); and MB III Shechem and Ta’anach (McLaren 2003, 28). Casemate walls appear to be less common than single-trace walls during the MB, and some sites demonstrate a combination of both, as at Carchemish, Hazor and Pella. Burke (2008, 61) suggests that casemates might have been used only in specific parts of a site in order to satisfy space constraints within certain quarters (e.g. Far’ah [S], Hazor, Shiloh). It would come as little surprise if a combination of construction techniques were discovered at most sites upon further investigation along different points of the settlement, as with the variable techniques of earthwork construction demonstrated at sites such as Dan (cf. Biran 1994; Biran et al. 1996).
**Buttresses**

Buttresses became a common feature in city walls during the MB, providing a technical advantage of lateral staying stability. The innovation of buttresses may have resulted in the much narrower MB city walls than those of the EB. These features were typically integrated in the external face of the wall (e.g. Aphek, Dan, Megiddo), but sometimes on the interior (e.g. Beit Mirsim, Far’ah [N]) or both (e.g. Pella). The projection of buttresses from the wall varies by site, but where they are regularly used, they tend to be spaced a couple metres apart (e.g. Megiddo, Far’ah [N]). Examples of sites with buttresses include: MB I Nebi Mend; MB II Umm el-Marra; and MB II-III Mumbaqat in the northern Levant; and MB I Aphek and Beit Mirsim; MB II Megiddo; and MB III Jerusalem, Shiloh and Gezer in the southern Levant (McLaren 2003, 29). In a non-utilitarian sense, the salients and recesses produced by buttresses may have provided an external aesthetic comparable to the sacred place, such as Mesopotamian temples (e.g. Wright 1985, 191, 516).

**Towers**

Although towers are integral features of a curtain wall system, like gates, they should be discussed independently. It should be noted that Herzog (1997) uses the term “bastion” rather than tower, whereas Burke (2008, 65) classifies bastions as larger than towers, functioning more as fortresses. In order to avoid confusion, I do not use the term bastion. MB towers tended to be square or rectangular, unlike their EB predecessors that were typically semi-circular, and vary in size, shape and projection. Typical towers average 10 – 12 m along the length of the wall and 5 – 6 m wide, but could be much smaller (e.g. Qashish, Yoqneam) or larger (e.g. Akko, Ebla, Gezer, Jericho). Towers may have been many storeys tall, sometimes consisting of multiple rooms. Examples of MB towers include: MB II-III Boğazköy in Anatolia; MB I Kannas and Ebla, MB II Tuqan, and MB II-III Carchemish and el-Qitar in Syria; and MB I Akko, Beit Mirsim, Burga, Megiddo, Poleg, and Zeror, MB II-III Far’ah (N), Beth Zur, el-Milh, Shiloh, Gezer and possibly Jericho in the southern Levant. Burke (2008, 65) suggests that towers were generally spaced ca. 20 to 35 m apart, yet the spacing between towers along wall circuits varies within sites and among sites. The spacing of towers is likely primarily determined by topographic factors to do with supporting the wall at different points (particularly where the wall changes direction), as well as areas suitable for sustaining structures along the edge of a mound. MB towers tend to project internally from the line of the wall, unlike the EB (McLaren 2003, 32-33), probably since walls were often situated immediately along the edge of a tell and/or the sloping earthen ramparts. As with the overall dimensions of towers, the amount of projection could vary, but examples (e.g. Beit Mirsim, Qashish) suggest at least ca. 1.5 m on both sides of the wall. Providing key lateral support for segments of the city wall was
probably the primary architectural function of towers. Nonetheless, from a defensive standpoint, towers offered defenders the advantage of elevation, visibility and angles of coverage along the wall due to the projection beyond the external line of the wall.

Gates

MB city gates provided multiple functions for a settlement as a whole, and as part of fortification systems. Clearly, gates served a primary purpose as controlled routes determining movement and communication between the inside and outside of settlements. Additionally, as massive structures that were heavily fortified, gates were connected to city walls and ramparts, functioning as integral features of a greater fortification system. Like towers, gates vary in size, shape and type, but essentially all MB gates contained large, tower-like structures flanking their entryways.

The most common type of gate in the MB was the so-called “triple-entry” (also “six-pier” or “Syrian”; see Burke [2008, 68] for terminology) gate, which only appears at the beginning of this period and is often considered to be one of the key characteristics of MB urbanism alongside earthen ramparts. Examples of sites with such gates include: Alalakh, Beth Shemesh, Carchemish, Dan, Ebla, Far’ah (S), Gezer, Hazor, Shechem, Tuqan, Yakaltum and Yavneh-Yam. Triple-entry gates are direct-axis passages with three piers projecting from either side of the entry chamber, forming two internal chambers on each side. Canaanite gates of this type were constructed ca. 12-15 m long and 8-10 m wide in each wing, with entrances ca. 2.5-3 m wide (wide enough for a chariot, according to Kempinski 1992a, 135; cf. Burke 2008, 71). Triple-entry gates throughout the Levant demonstrate remarkable similarity in plan, and vary only in minor details, becoming increasingly standardised in plan through the MB. The towers incorporated in these structures appear to be either solid (e.g. Gezer, Hazor, Tuqan), at least in the lower level, or have internal chambers (e.g. Alalakh, Beth-Shemesh, Far’ah [S], Hazor, Shechem, Yavneh-Yam), probably including staircases (Gregori 1986, 85f). The exceptionally well-preserved gates at certain sites from IB to MB (e.g. Ashkelon, Beydar, Byblos, Dan) demonstrate that the piers served as load-bearing devices for a barrel-vaulted archway over the passage. In a few instances, these gates appear to be supplemented by smaller outer gates (e.g. Ebla’s SW gate, Ashkelon Phase 12), creating an indirect approach to the main gate. Burke (2008, 68-69) suggests that the location of these additional gates probably traced earlier approaches to the sites, and demonstrate an integration of the MB gate with a site’s existing topography. This may also be the case with the MB gate in Area AA of Megiddo (Stratum XIII).

Other types of gates common in the MB were the double-entry and various types of single-entry gates. The double-entry, or four-pier, gate was the most ubiquitous type of gate throughout the Bronze Age of the Levant, and appears in many variations. MB examples of
sites with double-entry gates include: Akko, Ashdod, Ashkelon, Beit Mirsim, Byblos, Ebla, Far’ah (N), Megiddo Rukeis, Shechem and Yavneh-Yam. Postern gates appear to have persisted in the MB as in other periods, and simply consist of a variation of two opposite piers in the city wall with a narrow opening between them, and were presumably used for pedestrian traffic. Most sites undoubtedly had more than one gate within their fortification circuit, with different types and sizes serving multiple directions (and probably various functions) during the same occupational phase. The location of many MB gates at sites with prior occupation may be directly above earlier EB gates (e.g. Burke 2008, 67) and were probably situated with respect to already established roadways, suggested by Wilkinson’s (1993) “linear hollows”.

The construction of gates differs from other types of architecture, in that the foundations often consist of dressed stones rather than fieldstones. The superstructures were still constructed using mud-brick, as with most every other type of architecture, and any stones discovered above the foundation level tend to be orthostats (Burke 2008, 72). Preserved door sockets sometimes found just inside the base of the outermost piers suggest that two sets of doors were used in both double- and triple-entry gates. The fact that doors apparently sealed the gateway on both sides indicates that the gate structure could effectively be self-contained, in addition to preventing traffic from the outside and inside of a settlement. To a certain degree, the evidence of double door sockets supports Herzog’s (1997, 134) argument for gate structures serving as forts for elites controlling the inside and outside of the settlement.

PUBLIC ARCHITECTURE

To differentiate “palaces” or “temples” from any other type of large public architecture is fairly problematic, and somewhat contrived. However, despite the potentially artificial terminology, the terms represent existing types of architecture very common in the MB. Wright (1985, 120) suggests that the size of large public buildings of the second millennium B.C.E. was normally near 500 m², and that some reached 1000 m² and above (cf. Herzog 1997, 114). During the early MB, however, Wright’s approximation may overestimate the size of public buildings. For example, the “Megaron” temples at Megiddo (e.g. 5192) and the “Orthostate” temple of Hazor Area H suggest smaller scales, less than 300 m².

Palaces

The word “palace” implies that the building functioned for some type of royal leadership, which is simply not attested in MB Canaan. Such buildings have also been designated as “patrician houses” (e.g. Albright 1938) or “governors’ residencies” (e.g. Oren
1992, 105) yet, in remaining consistent with most literature, I retain the use of palace in this study. In the MB Levant, palaces were still very modest by comparison with neighbouring Mesopotamia and Egypt, and there could be more than one such building within a city, again challenging the link to any sort of royalty or single elite entity. Identifying such buildings at sites relies on their location in the city, which is generally near the gate or temple (elite zones), as well as by the quality of the building materials and certain construction techniques. The MB-LB Canaanite architectural concept of the palace was certainly influenced by neighbouring Mediterranean cultures, which were dominated by the central courtyard ground plan (Oren 1992, 105). Beyond general patterns, it remains difficult to reconstruct architectural details among palaces until further data come to light.

The basic plan of a palace consists of rectangular-shaped courtyards (sometimes several) with adjoining rooms on multiple sides. What separates these structures from common courtyard houses are: (1) their scale, in terms of larger dimensions of walls (ca. 2 m) and rooms, and their spatial extent over a broader surface area; (2) a common situation near other public architecture and sometimes an upper mound; (3) high-quality building materials, particularly orthostats and dressed or hewn stones (Oren 1992, 105), and sometimes nicely plastered, paved or decorated courtyard floors; and (4) construction techniques of deep and thick wall foundations, and sometimes a built-up earthen platform on which the complex is constructed. Drawing on textual and archaeological evidence from palaces in the north (e.g. Alalakh, Ebla, Mari, Ugarit), Ilan (1995a, 309) suggests that the roofed space of Canaanite palaces may have been devoted to a number of activities, such as food processing, craft production, storage and administration.

Examples of MB Canaanite palaces come from: Aphek, el-‘Ajjul, Hazor, Kabri, Lachish, Megiddo, Sera and Shechem. Evidence for most palaces appear to date toward the end of the period, MB II-III, rather than the beginning of the period, with only Aphek providing solid evidence for more than one palace phase in the MB I (see Chapter 5). Palaces in neighbouring Syria generally appear earlier than in Canaan, demonstrating much greater size and complexity (e.g. Alalakh, Ebla, Mari and Qatna). Herzog (1997, 114) contends that the eminence of these monumental structures early in the MB reflects the new order of social organization in the period. He suggests that the power-holding elite expressed its status through palaces rather than through cultic ceremonial architecture, which was a reversal from the period of EB urbanism.

**Temples**

Temples were less common in MB I than they were throughout the EB and later MB II-III. In fact, there appears to be a rather noteworthy phenomenon in the MB I of the eminence of palaces as the main type of monumental public architecture (aside from
fortifications), possibly reflecting a different power structure and social organisation at the beginning of MB urbanization (e.g. Herzog 1997, 114). Nonetheless, some modest temples did exist in MB I, and many more followed in MB II. These were typologically Megaron-type rectangular buildings with a central hall separated from a small space in the rear (i.e. “holy of holies”), with the lateral walls projecting at one end to form an open fronted porch. The enclosed body of the building may be subdivided into a main hall at the rear and one or two antechambers, and the entrance was generally a portico flanked by towers, commonly referred to as the Migdal (tower)-type temple. Examples of this type of temple exist throughout the Levant, at sites such as: Alalakh, el-Daba’, Ebla, Haror, Hayyat, Hazor, Mari, Megiddo and Shechem. As Wright observes, there is a striking similarity between the plan of MB temples and those of MB gates, which may relate to the Mesopotamian Gateway Temple (Tortempel):

There is an exact correspondence in design (as to both proportions and detail) between the broadly disposed double chambered gate-house with its three portals and the Breitbau temple consisting of ante-cella, cella and niche. This correspondence and with it the existence of a supra-functional design, a Bautyp is of relevance to the Palestinian area . . . and at least one temple, the Orthostate Temple at Hazor, bears some resemblance in plan to this gate design (1985, 138).

On one hand, the striking similarity among the formal aspects of temples across the MB Levant suggests architectural standardization (Mazar 1992, 211), as well as standardized religious practices. On the other hand, structures other than temples exist outside of settlements, namely “sanctuaries” (e.g. Nahariya, Ashkelon). Likewise, there are many examples of stelae (or massebot) in prominent places, such as areas considered to be cultic, yet also occur elsewhere. Altogether, the religious beliefs of MB Canaanites, and their architectural associations, seem to demonstrate a variety of forms and potential for individual preference. Combined with burial practices (see below), there is an undoubted shift in religious activity in the MB, whereby the household scale and context becomes the primary locus for religious activity rather than in public temples (Hallote 1994, 86).

PRIVATE ARCHITECTURE

Domestic dwellings

A starting point for understanding domestic dwellings in the Bronze Age Levant would seem rather straightforward, as Reich notes, “the mud-brick house on fieldstone foundations and roofed with a few wooden beams covered by reeds ad rushes has been the most characteristic dwelling in Palestine, from the Early Neolithic period until modern times” (1992, 5). However, despite fairly extensive excavation of MB settlements
throughout the southern Levant, knowledge concerning private structures is rather limited, either due to lack of excavation (preference for monumental architecture) or lack of systematic publication (Ben-Dov 1992, 99). Most attention has been drawn to large fortified settlements, yet examples also exist of smaller, unfortified settlements (i.e. “rural” villages) (e.g. Gophna 1979; Bahat 1975), which help contribute to our understanding of domestic dwellings. Together with evidence from sites such as Megiddo, Hayyat, Nagila, Beth Shemesh, Beit Mirsim and Hazor, it is possible to determine some general patterns for domestic architecture: (1) courtyard-type houses with enclosed, but usually uncovered, courtyards; (2) one to four rooms of varied sizes and partitions adjoining the courtyard, usually on one side; (3) often evidence of second stories built over the rooms; and (4) buildings sharing main walls, sometimes including the city wall. Overall, these buildings range in size up to ca. 8 x 11 m (i.e. Beit Mirsim, Albright 1938, 569), with walls ranging from 0.4 – 1.5 m wide, suggesting that they could have supported second stories. The walls of domestic architecture are built using the same principles as larger public architecture, with stone foundations and brick superstructures. However, the bricks tend to be small and variable in shape, size and composition, and generally appear to be made of recycled occupational debris. As Ben-Dov (1992, 104) notes, although second millennium B.C.E. houses are an intrinsic development and refinement of EB structures, the MB marks the crystallization of the central courtyard-house in Canaan, which remained through the Iron Age. The courtyard became a place where daily domestic tasks such as cooking were done, goods were processed and stored, and animals were kept.

**Burial practices**

In most areas of Canaan, some traditional forms of burial continued from the IB, such as cave tombs, rock-carved chambers, and dolmens/tumuli continued in the deserts and steppes. However, new forms accompanied the transition to the MB. Four general burial categories can be distinguished during the MB (cf. Ilan 1995a, 318): simple pit or cist burials, jar burials (especially infants), rock-carved chamber tombs, and masonry-built tombs (both chamber and cist tombs). Shaft burials were also common, yet were used in conjunction with other burial types, and constitute a feature rather than a distinct type of burial. The most profound change in burial practices that occurred from the MB I was the introduction of intramural burials within mainly domestic contexts (cf. Gonen 1987). All types of burials often occurred beneath the floor levels of occupation within sites, a practice which appears to have originated earlier in the northern Levant and Mesopotamia (Ilan 2003, 341). Evidence from Megiddo suggests that the extramural cemetery that was actively used in the EB, IB and LB was not used in the same way during most of the MB (Arie 2008, 8ff). This change in typical burial practice appears to coincide with the major phase of urban
construction during the MB I–I/II, from which period there is no evidence of any extramural cemetery at the site until the LB. Preference for intramural burial practices during the MB suggests a likely shift in religious and social ideology focusing on kin-based units of identity (e.g. Hallote 1994, 86). This ideological shift certainly had an impact on acceptable attitudes and orientation towards disposing of and commemorating the dead within the domestic sphere. MB intramural burial practices carry profound implications for conceptualizing architectural spaces as meaningfully constituted structures with deep communal ties and identities. Urban settlements were places for both the living and the dead, and were probably perceived with cosmological and sacred connotations.

**Urban Planning**

In addition to the common types of architecture employed at settlements, the MB introduced new urban planning concepts to Canaan. As Kempinski (1992a, 121) contended, MB town plans demonstrate a decisive change from the EB as settlements were built rapidly, uniformly and according to a master plan. However, some sites rather appear to have followed a pattern of slow and progressive urban growth from an early nucleus. Even rural villages, despite not having fortifications, were organized in such a way that the domestic dwellings were built in close proximity presumably in order to form a ring for security purposes (Ben-Dov 1992, 100). The most obvious intentional planning may be discerned from rectilinear ramparts, which predefined an artificial boundary for the settlement, consequently dictating the internal organization of the site. Tell el-Ajjul provides an example of a rectilinear layout including a relatively straight grid of streets (Ilan 1995a, 309), which may suggest a high degree of planning and organizational implementation (Kempinski 1992a, 126). Alternatively, many MB sites feature “upper” and “lower” cities, usually resulting from an earlier tell that expanded during the MB. An upper city basically consists of a tell formed by earlier occupation, whereas what becomes the lower city derives from an early MB expansion of the settlement. This pattern may be seen at sites such as Hazor, Jericho, Kabri, Megiddo and Rehov. Based on the evidence at hand, it appears that the upper city generally served as a sort of acropolis where public buildings, particularly palaces, were located. In the case of some sites, earthworks appear to have been employed to expand parts of the tell, thereby creating a lower terrace during the MB. Megiddo demonstrates earthwork construction along the east and northeast portion of the tell that created a terrace (Arie 2008), consolidating the steep escarpment along the southeast and fortifying the lower tell in the northeast (which initially may have been built up by EB settlement).
The internal organization of settlements consisted of a network of gates and streets that greatly determined movement through the urban environment. The design of gates, streets and large open spaces were most likely an integral aspect of the overall city plan from its inception. Excavations have often discovered more than one gate belonging to the same stratum at a site, yet there are insufficient data to suggest how many would be typical. Nonetheless, gates are an undeniably important feature in dictating movement and access into and out of a settlement, as well as predetermining much of the internal layout of streets. Excavations at Tel Nagila show evidence of streets well laid out, usually parallel, with houses situated in double rows between them (Ben-Dov 1992, 100; Amiran 1993), and often drainage channels built along them (Kempinski 1992a, 126). There were often large open spaces or courtyards within cities, generally belonging to a temple and/or palatial complex, or situated just inside city gates.

Water systems form an important aspect of any settlement, in terms of their accessibility to a fresh and abundant water supply, as well as securing that water source in the event of being besieged. These water systems may have been a very integral part of the urban planning of settlements. Some MB sites appear to have intentionally incorporated springs within the actual settlement (e.g. Aphek, Ashkelon, Dan, Beth-El, Jericho, Kabri), while others possibly demonstrate rock-cut tunnels leading to springs (e.g. Gezer, Jerusalem) or open reservoirs (e.g. Bosra, Qatna) (Burke 2008, 73). Systems of rainwater runoff catchment appear within settlements, with features such as clay pipes, sealed channels and closed cisterns (Ilan 1995a, 309). Likewise, drainage systems discovered at many MB sites demonstrate a high level of organization in order to integrate such a series of drains within the architectural layout. Nonetheless, despite these strategies in hydraulic engineering, evidence for MB irrigation practices unfortunately remains lacking.

The unfortunate shortage of data regarding household architecture within urban dwellings is problematic, since it results in a skewed dataset for what might be considered “urban architecture”. Since the majority of MB architecture excavated to date relates to monumental architecture (itself predominated by fortifications), it remains difficult to fully assess urban planning. Where domestic architecture has been excavated, the material is often dealt with very summarily, with disproportionate emphasis on the more impressive monumental architecture. However, treating domestic architecture as secondary to monumental architecture may be a major error. In fact, it could be entirely possible that some aspects of urban planning were dictated by pre-existing domestic organization at sites prior to—or in the insipient stages of—urban construction. Likewise, domestic dwellings may comprise the majority of the area within urban settlements, and therefore greatly affect the use of space, transportation and the demographic make-up of urban society. The neglect of this aspect of urban architecture during this period merits future attention, and would bear
considerable relevance to the present research. In particular, the domestic scale of mud-brick manufacture deserves research in order to determine how it may differ from that of monumental architecture, and might shed some significant light on the outcomes of this study.

**SUMMARY**

In this chapter, I have described the various types of architecture, building strategies and planning concepts most common at urban settlements during the MB. The general information provided in this chapter is essential for understanding architectural features discussed in more detailed contexts in Chapter 5. Together with the building materials and practices discussed in Chapter 3, the overview of architecture in this chapter provides a framework for conceptualizing the more detailed patterns in specific contexts in the following chapters. In Chapter 9 I will discuss the significance of building materials, types of architecture and urban planning with regard to conceptualizing the process of urban construction through the *chaîne opératoire* of mud-brick manufacture and use, particularly focusing on fortification architecture. Based on the patterns derived from metric data and mud-brick sampling (Chapters 6 - 8), I will discuss construction and greater urbanization in terms of specialized mass production measured by standardization as it pertains to social organization during MB urbanization (Chapter 10).
5. REVIEW OF MB SITES

The review of sites in this chapter is by no means a comprehensive treatment of all the MB settlements in the southern Levant but is intended to serve as a representative selection to discuss issues of urban architecture and construction sequences on a site-specific level, in context. In addition to Dan, Megiddo and Pella, I also cover ten relevant sites in this survey in order to compliment the case study sites. By examining each individual site in some detail, this chapter provides spatial and temporal contexts for the overview of MB building practices and architecture discussed in the previous chapters. The sites surveyed below represent all of the main regions (and most sub-regions) in the southern Levant that are relevant for discussing urbanization in the early MB. These regions are: the Upper Jordan Valley (Dan and Hazor), the Central Jordan Valley (Pella), the Lower Jordan Valley (Jericho), the Northern Coastal Plain (Akko and Kabri), the Southern Coastal Plain (Aphek, Ashkelon and Yavneh-Yam), the hills of the Shephelah (Beit Mirsim and Lachish), the Central Highlands (Shechem), and the Jezreel Valley (Megiddo).

Figure 13. Map of the southern Levant indicating the sites discussed in this chapter.
This review of sites details architectural features and phases within the context of each site, and describes the site in its situated context within the immediate landscape and region. Although the sites chosen for this review are only a select portion of the available corpus of known MB settlements, they generally represent the earlier part of the MB that may be characterized by urbanization. Furthermore, these have been excavated and reported thoroughly enough for basic comparison, and to discuss settlement location, urban planning and standard MB architectural features. Comparisons are necessarily limited by the amount of excavation of MB material at each site, which is essentially only a sample, and the data depend almost entirely on the accuracy of excavation, interpretation and recording of this material. As with most of this study, the vast majority of architectural elements reviewed in this chapter relate to fortifications (e.g. city walls, earthworks, gates, towers), which are the features most represented in excavations, and likewise constitute a significant amount of urban architecture during the MB.

In order to help clarify the chronological correlations between sites, Table 3 displays a synthesis of MB phases for the sites reviewed in this chapter and other relevant sites mentioned in this study (i.e. el-Dab'a and Ifshar) based on the most recent chronological comparisons and reports (e.g. Bietak 2002a; Bietak et al. 2008; Cohen 2002; Yadin 2009; Maeir 2010). A thoroughly detailed synthesis of relative chronology of these sites lies beyond the scope of this research, therefore Table 3 is not intended to be absolutely precise, but hopefully provides a suitable approximation of settlement developments at these representative sites during the MB. Most importantly, this synthesis seems to demonstrate that the trajectory of urbanization in the southern Levant led to a phase of urban construction at each of these sites by the end of the MB I, suggesting that these sites probably witnessed a fully-realized state of urbanism by that time, or shortly thereafter. The systems of urbanism represented by these sites and their catchments probably had a subsequent urbanizing impact throughout the rest of the region that may have had to do with increased peer-polity interaction or socio-political formations secondary to the initial mechanisms of urbanization at these earlier sites.

The sites below are dealt with regionally, and only the strata relating to phases during the MB I to mid-MB II are discussed, as they relate to urbanization on a broad scale. In addition to the inner-site architectural aspects of the settlements, the following site summaries will also attempt to account for the situation of sites within their local and regional environmental landscapes, as well as issues relating to interconnectivity by way of natural transportation routes, all of which are issues of great importance for conceptualizing the overall process of urbanization.
<table>
<thead>
<tr>
<th>Akko</th>
<th>Aphek</th>
<th>Ashkelon</th>
<th>Beit Mirsim</th>
<th>Dan</th>
<th>Hazor</th>
<th>Ifshar</th>
<th>Jericho</th>
<th>Kabri</th>
<th>Lachish</th>
<th>Megiddo</th>
<th>Pella</th>
<th>Shechem</th>
<th>Yavneh-Yam</th>
<th>el-Dab'a</th>
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<td>IB</td>
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<td>MB I</td>
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<td>Ph. 2</td>
<td>Pre-fortification</td>
<td>Pre-Palace I</td>
<td>Palace I, City Wall 1, Pre-Palace II</td>
<td>Ph. 14 (Gate 1), MD</td>
<td>XII (1-2) Tombs</td>
<td>Pre-XVII</td>
<td>A-C</td>
<td>-</td>
<td>-</td>
<td>XIVA</td>
<td>Pre-XB</td>
<td>Early Temple?</td>
<td>XIIB</td>
<td>City Wall</td>
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<td>Ph. 3</td>
<td>First Rampart</td>
<td>Palace II, City Wall 2</td>
<td>Ph. 13 (Gate 2)</td>
<td>G</td>
<td>XII (3-4) Ramparts</td>
<td>E-H</td>
<td>IVa, City Wall 1</td>
<td>P-6, Area D Cult Place</td>
<td>Str. 4, Ramparts, Palace</td>
<td>XII Wall Widened, Towers, Palace</td>
<td>XA Temple?</td>
<td>XXII</td>
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<td>Ph. 4</td>
<td>Gate, Second Rampart</td>
<td>Post-Palace II</td>
<td>Ph. 12 (Gate 3)</td>
<td>F</td>
<td>City Wall</td>
<td>Ramparts</td>
<td>Ramparts</td>
<td>Ramparts</td>
<td>Ramparts, P-5 Palace</td>
<td>XI Ramparts, Palace</td>
<td>XI Ramparts, Palace</td>
<td>X</td>
<td>XXI</td>
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<td>MB II</td>
<td>Third Rampart, Building A</td>
<td>Palace III</td>
<td>Ph. 11 (Gate 4)</td>
<td>E</td>
<td>Rampart</td>
<td>XVII/4</td>
<td>M</td>
<td>JIVb, Rampart 1, City Wall 2?</td>
<td>Str. 3, MB II Palace</td>
<td>VII Migdal Temple</td>
<td>XX-XVII, Wall C and D, Earthworks, Palace</td>
<td>Str. 8 – 3, Rampart, Gate III</td>
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<td>Ph. 10</td>
<td>D</td>
<td>XV/3</td>
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<td>Gate II</td>
<td>D/3-D/1</td>
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Table 3. A chronological synthesis of relevant phases of representative MB sites, including basic architectural features by phase. This table is based on the most recent chronological correlations and reports (e.g. Bietak 2002a; Bietak et al. 2008; Cohen 2002; Yadin 2009; Maeir 2010), and does not attempt to represent divisions according to absolute chronology. Note that Cohen’s (2002) four subdivisions of MB I are included in the left column.
UPPER JORDAN VALLEY

Dan

Tel Dan (Tell el-Qadi, ancient Laish) is located in the northeastern corner of the Upper Jordan Valley, in the Hula Valley near the base of Mt. Hermon and at the head of tributaries feeding the Jordan River. The artificial mound does not appear to sit on any natural rise above the surrounding area, but was built up by earlier occupational debris and particularly the massive earthworks of the MB. Although stone material was not abundant at the site, and would have to be brought from a distance of ca. 5 – 10 km, the spring located at the site was copious. The site is ideally situated for major transportation connections northward through the Beqa Valley, leading towards the Orontes, and southward through the Upper Jordan Valley toward Hazor. The surrounding level plain would have provided adequate soils for agriculture (Kotter 1986, 115-16).

Figure 14. Plan of Tel Dan (after Biran et al. 1996, Plan 1).

Excavations at the site by Hebrew Union College (Biran 1984; 1990; 1994; Biran et al. 1996) encountered MB architecture at multiple points along the perimeter of the site, mostly comprised of massive earthen ramparts constructed from the end of the MB I. Combined evidence from burials and sparse architectural remains demonstrate that the site experienced occupation from at least the mid-MB I (e.g. Maeir 2010, 39-40). Although the
site is generally not considered to have been fortified prior to the construction of its ramparts, evidence of an earlier mud-brick wall lying outside the (later) gate in Area K (and subsequently covered by the rampart) presents the possibility of an earlier stage of fortification (Ilan pers. comm.).

By the end of MB I, with the construction of huge earthen ramparts, the entire site reached a size of ca. 20 ha (with the settlement probably only ca. 16 ha within the earthworks). The ramparts were investigated in four areas of excavation around the site, each demonstrating different construction techniques. In Area A-B, in the south of the site, the total width of the rampart was approximated to be 60 m at its base, and its core comprises a stone wall (Wall 1), measuring ca. 6.5 m wide and 10 m high, with layers of sediment laid against it. The surface of the slope was coated with a glacis of 15 – 20 cm thick crushed yellow travertine at an angle of 38°, and the glacis was anchored into the underlying fill with 30 - 40 cm long “intrusions” (Biran 1994, 59f; see Fig. 15).

![Figure 15. Section through the earthen ramparts in Area A-B of Tel Dan (after Biran 1994, Fig. 34).](image)

In Area T, in the northwest, a supplemental rampart was built against a 3.5 m wide mud-brick wall with buttresses (2.9 x 1.8 m) at 2.2 – 2.3 m intervals. Based on ceramics in associated fills, the wall appears to date to the EB (Biran 1994, 68-70), but a brick wall (apparently MB) was preserved above it. In the east of the area, a mud-brick platform measuring ca. 8 x 5 m may relate to a tower (Burke 2008, 252). In Area Y, in the northeast, the core of the rampart consists of a supposed earlier (EB or early MB I) structure measuring ca. 13 m wide and 8.5 m high, with a series of retaining walls added with the steepening of the slope parallel to the line of the rampart. The materials used in the fill appear to be essentially the same as in A-B. As Burke (2008, 253) notes, the remains of a 3.5 m wide mud-brick wall built above the core (but also apparently above some of the rampart fill) are the remains of a fortification wall (contra Biran 1994, 66-67). In Area K, in the southeast,
the rampart also appears to incorporate an earlier structure(s) for a core ca. 6.5 m wide, as well a mud-brick wall comparable to that in Area Y.

The so-called Triple-Arched or Canaanite Gate was also discovered in Area K, integrated within the rampart construction and related to the mud-brick wall (Fig. 16). The entire gate structure measures 15.45 x 13.5 m with a 10.5 m long passage, and the brick superstructure survived as high as 7 m (47 courses). It was observed that some of the “lime and calcite plaster” originally covering the bricks remained in the joints (Biran et al. 1996, 60), yet this probably represents a cement affixing agent for the actual plaster coating of the walls. The entry is flanked by two 5.15 m wide towers flanking an entryway of the same width that is recessed 1.8 m from the exterior of the towers in the east and 0.8 m in the west (Biran 1984, 4). The entry is spanned by an arch consisting of three radial courses 1.25 m wide at the spring (i.e. the base of the arch) and 0.95 m wide at the top, altogether spanning 2.4 m and supporting 17 courses of brick above it.

![Figure 16. The triple-entry gate in Area K of Tel Dan (after Biran et al. 1996, Plan 10).](image)

A total of three arches were discovered still preserved in the gate, related to each set of piers forming the passage. The piers in the middle of the passage measure 1.7 m wide and subdivide the interior of the gate into four chambers measuring ca. 2.5 x 4.5 m (Biran 1984, 4). The northern and southern walls of the structure measure 1.85 m wide, and those
in the east and west measure 3.5 m and 2.8 m, respectively. The floor of the chamber consists of plaster 5-10 cm thick on laid on top of a stone make-up. The approach to the gate consisted of 20 stone steps for a distance of ca. 11 m to the east, with a likely earlier phase of steps ca. 50 cm beneath this. From the western (interior) face of the gate, a small stone pavement ca. 3 m long leads to 20 steps descending into the city to a street made of pebbles 14.5 m from the gate, continuing into the city (Biran 1984, 7). It appears that the gate was connected to the rampart with a mud-brick extension wall measuring 2.8 m long and 7.0 m wide to the north of the gate, built on a stone foundation. This wall then abuts the probable fortification wall further to the north (e.g. Burke 2008, 253).

The gate structure appears to have witnessed a number of supplementary additions that seem to function as supports. On the east face of the gate, along the north tower, a stone wall ca. 1.3 m wide and 2 m high extends along the base of the tower, and seems to be a subsequent revetment for both the tower and rampart (Biran 1994, 81). Likewise, on the western side of the gate a battered stone revetment appears to have been built to retain the fill of the rampart to the south. It seems probable that issues with the structural integrity of both the gate and the rampart (and perhaps due to the combination) led to the decision to bury the gate within the rampart during the MB I/II transition, not long after its initial construction (Ilan pers. comm.; cf. Biran 1994, 84f).

**Hazor**

Located in the southern portion of the Hula Valley in the Upper Jordan Valley, Hazor is a large site situated on a higher elevation than its immediate surroundings and near a spring located ca. 200 m to the east. Any route passing northward through the Upper Jordan Valley would have passed by the settlement, which is important since the valley serves as the major natural corridor connecting the southern Levant with inland Syria. The level and fertile soils just to the east of the settlement would have been suitable for agriculture, though drainage may have been a problem (Kotter 1986, 117-18).

Hazor became the largest settlement in the southern Levant during the MB, consisting of ca. 63 ha of settlement area (ca. 80 ha including the earthworks) (Herzog 1997, 120). Excavations have been carried out in many areas around the site, including the “Upper City” and “Lower City”. The mound referred to as the Upper City was the site of earlier EB settlement with ceramic evidence suggesting that there was also fragmentary IB and MB I occupation (Stratum XVIII or Pre-XVII) in this area (Yadin 1972, 120-22). The best evidence for MB occupation of the site derives from strata XVII-XVI (Upper City) and 4-3 (Lower City), beginning at the very end of MB I. At some time late in the MB I, an eastern spur of the mound was enlarged, followed by the expansion of the huge Lower City during the MB I/II transition (Dunayevsky & Kempinski 1990; contra Yadin 1975, 269-75).
Fortification elements, particularly the earthen ramparts, have been excavated in a number of areas (A, C, G, H, K and P) around the site, demonstrating a variety of construction techniques. The following description provides a very general summary of the detailed excavation reports (e.g. Yadin et al. 1989).

Figure 17. Plan of Hazor (after Yadin 1972, Fig. 3).

In Area A of the Upper City, a portion of a wall (W375) was discovered with its mud-brick superstructure measuring 7.9 m wide and preserved to 3.5 m high. The stone foundation, which consisted of massive stones on its exterior, measured 8.8 m wide and 1.0 – 2.0 m high, and rested on both bedrock and an earlier wall (W402) (Yadin et al. 1989, 51f). This wall was interpreted by the excavators as perhaps a fortification wall for the MB II Upper City mound, but subsequent investigation has suggested an LB date (Ben-Tor 1995). The wall was constructed with two types of bricks: (1) a “soft, black type” probably deriving from waterlogged soil nearby, and (2) a “lighter, stronger, lime-like brick” that probably derives partly from marl formations at the site (Yadin et al. 1989, 51). These bricks were alternately laid as headers and stretchers, with reports indicating “blocks” of bricks. The outermost portions of the wall contained only light bricks measuring 50 x 40 cm
(and plastered on the exterior face), and inner portions more crudely built with dark bricks and light bricks. Abutting this wall were a couple phases of MB occupational material, including a courtyard or street and a series of drainage pipes (Yadin et al. 1989, 52). Area G exposed 25.5 m of a stone “glacis” (10570) constructed around the northeast portion of the slope of the Upper City preserved ca. 4 m tall with a small fosse at its base (Yadin et al. 1989, 168-70). Although these features probably date to comparable MB construction, their stratigraphic relationship to other features remains somewhat unclear (Herzog 1997, 123-24), with Ussishkin (1991) even arguing for an Iron Age date.

In the Lower City, Area C in the southwest contains evidence for the most significant earthwork construction at the site, consisting of a ca. 700 m segment of freestanding rampart measuring 90 m wide and 15 m high with a fosse at its base measuring 80 m wide at its top and ca. 15 m deep (Yadin 1972, 51-52). The topography of the plateau is high on the north and east, offering natural protection on that side, but it slopes downward gradually to the southwest without any barriers, thus necessitating this massive construction to create an artificial topographic barrier around the entire settlement (cf. Herzog 1997, 122). Although the core of the rampart was never reached in this area, the fill consisted of a “mass of small stones and beaten earth . . . sheathed with several layers of small rubble stones”, which may have been eroded from structures atop the rampart (Yadin 1972, 52). The inner slope of the rampart also seems to have been supported by parallel supporting walls serving as revetments at its base. The segment of rampart in Area H in the north measures ca. 8.5 m high and ca. 55 m wide, and appears to sit on a natural slope (Yadin et al. 1989, 214). In Section AA, on the “Eastern Spur”, a deep trench was excavated through the rampart revealing a mud-brick core ca. 8 m wide at the top and 11 – 16 m wide at its base, preserved ca. 7 m high and constructed with bricks measuring 40 x 30 x 15 cm (Yadin 1972, 55). This mud-brick core appears to be a casemate wall, or possibly even a tower, which probably dates to an earlier MB phase, and was subsequently filled with stones and earth and covered with the earthen rampart. The fill of the rampart was interpreted as being constructed with a series of vertical “blocks”, each composed of sandwiched layers of various sediments. A glacis of a beaten chalky layer ca. 15 cm thick covered the surface of the slope. Similarly, Section BB was excavated ca. 140 m west of AA, revealing an earthen core with layers of sediment, yet no evidence of a mud-brick wall serving as a core (Yadin 1972, 55-56).
In addition to the earthworks excavated around the site, city gates have been discovered in areas K and P, both demonstrating a series of gates dating from the MB II. Located on the north-eastern edge of the Lower City, excavations in Area K demonstrate two MB gates in strata 4 and 3 (Fig. 18). The earliest of these gates (Stratum 4) was located ca. 22 m inside from the slope and comprised of a direct passage flanked by two ca. 9 m square towers (Yadin 1972, 59; Yadin et al. 1989 277f). The stone foundation of the towers consists of large, roughly trimmed fieldstones up to ca. 1.4 m high (only 0.3 – 0.5 m above ground level) with a mud-brick superstructure. Abutting these towers was a casemate city wall consisting of two ca. 1.7 m wide walls with a space (or fill) of 1.7 m between them, creating a total width of ca. 5 m (Yadin et al. 1989, 277-79). Outside of the gate was an open space (or possibly a road) of undetermined extent, paved with small basalt stones mixed with clay. Stratum 3 demonstrates a considerable change in the gate plan, with a triple-entry gate covering a total estimated area of ca. 20.3 x 16.5 m consisting of two 6.5 x 16.5 m towers situated 7.3 m apart, within which were two interconnected chambers. The tower walls consist of a lower foundation of large limestone boulders, some of which were partly dressed (especially on the outer façade). These walls were preserved ca. 3 m high (including ca. 1 m sub-surface foundation), above which was a mud-brick superstructure. The entry of the gate was ca. 3.1 m wide and formed by three sets of pilasters, each projecting ca. 2 m, and the floor consisted of a stone pavement with large basalt slabs at the entrance and exit (Yadin et al. 1989, 281-82). The casemate city wall (ca. 5.2 m wide)
abutted the gate towers, and soundings tracing the wall north of the gate found that the casemate ended ca. 13.7 m from the gate tower where it continues as a single wall. About 10 m outside the gate is a ca. 5 m high revetment wall constructed of massive basalt boulders that was uncovered for a length of 50 m. The stratigraphic interpretation of this wall links it with Stratum 3, in which it served to support the causeway encircling the city wall and leading to the opening (artificial platform) in front of the gate (Yadin 1972, 60-61). The gates discovered in Area P are contemporary with those in Area K, and consist of essentially two phases of the same basic plan. The Stratum 4 gate appears to have been a six-pier, triple-entry gate (only the north half survives). In Stratum 3, the west gate tower is reconstructed as 20.6 x 9.5 m, and the total area of the gate ca. 25 x 20 m (Burke 2008, 269).

Temples dating to the MB II were discovered in two areas of excavation in the Lower City. In Area H, just inside the slope of the northern rampart, a temple belonging to Stratum 3 was found beneath later phases of LB temples. This temple measured 19.75 x 18 m with the outer walls of the building measuring ca. 2.3 m wide. It is comprised of a large main room (8.9 x 13.5 m), with a niche in the far wall, and a porch consisting of an entryway (4.9 x 4.3 m) flanked by two rooms (2.7 x 4.25 m) (Yadin et al. 1989, 215f; Yadin 1972, 76ff). The threshold of the 3 m wide entry between the porch and main room is lined with large stones, and two basalt door sockets on the inside of this threshold indicate inward-swinging doors. The façade of the temple opens onto a large open space (possibly a courtyard) paved with small pebbles. The so-called “Double Temple” of Stratum 3 in Area F measures 48.5 x 24.5 m (exterior), with outer walls as wide as 3 m with huge stones used in the corners (Yadin et al. 1989, 139f). The fragmentary remains of the building have been reconstructed by Yadin (1972, 96f) as having an entrance (ca. 3.3 m wide) accessed by a vestibule (ca. 20 m) on the western side of the building. This entrance led to two sequential rooms in the middle of the structure, flanked on both sides by courts and adjoining rooms. Whether or not this structure is a temple or palace (perhaps more likely), it is certainly some type of public building.

Figure 19. The Stratum 3 MB Temple in Area H of Hazor (after Yadin 1972, Fig. 18)
In addition to the oft-cited architecture belonging to the MB discussed above, buildings of a domestic nature were excavated in Area C. The buildings in this area relate to strata 3 and 4, and feature a curving street (6212) with blocks of buildings on either side. Building 6205 is a large “corner house” consisting of a rectangular courtyard (7 x 4 m) with two small rooms on each of its long sides. Common MB intramural burials were also discovered beneath the floors throughout most of this area (Yadin et al. 1960, 78-81). The excavators also noted drainage channels in many areas of excavation throughout the Lower City, suggesting that they served a sort of drainage network with outlets served by the low-lying city gates (Yadin 1972, 65-66; Yadin et al. 1989, 143).

CENTRAL JORDAN VALLEY

Pella

The site of Pella (Khirbet Fahl), lies in the Central Jordan Valley about 5 km east of the Jordan River and nestled against the lower foothills below the Transjordan Plateau that rises to the east just to the south of the main mound is Tell el-Husn, which comprises a small ca. 1 ha mound elevated 65 m above its immediate surroundings. Directly between Pella and Husn is the perennial Pella Spring that forms Wadi Jirm, through which it flows to the Jordan. Nearby Wadi al-Hammeh, which is fed by the thermal spring of the Hammam Abu Dhabla, was also a likely water source for the site (Macumber 1992, 205ff). Although the remnant of Lake Lisan (i.e. Beisan) probably provided for floodplain agriculture in the proximate vicinity of the site during the EB, by the MB this had all but dried up as the Jordan River had become incised (Koucky & Smith 1986). The abundant geological diversity in the immediate vicinity of Pella deriving from the wadis, springs and margins of
the Leisan deposits provided excellent agricultural potential along the plateau immediately adjacent to the north of the site and fertile alluvial flats to the west. Grazing potential existed around the margins of the surrounding hills, where timber also would have been available. The site was clearly well-situated in terms of natural transport routes, being located so near the Jordan River and along the margin of the rising Transjordan Plateau, which was probably navigated via Wadi Malawi (Koucky 1992, 199ff).

The 8 ha site has been excavated primarily by the on-going excavations led by the University of Sydney in recent decades and MB architecture has been encountered in a number of areas around the main site and Tell Husn, comprising settlement activity dating from the early MB I. The ceramic material from the site suggests settlement early in the MB I, apparently parallel to the earliest MB I at Tell el-Hayyat (Maeir 2010, 51; cf. Bourke 2006, 243f).

![Figure 21. Map of Pella, with the main mound above and Tell Husn below (after Bourke et al. 2003, Fig. 1).](image-url)
In Stratum XB in Area III, on the east side of the mound, a substantial city wall (Wall 41) was exposed for more than 16 m, dating to the mid-MB I comparable to similar settlement development at Megiddo XIII and Aphek palaces I-II (Maeir 2010, 51; Bourke 2006, 243-45; contra Bourke et al. 2006, 21; McLaren 2003, 13ff). This city wall measures ca. 3.3 m wide (where not buttressed), and was preserved to a height of 7.5 m (6 m of brick superstructure comprised of 35 courses). The wall was buttressed on its exterior, measuring ca. 0.9 m wide and 3 m long, there widening the wall to ca. 4.2 m (Bourke et al. 2006, 16). The brick superstructure sits on a stone foundation of 1.5 m in height, comprised of medium-sized fieldstones. An eastern extension of the wall (Wall 7) was found to the north, with its brick interlocking with at least the upper courses of Wall 41, and suggesting a change in the direction of the wall, or perhaps the presence of a gate (McLaren 2003, 14-15). The brick superstructure of the city wall in this area appears to be constructed of three distinct bands: (1) a 2.4 m layer of dark grey to black bricks; (2) a 1.2 m layer of greenish-grey bricks; and (3) 0.35 m of dark grey bricks covered by 2.1 m of orange-brown bricks (Bourke et al. 2006, 16; cf. Smith & Potts 1992, 42f). In its earliest phase, a street apparently ran along the interior of this wall and between a parallel 1.5 m wall (Wall 52) inside the settlement. In the following phase, Stratum XA, a structure was added adjoining the interior of the city wall, perhaps forming a casemate. The city wall continued in use throughout the MB demonstrating five main phases of occupation concurrent with the function of the wall, including repairs and modifications (Bourke et al. 2006, 16-28).

Figure 22. Wall 41 in Area III of Pella (adapted from McLaren 2003, Fig. 8a).
Area XXVIIIc lies on the south-western side of the site and consists of a tower system flanked by city walls. The tower (Tower 1) measures 8 m x 12 m and was preserved to a height of 5 m (43 courses) in the north. Extending from the tower at an oblique angle toward the west is a curtain wall (Wall 9), which was traced for 11 m of its length. This wall is set back ca. 1.5 m from the outer face of the tower and varies in width from 2.5 - 3.0 m, with an internal buttress measuring 1 m deep and 2.5 m long. From the eastern side of the tower, and flush with its outer face, runs a similar wall (Wall 10) of the same width traced for 16 m (McLaren 2003, 16ff). East of the tower, a short segment of a 1.5 m wall (Wall 15) abuts Wall 10 perpendicularly at a point where the latter also “steps back” at a ca. 70 cm offset. The combination of Wall 15 may have to do with the tower or could be evidence for a casemate construction (Bourke et al. 2003, 342). The fortifications in this area appear to date to the same phase of construction as those in Area III, and likewise demonstrate distinct phases of MB occupation in association with one another.

Figure 23. The fortification system in Area XXVIII of Pella (adapted from McLaren 2003, Fig. 17).

Area XXXII lies slightly inside the southern portion of the site and contains a sequence of MB through LB temples. In XXXIIW, the earliest phase of MB temple architecture was discovered, with a 5 x 1 m “slice” of a segment of the western (back) wall of the “green mud-brick” temple, with its inner facing still preserved (Bourke 2007, 5). A subsequent temple made with brown mud-bricks appears to be of the same orientation, but was probably larger—both probably ranged from 7 – 10 m in overall dimensions (Bourke pers. comm.). Initial 14C dates from these early temples suggest that they possibly date from the earliest MB I stage of settlement (Maeir 2010, 52; Bourke 2007). These structures were cut by foundational deposits for the MB II Fortress (Migdal) Temple, which comprised of
stone foundations 2 – 3 m wide preserved as much as 4 m with large foundational fills that may have extended or levelled the area. The first phase of this temple consisted of a large rectangular construction measuring 22 x 16 m with two projecting stone piers (antae) flanking the entry in the east. The structure was later modified with internal walls and tall towers constructed on the entry piers (Bourke 2008).

Although the results are preliminary, Tell Husn appears to have MB fortification architecture constructed above (and partly adjoining) earlier EB fortifications (cf. Bourke 2010, 6). In Area XXXIVF, on the northeast side of the mound, there appears to be a supplemental rampart along the north slope, containing layers of fill laid against a large stone wall (Wall 34), which may be a retaining wall and/or foundation for a potential brick superstructure that has not survived (personal observation). The extent of any MB earthworks on the main mound of Pella remains unclear pending future investigation.

**LOWER JORDAN VALLEY**

**Jericho**

Located in the Lower Jordan Valley, Jericho (Tell es-Sultan) is situated ca. 10.4 km east of the foot of the steep cliffs of the Judean Highlands and ca. 14 km from the Dead Sea to the southeast. The ca. 4.5 ha site lies 258 m below sea level and demonstrates a nearly continuous occupational sequence from the Neolithic period. The settlement situation was clearly valued for the copious spring (Ein el-Sultan) that became incorporated in the site during the MB. This spring and the rich surrounding alluvium form an oasis within the otherwise arid Dead Sea region. The major north-south transportation route through the Jordan Valley would have passed through (or near) the settlement, and an important natural passage westward into the Judean Highlands was possible through wadis (i.e. the Ma'ale Adummim) leading directly from the site (Orni & Efrat 1973, 350).

Four major excavations have taken place at the site over the last century, all of which uncovered MB remains including fortifications, domestic and public architecture, and burials. The variety of excavation techniques, discoveries and interpretations present many challenges to synthesizing the developments of the settlement in the early MB. Although the current Italian-Palestinian expedition has gone to great lengths to clarify many of these issues, the stratigraphy and chronology of the site remain thoroughly unclear and problematic. Maeir (2010, 57-61) suggests that the chronology adopted by the Italian-Palestinian expedition over-emphasizes ceramic comparisons with Syria, resulting in improper dating of phases too early. Maeir’s observations have been taken into account in Table 4, above. The MB remains at the site date from mid-late MB I and belong to Stratum
IV, which is sub-divided by the current excavators into IVa (MB I), IVb (MB II) and IVc (MB II/III).

Figure 24. Plan of MB Jericho (after Herzog 1997, Fig. 4.11; compiled from Sellin & Watzinger 1913, Taf. I; Garstang & Garstang 1948, Pl. XV; and Kenyon 1981, Fig. 1, Pl. 336).
The earliest evidence of MB architecture (Stratum IVa) consists of stone terrace walls along the slope of the tell (e.g. W.420 in Area F, W.633 in Area G) supplementing a large area on top of the “Spring Hill” that extends with a rectangular plan ca. 100 x 50 m, and where monumental public buildings may have been located (Nigro 2006, 27). Below this upper mound to the east lies Area D (Kenyon’s Site H) next to the spring, and contains the city wall (W.7), which has been connected by the current excavations to Garstang’s “East Tower” and Wall B to the south and Kenyon’s walls (HCJ+HCP) and tower (HBJ) to the north (Nigro 2000, 165ff; 2006, 25f). Garstang’s (1932, 15-17) tower measured 16.4 x 7.8 m with a ca. 1 m stone foundation having a ca. 2.5 m preserved brick superstructure made of well-bonded grey bricks measuring 30-32 x 35-36 x 13 cm (same brick measurements as Wall B). This tower may actually be the tower of a gate structure (cf. Nigro 2000, 169, n. 8). W.7 may be also be identified with Kenyon’s Wall HCJ+HCP (as well as earlier phase HAJ+HAH+HAL) connecting to a rectangular tower (HBL+HBJ+HBLK) (Kenyon 1981, 339-40, 357-58). Altogether, W.7 measures an estimated 3.5 – 4.0 m wide, and contains reddish yellow bricks measuring 42 x 36 x 15 cm (some as long as 60 cm), and the tower structures (or gates) appear to be spaced ca. 20 m apart (Nigro 2000, 165ff; 2006, 25f; Kenyon 1981, 357f). Kenyon also observed drains connected to this wall (or series of walls).

In Area A in the south, Building A1 was discovered consisting of a wall (W.19) 1.75 m wide and tower. Although these architectural features are adjoined by a courtyard, these architectural elements probably relate to the city wall of IVa, particularly since a ca. 30 cm deep buttress was found on the exterior face of W.19 indicating that it belongs to a long segment of wall (cf. Nigro 2000, 206). Probably connected to this architecture in Area A is structure E1 just to the west in Area E, comprised of a 7.5 m tower and a stone revetment wall (W.274) (Nigro 2000, 183). Therefore, a reconstruction of the settlement during the late MB I (and probably MB I/II transition) includes the city wall (ca. 3 – 4 m wide) with towers at regular intervals set along the perimeter, which expanded the size of settlement to 4.5 ha (doubling the 2.2 ha EB settlement). Also during this phase, it seems that the upper mound was being enlarged with supplementary revetments creating terraces.

Evidence from the following MB II (IVb) provides information regarding the construction of an earthen rampart, as well as residential areas. The three phases of MB ramparts distinguished by Kenyon at the site have been much debated by scholars since (e.g. Yadin 1972, 56; Ussishkin 1989, 41; Herzog 1997, 137, 139; Sarie’ 1998; Marchetti & Nigro 2000). The most recent interpretation distinguishes two phases of the earthen rampart belonging to MB II and III, respectively, which essentially expanded the area of the settlement. Evidence for the first, MB II (IVb), rampart derives primarily from areas A, C and E, and Kenyon’s trenches I, II and III, and may be summarized as follows (after Burke

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2008, 276-81): (1) on at least the west side of the site it probably measured 24 m wide and 7 m high; (2) it consisted of a typical fill of layered sediments covered with a plaster-like glacis; and (3) it had a stone revetment wall at its base and internal stone retaining walls (possibly from an earlier city wall). In Area C, a large wall (W.84) 5.75 m wide was discovered on the top of the rampart, consisting of a typical mud-brick superstructure (bricks 30 x 30 x 10 cm) on a fieldstone foundation with various supplementary walls and buttresses along its base. It seems that building A1 (tower) continued in this phase as A2, with additional domestic structures built around it on its eastern side (Nigro 2000, 213f; 2006, 33).

Areas excavated within the settlement in the north by Sellin and Watzinger (1913), and in the east by Garstang (1932, 17-18) and Kenyon (1981, 365ff), demonstrate elements of urban planning including domestic and public buildings during MB II. Herzog (1997, Fig. 4.12) synthesizes a total 1200 m$^2$ of exposure by Garstang and Kenyon, demonstrating streets that demarcate blocks of domestic structures with integrated drainage systems (Fig. 25). Parallel stepped streets led to the upper level of the settlement where Garstang uncovered the corner of a large public building with ca. 1.5 m wide walls with an incorporated drain (cf. Herzog 1997, 139f).

Figure 25. Plan of the eastern residential quarter of Jericho (after Herzog 1997, Fig. 4.12; compiled from Garstang 1932, Pl. XV; and Kenyon 1981, Pl. 336).
In the north of the site, contemporary MB II settlement comprises architecture built on top of, or alongside, the EB city wall and a lower level of domestic dwellings abutting the MB fortifications (Fig. 26). The upper and lower areas of settlement were again connected by two parallel stepped streets, and on the upper mound a ca. 2 m wide street ran in a curve within the line of the EB wall with structures on both sides (Herzog 1997, 140-41).

Altogether, these residential areas demonstrate domestic buildings sharing walls and often having rectangular rooms organized around small courtyards.

Figure 26. Plan of the northern residential quarter of Jericho (after Herzog 1997, Fig. 4.13; adapted from Sellin & Watzinger 1913, Taf. II, III).
NORTHERN COASTAL PLAIN

Akko

Tel Akko (also Acco, Acre) is a ca. 20 ha site located on the Northern Coastal Plain, at the northern cape of the Haifa Bay (ca. 700 m inland, at present) and situated on a raised sandstone (*kurkar*) hill on the north bank of Nahal Na’amah. The site is surrounded by an area with varied potentials for agriculture (with fertile soils, but possibly poor drainage), and transportation connections existed via the coastal road running from the Jezreel Valley northward along the coast and, of course, the sea (Kotter 1986, 170). The MB remains at the site have only been published in preliminary reports (e.g. Dothan 1985; 1993b; Dothan & Raban 1980; Raban 1991) and belong to the fortification system excavated in areas AB, B, F and H, representing at least three main phases from the MB I-II. Although a large southern portion of the site has been destroyed, the MB I remains are believed to have covered the entire mound, yet in subsequent phases of the MB II the settlement was reduced in size (Dothan 1993b, 19).

Figure 27. Plan of Tel Akko (after Dothan 1985, Fig. 1).

According to Dothan (1993b, 18), the earliest earthen rampart was oriented around the southern portion of the tell, with later superimposed ramparts added to the north as the settlement expanded in that direction. The stratigraphy of the ramparts remains unclear from the preliminary reports, yet the following observations may suffice. The earliest rampart(s)
was composed primarily of clay (*ḥamra*), and served as the base for a wall discovered along the northern slope. The wall consists of a ca. 3.5 m wide foundation of huge boulders ca. 2.5 m tall, and brick superstructure ca. 2.5 m wide, which was exposed for a length of 20 m, demonstrating segments and recesses, with a tower projecting outward on the eastern side. A stone-built staircase with nineteen steps leads from the top of the contemporary (second?) rampart to the top of this wall. In the third main phase of the fortifications, a large mud-brick building (Building A) measuring ca. 9 m wide and 14 m long was constructed inside the mud-brick wall, and may have been an expansion of an earlier building (Dothan 1993b, 18, 20). The excavators date the first two phases of the fortifications to the MB I, and the foundation of Building A to the end of this period, yet it continued in use into the MB II (Dothan 1993b, 18). Burke’s (2008, 234) reconstruction of the second phase of earthen ramparts suggests they were elliptical, forming a ca. 950 m long perimeter around the site. However, the excavators (Dothan 1993b, 19) consider it likely that the southern boundary of the site did not have earthen ramparts, since it was located on the river where there may have been a lagoon through which ships could pass.

A gate (the so-called “Sea Gate”, since it faced the sea) was discovered in Area F, on the northwest side of the mound, constructed on top of the earliest earthen rampart (Fig. 28). Unique in its design, the gate consists of essentially two adjoining units, an interior brick unit and exterior stone unit, oriented perpendicularly to the edge of the tell with a total length of ca. 20 m. The inner unit of the gate consists of a four-pier gate construction built of mud-brick. The outer unit comprises two roughly parallel stone walls built of large undressed boulders (up to ca. 2 m wide) on the outer slope of the earthworks (Dothan & Raban 1980, 36). The outer entry is flanked by pilasters (a ca. 1.5 m projection from the northeast wall and only ca. 0.4 m from the southwest wall), and is perpendicularly abutted by a narrow brick wall on the northern pilaster. The two walls (ca. 1.6 – 2 m wide) are spaced 4.2 m at the widest point, narrowing to 3.6 m near the outer entry, and their foundations reach as far as 1.5 m below the clay floor of the entrance. Evidence was also found of a potential wooden threshold in the outer entry, as well as a plastered projection just inside the pilasters, perhaps relating to a door-jam. The inner face of all the walls, both stone and brick, is plastered with “smooth reddish clay from top to bottom”, apparently as far down as the lowest courses of the foundation. Regarding the surface of the gate, the excavators describe: “A beaten clay floor lies between the two stone walls [of the outer unit], laid on a sand fill in the northwest and directly on the rampart elsewhere. A threshold found under this floor probably belonged to an earlier, more steeply inclined floor” (Dothan & Raban 1980, 37). A trial sounding under the floor within the brick unit further revealed underlying layers with MB I sherds.
Adjoining either side of the inner unit of the gate structure are massive brick structures that may be towers, but are most probably city walls (e.g. Burke 2008, 235). Although information remains lacking for the innermost portion of the structure, where it should open into the settlement, it seems that the excavators’ interpretation of the brick unit being “two wings” forming a “guard room” (Dothan & Raban 1980, 37) is unlikely. Rather, it is possible that this inner brick unit actually represents an early gate, consisting of a direct-entry four-pier gate built into the city wall. The later addition of the stone walls seems to have coincided with the construction of the second, supplementary rampart on the outer slope, and was intended to provide support for the inner unit as well as entry through the new rampart. Altogether, the combined units of the gate created a unique structure with three pairs of asymmetrical pilasters, making it similar to the common six-pier gate. An additional noteworthy feature is a series of stone steps leading to the outermost entry (Dothan 1993b, 19), indicating that this gate was only meant for foot traffic, similar to the gate in Area AA of Megiddo.

Within the two chambers of the gate, MB I sherds were encountered above, below and within the sequence of three floors associated with the gate, which Cohen (2002, 70) compares to Phases 1 and 2 at Aphek. Thus, the first rampart, gate sequence and second rampart all seem to fit well within the MB I. Subsequently, the interior of the gate was filled
with clean sand to the preserved top of the walls, which was sealed by a thick layer (up to 1.2 m) of brick material and clay fill, all dating to the MB I (Dothan & Raban 1980, 38). This fill corresponds to the construction of the third rampart around the end of the MB I, which relates to Building A.

**Kabri**

Tel Kabri is located in the Northern Coastal Plain about 4 km from Nahariya (on the coast). Being situated near the eastern edge of the Coastal Plain, any route going along the plain at the base of the hills of the Upper Galilee would have passed the site. Likewise, the Nahal Gai’ton, which opens near the site, would have provided access into the Upper Galilee (Kotter 1986, 173-74). The MB settlement was strategically positioned encompassing one powerful spring (Ein Sefa) within its fortifications, while a second spring (Ein Giah) lies just outside the north-eastern line of the ramparts. Although water would have been plentiful, drainage may have caused serious problems at times (cf. Horowitz 2002; Tsuk 2002).

Figure 29. Plan of Tel Kabri (after Kempinski 2002a, Fig. 1.3).
The earliest evidence of MB activity at the site dates from the MB I, at which time Kempinski (2002c, 451) estimated a settlement size of 15 – 20 ha. The MB palace in Area D was originally considered to date from the beginning of the MB II, yet recent discoveries have found earlier phases within the palace dating to the mid-MB I (Yasur-Landau & Cline 2010, 8). Although the extent of this early phase of the palace cannot yet be determined, it seems that the thick wall foundations were built with large stones, and floor L.2346 is a thick plaster floor. It would seem that in the MB I/II transition the palace underwent a series of modifications and expansions resulting in the much more exposed remains of the MB II palace (Fig. 30).

Figure 30. Plan of the MB palace in Area D-West of Tel Kabri (after Yasur-Landau & Cline 2008, Fig. 1).

Recent geophysical survey and excavation in the area of the palace determined that the plaster floors and architecture of the palace complex continue to the north and east, indicating that the MB II palace covers at least 3,000 - 4,000 m² (Cline & Yasur-Landau 2007, 158) rather than the 2,000 m² earlier estimated by Kempinski. Evidence of multiple thick plaster floors and renovations demonstrate the long life of this structure through the MB II until its destruction late in the period (Yasur-Landau & Cline 2008, 8). Although exposure of the structure remains limited, features include thick walls, plastered floors, central hallways or rooms with adjoining corridors and a series of what appear to be drains built into some walls (contra Yasur-Landau & Cline 2010). Room 611 is a particularly notable hallway or covered courtyard measuring 10.4 x 10.4 m square and demonstrating a
number of plaster floors, at least one of which was painted (cf. Oren 2002, 58ff). One phase of this room (and its doorways) demonstrates frescoes painted on lime plaster showing strong affinities with Aegean-type frescoes, both technically and stylistically (Cline & Yasur-Landau 2007, 163-5; Niemeier & Niemeier 1998; 2002, 282-85). These frescoes have only a few roughly contemporary parallels in the Near East (e.g. Alalakh, Mari, el-Dab’a, Qatna) and indicate the possibility of an Aegean-influenced stylistic motif that may be part of a Near Eastern palatial-cultural koine.

The site attained its present form during the MB with the construction of its freestanding earthen ramparts, which encompass an area of ca. 32 ha. The trajectory of MB settlement at the site appears to have begun in the MB I, with the site reaching its peak size in the MB II along with massive fortifications and a monumental public building. Kempinski divided the MB remains into Stratum 4, dating to the MB I/II, and Stratum 3, dating to MB II-III. Renewed excavations at the site by Yasur-Landau and Cline have improved the resolution of some chronological issues and further investigated the areas first exposed by Kempinski and Niemeier (Kempinski 2002a).

Dating no later than early MB II (Kempinski 2002b, 39), and probably to the MB I/II transition, the freestanding ramparts of Tel Kabri are broad and flat, about 35 m wide and standing 6-8 m above the modern ground level in Area C, where they were investigated by Kempinski. Sectional trenches through the rampart revealed the massive core which, according to the excavators, was constructed of “black mud and pebbles”, with layers of “crushed kurkar and mud” deposited on either side using the “sandwich method” (Kempinski 2002b, 37) (Fig. 31). The alternating layers of fill were as thick as ca. 8 m and were interleaved. Although never explicitly stated in any excavation reports, the topography of the preserved rampart and surrounding plain suggest the presence of a fosse below the rampart.

Figure 31. Schematic section of ramparts at Tel Kabri, combining elements of Areas C and T (after Kempinski & Niemeier 1991, Fig. 10).
There were two walls associated with the ramparts, both essentially serving as revetments. The inner wall (W400) reached a width of ca. 4 m and was comprised of a 1 m base of large stones with a mud-brick superstructure preserved almost up to the surface. According to Kempinski (2002b, 37), this wall was built on the inner side of the rampart after the earthworks were constructed and served as a retaining wall supporting the fill of the rampart that sloped into the city. The outer wall (W404/W1600) at the base of the rampart measured ca. 5.5 m wide and was encountered in two separate trenches around the tell, suggesting that it may have surrounded the entire site (Kempinski 2002b, 37). A section cut through this wall revealed that it was constructed of two rows of huge stones with a mixed fill between them, with the outer row and fill possibly being a later addition to a more basic revetment wall.

Domestic architecture was discovered adjoining the fortifications in Area C. Two phases post-dating the rampart were associated with Stratum 4, the earliest of which was a fragmentary surface with MB I ceramics and associated with Tomb 503. A structure was subsequently built using W400 as its northern wall, consisting of a number of rooms around a large open courtyard with a thin plaster floor (Kempinski 2002b, 39f). Associated with this structure were various types of intramural burials, including jar and pit burials as well as built tombs (Kempinski 2002b, 46-54). In Stratum 3, the basic plan of this structure continued in use with slight modifications, and an installation (appearing to be a furnace of some sort) was constructed in the courtyard.

SOUTHERN COASTAL PLAIN

Aphek

Tel Aphek (Tell Ras el-‘Ain) is located on the Coastal Plain (Plain of Sharon) about 17 km inland from Jaffa and is situated on a small rise above the springs (ca. 100 m away) that form the source of the Yarkon River. The surrounding area has fertile soils suitable for agriculture, and the site is ideally situated at a crucial point along the route traversing the Coastal Plain, which passes between the headwaters of the Yarkon and the foothills to the east (Kotter 1986, 179-80). The 12 ha site attests a continual sequence of settlement from early in the MB I, and serves as a key source for understanding the ceramic sequence of this period. Excavations carried out at the site have focused on Areas A, B and X on the acropolis in the northwest of the settlement. In these areas, evidence demonstrates a number of monumental buildings and fortifications with multiple phases belonging to the MB I and II. The following description of architectural phases follows the stratigraphic revisions made in the most recent excavation report (Yadin 2009), and is represented in Table 4.
<table>
<thead>
<tr>
<th>Period</th>
<th>Area A Str.</th>
<th>Description</th>
<th>Area B Str.</th>
<th>Description</th>
<th>Area X Str.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB I</td>
<td>-</td>
<td>VI</td>
<td>-</td>
<td>19</td>
<td>“Rural”</td>
<td>Remains</td>
</tr>
<tr>
<td>MB I</td>
<td>-</td>
<td>Vd</td>
<td>-</td>
<td>18</td>
<td>Pre-Palace I</td>
<td></td>
</tr>
<tr>
<td>MB I</td>
<td>XVII – XV</td>
<td>Pre-Palace II</td>
<td>Ve-a</td>
<td>City Wall (C250)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MB I</td>
<td>XIV</td>
<td>Palace II</td>
<td>IV</td>
<td>City Wall (C261)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MB I/II</td>
<td>XIII – XII</td>
<td>Post-Palace II</td>
<td>IV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MB II</td>
<td>XI</td>
<td>III</td>
<td>Palace III-IV</td>
<td>16 - 15</td>
<td>Palace III - IV</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Stratigraphic phases and areas of excavation at Tel Aphek (based on Yadin 2009).

Figure 32. Plan of Tel Aphek (after Kochavi et al. 2000, Fig. 1.5).
The earliest phase of MB I (Stratum X19, B VI) suggests a small-scale settlement lacking significant architecture. Following this phase is a major constructional fill (X18, B Vd) of ca. 0.5 - 1.5 m (Yadin 2009, 11) creating a platform for the first phase of monumental construction comprising Palace I (X17) and the first city wall (C250 in Area B Va-c). Palace I witnessed three sub-phases (X17c-a) of renovation during its lifetime and excavation was only able to expose what may be a northern wing of the building. The building has walls of ca. 1.2 m wide with plastered mud-brick superstructures and deep stone foundations arranged as an open courtyard (L.7169, ca. 6.0 x 7.5 m) with a hearth and adjacent rooms (Yadin 2009, 11-12). The palace probably adjoined the city wall (C250) to the north, which was uncovered for a length of ca. 25 m running east-west along the edge of the mound. The wall measures 2.25 – 2.50 m wide and comprises a stone foundation set into a foundation trench with a mud-brick superstructure. The foundations of the wall vary significantly in depth (ca. 0.35 – 2.50 m) due to the slope of the mound, yet the builders apparently succeeded in creating a fairly level base for the mud-brick wall. The wall featured externally protruding buttresses at ca. 15 m intervals, constructed using the same dimensions and techniques as the main wall segment, and providing structural support against the slope (Gal & Kochavi 2000, 71).

Figure 33. Plan of MB excavated areas at Tel Aphek (after Yadin 2009, Fig. 2.1).
Evidence was also discovered of a small earthen rampart abutting the wall in the western area of exposure where the slope was not as steep. A drainage channel (L.1405) was also built into the stone foundation of the wall (Gal & Kochavi 2000, 73, 75). Wall C520 apparently suffered from erosional degradation and was repeatedly repaired, ultimately leading to a complete rebuild as Wall C261. This wall was partly founded upon several brick courses from C250, but does not follow the exact line of its predecessor. The difference of elevation created by the slope of the mound was overcome by building the wall in ca. 5 m segments that were stepped according to topography (such as Hazor Area P), and each segment had a small external buttress, such that they were spaced ca. 5 m apart (Gal & Kochavi 2000, 85).

Palace II is a monumental structure uncovered in Area A and was apparently in contemporary use with already existing Palace I. The exposed remains of this building extend over ca. 750 m², and two main phases of the building were distinguished. Phase B comprised a western courtyard with a thin lime-plaster coating (Floor 442) on a pebble bedding and an eastern courtyard with a similar floor. The excavators believe that Wall K101/111 (ca. 0.8 m wide) served as the northern enclosure of the courtyard and building during this phase (Yadin & Kochavi 2000, 151-52). The final phase (A) of Palace II demonstrates three large interconnected courtyards, consisting of the previous two courtyards and a new addition north of Wall K101/111. The main courtyard (60) measures 15 x 20 m, with its eastern wall (L123) consisting of large stones, “hammer-trimmed” on both faces, measuring 1.6 m wide. Courtyards 60 and 421 feature lime-plaster floors ca. 10 cm thick, yet Courtyard 547, to the east, only shows evidence for repeated thin plaster floors (Yadin & Kochavi 2000, 153-54). This phase also demonstrates a number of burials beneath the floors of the courtyards, which appear to have undergone repeated repairs in many cases relating to the burials (Yadin & Kochavi 2000, 154, 156).

Palace III was discovered in Area X (X16), having ca. 2 m wide stone foundations for its walls and featuring a main courtyard (L.6107) measuring 10.0 x 8.5 m and featuring two large circular pillar bases and a drain leading to a stone-lined pit (Yadin 2009, 19). This courtyard may have been partly covered, and partly open (hence the drain and sump) (Yadin 2009, 27, 39). Rooms adjoining the courtyard include L.6184 (3.5 x 4.5 m) to the west and L.6240 (4.0 x 5.0 m) to the south (Yadin 2009, 27). Palace IV (X15) represents a change of plan and renovation of Palace III, mostly consisting of sub-dividing the eastern portion of the courtyard into smaller units, creating a wing with “cultic associations” (Yadin 2009, 31). Overall, it seems that opposed to its more robust and fortified nature during the MB I, during MB II Aphek mostly consisted of a single unfortified public structure on the acropolis surrounded by small-scale architecture (cf. Yadin 2009, 39).
Ashkelon

The site of Tel Ashkelon is located on a coastal cliff on the Southern Coastal Plain, and reaches an elevation of ca. 30 m above the sea, which is immediately to the west. Relatively recent sand dunes have encroached on the surrounding area, making it difficult to estimate the amount of ancient soils appropriate for agriculture within the immediate vicinity or ascertain the source of water for the settlement. Being located directly on the coast, Ashkelon clearly utilized maritime transport in addition to the main route along the Coastal Plain, which was probably located further inland (Kotter 1986, 182-83). The site would have been relatively unprotected on all sides were it not for the construction of massive earthen ramparts during the MB I. These earthworks reached a height of at least ca. 15 m (not including the curtain walls or towers) and a width of 70 m at their base (Stager 1993, 1578), and form a 2.2 km perimeter enclosing a settlement of ca. 60 ha. Thus far, MB architecture has only been encountered in excavations carried out on the North Slope of Grid 2 in the northeast portion of the site encountered five phases (14-10) of the MB that include a series of gates, ramparts and a fosse.

Figure 34. Topographic plan of Tel Ashkelon indicating Grid 2 in the north (after Burke 2008, Fig. 61).
The earliest MB I architecture is represented by Phase 14 and consists of an earthen rampart (Glacis #1), fosse (Moat 21) and gate (Gate 1). The earthen rampart is described as consisting of a mud-brick “capping” that seals layers of crushed *kurkar* and sand (Voss 2002, 380). However, the mud-brick most probably derives from either some architecture consolidating the top of the slope or, most likely the collapse of a brick city wall crowning the rampart. The fosse was carved out of the sandstone (*kurkar*) bedrock, measuring ca. 8 m wide at the top and tapering to a depth of ca. 7 m (Stager 2008, 221). It was traced for a distance of 70 m unto the sea cliff, and found to flank an ash-covered road that passed over the fosse at a right angle via a ca. 20 m wide causeway (i.e. the fosse terminates in an apse-shaped arch) providing direct entry through the gate. This double-entry gate measured 12 x 20 m and was constructed with both lightly-dressed and plastered stone and light brown mud-bricks of uniform size bonded with light yellow mortar (Voss 2002, 379). Two sets of piers enclose a corridor (or “vaulted chamber” measuring 3.6 x 9.0 m) made up of stones set with mortar that apparently formed a corbelled vault with its spring line beginning from the foundation. According to Voss (2002, 380) the inner set of piers, which are made of mud-brick, were constructed first with the stone corridor later abutting them. These piers (2.8 m wide, protruding 0.5 m) flank an entry of 2.5 m at the base of an arch whereas the outer piers (1.82 m wide, protruding 0.65 m), made of semi-dressed stone, span 2.3 m with no evidence of an arch (though they were badly disturbed by the subsequent gate) (Voss 2002, 380-81; Burke 2008, 238). On the interior of the settlement, the gate opens onto a space 7.1 x 7.1 m flanked by large mud-brick walls and leading into the city (Burke 2008, 238). All of the surfaces, including the road leading to the gate, consisted of beaten earth with high quantities of black ash (Voss 2002, 379ff).

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Figure 35. Plans of the four phases of MB gates at Tel Ashkelon (after Stager 1993).
The following Phase 13 comprises an expansion of the rampart (Glacis #2-4) and a new gate (Gate 2). Expansion of the rampart resulted in the burial of the earlier fosse with a huge deposit of occupational debris known as the Moat Deposit (MD). The earthworks were expanded northward ca. 15 m and covered with a stone glacis. They appear to be revetted along their base, beneath which a smaller fosse was created (Voss 2002, 380-81). According to Burke (2008, 240), a plastered drain ran along the surface of the glacis, suggesting extra care against erosion. The indirect approach to the gateway followed a ramp running parallel with the rampart before making a right angle with the 7 m wide corridor in front of the gate. Gate 2 was constructed directly on top of Gate 1, which served as a sort of foundation for the latter, and consists of the same plan on a slightly larger scale. Evidence of two storeys were preserved (Voss [2002, 231] suggests a third storey due to the height of Glacis #2), including some of the mud-brick (inner) and stone (outer) arches. These arches and the inner corridor attest the technique of barrel vaulting as opposed to radial arches (e.g. Dan), demonstrating an important technological development (Stager 2008, 231). Ashlars outlined with white gypsum plaster formed the 7 m wide entry façade, bonded with alternating headers and stretchers (Stager 2008, 231). Three distinct phases of this gate were noted by the excavators, particularly having to do with repairs from the collapsed arches and vault, as well as mud-brick revetments and buttresses added outside the entrance to support the rampart flanking the approach. The 9 m long entry corridor was traversed through the outer entry of 2.3 m and inner entry of 2.45 m, opening onto the inner court that was flanked by massive mud-brick walls anchoring the inner slope of the rampart. Voss (2002, 383) suggests that the continual maintenance of this gate led to the decision to abandon and bury it. At some point a corbelled mud-brick drain was set into the street to enable drainage (presumably for the subsequent phase).

Phase 12 consists of Gate 3, which was built directly over the buried remains of the previous gate, yet also extended much further outward along the earlier ramped street with a total length of 29 m. Unlike its predecessors, this structure was constructed entirely of mud-brick with its walls serving both as retaining walls for the rampart and ramp fill, as well as forming the corridor of the gate, itself. This gate encloses the approach from Phase 13 with a single outer entry (5.5 m wide) leading to the inner corridor. Since the upper portion of the gate was built above nearly two storeys of the previous gate, the steep ramped approach had to be built up, necessitating the revetment walls to the east and north. This new ramp ran parallel with the rampart and retaining wall for 27 m before turning right into the ca. 7 x 29 m passage through the upper gate, formed by 3 m wide walls on either side (Voss 2002, 383).

Gate 4 of Phase 11 is a comparably small pedestrian gate, which may indicate a shift in the location of the main northern gate of the settlement to a different location (Stager
The gate is a four-pier, double-entry gate measuring 7.3 m square, with a 3.7 x 3.9 m single chamber, 1.5 m wide entries and ca. 1.8 m thick walls. Voss (2002, 384) notes two types of bricks used, dense brown and sandy yellow bricks, and contends that these bricks were of poorer quality than the earlier gates. The approach leading up to the gate was widened into a fan-shaped revetment corridor. Also belonging to the fortifications of Phase 11 is a mud-brick tower (ca. 14 x 8 m) that was constructed to the top of the rampart in this phase and continued to be used in later phases (Burke 2008, 243). A courtyard building (the so-called “calf shrine”) was discovered along the gate’s approach, as well as four built tombs (mostly of mud-brick), all belonging to Phase 11. The 8.7 x 10.5 m courtyard building was constructed against a revetment wall from Phase 12, and consists of six small rooms adjoining two sides of a 4.5 x 7 m courtyard (Stager 2008, 234). In subsequent phases (10-9) of the North Slope, the gate, corridor and courtyard building were buried under the final rampart that was ca. 70 m wide, and apparently topped by a mud-brick wall (ca. 3.3 m wide) that was exposed above the remains of Gate 4 (Burke 2008, 243).

Yavneh-Yam

Yavneh-Yam is located on the Southern Coastal Plain ca. 32 km north of Ashkelon and situated directly on the coast. The site and its surroundings are almost completely covered with recent sand dunes, making it difficult to determine its natural situation (Kotter 1986, 201-2). The coastal route probably traversed the plain slightly further inland from the site, but clearly maritime transport was of key importance for the settlement. The ca. 25 ha site is surrounded on its northern, eastern and southern sides by a freestanding earthen rampart laid out in straight segments forming a rectilinear plan transected by the coast. Kaplan (1975) assumed that the ramparts originally delineated a square site (800 x 800 m), the western portion of which was eroded away by the sea; accordingly, the site would have been ca. 64 ha. However, the present earthworks probably preserve the original layout based on observations at other sites (e.g. Akko, Ashkelon, Carchemish) that appear to forego fortifications along the segments adjoining a body of water (Herzog 1997, 125). The inhabitable area within the ca. 1,500 m earthwork perimeter would have been ca. 17 ha (Burke 2008, 316).
The earthen ramparts were investigated in Area A in the north of the site where a section was cut through the rampart. Kaplan describes the earthwork as follows:

First, the whitish sand covering virgin soil was levelled along the rampart’s proposed alignment. A layer of hamra (the red clay soil of the Coastal Plain), 12 cm thick, was then laid as a bedding for the rampart core, constructed of light-brown, pounded earth. In the final stage, the core was encased by a sheath of hamra, built up from the base on both sides of the core, toward the top. The glacis was in two layers: the lower layer, of heavy clay soil approximately 60-70 cm thick, extends from the top of the rampart down to virgin soil. The second, covering layer, of crushed kurkar 50 cm thick, was probably intended to prevent the damp clay soil from desiccating and pulverizing. At a later stage, an additional glacis was laid over the crushed kurkar layer. This new glacis was constructed in two parts: the lower, about 3 m high, was in the form of a retaining wall inclined about 45 degrees; from that point, and up to the top, the rampart was paved with stone and raked to approximately a 30-degree angle (1993, 1505).

Based on Kaplan’s schematic plans, Burke (2008, 316) suggests the width of the rampart measured ca. 75 m at its base. Interestingly, there is no evidence for any walls (e.g. revetment, retaining, core) associated with the rampart construction, nor of a city wall. Of course, the construction and preservation of such features most likely vary at different points around the site, and the limited exposure of Area A must be considered preliminary. Seven occupational layers belonging to the MB were also uncovered in Area A on the slope of the rampart and adjoining enclosed area, which presumably post-date the construction of the rampart (Kaplan 1993, 1505).

Three successive gates were uncovered in Area H, a depression along the eastern segment of the rampart, with the earliest probably dating to the end of MB I, the second to MB II and third to LB I. The earliest gate, Gate III, was a typical triple-entry, six-pier gate constructed with sun-dried mud-bricks. The 18 m long passage was flanked by towers (ca. 9.5 – 10 m wide) set 5.2 m apart, and the 2.4 – 2.5 m projecting piers formed an entry of ca. 2.8 m (Burke 2008, 69, Table 9). Gate III was probably a contemporary construction with the rampart, as it appears to be integrated into the depression of the slope. Still, it remains unclear how exactly Gate III and the successive gates were integrated in the earthworks. Although Gate II was similar in plan, it differs in having a double-entry and an exceptionally thick-walled (ca. 2.4 m) right-hand (east) tower, possibly having a staircase leading to an upper level (Kaplan 1993, 1505). Both gates had thick rubble walls on their exterior. In addition to the gates in Area H, a sounding was also made elsewhere along the eastern segment of the rampart, suggesting another set of gates (Kaplan 1993, 1505).
Shephelah

Beit Mirsim

Tel Beit Mirsim is located in the southern Shephelah of the Coastal Plain, south of Nahal Dumah. The site is situated on a hill rising ca. 50 m above the valley to the north, which would have provided good defensive position and drainage. Although not situated on any main thoroughfare, the valley provides natural transportation northward to the Hebron region and southward to the Coastal Plain. Many of the soils in the valley, as well as the modern annual rainfall, are of marginal agricultural value, which may have caused difficulties during dry years (Kotter 1986, 153-54).

Of the ca. 3 ha site, an area of ca. 1500 m² in the southeast of the settlement was excavated to MB layers. Although excavation of this site by Albright from 1926-32 served as somewhat of a cornerstone for ceramic typology and chronology for decades, the subsequent development of more rigorous methods of excavation and stratigraphic analysis have led some scholars (e.g. Eitan 1972; Yadin 1973; Bienkowski 1989; Greenberg 1993) to re-evaluate the MB results. After a hiatus of occupation after EB III, strata I and H represent renewed settlement beginning in the IB, with H possibly belonging to an early phase of the MB I. Despite Albright’s (1993, 178) suggestions of a Stratum H city wall and/or rampart, no evidence of such has yet come to light, nor is the nature of the stratum clear. Furthermore, Albright’s Stratum G city wall has been interpreted as actually belonging to F (Eitan 1972, 19ff), which I prefer, or even as late as E (Yadin, 1973), in MB II. In any case, it would seem that strata G-F belong in the middle to late MB I (Cohen 2002, 75), which may suffice as the period from which MB urbanization began at the site (cf. Herzog 1997, 107).

Stratum G features several irregularly-spaced domestic buildings with narrow walls and front or corner courtyards. One building (the “Patrician House”) consisted of a hall measuring 4.5 x 11.2 m with three small rooms on one side and walls ca. 0.8 m wide (Herzog 1997, 107). Following this phase, Stratum F represents a new horizon of occupation without any evidence of a gap in occupation. Albright (1938, 23) notes that the plans of most buildings differ from those of G, and the character of the masonry of the fortifications and domestic structures was the same. The fieldstone foundation of the F city wall was exposed for over 80 m, demonstrating a very consistent width of 3.2 - 3.3 m along all its segments, and preservation as high as 3.45 m (Albright 1938, 17, 19). Each ca. 23 m long straight wall segment was connected by a tower, two of which were exposed, measuring 10 – 10.5 x 6 m and projecting 1.5 m into the city. According to Albright (1938, 17), internal buttresses measuring 30 – 50cm were subsequently added to both the wall.
segments and eastern tower. Although the probable gate structure uncovered was very fragmentary, Herzog reconstructs it in his plan as an indirect triple-entry gate (Fig. 37).

**Figure 37. Plan of Stratum F of Beit Mirsim (after Herzog 1997, Fig. 4.4).**

Stratum E, dating to the MB II, witnessed the construction of an earthen rampart, referred to by Albright as *terre pisé*, which was built on the outside of (and possibly abutting in some places) the F city wall. As Herzog (1997, 144, 146) discusses, the observations provided by Albright (1938, 27ff) regarding any earthwork are brief and unclear as to its actual construction or extent, and it may have been no more than mud-brick collapse from the city wall (contra Burke 2008, 245). The Stratum E settlement appears to have been organized with an emphasis on street layout and building units oriented according to the peripheral contour of the earlier city wall (Herzog 1997, 148). Many streets feature long segments of drainage channels, demonstrating a high degree of urban planning involved with this—and following—periods. Portions of a gate were excavated, revealing piers measuring 1.5 x 1.5 m with an entry of ca. 3.25 m (Burke 2008, 245). Altogether, it seems that Stratum E (and subsequently in D) was organized around, and in some places incorporated, portions of the F city wall without actually renovating it. Yet, at some points it seems that strata E-D architecture builds over dismantled sections of the wall, indicating a clearly different attitude towards fortification and demarcating urban boundaries from the MB I.
Lachish

Lachish (Tell ed-Duweir) is located along the western foothills in the Shephelah ca. 30 km from the coast and Ashkelon. The settlement sits on a natural rise with steep slopes that would have facilitated good drainage and defence. It is skirted on the east and north by Nahal Lachish, providing transportation east into the Hebron hills and west to the Coastal Plain. The surrounding land-use potential is good, though the area for field crops is limited (Kotter 1986, 162-63). The ca. 12 ha site is roughly rectilinear, being thusly shaped by the MB earthworks that were supplementary to the natural mound.

Figure 38. Topographic map of Lachish (after Tufnell 1953, Pl. 106)

The presence of MB I settlement at the site is confirmed by ceramic evidence and limited exposure of three phases (P-6) in a sounding below the MB II palace in Area P and fragmentary material relating to a “cult place” in Area D with at least two MB I phases. The magnitude of the MB I settlement remains unknown, since it was not encountered elsewhere (e.g. North-East Section), yet Ussishkin (2004a, 144) suggests the possibility of an MB I acropolis.
The rectilinear shape, layout and size of Lachish result from the earthworks dating to the MB II. The British excavations (Tufnell 1958) at the site investigated these fortifications in a trench on the northwest side of the mound with a particular interest in the rampart and fosse. The rampart fill was found to consist of “grey debris and brick wash” laid in alternating layers, and in some places it consisted of dense, dark clay with limestone chips (Tufnell 1958, 45f). The slope of the rampart was probably greatly determined by the underlying bedrock, which it supplemented, and it was covered with a lime-plaster glacis. A fosse was cut from the bedrock around the base of the rampart, measuring 2 m deep and 9 m wide, and the rampart measured ca. 30 m horizontally from the fosse to its top, which was preserved ca. 7 m high (Tufnell 1958, 46). Tufnell did not associate any wall with this phase, but identified a ca. 3.2 m wide mud-brick wall that dated slightly later (1958, 48), but might be the MB II city wall.

The MB II palace was discovered in Area P in the centre of the mound, and consists of two superimposed phases (P-5 and P-4) of a massive structure of which only a portion was exposed. The P-5 palace was a large structure with massive construction consisting of a row of three rooms (i.e. the “Three Room Structure”), which seems to form the northern end of the Bronze Age acropolis and may have been a watchtower or casemate wall of the acropolis (Ussishkin 2004a, 146, 151). Although little more is known about the P-5 structure, it may be reconstructed by the Three Room Structure at its northern end from which the building extends ca. 35 m to the south. The Three Room Structure appears to have been reused in P-4, as well as many other large stone blocks, suggesting that most of the P-4 structure represents renovations of a palace that originated in P-5 (little time elapsed between the phases based on the pottery) (Ussishkin 2004b, 56). The exposed northwest wing of the P-4 palace exceeded 1100 m², demonstrating a spacious plastered courtyard to the northwest (of unknown extent), and walls averaging ca. 1.5 m wide (probably supporting a second level) with brick superstructures on stone foundations (Ussishkin 2004a, 154). The walls and floors of the rooms were covered with thick (and several) layers of white plaster, and the conflagration that destroyed the structure preserved evidence for wooden beams incorporated into the structure. The many storage vessels discovered in most rooms suggest that this wing was used predominantly for storage and domestic-scale activities (Ussishkin 2004a, 157).

Of particular importance to this study is the brick analysis done at Lachish by Arlene Rosen (1986; 2004). Rosen sampled mud-bricks from a variety of structures and periods ranging from the MB to Iron Age. Of the five MB samples taken by Rosen, all derive from the same context (Wall 370 of the P-4 palace), limiting the amount of comparison that may be made within the site, itself. However, these samples may provide some comparative data in light of the brick analysis and discussion in the following chapters of this study.
According to Rosen (2004, 2585), the bricks of the palace wall were moderately heterogeneous, with the majority being similar to samples MBP-1 and -5, and deriving from the wadi alluvium. The less common bricks (ca. 10% of the wall) contained occupational debris and a high quantity of clay.

<table>
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<th>Sample</th>
<th>Remark</th>
<th>Source</th>
<th>Sand %</th>
<th>Silt %</th>
<th>Clay %</th>
<th>Mean Phi</th>
<th>Sorting Index</th>
<th>Dry Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBP-1</td>
<td>Typ. Br.</td>
<td>Wadi All.</td>
<td>51.0</td>
<td>38.5</td>
<td>10.5</td>
<td>0.2</td>
<td>8.82</td>
<td>10YR 5/3</td>
</tr>
<tr>
<td>MBP-2</td>
<td>Rare Br.</td>
<td>Pln./Mid.</td>
<td>13.0</td>
<td>64.0</td>
<td>23.0</td>
<td>6.1</td>
<td>2.44</td>
<td>2.5Y 6/2</td>
</tr>
<tr>
<td>MBP-3</td>
<td>Rare Br.</td>
<td>Pln./Mid.</td>
<td>5.5</td>
<td>64.5</td>
<td>30.0</td>
<td>6.7</td>
<td>2.64</td>
<td>10YR 5/4</td>
</tr>
<tr>
<td>MBP-4</td>
<td>Rare Br.</td>
<td>Midden</td>
<td>11.5</td>
<td>64.5</td>
<td>24.0</td>
<td>6.4</td>
<td>2.60</td>
<td>2.5Y 6/2</td>
</tr>
<tr>
<td>MBP-5</td>
<td>Typ. Br.</td>
<td>Wadi All.</td>
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<td>60.0</td>
<td>13.0</td>
<td>5.0</td>
<td>2.95</td>
<td>10YR 6/3</td>
</tr>
</tbody>
</table>

Table 5. Rosen’s (1986; 2004) MB brick samples from Lachish.

**CENTRAL HIGHLANDS**

**Shechem**

Shechem (Tell Balatah) is located in the Samaria Hills at the eastern end of the Nablus Pass. The settlement lies on a small rise that probably offered little strategic value besides visibility. However, the surrounding land has good agricultural and grazing potential, and Ain Balatah is a copious spring located very near the settlement. The site occupies a crucial transportation node along the only major route running north-south through the highlands from Jezreel to Judea, as well as a route running from Shechem through Wadi Bira towards the Jordan Valley (Kotter 1986, 143-44).

Two MB I phases (Stratum XXII and XXI) date from the mid- to late-MB I (cf. Cohen 2002, 92). The remains from this period include a stone-lined platform (968), a few wall segments and a drainage channel (Herzog 1997, 109). These and other features were interpreted by excavators as major levelling and filling operations in preparation for monumental construction (Wright 1978, 1086). Herzog (1997, 111) suggests the possibility that stones beneath Wall D in Area VI,2 may represent a city wall demarcating a possibly 2.5 ha MB I settlement, of which no fortifications were identified by the excavators. In the early MB II, Wall D of Stratum XX measured 2.5 – 2.85 m wide and was exposed for more than 75 m. Although this wall is often referred to as a fortification or city wall, its function remains unclear. Also, since Wall D is situated ca. 45 m within the line of later (Stratum XVI) Wall A, it may indicate that the early MB II settlement (Stratum XX) remained limited to the 2.5 ha of the MB I (Herzog 1997, 141). The space between Wall D and Wall 900 to the south was an “acropolis”, which was occupied by a large public building consisting of a

The area of settlement was subsequently enlarged to a circular mound of ca. 4.5 ha with the construction of a series of MB II fortifications (strata XX – XV) featuring supplementary earthen ramparts and revetments. In Stratum XIX a supplementary rampart (the “C Rampart”) was constructed ca. 37 m beyond the line of Wall D to the northwest and consisted of an earthen embankment ca. 27 m wide retained by Wall C, a stone revetment preserved ca. 5 m high (Seger 1975, Fig. 2; Campbell 2002, 44f). The next major phase of development (Stratum XVI) possibly followed a destruction horizon (Campbell 2002, 103) and featured Wall A, which was constructed together with an additional supplementary earthworks (probably pulled down from the C Rampart against the interior face of Wall A) (Campbell 2002, 103-15; Wright 1978, 1089). Wall A appears to be both a revetment wall for the rampart, as well as a city wall (curtain) as indicated by a mud-brick superstructure (Campbell 2002, 115). This wall was constructed with large boulders and measured ca. 4 m at its base, narrowing to ca. 2 m at the top (Campbell 2002, 109).
Also attributed to Stratum XVI was the NW Gate, a triple-entry gate measuring 18.3 m deep (with a passage of the same length) and 16.8 m along the exterior wall. Each of the piers projected ca. 2 m, forming a 2.8 – 3.0 m entry between them, and were lined with massive limestone orthostats (Campbell 2002, 110f). On either side of this gate, and abutting Wall A, were structures interpreted as relating to a palace, temple and/or palace shrine (Campbell 1993, 1350; Herzog 1997, 143). Two drains were found in this area with outlets (measuring ca. 0.45 m wide and ca. 1 m high) constructed in Wall A more than 5 m from its base (Burke 2008, 308). The Stratum XV architecture in the northeast portion of the site consisted of a city wall (Wall B) and the E Gate. Wall B measured ca. 3.25 – 3.75 m wide and was constructed with inset-offset segments, mostly situated on the crest of the earlier rampart (Campbell 2002, 150). The E Gate was a double-entry gate measuring ca. 18.2 x 13.8 m along its longest sides (outer face and southern elevation), flanked by towers, and comprised of two sets of piers projecting 1.6-1.8 m creating a ca. 3.35 m entry (Campbell 2002, 133; Burke 2008, 310). This gate consisted of two phases, with the latter belonging to Stratum XV (Burke 2008, 310) and the earlier probably to Stratum XVI.

As Herzog (1997, 143) observes, the reconstructed phases of Shechem’s fortifications during the MB II are greatly influenced by militaristic considerations that over-complicate the already convoluted stratigraphy and fail to account for practical issues of urban expansion dealing with the site’s natural topography. Following similar suggestions by Lederman (1985) and Ussishkin (1989), Herzog (1997, 143) envisages the earthworks as a single undertaking carried out in progressive stages (e.g. Jericho). Herzog explains this construction as an effort to extend the settlement area by creating an artificial mound to the north of the earlier MB I – I/II settlement. I prefer this interpretation since it helps simplify the site’s MB II stratigraphy into two general phases and correlate architectural elements. Accordingly, most of the earthworks belong to the same overall phase of settlement expansion (strata XX – XVII) whereby the area between walls C and D was an artificial mound retained on either side. The palace complex inside Wall D belongs to this phase, and there may have been an early phase of the E Gate, as well as a city wall underlying later walls A and B. In the following phase, walls A and B (strata XVI and XV) belong to the same curtain wall in which the two gates are situated and the public structures in the northwest abut. Also in this phase, a large temple (Migdal or Fortress Temple) was constructed partly over the earlier palace complex, measuring 26.3 x 21.0 m on the exterior and 13.5 x 11.0 m in the cella, with walls 5.1 m wide. The first phase of this building had a direct-access entry between two towers measuring ca. 7 x 5 m, and later had a bent-access entry that passed before two flanking stelae (Campbell 1993, 1349-50).
Jezreel Valley

Megiddo

Tel Megiddo (Tell el-Mutesellim) is located in the Jezreel Valley at the base of the Carmel range along the edge of the Plain of Esdraelon. The MB settlement was built on cultural deposits from earlier periods, themselves partly built on a natural outcrop of bedrock rising slightly above the edge of the plain. The site is surrounded by perennial springs, the strongest of which, Ain el-Qubbi, sits just below the lower tell. The surrounding hills and plain comprise a variety of soils, sediments and stones that would be ideal for a number of agricultural and building-related applications. The site is strategically situated at the mouth of Wadi Arah (“Iron Valley”), which served as a pass through the Carmel connecting the Coastal Plain to the Jezreel Valley, forming a crucial segment of the major thoroughfare following the Coastal Plain and connecting that thoroughfare with the Jordan Valley further inland.

Figure 40. Plan of Tel Megiddo showing areas of excavated MB I remains (adapted from Loud 1948, Figs. 378, 397–98, 407; Schumacher 1908, Taf. II).
Despite gaps in some areas, it seems that portions of Megiddo were sporadically occupied through the IB, but the revival of settlement of an urban nature begins to appear in the mid-MB I. The tell attained its largest size of ca. 12 ha (ca. 8 ha upper mound and ca. 4 ha lower mound; Arie 2008, 10) by the MB II, probably enclosing a total settlement size of ca. 8-9 ha. Multiple excavations have been carried out at the site over the course of the 20th century, from which the most relevant MB finds have been: (1) the fortifications discovered in Schumacher’s trenches through the slope at many points around the tell (Schumacher 1908, 23-36; indicated in blue in Fig. 40); (2) the Oriental Institute of the University of Chicago’s areas AA, BB and CC, in which various types of fortifications, domestic and public architecture were excavated (Loud 1948; indicated in red in Fig 40); and (3) strata encountered in areas F, J, K and M of the current Megiddo Expedition by Tel Aviv University (Finkelstein et al. 2000, 2006; In Press).

The conventional understanding of MB stratigraphy at this site is based on the University of Chicago’s second publication (Loud 1948), which was very summary in comparison to their first volume (Lamon & Shipton 1939) due to factors arising from World War II. Therefore, many of the stratigraphic interpretations and descriptions of architecture were presented as preliminary, especially in Area AA, where the lowest levels reached belonged to the MB I, but these strata were incompletely excavated and understood (cf. Loud 1948, vii). Subsequent studies have reinterpreted the stratigraphy based on parallels from other sites (e.g. Kempinski 1989; Kenyon 1958) and reassessment of some of the material (e.g. Gerstenblith 1983; Kenyon 1969). However, recent work by the on-going excavations of the Megiddo Expedition has begun to reassess the results of the University of Chicago, particularly in Area AA. Although preliminary, our results indicate that: (1) there appear to be multiple sub-phases of construction from strata XIV – XII that were all attributed to XIII or XII; (2) the Stratum XIII “gate” in Area AA was not actually a gate (except perhaps in Stratum XIV), but that the gate during this period was situated just to the east and appears to be a multi-entry gate with a direct axis; and (3) there are quite substantial earthworks belonging to Stratum XIII that were not fully observed (Matthew Adams pers. comm.). Despite these extremely important insights, due to the preliminary nature of our results, I will rely on the current conventional understanding of MB Megiddo in the following overview of the site, pending further research.

The gradual process of urbanization at Megiddo may have begun as early as Stratum XIV in the very beginning of the MB I. Nonetheless, the first phase of truly urban character began in the mid-MB I with Stratum XIII, at which time the perimeter of the tell was surrounded by fortifications. The fortifications of strata XIII – XII were, in most areas, a series of sequential phases of additions, making it difficult to discern with which sub-stratum each element should be associated. However, these phases of development should
be considered as part of the same overall trajectory, all occurring from mid- to late-MB I. In its earliest phase, the city wall measured ca. 1.5 m wide (ca. 1.8 with buttresses) in areas AA and BB, with external buttresses (one brick thick) spaced at ca. 3 m intervals, with a rubble street (2149) running along the inside of the wall in Area BB. A series of fortification walls spanning strata XIII – XII were discovered in Area CC, with the XIII phase probably represented by a wall similar to those in AA and BB with an apparent tower, similar to building 4104 in Area AA. The Stratum XIII gate in Area AA consists of a double-entry, single-chambered structure with a 90° bent axis and tower located on the inside of the bending axis (Fig. 41) (cf. Kempinski [1989, 109] for two phases of the gate). The entry between the two sets of piers varies from 1.8 - 1.5 m. The gate has a stepped approach that follows the city wall and is bordered by a large outer wall, which appears even wider than the former. Kempinski (1989, 109) suggests that this gate was actually a “citadel gate” since a city gate may be assumed west of Yadin’s 1967 trench in the lower mound (cf. Yadin et al. 1972). The gate opens onto a small space from which a curved street leads away (Loud 1948, 8). A narrow drain runs from the inside of the settlement through the stone socle of the city wall and empties above the stepped approach. A supplemental earthen rampart was constructed outside the outer wall and city wall to the west of the gate, having a ca. 1 m thick glacis of crushed limestone.

Figure 41. The Stratum XIII gate in Area AA of Tel Megiddo (after Loud 1948, Fig. 7).
The general character of XIII clearly demonstrates major steps toward urban planning, at least in the fortifications and earthworks around the site. An important factor during this period is the probable expansion of settlement to the lower mound, adding ca. 4 ha to the size of the site. This expansion was greatly accomplished by earthworks, as apparent from Yadin’s excavations (Yadin et al. 1972) and recent excavations in Area F (Ilan et al. 2000, 78). Despite the systematic construction of fortifications and extension of the settlement, evidence from within the settlement suggests a different situation. The interior plan demonstrates agglutinated architecture that is relatively dense in places, with narrow alleyways, and little monumental architecture. A few exceptions come from Area BB, such as building 5123 which appears to be a palace-type public building measuring ca. 70 m² with a large court flanked by four rooms on its west side and two rooms towards the north, with subsequent additions through Stratum XIII (cf. Kempinski 1989, 122). Also in BB was an apparent cultic area partly reusing the western portion of older Temple 4040 and enclosed by a wall.

![figure](image)

Figure 42. Stratum XIII of Tel Megiddo as reconstructed by Herzog (1997, Fig. 4.2).

After what may have been a fairly short period of time, Stratum XII modifications to the site demonstrate more organized urban planning and monumental architecture. The city wall was doubled during this phase, making it ca. 3-4 m wide with wider buttresses spaced at ca. 5 m intervals on the outer face, which was preserved to a height of 2.5 m. According to the excavators (Loud 1948, 87), this addition comprises bricks of better manufacture and increased standardization from the previous phase.
By Stratum XII in Area CC, a sloping glacis (part of an apparent supplemental rampart) connected the tower and inner wall (B) to an additional outer wall (A), a construction design that only appears in this area (Fig. 44). The widening of the wall in Area BB incorporated a tower measuring ca. 5.0 x 10.5 m that projects outward from the wall trace (Fig. 43). The gate in Area AA was buried and the fortifications in the area were completely redesigned. Apart from reusing portions of the Stratum XIII wall, the trace of the city wall continued over the earlier gate. The excavators (Loud 1948, 8) believed that the Stratum XII gate was shifted to the east, just beyond the area of excavation. Kempinski (1989, 47) suggests that this new gate may have had a direct entrance, and was probably related to a change in the plan of the lower city and the abandonment of the hypothetical lower city gate.
Major changes also occurred in the organization of the interior of the settlement in Stratum XII. The street running inside the earlier city wall in Area BB was moved ca. 12.5 m further inside, with structures abutting the city wall, as in Area AA. The area opposite the street in BB shows a well-planned quarter with rectangular courtyard buildings encompassing the “sacred area”. The sacred area was apparently enclosed by a temenos wall, and comprises a high place (and possibly a temple structure) with a “cult cell” (ca. 5.5 x 3 m) encircled with stelae (Kempinski 1989, 46, 178). To the west a palace (5001) was constructed, possibly measuring ca. 45 x 28 m, with huge stones for the foundations and thick plaster floors, and it is the first of a series of palaces in the area. Kempinski (1989, 123) observes the regularity in plan among some of the domestic structures in areas AA and BB, particularly with a main room or courtyard flanked by parallel rooms. From the wide exposure in Area BB it seems that the space was oriented according to somewhat of a grid, with the sacred area being nearly square (ca. 38 x 40 m) and all the surrounding buildings and streets oriented in the same regular direction. This organization demonstrates an important development from the preceding phase.

Around the beginning of the MB II, the upper mound of Megiddo was altered by the construction of earthen ramparts over the preceding fortifications in many areas around the site, extending the area from ca. 6.8 to 8.3 ha (Kempinski 1989, 57). These Stratum XI ramparts were investigated in Area AA, where earthen fill appeared to be piled ca. 3 m high, using the earlier Stratum XIII-XII city wall as a core, and this was covered by a crushed limestone glacis. Apparently integrated with the glacis was the city wall, lying further beyond the line of the earlier walls and comprised of a narrow wall with regular internal buttresses. A portion of the Stratum XI gate was exposed in the east of Area AA, consisting of a tower measuring ca. 10 x 6 m and possibly representing part of a triple-entry gate. The line of fortification in Area BB was not preserved, probably having been eroded from the far edge of the slope, and here the eastern line of structures bordered the fill of the earthworks. The sacred area continued in use, and was bordered on its western side by a casemate-type construction belonging to Palace 5059, which appears to be an addition and modification of 5001. In most other respects the same general layout of the area shows continuity with Stratum XII.
DISCUSSION

Situational aspects of settlements

Since the distribution of the sites surveyed in this chapter represents the various regions within the southern Levant, it seems tenable to make some regional inferences based on comparisons among these sites. Considering the location and situation of the settlements within their immediate landscape, I will reiterate a few general observations regarding MB urban settlements in terms of their physical location, situation (location relative to natural resources and environment) and inter-regional connectivity. The majority of MB sites are found on natural hill tops or artificial mounds from previous occupation with slopes protecting the site from approach on most sides (Kotter 1986, 208-10). However, based on our current understanding of site taphonomy, some sites appear to have little or no apparent natural defences from their immediate situation (e.g. Akko, Kabri, Yavneh-Yam). Yet in such cases, sites were surrounded by substantial earthworks in order to compensate for their lack of defence. Although sites with natural defensive protection also employ earthworks, it seems clear that at least one function of these architectural features was to establish (or increase) the defensive situation, and probably demarcate the boundary of settlements where there otherwise was little natural topographic advantage. Interestingly, many sites do not feature enclosed or defensible water sources, suggesting that either siege defence was not really an important consideration during the period, or that other water storage strategies were implemented.

All of the sites are found contiguous with areas that could serve for various types of agriculture and often animal grazing. Locations of sites providing access to soils and topography that could be useful for a variety of economic pursuits may have been an important settlement factor, and would have been essential for the growth and sustainability of urbanism (Kotter 1986, 213f). Alluvial sedimentary deposits around these sites would also provide the essential raw materials for mud-brick manufacture, yet the availability of stone appropriate for building purposes appears much more variable, and would sometimes have to be imported to the site. Being a prerequisite for sustaining a human population, a nearby water source clearly must have existed at each site. Although evidence remains obscure for some sites, most of those surveyed here have abundant water sources within a close proximity of the settlements that could meet the many hydrological demands of urban construction and sustaining an urban population.

The majority of these settlements were likewise located along natural transportation routes, and many (particularly in valleys or mouths of wadis) utilized strategic situations in relation to key geographic points of constraint in movement or made full use of coastal geography (and presumably maritime routes). Following the criteria described by Kotter
(1986, 219), natural transportation routes refer to the path of least natural resistance tracing basins or contacts between geological formations and avoiding steep slopes, deeply-incised valleys, swampy areas, sand dunes and heavily forested areas. It would seem that MB settlements took advantage of the natural transportation routes of the southern Levantine landscape, which heavily dictated movement according to geological and topographical features. Since transportation appears to have been a primary consideration in the situation of settlements, it stands to reason that regional exchange and interconnectivity were major contributing factors during urbanization, even early in the MB, and were very likely some of the prime-movers behind urbanization. Whether these patterns of location and situation represent a matter of initial site selection, or are simply the result of successful urbanization reached at these settlements is difficult to fully ascertain; thus, some caution should be exercised not to misinterpret causation for association, or vice versa.

**Chronological aspects of settlements**

In an effort to conceptualize the process of urbanization diachronically, as seen through the phases of construction at these sites, Table 4 is an attempt to synchronize such developments across all the sites. Based on this synchronization, it seems that the trajectory of urban construction at these settlements demonstrates a roughly contemporary trajectory of development, probably representing the earliest wave of urbanization in MB Canaan. This early urbanization culminated in fully-realized urban settlements by the end of the MB I (or MB I/II transition, at the latest) at all of these sites. It remains unclear how distinct these phases of construction truly are, and whether or not the divisions interpreted as distinct strata by excavators reflect gradual renovations, complete occupational re-planning, or are purely arbitrary tools used by archaeologists. Our understanding of the scale of time involved in this process is further limited by the resolution of the ceramic assemblages and our ability to identify meaningful distinctions within them. In realistic terms, a stratum could represent a month, a decade, a generation, or longer. Nonetheless, although the nature and extent of the evidence at each of these sites varies, it seems that the process of urbanization occurred gradually over more than one phase. During this gradual process, which may be generally interpreted as occurring over two or more strata, the earliest MB occupation appears to be modest, becoming superseded by monumental architecture and settlement expansion shortly thereafter.
6. ANALYTICAL METHODS AND SAMPLING

The preceding chapters have described and contextualized the many developments regarding urbanization in the MB, particularly focusing on urban architecture. From here forward, I will exercise a more analytical approach in order to indicate significant patterns within the context of urban construction. Identifying architectural patterns will help conceptualize the process of construction and organization of labour during the process of urbanization. The methods described in this chapter outline the acquisition and analysis of data on both regional and site-specific scales of resolution. The goal of this variable-scale approach is to trace patterns that may be identified on a particular level of investigation and then compared more broadly to general regional observations, allowing me to make observations regarding major socio-cultural and economic processes in MB society. A low-resolution dataset derives from metric observations of architecture from a sample of many sites throughout the Levant, particularly focusing on the frequency of standard features, widths of walls and dimensions of mud-bricks. A high-resolution set of data derives from detailed sampling of mud-bricks at the case-study sites, including both visible observations and geoarchaeological analyses of the samples.

METRIC OBSERVATIONS

A major challenge for any method collecting and analysing metric architectural data from various sites across a region is the inevitably skewed data resulting from different excavations. The lack of preservation and exposure of excavated architecture at many archaeological sites essentially precludes the possibility of systematically collecting measurements from any sites that are not currently being excavated or have sufficiently-preserved exposures. Thus, I must rely primarily on published data for the dimensions of architectural elements, which may vary considerably in: detail, contextual clarity, the degree of approximations or averages, types of measurements provided (e.g. length, width, height) and whether or not measurements represent typical or exceptional dimensions of particular structures. For example, some excavation reports may provide consistent details of every single wall recorded in excavation, whereas others might hardly mention any measurements whatsoever, resulting in a skewed dataset. Acknowledging such inherent problems with the present datasets, attempting detailed statistical analysis would be of limited value to this
study. Nonetheless, some general preliminary patterns are still worth considering in terms of overall conventions and trends over time.

**Dimensions of mud-bricks**

In archaeological contexts, *in-situ* mud-bricks generally preserve their dimensions, the bonding techniques used to lay them and the mortar with which they were laid. Therefore bricks provide a potentially abundant source of material to observe ancient metric practices, especially since they were manufactured “to fit”, being form-moulded to particular dimensions in order to be used effectively in walls. Despite this remarkable potential for research, relatively little systematic archaeometric observations, particularly simple records of dimensions, have been published in excavation reports in the Levant, and attempts at synthetic study of these data have remained quite summary due to the lack of data. Archaeological excavations early in the twentieth century (e.g. Albright 1938; Petrie 1934; 1938; 1952; Petrie & Tufnell 1930; Schumacher 1908; Sellin & Watzinger 1913) tended to be more systematic about recording, publishing and discussing metrological observations, especially regarding mud-bricks. Petrie (1934; 1952; Petrie & Tufnell 1930) especially noted types of bricks, according to their dimensions, and attempted to map their usage and frequency. The dimensions of bricks in Mesopotamia have been observed from both archaeological and textual perspectives (e.g. Powell 1982; Robson 1999). A few studies of brick dimension in Egypt (Hesse 1970; 1971; Kemp 2000, 84-88; Spencer 1979, 147f) have endeavoured to elucidate patterns at sites using graphic plots of sets of measurements, representing such meaningful data as coefficients of correlation between length and breadth and standard deviation.

As some studies (e.g. Hesse 1970; 1971; Kemp 2000; Spencer 1979; Wright 1985) have noted, analysing the dimensions of bricks to the nearest millimetre is an unrealistic and unhelpful level of precision. Even the amount of shrinkage during drying could possibly affect different bricks using the same mould by half a centimetre or more; furthermore, standards of measurement in the ancient world were probably much less precise than those of the modern world, but were rather approximations, such as the corporeal cubit which, measured from person to person, could vary by multiple centimetres. Therefore, in the current study I approximate brick dimensions to the nearest centimetre and, as the statistical results below suggest, the highest frequencies of measurements actually range by a few centimetres.

Furthermore, approaching ancient metric practices in terms of approximations lends itself to interpreting the relationships between different dimensions in architecture (from bricks to buildings), in terms of proportional ratios. The concept of proportional ratios among bricks was highlighted early on by Schumacher (1908, 27ff) at Tel Megiddo, and
elaborated by Wright (1985) in his discussion about bricks throughout the Levant. As Wright notes:

Manifestly the dimensions of some bricks are determined by a scheme of simple arithmetic proportions between length and breadth (and to some degree the thickness can be brought into the relation). According to this system the basic dimension should be a standard unit of measure, foot or cubit etc., and the other dimension a simple multiple or fraction of this (1985, 356).

Therefore, identifying such approximations as ranges of measures and proportional ratios is a main goal in determining patterns of mud-brick manufacture and use in this study.

**Regional Bronze Age patterns**

The database of mud-brick dimensions compiled in this study draws mainly from numerous excavation reports and some personal observation. Altogether, the database represents instances of brick dimensions from the EB through the MB (with a few LB for reference), and from both the northern and southern Levant (see Appendix 2.1). The broad scope of this dataset, intentionally extending beyond the MB of the southern Levant, is mainly for the purpose of multiple comparisons in order to determine any levels of variation or standardization in the region, as well as ensuring a large enough dataset for any statistical value. It is essential to include data from the EB in order to track phenomena unique to MB urbanization by diachronic comparison. Likewise, it is important to track patterns through the MB in order to identify variation from initial urbanization into later, fully urban phases. Data from Mesopotamia and Egypt were excluded because, despite having some degree of influence and sharing many commonalities with the Levant, those regions employed different mud-brick traditions.

The overall database of mud-brick dimensions (Appendix 2.1) comes from 36 sites and contains 176 cases (some of which are averages), 21 cases of which are unspecified EB, 7 EB I, 11 EB II-III, 16 EB IV, 1 IB, 7 unspecified MB, 33 MB I, 32 MB I/II, 40 MB II-III and 8 LB. I describe the cases by the following variables: “site”, “region”, “period”, “length”, “width”, “height”, “ratio” and “sub-ratio”. The region simply distinguishes between the northern Levant and the southern Levant in order to track any major variation between the two. I use the following designations for different chronological periods, in order: EB (in general, where detailed information is lacking), EB I, EB II-III, EB IV (northern Levant), IB (southern Levant), MB (in general, where detailed information is lacking), MB I, MB I/II, MB II, MB II-III (where appropriate) and LB. The two variables of “length” and “width” correspond to the longer side and the shorter side of the brick, respectively; these terms are not relative to the position of the brick in a wall. “Ratio” corresponds to an inferred ratio of length:width:height, for example 6:3:1 (where length = 60
cm, width = 30 cm and height = 10 cm), “sub-ratio” corresponds to a ratio of only length:width, for example 2:1 (for the measurements above).

**Patterns within sites**

Systematic measurements of multiple bricks from the same walls and from different contexts across a single site enable the analysis and interpretation of brick construction patterns within sites. These patterns may indicate important issues in the construction process, especially the organization of brick manufacture. Ideally, a number of bricks may be observed from different structures of the same stratum around a site. In this way, one may be able to reconstruct single construction events and identify patterns within the mass production and building practices of bricks. Furthermore, such patterns may be compared between sites of similar data resolution in order to further differentiate meaningful practices among sites.

At each of the case-study sites, it was possible to take first-hand measurements of bricks from the architectural exposures described below and, when applicable, the dimensions of the bricks were recorded from which samples were taken. These observations may be compared to the observations published in excavation reports from these sites. In his excavation of the MB city wall in various places around the site of Megiddo, Schumacher (1908, 26-36) recorded the dimensions of the bricks in great detail, even producing tables of the dimensions of all the bricks in a single exposure of wall (Table 6). These exceptionally detailed data may be combined with basic observations from the University of Chicago’s excavations (Loud 1948, 87) (Table 7). Similar details exist from the excavations at Pella, from reports (McLaren 2003) and excavation notes (Table 8). Details from Dan derive especially from the study of the MB gate done by the Getty Conservation Institute (2000) (Table 9).
<table>
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<th>Course</th>
<th>Continuous heights (with joints)</th>
<th>Lengths of successive bricks (joints including)</th>
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<th>at city wall</th>
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<td></td>
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<td>0.30 - -</td>
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<td>0.39 0.19  - -</td>
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<td>0.47 0.85? 0.55 -  -</td>
<td>0.34</td>
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<td>0.35 0.32</td>
</tr>
<tr>
<td>5.</td>
<td>0.59</td>
<td>0.04 0.37 0.44 0.40 -</td>
<td>0.30</td>
<td>0.35 0.32</td>
</tr>
<tr>
<td>6.</td>
<td>0.70</td>
<td>0.08 0.42 0.06 0.46 -</td>
<td>0.16</td>
<td>0.35 0.32</td>
</tr>
<tr>
<td>7.</td>
<td>0.84</td>
<td>0.30 0.05 0.35 0.44 0.54 Destroyed</td>
<td>0.37</td>
<td>0.37 0.32</td>
</tr>
<tr>
<td>8.</td>
<td>0.94</td>
<td>Broken 0.07 0.10 0.50 &quot; Destroyed</td>
<td>0.18</td>
<td>0.36 0.35</td>
</tr>
<tr>
<td>9.</td>
<td>1.05</td>
<td>&quot; 0.42 0.45 - &quot; 0.50 0.40 0.37 0.70 0.40 0.30 -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>1.16</td>
<td>0.10 0.63 -  &quot;</td>
<td>0.44 0.47 0.18 0.34 0.38 0.40</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>1.27</td>
<td>0.61 0.04 0.34 0.42 &quot;</td>
<td>0.44 0.10 0.70 0.74 0.74 - -</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>1.37</td>
<td>0.50 0.32 0.35 0.57 &quot;</td>
<td>0.46 1.10 0.60 0.44 Destroyed</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>1.51</td>
<td>0.61 0.35 0.35 0.42 &quot; 0.72 0.53 0.70 0.47 &quot; &quot;  &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>1.63</td>
<td>Broken 0.30 0.77? - &quot;</td>
<td>0.78 0.70 0.35 0.63 &quot; &quot; &quot;</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>1.72</td>
<td>&quot; 0.50 0.35 - &quot;</td>
<td>0.54 0.72 0.60 0.60 &quot; &quot; &quot;</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>1.83</td>
<td>&quot; 0.32 0.35 0.30 &quot;</td>
<td>0.50 0.71 0.60 0.46 &quot; &quot; &quot;</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>1.96</td>
<td>&quot; 0.35 0.75? 0.57 &quot;</td>
<td>0.44 1.04 0.40 - &quot; &quot; &quot; &quot;</td>
<td></td>
</tr>
</tbody>
</table>

Table 6. Dimensions of bricks in the outer face of the MB wall in Pflock 4 recorded by Schumacher (1908, 30).
<table>
<thead>
<tr>
<th>Length</th>
<th>Width</th>
<th>Height</th>
<th>Ratio</th>
<th>Sub-Ratio</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>33</td>
<td>11</td>
<td>3:3:1</td>
<td>=</td>
<td>Avg. Q 10 Trench, Chicago AA</td>
</tr>
<tr>
<td>33</td>
<td>13</td>
<td>11</td>
<td>3:1:1</td>
<td>=</td>
<td>Avg. Q 10 Trench, Chicago AA</td>
</tr>
<tr>
<td>33</td>
<td>18</td>
<td>11</td>
<td>3:2:1</td>
<td>2:1</td>
<td>Avg. Q 10 Trench, Chicago AA</td>
</tr>
<tr>
<td>35</td>
<td>35</td>
<td>10</td>
<td>3:3:1</td>
<td>=</td>
<td>Chicago BB; course brown clay; also Chicago CC (Loud 1948)</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>10</td>
<td>4:4:1</td>
<td>=</td>
<td>Chicago CC; very fine light-coloured clay (Loud 1948)</td>
</tr>
<tr>
<td>53</td>
<td>32</td>
<td>11</td>
<td>5:3:1</td>
<td>3:2</td>
<td>Avg. Q 10 Trench, Chicago AA</td>
</tr>
<tr>
<td>66</td>
<td>33</td>
<td>11</td>
<td>6:3:1</td>
<td>2:1</td>
<td>Schumacher; Q 10 Trench</td>
</tr>
<tr>
<td>100</td>
<td>33</td>
<td>11</td>
<td>9:3:1</td>
<td>3:1</td>
<td>Schumacher</td>
</tr>
</tbody>
</table>

Table 7. Overall MB Brick dimensions available at Megiddo.

<table>
<thead>
<tr>
<th>Length</th>
<th>Width</th>
<th>Height</th>
<th>Ratio</th>
<th>Sub-Ratio</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>37</td>
<td>10</td>
<td>3:3:1</td>
<td>=</td>
<td>Installation; 071165</td>
</tr>
<tr>
<td>35</td>
<td>35</td>
<td>12</td>
<td>3:3:1</td>
<td>=</td>
<td>Fortification; 071282</td>
</tr>
<tr>
<td>48</td>
<td>35</td>
<td>10</td>
<td>4:3:1</td>
<td>=</td>
<td>Fortification; 071283</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>10</td>
<td>3:3:1</td>
<td>=</td>
<td>Tower 1; laid with a running bond (McLaren 2003, 17)</td>
</tr>
<tr>
<td>50</td>
<td>40</td>
<td>10</td>
<td>5:4:1</td>
<td>=</td>
<td>Tower 1; interior tower face (McLaren 2003, 17)</td>
</tr>
<tr>
<td>70</td>
<td>40</td>
<td>10</td>
<td>7:4:1</td>
<td>=</td>
<td>Tower 1; inside of the core (McLaren 2003, 17)</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>8</td>
<td>4:4:1</td>
<td>=</td>
<td>paving bricks (4) between IIIF walls 3 and 4; Smith and Potts 1992:46</td>
</tr>
<tr>
<td>23</td>
<td>18</td>
<td>14</td>
<td>3:3:1</td>
<td>=</td>
<td>Temple; 050393</td>
</tr>
<tr>
<td>35</td>
<td>32</td>
<td>12</td>
<td>3:3:1</td>
<td>=</td>
<td>Temple; 050602 and 070185 avg.</td>
</tr>
<tr>
<td>55</td>
<td>38</td>
<td>12</td>
<td>4:3:1</td>
<td>=</td>
<td>Temple; 050608</td>
</tr>
</tbody>
</table>

Table 8. Overall MB brick dimensions available at Pella.

<table>
<thead>
<tr>
<th>Length</th>
<th>Width</th>
<th>Height</th>
<th>Ratio</th>
<th>Sub-Ratio</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>38</td>
<td>14</td>
<td>4:3:1</td>
<td></td>
<td>Avg. Gate, Getty Institute</td>
</tr>
<tr>
<td>38</td>
<td>38</td>
<td>13</td>
<td>3:3:1</td>
<td>=</td>
<td>Gate, N. Tower</td>
</tr>
<tr>
<td>42</td>
<td>40</td>
<td>13</td>
<td>3:3:1</td>
<td>=</td>
<td>Gate, N. Tower</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>10</td>
<td>4:4:1</td>
<td>=</td>
<td>Early Wall outside Gate; Gate, S. addition</td>
</tr>
</tbody>
</table>

Table 9. Overall MB brick dimensions available at Dan.
Architecture

In addition to the dimensions of bricks, I considered it worthwhile to investigate patterns existing among the dimensions of architectural structures within and among sites. Foremost among these dimensions are the widths of walls, which are the most commonly recorded and published metric observations that may be directly compared. Altogether, it was possible to collate the widths of 206 walls in the Levant, from 51 sites ranging from the EB through the LB (Appendix 2.2). These walls are categorized according to their type: (1) city walls (curtain walls), (2) walls belonging to public architecture, (3) walls belonging to fortification structures (e.g. towers, gates; not curtain walls), and (4) miscellaneous walls, that are generally domestic. Other noteworthy architectural measurements include the dimensions of structures, both interior and exterior, wherever these data were available from 51 sites ranging from the EB through LB (Appendix 2.3). The 215 cases include the dimensions of: gates, towers, earthworks, public buildings, interior of public buildings, courtyards, miscellaneous external dimensions, and miscellaneous internal dimensions. Taken together, the dimensions and instances of these types of architecture, as well as important elements (e.g. buttresses, pilasters, door-sockets, material composition, orthostats), may demonstrate important patterns of building practices, technical innovations and urban planning.

Geoarchaeological Analysis

The purpose of taking samples of bricks is to determine different aspects of their basic composition, which indicates the types (if not precise) sources of sediment used, the general quality of the brick and, most importantly, allows me to distinguish between different patterns of manufacture within a corpus of comparable material. Studies discussing mud-brick composition have been primarily concerned with determining potential sources of the raw material, often noting colours in comparison with natural sediments (e.g. Kenyon 1957, Fig. 4; Wright 1985, 353) and differentiating red or brown bricks as being made from off-site sediment, whilst grey bricks consist of occupational debris (Moorey 1994, 305; Oates 1990, 389). Ceramic petrology or other types of provenience studies are helpful for a class of objects such as ceramics since they are traded commodities, for which it is useful to determine areas of production and patterns of exchange. However, it remains clear that bricks used in major construction projects during the Bronze Age were made from the most appropriate sediment sources in a very close proximity to the site. There tends to be ample alluvial and colluvial sediment appropriate for mud-brick manufacture, particularly since MB sites all appear to be located very near water sources, making it unnecessary to acquire bricks from elsewhere. Furthermore, since all the raw materials become mixed during brick
manufacture (rendering XRF-type analytical technologies of little use for provenience), I considered there was little to gain by assessing the geochemical composition of bricks in order to determine the exact sources of sediments. Instead, I address compositional (combined with metric) patterns among bricks in order to indicate the organization of brick production and construction of architecture.

**Case study samples**

My key strategy involved with sampling from the case-study sites was obtaining representative samples of characteristic brick-types from clear archaeological and architectural contexts. This included taking special care in sampling typical bricks in a wall, meaning those that seem to be the most frequently occurring dimension and/or colour, as well as exceptional bricks of visibly different dimensions and/or colour from the norm. In every possible case, I also took samples of typical mortars. I sampled each brick by scraping and collecting ca. 50 g or more material from bricks in context. I also documented the location of these bricks on a plan and the dimensions of all measureable bricks.

**Megiddo**

The highest-resolution data from Megiddo comes from my own excavation and detailed sampling in Area K. Situated in the southeast of the site, Area K is oriented along the outside curve of the upper tell, with the MB city wall running along the edge of the area. In order to investigate the extent and construction of the MB fortifications in this area, Mario Martin, Kyle Leonard and I undertook the following work in the 2010 excavation season: (1) we excavated a trench (hereafter the “Q 10 Trench”) in the northernmost 1.5 m of square Q 10 by steps (situations 1-3), cutting a section through the wall; (2) we then levelled the mud-bricks across square Q 10 to the same general course in order to gain an understanding of the horizontal arrangement of the bricks within the wall (Situation 3); (3) we excavated the Q 10 Trench for a further ca. 60 cm in order to produce a deeper section and in hopes of finding the lowest extent of the wall (Situation 4); and (4) we extended the Q 10 Trench downward along the slope of the tell in square R 10 in order to determine the full width (and potential phasing) of the wall and uncover any other fortification features, such as an earthen rampart or glacis.
Even at the outset of excavating the MB wall in Area K it seemed relatively clear that it belongs with the city wall of Chicago’s strata XIII and XII. This stratigraphic affiliation is based on comparisons with the same architecture from the Chicago excavations in nearby areas BB and CC (where the city wall was recorded at similar elevations). The particularly valuable discovery in the Q 10 Trench of a shaft grave burial (Burial 103) within the brick wall provides a secure *terminus ante quem* for the construction of the wall clearly linking it to Chicago XIII and the mid-late MB I.

I collected mud-brick samples from the four successive situations of exposure, each one essentially demonstrating the horizontal horizon of a single course of bricks within the excavated portion of the wall. I took additional samples from the southern section of the Q 10 Trench, which is an exposure that demonstrates the arrangement of the bricks in each course. Table 10 and figures 46 through 49 below list the contexts of the samples, as well as their basic descriptions.
Figure 46. Situation 1, with samples A and B indicated.

Figure 47. Situation 2, photo and plan, with samples A-E indicated.
Figure 48. Plan of Situation 3 with samples A-G indicated.

Figure 49. Photo of Situation 3 with samples A-G indicated. Note that the mud-bricks throughout the square were levelled with the exception of a 1 x 1 m artificial pillar that was left in order to preserve the highest extent of mud-brick preservation and provide a clear section of the bricks up to that elevation.
<table>
<thead>
<tr>
<th>Sample</th>
<th>Colour (Dry)</th>
<th>Dimensions (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEG/10/K/1A</td>
<td>10YR 8/2 very pale brown</td>
<td>36 x 32</td>
</tr>
<tr>
<td>MEG/10/K/1B</td>
<td>2.5Y 7/3 pale yellow</td>
<td>37 x 31</td>
</tr>
<tr>
<td>MEG/10/K/2A</td>
<td>10YR 7/3 very pale brown</td>
<td>Fragment</td>
</tr>
<tr>
<td>MEG/10/K/2B</td>
<td>2.5Y 7/4 pale yellow</td>
<td>36 x 36 x 11</td>
</tr>
<tr>
<td>MEG/10/K/2C</td>
<td>10YR 7/2 light gray</td>
<td>36 x (36)</td>
</tr>
<tr>
<td>MEG/10/K/2D</td>
<td>10YR 6/3 pale brown</td>
<td>Mortar</td>
</tr>
<tr>
<td>MEG/10/K/3A</td>
<td>10YR 5/3 brown</td>
<td>33 x 33</td>
</tr>
<tr>
<td>MEG/10/K/3B</td>
<td>10YR 7/3 very pale brown</td>
<td>36 x 34 x (12)</td>
</tr>
<tr>
<td>MEG/10/K/3C</td>
<td>10YR 7/2 light gray</td>
<td>36 x (34) x 12</td>
</tr>
<tr>
<td>MEG/10/K/3D</td>
<td>10YR 8/2 very pale brown</td>
<td>Fragment</td>
</tr>
<tr>
<td>MEG/10/K/3E</td>
<td>10YR 6/2 light brownish gray</td>
<td>34 x 34</td>
</tr>
<tr>
<td>MEG/10/K/3F</td>
<td>10YR 7/2 light gray</td>
<td>50 x 32</td>
</tr>
<tr>
<td>MEG/10/K/3G</td>
<td>10YR 7/2 light gray</td>
<td>50 x 32</td>
</tr>
<tr>
<td>MEG/10/K/4A</td>
<td>2.5Y 6/3 light yellowish brown</td>
<td>36 x 36</td>
</tr>
<tr>
<td>MEG/10/K/4B</td>
<td>2.5Y 7/3 pale yellow</td>
<td>56 x 32</td>
</tr>
<tr>
<td>MEG/10/K/4C</td>
<td>2.5Y 7/3 pale yellow</td>
<td>Plaster</td>
</tr>
<tr>
<td>MEG/10/K/4D</td>
<td>2.5Y 7/3 pale yellow</td>
<td>Fragment</td>
</tr>
<tr>
<td>MEG/10/K/4E</td>
<td>10YR 7/2 light gray</td>
<td>Fragment</td>
</tr>
<tr>
<td>MEG/10/K/SA</td>
<td>10YR 6/2 light brownish gray</td>
<td>13</td>
</tr>
<tr>
<td>MEG/10/K/SB</td>
<td>10YR 6/2 light brownish gray</td>
<td>32 x 14</td>
</tr>
<tr>
<td>MEG/10/K/SC</td>
<td>2.5Y 7/2 light gray</td>
<td>32 x 12</td>
</tr>
<tr>
<td>MEG/10/K/SD</td>
<td>10YR 7/2 light gray</td>
<td>36 x 12</td>
</tr>
<tr>
<td>MEG/10/K/SE</td>
<td>10YR 6/2 light brownish gray</td>
<td>Mortar</td>
</tr>
<tr>
<td>MEG/10/K/SF</td>
<td>10YR 7/2 light gray</td>
<td>Fragment</td>
</tr>
<tr>
<td>MEG/10/K/SG</td>
<td>10YR 6/2 light brownish gray</td>
<td>Mortar</td>
</tr>
</tbody>
</table>

Table 10. List of samples taken from Q 10 Trench in Area K of Megiddo.

Figure 50. Situation 4, photo and plan, with samples indicated.
In addition to the samples from Area K, I also collected strategic samples from *in-situ* mud-bricks still exposed in Chicago’s Area AA. The three types of early MB architecture to which these bricks belong are from Stratum XIII: (1) the city gate, (2) the city wall, and (3) a domestic wall. The following Table 11 and figures 52 through 54 show the contexts of the samples, as well as their basic descriptions.
Table 11. List of samples taken from Chicago Area AA of Megiddo.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Colour (Dry)</th>
<th>Dimensions (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEG/10/AA/GA</td>
<td>2.5Y 7/3 pale yellow</td>
<td>36 x 30</td>
</tr>
<tr>
<td>MEG/10/AA/GB</td>
<td>10YR 6/2 light brownish gray</td>
<td>Mortar</td>
</tr>
<tr>
<td>MEG/10/AA/GC</td>
<td>2.5Y 7/3 pale yellow</td>
<td>30 x 30</td>
</tr>
<tr>
<td>MEG/10/AA/GD</td>
<td>10YR 6/3 pale brown</td>
<td>36 x (32)</td>
</tr>
<tr>
<td>MEG/10/AA/WA</td>
<td>2.5Y 7/3 pale yellow</td>
<td>56 x 32</td>
</tr>
<tr>
<td>MEG/10/AA/WB</td>
<td>10YR 5/2 grayish brown</td>
<td>32 x (32)</td>
</tr>
<tr>
<td>MEG/10/AA/WC</td>
<td>2.5Y 7/2 light gray</td>
<td>36 x 36</td>
</tr>
<tr>
<td>MEG/10/AA/WD</td>
<td>10YR 6/2 light brownish gray</td>
<td>36 x 36</td>
</tr>
<tr>
<td>MEG/10/AA/DA</td>
<td>10YR 6/2 light brownish gray</td>
<td>33 x 15 x 11</td>
</tr>
</tbody>
</table>

Figure 53. City Gate with samples A-D indicated.

Figure 54. City Wall with samples A-D indicated.
**Pella**

During a visit to the site of Pella at the end of the 2011 field season, I sampled representative mud-bricks (listed in Tables 12 and 13) from previously exposed walls that were still well-preserved and accessible. In Area XXVIIIC I collected samples of typical light and dark bricks, as well as mortar, from the section of a cut (Loci 7-9) through Tower 1 (Figs. 55 and 56), as well as dark-coloured bricks towards the bottom of the tower on its west face. Also in Area XXVIIIC, I took samples from the inner exposure of Wall 9, extending westward from the tower (Figs. 55 and 57).

---

*Figure 55. Areas III and XXVIII indicated at Pella (adapted from Bourke et al. 2003: Fig. 1; McLaren 2003: Figs. 8a, 17).*
<table>
<thead>
<tr>
<th>Sample</th>
<th>Colour (Dry)</th>
<th>Colour (Moist)</th>
<th>Dimensions (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PELLA/11/XXVIII/T/A</td>
<td>10YR 6/3 Pale Brown</td>
<td>10YR 4/3 Brown</td>
<td>Mortar</td>
</tr>
<tr>
<td>PELLA/11/XXVIII/T/B</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>10YR 5/6 Yellowish Brown</td>
<td>38 x 38 x 10.5</td>
</tr>
<tr>
<td>PELLA/11/XXVIII/T/C</td>
<td>10YR 7/4 Very Pale Brown</td>
<td>10YR 6/6 Brownish Yellow</td>
<td>38 x 38 x 10.5</td>
</tr>
<tr>
<td>PELLA/11/XXVIII/T/D</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>10YR 5/6 Yellowish Brown</td>
<td>38 x 38 x 10.5</td>
</tr>
<tr>
<td>PELLA/11/XXVIII/TW/A</td>
<td>10YR 4/4 Dark Yellowish Brown</td>
<td>10YR 3/4 Dark Yellowish Brown</td>
<td>34 x 8</td>
</tr>
<tr>
<td>PELLA/11/XXVIII/TW/B</td>
<td>10YR 5/3 Brown</td>
<td>10YR 4/3 Brown</td>
<td>10 (high)</td>
</tr>
<tr>
<td>PELLA/11/XXVIII/TW/C</td>
<td>2.5Y 6/3 Light Yellowish Brown</td>
<td>2.5Y 5/4 Light Olive Brown</td>
<td>10 (high)</td>
</tr>
<tr>
<td>PELLA/11/XXVIII/W9/A</td>
<td>10YR 8/2 Very Pale Brown</td>
<td>10YR 6/4 Light Yellowish Brown</td>
<td>36 x 36 x 10.5</td>
</tr>
<tr>
<td>PELLA/11/XXVIII/W9/B</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>10YR 5/6 Yellowish Brown</td>
<td>36 x 36 x 10.5</td>
</tr>
</tbody>
</table>

Table 12. List of samples taken from Area XXVIIIC at Pella.

![Image of a wall with sample locations marked A, B, and D]

Figure 56. Samples taken from the tower in Area XXVIIIC.
In Area III representative samples came from distinct “bands” of bricks at different heights in Wall 41 (Figs. 58 and 59) including: (1) the lowest band of “black” bricks with their “orange” mortar, above which were (2) “green” bricks with another type of mortar, and (3) various bricks in an upper portion of the wall. Additionally from Area III, I collected samples from three walls representing phases of MB I – I/II architecture adjoining the city wall, still exposed in the west section of the area (Fig. 60).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Colour (Dry)</th>
<th>Colour (Moist)</th>
<th>Dimensions (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PELLA/11/III/W41/A</td>
<td>2.5Y 7/3 Pale Yellow</td>
<td>2.5Y 5/4 Light Olive Brown</td>
<td>38 x 38 x 9</td>
</tr>
<tr>
<td>PELLA/11/III/W41/B</td>
<td>10YR 6/3 Pale Brown</td>
<td>10YR 3/3 Dark Brown</td>
<td>Mortar</td>
</tr>
<tr>
<td>PELLA/11/III/W41/C</td>
<td>10YR 6/2 Light Brownish Gray</td>
<td>10YR 4/2 Dark Grayish Brown</td>
<td>38 x 38 x 10</td>
</tr>
<tr>
<td>PELLA/11/III/W41/E</td>
<td>10YR 6/3 Pale Brown</td>
<td>10YR 4/3 Brown</td>
<td>Mortar</td>
</tr>
<tr>
<td>PELLA/11/III/W41/F</td>
<td>10YR 6/3 Pale Brown</td>
<td>10YR 4/3 Brown</td>
<td>38 x 38 x 10.5</td>
</tr>
<tr>
<td>PELLA/11/III/W41/G</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>10YR 5/4 Yellowish Brown</td>
<td>38 x 38 x 10.5</td>
</tr>
<tr>
<td>PELLA/11/III/W41/H</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>10YR 4/3 Brown</td>
<td>38 x 38 x 10.5</td>
</tr>
<tr>
<td>PELLA/11/III/W41/I</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>2.5Y 5/3 Light Olive Brown</td>
<td>38 x 38 x 10.5</td>
</tr>
<tr>
<td>PELLA/11/III/S/A</td>
<td>7.5YR 7/3 Pink</td>
<td>7.5YR 6/6 Reddish Yellow</td>
<td>37 x 10</td>
</tr>
<tr>
<td>PELLA/11/III/S/B</td>
<td>10YR 7/4 Very Pale Brown</td>
<td>10YR 5/6 Yellowish Brown</td>
<td>37 x 10</td>
</tr>
<tr>
<td>PELLA/11/III/S/C</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>10YR 6/6 Brownish Yellow</td>
<td>53 x 10</td>
</tr>
</tbody>
</table>

Table 13. List of samples taken from Area III at Pella.
Figure 58. Samples taken from the lower courses of Wall 41 in Area III.

Figure 59. Samples taken from the upper courses of Wall 41 in Area III.
In the temple area (Area XXXIIW), samples came from the single extant wall segment of the earliest MB temple, including the inner facing of the wall.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Colour (Dry)</th>
<th>Colour (Moist)</th>
<th>Dimensions (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PELLA/11/XXXIIW/A</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>2.5Y 5/3 Light Olive Brown</td>
<td>Facing</td>
</tr>
<tr>
<td>PELLA/11/XXXIIW/B</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>2.5Y 4/3 Olive Brown</td>
<td>Fragmentary</td>
</tr>
</tbody>
</table>

Table 14. List of samples taken from Area XXXIIW at Pella.

Figure 61. The thin “slice” (just left of the metre stick) of “green mud-brick” temple that was sampled in Area XXXIIW (after Bourke 2007, 5).
Finally, I also analysed some mud-bricks that the excavators had previously sampled, courtesy of David Thomas and Stephen Bourke. These samples included bricks from different MB temples in the temple area (XXXII) and MB fortifications in Area XXXVIIC.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Colour (Dry)</th>
<th>Dimensions (cm)</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>PELLA/DT/50393</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>23 x 18 x 14</td>
<td>Temple MBA XXXII K PO 155</td>
</tr>
<tr>
<td>PELLA/DT/50561</td>
<td>7.5YR 7/2 Pinkish Gray</td>
<td>15+ x 16 x 14</td>
<td>Temple MBA XXXII D</td>
</tr>
<tr>
<td>PELLA/DT/50602</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>36 x 32 x 12</td>
<td>Temple MBA XXXII K PO 157</td>
</tr>
<tr>
<td>PELLA/DT/50608</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>55 x 38 x 12</td>
<td>Temple MBA XXXII K PO 158</td>
</tr>
<tr>
<td>PELLA/DT/70185</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>34 x 32 x 10</td>
<td>Temple MBA XXXII Y W14</td>
</tr>
<tr>
<td>PELLA/DT/71165</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>38 x 37 x 10</td>
<td>Installation MBA XXXII Y F140</td>
</tr>
<tr>
<td>PELLA/DT/71282</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>35 x 35 x 12</td>
<td>Fortification MBA XXXVII C</td>
</tr>
<tr>
<td>PELLA/DT/71283</td>
<td>10YR 7/3 Very Pale Brown</td>
<td>48 x 35 x 10</td>
<td>Fortification MBA XXXVII C</td>
</tr>
</tbody>
</table>

Table 15. List of samples analysed from Pella courtesy of David Thomas and Stephen Bourke.
At the site of Dan, I sampled multiple exposures of the gate structure in Area K (Figs. 63-65) including: (1) the uppermost remaining portion in the north; (2) inside the core of the northern tower; (3) a later addition abutting the south of the structure; (4) inside the core of the southern tower; and (5) mud-plaster preserved just inside the archway. In addition to the gate itself, I collected samples from an earlier MB wall situated outside the gate that became incorporated within the subsequent earthen rampart.

Figure 63. Plan of Tel Dan with Area K indicated (adapted from Biran 1996 et al., Plan 1, Plan 10).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Colour (Dry)</th>
<th>Dimensions (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAN/11/K/G/A</td>
<td>7.5YR 5/6 Strong Brown</td>
<td>42 x 13</td>
</tr>
<tr>
<td>DAN/11/K/G/B</td>
<td>10YR 6/3 Pale Brown</td>
<td></td>
</tr>
<tr>
<td>DAN/11/K/G/C</td>
<td>7.5YR 5/6 Strong Brown</td>
<td></td>
</tr>
<tr>
<td>DAN/11/K/G/D</td>
<td>5YR 4/6 Yellowish Red</td>
<td></td>
</tr>
<tr>
<td>DAN/11/K/G/E</td>
<td>7.5YR 6/4 Light Brown</td>
<td>10 (high)</td>
</tr>
<tr>
<td>DAN/11/K/G/F</td>
<td>7.5YR 5/6 Strong Brown</td>
<td></td>
</tr>
<tr>
<td>DAN/11/K/G/G</td>
<td>5YR 4/6 Yellowish Red</td>
<td></td>
</tr>
<tr>
<td>DAN/11/K/G/H</td>
<td>7.5YR 5/6 Strong Brown</td>
<td></td>
</tr>
<tr>
<td>DAN/11/K/W/I</td>
<td>7.5YR 6/4 Light Brown</td>
<td>40 x 10</td>
</tr>
<tr>
<td>DAN/11/K/W/J</td>
<td>5YR 4/6 Yellowish Red</td>
<td>10 (high)</td>
</tr>
<tr>
<td>DAN/11/K/G/K</td>
<td>7.5YR 5/4 Brown</td>
<td>Facing</td>
</tr>
</tbody>
</table>

Table 16. List of samples taken from Area K at Dan.
Figure 64. Eastern exposure of the gate with samples indicated.

Figure 65. Samples taken from the early MB I wall outside of the gate in Area K at Dan.
Analytical procedures

Sample preparation

After taking all my samples, I later described them under controlled conditions in a lab, initially recording the following aspects: (1) Munsell colour when dry, (2) Munsell colour when moist, (3) plasticity, (4) total dry weight, and (5) additional observations. Upon general observation, the colour of bricks may indicate the type of source of the sediment (e.g. swampy deposits, ashy middens, soil types) used in their composition. Likewise, the level of plasticity provides an initial indication of the general particle-size composition (i.e. low plasticity with higher sand content or high plasticity with higher clay content).

The preparation of sub-samples included: (1) drying the total sample overnight in an oven below a temperature of 40°C; (2) putting the sample through a 4mm dry sieve; (3) breaking up large conglomerates in a mortar; (4) quartering the whole sample to obtain a representative sub-sample; (5) weighing out a ca. 35-40g portion for grain-size analysis and a ca. 10g portion for magnetic susceptibility. The latter aliquot was subsequently subdivided into sub-samples for the other analyses.

Grain-size

The hydrometer technique (after Lambe 1951, 29-39) of grain-size (GSA) (or particle-size) analysis measures the density (g/L) of silt and clay particles suspended in a graduated cylinder by using Stoke’s Law to calculate the rate of descent of different particle sizes. The results determine what percentage of the total sample belongs to given size-fractions of particles. The prepared samples are mixed with 25ml of 5% Calgon \([\text{NaPO}_3]_6\) and distilled water up to 1L. For the sand fraction of the samples, graded sieves are used to separate the sands into different diameter sizes (>2.0mm, >1.0mm, >0.5mm, >0.25mm, >0.125mm, and >0.063mm), which are then weighed in order to determine their individual percentage of the total sample.

Microartefact analysis consists of viewing the sand fractions previously separated during GSA using a binocular stereo microscope in order to describe the shape and sphericity of the particles and note percentages of observable inclusions (e.g. charcoal, shell, bone, sherd, flint, limestone, basalt, quartz). Each of these categories were then scored by points 0-3 in terms of non- to high-frequency, and the anthropogenic artefacts were noted separately in the same manner.

Magnetic susceptibility

Magnetic susceptibility measures the ability of a material to become magnetised by an external magnetic field. A major influence on magnetic susceptibility among sediments
in the archaeological record is burning, which enhances $\chi$ due to the alignment of iron
minerals (Goldberg & Macphail 2006, 350). In this study, I used a Bartington MS2 meter to
carry out analysis in the sediment laboratory at the Institute of Archaeology, UCL. Sub-
samples of ca. 10g were weighed precisely and put in diamagnetic pots that were then
measured using low frequency (LF) and high frequency (HF). The meter provided the
volume magnetic susceptibility, $\kappa$ ($10^{-5}$ SI), from which the mass-specific magnetic
susceptibility, $\chi$ ($10^{-6}$ m$^3$kg$^{-1}$), was calculated as follows: $\chi = (\kappa / W_{\text{DRY}}) / 10$, where $W_{\text{DRY}}$ is
the weight of the dry sample. The values used in the present study are $X_{\text{LF}}$ ($10^{-6}$ m$^3$kg$^{-1}$).
Since this analysis does not alter the sample in any way, after analysis was completed the ca.
10g samples were sub-divided into 5g for LOI, 4g for sediment pH and 0.05g for phosphate
analysis.

**Loss on ignition**

For the purpose of this study, I used LOI to measure the amount of organic material
(for the most part humus) in each sample by burning off the organic content at a sustained
high temperature. The ca. 5g samples were accurately weighed ($W_{\text{DRY}}$) into numbered
crucibles, with their own weight ($W_C$) noted. Crucibles were then heated at 550°C for two
hours and, once sufficiently cooled, were weighed ($W_{550}$) in order to determine the loss of
organic material (after Heiri et al. 2001). The formula used for determining the percent of
organic material in each sample is: $\% \text{ OM} = 100[W_{\text{DRY}} - (W_{550} - W_C)] / (W_{\text{DRY}})$.

**Sediment pH**

I used this method to determine if there were any significant patterns among the pH
levels among the samples. Using a pH meter (HANNA HI 9024) that had been calibrated by
standard buffer solutions (e.g. pH 4.0 and pH 7.0) and temperature, measurements were
taken on pre-mixed solutions. These solutions consisted of an aliquot of 4g mixed with
deonized water in a sediment-to-water ratio of 1:2.5. This was left to stand for 15min after
being mixed. The pH measurement of each sample was taken after the electrode had been
immersed in the solution at a depth of 4cm for 1min.

**Phosphate**

The technique I used to spot-test readily dissolved phosphates within each sample
was based on the Grudlach Method (Gundlach 1961), which provides a rapid means of
detecting organic phosphates in sediments. This test detects human waste, such as excreta
and refuse, which increase levels of phosphates in archaeological contexts (cf. Garrison
2003, 134-8; Goldberg & Macphail 2006, 344-50). As a rapid test intended for field
implementation, this technique does not provide absolute values of phosphate, nor does it
discriminate between different forms of phosphate, rather it identifies possible anthropogenically-contaminated sediments based on total levels of phosphate intensity.

This procedure was developed by Bjelajac et al. (1996) and serves as a validated quantification of Eidt’s (1973; 1977) test. The procedure uses two prepared reagents: Reagent A consisting of 30ml 5N(M) HCL to 5g ammonium molybdate dissolved in 100ml of distilled water; Reagent B consisting of 1g ascorbic acid added to 200ml of distilled water. A 0.05g sediment sample is placed on ashless filter paper (No. 42) resting on a small petri dish, two drops of Reagent A are then added to the sample, followed by two drops of Reagent B after 30 seconds. After the application of Reagent B, four characteristics are observed and quantified according to scoring schema (Bjelajac et al. 1996, 246): (1) the length (seconds) it takes for colour to appear; (2) the length (mm) of radiating lines; (3) the completeness of the ring of colour; and (4) colour intensity.

**SUMMARY**

The sampling and analytical methods outlined in this chapter contribute new data and methods that may be used for many applications. Although many classes of artefacts are commonly assessed according to standardization, this has not normally been done for architecture—especially mud-bricks—on a regional scale in the Bronze Age Levant, therefore making my metric analysis an original contribution. Likewise, although previous studies have analysed mud-bricks (see Chapter 1), these analyses tend to focus on determining the source of sediments rather than identify patterns of manufacture. I use a combination of laboratory methods designed to identify a number of aspects of brick composition that may have implications for the manufacture process. Since my brick samples derive from clear contexts that represent architectural phases, the results of my analysis have direct implications for patterns of brick manufacture and the process of urban construction at my case-study sites.
7. Metric Observations

The data acquired for my databases of mud-brick dimensions and numerous dimensions of architectural units allow me to elucidate construction patterns on various levels of comparison. On a broadly regional level, mud-brick dimensions from sites throughout the Levant ranging from the EB through the LB indicate general patterns when comparing the results between the northern and southern Levant, and especially between the EB and MB. A site by site inventory of architecture throughout the Levant, particularly focusing on Canaan, allows for regional and sub-regional levels of comparison.

Dimensions of Mud-Bricks

The shape of form-moulded mud-bricks preserves a key aspect of their manufacture, which may be used to identify general patterns of practice regionally and diachronically. My regional dataset serves to identify very broad patterns, from which it is possible to interpret a general technical worldview regarding units of measure and the exchange of such concepts among settlements. On a site-specific level, detailed dimensions of bricks from many architectural exposures allow basic statistical analysis regarding brick production.

This approach challenges the assumptions of individuals such as Delougaz (1933; cf. Moorey 1994, 305), who question the ability to assess standardization in mud-bricks. He appropriately noted that bricks of different sizes and proportions were used during the same periods. However, he also claimed that the practice of identifying standardization is difficult to undertake, since brick-making is not a particularly specialized technical task and, although one brick-maker may produce thousands of bricks of identical size (from a particular mould), such an output is not a sign of intentional standardization (Delougaz 1933, 6f). Contrary to this view, I argue that regardless of intention, measuring the degree of standardization among bricks within a specific site illuminates the scale, intensity and organization of the production of mud-brick architecture. The patterns of brick manufacture are fundamental to understanding construction strategies, organization of labour and even the structure of society, upon comparing these patterns with other classes of material culture (see Chapter 10).
Regional Bronze Age patterns

Based on the sample of brick dimensions throughout the Levant (Chapter 6), I made the following general observations. In length, 30.3% of EB bricks are 40-43 cm and 14% are 50 cm (Fig. 66). In width, 27.9% of EB bricks are 30-36 cm and 14% are 40-42 cm, with the latter basically corresponding to square bricks (Fig. 67). In height, 74.5% of bricks are 10-12 cm and 16.3% are less than 10 cm high (Fig. 68). The most common proportional ratio in the EB is the square brick, accounting for 34.9% of the sample, with sub-divisions of 5:5:1 (9.3%), 4:4:1 (7%), 3:3:1 (7%), 2:2:1 (7%), 6:6:1 (2.3%) and 7:7:1 (2.3%) (Fig. 69). The bricks that are square in the EB tend to be most frequent in the northern Levant and in the Jordan Valley. The ratio of 4:2:1 for rectangular bricks only accounts for 14% of the sample, and there appear to be fewer discernible patterns of ratios in the southern Levant than the north.

Figure 66. Histogram showing the frequencies of dimensions for the length of EB bricks.
Figure 67. Histogram showing the frequencies of dimensions for the width of EB bricks.

Figure 68. Histogram showing the frequencies of dimensions for the height of EB bricks.
Figure 69. Percentages of the ratios of EB bricks.

Figure 70. Percentages of the sub-ratios of EB bricks (square bricks are signified by “=“).
In contrast to the EB, the length of MB bricks is bi-modal (Fig. 71), with high frequencies occurring at both 40 cm and 50 cm. A significant 48.5% of bricks are within the range of 33-42 cm in length, which may be further sub-grouped into 33-36 cm (19.6%) and 38-42 cm (26.8%), and 29.9% of bricks fall within the range of 50-60 cm, with 9.3% between 55-57 cm. In width, 67.7% of bricks fall within the range of 30-40 cm, with 51% between 35-40 cm (Fig. 72). MB bricks are consistently slightly (ca. 1.5 cm) thicker than their EB predecessors: 76.3% are between 10-12 cm, 36.1% are 12 cm, exactly, and only one brick (1%) is less than 10 cm (Fig. 73). The most common proportional ratio in the MB is the square brick, which accounts for 40.8% of the sample, but may be sub-divided into ratios of 3:3:1 (26.5%), 4:4:1 (12.2%), 2:2:1 (2%), 5:5:1 (1%) and 6:6:1 (1%) (Fig. 75). Altogether, there are more square bricks in the MB than the EB, particularly of the 3:3:1 ratio, and square bricks in the MB demonstrate considerable consistency in their dimensions. The sides of these square bricks fall within the range of 30-45 cm (with only six outliers), 50% of which are between 35-40 cm and the median occurs exactly at 40 cm. The high percentage of square bricks of the same proportional ratio (i.e. 3:3:1 and 4:4:1) is significant by comparison with the EB. Square bricks of the 3:3:1 ratio appear to have been concentrated in the northern Levant and Jordan Valley in MB I - I/II, spreading elsewhere in MB II. Common proportional ratios for rectangular MB bricks are 4:3:1 (14.3%) and 3:2:1 (10.2%) (Fig. 74). Therefore, with 40.3% of bricks being square and 24.5% demonstrating common proportional ratios, it seems that some concept of proportion existed and was implemented more commonly in the MB than during the preceding EB.

Figure 71. Histogram showing the frequencies of dimensions for the length of MB bricks.
Figure 72. Histogram showing the frequencies of dimensions for the height of MB bricks.

Figure 73. Histogram showing the frequencies of dimensions for the width of MB bricks.
Figure 74. Percentages of the ratios of MB bricks.

Figure 75. Percentages of the sub-ratios of MB bricks (square bricks are signified by “=“).
Based on these observations, it seems that there was a higher degree of standardization in the MB than the EB in terms of both general dimensions and proportions of mud-bricks. MB brick dimensions and proportions have more significant frequencies than those in the EB. As suggested in Chapter 3, the dimensions of bricks in ancient architecture should be understood as approximate ranges of measurements rather than precise units. Frequencies in the proportions suggest that in the Bronze Age Levant there existed roughly standard units of the “common” (ca. 50 cm) and “short” (ca. 40 cm) cubit, as well as something akin to the “foot” (ca. 33 cm) and subdivisions of “palms” (ca. 11 cm). All of these standard units are more frequent in the MB than the EB.

Another important overall pattern in Levantine bricks is that they have very little in common with the dimensions of bricks in Egypt, which are smaller and more rectangular (cf. Hesse 1970; 1971; Kemp 2000, 84-88; Spencer 1979, 147-48); this may have to do with compositional constraints on size versus strength (e.g. too much sand and not enough clay). Drier climate conditions in Egypt also enabled bricks to be made year-round, and called for different construction strategies from those in the Levant. MB Levantine bricks have slightly more in common with Mesopotamian bricks, as attested in Old Babylonian texts, particularly dimensions of 33cm (2/3 cubit) and 50 cm (1 cubit), which are generally either square or “half” (Powell 1982; Robson 1999, 58ff; 2000, 12). However, Mesopotamian bricks are usually only ca. 8 cm (5 fingers) in height (Robson 2000, 12), and are sometimes baked rather than sun-dried (where possible), which allowed for different building strategies. Therefore, it seems clear that, as with many aspects of material culture, mud-bricks in the Bronze Age Levant demonstrate somewhat of a combination of influences from its neighbouring regions.

Patterns within sites

Upon comparing the dimensions of bricks from the case studies, there are a few noticeable differences between each site. The dimensions of bricks from the fortification structures at Pella are very consistently ca. 38 x 38 x 10.5 cm (contra McLaren 2003, 30), with very little deviation (0.84). Since these dimensions are consistently the same, the builders most likely used bricks made by the same brick-maker, or by multiple brick-makers using standard-sized brick moulds. The dimensions of mud-bricks at Megiddo lie within a generally consistent range of 35 x 35 x 11 cm (cf. Loud 1948, 87; Schumacher 1908, 26ff), but with a greater standard deviation (2.23) than those at Pella. There are also more rectangular bricks ca. 53 x 32 x 11 cm (or longer, Schumacher 1908, 26ff), which were used as headers/stretchers along with square bricks and smaller half-bricks. Horizontal joints between bricks at Megiddo and Pella measure an average of ca. 1cm of mortar, whereas vertical joints are much more variable. The variability of the width of vertical joints
between bricks suggests compensation for the slightly higher variability in the length and width among bricks, which is probably a result of shrinkage during drying and slightly different moulds, whereas the height of bricks is much more consistent.

According to the study done by the Getty Conservation Institute (2000, 33), the bricks of the MB gate at Dan were relatively consistent in dimension, measuring ca. 57 x 38 x 14 cm. However, the measurements I took when sampling tended to be ca. 40 cm in length and 13 cm in height, but seem to vary considerably in a range from square and nearly-square to rectangular stretchers ca. 53 x 40 cm. Unfortunately, these measurements are limited to approximations due to the deterioration of the bricks in recent years, as well as accessibility to only certain limited exposures.

The consistency of brick dimensions at Pella suggests more standardization than at Megiddo or Dan. One possible explanation is that brick-makers—no matter how many groups—used standard-sized brick moulds. Since the general size of square bricks at Megiddo and Pella are quite similar, these sites may represent at least a sub-regional (i.e. Jezreel and Central Jordan Valleys) level of social and technical interaction, if not more broadly regional.

ARCHITECTURE

Walls

A few features used in fortification walls demonstrate vast technological improvements in this architecture from the preceding urban period in the EB. The most important difference in MB wall design from the EB is the use of straight wall segments rather than curved ones, and this appears to be the common practice at all sites. The structural benefit of straight segments is constructing cohesive units of architecture that are regularly proportioned with well-laid bricks, which cannot be achieved to as high a degree with a curved wall. Another major factor in narrow wall construction derives from the very common technique of buttressing the face of a wall which provides laterally stability for the structure, enabling tall mud-brick construction with narrow foundations and superstructures. Besides buttressing, walls were sometimes offset or of casemate construction toward a similar effect of structural stability. Likewise, rectangular towers were very commonly integrated within the curtain system by connecting segments of walls (which is probably why they seem to be placed at regular intervals) and providing additional support for all elements.

All of the above factors help explain the consistently narrower fortification walls attested in the MB (averaging ca. 3.2 m wide, Fig. 77) as compared to those of the EB (averaging ca. 5 m wide, Fig. 76). Although, there is much less deviation of width during
the MB as compared to the EB, there is still some variation between sites, suggesting that no standard width was in practice, regionally or sub-regionally. In some cases, the variations in width may result from different dimensions of bricks, even within different segments of architecture at a single site. For example, a wall may be five rows of bricks wide, but the overall width could vary depending on the dimensions of those bricks and the amount of mortar used. A further issue arises from the dataset of walls that I compiled from many different excavations and publications. The widths may refer to either the stone foundations/socles of walls or the brick superstructure. In most cases, measurements provided in reports appear to refer to the more easily distinguished stone substructures of walls, which may or may not represent the width of the brick superstructure (which may be narrower). In any case, these measurements are almost always recorded to the nearest 5 cm or more, and should be interpreted as approximations, which often vary somewhat even within the same structure.

Regarding types of non-fortification walls within sites, there appears to be little consistency in dimension. Miscellaneous (mostly domestic) MB walls tend to be rather narrow, with a mean width of 1.10 m and standard deviation of 0.99. Noteworthy frequencies include 18% being 0.40 – 0.50 m and 28.2 % being 0.75 – 1.05 m wide, with walls generally being wider in the northern Levant than in the south (see Appendix 2.2). Walls belonging to MB public architecture (e.g. temples, palaces) are also inconsistent, yet are generally wider in the northern Levant than the south (Figs. 78 and 79).

![Figure 76. Histogram showing the frequencies of dimensions for the width of EB walls.](image)
Figure 77. Histogram showing the frequencies of dimensions for the width of MB walls.

Figure 78. Histogram showing the frequencies of dimensions for the width of walls in MB public buildings.
Figure 79. Box-plot showing the difference between the width of walls in MB public buildings between the northern and southern Levant.

**Buildings**

Comparing the overall internal and external dimensions of various types of buildings did not seem to indicate any significant patterns, except that gates possibly became slightly smaller over the course of the MB, whereas temples and palaces seem to have become larger (see Appendix 2.3). The lack of standard dimensions for architecture suggests that there was little emphasis on large-scale units of measurement, and that importance was instead placed on stylistic considerations by using standard architectural forms and features.

**DISCUSSION**

Based on the survey of sites in Chapter 5 and a large architectural inventory (Appendix 2), a number of observations may be made regarding the architectural features of MB settlements. As with most of the data regarding MB settlements, the architectural inventory available for comparison is greatly dominated by elements belonging to fortification systems, and lacking in other types of buildings. Although the topography and demographic considerations vary at each site, there remains a remarkable similarity in the construction of fortifications. Whether elliptical, rectilinear, supplementary or freestanding, all of the sites reviewed in Chapter 5 feature some form of earthen ramparts. Although some basic ramparts were constructed in the EB, they are unique to the MB as a widespread phenomenon and clearly feature as a development occurring with urbanization. Beyond their mere presence at sites, the techniques used to construct these earthworks demonstrate remarkable similarity considering the variability of materials and unique topographic
challenges at each site. From the evidence it appears that different layers of sediment, ranging from dense clay to crushed stone, were laid in alternating patterns for the fill of the embankment. The glacis covering of earthworks usually consists of a layer of crushed stone (sometimes crushed so finely it resembles plaster), which consolidates the earthen fill, protects it from moisture penetration and probably provides a pleasing aesthetic. Although implemented differently from site to site (and even within sites), the universal application of these rampart construction techniques facilitated drainage and mitigated erosion. This standard practice demonstrates a shared building know-how that was implemented regionally despite varied local conditions.

A very standard feature of the fortification systems of these sites are their gates. All of the gates exposed at the sites above have multiple entries of various combinations flanked by towers on at least one side. Perhaps the most striking phenomenon is the frequency of triple-entry gates at these sites, which are nearly formally identical in their basic features. Despite the formal differences between gates, whether single-entry to triple-entry, direct or indirect axis, it is important to note how the entries ranged in width from ca. 2.3 – 3.5 m, thus universally confining movement in a very regular manner. This fairly narrow entry, together with evidence of stepped approaches (e.g. Dan, Megiddo) suggest that urban traffic was generally confined to pedestrians on foot rather than animal-drawn carts. The fact that the only routes to and from the urban settlement were within heavily fortified gates suggests that movement and exchange were closely controlled and monitored by socio-political entities in the urban context. Furthermore, since such gates appear as such regular features during the early urban phases of construction at all MB sites in Canaan, their function in relation to socio-political organization during urbanization should be considered.
8. Mud-brick Composition

On a site-specific level, my case studies provide detailed information regarding the composition of bricks, along with systematic observations of brick dimensions in context, allowing me to observe specific building patterns within and between the three sites. In this chapter, I will discuss these patterns and their implications for understanding the process of construction during phases of urbanization at the case studies.

Geoarchaeological Analysis

The analytical procedures described in chapter 6 were undertaken on all the samples taken from the case-study sites. In the following discussion I exclude the results from testing the pH levels and phosphate content of the samples, because neither of these analyses yielded meaningful patterns in the data; however, this data is presented in Appendix 1. It is also worth noting that some rather “messy” data merged from the analysis of mud-brick composition, and some of these problematic data are discussed below.

General patterns of brick composition

The following categories are based on observations after correlating the results of each type of analysis in an effort to interpret significant patterns at each site, and among all the sites.

Source

The microartefact analysis of all the samples from the case study sites suggests that the sediment sources exploited for brick manufacture at both sites came from low-energy (e.g. spring, marsh), rather than high-energy (i.e. fluvial), deposits. This is indicated by low-sphericity and sub-angular to sub-rounded shapes of sand particles. Therefore, the likely sources for raw sediment were the springs adjacent to (or incorporated within) the sites, as well as other nearby springs, where there would also have been ample water for the manufacture of the bricks. Colluvial wash from nearby hill-slopes could have been used, as well, but it would have to be transported to a water source for manufacture.
**Colour**

The colours of bricks at the sites represent a combination of source material and manufacture. There is a correlation at Megiddo and Pella between a higher magnetic susceptibility and darker colour, namely in the range of 10YR 4-5/3 “brown” to 10YR 3/2 “very dark grayish brown” (moist colours). Thus, it seems that the darker-coloured brown bricks and mortar represent the inclusion of ash into the admixture during manufacture. With respect to grain-size and microartefact analyses, these bricks and mortars share the same composition and come from the same types of source material. The samples from Dan, however, demonstrate an opposite correlation with darker-coloured bricks having lower magnetic susceptibility.

**Mortar**

At both Megiddo and Pella, all mortar has higher magnetic susceptibility than bricks, which could be due to ash being used to increase plasticity. Considering the fact that all the mortars also have higher quantities of anthropogenic inclusions (e.g. charcoal, bone, sherds) than bricks, the raw material was probably from occupational deposits. This pattern in the data suggests a standard building practice at both sites that is unattested at Dan, where the mortars do not demonstrate any compositional trends different from bricks.

Figure 80. Scatter plot showing the correlation between mass-specific magnetic susceptibility and anthropogenic microartefact scores for the Megiddo samples.
Among all the sites, samples with higher percentages of clay generally tended to have larger amounts of organic material lost on ignition than their counterparts. This is likely due to the fact that clay particles trap organic humic material within soils, meaning that this pattern could relate more to the source of sediment rather than the composition of bricks derived from the manufacturing process. Yet a clearer pattern emerges at Megiddo, where samples with more organic material also have higher magnetic susceptibility than the rest. This trend may also relate to the humic content in sediment sources. However, there is also a clear correlation between high magnetic susceptibility, an increase in organic material and large amounts of anthropogenic microartefacts. This correlation suggests that levels of organic material may be more directly related to the addition of ash to the admixture of bricks rather than the humic content in soil. In this case, the organic content derives chiefly from burnt organic material in the ash, and has little to do with the percentage of clay in the samples.
Grain-size analysis

The grain-size analysis of the samples demonstrated that the brick compositions at each site were fairly evenly distributed across a range of relatively high proportions of clay to high proportions of sand, and everything in between. There were very few outliers or distinct clusters of grain-size percentages indicated among the samples. Figures 82 - 84 display scatter plots for each site with sand plotted against clay, including the results of basic cluster analysis with the number of clusters arbitrarily chosen by the brick types indicated at each site (below). I indicate only the potential clusters that are easily distinguished from other cases in these scatter plots.

![Figure 82. Scatter plot for Pella samples, with sand plotted against clay. Included are the results of basic cluster analysis with the 4 clusters arbitrarily chosen by the brick types indicated at Pella.](image-url)
Figure 83. Scatter plot for Megiddo samples, with sand plotted against clay. Included are the results of basic cluster analysis with the 5 clusters arbitrarily chosen by the brick types indicated at Megiddo.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>21.28</td>
<td>45.53</td>
<td>56.13</td>
<td>35.27</td>
<td>26.21</td>
</tr>
<tr>
<td>SiO2</td>
<td>26.79</td>
<td>35.60</td>
<td>26.70</td>
<td>34.81</td>
<td>49.57</td>
</tr>
<tr>
<td>Clay</td>
<td>51.94</td>
<td>18.86</td>
<td>17.17</td>
<td>29.92</td>
<td>24.23</td>
</tr>
</tbody>
</table>

Number of Cases in each Cluster:
- 1: 4,000
- 2: 11,000
- 3: 10,000
- 4: 9,000
- 5: 2,000

Valid: 36,000
Missing: 0.00

Figure 84. Scatter plot for Dan samples, with sand plotted against clay. Included are the results of basic cluster analysis with the 3 clusters arbitrarily chosen by the brick types indicated at Dan.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>57.63</td>
<td>24.51</td>
<td>46.39</td>
</tr>
<tr>
<td>SiO2</td>
<td>36.47</td>
<td>47.73</td>
<td>44.70</td>
</tr>
<tr>
<td>Clay</td>
<td>5.90</td>
<td>27.77</td>
<td>8.92</td>
</tr>
</tbody>
</table>

Number of Cases in each Cluster:
- 1: 7,000
- 2: 3,000
- 3: 6,000

Valid: 16,000
Missing: 0.00
It appears that only a few of the clusters at each site are distinct from the overall distribution, but are probably not significant enough to stand alone as evidence for brick types or sediment sources considering the remining distribution. The same distribution is clear in the ternary graphs below (Figs. 85 – 87), in which the brick types are indicated as somewhat overlapping these possible clusters, which are solely based on the grain-size percentages. Only considered alongside other correlating compositional characteristics, as with the brick types below, do the grain-size distributions seem to indicate useful patterns for interpreting brick manufacture.

**Brick types**

Architecture at each site contains a variety of brick colours and compositions. Upon initial observation, the easiest distinctions made among bricks are light or dark, different hues of colour and soft or hard composition. Following the series of analysis conducted on the samples representing these different bricks, I discerned a set of brick “types” at each case study site based on patterns of composition (Table 17). Each of these types is sub-grouped and classified by dry Munsell colour, which correlates with patterns in composition. It should be noted that this typology is necessarily an artificial system of classification limited by the scope of sampling for the present purposes of identifying patterns in architecture. Nonetheless, each brick type probably represents a brick “recipe”, in terms of raw materials used in the admixture, which may signify different groups of brick-makers, each using their own preferred ingredients, derived from particular sources, and mixed according to relatively consistent proportions.

<table>
<thead>
<tr>
<th>Site</th>
<th>Brick Type</th>
<th>Colour Group</th>
<th>MagSus</th>
<th>OM</th>
<th>Micro</th>
<th>Sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pella</td>
<td>Light A</td>
<td>Pale Brown</td>
<td>L</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>M/H</td>
<td>M</td>
</tr>
<tr>
<td>Pella</td>
<td>Light B</td>
<td>Pink</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>M/H</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>Pella</td>
<td>Light C</td>
<td>Yellowish Brown</td>
<td>L</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Pella</td>
<td>Dark</td>
<td>Brown</td>
<td>H</td>
<td>M</td>
<td>H</td>
<td>M/H</td>
<td>M/L</td>
<td>M/L</td>
</tr>
<tr>
<td>Megiddo</td>
<td>Light A</td>
<td>Pale Yellow</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Megiddo</td>
<td>Light B</td>
<td>Light Gray/Yellowish Brown</td>
<td>L</td>
<td>H</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>Megiddo</td>
<td>Light C</td>
<td>Light Gray</td>
<td>M</td>
<td>M/H</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Megiddo</td>
<td>Light D</td>
<td>Very Pale Brown</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>M/L</td>
<td>M</td>
</tr>
<tr>
<td>Megiddo</td>
<td>Dark</td>
<td>Brown/Gray</td>
<td>H</td>
<td>M/H</td>
<td>H</td>
<td>M/L</td>
<td>H</td>
<td>M/L</td>
</tr>
<tr>
<td>Dan</td>
<td>Light</td>
<td>Light Brown</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>M/H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Dan</td>
<td>Medium</td>
<td>Strong Brown</td>
<td>L</td>
<td>M/H</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Dan</td>
<td>Dark</td>
<td>Red</td>
<td>M</td>
<td>H</td>
<td>M/L</td>
<td>L</td>
<td>M</td>
<td>H</td>
</tr>
</tbody>
</table>

Table 17. Brick types by site and their characteristics. Columns: MagSus = magnetic susceptibility, OM = organic material, Micro = anthropogenic microartifacts. Values: L = low content, M = medium content, H = high content.
Figure 85. Ternary graph of MB bricks at Pella showing the distribution of grain-size percentages of each sample. Brick types are distinguished by colour (yellow = Light A; red = Light B; purple = Light C; and blue = Dark).
Figure 86. Ternary graph of MB bricks at Megiddo showing the distribution of grain-size percentages of each sample. Brick types are distinguished by colour (purple = Light A; green = Light B; yellow = Light C; red = Light D; and blue = Dark).
Messy data

Although correlations of much of the analytical results yielded somewhat clear patterns identified in the categories above, there remain some problematic sets of data. I was able to identify a number of similar compositional trends at Megiddo and Pella whereas, in many cases, the trends at Dan yielded contrary results or there were no consistent trends among any of the case studies. The relationship between magnetic susceptibility and organic material lost on ignition exemplifies the varied results from each case study (Figs. 88 – 90). Based on the results from Megiddo, it would appear that there is a direct correlation between these two variables. This correlation could potentially be explained by ash used in the bricks and mortar, which is further supported by the direct relationship between magnetic susceptibility and anthropogenic microartefacts (above). However, the results from Pella are less conclusive regarding the relationship between magnetic susceptibility and organic material lost on ignition, and those from Dan are the opposite of Megiddo.
Figure 88. Box-plot showing the correlation between mass-specific magnetic susceptibility and the percentage of organic material for the Megiddo samples.

Figure 89. Box-plot showing the correlation between mass-specific magnetic susceptibility and the percentage of organic material for the Pella samples.
Future research including more data from these case studies, as well as others, may bring more order to the data. In particular, further geochemical analyses may indicate important patterns that the present procedures have not identified. Nonetheless, it is important to acknowledge the fact that the study of mud-brick composition should not necessarily entail establishing simple linear relationships between component materials. Although the researcher may desire clear linear relationships in the data, the nature of data interpretation involves simplifying the noisiness in order to see general patterns, yet these may not always represent the real world. In the case of mud-brick composition, which results from human agency in the process of manufacture, and greatly depends on the varied natural environment, one cannot expect to find clear patterns in all the data.

**Case studies**

**Pella**

The grain-size composition of the mud-bricks at Pella indicates a great level of consistency (Fig. 91). The bricks in Area XXVIII C all have slightly higher silt content than those in Area III, which possibly reflects different brick-makers for different areas of construction at the site. In the case of the different bands of brick colours in Area III, the different bands (of a few courses each) reflect either different sources for raw material or the
slight addition of ash into the mixture of the 10YR 4/2 dark grayish brown (the lowest band), which appears to be lacking in the next band of 2.5Y 5/4 light olive brown bricks. In all other respects, the grain-size composition and dimensions of the two types of bricks are identical, as well as their mortar. Therefore, these brick types are functionally identical in terms of their mechanical properties. Since these two types of bricks are segregated into uniform bands rather than mixed at random (e.g. Megiddo), each band represents a set of distinct bricks being available at a single point in time during construction. The different bands of bricks seem to represent distinct batches of manufacture. The difference between these batches may be: (1) ever-so-slightly different mixture (or source) of ingredients from batch to batch, in which case it could be either the same brick-maker or multiple brick-makers producing varied batches; or (2) distinct preferred recipes, which would indicate different groups of brick-makers by each brick type. In either case, the result would be slightly different bricks available at different times (once dry), to be incorporated into a wall in different segments (bands), subject to sequential availability during building.

Figure 91. Grain-size percentages of Pella mud-brick samples (Green = Clay, Red = Silt, Blue = Sand).
Figure 92. Mass-specific magnetic susceptibility of Pella mud-brick samples.

Figure 93. Percentage of organic material in Pella samples, based on LOI.

Figure 94. Score of anthropogenic microartefacts in Pella samples.
Pella demonstrates four different types of brick: (1) Light A (pale brown; 10YR 7/3 – 8/2), (2) Light B (pink; 7.5YR 7/2 – 7/3), (3) Light C (yellowish brown; 2.5Y 6/3 – 7/3) and (4) Dark (brown; 10YR 4/4 – 6/4). Dark bricks have higher magnetic susceptibility, anthropogenic microartefacts and sand, but less silt than their lighter counterparts. As with Megiddo, the mortars at Pella are Dark-coloured and share the same compositional characteristics as Dark bricks (high magnetic susceptibility and anthropogenic microartefacts), and they also tend to have little clay. This pattern among mortars of the MB stands in marked contrast to those of the EB, which are lighter-coloured and tend to have lower magnetic susceptibility and more variable grain-size compositions. MB bricks also demonstrate much more consistency than their EB counterparts in terms of colour, composition and dimensions.

Megiddo

The grain-size analysis among the bricks at Megiddo indicates much more variability than the bricks at Pella. There seems to be no pattern in the variability of the composition of bricks even among the same courses of the same wall in Area K. Also, unlike Pella there are no bands or segments of uniform bricks in the walls at Megiddo. Instead, there is a general patchwork of many different colours with variable composition. Megiddo demonstrates five different types of bricks: (1) Light A (pale yellow; 2.5Y 7/3 – 7/4), (2) Light B (light gray/yellowish brown; 2.5Y 6/3 – 7/2), (3) Light C (light gray; 10YR 7/2), (4) Light D (very pale brown; 10YR 7/3 – 8/2) and (5) Dark (gray/brown; 10YR 5/2 – 6/3). Light C and Light D bricks are only attested in Area K, suggesting that these bricks represent batches manufactured at the time when that portion of the city wall was constructed, but not when the architecture in Area AA was constructed. Alternatively, these brick types may represent a source of manufacture that was situated nearer to that side of the tell. However, since the samples from Area AA come from a single horizon due to the limitations of preservation, it may be possible that these brick types were actually used in the area, but in other courses. Notably, Dark bricks have high magnetic susceptibility, anthropogenic microartefacts and generally more silt than all types of light bricks. Without exception, all samples of mortar are Dark-coloured and share the same compositional characteristics as Dark bricks (high magnetic susceptibility, organic material and anthropogenic microartefacts), which most probably means that Dark bricks consist greatly of recycled occupation debris derived from the site, as with the mortars.
Figure 95. Grain-size percentages of Megiddo mud-brick samples (Green = Clay, Red = Silt, Blue = Sand).

Figure 96. Mass-specific magnetic susceptibility of Megiddo mud-brick samples.

Figure 97. Percentage of organic material in Megiddo samples, based on LOI.
Figure 98. Score of anthropogenic microartefacts in Megiddo samples.

Dan

Dan demonstrates three different types of brick: (1) Light (light brown; 10YR 6/3, 7.5YR 6/4), (2) Medium (strong brown; 7.5YR 5/6) and (3) Dark (red; 5YR 4/6). Unlike Megiddo and Pella, Dark bricks at Dan have lower magnetic susceptibility, anthropogenic microartefacts and sand, but more organic material and clay than Light and Medium bricks. The mortar that was used is the same composition as the different types of bricks, and its use appears to be quite variable—in some places Light with Dark bricks, or vice versa, in other places Dark with Dark bricks. Furthermore, there is no discernible difference in the level of magnetic susceptibility between bricks and mortar at Dan as there is at Pella and Megiddo. Consistently throughout different parts of the gate complex, the amount of mortar used is relatively low as compared to the amount used in the earlier MB wall, the latter of which agrees more with the construction at Pella and Megiddo. An additional uniqueness to the bricks at Dan is the high frequency of large gravels (ca. 1-5cm) among all types of bricks. Although this phenomenon probably relates to the naturally higher proportion of large gravels in sediments within the vicinity of the site, such gravels would have an effect on the durability of bricks.
Figure 99. Grain-size percentages of Dan mud-brick samples (Green = Clay, Red = Silt, Blue = Sand).

Figure 100. Mass-specific magnetic susceptibility of Dan mud-brick samples.

Figure 101. Percentage of organic material in Dan samples, based on LOI.
**DISCUSSION**

A few important patterns emerge from comparing the results of the case studies. The number of brick types at a site and their distribution probably indicate different batches of brick manufacture. Discrepancies among batches of bricks evidently relate to different raw materials and/or proportions of those materials in the admixture for each batch. On the one hand, it is possible that different brick types could be produced by the same brickmaker, or brick-making group, simply representing slight variations in raw materials, proportions or mixing time (thoroughness) among different production batches. On the other hand, such variations may reflect multiple groups of brick-makers, each of which having their own “recipe” derived from particular materials and mixed according to particular proportions and practice. Therefore, two possible interpretations for the source of different brick types are: (1) each type represents a different batch, or single episode of manufacture that may always vary to some degree based on discrepancies in ingredients, proportions or mixing time; or (2) each type represents a manufacture recipe preferred by a brick-maker, and the number of brick types reflects the number of different brick-makers. Of course, these interpretations are not exclusive of one another, and they most likely occurred together.

The bricks at Pella are very uniform, in general, and also segregated by type rather than mixed at random. Segments of walls may have been built with sets of bricks from the same batches. It is important to note that a number of bricks of the same batch (if not all) were used at one time in the same place, rather than being divided and distributed to multiple points around the site. This observation possibly suggests that only one segment of architecture was being constructed at a time and/or groups of brick-makers were dedicated to specific loci of construction (e.g. a particular portion of the city wall, gate, tower). In contrast with Pella, the bricks at Megiddo and Dan exhibit much more variability within
even the same courses of walls. Megiddo demonstrates the most brick types, yet two of the types only seem to occur in the wall in Area K, suggesting that not all brick types were universally available everywhere on site at any given time during the construction of the fortifications.

On one hand, it might be advantageous to vary the composition of bricks in walls for the same reason as different sediments aid drainage in ramparts. On the other hand, there appears to be no structural benefit gained by the distribution of these different types of bricks throughout a wall, since different brick compositions will expand and contract at unequal rates, relative to humidity and temperature. It is my opinion that it would be preferable to use homogenous bricks within the same courses of walls (as at Pella) in order to prevent deterioration and disaggregation of bricks within the structure; the deterioration of the gate at Dan is a prime example of combining bricks of dissimilar composition. As observed by the Getty Conservation Institute (2000, 32, 87), the lighter mud-bricks tended to be used as exterior facing bricks in the construction of the walls, with the dark bricks composing the core. Since these types of bricks were found to have considerably different compositions, including plasticity index and swelling capacity, rapid changes in temperature and humidity probably caused serious deterioration to the structure, especially the façades. For Megiddo and Dan, it seems likely that the bricks of multiple brick-makers were incorporated at a single time in the process of building. It is possible that essentially the same number of brick-makers were producing bricks during urban construction at all sites, yet at Megiddo and Dan all the bricks were used in the same structure at a single time (i.e. the bricks from brick-makers “x”, “y” and “z” were used for wall “a” at the same time), whereas at Pella different bricks may have been used in different buildings at the same time (i.e. the bricks from brick-maker “x” were used for wall “a” as they were available).

Since the homogeneity of bricks appears to have been of low priority, a possible scenario for Megiddo and Dan is that walls were built rapidly with whatever variety of bricks were available at a given time. In such a case, many independent groups of brick-makers may have produced an overall high quantity of bricks that were comprised of many batches and brick types. Furthermore, the variability of brick-type distribution within the walls at Megiddo and Dan may have resulted from an *ad hoc* use of all available bricks by the builders. Along these lines, Rosen (1986, 84) suggests that bricks might even be a form of tax on farmers and/or landowners, hence explaining the variability. However, if this situation were the case, there would probably be much more variability in dimensions and composition than the data demonstrate.

These patterns also appear when correlating the dimensions of bricks at each site, since those at Pella are very standardized whereas there appears to be more variation at Megiddo and Dan. The differences between Pella, on one hand, and Megiddo and Dan, on
the other, are probably a matter of the organization of production, whereby the specialized mud-brick production at Pella may be characterized as more attached than the other two sites, which appear to be more independent (e.g. Costin 1991). Another possible explanation for variability of brick types, especially at Megiddo, is that the admixture used for each batch of bricks was poorly mixed so that the ingredients were not thoroughly or equally distributed throughout all the bricks. Again, this possibility indicates that speed was probably prioritised over quality or consistency during the process of construction at Megiddo, and possibly Dan. On the other hand, there simply could have been more, but smaller, brick-making teams producing many, but small, batches of different bricks. With this scenario, speed may not have been drastically different, but it would mean a smaller scale and more heterogeneous degree of organization. These concepts of standardization and modes of production will be discussed in greater detail in Chapter 10.

Based on the analyses undertaken, the raw sediment used at all of the sites could have derived from any of the naturally occurring sediments in the proximity of each site. Based on cost-efficiency, the most likely sediments would be those nearest the springs adjacent to (or incorporated within) the sites, where there also would have been ample water for the manufacture of the bricks. Since ancient builders were probably inclined to conserve cost (i.e. labour) by utilizing the nearest possible resources, sourcing and production would have been as close as possible to eliminate the need for excess transportation. Along similar lines, the mortar at both Megiddo and Pella appears to derive from occupational deposits, suggesting that it was sourced and manufactured directly on-site. This observation is based on the fact that all the samples of mortar from both sites consistently have higher magnetic susceptibility (derived from pyrotechnic activities) and higher quantities of anthropogenic inclusions than bricks. As Rosen (1986, 84) observes, organic and carbonate residues derived from the breakdown of ash and charcoal from occupation debris can serve as an effective binding agent, especially in lieu of high clay content. The practice of making mortar from recycled occupation material was apparently not implemented at Dan, suggesting the possibility that Megiddo and Pella realized a particular technological innovation that Dan did not, possibly relating to different spheres of socio-cultural interaction, with distinct sets of technical conventions.

If the case-study sites are representative of urban construction throughout the southern Levant, then it would seem that there were site-specific variations of common mud-brick building practices. On one hand, minor variations in building practices among sites suggest considerable autonomy, particularly with regard to strategies for brick-manufacture and the management of labour. On the other hand, the overall similarities among brick use and architectural types suggest a fairly high level of interaction among sites, through which
urban-planning, building strategies and innovations (e.g. earthen ramparts, multi-entry gates, standardized units of measurement) must have been transmitted.

**SUMMARY**

In Chapters 7 and 8 I interpreted the patterns derived from data my analyses, and their implications for understanding the process of construction during MB urbanization. I will discuss these patterns in Chapter 9 with regard to the *chaîne opératoire* of mud-brick construction, and in Chapter 10 with regard to technological innovation and production as ways of understanding MB urbanization.
9. CONCEPTUALIZING URBANIZATION

In order to apply the patterns of mud-brick and architectural practices towards conceptualizing the greater process of MB urbanization, this chapter will contextualize the process of urban construction within the chaîne opératoire of building mud-brick architecture. Urbanization involves a number of complex elements and processes beginning with developing social complexity and is certainly not limited to the mere construction of the physical urban environment. However, as the most tangible and accessible aspect of urbanization within the archaeological record, construction represents a key point in the process of urbanization during which the cultural, economic and political forces of developing social complexity merge in a massive expenditure of energy in space and time, ultimately making urbanism physically manifest. Therefore, by detailing the materials and labour involved in the chaîne opératoire of construction, it may be possible to better understand important patterns of organization, as well as quantify the scale of this process. Assessing construction in terms of its cost—the expenditure of energy—ultimately allows us to reconstruct an urban construction scenario based on my case studies.

In order to reconstruct the process of construction, we may quantify the resources, chaîne opératoire and scale of urban construction according to the cost of architecture using the approach of “architectural energetics” (Abrams 1994; Abrams & Bolland 1999). This approach involves quantifying the cost of construction of architecture into a unit of energy, namely labour-time expenditure which, for the present purposes, consists of procuring and transporting materials, manufacturing bricks and assembling the finished product (Abrams 1994, 2). Since the energy expended in construction is primarily through labour, I will express the energetic unit of cost as “person-days”. Person-days are the amount of work one might expect from an individual during a full workday calculated by the following reliably reconstructed rates of labour for specific tasks related to mud-brick and earthwork construction, and then applied to volumetric estimates of certain types of architecture. Although other researchers have suggested that the length of a workday may be between five to eight hours, depending on the physical intensity of the work (Abrams 1994, 43; Erasmus 1965), defining a precise workday is less important than approximating the product of the labour, especially in terms of bricks manufactured, transported and laid. As with the analysis of bricks and architecture in previous chapters, the approach of architectural energetics begins with the surviving archaeological material at hand, and works backward.
through the *chaîne opératoire* to address the scale, intensity and organization involved with the construction process. This analysis involves quantifying the volume of materials used in construction and then translating those volumes into their labour equivalents (Abrams 1994, 5). By building on my brick analyses above, I use the dimensions of bricks and type of mortar most frequent at Megiddo and Pella as guidelines for roughly-accurate approximations of material units for the many types of labour involved in the construction process.

The approach of architectural energetics, as well as a general emphasis on the *chaîne opératoire* that is greatly aided by the brick study (Chapters 3 and 8), makes the present research more useful than other studies attempting to quantify the construction of Bronze Age fortifications (e.g. Finkelstein 1992, 208ff; Schaub 2007). In particular, Burke (2008) discusses the construction rates and labour consumption of MB fortifications, yet greatly oversimplifies the process, relying on limited rates of labour for excavating sediment and manufacturing bricks, and not even mentioning transportation. Furthermore, drawing too strong a parallel between roughly contemporary Mesopotamian society and nascent social complexity in Canaan, Burke (2008, 143) oversimplifies and misconstrues the organization of production involved with the process of construction during MB I Canaan, suggesting that fortifications were possibly built by corvée labourers, hired labourers or an army. He particularly favours the latter option:

> It can be safely concluded that there were no fortified settlements in the southern Levant that could not have been fortified in less than about eight months by employing a workforce of just two thousand soldiers. . . . In light of the political organization suggested for the Levant during the Middle Bronze Age [i.e. defensive settlement networks], there is little doubt that these fortifications were most often, if not primarily, built using conscripted troops during typical periods of enlistment . . . as described in Old Babylonian sources (2008, 155).

As should already be clear thus far from my study, the scenario presented by Burke and its assumed degree of political organization seems incongruous with the degree of centralization and social complexity during the MB I in Canaan, which appears small-scale and heterogeneous (e.g. Bunimovitz 1992). A more representative scale for construction and socio-political organization will be discussed below and in the following chapters in light of the results of the present study.

**Rates of Labour**

The rates of labour discussed below are reconstructed based primarily on ethnographic observations and limited experimental archaeology, and only secondarily on ancient historical accounts from roughly contemporary periods in Mesopotamia and Egypt.
The categories of labour I discuss relate specifically to mud-brick and earthwork architecture: (1) excavation of sediment; (2) brick-making; (3) brick-drying; (4) transportation; and (5) mortar. Additionally, although not actually a type of labour, I include the use of temper in brick manufacture in this discussion since it represents a major constraint affecting the scale and intensity of brick construction. Due to the unavoidable simplicity of these rates of labour (pending continued experimental and ethnographic research), and ignoring less labour-consuming aspects of construction (e.g. plastering walls, roofing, stone foundations), the energetic costs derived from these rates represent minimum estimates for the overall processes, and are intended only to help conceptualize the process rather than provide a fully accurate account or reconstruction.

**Excavation of sediment**

One of the first steps in any construction process would have been acquiring sediment for manufacturing bricks and building earthworks. In the case of mud-bricks, the sediment would have come from the nearest available source in the proximity of both the site and the source of water where the bricks would be manufactured and dried. Based on the samples I analysed for the case studies, it appears that the sediment used in the bricks could have come from near the springs at each site, reducing the need to transport the sediment to the water source from elsewhere. In the case of earthworks, the majority of the sediment used would most likely have come from the excavation of a fosse at the base of the rampart (e.g. Prausnitz 1975, 208). Using material from the excavation of a fosse for much of the fill of the rampart is reminiscent of Kaplan’s (1975, 2) notion that earthen ramparts originated from the Mesopotamian system of digging canals with levee embankments on one side. These and additional materials (e.g. crushed limestone, gravels) used for internal layering and the glacis would have been transported from the best sources within close proximity to the site (e.g. Bullard 1970, 118f).

Erasmus’ (1965, 285) experimental research in Mesoamerica concluded that one man could excavate 2.6 m³ of earth in a five-hour day using wooden tools (cf. Ashbee & Cornwall 1961). Old Babylonian texts demonstrate a practice of calculating labour in person-days based on volume and units of commodities (e.g. bricks), and public labour projects, such as irrigation canals, occurring as “story problems” in mathematical texts (cf. Walters 1970, 119, 148). Mesopotamian texts provide the figure of 10 gin (3 m³) as the median quantity of earth that an individual labourer was expected to dig in one day in relation to canal excavation (Goetze 1962, 15). Since canal excavation in Mesopotamia bears a considerable similarity to the excavation of sediment in the Levant, the rate of 3m³ seems like a very reliable figure. Of course, there are further variables that would greatly affect any rate of excavation, namely the weight, density and moisture content of the
material, and the tools used to excavate it. However, until additional data are available, the rate of \(3\text{ m}^3\) may be assumed as the most reliable figure for the excavation of sediment for mud-bricks and earthworks for the purpose of this study.

**Brick-making**

Twentieth-Century observations of traditional brick-making in the Near East suggest that almost as many as 3,000 mud-bricks could be made by a single experienced brick-maker and an assistant in one day (e.g. Delougaz 1933, 6-7; Wright 1985, 352; cf. Kemp 2000, 83; Norton 1997, 42). However, such observations seem to indicate only the moulding of the bricks, and do not fully account for excavating sediment, mixing the components or turning/stacking the bricks during drying. Accounting for more of the entire process of manufacture, McHenry (1984, 67) observed that using hand tools, a crew of two can produce 300-400 bricks per day. Similarly, Van Beek and Van Beek (2008, 151) observed that among traditional mud masons in the Near East, it is widely accepted that a brick-maker can produce about 100-150 bricks per day, either working alone or as one person’s share in a team effort. Considering the smaller size of modern bricks—only about one third (or less) of those used in the Bronze Age—the figures of thousands of bricks per day considerably over-estimate brick numbers that might have been produced during the MB.

Fathy (1969, 252) provided the figure of 3,000 bricks measuring 23 x 11 x 7 cm being moulded in a working day by a four-person team; however, this figure does not reflect acquisition or mixing of materials. Based on all these scenarios, I suggest that a figure of 1,000 bricks per full-time brick-\textit{moulder} per day is a more accurate rate for making large Bronze Age bricks (cf. Burke 2008, 145-46), yet this would also require the labour support of five individuals excavating and mixing enough sediment to supply the equivalent volume of ca. 15 \textit{m}^3 admixture per day. Therefore, the most efficient energetic cost of manufacturing 1,000 bricks by a brick-making team would actually equate to six person-days, ignoring the negligible amount of labour spent on turning and moving bricks during drying (cf. Heimpel 2009, 224; Houben & Guillaud 1994, 212; Keefe 2005, 64; McHenry 1984, 67; Robson 1999, 75-76; Van Beek & Van Beek 2008, 151). Also, when referring to a “brick-maker”, in terms of the patterns observed from the case studies, one should actually think in terms of a group of individuals—a brick-making team—whose cooperative work produces the same bricks.

**Brick-drying**

An often underemphasized constraint on the rate of brick manufacture is the amount of time needed for drying. It is of utmost importance that bricks dry thoroughly in order to prevent structural weakness in walls. Different estimates suggest drying times of bricks to
be anywhere from merely a few days (McHenry 1984, 63) to weeks (Van Beek & Van Beek 2008, 153). For Bronze Age bricks, drying probably took roughly a week at an even rate during the warm dry season in the Levant, with bricks first being dried flat (as they were cast) for three days, turned over for two days and then stood on alternating ends for an additional two to three days before they could be stacked loosely for use (Nims 1950, 27; Wright 1985, 352). Taking the standard dimensions of bricks from Pella (38 x 38 x 10.5 cm) as a guide, with each brick measuring 0.14 m² in surface area (lying flat), and assuming 1,000 bricks were produced in one day, then over 200 m² of open surface (a square of 14.5 x 14.5 m) would be needed for the first five days of drying. This space allows for 15 cm between bricks to enable turning, walking and handling the moulds. However, since a series of bricks may be cast using one large mould, the spaces on some sides of the bricks could be as narrow as 1-2 cm. After these initial days, the bricks would be laid on alternating ends for a few additional days, taking up only ca. 80 m² (a square of 9 x 9 m), and eventually loosely stacked. Continuously manufacturing bricks at the rate of 1,000/day in the same area would require a fairly flat surface area of nearly 1,300 m² (a square of 36 x 36 m). If 1,000 bricks per day were produced from mid-May through mid-October (ca. 150 days), the total product would number 150,000 each year at a cost of 900 person-days. If the scale of production around a single water source were something like seven times greater (e.g. 7,000 bricks/day), then an area up to 1 ha would be required for drying. Although feasible, such a seasonal output (1,050,000 bricks) would also require 42 full-time labourers, for a total cost of 6,300 person-days.

Transportation

To some extent, every type of material used in the construction process would need to be transported at least once, even for the construction of earthworks (cf. Atkinson 1961, 295). However, since the majority of sediment used as direct material for earthworks or raw material for brick manufacture did not require significant transportation, the main objects being transported over a distance would have been dry mud-bricks. Estimating the weight of dry bricks presents a problem, since they consist of a mixture of sediment and temper. The weight of sediment varies depending on its grain-size composition, density and level of moisture, yet the dry weight of 1 m³ of the type of sediment used at the case-study sites would have been at least 1,500 kg (cf. Julien 2010, 325; Finkelstein 1992, 208; 1 ft³ of solid chalk weighing ca. 50.8 kg, Ashbee & Cornwall 1961, 131). If mud-bricks contained only sediment, the weight of each brick would then be at least 22.5 kg. However, the addition of temper not only strengthened bricks, but also lowered their bulk density, making them considerably lighter for transport. Van Beek and Van Beek (2008, 260-61) indicate the average density for bricks from Tell Jemmeh (Bronze Age through Hellenistic) is 1.16 oz/in³.
(2.01 g/cm³), suggesting that the Pella bricks would weigh 30.48 kg. However, according to Old Babylonian sources dealing with construction, the weight of “Type-5” bricks (after Powell 1982), measuring 25.0 x 25.0 x 8.3 cm, was ca. 7.5 kg (Heimpel 2009, 191; cf. Robson 1999, 62-63), which is a density of 1.44 g/cm³. Following this MB-contemporary example as a guideline, a typical (square, “short cubit”) brick from the case-study sites would weigh ca. 22 kg.

Estimating the rate of labour at which bricks could be transported relies on determining the most effective loads an individual can manage over particular distances. Based on Cottrell and Kamminga’s (1990, 194) rates for the transportation of loads, the following provides a suitable model for the rate of transport by an adult male: carrying a 60 kg load and returning unloaded for a daily distance of 11 km, an adult male may do so at a daily rate of 660 kg/km. At sites such as Megiddo and Pella, where the brick-manufacture sites were probably around the springs adjacent to the tells, the average distance that loads of bricks would have to be transported would be around 800 m, and less at Dan. According to the rate of 660 kg/km, if an individual carried three bricks at a time, ca. 66 kg, over a total of 11 km, they would be able to carry up to 13 loads in one day, or 39 bricks. In Old Babylonian mathematical texts, the nazbalum, or “carriage”, is the well-attested product of bricks that may be carried over a certain distance by an individual labourer. In the case of sun-dried bricks, the carriage is 64,800 (in metric terms) for Type-5 bricks (Heimpel 2009, 191; cf. Robson 1999, 62-63). Therefore, over a distance of 800 m, 81 such bricks—or 607.5 kg—could be carried per person-day, translating to roughly 28 of the Pella bricks. Therefore, transporting 1,000 bricks would cost 35 person-days. Although there is no direct evidence for the use of animals to transport bricks, if donkeys were used, then the rate of 9 bricks/load (ca. 200 kg) for 19 loads over a total of 15 km would equal 171 bricks per day (cf. Cottrell & Kamminga 1990, 194). Thus, the use of donkeys could potentially reduce the person-days significantly, and 1,000 bricks could be transported by six donkeys (operated by perhaps six individuals) in one day. Similarly, carts and sledges were very probably used during this period, yet data regarding the use of such devices during the period is indirect and scant. Therefore, awaiting further research in this regard, I will exclude figures for animal transportation (e.g. Littauer & Crouwel 1979), including the use of load-bearing devices, from the suggested reconstruction below, and focus solely on the most basic unit of transport, the human labourer.

**Mortar**

With regard to mortar manufacture, as noted above (Chapter 8) the sediment from which mortar was made at Megiddo and Pella was probably recycled directly from tell deposits. The purposes for using this source material are twofold. Firstly, as noted in
Chapter 8 (cf. Rosen 1986, 84), ashy occupational sediments provide useful chemical binding properties that would be ideal for mortar. Secondly, the immediate location of occupational deposits would likely have been in close proximity to the place where the mortar would be used immediately. This spatial proximity would be important since the mortar mixture needs to remain moderately moist (plastic) to be used in brick-laying, and it may have been difficult to transport fresh, moist mortar from off-site. It is likely that the individuals laying bricks in a wall continually mixed fresh mortar as they went, taking advantage of the easily accessible sediments on-site. Although this suggestion is only one possibility, I argue for its likelihood based on the energy-efficiency involved in on-site mortar manufacture rather than transporting occupational deposits to an off-site location for mortar manufacture, and then transporting heavy, moist mortar from offsite (which may dry rapidly).

As opposed to bricks, mortar manufacture could probably be done on-site because: (1) the lower volume required less water and temper, both of which would have to be transported on-site; (2) there was no need for drying space; and (3) the mortar needed to be moist rather than dry (which is the converse from bricks). Therefore, since only a small portion of the materials for the admixture needed to be transported, I suggest that the cost of manufacturing mortar was less than that of bricks, by volume. The situation at Dan appears to be quite different, since the mortars consist of the same material as the bricks, themselves, and therefore probably derive from the same manufacturing process whereby part of the moist brick admixture was transported to the site of construction for use as mortar.

Although the difference in cost between the mortar manufacture and transport at Dan and that at Megiddo and Pella is negligible, it was probably ideal for builders to be able to use fresh mortar as needed when laying bricks; perhaps this is why there was much less mortar used at Dan than the other sites.

At Megiddo and Pella the amount of mortar in walls averaged ca. 1 cm on every side of a brick (pers. observation), whereas the practice of mortaring appears much less clear or consistent at Dan. Based on the standard brick size at Pella, for every 0.0152 m³ brick in a wall, there would have been 0.0023 m³ of mortar, accounting for over 13% of the total volume of a wall (cf. Burke 2008, 146). For every 1,000 bricks (15.2 m³), 2.24 m³ of mortar would be required, which could easily be excavated and mixed in one day by one individual, with another transporting water and temper, equalling a cost of two person-days. Finally, brick-laying per 1,000 bricks was probably done by a team of two individuals, possibly with assistance from the mortar-mixer.
Temper

Another important consideration for the cost of brick (and mortar) manufacture is the vast quantity of straw or chaff required. Although, at present, it is not possible to estimate the rates of labour involved in the acquisition and handling of temper, it remains a crucial commodity for the manufacture of bricks, and therefore features in this discussion. An often-cited example of the amount of temper used in bricks comes from Oates (1990, 389-90), who provides a rough estimate that 100 bricks (of unspecified size) would require ca. 60 kg of chaff, the product of ca. 1/8 ha of barley. Based on these figures, Oates suggests that 1,000 bricks would require the by-product of around 1 ha of agricultural land, as a conservative estimate. Although this estimate provides a helpful beginning point, the amount of chaff suggested is probably excessive, whereas the estimated yield of chaff per hectare is far too low. Other figures for brick manufacture suggest that straw should account for 2.5 per cent of the weight of the mud mixture (Keefe 2005, 58) or a volumetric guideline of three parts sediment to one part straw (Politis 1999), the more the better.

Emery (2011, 2) notes that in Egypt chopped straw was added to the earth mixture in a ratio of roughly one part straw to five parts earth. Furthermore, Emery observes that straw in modern Egypt is sold by the hamla or himl, a measure of 555 pounds, which is theoretically what a donkey can haul in baskets (e.g. Fathy 1969, 198f), and in ancient Egypt, the donkey load for straw was a known measurement expressed as ‘ət. In Fathy’s construction of the village of New Gourna in Egypt, he followed traditional brick-making techniques, employing a ratio 45 lbs (20.4 kg) of straw to 1 m$^3$ nearby soil and 1/3 m$^3$ sand, which was mixed with water and left to soak and ferment for 48 hours (1969, 118, 252). Taking the middle ground between Oates and Fathy, I suggest the conservative figure of 40 kg of straw per 1 m$^3$ of sediment for the manufacture of Bronze Age bricks in the Levant. The bulk density of straw may range between 24 – 111 kg/m$^3$ (Lam et al. 2008, 356), depending on moisture and other factors, yet a typical density for chopped straw may be 70 kg/m$^3$ (Food and Agricultural Organization of the United Nations 2004, 25). Therefore, in terms of volume, the ratio of straw to sediment in the manufacture of bricks may have been close to 1:2.

The next question regards how much straw is yielded by cereal crops, indicating how much agricultural land might have been exploited for brick manufacture. In an experimental study on crop growing and irrigation in Jordan, Mithen et al. (2008) provide figures for the amount of straw yielded from common barley and durum wheat based on various percentages of optimal irrigation. The average amount of straw yielded from no irrigation was about 4 Mg ha$^{-1}$ (tons per hectare) and an 80% optimal irrigation level yielded about 8 Mg ha$^{-1}$ (2008, 17). Although no clear information exists regarding the harvest
indices (the grain yield as a percentage of the total plant weight or biomass of the crop) of cereal crops in the Bronze Age Levant, based on a number of studies on archaeological grains, Araus et al. (1999, 348) indicate that grain yield would have been around 25% of the total biomass. They suggest that grain yields in the Eastern Mediterranean, Mesopotamia and Egypt during the mid to late third millennium B.C.E. could have ranged from 1 to 4 Mg ha⁻¹ (Araus et al. 1999, 350). Assuming these figures, and implementing a harvest index of 25%, the amount of non-grain biomass—essentially straw and chaff—yielded per hectare of wheat or barley might have averaged about 7.5 Mg. This figure suggests that the entire biomass by-product of 1 ha of cereal crop could have provided temper for ca. 187.5 m³ of brick/mortar manufacture. However, this figure is clearly over-simplified, since not all of this harvest by-product would be available for brick-making as different types of straw and chaff were also needed for: weaving, thatching, animal fodder, fuel, ceramic temper, etc.

Since the numbers of bricks required for just the city walls at my case study sites could number well over one million, then the amount of straw used in the brick manufacture would have required the full by-product of roughly one square kilometre of agricultural land over the course of construction at a single site. The exploitation of this commodity demonstrates a fairly high degree of power and organization in order to coerce individuals such as subsistence farmers to relinquish straw and chaff that they could use for other purposes. From this example we can see mechanisms of centralization, even in a form as simple as a possible straw taxation, and it is also apparent how the process of construction tied directly into the system of agriculture. Furthermore, since the quantity of temper was a main constraint on the rate of mud-brick production, the more land that could be centrally controlled and managed, the faster a city could be built.

**VOLUMETRIC ESTIMATES OF ARCHITECTURE**

**City walls**

Estimating the volumes of city walls is problematic, since none in the Bronze Age Levant have been preserved to their full height, and their dimensions and features tend to vary around the site. Burke (2008, 60ff, 151) suggests an average of 10 m for the height of MB city walls, yet the brick superstructure of the walls excavated at Pella were only preserved to a height of 6 m, and the those of the gate at Dan were preserved to a height of 7 m (which appear to be their full height) (see Chapter 5). Therefore, a working estimate for the height of the brick superstructure of MB fortification walls in Canaan may be 7 m. This figure simply serves as an estimate in order to indicate the general scale of construction rather than a precise reconstruction.
Taking the upper mound of Megiddo as an example, the ca. 1.65 m wide city wall of Stratum XIII may have been ca. 1,000 m long, encompassing ca. 8 ha (contra Kempinski [1989, 57] who argued that the strata XIII – XII upper city was ca. 6.8 ha, and only enlarged to ca. 8.3 ha in Stratum XI). Therefore, the volume of the walls would have been ca. 11,550 m$^3$, which amounts to ca. 743,589 bricks (of the modal volume at Megiddo, 13,475 cm$^3$) and ca. 1,502 m$^3$ of mortar. When the width of the wall was subsequently doubled to 3 m very shortly thereafter (i.e. Stratum XII), the total volume would have been ca. 21,000 m$^3$, or ca. 1,351,980 bricks and ca. 2,730 m$^3$ of mortar. At Pella, the 8 ha mound was likewise surrounded by a ca. 1,000 m long city wall that averaged 3 m in width. Therefore, the volume of the wall would have been the same as at Megiddo strata XIII + XII (21,000 m$^3$), or ca. 1,204,986 bricks (of the standard volume at Pella, 15,162 cm$^3$) and ca. 2,730 m$^3$ of mortar. The total cost of constructing these walls would have been tens of thousands of person-days at each site (see Table 20, below). Although there is a debate regarding the existence of an MB I city wall at Dan, for the sake of this discussion we may assume there was one based on the limited evidence from areas T, Y and K. As summarized in Chapter 5, it appears there may have been a ca. 3.5 m wide fortification wall associated with the crest of the earthen ramparts surrounding the site. Since these earthworks averaged ca. 60 m in width, and the circumference of the 20 ha site (including the earthworks) was ca. 1,583 m, then a city wall situated atop the middle of the ramparts (i.e. ca. 30 m inside the outer extent of the earthworks) may have been ca. 1,400 m long. Therefore, a conjectured 3.5 m wide city wall at Dan would have had a volume of ca. 34,300 m$^3$. This wall would contain ca. 1,434,663 bricks (assuming a brick size observed at Dan, measuring 40 x 40 x 13 cm or 20,800 cm$^3$) and 4,459 m$^3$ of mortar. However, based on my observations from the gate at Dan, it is possible that less mortar was used than at Megiddo and Pella. In any case, the construction of the city wall at Dan would require well over one-hundred thousand person-days (see Table 20, below).

The size of the labour-force and the amount of straw required to build this architecture would depend on the amount of time the planned project would take and vice versa. As noted above, mud-brick construction projects in the Levant most likely took place only during the dry summer months (ca. 150 days), which is the only time when bricks could be manufactured on a large scale, due to: (1) the availability of straw from spring harvests; (2) the dry heat essential for bricks to dry thoroughly and quickly; and (3) a lull between intensive labour for harvesting cereal crops, maximizing the available workforce. The net amount of direct by-product of agricultural land required to produce enough straw for the walls at either Megiddo or Pella amounts to ca. 112 ha, and ca. 183 ha for Dan. It is probably unrealistic to assume that all of the by-product of an urban centre’s agricultural hinterland could be fully utilised for construction purposes, since straw and chaff were
required for many other purposes besides urban brick-manufacture. Therefore, two possible options exist for interpreting the size of the agricultural hinterland based on the demands for temper. On one hand, the agricultural land might have been larger than the figures above in order to be both self-sustaining and be able to provide all the temper required for urban construction. On the other hand, the demand for agricultural by-product could be minimised with construction occurring over a number of seasons. I prefer this second interpretation, since it is far more likely that large-scale construction projects occurred over multiple seasons due to a number of additional constraints, such as labour and additional raw materials. Table 20 suggests a few scenarios for the labour and resource requirements for construction according to how many seasons are spent on the project. This reconstruction only accounts for the conservatively-estimated fortification walls of my case-study sites, excluding nuanced elements such as buttresses, towers and gates. Considering other types of public and domestic architecture, not to mention the ca. 4 ha lower mound of Megiddo or Tell Husn at Pella, these conservative figures could more than triple if accounting for the entire settlement.

**Earthen ramparts**

Estimating the original volume of any type of earthwork is complicated by the fact that the height and shape of such features have been altered over time due to post-depositional factors of site formation (O’Neal *et al.* 2005; Rosen 1986). Table 18 demonstrates the volumes of earthworks at certain sites that have been estimated by previous studies (e.g. Biran 1990, 65; 1994, 71; Burke 2008, 144ff; Finkelstein 1992, 208ff; Herzog 1989, 32; Mazar 1997a, 250; Oren 1997b, 257; Zettler 1997, 170f, n. 42), some of which also include labour estimates. Yet, as Burke (2008, 147) observes, since many calculations neglect the varied character of ramparts at different points around a site, calculations often overestimate the volume based on the assumption that the largest segment of the ramparts is representative of the whole. I accept Burke’s revised estimates for these sites shown in Table 19, and provide an additional estimate for the volume of the earthen rampart at Tel Kabri of ca. 441,000 m³ based on an average width of 35 m and estimated average original height of ca. 6 m around the site (cf. Kempinski 2002b, 35-37; 1991, 8*-9*). Also, since the earthworks at Megiddo and Pella have not been systematically investigated, a very conservative estimate of their possible volumes would be ca. 12,500 m³. This figure assumes supplementary ramparts of 5 m in width and height, and of the same lengths around each site as the city walls above them. Furthermore, I only account for the upper mound of Megiddo, despite the lower mound potentially significantly comprised of early MB earthworks, and the main mound of Pella, despite evidence for earthen ramparts on Tell Husn.
Table 18. Previous estimates of the volume and labour requirement for the construction of earthen ramparts at various sites (after Burke 2008, 144, Table 20).

<table>
<thead>
<tr>
<th>Site</th>
<th>Volume (m³)</th>
<th>Number of Workers</th>
<th>Duration in Days</th>
<th>Excavation Rate (m³/person-day)</th>
<th>Person-days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dan (Biran 1990, 65; 1994, 71)</td>
<td>1,000,000</td>
<td>1,000</td>
<td>1,000</td>
<td>1</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Dan (Finkelstein 1992, 208ff)</td>
<td>1,000,000</td>
<td>2,000</td>
<td>900</td>
<td>0.56</td>
<td>1,800,000</td>
</tr>
<tr>
<td>Haror (Oren 1997b, 257)</td>
<td>150,000</td>
<td>400</td>
<td>180</td>
<td>2.08</td>
<td>72,000</td>
</tr>
<tr>
<td>Hazor (Finkelstein 1992, 208ff)</td>
<td>1,000,000</td>
<td>2,000</td>
<td>900</td>
<td>0.56</td>
<td>1,800,000</td>
</tr>
<tr>
<td>Mevorakh (Finkelstein 1992, 208ff)</td>
<td>40-45,000</td>
<td>200</td>
<td>480</td>
<td>0.47</td>
<td>96,000</td>
</tr>
<tr>
<td>Michal (Herzog 1989, 32)</td>
<td>31,500</td>
<td>200</td>
<td>120</td>
<td>1.31</td>
<td>24,000</td>
</tr>
<tr>
<td>Michal (Finkelstein 1992, 208ff)</td>
<td>31,500</td>
<td>200</td>
<td>240</td>
<td>0.69</td>
<td>48,000</td>
</tr>
<tr>
<td>Shiloh (Finkelstein 1992, 208ff)</td>
<td>40-45,000</td>
<td>600</td>
<td>469</td>
<td>-</td>
<td>281,400</td>
</tr>
<tr>
<td>Sweyhat (Zettler 1997, 170f, n. 42)</td>
<td>170,000</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Timnah (Mazar 1997a, 250)</td>
<td>140,000</td>
<td>300</td>
<td>467</td>
<td>1</td>
<td>140,000</td>
</tr>
</tbody>
</table>

Table 19. Revised estimated volumes of ramparts and costs of construction, including revised estimates from Burke (2008, 144ff), and assuming the maximum-efficiency construction rate of 3 m³/person-day.

<table>
<thead>
<tr>
<th>Site</th>
<th>Volume (m³)</th>
<th>Construction Rate (m³/Person-Day)</th>
<th>Total Person-Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dan</td>
<td>236,250</td>
<td>3</td>
<td>78,750</td>
</tr>
<tr>
<td>Haror</td>
<td>91,275</td>
<td>3</td>
<td>30,425</td>
</tr>
<tr>
<td>Hazor</td>
<td>961,670</td>
<td>3</td>
<td>320,557</td>
</tr>
<tr>
<td>Kabri</td>
<td>441,000</td>
<td>3</td>
<td>147,000</td>
</tr>
<tr>
<td>Michal</td>
<td>31,500</td>
<td>3</td>
<td>10,500</td>
</tr>
<tr>
<td>Megiddo</td>
<td>12,500</td>
<td>3</td>
<td>4,167</td>
</tr>
<tr>
<td>Pella</td>
<td>12,500</td>
<td>3</td>
<td>4,167</td>
</tr>
<tr>
<td>Shiloh</td>
<td>28,955</td>
<td>3</td>
<td>9,652</td>
</tr>
<tr>
<td>Sweyhat</td>
<td>170,000</td>
<td>3</td>
<td>56,667</td>
</tr>
<tr>
<td>Timnah</td>
<td>90,000</td>
<td>3</td>
<td>30,000</td>
</tr>
</tbody>
</table>

The number of workers and seasonal duration in Table 18 represents a portion of the presumed population at these sites. Renfrew (1984, 238) suggested that 20% is the highest portion of a population among early political entities that could be enrolled in public works for three months out of the year, yet still sustain the economy. Thus, Burke applies 20% to Broshi and Gophna’s (1986) population density coefficient of 250 persons per hectare in order to estimate the likely workforce available at a given site. The major problem with such population estimates is that they only reflect the known size of a settlement after the
construction of the urban settlement, and therefore do not necessarily correspond to the available populations in the vicinities of sites from which labour forces might have been drawn during nascent urbanization. Since there seems to be limited value in estimating populations in order to determine the duration of construction projects, my reconstruction below rather suggests possible general scenarios based on time, straw supply and labour requirements.

**COST OF CONSTRUCTING FORTIFICATIONS**

The hypothetical costs of constructing the MB I fortifications at Megiddo, Pella and Dan are shown in Table 20, based on the following rates of labour: (1) six person-days per 1,000 mud-bricks manufactured; (2) 24 person-days per 1,000 bricks transported; (3) two person-days per mortar manufactured per 1,000 bricks laid; (4) two person-days per 1,000 bricks laid; and (5) one person-day per 3 m$^3$ of earthworks built. The net amount of the direct product of agricultural land required to produce enough straw for the walls at Megiddo and Pella amounts to 1.12 km$^2$ and 1.83 km$^2$ for Dan. I base the number of seasons on the two main constraints of labour-force and straw, and suppose a 150-day dry season (see Table 21).

<table>
<thead>
<tr>
<th>Site</th>
<th>Brick Manufacture</th>
<th>Brick Transport</th>
<th>Mortar Manufacture</th>
<th>Brick-Laying</th>
<th>Earthworks</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Megiddo</td>
<td>8,112</td>
<td>32,448</td>
<td>2,704</td>
<td>2,704</td>
<td>4,167</td>
<td>49,881</td>
</tr>
<tr>
<td>Pella</td>
<td>7,230</td>
<td>28,920</td>
<td>2,410</td>
<td>2,410</td>
<td>4,167</td>
<td>45,165</td>
</tr>
<tr>
<td>Dan</td>
<td>8,608</td>
<td>34,433</td>
<td>2,869</td>
<td>2,869</td>
<td>78,750</td>
<td>127,529</td>
</tr>
</tbody>
</table>

Table 20. The cost of constructing fortifications in person-days.

From the figures in Table 20, it is clear that brick transport is the single most labour-consuming aspect of constructing fortification walls. Brick and mortar manufacture, together with brick-laying require less than half of the labour of brick transportation. In light of these figures, it appears that previous attempts to assess the labour requirements for mud-brick (or other types) of construction need serious revision to account for transporting materials (raw or manufactured). Nonetheless, the rates for transport I suggest are only preliminary, and future ethnographic and experimental research should be conducted to achieve improved data. Since the rate of brick transport is based on the brick sizes common at Megiddo and Pella, transportation of bricks at Dan may have actually been more costly since the bricks are slightly larger. Another insight from these figures is that the massive earthworks at Dan account for more than half of all the fortifications and significantly
increase the cost of construction, suggesting that this form of architecture was highly valued at the site. The conservative estimates of earthworks at Megiddo and Pella still constitute a large portion of the overall cost of construction, and certainly would be much greater if I could estimate the volume of the earthworks for the lower mound at Megiddo, as well as Tell Husn and the main mound at Pella.

<table>
<thead>
<tr>
<th>Site</th>
<th>Seasons</th>
<th>Bricks/day</th>
<th>m³/day of Earthworks</th>
<th>Full-time Labourers per Season</th>
<th>Agricultural Land Required (Net ha)</th>
<th>Conjectured Agricultural Land Utilized (Gross ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Megiddo</td>
<td>1</td>
<td>9,013</td>
<td>27.7</td>
<td>333</td>
<td>112.0</td>
<td>335</td>
</tr>
<tr>
<td>Pella</td>
<td>1</td>
<td>8,033</td>
<td>27.7</td>
<td>301</td>
<td>112.0</td>
<td>335</td>
</tr>
<tr>
<td>Dan</td>
<td>1</td>
<td>9,564</td>
<td>1,575</td>
<td>850</td>
<td>183.0</td>
<td>550</td>
</tr>
<tr>
<td>Megiddo</td>
<td>3</td>
<td>3,004</td>
<td>9.3</td>
<td>111</td>
<td>37.3</td>
<td>112</td>
</tr>
<tr>
<td>Pella</td>
<td>3</td>
<td>2,678</td>
<td>9.3</td>
<td>100</td>
<td>37.3</td>
<td>112</td>
</tr>
<tr>
<td>Dan</td>
<td>3</td>
<td>3,188</td>
<td>525</td>
<td>283</td>
<td>61.0</td>
<td>183</td>
</tr>
<tr>
<td>Megiddo</td>
<td>5</td>
<td>1,803</td>
<td>5.6</td>
<td>67</td>
<td>22.4</td>
<td>67</td>
</tr>
<tr>
<td>Pella</td>
<td>5</td>
<td>1,607</td>
<td>5.6</td>
<td>60</td>
<td>22.4</td>
<td>67</td>
</tr>
<tr>
<td>Dan</td>
<td>5</td>
<td>1,913</td>
<td>315</td>
<td>170</td>
<td>36.6</td>
<td>101</td>
</tr>
</tbody>
</table>

Table 21. Examples of construction durations based on 150-day work seasons and the above rates of labour.

Table 21 represents my attempt to quantify the amount of time the construction of fortification architecture might take for each site, assuming that the work took place during hypothetical 150-day dry seasons. Of course these figures are problematic since they assume the product of full-time labourers working in unison according to specific tasks, and therefore probably represent a model of efficiency inappropriate for the ancient world (or perhaps in any real society). In reality, some individuals may have alternated through different tasks during a workday, and there may have been gaps in supply or labour constraining certain aspects of a project. Also, as I mentioned above, data remains lacking as to whether or not, or to what degree, animals were used for transport, which could have drastically reduced the overall labour requirements. Nonetheless, the purpose of Table 21 is to indicate the overall scale of time correlated with labourers and supply of temper. It would clearly require hundreds of full-time workers and temper derived from multiple square kilometres of agricultural land in order for the fortifications of any such settlement to be constructed in one or two seasons. Such an amount of labour and resources would have to be extremely well-organized in order to be utilized effectively. Alternatively, if construction were to take place over the course of five seasons, the amount of full-time labourers and temper would be reduced to a manageable and realistic size.
It is important to bear in mind that this reconstruction only accounts for fortification architecture, because it provides the most accessible and quantifiable data at hand, and represents a significant proportion of the overall built urban environment. Other types of buildings were probably built concurrently with the fortifications, both public and private, undoubtedly increasing the scale and cost of construction, as well as the demand on the local population. Also worth considering are the many building-related activities that could be done during the opposite wet season, such as any work with stone or timber, and especially collecting fieldstones and using them to create wall foundations. Although mud-brick-making activities probably did not occur during such times (at least on a large scale, though perhaps domestically), earthwork construction may have continued to some extent. Therefore, the off-season need not exclude all aspects of construction from occurring, but it would only be possible to construct mud-brick architecture on a large scale during dry seasons that coincide with: (1) the lull in intensive cereal crop activity when labourers would be most available; (2) the readily available supplies of temper from spring harvests; and (3) appropriate seasonal climatic conditions for brick manufacture and use.

**DISCUSSION**

The scale and intensity of urbanization as apparent from the construction process was probably a major catalyst for socio-economic consolidation resulting in a centralized political economy. In terms of the visible link between urban construction and agriculture (indicated by the requirements for temper), if the reconstruction above were to be re-scaled in order to account for all the architecture within a settlement, then the area of agricultural land utilized by the case studies may have reached 4 km\(^2\) or more. Likewise, it is clear that urbanization had a substantial impact on square kilometres of rural hinterland around an urban site. Therefore, any notion of an urban-rural dichotomy seems inappropriate for understating urbanism. The urban entity could not be physically constructed, constituted or subsequently sustained without the resources (including labour) derived from the rural hinterland. Thus, even from the limited perspective of mud-brick construction, it becomes clear that the system of urbanism extended far beyond the walls of an urban settlement and was fundamentally integrated with the agricultural system—not subsequent to, but actualized by urban construction.

Major questions remain concerning the incentive for greater numbers of people in a society to provide labour or materials towards the process of urbanization. Of course, there may have been a system of redistributing surplus goods in payment for services, for which there is ample evidence in neighbouring regions. During pre-Sargonic and Ur III periods in Mesopotamia, individuals were allotted plots in return for being drafted for collective public
labour projects, and also received a specific type of barley ration in relation to their service (Maekawa 1987, 61). Labour was also a form of taxation (e.g. Eyre 1987), and it seems probable that even children were expected to remit work duties, possibly beginning around five or six, in return for food and wool allotments (Waetzoldt 1987, 134). During the Old Babylonian period contemporary with the MB, Klengel (1987, 160) notes that in regions not dominated by irrigation agriculture, collective organizations composed of rural households might hold collective debts to larger entities, as apparent from tablets at Alalakh. Public services, especially documented at Mari, consisted of temporary public labour (e.g. digging canals, repairing dikes) for various periods of time; for instance, when the king of Isin reduced the corvée labour required of the muškēnū to four days a month (Klengel 1987, 161).

Although these few examples from Mesopotamia illustrate socio-political mechanisms acquiring regular labour for public projects, evidence does not exist in the southern Levant for such a bureaucratic political or legal system to enforce regular taxation. Also, there is an astonishing lack of storage facilities among MB I settlements from which to argue for large-scale redistributive economies. Therefore it would be problematic to assume that labour service was reciprocated by structured means of specific allotments of food, for example. An alternative option would be a sort of tribal system of predominantly kinship-based service through which local Canaanite groups were capable of achieving major construction projects, as well as specialized production of different goods, by coordinating limited local manpower. As Bunimovitz observes, “according to the accepted socio-political explanation of the Execration Texts, the new cities which sprang up in Palestine during the MB I developed from tribal units” (1992, 227). In order to unify and organize labour forces from relatively disparate groups scattered around a site’s hinterland, perhaps some types of conflict-based coercion and incentive were employed. Alternatively, groups may have more or less volunteered their resources, being socially compelled by: (1) the competitive forces already acting on their greater social conscience that were already driving social complexity; and/or (2) “familial” recruitment of labourers and resources involving exchange between approximate social equals within a general system of reciprocity (Abrams 1994, 97). Populations were probably predominantly mobilized through extended familial relations—kinship and tribal—drawing from both sedentary and nomadic segments of the local demographic. Within such a community there would also have been a concomitant increase in organizational complexity that required a greater level of management, providing a means for social groups to vie for socio-political power.

Previous discussions (e.g. Burke 2008) concerning the sources and types of labour used in constructing earthen ramparts have generally assumed that the workforce was predominantly able-bodied adult males, comprising roughly 20% of the total population, and
particularl
y those having a certain amount of skill. These assumptions significantly reduce
the available demographic pool from which labourers could be drawn, greatly affecting the
duration of construction projects. However, unlike the skill requirements for somewhat
specialized processes that require the least labour (e.g. brick-making, brick-laying),
essentially anyone—men, women, or even elderly and children—could contribute towards at
least earthwork construction and transporting materials, which clearly comprise the vast
majority of cost. The necessity of supporting the labouring population during construction
processes would have required the flow of agricultural resources from an immediate
hinterland toward a nascent urban centre. Thus, the centralization of population and
resources needed to sustain the consequent urban socio-economic system may have been
facilitated by something as simple as food for labourers. Concerning support for the vast
number of labourers estimated for the construction of the Egyptian pyramids, Mendelssohn
remarks:

Its communal feeding, clothing and upkeep for three or four months each year must
have completely revolutionised the pattern of life of the whole country. In the
course of ten or twenty years of construction, a large section of the working
population came under the jurisdiction of a central administration which had now
become responsible for their livelihood and to whom they had become answerable
instead of to their tribal council and their village elders. The whole exercise
involved far too drastic a change in the life of everybody to be reversed to the
original pattern after a span of twenty years. No economy in the world, not even
that of ancient Egypt, could have survived such a switching on and off of this
immense working force (1976, 131-32).

Once the segmented sustainable economies of the IB to early MB I had adapted to support
larger populations that were not directly involved in agriculture, the system of urbanism had
already begun and the stage was set for increasing portions of society to engage in full-time,
attached specialized urban activity, which would further differentiate society. Therefore,
rather than interpreting initial urban construction as the result of “efficient bureaucracy and
competent political and economic organizations” (Finkelstein 1992, 210), I argue that the
process of construction should be interpreted as a catalyst for such subsequent socio-political
realities.

According to Abrams (1994, 92), the basic principle of the concept of social
solidarity is that in order to effectively function as a more adaptive (i.e. energetically
effective) unit, human society must create mechanisms that foster and maintain cooperative
sentiment among its members. For societies with relatively few members, such mechanisms
are largely kinship-based. However, as human societies increase in size, social
differentiation and inequality, additional mechanisms beyond those of kinship must be
created to offset the increasing entropic tendencies of the system. One such mechanism to
foster cooperation is through participation in public construction projects (e.g. McGuire & Schiffer 1983, 281). As some suggest, periods of the greatest stress on the social system, such as early stages of state formation and consolidation, should correlate with times of the greatest public architectural activity (e.g. Trigger 1990; Webster 1976). Abrams (1994, 93) makes an important distinction between functionalist and evolutionary causality for explaining large architectural projects. In the former case, social solidarity or political legitimization is assumed to be the motivation for large architectural projects. However, rather than an *ex post facto* argument for construction, a perspective of selection suggests an underlying evolutionary causality based on individual perceptions of maintaining or enhancing quality of life. Commoners may perceive many ways of benefitting through participation in construction activities, whereas members of elite classes may perceive benefit through the solidification of power positions. As an alternative explanation to the mono-causal distribution of resources, Abrams (1994, 93f) considers the social, economic and political consequences of construction as they influence the overall effectiveness of harnessing energy relative to alternatives. Therefore, it is possible to view the construction process as a way of both generating and legitimizing power specifically through the production of architecture, through which emerging institutions or elites may gain socio-political and economic leverage in terms of labour rather than land (Abrams 1994, 94; Price 1984, 226ff; Trigger 1990). If competing social entities are measured by ability, then the successful completion of an architectural project may serve as a material endorsement of organizational skills (Abrams & Bolland 1999, 268). In the context of large-scale urban construction of the MB I, many different groups may have used the consumption of labour and intensified modes of architectural production to compete for power in the emerging complex political economy.

In the following chapter, this discussion will continue by investigating developing social complexity through technological innovations among different types of MB material culture and interpreting modes and organization of production through degrees of standardization.
10. Technology and Standardization

In the previous chapters I have interpreted important patterns in the archaeological record regarding the manufacture of bricks and construction of architecture. By doing so, I have addressed many of the issues relating to how MB urban settlements were built by quantifying construction and indicating general aspects of labour organization, production and economy regarding this process. In order to tie these observations into the greater process of urbanization, in terms of understanding the development of social complexity, this chapter investigates socio-cultural activity from the perspective of technological innovation and standardization.

The MB period was a time of unprecedented technological innovation across most, if not all, aspects of material culture, and should be evaluated in terms of the social mechanisms driving and facilitating such innovation. In addition to architecture, in this chapter I will address a number of aspects of material culture during the MB in order to conceptualize how technological innovation and specialized production relate to developing social complexity leading to and comprising urbanization. By tracing the technological innovations especially related to ceramic and metallurgical production from the Chalcolithic period through the MB, this chapter relates a number of key sources of archaeological evidence in order to assess the development of complex society. Architecture and the process of urban construction do not stand alone in the overall process of urbanization, and should be critically assessed alongside other classes of archaeological evidence.

Patterns of innovation, especially as perceived through production, may help indicate some of the processes behind the developing social complexity unique to the MB period that may apply to our architectural approach towards urbanization. Standardization provides a perspective from which we may assess modes of production on various scales in MB culture and illuminate organizational principles in urbanization and MB society. Key to this discussion is the body of social theory concerning craft specialization, organization of production and standardization (e.g. Arnold 1991; Blackman et al. 1993; Clark 1995; Clark & Perry 1990; Costin 1991; Costin & Hagstrum 1995; Dobres & Hoffman 1994; Eerkens & Bettinger 2001; Janusek 1999; Kamp 1993; Lewis 1996; Longacre 1999; Peregrin 1991; Polanyi 1957; S. Rosen 1997; Roux 2003a; 2003b; Stein 1998; Tite 1999). Most literature discussing these issues, especially standardization, deals with ceramic assemblages since they provide an abundant source of cultural material for direct comparison and ample data.
for statistical analysis. Although little work has been done to assess degrees of standardization or the organization of production regarding architecture, the potential for doing so will be discussed below based on the patterns in the construction process I have thus far illuminated.

The general understanding of craft specialization centres around differential participation in economic activities by which there are fewer producers than consumers within a particular society (e.g. Costin 1991). Specialization also implies an investment of labour and capital towards production such that an individual produces more of that commodity and less of others than they consume (Blackman et al. 1993, 60). Thus, stress is often placed on individuals producing commodities over subsistence, which presumes the existence of an economic system to support such specialized endeavours (Golden 2010, 99). Key concepts behind craft specialization and the organization of production have to do with the context of production, in which Costin (1991) distinguishes between independent and attached specialization. Independent specialization is a system of production characterized by specialists working primarily for their personal interests in meeting a modest local demand. S. Rosen (1997, 84) observes that specialization need not occur only with elite control or incentive, nor full-time occupation, and it may be opportunistic without being intensive, as may be the case in an independent context. Attached specialization is a mode of production characterized by a form of social institution either controlling or heavily influencing production and labour, while also facilitating the demand that drives the industry. Thus, independent specialization develops in response to utilitarian and economic needs, and attached specialization suggests some socio-political process at work (cf. Brumfiel & Earle 1987). According to Costin (1991, 41), attached production involves specialists creating elaborate, labour-intensive products, implying a correlation between skill and the intensity of specialization. Furthermore, the presence of standardized products indicates that finished goods are the product of a single production unit, or limited number of units (Rice 1981; Costin 1991). Another important parameter of specialization is the constitution of the production unit, which describes the group size and social relations of those individuals who regularly cooperate to produce a recognized corpus of goods (Costin & Hagstrum 1995, 620). At one extreme is household production, in which crafts are manufactured within a domestic setting by a single family member or a small group of related individuals who reside together. At the opposite extreme is the factory or workshop, in which a large facility is comprised of unrelated individuals who are recruited voluntarily or involuntarily. These fundamental concepts will be elaborated below within the context of specialized production dealing with technological innovations in the MB. In the following discussion, it will become clear how brick production, monumental architecture and urban
planning should be critically evaluated in terms of standardization since they may contribute significantly to our understanding of socio-economic processes.

**TECHNOLOGICAL INNOVATION IN DEVELOPING COMPLEX SOCIETY**

**The concept of technological innovation**

Technology is essentially the capability derived from the practical application of knowledge particularly regarding tools, techniques, systems and/or methods of organization. Innovation involves the occurrence of technology within human society, and in the present discussion technological innovation will be approached from a predominantly evolutionary perspective in order to interpret socio-cultural changes over time, especially as they relate to building the concept of an urban society. To take this further, it is important to first distinguish between the concepts of *invention* and *innovation*, which are related and often confused with one another. Fagerberg (2005) regards invention as the first appearance of an idea related to a new product or process, and innovation as the first attempt to put the former into practice. Rather than being a unique occurrence, innovation may be seen as a continuing accumulation of changes (O’Brien & Shennan 2010, 3). In his study of technical change, Elster (1986, 93) views invention as the generation of a new idea and innovation as “new technical knowledge”, with diffusion often involving innovation as modifications to a product or process made in response to a new context (O’Brien & Shennan 2010, 4). Roux (2010, 217) observes that the emergence and fixation of new technological features implies two levels of analysis, the individual and collective, whereby invention occurs on the scale of the individual (a cognitive activity) and innovation is the adoption of an invention on a collective scale (an historical event). Furthermore, Roux (2010, 225) argues that the phenomenon of innovation results from a dynamic process emerging from complex interactions among its constitutive components: (1) the technical task, defined in terms of *chaînes opératoires* (e.g. Lemonnier 1993; Sellet 1993); (2) the environment, which provides the materials used in the technical task; and (3) the subject carrying out the technical task whose intentions are rooted in a group’s socio-cultural representations.

Technological innovation provides a fundamental medium through which social relationships, power structures, worldviews, and social production and reproduction are expressed and defined. Thus, Dobres and Hoffman (1994, 214-15) advocate practice theory to approach a social theory of technology (e.g. Bourdieu 1977; 1984; Giddens 1979; 1984; Ortner 1984), highlighting the social agency in technological activities based on two premises: (1) technology is the meaningful engagement of social actors with their material conditions of existence; and (2) technology not only comprises the tangible techniques of object-making, but also makes fundamental metaphors of daily social interaction tangible.
To summarize, invention is a single instance of the conception of an idea, process or object that was otherwise non-existent within a particular context. Innovation is the reception of an invention, whether old or new, within society by putting it into practice, marking a socio-cultural change toward something new (or different). From a technological standpoint in craft production, the knowledge of a number of invented technologies may exist, having been passed down by tradition through generations; however, a technology may only become widely accepted and practiced when the conditions are present in society such that there exist the capability and demand to produce it. Technological innovation may be seen in the process of technology being transferred from one group to another, in which the latter adopts the technology because it fills the demand and capacity of that particular society. Innovation is then actualizing the potential of such technology within a socio-economic system capable of doing so and able to provide enough demand to warrant production. Finally, it is important to acknowledge that innovations may not necessarily be actualized for their techno-economic advantages but also for symbolic and/or social reasons, and perhaps predominantly the latter. These concepts will be further elaborated in the following discussion regarding specific innovations in Canaanite society.

The Chalcolithic period as a starting point

Although my research focuses on the early MB, in order to understand key socio-cultural transformations in the MB, it is helpful to observe antecedent developments and trajectories through time. Furthermore, much of the literature regarding craft specialization in the Chalcolithic period applies social theory that is useful for the present discussion. Innovations in craft specialization are some of the hallmarks of the Chalcolithic period in Canaan, and have been observed in specialized production of ivory, copper metallurgy, ceramic and stone carving (Levy 1995, 232). During this period, craft specialization developed to a higher degree than at any previous time, and was accompanied by a significant increase in long- and short-distance trade of objects, including: vessels carved out of basalt, cast copper, tabular scrapers, pottery, obsidian, sickle blades and ivory objects. The raw materials used to craft these objects came from regions throughout the Levant, eastern Turkey and Egypt (Levy 1995, 244). The organization of production behind this craft specialization, and Chalcolithic society in general, has been interpreted from part-time and egalitarian (Gilead 1988, 422-23) to more ranked social hierarchies (Levy 1986, 1995; cf. Gopher & Tsuk 1996; Gal et al. 1996). Nonetheless, as Rowan and Golden (2009, 66) observe, there remains little evidence for egalitarian formulations, due to the presence of craft specializations relying upon non-local resources, technologically sophisticated metallurgy and wealthy cave tombs. Nor is there substantial evidence for the traditional elements constituting a “chiefdom” society (e.g. Levy & Holl 1988), such as architectural
differentiation or overt displays of authority (Bourke 2001, 151; Joffe 2003, 53). At the very least, the Chalcolithic seems to demonstrate what Perles (2001, 305) has called “heterarchical organization”, referring to a social order based on a differentiation of social and economic roles or certain social distinctions based on economic tasks and connection with the cult, but not involving ranking or a permanent hierarchical structure. Accepting that the evidence for socio-economic complexity is incontrovertible, Golden (2010, 181-82) tentatively accepts some utility in describing Chalcolithic as a chiefdom society, though fully aware of the inherent problems with the term “chiefdom”, which was initially used to refer to a specific form of society observed in the South Pacific. Rather, in a general sense, as Arnold (1996, 2) suggests the term “chiefdom” remains useful to broadly characterize societies intermediate in overall complexity/integration between egalitarian and state-level organization. Likewise, Johnson and Earle (1987) propose that chiefdom-level societies are often characterized by small regional cultural areas with population centres integrating multiple communities through social, economic, and religious activities.

A helpful body of literature has been devoted to the innovation and evolutionary dynamic processes of change during the Chalcolithic period, demonstrating strikingly similar features to some of the processes during the early MB. In particular, the technological innovations involved with ceramics and metallurgy during both the late Chalcolithic period and the early MB will be discussed below in terms of their technical phenomena and implications for the greater socio-cultural developments with which they should be seen as integrated.

Ceramics

The technological innovation of the wheel-shaping technique

Being abundant within the archaeological record, ceramics have featured greatly in most discussions regarding socio-cultural change. Morphological changes in ceramic assemblages often provide good data for relative chronological dating, and detectable changes in manufacture technologies may indicate modes of production. By tracing the technological innovation of ceramics in the southern Levant, it is possible to assess important changes in modes of production that relate to social complexity. In order to understand ceramic technology in the southern Levant, the most important innovations should be approached diachronically, beginning with rise of wheel-fashioning technology in the Chalcolithic period. The wheel-coiling technique emerged during the first half of the fourth millennium B.C.E. for the manufacture of ceremonial vessels, known as “V-shaped” bowls (Roux 2003a). This technique utilizes the wheel’s rotary kinetic energy (RKE), which corresponds to a highly constrained technical system (whose component properties are characterized by strong constraints) requiring the mastery of perceptual-motor skills learned
over a long period and discontinuous with skills previously developed for fabricating ceramics (Roux 2003a, 15; Roux & Corbetta, 1989). As Roux (2003a, 16) notes, the emergence of the wheel-coiling technique appears concomitant with important structural changes in Chalcolithic society, such as the development of large villages, long-distance exchange networks, evidence of territoriarity, specialized burial areas and ritual places. These major changes in Chalcolithic society indicate a trajectory towards an incipient urban concept, despite the fact that urbanism did not truly come to fruition in the Chalcolithic period.

The dynamic conditions of the innovation of the wheel-coiling technique in the late Chalcolithic should be sought in the context of production. As Roux (2003a, 24; 2010, 225) observes, the innovation of wheel-coiling has been interpreted as emerging from a complex interaction among many factors, including: (1) a technical invention made on an individual scale; (2) the existence of specialized potters attached to an elite; and (3) a demand on a collective level for objects of ceremonial value (initiated by politico-religious changes marked by the emergence of chiefdoms). Thus, the innovation of wheel-coiling appears embedded in an elite-initiated demand during a time of developing socio-political structure. In order to explain the specific innovation of the wheel-coiling technique using RKE, Roux (2003a, 15ff) follows a dynamic systems approach and observes that basic wheel technology existed as a continuous trajectory of technical evolution dating to the sixth millennium B.C.E., from which the innovation of RKE as a shaping technique represents a discontinuous jump in evolution. This approach favours Creswell’s (1996) hypothesis that continuous transformations in techniques may be more or less autonomous as part of evolution (i.e. fairly linear developments of the basic wheel-manufacture technique), whereas discontinuous changes (i.e. wheel-coiling using RKE) follow changes in society. From this perspective, innovation does not occur for a techno-economic advantage but for symbolic and/or social reasons (Roux 2010, 226). Although RKE represents a technical innovation in ceramic manufacture, wheel-coiling does not necessarily correspond to efficient production, rather the technique probably required more labour-investment than others (Rowan & Golden 2009, 37). Thus, the innovation of this particular technique probably demonstrates the active consumption of specialized and controlled labour. Accordingly, wheel-coiling technology in the late Chalcolithic originated in the dynamic interaction of the invention and the demand for ritual objects, and it was actualized in a context defined by two main parameters: (1) the existence of specialized craftspeople attached to an elite, and (2) the demand for newly invented vessels by a limited elite taking place during a time of significant socio-political change (Roux 2003a, 25).

When the Chalcolithic cultures collapsed in the fourth millennium B.C.E., the ceramic material culture became characterized by regionalism and the appearance of new
techno-stylistic traits (Roux 2010, 227; Miroschedji 1989). Although the wheel was still used in ceramic production, the technique of wheel-coiling was not present in EB I (RKE was only used for finishing operations), and is only represented by a very small proportion of ceramic objects during EB II-III, suggesting that very few craftsmen employed the technical ability (cf. Roux & Miroschedji 2009). Again disappearing completely during the EB IV/IB, the wheel-forming technology reappeared during the early MB and became the predominant technique of manufacture during the period. Considering the context of production, through the fourth and third millennia the wheel-coiling technique appears to have persisted among a small number of specialized craftsmen and was not subject to transfer by them or borrowing by others, as was probably the case with the lost-wax technique for metallurgy, as well (see below). The innovation of wheel-coiling was connected to the elite’s politico-religious needs during the early fourth millennium B.C.E., and its disappearance coinciding with the end of the Chalcolithic social structure is therefore to be expected (Roux 2010, 229).

Thus, during the intervening centuries between the end of the Chalcolithic and the MB, most ceramic production did not benefit from wheel-coiling technology. This lack of innovation resulted from a technological system Roux (2010, 227-30) characterizes as “fragile and closed”, under the control of a few individuals aimed at making a restricted range of objects, and therefore explaining why wheel-coiling disappeared twice and was so slow to develop. In order for such a closed system to develop into an open system, innovative technical practices would have to be applied to a wide range of objects used by the majority. An open system became realized during the MB I when ceramic production began implementing the fast wheel, or wheel-throwing technique, on a widespread basis. The wheel-throwing technique represents another discontinuous innovation from the wheel-coiling trajectory, and was used to make an increasingly predominant array of vessels and overall majority of ceramic production through the MB. Subsequently, the broad disappearance of the fast-wheel technique in the LB, and general reversion back to wheel-coiling (Magrill & Middleton 2001), implies a shift in production that probably coincided with socio-political reorganization that may be related to the political boundaries created by the assumed city-states of the period, in turn altering the modes of ceramic production and creating a more controlled economy.

Just as the innovation of the wheel-coiling technique had occurred alongside changes in the structure of Chalcolithic society, similar socio-cultural conditions existed during the early MB giving way to the discontinuous innovation of wheel-throwing from the former wheel-coiling technique. However, rather than this technology being greatly constrained by the elite for the production of one particular class of vessel for regulated ceremonial consumption in the late Chalcolithic, the open system of the MB allowed
widespread technological innovation, probably due to a developing market economy. Over the course of the MB, workshops implemented the wheel-throwing technique to produce an increasing majority of vessels, much to the detriment of domestic production (except for certain cooking pots [Maeir & Yellin 2007]), ultimately resulting in a high level of standardization among MB ceramics (Besana et al. 2008, 135-36; Franken 1991, 76).

**MB ceramic production**

At the turn of the second millennium B.C.E. in the northern Levant, the ceramic horizon demonstrates changes in pottery technology, such as those noted at Ebla by Nigro (2002, 301): (1) the systematic use of the fast wheel; (2) specialization of wares according to their functions (in terms of clays, tempers and treatments); (3) changes in clay preparation and sieving (e.g. mineral sand tempers rather than straw); (4) general decrease of the firing temperature (possibly related to structural changes of pottery kilns); (5) frequent use of a wooden tools for smoothing and regularizing the vessels surface; (6) combed bands as decorative motifs in crucial turns of shape; and (7) coating of vessel surfaces with slips, usually made of the same clay as fabrics and applied before firing. In particular, the appearance of new wares becomes a typical phenomenon of the MB and demonstrates the specialized complexity and standardization of ceramic production during this period. Besana et al. (2008, 135-36) observe similar patterns within the same ceramic horizon at Qatna, noting: (1) an overall simplification and reduction in the variety of profiles; (2) changes in ware; (3) a self-slip surface treatment; (4) a lower firing temperature; (5) and everything made using the fast wheel. The MB I corpus demonstrates a limited range of forms which, together with a low product quality and the presence of numerous firing discards, which Besana et al. interpret as clear evidence of the intent to increase productivity by means of faster manufacturing procedures.

The technological innovations of ceramic production (and architecture) in the northern Levant began to appear slightly later in the southern Levant, where we may go into more detail. Particular aspects of pottery forms and decorations during the MB I – II across Canaanite culture need not be detailed here since they have been dealt with extensively elsewhere (e.g. Amiran 1969, 90-123; Beck 2000; Cohen 2002; Gerstenblith 1983; Maeir 1997; Yadin 2009). The proliferation of high-quality production techniques during this phase indicates a key change in the modes of pottery production and distribution from the early MB I and IB (Maeir 2010, 66), which arguably accompanies major developments in the political economies and overall dynamic systems of interaction in the region. These production techniques continued through the MB II, during which time the fast wheel remained the predominant tool, and standardization was very high. As Franken (1991, 75) notes, the throwing speeds made possible by the fast-wheel technology increased the
production potential; however, it would not be economical to use this method if there were not a large market for its products. The economy of production would require a quick turnover, and once such a market exists, small workshops might be pushed out of business. Concomitant with this process, forms become increasingly standardized and there is less chance that such pottery will be decorated, which would take extra time. The lack of detailed decoration and increasingly widespread use of slips and burnishes may be indicative of such an economic attitude towards production in the MB (Franken 1991, 76-77). In addition to economic considerations, if decoration is considered an expression of group identity (e.g. Eckert 2008; Hegmon 2000; Sassaman & Rudolphi 2001), then the lack of decoration among the pottery during this period might suggest that a number of ethnic groups could use it (Rosen, pers. comm.). The interaction of multiple discrete social/ethnic entities early in the MB would certainly have an impact on the processes of urbanization, especially the mobilization and organization of a labour-force.

Based on archaeometric studies of MB ceramics using Instrumental Neutron Activation Analysis, Maeir (1997; 2010, 96ff; Maeir & Yellin 2007) illuminates important patterns relating to the production and distribution of pottery in the Central Jordan Valley. Although the results of this analysis are fairly ambiguous, some observations may be made. Despite deriving from different sites, MB I samples seem to cluster fairly closely when plotted (using Principal Component Analysis), with a few distinct and regionally-oriented groups (Maeir 2010, 105). This pattern differs from the limited IB evidence for independent production (separate clusters by site), and points toward a more specialized MB system in which pottery become predominantly produced by sub-regional production centres that distributed their products to surrounding sites. These MB I clusters differ from the later MB II, during which it appears there were many production sites using similar raw materials and distributing their products through abundant inter-site trade. The formal and technical characteristics among ceramics in different regions suggest very close, on-going connections between sites during the MB, since there are intra- as well as interregional similarities. In addition to “plain wares”, Maeir (2010, 106-8, 111) observes that certain special pottery groups (e.g. local Tell el-Yehudiye Wares; Red, White and Blue Ware; Chocolate-on-White Ware) seem to derive from specialized production centres in adjacent sub-regions. The typological and compositional distinctions between the special pottery groups and the plain wares may indicate that they were produced at different locations, as well as distributed according to different trade systems for distinct classes of pottery (cf. Fry 1980; Rands & Bishop 1980, 43).

Although regional variations exist during the MB I, most ceramics are very similar throughout the entire Levant. According to Maeir (2010, 109), this widespread standardization of pottery over the course of the MB in the southern Levant suggests
“professional” settings for production. However, as he also points out, there appear to have been multiple modes of production, including the household level in addition to large-scale specialized industry (especially with regard to hand-made cooking pots). The fact that such changes in the modes of pottery production seem to occur along the same horizon as the early phases of urban settlement activity in Canaan should come as little surprise since a system of urbanism facilitates attached craft specialization and creates an outlet (i.e. exchange networks and markets) for product consumption. Together with specialized modes of production, the significant developments in ceramic technology during the MB I as compared to previous periods (e.g Maritan et al. 2005; Ben-Shlomo et al. 2009; Uziel et al. 2009), particularly the widespread use of the fast-wheel (Besana et al. 2008, 137; Franken 1991, 75-77; 2005, 194; Nigro 2002, 301), help reinforce the emergence of workshop-scale industries (Franken & London 1995; Morandi Bonacossi 2008, 111; Wood 1990).

The wide dissemination of similar styles and production techniques by the MB I/II transition probably relates to both the active exchange relations that existed between various regions, as well as technological innovations at pottery production centres. As Maeir (2010, 109) suggests, periods of high levels of technological development and extensive trade frameworks witness greater standardization than less economically-active periods: “this picture is fully supported by the compositional analysis indicating a much wider diffusion of the different types over the entire region in the MB II–III, less so in the MB I, and even less during the [IB].” The implication of this widely dispersed and interactive system of production and distribution of goods indicates that presumed political powers and boundaries did not control or restrain it. Rather, the apparent lack of antagonistic political boundaries (Maeir 2010, 111) indicates that economic factors of production and distribution played significant roles in MB technological innovation and forming the Canaanite culture of the second millennium B.C.E.

Metallurgy

Background to metallurgy in the southern Levant

The presence of metallurgy is generally considered to be evidence for the existence of a complex society that is able to support and maintain craft specialists with the skills and knowledge required to undertake the many steps involved in acquiring and working the raw materials and producing highly-valued elite goods (Genz 2000, 55). The production of metal objects requires an extensive support network for the acquisition of ores and timber for charcoal. For these organizational reasons, Philip argues that much metal production was probably in the hands of institutions, temples, palaces, or local rulers, who could then control the distribution of the products:
In this way metal production formed part of the political process, a means of dominance and control. Unlike other luxury materials, metal can be recycled, hence a degree of control was probably exercised over the circulation of scrap. The sheer scale and complexity of metal production, and the way in which it integrates many different aspects of the political and economic spheres, suggests that the metal industry played an important role in the development of complex societies (Philip 1991a, 100).

Although the beginnings of metal working in the Levant may be traced to earlier periods, it was in the late Chalcolithic period that major technological innovations occurred, as demonstrated by: (1) “utilitarian” goods predominantly made of “pure” copper (e.g. axes and chisels); (2) complex metal castings (e.g. maceheads and standards); and (3) metallurgical remains in the archaeological record (e.g. slag and crucibles) providing evidence for local production (Golden 2010, 78, cf. Shugar & Gohm 2011, 144). As with innovations in ceramic technology during this period, technological developments in metallurgy demonstrate highly technical skills and organized mechanisms of production. In particular, the invention and/or innovation of the use of complex metals (i.e. co-smelting technology) is remarkable during this period in terms of the amount of the material and its variety discovered in the archaeological record (Golden 2010, 5). In addition to copper, gold metallurgy is also apparent in the region during this period, providing evidence for the technological advance of acquiring the high temperatures required to melt gold, and the existence of long-distance exchange in order to acquire raw materials (Levy 1995, 234).

The chaîn opératoire of metallurgy involves the organization of complex processes ranging from mining ores to casting objects. Roberts et al. (2009, 1017-18) emphasize certain universal features of early metal production across Eurasia, including: (1) the use of specialized ceramic fabrics for crucibles, moulds, and furnaces; (2) the ability to source and prepare the correct raw materials; (3) the importance of a good supply of fuel such as charcoal; (4) some way to conduct and control air flow such as blowpipes or openings pointed towards prevailing winds; and (5) the surprisingly low reducing conditions and temperatures needed to transform ore into metal (cf. Bourgarit 2007). The complexity of practicing metallurgy necessitates a support system that extends beyond the specialized craftsmen. As Roberts et al. (2009, 1018) note, even the existence of a part-time smith would still require the commitment and support of the a community to aid in the metalworking process, including: (1) ore extraction and processing, (2) fuel collection and preparation, (3) providing sustenance for specialists, and (4) aiding in the trade and consumption of metal objects. Thus, the innovation of metallurgy of the scale apparent in the late Chalcolithic period demonstrates far-reaching implications for the potential organizational structure of the society.
In terms of metal production, an important distinction should be made between “pure” copper and complex metals, since the latter represents a separate innovation in metallurgical technology by which copper is alloyed with other materials. The purposes of alloying copper are essentially: (1) to harden the metal (by deoxidization), making it easier to work without fracture; (2) the colour may alter to a silvery hue (with arsenic); (3) it decreases the melting temperature of the metal; and (4) improves casting (Shugar & Gohm 2011, 135). The extent to which such alloying was intentional or not, meaning whether complex metals were mixed from distinct materials or directly derived from so-called “natural alloys” (ores with high content of other metals, e.g. arsenic, antimony), remains somewhat unclear. Yet, based on the especially high quantity of complex metal objects found in parts of the southern Levant during the late Chalcolithic period onward, it would seem that if ores containing natural alloys were being utilized, it was probably by choice. However, there are no known sources of ores containing significant amounts of arsenic and/or antimony in the southern Levant, whereas there are plenty of local “pure” copper ores, necessitating long-distance importation of these metals. Copper with arsenic is known from Anatolia, Armenia, the Transcaucasus and Azerbaijan (Hauptmann 2007), with possible sources of copper with arsenic and antimony in Syria (Golden 2009, 291; Shalev 1996, 161). Shalev and Northover (1987) argue that the ores used to manufacture “pure” copper objects at Shiqmim derived from Wadi Feinan, which is located over 100 km away. Levy and Shalev (1989) suggest that Feinan ores were collected by a restricted group of metalworkers who went to the mines and brought select ores and fuel back to the settlement.

Aside from the various potential origins of constituent raw materials, metal objects appear to have been manufactured locally, especially among sites located in the Beersheva valley, such as Abu Matar, Bir es-Safadi and Shiqmim (Rowan & Golden 2009; Shalev et al. 1992). As Thornton (2009, 304) observes, the smelting was done in small crucibles at low temperatures and under low reducing conditions, producing small amounts of highly viscous slag containing high levels of copper (cf. Hauptmann et al. 1993, 568). This slag could then be entrapped either in metallic form (as prills) or in oxide form, requiring a second stage of smelting to produce metal (cf. Shugar 2003). Regarding the casting of copper objects, Shalev and Northover (1987) demonstrate the existence of two major technologies: (1) casting pure copper into an open mould, annealing and hammering in order to produce a final shape and hardness of objects; and (2) the “lost wax” method that involves the use of arsenical copper whose casting properties, hardness and final appearance are superior to pure copper. The later technique flourished during the late Chalcolithic, during which time many elaborate castings were produced, such as those discovered at Nahal Mishmar. Such techniques, particularly those involving alloying, demonstrate a sophisticated knowledge of metallurgy. Golden (2009, 291) observes that the remains from Shiqmim and Abu Matar
related to “pure” copper-working display a pattern that may be expected for an independent industry: “Although the village metalsmiths may have been producing primarily for a limited sector of society (i.e. the wealthy and elite), there is little to indicate that the elite had direct control over production.” As either a concurrent development, or possibly a secondary development (Golden 2010, 158f), the complex metal castings suggest the existence of attached workshops that were deliberately controlled and kept secret, as seems to be the case with similar production of the technologically advanced ceramics during the period. Whether workshops were attached and/or independent, given the similarities in the metallurgical techniques and debris examined at multiple sites, it seems likely that technical knowledge was shared throughout the southern Levant, though possibly only among a certain class of individuals (e.g. the priestly elite) (Levy and Shalev 1989, 365; Golden et al. 2001, 960; Thornton 2009, 304). As the production of metal became increasingly facilitated by society, specialists would gain technical knowledge through familiarity with the various properties of the material, and they could pool information, skill, and resources via integrated production systems (Golden 2010, 164): “It would be at this stage that progress would begin to accelerate as new technological solutions developed, whether by deliberate experimentation or by astute observation of accidents.”

By the end of the Chalcolithic period, the metal industry underwent significant changes, witnessing the virtual disappearance of elaborate castings made with complex metal alloys. By the beginning of the EB, the manufacture of elaborate forms ceased, and although evidence exists for continued metal production (e.g. Arad, Feinan, Nahal Tillah, Timna), the great florescence of Chalcolithic copper production was on the wane as craftsmanship and creativity declined (Golden 2009, 296). In the EB I, settlements appeared along the coastal lowlands where smelting of predominantly “pure” copper was carried out as well as at the ore sources of Timna and Feinan (Levy 1995; Genz and Hauptmann 2002; Levy et al. 2002). As Thornton (2009, 304) observes, the smelting technology did not change much from the Chalcolithic to the EB I, as demonstrated by the heterogeneous slags. Only in the subsequent EB II–III was there a significant change in the metallurgical tradition of the southern Levant, whereby metal production became relatively large-scale and centralized (Adams 1999; Levy 1995), taking place outside of habitation areas (Genz & Hauptmann 2002, 150) and settlements began importing metal ingots rather than ores (Golden et al. 2001, 961). Technologically speaking, Thornton (2009, 304) describes a shift from crucible-based smelting to furnace-based smelting and from iron-rich “tile ores” to manganese-rich ores (Craddock 2001; Hauptmann et al. 1992, 7). The wide use of draft-induction aids, such as tuyères and bellows, as well as “intentional” fluxes, led to improved separation between slag and metal, as demonstrated by the presence of tap slags, plate slags, and primary ingots by the late third millennium B.C.E. (Thornton 2009, 305; cf. Craddock
According to Thornton (2009, 305), these technological innovations in smelting allowed for large-scale production of metal from complex, sulfidic ores, as well as the production of “true” alloys, such as tin-bronze. By the end of the third millennium B.C.E., despite the widespread collapse of urbanism toward the end of the EB III, metallurgical technology had developed along a linear progression from the Chalcolithic period, eventually realizing the capacity to produce tin-bronze. However, despite linear technological developments in metallurgy over the course of the third millennium B.C.E., the production of complex metals, especially tin-bronze, had not yet become a major widespread innovation.

**MB metallurgy**

After a long history of mainly copper and arsenical copper metallurgy in the southern Levant, the MB constitutes a period of complex metal alloying (Shalev 2009, 69). The manifestation of tin-bronze and other complex alloying practices by the start of the second millennium B.C.E. in the southern Levant allowed for a leap in metallurgical innovation during—and probably deeply-integrated with—the developing social complexity of nascent MB society. In comparison to pure copper, the presence of arsenic, antimony and especially tin within alloys: (1) slightly lowers the melting point; (2) improves the quality of the cast; (3) increases the hardness of the metal through cold-working; (4) improves the ability to be hot-worked repeatedly; and (5) alters the colour (Roberts et al. 2009, 1017-18). Despite such clear benefits, the role of tin-bronze in early metallurgy appears to have been limited until its widespread appearance throughout Eurasia in the second millennium B.C.E. Clearly, the major constraint for this complex alloying in the southern Levant was obtaining tin from sources far removed from the region, as the majority of tin ore sources throughout Eurasia are concentrated in a narrow geological belt stretching from Europe to Southeast Asia (Roberts et al. 2009, 1017). Of great interest is the fact that the most marked EB to MB increase in the use of tin-bronze appears in Egypt, Canaan and Crete, all of which have virtually no supplies of tin during the EB, but increasing by several hundred per cent in the MB. However, there appears to be no change in alloying patterns between the EB and MB in Mesopotamia and north-west Iran, through which and from which tin was presumably exchanged. Based on this pattern, Eaton and McKerrall (1976, 181) suggest a Mediterranean-based western supply of tin during the MB period (contra Philip 1991a, 94), which would seem to agree with the overall evidence of Mediterranean interaction from the MB I onward in much of Canaan (especially the distribution of settlements oriented according to coastal interaction). However, Philip (2006, 231; 1995) notes that despite a similar repertoire of styles, the preference for producing particular weapon-types in unalloyed copper as a local practice in Tell el-Dab’a, suggesting the possibility that tin may
not have been as abundant in the Egyptian Delta as in the southern Levant. Whether or not the acquisition of tin may have been one of several causative factors of the initiation of intensive long-distance trade throughout the Levant at the start of the second millennium B.C.E., the major increase in tin-bronze during the period suggests that there were a number of complex social factors contributing towards intensified international exchange, which may have greatly resulted from changes in metal production concomitant with developing social complexity.

The increase in tin-alloying allowed specialists to create alloys using the “pure” copper ores native to the southern Levant to the same effect as other complex metal alloys (i.e. arsenical copper). However, it should be noted that there are only a few indications of copper production locally in the Feinan during the MB (Hauptmann 2007, 306), yet this does not preclude the likelihood of materials being acquired from here and produced elsewhere. Rosenfeld et al. (1997, 862-63) suggest that the introduction of tin-bronze in Canaan during the MB significantly encouraged the production of sophisticated objects like figurines, as opposed to the EB, when figurines were mostly made of ceramics. Also during the MB, El Morr and Pernot (2011, 2621-22) argue that Levantine craftsmen possessed a fully-mastered knowledge of alloying metallurgy in operations such as cold-working and annealing treatments, as well as accurately designing and making moulds that would reduce casting defects. Evidence from Byblos shows that fenestrated axes were cast in multiple-piece moulds made of soft stones (e.g. steatite), and daggers and riveted spearheads were cast in two-piece moulds (El Morr & Pernot 2011, 2619).

From the perspective of the shaping of metal objects, one of the most important technological innovations during the MB was the return of the “lost wax” technique. As with the RKE technique for wheel-shaping ceramics, the return of the “lost wax” technique demonstrates that the early MB provided a socio-cultural milieu for discontinuous technological innovations (see discussion below). Throughout the history of metallurgy, copper-based items were often hammered into shape, and the use of moulds, often thought of as “open” but probably closed with a simple lid (Philip 1991a, 93), allowed roughly-shaped objects to be cast and finished by hammering. By the MB more sophisticated two-piece moulds were in use which, if made of suitable stone (e.g. schist or steatite), permitted the repeat production of weapons, jewellery and figurines in quite complex shapes. Together with complex alloying technology and the “lost wax” technique, an array of sophisticated products were manufactured in the MB, such as elaborate dress-pins, metal belts (of a type found widely throughout Syria, Cyprus and the Nile Delta), socketed axes, and daggers with finely-ribbed blades (Philip 1991a, 93-94).

Another key innovation during the MB was the addition of lead to the corpus of complex metal alloys, particularly in the southern Levant. Adding lead to copper makes the
alloy easier to cast because the melting point is reduced and fluidity increased, thus allowing the metalworker to produce more the detailed and intricate castings characteristic of the period. However, since lead is only slightly soluble in copper and forms a separate metallic phase in the alloy, the resulting leaded bronze could be relatively weak (Rosenfeld et al. 1997, 862-63), and would surely be a marked disadvantage in the case of weapons designed to take a sharp edge (Philip 1991b, 99). The most obvious advantage of leaded bronze would be to improve the filling of complex moulds by increasing the fluidity of the melt, perhaps proving helpful for elaborate MB castings. However, Philip (1991b, 99,101) suggests that the technical advantages of lead are minimal, and that its use during this period rather results from its value as a cheap dilutant in alloys for short-term economic advantages. Shalev (2009, 77-78) notes that the thicker a weapon is, the more lead was deliberately added to the cast, resulting in the highest amount of lead being measured among duckbill axes, less in the flat socketed axes, and much less in thinner blades like the spears and daggers. Further patterns of specific alloys being used for particular types of objects may exist. As Rosenfeld et al. observe:

Arsenical bronze was used conservatively in manufacturing weapons and tools, although tin-bronze was also simultaneously used. Tin-bronze was a preferable alloy in the manufacture of domestic items. Lead was mixed in bronzes used for figurines, but metalworkers avoided mixing lead in arsenical or tin-bronzes intended for weapons, in order to gain an adequate level of quality. Tin was not added to copper arsenide ores or to arsenical bronze, since the latter were of a sufficiently high quality for producing weapons. On the other hand, tin-bronze was the main alloy used for more intricate casting of artistic, sophisticated figurines (1997, 862-63).

Hauptmann (2007, 201) observes that Feinan copper is one of the lead-richest metals in the Eastern Mediterranean, with similarly lead-rich copper ores only occurring elsewhere in eastern Anatolia. The relatively high lead content during the MB I may thus indicate the intensive exploitation of the Feinan ores for the majority of copper during the period. It seems that MB metalworkers were well acquainted with the technical alloying properties of tin, lead, and copper-arsenide ores, and chose the most adequate alloy for the cast production of each artefact. In addition to taking economic and supply issues into consideration, we should also be aware of production aimed at achieving particular appearances in the finished product relating to colour, which can vary widely depending on alloys, thus changes in alloying practices may be related to consumption preferences (El Morr & Pernot 2011, 2622).

A final consideration for the alloying practices observed at the turn of the second millennium B.C.E. is the environment. Kaufman (2011; pers. comm.) suggests two main environmental factors that greatly influenced the innovation of tin-bronze technology in the
southern Levant during the IB-MB period as a fuel-saving mechanism: (1) the widespread anthropogenic deforestation due especially to the use of timber charcoal for metal production; and (2) the aridifying landscape caused by the Late Holocene climatic episode (ca. 2300 B.C.E.). Based on a diachronic study of the rich stratified assemblage of metal artefacts from ‘Enot Shuni spanning the IB, IB-MB transition and MB I-II, he argues that the mass adoption of tin alloying resulted from the low thermodynamic requirements for tin as a technological adaptation to environmental change during a time of widespread metallurgical production and increasing pyrotechnic fuel requirements. The climatic shift during the late third millennium B.C.E. is well documented (Rosen 1989; 1997; 2007; Frumkin et al. 1999), and a failure to adapt to shifting environmental conditions may have been a primary factor (Rosen 1995; 1997; Rosen & Rosen 2001) together with others (cf. Dever 1989, 236-38; Esse 1989, 92f; Liphschitz et al. 1989, 267) leading to the collapse of EB III urbanism in the southern Levant. It may be possible that certain technological innovations, particular tin and lead alloying in bronze metallurgy, as well as the lower firing temperatures observed in ceramic manufacture, resulted from a combination of socio-technic adaptability to environmental factors driven by developing social complexity and an increased demand of specialized crafts, particularly in the MB I. Timber management for the metal and ceramic industries would be an extremely important aspect of the social organization and environmental adaptation related to specialized craft production, especially in relatively arid region like Transjordan, where once cut, local timber supplies may have taken some time to regenerate (Philip 1991a, 100).

**Technological innovation in other specialized craft production**

In addition to the MB technological innovation readily apparent in the production of ceramics and metals, some observations have been made regarding the production of glass, textiles and stone vessels. Glass production may have first appeared in the southern Levant during the MB, as evident by documents from Egypt (Lilyquist 1993, 52, 57), and Ilan (1995a, 310) suggests that glass production was an offshoot of the pyro-technology utilized for metallurgy and frit. However, evidence remains too limited to speculate regarding the innovation of glass during this period. Barber (1991, 165, 300f) argues that the warp-weighted loom was abruptly imported into the southern Levant during this period based on the sudden appearance of loom weights (of apparently EB Anatolian type), spindle whorls and the technical “half-basket” weave evident in textiles. Information regarding the textile industry is known from the EB IV onward at Ebla, particularly based on the archives from the Royal Palace G, yet it is interesting to note evidence relating predominantly to the use of the horizontal ground loom rather than the warp-weighted loom, even subsequently in the MB (Peyronel 2007, 26). The discovery at Ebla of some loom weights dating to the MB I
may be the “missing link” between Anatolia, where the warp-weighted loom was used since the Neolithic period, and the southern Levant, where it clearly appears. As Peyronel (2007, 30) notes, the coast and possibly northern inner Syria may have been important to the transmission of the warp-weighted loom and its various technological potentials.

Sparks (1991; 2007) illuminates some relevant patterns in exchange, distribution and manufacture of stone vessels during the MB. Probably in response to the popularity of imported Egyptian stone vessels, early in MB II (and arguably beginning late in the MB I) locally-manufactured gypsum vessels first appear in the southern Levant. These vessels initially imitate the shapes and styles of their Egyptian calcite counterparts, yet there is always a clear distinction both in the material and the technical aspect of manufacture. The manufacture of gypsum vessels in Canaan was done by using chisels, rather than drills, to remove their interior (Sparks 2007, 92), and distinct styles of decorative motifs exist during MB – LB, probably representing workshops at Jericho and Pella (112-17). Since there is no sign of a gypsum vessel industry in the southern Levant prior to the MB and the earliest forms mirror Egyptian shapes closely, Sparks (2007, 118-20) argues that the local workshops developed in response to the expanded trade in Egyptian stone vessels early in the MB rather than evolving in isolation. Furthermore, this one-way influence is demonstrated only in shapes, not decoration or technical production, demonstrating no direct process of technical exchange and suggesting that the workshops drew inspiration from the traded goods rather than instruction from Egyptian craftsmen. The innovation of local manufacture of stone vessels indicates that the demand for such objects surpassed the supply deriving from Egypt, and there also may have been a preference for local Canaanite styles. The sharp increase in demand was probably facilitated by the organization of related contemporary craft production, suggesting that social structures were becoming manifest during the MB to support specialized craft production on a large scale, to be consumed via and alongside an existing network of exchange.

**Technological Innovation in MB Architecture**

Building on the discussion of technological innovation in ceramics, metallurgy and other specialized craft production, it is appropriate to return to the topic of architecture with the awareness of the number of concomitant developments that occurred during the MB. From an architectural standpoint, many major technical and stylistic innovations are apparent in the archaeological record commencing with the earliest phases of urbanization during MB I, as described in the previous chapters. Compared to previous periods, MB architecture and the means of its construction became more specialized. Many of these innovations demonstrate technical (structural) superiority over their EB predecessors. Although some evidence survives for earthworks during EB II-III in Canaan, they were very
basic, small and supplementary to existing architecture, whereas earthworks of the MB are
generally quite massive and intentionally constructed as major constituents of urban
planning. Furthermore, the construction techniques used in ramparts, as demonstrated at
many sites in the MB, show careful engineering behind integrating the different parts of the
core and fill of these earthworks. The regular buttressing of city walls (as well as integrated
straight wall segments and towers) during the MB was clearly a structural improvement over
earlier technology, enabling the construction of narrower walls with improved stability,
thereby reducing the overall size and labour requirement for walls of height and strength
comparable to those of the EB II-III. The MB appears to be the first instance of arches in
the Levant, representing a technological breakthrough allowing a structure to span a
relatively wide open space while eliminating tensile stress. Therefore, roofed openings
could span wider entries using mud-bricks without relying on corbelled vaulting and stone or
timber lintels. Alongside the arch was the innovation of multi-entry gates, in which the
projections (i.e. piers) appear to have formed the base of the arches, indicating that the
widespread occurrence of multi-entry gates throughout MB Canaan is related to the stylistic
and technical innovation of arches. However, it is interesting to note that the innovation of
this technology was apparently not without specific engineering faults, since the gates at
Ashkelon and Dan seem to indicate multiple phases of repairs probably relating to the great
amount of outward thrust in the body of the gate structures generated by the arches.

In addition to the improved technical characteristics of MB architectural
innovations, we should also consider stylistic aspects of these innovations that may have
been integral to their reception in nascent MB Canaanite society. The major difference
between the production of craft goods and architecture is in the nature of consumption.
Crafted goods are exchanged and consumed relatively quickly by particular individuals,
generally moving through a system of exchange, whereas architecture is consumed by a
community (generally speaking) over a very long period of time in a fixed space. Therefore,
the innovation of architectural styles represents important considerations made on the part of
society, or at least coercive factions guiding society. In addition to their utilitarian functions,
by extending the size and relative elevation of settlements over their surrounding area, as
well as forming an artificial slope, earthworks must have been a powerful symbol of
urbanism that was ubiquitous during the period. Likewise, the particular designs of gates
with arched entries flanked by towers—and probably the same for many temples (i.e. migdal
temples)—suggest that this style held important symbolic value in society. The fact that
most of these innovations, as well as frequent courtyard buildings and drainage systems,
occur along the same temporal horizon indicates that there may have been a prevailing
concept of the city. Although antecedents for some of the architectural types observed in the
MB existed to a limited extent in EB Canaan, what become common forms and building techniques already in MB I belong to a trajectory that is discontinuous from the EB and IB.

Discussion

The many innovations that occurred from the early MB do not appear to derive from independent inventions in the southern Levant but were probably transmitted to Canaanite society from elsewhere. Although such developments as architectural innovations may have occurred along relatively linear socio-cultural trajectories in parts of Syria, where there appears to have been more continuity between the EB and MB (cf. Cooper 2006), parallel innovations in the southern Levant were discontinuous, and integral to the developing social complexity of the MB I. Explanations for why these specific innovations and/or transmission of technologies and styles occurred need not be reduced to diffusion, particularly mass immigration of peoples from the north (e.g. the Amorite hypothesis). Rather, as many aspects of the archaeological record indicate, trans-regional exchange was quite active already at the turn of the second millennium B.C.E., through which ideas (including technological knowledge), materials and, to some extent, people interacted. As a number of complex interactions occurred in the southern Levant, especially driven by the economic potentials of long-distance exchange, developing social complexity facilitated widespread discontinuous innovations of techniques old and new, local and foreign. Even considering the existence of specialized crafts, there are essentially no indications from the archaeological record that there were dominating elite institutions during the early MB responsible for facilitating or controlling the production of goods. Rather, it seems likely that heterarchical competition was driven by economic potential in exchange, which created an open system for widespread technological innovation.

Situating the process of technological innovation and specialized production within the context of urbanization, the amalgamation of people, concepts and productive processes would have provided the final major catalyst for socio-cultural change. Shennan (2000) suggests that the most important factor in understanding culture change is population dynamics, because there is a strong element of vertical transmission in the acquisition of the techniques of artefact production. Descent with modification sees culture as an inheritance system, in which a great variety of factors affect the extent of local cultural continuity, not just migration and diffusion or simply adaptation. To be sure, early in the MB there was a population increase in at least a relative spatial sense—the agglomeration of many people in and around urban centres—but it remains difficult to estimate the absolute dimension of population dynamics throughout the region. The important factor to consider is that urbanization alone would have resulted in bringing people, ideas and disparate technologies together, promoting dynamic cultural adaptation resulting in innovation. As the production
of goods intensified and became more widespread, specialists gained technical knowledge through familiarity with the various properties of the materials they used and interaction with others within a developing urban context where information, skills and resources were pooled through integrated production systems. It would be during this stage of urbanization that innovation accelerated as new technological solutions developed (cf. Golden 2010, 167; Lemonnier 1993, 21). The open technological system that seems to have prevailed during the early MB allowed such innovations to become widespread and specialized production to occur on a large-scale, resulting in standardization.

**STANDARDIZATION AND SOCIAL COMPLEXITY**

**Defining standardization**

Standardization refers to a the relative degree of homogeneity or decrease in product variation, and may also be used to describe the process of achieving such homogeneity (Arnold 1991; Blackman et al. 1993; Costin 1991; Feinman et al. 1984; Rice 1981; Sinopoli 1988). The degree of standardization is often taken to reflect the intensity and scale of production, as well as the degree of specialization (Costin 1991, 33; Kramer 1985, 88; Rice 1987, 202). Costin (1991, 16-18) considers intensity to be the relative economic exclusivity of production-related activities (i.e. part-time vs. full-time), whereas scale is a proxy measure of the requisite labour force, production output and the physical size of the production area (Rice 1987, 180f). Economies of scale result from intensive or regulated manufacture, and are therefore expected to generate increasingly standardized products (Arnold 1991, 364).

Not all specialist-produced goods are necessarily standardized, such as luxury and high-status goods produced by attached specialists that may be unique, where uniqueness confers value to the product (Costin 1991, 34; Earle 1982); however, virtually all standardized goods are made by specialists (Blackman et al. 1993, 61). Feinman et al. (1984, 299) observe the roles of cost effectiveness and improved efficiency in standardization, suggesting that increases in task mechanization and routinization made possible by economies of scale are important causes of standardization. Yet, specialists are generally inclined to produce standardized goods because their tasks are routine and fewer individual craftsmen introduce less idiosyncratic behaviour into an assemblage (Hagstrum 1985, 69; Rice 1989; 1991; van der Leeuw 1976).

For assessing standardization among ceramics, Costin and Hagstrum (1995, 622) distinguish between attributes reflecting function and the organization of production, these are intentional and mechanical, respectively: “Intentional attributes are less likely to inform us about the organization of production because they are intended primarily to meet specific
functional and/or social needs. Mechanical attributes are those which the potter unintentionally introduces into his or her works.” Mechanical attributes may indicate a number of patterns in production behaviour (e.g. training, skill, experience, the amount of supervision or quality control, efficiency, motor habits, work habits and idiosyncratic behaviour) or technical choices (e.g. resource selection; texture and colour variation caused by differences in clay and pigment preparation and by firing fluctuations; variability in metric aspects of designs such as line width; minor size variation within size classes; and morphological and proportional variation within specific shape classes).

Patterns of standardization among goods may also communicate information about social status and group affiliation within large, heterogeneous complex societies (Blackman et al. 1993, 61; cf. Wattenmaker 1990, 12-16). The “standardization hypothesis” (e.g. Costin 1991, 2000; Costin & Hagstrum 1995; Rice 1981; 1991) proposes that more uniformity is due to a higher rate of specialized production, and may be detected in the archaeological record through raw-material composition and manufacturing techniques (Bishop et al. 1988), form and dimensions (Sinopoli 1988) and decoration (Hagstrum 1985).

The rate of production may be correlated with economic specialization, encompassing the many ways to organize craft production (e.g. domestic vs. specialized production, part-time vs. full-time, attached vs. independent, individual vs. workshop) (e.g. Costin 1991).

In testing the standardization hypothesis, Blackman et al. (1993) investigate a group of fine-ware stacked kiln wasters from the urban centre of Leilan, Syria (ca. 2300 B.C.E.), to see whether or not the degree of standardization provides a valid index for specialization. As Tite (1999, 192) summarizes, among the wasters they observe a high degree of homogeneity in the dimensions, chemical compositions (as determined by NAA) and the procedures followed during vessel production. However, upon extending the study to include sherds of the same vessel type from other contexts at Leilan, the homogeneity became more blurred, probably resulting from multiple workshops working concurrently to meet the high demand for utilitarian vessels at a large urban site. Altogether, they argued that the standardization hypothesis is clearly valid for pottery that has been mass produced by a given specialist workshop in a single production event (i.e. the stacked kiln wasters) and, although multiple production events in several workshops resulted in increased variation in composition and dimensions, such blurring does not completely obscure the standardization signature associated with specialized mass production. The conclusions reached by Blackman et al. are consistent with results from Longacre et al.’s (1988) ethnoarchaeological study regarding the production of cooking vessels in the Philippines, which demonstrates that specialist producers achieve a higher degree of dimensional standardization than did household producers (cf. Tite 1999, 193).
Although it seems clear that individual specialist workshops may produce a high degree of standardization in their output, it remains less clear whether or not the standardization of multiple workshops within the same site or area would correlate with each other. In a study of pottery production at the medieval south Indian city of Vijayanagara, Sinopoli (1988, 582) suggests that non-centralized production by numerous independent craft specialists would produce a relatively diverse ceramic assemblage due to variation between individual workshops in methods and materials, especially as a direct result of competition among such workshops. Likewise, in an ethnoarchaeological study of non-centralized Ticul potters in Mexico, Arnold and Nieves (1992) noted that each workshop has its own measurement standards and procedures that are carefully guarded as trade secrets, despite the fact that all the workshops are producing the same ceramic types for the same market. Based on the observations in these studies and their own, Blackman et al. (1993, 75) argue that different measurement standards used by competing independent workshops in a non-centralized system may be expected to generate a higher degree of metric variability among their products than would be seen in the products of a single workshop, even though every object is made by a “craft specialist”. Thus, standardization may be an effective index of craft specialization under conditions of close spatial and chronological control over the samples in question, and the standardization hypothesis is an effective method for reconstructing the productive organization of complex societies (Blackman et al. 1993, 77).

Evidence of standardization in MB architecture

The evidence for standardization in MB ceramic production and metallurgy was discussed above, demonstrating this phenomenon in other aspects of MB society beyond urban architecture. The goal of this section is to demonstrate the existence and importance of standardization from the standpoint of architecture as part of overall MB urbanization.

Mud-Bricks and socio-political entities

The production of architecture occurs on two different levels, the manufacture of individual building units (e.g. bricks) and using those units to build a structure (e.g. a wall). Mud-bricks may be assessed according to the standardization hypothesis, since they represent objects that are mass produced by specialists (i.e. brick-makers). Structures, themselves, cannot be assessed in the same way as bricks since they are not replicated on a mass scale by any given group. Nonetheless, formal characteristics of building-types, as well as general dimensions and proportional ratios of measurements, may be assessed along a relative scale of standardization. Although such broad patterns may not aid us in determining the organization of production or specialization involved in their construction,
any broad patterns of standardization among buildings may indicate degrees of urban planning within sites and regionally among sites. In the construction process, standardization relates to the management of technological issues with building material (e.g. compatibility, interoperability, repeatability, quality) and organization of labour and production.

The construction of urban public architecture is the most tangible evidence for organized mass production in the sense that huge numbers of labourers are engaged towards a coordinated and planned effort. While there may be some degree of variability, the individual units (e.g. bricks) produced by different groups must at least be compatible with one another in order to be of any value in structures. Likewise, the structures must be planned spatially and constructed according to a particular sequence requiring cooperative management of labour and materials. Therefore, the process of constructing public architecture actually requires a relatively high degree of overall standardization together with urban planning. However, different levels of standardization within this overall process may indicate distinct types of organization.

Different brick-makers might have different mental templates for what constitutes an ideal mud-brick, possibly resulting in as many idiosyncrasies within a site as there are various groups of brick-makers during an episode of urban construction. In order to achieve homogeneity and compatibility across a site, brick manufacture would probably be highly managed and/or centralized in order to produce few idiosyncrasies. During major building events, specialization and routinization likely played important roles in standardized output, since large quantities of bricks would have been produced over a short amount of time by the same individuals who retained mental templates of the composition and dimensions of bricks (cf. Costin & Hagstrum 1995, 619-20; Eerkens & Bettinger 2001, 500). The mass production of bricks for use in constructing public architecture occurred over an intensely active period of time, only being possible during the dry season and probably taking place over the course of a few years in total. The scale and intensity of this process demonstrates political power and economy in the ability to control and organize so much energy.

During the seasons of intense brick manufacture and building, the specialists and their mode of production may be conceptualized in terms of other specialized production, in which brick-making is an industry attached to the urban entity rather than being independent, and we may liken groups of brick-makers to “workshops”. What may be remarkable is the evident variability in brick standardization along a single temporal horizon within a site. We should expect individual workshops to mass-produce highly standardized bricks, at least in dimension, if not composition (depending on consistent access to raw materials). The larger a workshop is, or more directly managed a number of workshops are, the greater degree of widespread standardization we may expect to see among the bricks.
across a site, especially in segments of walls undoubtedly built at one time. Conversely, a
high degree of variability across a site, and particularly in the same segments of walls,
suggests a number of workshops that, despite being attached industries, are mass-producing
bricks according to their individual mode of standardization with no apparent concern for a
unified standardization or organization of production across the industry as a whole.

Therefore, we may say that brick-making workshops represent attached
specialization in the sense that the mode of production is either controlled or highly
influenced by a social institution of some sort, which creates the demand driving the
industry. Yet the fact that it is an attached industry does not necessarily determine the
degree of organized production among different workshops. Considering the greater amount
of variability among the bricks at Megiddo than Pella, for example, we may interpret more
de facto workshops operating at the same time, each with their own relatively-standardized
output, yet ultimately resulting in a low degree of overall standardization across the site. In
the case of Pella, there appear to be far fewer de facto workshops, resulting in a high degree
of standardization across the site. The difference between these two settlements may be an
indication of socio-political organization. Whereas the apparently centralized organization
of mass production at Pella suggests a degree of hierarchy, or at least a ranked majority, the
multiple workshops at Megiddo possibly represent a heterarchical organization of socio-
political entities working together. Although such entities may have worked together toward
the same construction effort, they were also probably competing for power through brick
(and greater architecture) production in the sense that ownership of labour demonstrates
property relations and power structures (e.g. Zeidler 1987; Habermas 1979). In fact, it is
entirely plausible that urban construction was a major arena for competing socio-political
entities to contend for domination by their contribution towards construction, and
consolidation of power through the consumption of labour and resources. In a sense, the
process of urban construction is a highly-visible political campaign, in which whoever can
win over the most support and contribute the most to the urban system eventually comes out
on top with the most power.

**Standard MB practices**

With regard to architectural structures, we cannot assess production in the same
sense as the homogeneity of a cultural assemblage deriving from specialized mass
production, nor indicate patterns of standardization relating to the intensity, scale or
organization of production. However, we may be able to compare observable aspects of
structures (e.g. forms, types, styles, building techniques, dimensions, proportions,
orientation) on a relative scale of “standard” practices during the MB, which is to speak of
standardization in a general sense of normative practices. As discussed above, there were a
number of architectural innovations during the MB that occur very frequently at sites from their earliest urban phases. Standard architectural elements include: earthworks, multi-entry gates, towers, drain systems and courtyard buildings. Standard architectural techniques include: brick-laying using a running bond; arches, as evident from the projections (piers) in entries to gates or other public buildings; buttresses (particularly external) on city walls; superimposed layers of varied sediments in the fill of earthen ramparts; glacis coatings of ramparts; and straight, rather than curved, wall segments connected by regularly-spaced towers. The frequency of these architectural elements and techniques during the same horizon of urbanization at sites distributed throughout the region indicates an overall standardization of urban architecture during the period. Additionally, the widespread frequency of standard units of measurement during this period (Chapter 3) probably represents yet another MB technological innovation resulting in less variability in the dimensions of bricks and walls than during the EB. Of course, this relative standardization should come as little surprise considering the high level of interaction during the period and proliferation of technological innovation in an open system.

Urban Planning

Approaches toward “urban planning” may range from discerning a regular urban design among coordinated buildings with a discernible and formal organization of space (e.g. Carter 1983) to pre-mediated, self-conscious patterning across all scales (e.g. Ashmore 1989) (Smith 2007, 6-7). The level of planning is something that might be assessed according to an ordinal scale (e.g. Rapoport 1988), taking into account such issues as the coordinated arrangement of buildings and spaces, orthogonal layouts, access and visibility, and orientation. On this scale, orthogonal layouts of settlements (i.e. according to a grid) would indicate a higher level of planning than simple common alignments or semi-orthogonal blocks of buildings (Smith 2007, 15).

Of special note among MB settlements are the regular augmentation and extension of sites by earthwork construction. Newly establishing or intentionally extending the boundaries of settlements demonstrates extremely intentional urban planning of the greatest order by transforming the natural and artificial landscape. The rectilinear layouts of many sites began only during the MB in the southern Levant (Burke 2008, 80ff) and probably related to the technological innovation of using straight segments in city walls rather than curved. Rectilinear layouts were only possible where topography allowed—generally at newly established sites, rather than resettled tells—and we might expect to find more rectilinear layouts in Canaan were it not for size and topographic constraints at so many site locations.
Discussing the internal layout of MB sites is problematic due to the limited wide exposures available for study. Nonetheless, some basic observations may be made. The internal layout of sites with both rectilinear and elliptical layouts appears to be a coordination of structures that is semi-orthogonal at best, and generally simple alignments of buildings relative to streets and larger buildings or zones. It seems that there may have been some priority given to planned “zones” within settlements, especially “sacred” or “elite” precincts (e.g. Herzog 1997; Kempinski 1992b). Such zones appear to feature enclosed spaces (e.g. large open courtyards) and/or large buildings with similar orientation, with architecture adjoining the zones appearing semi-orthogonal only due to common alignment with the orientation of buildings in the zone. Streets (and possibly drainage systems) would have to be planned to some extent before the construction of buildings within a settlement, yet little evidence suggests any intentionally planned network, and most of the street systems (aside from perhaps the major thoroughfares) developed over time.

Overall, despite the many standard architectural features that appear across MB sites, there does not seem to be a very high degree of internal urban planning, which may be indicative of heterarchical coordination in urban construction rather than any linear hierarchical control. Thus, as with the organization of brick production, it seems that despite a process of centralization, there were no single socio-political entities controlling the urbanization of sites from the standpoint of construction. This lack of conventional hierarchical elites is indicated in the archaeological record by the absence of clear elite institutions during the early urban phases at sites. Even the “palaces” or public buildings during the earliest urban phases at some sites (e.g. Aphek’s Palace I, Kabri’s Proto-Palace, Megiddo’s XIIIa Palace) are fragmentary and greatly reconstructed, presenting no indication of elite identities. Furthermore, there is no evidence for temple institutions during these earliest phases (except possibly Pella and Hayyat) rather, as at Megiddo XIII-XII, there were merely “cultic” areas featuring stelae, and temples only become truly evident in the subsequent MB II.

The symbolic aspects of MB urbanization

The greatest effort in MB urban planning was undoubtedly in the construction of the elements of fortification, which consequently determined much of the internal layout of the settlement according to their shape and movement dictated by the locations of gates. Additionally, taken together with the scale of architectural volume and labour requirements for fortifications, and the high frequency of very standard elements occurring in fortification architecture, it would seem that MB urban planning was primarily concerned with the delineation of urban space, rather than organizing that space. There is a clear emphasis on planning and organizing the architecture serving as the boundary of the architectural entity
of the urban settlement. The standardization of this architecture, in a general sense, may present the possibility that fortifications were highly symbolic phenomena, which projected an outwardly-oriented symbol of urbanism. Especially as perceived from the outside, in contrast with the natural landscape MB urban settlements were probably very striking with their monumental façades and towering elevations. Whether these urban settlements reoccupied old tells or were newly-settled, they adhered to what appears to be the MB “standard”, being a monumental settlement sitting atop steep slopes (artificial, natural or ancient), which may have been a symbol of urbanism in connection to the tells of the past. If architecture can be viewed as a metaphor for a worldview, then monumentality in the MB may be a material manifestation of a new (or renewed) ideology and a changed sense of socio-cultural identity based around the urban settlement and system of urbanism.

SIGNIFICANCE OF TECHNOLOGY AND STANDARDIZATION FOR UNDERSTANDING MB URBANIZATION

Urbanization by late in the MB I demonstrates the consolidation of people and resources on a large scale and represents a key point in the evolution of society during the MB. The occurrence of technological innovations across the entirety of material culture in the southern Levant over the course of the MB I indicates parallel developments in social complexity that are otherwise difficult to perceive. According to a dynamic systems approach towards socio-cultural evolution, the discontinuous innovations among all the technologies discussed above could have only occurred under the proper social circumstances through which technical knowledge was received and, most importantly, put into practice. The actualization of technical innovations required organizational systems for specialized production. During the IB and early MB I certain villages certainly existed in which groups of individuals engaged in specialized craft production, such as ceramics and metals, albeit on a relatively small scale for local consumption. Although innovation probably began within this context of independent workshop settings in villages that were only loosely connected to a broad network of exchange, the continual process of innovation meant intensification of specialized activity, leading to production in attached workshop settings. These workshops were probably not attached in a conventional sense to particular social institutions or political elites, rather their specialized activity might have been supported by their local communities that were organized by kin- or tribal-based relations.

As the somewhat defunct exchange networks of the preceding millennium became revitalized alongside the societies in surrounding regions, increased interaction in the southern Levant provided the potential for access to raw materials (e.g. tin), a market output for goods and the accelerated transmission of technology. As the scale and intensity of
production increased, workshops and the social groups behind them nucleated as nascent urban communities situated along key transportation routes oriented toward major interregional gateways for exchange. These on-going developments lead to ever-greater innovation within an open technological system, in which knowledge, skills and secondary invention took place at an accelerated rate. In urbanizing settlements, ever-intensifying specialized activity required large-scale organization of agricultural surplus and raw materials, as well as merchants to exchange goods. The mass production of objects within attached specialized settings resulted in high degrees of standardization within assemblages relative to particular large-scale workshops. The fact that a number of technological innovations appeared at the same time as the developing social complexity that results in urbanization is no coincidence, since both of these processes facilitated each other as mutually-constructive forces of socio-cultural evolution. The climax of this concentration of people, resources and energy led to large-scale urban construction, which directed the organization of production, including agriculture, towards the physical manifestation of urbanism.

Urbanization was a manifestation of organized specialized production on a mass communal scale as seen in construction process. Although the production of sundried mud-bricks is not “specialized craft production” per se, since a mud-brick is not traded or consumed in the same way as other manufactured objects or material commodities (e.g. ceramic, metal, stone, bone, wood, glass, precious stones), mud-bricks are nonetheless consumed in a certain sense. During urban construction, the scale of mud-brick production was primarily industrial for a particular utilitarian purpose, namely public urban architecture. Within this context, as products of specialized manufacture, mud-bricks would be of extremely high demand, and consumed immediately by being placed into walls of all sorts. By approaching mud-bricks as products of specialized mass production during a phase of urbanization, it is possible to identify different workshops and consider the organization of production in construction according to patterns of standardization, as well as the different socio-political entities they might represent.

Urbanization merged these heterarchical social entities (represented in the archaeological record by different modes of standardization) and consolidated specialized activity through an urban infrastructure, enabling mass production and resulting in the widespread standardization of material culture so characteristic of the MB. It is conceivable that outside of large-scale construction during urbanization only very limited full- or part-time brick-makers continued to manufacture bricks for on-going consumption for domestic buildings, repairs or rebuilding at an urban settlement, or possibly to be traded further afield (if such were the demand). If such were the case, one would expect to find a degree of standardization among bricks in certain types of architecture during minor construction
events. Conversely, were there no signs of standardization, it seems likely that individual non-specialists made their own bricks whenever necessary (e.g. a person building their own domestic unit), in which case there would not be enough demand for the existence of specialists unless a major construction project called for it. Modern ethnographic examples exist for both types of production of mud-bricks (e.g. Emery 2011, 4; Fathy 1969; 1973; Politis 1999).

The late Chalcolithic period provides a helpful analogy in which technological innovation was discontinuous from a linear trajectory of technological evolution due to developing social complexity. Social complexity enabled the structure and organization required for specialized production, which was fuelled by an elite demand for specific types of objects. Likewise, technological innovation during the early MB was discontinuous from the linear trajectory of preceding millennia because of developing social complexity, as well as dynamic interaction on intra- and inter-regional levels. Together with the social complexity, which provided the structure and organization required for specialized production, the interconnectivity apparent in the southern Levant in the early second millennium B.C.E. facilitated exposure to external technologies and access to raw materials. While the ideology that seems to have driven Chalcolithic society was centred on the cult, ideology in the early MB may have been more concerned with urbanism and the market economy. Rather than an ideology derived from the controlled cult, the MB carried the social potential of belonging to a corporate identity manifest in the public built environment and engagement on the global scene. Despite all its discontinuous innovation, the late Chalcolithic remained a technologically closed system, since the production of highly specialized crafts was heavily controlled (e.g. the V-shaped bowls for cultic ceremonial use only) and occurred only on a small scale, with little widespread dissemination or standardization. However, the MB realized an open system, apparently without the same elite or political boundaries of before, and in which technological innovations became widespread with large-scale production leading to standardization. In sharp contrast with the MB, in many respects (e.g. ceramic technology, architecture) the subsequent LB was a period lacking discontinuous innovation, probably relating to a partially closed system resulting from political boundaries (i.e. city-states), political protocols and intensely specialized economies.

In the processes of urban construction and specialized craft production, we may emphasize various social groups, signified by different workshops (attached or independent), requisite agriculturalists and construction labourers. Many of these organized social entities probably cut across minor, local hierarchies and allowed for decision-making on a range of scales without disturbing an integrated organizational heterarchy (cf. McIntosh 1999, 11). Nascent urbanization may have been a time of social fluidity, a sort of inchoate amalgam of
developing complexity, which could be navigated by personal or communal investment in particular activities and affinities to social institutions, particularly emerging urban entities. If we look at urbanization as a time of nucleating heterarchy, then we would conceive a number of relational elements that are unranked or ranked in a number of ways (Crumley 1995, 3) with flexible, contingent and constantly fluctuating power relations (Stein 1998, 7).

As has been posited for irrigation management elsewhere (Davies 2009, 29; Stein 1994, 42), the construction process may have fostered independent loci of corporate authority that could contend with other forms of emergent authority. Within the milieu of urbanization, power could be attained on an individual or collective scale by exercising mastery over people (labour), resources (economy), ideology and political relationships (Mann 1986). The competition for these sources of power among coordinated heterarchies could be the primary structuring factor in society (Brumfiel 1992) and provides an internal dynamic for developmental change. Rather than viewing chiefdoms and states as well-bounded, homogeneous adaptive systems with clearly-defined structures, Stein (1998, 6) suggests focusing on power relationships, whereby developing polities are “fuzzy” networks with poorly defined and contingent boundaries formed through differential and constantly shifting patterns of cooperation and competition among emerging elites and other groups.

From the standpoint of emerging hierarchy, Feinman (1995) notes that would-be leaders might employ network-based strategies, emphasizing external ties as a way to obtain exotic goods, or corporate-based strategies, in which leaders derive their power from the size of their corporate faction rather than through access to exotic prestige goods. Furthermore, a key factor in the emergence of complexity is the ability to create and perpetuate economic inequalities through the mobilization and concentration of surpluses. Hesse (2010, 80) considers a central “coordinating agency” (i.e. temple and palace institutions) as crucial to socio-political developments by organizing labour and surplus to increase the agricultural infrastructure, defence, and to maintain specialists and administrators. However, in the early MB of the southern Levant such institutions either did not exist prior to later urbanism or remain undetectable. Therefore, major administrative institutions cannot be considered as a major central coordinating agency or incentive forces behind production during this early period. Rather, from a perspective of urbanization, the control of labour leading to the production of architecture should be considered a primary source of power in the competitive public arena of urban construction. The management of labour and resources was certainly an important way for socio-political entities to ascend within an emerging system of inequality. It is the scale on which construction takes place that makes it the single greatest transformative potential for the socio-economic structure of society, and thus the chief means for consolidating power. The eventual institutionalization and ownership of
production in the subsequent system of urbanism may have further consolidated wealth and power in the hands of a few elites who rose to the top of local MB social structures.

On a regional scale, a discussion of standardization cannot apply to particular patterns of production, but to more universal practices, such as object types, classes and style. Particularly from an architectural standpoint, common patterns of practice likely express a prevailing ideology of the urban settlement, which may be interpreted through standard units of measure or architectural typologies, possibly constituting the cultural embodiment of a worldview. The urban environment is a cultural landscape in contrast to the natural landscape (e.g. Preucel & Hodder 1996), and is a physical “space” transformed by cultural associations to attain special significance as an experienced “place” (e.g. Tilley 1994, 15ff). MB urban settlements were dramatically separated from their surroundings by elevation and integral make-up of culturally-constituted monumental architecture, and fortifications served as physical and symbolic boundaries between the culturally-derived place and the outside world, marking the social boundary separating those who belong to the urban entity and those who are outsiders. More than any other type of manufactured product, the architecture constituting a settlement was inscribed with identity and memory, and served as a continually-experienced cultural manifestation deeply integrated in the fabric of urban society.

**Summary**

This chapter has discussed the implications of technological innovation and standardization for MB urbanization, particularly highlighting the potential of considering architecture as a class of specialized production. The degree of technological innovation in a society may be an indication of its evolutionary trajectory according to an open or closed system. In the case of the MB, technological innovation appears across nearly every aspect of material culture, indicating a major departure from the preceding millennium, and the discontinuous nature of this innovation serves as tangible manifestation of developing social complexity during MB I. Likewise, as a relative indicator of the scale and intensity of production of goods, standardization serves as a useful means for assessing the management and organization of labour and positing the existence of various social entities. The high degree of widespread standardization apparent in ceramic production by the MB I/II transition seems to parallel phases of urban construction at many sites. Based on the patterns I have demonstrated regarding brick manufacture and architecture, the varied standardization visible from the mass production of mud-bricks indicates the possibility of various groups (e.g. labour, social, ethnic) being involved with urban construction. It seems that despite centralization, the productive forces of MB urbanization consisted of
coordinating heterarchical entities that contributed to an internal dynamic for developmental change in society, thereby reinforcing an open system that fostered technological innovation rather than a system heavily controlled by a single elite social entity or institution.

The broad implications of standardization within the archaeological record derive from the potential to assess changes in the complexity, organization and values of a society over time. Various degrees or forms of standardization among similar classes of objects during one period may be used to interpret the existence of social institutions otherwise imperceptible elsewhere in the archaeological or historical record. Standardization may also indicate aspects of cultural norms and worldview belonging to the society consuming objects produced. Technological development and production serves as a fundamental medium through which social dynamics may be identified and interpreted (e.g. Dobres & Hoffman 1994, 212-14). In addition to oft-used ceramics, architecture provides an abundant source of material for the assessment of standardization among mass production, particularly during periods of major construction activity.
11. CONCLUSION

The purpose of this study is to address the issue of urbanization during the MB of the southern Levant by identifying and investigating patterns in the archaeological record during this period of dramatic transition from non-urban society and culture to a system of urbanism. After roughly a century of scholarship regarding this topic, interpretations of the origin and nature of urbanization during the MB are slowly advancing beyond notions of diffusion that rely too heavily on historical sources from Egypt and Mesopotamia. Archaeological data and approaches from social theory have much to contribute to the question of urbanization. Nonetheless, despite recent research dealing with patterns of production and distribution of ceramics (Maeir 1997; Maeir & Yellin 2007), and stressing the importance of technological innovation (Uziel 2011), explanatory approaches toward MB urbanization and urbanism that apply social theory are sorely needed. Therefore, in setting out to address how MB urbanization occurred, my research highlights three research questions: (1) how were urban settlements built, in terms of materials and building practices? (2) what was the cost of building the MB city, and how was this construction organized, in terms of resources and labour? and (3) how does this process of construction relate to the overall social processes of urbanization?

METHODS AND RESULTS

In order to address the questions of urbanization, I have approached the subject primarily from the perspective of architecture and the process of construction, drawing from a wider range of subjects and disciplines. By synthesizing a large and diverse body of research on MB building materials, practices and rates of labour, I have been able to reconstruct a reliable chaîne opératoire for the construction process, from the manufacture of bricks to the erection of fortification architecture. Based on rates of labour applied to volumetric estimates of architecture, I calculate the cost of construction for fortifications at the case-study sites, as well as hypothesize different scenarios according to resources and time. This cost of construction highlights the many inter-connected processes and constraints involved with large-scale mud-brick construction as part of a framework to conceptualize and situate a discussion regarding the organization of labour.

By comparing the patterns apparent in monumental architecture (e.g. forms, types, styles, building techniques, dimensions, proportions, orientation) on a relative scale of
standard practices during the MB, it is clear that many new architectural innovations were implemented at sites throughout the region already in the early phases of urban construction. Architectural elements that became standard in the MB include: earthworks, multi-entry gates, towers, drain systems and courtyard buildings. Standard architectural techniques include: arches, as evident from the projections in entries to gates or other public buildings; buttresses (particularly external) on city walls; superimposed layers of varied sediments in the fill of earthen ramparts; glacis coatings on ramparts; and straight, rather than curved, wall segments connected by regularly-spaced towers. The frequency of these architectural elements and techniques during the same general temporal horizon among sites distributed throughout the region indicates an overall standardization of architecture during the period. It is this sort of standardization that serves as a major criterion for what I consider to be “urban” architecture during the MB. Additionally, the widespread frequency of particular units of measurement during this period as demonstrated by dimensions of mud-bricks probably represents yet another MB technological innovation and standard, normative practice.

Upon more detailed examination of mud-bricks, many important patterns emerge regarding their manufacture, with consequent implications for labour organization. Using the methods developed in this study, I have been able to categorize different types of bricks, the use of these bricks and assess the degree of metric standardization at each of the case-study sites. I proceed on the assumption that different types and dimensions of bricks reflect the process of manufacture whereby differences represent either discrepancies between batches produced by the same brick-maker or simply different brick-makers. In principal, few brick types, consistent brick-laying techniques and low metric variability would suggest an overall high degree of standardization at sites, and vice versa.

The analytical results of the case studies indicate that at least three types of bricks were manufactured at Dan, four at Pella and five at Megiddo. The bricks at Pella are very uniform and segregated by type rather than mixed at random within distinct segments of walls. It is likely that the bricks of the same batch (if not all) were used at one time in the same place, rather than being divided and distributed to multiple points around the site. In contrast, the bricks at Megiddo and Dan exhibit much more variability within even the same courses of walls. Since there appears to be no structural benefit gained by the distribution of these different types of brick (of varied composition) throughout a wall, it seems likely that the bricks of multiple brick-makers were incorporated at a single time in the process of building at Megiddo and Dan. It is possible that essentially the same number of brick-makers were producing bricks during urban construction at all sites, yet at Megiddo and Dan all available bricks were used ad hoc in the same structure at a single time, whereas at Pella distinct batches of bricks may have been used only in particular loci of construction.
Most importantly, despite various overall levels of standardization at each of the case-study sites, the bricks and construction techniques from all of the MB I architecture I assessed demonstrate multiple groups of agency during the process of their construction. Assuming that these case studies represent other centres of early MB urbanization, then the implications of my study can be applied to the greater southern Levant. The centralization that is clear from the consolidation of people and resources at an urban centre during the process of construction does not necessarily require the presence of a strict social hierarchy controlling the organization and planning of production. Rather, my data suggest that the primary organizing principle in the production of urban architecture derived from heterarchical units that operated in a coordinated effort. Minor variations in building practices among sites suggest a considerable degree of autonomy, particularly with regard to strategies for brick-manufacture and the organization of labour. Nevertheless, the overall similarities among brick use and architecture suggest a fairly high degree of interaction among social groups at different sites throughout the region, through which urban-planning and building strategies were innovated and transmitted.

**Theoretical Implications**

My findings are to some extent at odds with the existing understanding of urbanization during this period, which generally assumes the existence of some sort of sub-regional hierarchical socio-political structure capable of single-handedly controlling a standing labour-force for major urban construction and administering urban settlement networks. Such socio-political entities are sometimes considered to be foreign in origin—from Egypt or Syria—introducing, or even imposing, urbanism in the southern Levant. Syrian influence on MB material culture, especially architectural forms, in the southern Levant certainly existed to a fairly significant extent. However, the transmission of ideas and technology to Canaanite society was complex (e.g. Ilan 1995a, 300f), and should not be reduced to mono-causal theories of immigration or colonization, which conflate innovation with physical importation. Still, many studies continue to look to external sources as models for understanding urbanization in the southern Levant. Burke’s recent work (2008, 155-56) illustrates a popular view of the process of construction and urbanization in the MB. Yet relying heavily on historical texts from elsewhere, Burke’s conclusion posits the availability of “conscripted troops”, which assumes an advanced state of socio-political complexity in the southern Levant capable of administering such a workforce. Even the suggested categories of corvée or hired labour (Burke 2008, 143) seem unlikely for pre- or proto-urban Canaanite society in the MB I. Although he does not explicitly argue for direct exogenous agency behind urbanization, the only possible explanation for entities capable of such
elaborate large-scale organization as suggested by Burke would be colonizers, over-relying on theories of diffusion (e.g. Albright 1933; Dever 1976; Kenyon 1966; Mazar 1968). There is no indication from the archaeological record that administrative social institutions—indigenous or foreign—existed prior to the first clear phase of urbanism at the end of MB I at the very earliest.

It is now clear that urbanization occurred gradually over a period of time throughout the region and over a number of developmental phases at individual sites (e.g. Greenberg 2002, 107; Maeir 2010, 175ff). All of the sites reviewed in Chapter 5 demonstrate multiple phases of MB I activity prior to the process of urban construction (see Table 4). On a regional scale, urbanization and transformation from IB to MB appears to have been a gradual process. Certain exceptions exist on a site-specific scale, where there may have been dramatic transformations from the end of the MB I (e.g. Hazor, Kabri). Changing settlement patterns in the southern Levant during the beginning of the MB appear to be oriented according to networks of interaction, both externally and internally. Along the Coastal Plain, maritime interaction was extremely important, with extensive contact resuming with Egypt by the Twelfth Dynasty (Ilan 1995a, 308; Marcus 2002; 2007, 164; Raban 1985). Likewise, natural inland transportation routes (e.g. Jezreel Valley, Jordan Valley) featured greatly in this interaction, as indicated by early MB I settlement activity at certain sites (e.g. Dan, Pella, Megiddo). The existence of tin for the local production of metal alloys and the implementation of a number of new technologies demonstrate far-reaching networks of interaction and exchange from early in MB I (and the IB). Long-distance trade was probably a key factor in the development of competitive market forces driving much of the technological innovation and specialized production behind urbanization. Critically, rather than being controlled by an overarching socio-political power, the settlement system comprised economic ties throughout a heterogeneous network (e.g. Stager 2002, 361).

In addition to being implicit in the settlement patterns, the socio-economic situation during MB I is reinforced by patterns in construction and general production, which I use to explain the development of social complexity. By situating architecture together with other socio-cultural activity during the early MB (e.g. ceramic production, metallurgy), I investigated the development of social complexity from the perspective of technological innovation. Uziel (2011) highlights the importance of technological innovation in the MB as perhaps the greatest defining characteristic of the period. However, he limits his interpretation of the cause and significance of this phenomenon by ultimately considering technological determinism as the explanation for so many innovations in the MB (Uzierl 2011, 59ff). This viewpoint places too much emphasis on an assumed ideological stance towards technology suggesting an unrealistic self-awareness of a collective Canaanite
identity, and neglects how innovation relates to social complexity. Alternatively, looking at data from the archaeological record from a dynamic systems perspective, I argue that discontinuous technological innovation reflects evolving complexity in Canaanite society and that such innovation contributed toward the forces of production, social ranking and power relations during the process of MB urbanization.

Like the Chalcolithic period, technological innovation in the MB was discontinuous, meaning that it makes an evolutionary leap forward from the linear developmental trajectory of preceding periods (e.g. Creswell 1996; Roux 2003a, 15ff). Such discontinuous change in technology does not necessarily occur for a techno-economic advantage (Roux 2010, 226), but for symbolic and/or social reasons, paralleling changes in society. As a number of complex interactions occurred in the southern Levant at the beginning of the second millennium B.C.E., developing social complexity facilitated widespread discontinuous innovations of technologies. According to a dynamic systems approach toward socio-cultural evolution, these discontinuous innovations could have only occurred under the particular social circumstances through which technical knowledge was received and, most importantly, put into practice.

I argue that what makes the MB different from other periods is that it fostered an open socio-technological system, without the elite or political boundaries that were in place before (or after), in which technological innovations became widespread with large-scale production leading to standardization. Technological innovation appeared across nearly every aspect of material culture, indicating a major departure from the linear evolutionary trajectory of the preceding millennium. As a relative indicator of the scale and intensity of the production of goods, I use standardization as a means for assessing the management and organization of labour and suggest the existence of various social entities. The high degree of widespread standardization apparent in at least ceramic and architectural production by the MB I/II transition seems to parallel phases of urban construction at many sites. Together with the urban settlement as the physical manifestation of urbanization, standardization demonstrates the existence of complex society through specialized mass-production, which requires a complex social structure to support the equivalent of “attached workshops”. Yet despite these factors, the nature of MB social organization during urbanization—as reflected in the construction process—appears to be heterarchical and probably composed of tribal, kin or village-based units (e.g. Bunimovitz 1992, 227) vying for control of resources during this process of social transformation.

The patterns of similarity apparent in architecture throughout the Levant demonstrate a high-degree of interaction (even in the earliest stages of the MB I) through which technical strategies were shared. The fact that similar innovations were applied at so many sites throughout the region suggests a sort of peer-polity interaction (Ilan 1995, 297-
Monumental architecture is of key importance for understanding aspects of the meaning of urban architecture, not only because it required such great investment to construct, but the process of construction also had an impact on society as well as the urban landscape.

In particular, the earthworks that became standard architectural features at sites during the MB may have held a powerful symbolic meaning for the city during the period beyond the more practical functions already highlighted (e.g. Uziel 2011). Wilkinson (2003, 7) considers tells to be “signature landscapes” in the Near East, describing them as “those landscapes that are sufficiently physically etched into the land to remain in some way to the present day.” For the MB inhabitants of the Levant, residual EB tells would have certainly been well-recognized and well-remembered cultural phenomena in the landscape. The longevity of these monuments to ancient society, combined with their visibility and “place-value”, probably contributed to a sanctity of place that flat sites could not match (Wilkinson 2003, 108). As Greenberg notes, “the rampart was used by its builders to give concrete form to a pre-existing concept of “city”; it was a conventional symbol of urbanism, as the city wall had been in EB II” (2002, 108). Thus, the standard MB construction technique of surrounding new settlements with imposing earthen ramparts which, from the outside, create the same appearance as the slopes of a tell, may have symbolically emulated the sense of longevity, value and sanctity associated with ancient cities. In other words, MB individuals created artificial tells that would evoke the same deep ideational values connected with ancient tells that no doubt held profound socio-ideological meaning for the inhabitants of the Levant, even after centuries of urban hiatus.

The urban settlement provided the physical embodiment of notions of economy, services and greater regional interaction (Greenberg 2002, 108), and it served as a symbol of the social identity and order that was forged through the process of its construction (e.g. Mendelssohn 1976, 140). The public architecture built over tens of thousands of person-days stood as monuments to the process by which they were constructed, infused with meaning and identity, down to the individual mud-bricks that were formed by human hands. These associations connected people with the place—and with a greater community—through a sense of inscribed memory (Connerton 1989, 72-3; Wilson 2010, 5). The resulting urban landscapes were powerfully juxtaposed against the surrounding landscape by monumental MB fortifications, which served as physical and symbolic barriers between the ordered, cultural world and the space beyond. The built environment represented that which was the culturally derived “place” and that which was not (e.g. Tilley 1994, 15ff). Likewise, it is possible that city walls marked the social boundary separating those who belonged to a
city from outsiders, and this social delineation perhaps further enforced the communal identity that was forged during the process of construction, contributing to the cohesiveness of a settlement’s inhabitants (Herzog 1997, 133). Innovations evident among fortifications in the MB (particularly earthworks with increasingly rectilinear layouts) suggest a prevailing intentionality behind the planning and standardization of the urban environment that was not as visible in the EB, and probably derived from an overall worldview present in Canaanite society.

LIMITATIONS OF THE STUDY

As with any doctoral research, the limitations inherent in my methods, available dataset and time constraints proved to be obvious challenges for addressing my research questions. Despite such challenges, I believe that the methods I developed for analysing patterns in architecture, specifically mud-bricks, serves as an original contribution to the field of study. The process of sampling and analysing my material brought up a number of unexpected issues and questions, some of which I was able to address, and others of which I was not. In this process, I have gained a number of insights concerning the strengths of my approach and ways in which it could be improved.

Sampling

The major problem with the metric architectural data collected from various publications is that, despite my systematic collection and classification of data, the excavations and publications, themselves, do not record or present/publish metric data consistently or systematically. Therefore, in any given publication, the data provided may or may not be comprehensive, approximated or contextualized. It may not be clear whether the widths of walls or dimensions of buildings represent a mud-brick superstructure or stone foundations. Likewise, it is usually unclear whether or not the dimensions of buildings or bricks are representative of typical, exceptional, intact or fully exposed units. Some site reports provided fairly regular and comprehensive brick dimensions, such as Alalakh (Woolley 1955), which provides 35 sets of brick dimensions from EB I to MB II, including basic descriptions (e.g. stratum, average measurement, building type, colour). Publications for other sites have considerably fewer sets of dimensions and/or descriptive information, and even more sites have no information whatsoever. The same situation was true for metric observations of other aspects of architecture. Therefore, the data regarding brick dimensions that took a considerable amount of time and effort to compile ended up being of little statistical value for interpreting useful patterns of practice on site-specific, regional or diachronic scales of comparison. Nonetheless, I used basic statistical descriptions of the
data I had and conflated some of the data from well-represented sites to minimize how skewed the distribution was. Although the data proved to be problematic, they still provided some helpful patterns on the most general level of interpretation.

In terms of sampling mud-bricks for laboratory analysis, there are a number of constraints involved in acquiring worthwhile material. Based on my own experience excavating, sampling and analysing mud-bricks prior to this study, I designed my sampling method for personally visiting sites with clear and well-preserved (preferably fresh) exposures of in-situ brick from which I had permission to take samples and document according to my own conventions. By sampling in this way, I was able to document the context of the samples, take an appropriate number of representative samples according to each context, and make appropriate observations (e.g. building techniques, brick types, brick dimensions). Of course, this ideal sampling scenario already limited the potential sites for sampling, not to mention the ability to acquire permission to take samples from the few sites meeting the criteria. Beyond my case study sites, over the duration of my doctoral research there were only about four other active sites where I could have potentially sampled, had circumstances and time permitted.

Although some excavations tend to take and store samples of bricks, my experience has shown that this practice is usually done haphazardly—just for sake of having a sample—with minimal documentation. Without contextual information or knowing how representative brick samples may be of the greater architectural unit, their potentials for addressing patterns in construction are extremely limited. A single chunk of brick is hardly more useful than a single sherd of pottery. Therefore, although many individuals were willing to give me access to previously taken brick samples, I considered these to be of marginal value, and they did not factor into the present research, with the exception of samples previously taken from Pella that had adequate contextual information to contribute to my own samples.

Analysis

Perhaps the greatest limitations for sampling bricks in the field is knowing how much time it will take to process each of the samples in the laboratory. Every minute spent taking a sample in the field can translate into hours in the laboratory. On average, each sample took about four hours of active time to process using all of the analytical procedures, adding up to several hundred hours spent before data could be compiled. Further conditions can also greatly affect laboratory work, such as workspace, access to equipment, and malfunctioning equipment and supplies. Taking these factors into consideration, and in order to complete my research in a timely manner, it would not have been possible to take or process many more samples than I did. Likewise, I chose not to undertake more thorough
analytical procedures than absolutely necessary. For example, I realized half-way through my research that it would have been of great value to submit my samples to phytolith analysis, but it would have been time-prohibitive for me to learn and implement this additional procedure.

**Future Study**

There are a number of ways in which the present research can be expanded in the future. The results I have provided in this study should be considered preliminary due to the original nature of my methods, and there are a number of respects in which the data and implications could be improved. The scope of my research was only able to encompass limited case studies and readily available data from publications.

**Case studies**

In order to improve the datasets and provide higher resolution of the manufacture processes at specific sites, samples are needed from additional case studies throughout the region of the southern Levant. As much as possible, these should include sub-regions thus far not represented, as well as within the represented sub regions for detailed comparison. Likewise, it would be of great value to include case studies from the northern Levant (particularly the “Citadel Cities” in northern Syria [Wilkinson et al. 2012]), and possibly the Egyptian Delta, in order to track patterns over a wider geographic distribution. Although the focus of the present research was on matters relating to urbanization during MB I, there are additional topics that could be addressed for earlier or subsequent periods, especially looking at changes over time using high-resolution data. To this end, I also took samples of EB architecture at Pella and Dan during my field sampling, and acquired many new samples during the 2012 excavation season at Megiddo that represent a number of phases during the MB. These and other sites hold much potential for future sampling across many periods and types of architecture.

**Brick data**

In the future I plan to present and publish field methods for excavating, recording and sampling mud-bricks. The purpose would be to provide a systematic and standardized procedure that any field archaeologist can follow. Future researchers would then have access to useful data and material. At the very least, dimensions of bricks alone can provide valuable information without sampling or specialized recording techniques. A working form of this method was implemented in the 2012 summer seasons by the Jezreel Valley Regional Project and Megiddo Expedition. This practical field method could be implemented in a
number of geographic regions and chronological periods with far-reaching applications in archaeological research.

**Phytolith and botanical analyses**

In addition to the laboratory procedures I used to analyse my brick samples, it would be productive to include phytolith, macro- and microbotanical analyses of bricks. These analyses could potentially illuminate the types and/or quantity of straw or other vegetal matter used as temper in brick manufacture. Results could potentially indicate any of the following: seasonality of brick manufacture, the use of domesticated crops or wild plants, whether or not a variety of materials are used, and possible agricultural subsistence strategies. At the very least, these analyses would provide a further category for correlating compositional data from brick analysis in order to interpret patterns of manufacture, and can be incorporated with the existing analytical procedures.

**Experimental archaeology and ethnography**

There are a number of applications for experimental archaeology that would contribute significantly to our understanding of brick manufacture and earthwork construction. In light of the rates of labour and techniques presented in this study, there are a number of ways in which the proposed chaîne opératoire could be tested and better understood based on systematic trials and observations. Based on our understanding of ancient building practices, systematic experiments should be undertaken to replicate the process of mud-brick manufacture in order to test a number of important issues, including: patterns in sediment compositions and brick quality; variations in temper type and use; drying times and considerations; mortar manufacture and use; transportation of materials and bricks; brick-laying; manufacture and use of mud plaster; and rates for all of these tasks. Of particular potential value to understanding mass production of bricks during a period of urbanization would be determining correlations between the manufacturing process and resulting brick-types, correlating types with raw materials, manufacture technique and batches produced. Likewise, deviations in brick dimension should be assessed based on the extent of shrinkage during the drying process in order to determine whether or not variations in composition may result in differently-sized bricks formed by the same moulds.

Additional ethnographic research will provide an extremely useful source of information regarding brick manufacture and construction techniques on which experimental work should be based. Furthermore, future research on bricks and brick architecture should encompass many more geographic regions (e.g. Africa, South and Central Asia, Americas) and periods.
Near Eastern systems of belief

As suggested above, the city was probably an important symbolic manifestation of certain aspects of the MB Canaanite worldview, much of which may be apparent from roughly contemporary mythologies pervasive throughout the Near East and beyond. Cosmogonies, or myths dealing with creation, represent much of the conceptual framework of ancient society’s view of origins, cosmology, divine power and human rule. Many cosmogonic myths involve a struggle between two divine entities for universal kingship and sovereignty, in which one of the combatants—the proponent—represents good, order and fertility, while the opponent represents evil, chaos and infertility; thus, the outcome has universal cosmological significance (Homsher 2005, 5). Examples of such myths may be found throughout the Eastern Mediterranean and Near East from the third to first millennia B.C.E., including: Hittite Illuyakensas; Hurrian Ulikummi; Greek Apollo-Python and Zeus-Typhon; Canaanite Baal-Cycle and Aqhat; Mesopotamian Enuma elish, Anzu, Lugal-e and Gilgamesh; Egyptian Set-Horus; Indian Vritra; and Persian Bundahišn. The many affinities shared by these myths suggest fundamentally common ideologies regarding cosmology, which were most likely shared by Bronze Age Canaanites to some degree.

Future work regarding urbanization in the Levant during the MB should take this worldview into consideration as it relates to the perception of cities and the role of the divine and greater cosmos in urban construction. Certain myths may have important relevance for interpreting the symbolic significance of construction, such as Gilgamesh constructing the massive brick wall of Uruk and others in which kings are credited with laying foundation bricks of monumental buildings. Particularly relevant literature for the Levant is the Canaanite Baal-Cycle preserved in LB Ugarit (Ras Shamra), where the text was most likely composed around the mid-second millennium B.C.E. (Smith 1997, 81). Closely connected Mesopotamian myths include: (1) Lugal-e, from the late third millennium (Jacobsen 1987, 234); Anzu, with a version preserved in Old Babylonian (Dalley 1992, 203); and Enuma elish, possibly from the early second millennium, but preserved from the turn of ca. 1000 B.C.E. (Dalley 1992, 228; Batto 1992, 35-6; Clifford 1994, 83; Lambert 1964, 3ff). These and other (e.g. Gilgamesh, Atrahasis) canonical Mesopotamian texts have been found at Hattuša in the Hittite empire, Ugarit, Emar (a crossroads of East and West) and Meggido in Canaan, indicating their relevance throughout western Asian society. Furthermore, the residual influence of the worldview reflected in these myths can be detected in the Hebrew bible, which was written in the southern Levant during the first millennium B.C.E., but pieces together much earlier mythological traditions in the region (cf. Homsher 2005). By investigating prevailing patterns in mythologies of the ancient Near East, it may be possible
to interpret key ideologies that contribute to understanding the impetus and perceptions of urbanism during the MB.

**CONCLUSION**

In this study, I have synthesized data and contributed to the current understanding of the MB in the southern Levant and sought to better understand the process of urbanization during this period during which Canaanite society was transformed. The data I compiled for my analysis should prove useful for further research using similar or different methods. The methods I developed for field sampling and analysis have proven to be an effective first step towards using mud-bricks to address complex anthropological questions. This potential builds on the contributions made through geoarchaeological sampling and analyses undertaken by most researchers, which usually address issues of provenience and composition, but neglect further applications regarding manufacture and social practice.

My work on mud-bricks and architecture contributes to research on technological innovation and organization of production. By assessing bricks according to standardization, as a measure of specialized production, it was possible to assess patterns of specialized production and social organization based on well-contextualized archaeological material. As far as I am aware, my study is the first attempt to discuss architecture in terms of modes of production, which is usually reserved for other classes of artefacts, particularly ceramics. However, for understanding the specific process of construction during a particular phase (i.e. urbanization), architecture serves as the most valuable assemblage of material for analysis, since it is immediately and permanently “consumed” in a fixed place, unlike ceramic assemblages that may represent different origins of manufacture over a length of time. Taken together with other aspects of technological innovation during this period (e.g. ceramics, metallurgy, textiles), mud-brick architecture permits a discussion of MB urbanization as a process of developing social complexity based on patterns of social organization measureable and grounded in the archaeological record.
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