THE “ENERGETICS” OF MYCENAEAN DEFENSE WORKS: ASSESSING LABOUR INVESTMENT FOR FORTIFICATION CONSTRUCTION DURING THE LATE HELLADIC PERIOD (ca. 1600-1200 B.C.)

A Thesis Submitted to the Committee on Graduate Studies in Partial Fulfillment of the Requirements for the Degree of Master of Arts in the Faculty of Arts and Science

TRENT UNIVERSITY

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ABSTRACT

The “Energetics” of Mycenaean Defense Works: Assessing Labour Investment for Fortification Construction during the Late Helladic Period (ca. 1600-1200 B.C.)

Philip S. Cook

This thesis examines the mobilization of labour required for fortification construction during the Late Helladic (LH) period of the Aegean Bronze Age. It adopts an “energetics” approach to architecture, as a framework for systematically calculating the labour costs of construction, and using such costs to infer relative differences in political power among groups and communities through the implied differences in labour control. Accordingly, construction costs were generated for thirty-six LH fortifications, located across seven distinct regional zones of the Greek mainland and Aegean Sea. These values were then compared and evaluated against what is known of the political geographies for each region, to measure the extent to which the mobilization of labour was a function of regional power in Late Bronze Age Greece. These assessments revealed that a wide range of variation existed among the sampled regions in terms of the strength and nature of this connection, underscoring the diversity in labour relations that developed throughout the Aegean during the LH period. The labour costs were also used to suggest specific systems of recruitment that may have been in place for mobilizing workers, and to argue that fortification construction would not have been particularly burdensome or demanding for certain local populations.

Keywords: Aegean Late Bronze Age, fortifications, Mycenaean, monumental architecture, construction, energetics, labour, power
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CHAPTER 1
INTRODUCTION

1.1 Research Context and Objectives

The construction of fortifications represents a distinctive feature of the Aegean Late Bronze Age (LBA). A growing number of settlements had begun to erect substantial defense works throughout the 17th-15th centuries B.C., and by the 14th century B.C., fortification construction escalated dramatically in both prevalence and scale, coinciding with the expansion of Mycenaean culture across the Aegean. Although the largest and most impressive fortifications are generally associated with the major citadels of the Mycenaean palaces, fortifications were not strictly a “palatial” phenomenon. Rather, they represented a surprisingly pervasive form of monumental architecture, as fortifications appear at different types of settlements, and varied immensely in terms of where, when, and how they were built.

Mycenaean fortifications have traditionally been studied in functional and symbolic terms, which generally give emphasis to either their defensive properties or potential meanings. Alternatively, they might also be understood as products of labour investment. The actual logistics and scale of their construction have been topics of widespread interest and speculation, as the fortifications observed at several major sites are thought to have been exceptionally costly in time and manpower—so much so that even later Greeks such as Pausanias (Description of Greece 2.16.5) saw them not as works of earlier people, but of the mythical Cyclopes. Certainly, an understanding of fortifications in relation to their labour costs would allow us to appreciate these structures
in more direct and comprehensible human terms—something different than what we would otherwise get from more abstract, subjective impressions of size.

Examining the different scales of labour required for construction might also be useful for understanding labour relations in the Mycenaean world, regarding how labour mobilization for monumental construction corresponded to the larger political landscape of the LBA Aegean. Following a long tradition in anthropological thought, archaeologists have often identified a positive correlation between monumental architecture, labour control, and political power, whereby larger pools of surplus labour could be mobilized by more powerful elites for the construction of grander, more intensive works of architecture, as a means of both expressing and augmenting their authority (e.g., Price 1984; Abrams 1989, 1994; Trigger 1990; Webster 1990; Kirch 1990; Moore 1996; Knapp 2009). Although this general principle has been observed across a wide range of past societies, to what extent can it be demonstrated for Mycenaean Greece? Can this trend be observed uniformly across the Aegean throughout the LBA, or were there subtle differences in how monumental construction related to local and regional structures of power? Essentially, how did the scale of labour mobilized for construction correspond to the presence or extent of Mycenaean palatial authority?

By calculating the labour costs of LBA fortifications, and evaluating them in relation to the underlying political geographies that developed in each region over time, this thesis uses fortifications as one way to measure the extent to which labour mobilization was a function of regional power in LBA Greece. The purpose will be to demonstrate that, in fact, a wide range of variation existed among the different regions in terms of the strength and nature of this connection. The unique trajectories of
development for each region led to a diversity of settlement systems and inter-site political relations, which accordingly may have produced a similar regional diversity in the organization of labour. Other potential implications of the construction costs are considered as well. They are used to identify the very systems of recruitment by which workers may have been mobilized (familial, festive, corvée, etc.), and to suggest that the scale of labour expenditure for such building projects would not have been burdensome enough to undermine LH society and potentially induce the collapse of the Mycenaean palatial system by ca. 1200 B.C.

A general connection between labour mobilization and regional power may already be somewhat apparent, given the occurrence of large-scale fortifications at various palatial sites, and the observable differences in size among the fortifications of major and minor settlements. This study represents an attempt to substantiate these observations with more empirical measures, by using the physical qualities of the structures themselves to calculate levels of energy investment, and compare such investment systematically as discrete units of labour-time. By comparing them in a regional context, it will also be possible to outline any potential variation that would otherwise be overlooked by more general assessments of Mycenaean fortification construction. Ultimately, the labour-cost estimates calculated here will prove valuable in testing the currently informal, subjective presumptions of how monumentality, labour control, and power were interrelated in Mycenaean Greece, and how this might have differed for each region.
1.2 Outline of Thesis

This thesis begins by first providing background into the development of Mycenaean society during the LBA, and discussing what is known of Mycenaean labour organization and the construction of fortifications (Chapter 2). Following this review, I then outline the theoretical framework for this study and discuss the underlying principles of an “energetics” approach (Chapter 3), which concerns the connection between power and labour mobilization, and how such a connection may be inferred from monumental architecture. In Chapter 4, I describe the energetics method itself, regarding how labour-cost calculations are typically made, what they represent, and the methodological weaknesses that may be potentially involved. This general discussion lays the groundwork for describing my own application of energetics to Mycenaean fortifications.

The labour-cost calculations are then presented in Chapter 5, focusing first on the overall statistical trends that can be observed from the sample as a whole, and then outlining the labour-cost patterns that are specific to each region. In Chapter 6, the labour costs are evaluated against what is known of the political geographies for each region and how they developed over time. Each section begins with a review of the literature, drawing on the broadest available range of independent studies, syntheses, monographs, and reports, where each region is discussed and characterized in terms of settlement organization, population density, sociopolitical structure, and possible intersite relations (as well as how these features may have developed and changed over time). Then, I reassess the calculated differences among the labour-cost estimates, and look at the
correspondence between the scale of labour mobilized to build fortifications, and the perceived extent of a site’s regional power and political status.

Finally, these various discussions are brought together in Chapter 7, with a consideration of the extent to which fortification construction can be useful for effectively locating power in the LBA political landscape. The estimates are also used to suggest specific systems of labour organization, and to explore whether labour expenditure could have been causally associated with the phenomenon of collapse observed throughout the Aegean towards the end of the 13th century B.C.

1.3 Notes on Chronology

Table 1.1 shows the relative and absolute chronology for the areas and periods covered in this thesis, as adapted from Bennet (2007:178, Table 7.1) and Shelmerdine (2008:4). The absolute date ranges represent approximations, and are subject to further changes and refinements. The abbreviations for the Middle and Late Helladic (MH, LH), Minoan (MM, LM), and Cycladic (MC, LC) periods are used in thesis, as are those for Middle Bronze Age (MBA) and Late Bronze Age (LBA).

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Table 1.1. Chronological table for the Aegean Bronze Age (adapted from Bennet 2007:178 and Shelmerdine 2008:4).
2.1 Introduction

This chapter provides thematic background by outlining the history of social and political development associated with the rise and decline of Mycenaean society. The review begins with a broad focus, by summarizing the overarching changes in social organization and material culture that occurred throughout much of the Aegean from the end of the MH period to LH IIIC. Attention is then given to emphasizing the regional differences in these changes, and in particular, to how distinct political geographies emerged out of unique trajectories of local and regional development.

From this larger context of sociopolitical change, the focus then shifts to the subject of labour relations in the LH period, regarding what is currently known of the modes of labour organization associated with construction, and how they were structured specifically under Mycenaean palatial systems. The chapter concludes with a discussion on LH fortification construction, as one particular product of such labour relations. I summarize the history and development of style and form, what is known of the processes and techniques of construction, and how such fortifications have traditionally been studied and interpreted. This discussion will serve as a point of departure for considering how LH fortifications may be alternatively studied from the perspective of labour investment, and how the scale of labour mobilized for construction might relate back to the systems of regional political power that developed over the LBA.
2.2 General Patterns of Development during the Late Helladic Period

2.2.1 Early Mycenaean period (MH III-LH II)

The MH “hiatus” in occupation and activity that occurred throughout much of the central and southern mainland had effectively subsided by MH III (Cherry and Davis 2001:155-6; Wright 2004a:119-28), when existing settlements began to expand, and new settlements were founded further inland or on the slopes of coastal plains (Rutter 2001:131; Wright 2008:233-42). At this time, we also see distinct changes in domestic architecture and settlement layout. The apsidal, free-standing structures that typified most MH communities were gradually replaced by rectilinear axial buildings, which often shared a similar orientation and indicate an increased concern for civic planning, in response to settlement growth and consolidation (Dietz 1991:293-4; Wright 2008:235-8).

Changes in mortuary behavior during the early Mycenaean period offer perhaps the clearest indication that communities were becoming more stratified, as a distinct class of “elites” began to differentiate themselves through deposited wealth and treatment of the dead (Mee and Cavanagh 1984; Wright 1987; Graziadio 1991; N. Papadimitriou 2011; Petrakis 2010). During MH III-LH I, there was a general tendency to shift from scattered, intramural burials to extramural cemeteries, where we often find well-demarcated tumuli, mounds, or collective plots that were likely used exclusively by specific lineages or factions (Mee and Cavanagh 1984:45-9; Dabney and Wright 1990:49; Voutsaki 1998:44). The appearance of reserved burial areas also coincided with a gradual change in grave type, as nascent elites tended to adopt more monumental grave structures (Bennet 1995:596; Wright 2008:238). Although associating tomb types with specific social classes may be problematic (Mee and Cavanagh 1984:49; Voutsaki 1998;
Lewartowski 2000:47-51; Cavanagh 2008:334), monumental tholoi and elaborate chamber tombs were used more frequently in LH I-II by the higher-ranking members of various mainland communities. The majority of the populace still continued to use the simple pits and cists that had been more pervasive during the MH period (Wright 2008:238).

Social differentiation is also reflected in the grave goods themselves, as the elites of the early Mycenaean period were interred with progressively richer assemblages. The range of deposited items typically included boar’s tusk helmets, obsidian points, imported pottery, and various exotica, as well as weapons, jewelry, and vessels made of gold, silver, or bronze (Crowley 2008:259-61). These assemblages suggest that the status of emergent Mycenaean elites was generally tied to both the expression of a warrior ethos (Cavanagh 2008:335; Deger-Jalkotzy 1999; Harrell 2013), and the establishment of overseas contacts—especially with the Aegean islands and the contemporary Minoan palaces, which are seen as having played a major role in stimulating the rise in wealth and social differentiation on the mainland (Dietz 1998; Graziadio 1998; Voutsaki 1999:103). The escalating display of exotic wealth observed in early Mycenaean tombs points to a particular strategy of conspicuous consumption, in which competing elites used exotica to demonstrate their access to distant lands and exclusive gift-exchange networks, thereby enhancing their status and legitimizing their power at the local level (Voutsaki 1995, 1998, 2010a; Graziadio 1998; Schon 2010). The concurrent rise in the monumentality of funerary structures may be similarly interpreted as conspicuous consumption (Mee and Cavanagh 1984:49; Wright 1987; Fitzsimons 2011), where power
and status would have been expressed through the implied access to labour, resources, and knowledge for construction (Trigger 1990).

Such elite competition occurred not just within local communities, but also on an inter-site and regional level. Comparable settlement sizes and the relatively wide distribution of tumuli, tholoi, and chamber tombs across certain regions speak to the existence of a number of prominent communities during the early Mycenaean period, which would have been in direct competition for land and resources under the pressure of a growing population (Wright 2008:244). The success of certain settlements over others would have come about not only through diplomatic strategies or overseas contacts with Crete and abroad, but also potentially through direct force (Acheson 1999; Davis and Bennet 1999), as warfare would have provided an opportunity for local elite individuals, factions, or lineages to enhance their status, consolidate power over a broader territory, and enlarge both the labour force they commanded and its productive capacity (Wright 2008:244-9). Such open conflict is suggested by the construction of early fortifications at various major settlements in Messenia, the Argolid, and Attika during MH III-LH II (Hope Simpson and Hagel 2006:33-43, 52-58, 64-72).

2.2.2 Mycenaean palatial society (LH IIIA-B)

By LH IIIA, and continuing into LH IIIB, a few of the most successful settlements developed into state-level polities. The emergence of Mycenaean “palatial states” can be loosely characterized by the formal institutionalization of centralized power, which was tied to and manifested in the monumental palace complexes. Traditionally, Mycenaean palaces have been identified at Mycenae and Tiryns in the
Argolid, Pylos in Messenia, Thebes in Boeotia, and Knossos on Crete; other potential palatial centres may include Athens in Attika, Orchomenos in Boeotia, and Dimini in Thessaly (Shelmerdine and Bennet 2008:289; Middleton 2010:4-7). However, the identification of specific sites as palatial centres can be challenging and often disputable, owing to the ambiguity of the term “palace”. It represents both an architectural and social label, whose use often obscures the observed variation among traditionally identified palatial sites in form and function. Nevertheless, palaces are generally recognized by most as structures that served as the residence of a ruling elite, an administrative facility, a centre for craft production and the storage of staples, raw materials, and finished goods, and a focal point for ritual and feasting (Dickinson 2006:35; Wright 2006a; Galaty and Parkinson 2007:5; Shelmerdine and Bennet 2008:290-1).

One standard criterion for identifying a Mycenaean palace is the presence of Linear B tablets, which were used primarily for recording economic transactions. There is a remarkable consistency across the Aegean in the structure and language of the script (Palaima 2004:283), although there are also pronounced differences in where it has been found, and the nature and scale of such inscription (which, to a certain extent, may simply reflect accidents of preservation and discovery). Extensive archives have been discovered at Pylos and Knossos, while substantial quantities of clay tablets have also come from Mycenae, Tiryns, and Thebes (Palaima 2004:270). Linear B is present to a lesser extent at other sites not traditionally regarded as palatial, as inscribed sealings and other media with Linear B signs have been found at over a dozen other settlements (Sacconi 1974; Adriimi-Sismani 2006; Cosmopoulos 2006; Driessen 2008; Van Alfen 2008; Carlier et al. 2012). The occasional and infrequent presence of Linear B on sealings and imported
pottery need not imply literacy at a particular site itself (Shelmerdine 2001a:357), although we cannot rule out the possibility that in some cases, knowledge and use of Linear B may have extended beyond the physical and administrative confines of the palaces.

Another criterion is the presence of a central “megaron” complex—an axial, tripartite building unit that generally formed the architectural and ideological focus of Mycenaean palatial centres (Kilian 1988; Shelmerdine 2001:350; Wright 2006a, 2006b). Broad similarities in layout and construction can be readily observed among the megara at Mycenae, Tiryns, and Pylos (Younger 2005), although even these “canonical” palaces still exhibit subtle differences. Architectural similarities are perhaps less apparent among other major sites such as Thebes, Orchomenos, Gla, and Midea, which exhibit large building complexes with workshops, Linear B, remains of fresco decoration, and/or comparable construction techniques, but lack recognizable megara (Dickinson 1994:78, 91; Dakouri-Hild 2001a; Iakovides 2001; Walberg 2007). Conversely, two megara-like structures were in use at Dimini, but do not exhibit the monumentality, sophistication, and decorative elements of other major Mycenaean centres (Pantou 2010:382-3).

However they may be identified, Mycenaean palaces are understood to have been the central nodes of state-level polities, which varied in size and complexity, and were founded on dynamic and integrated political economies. Interpretations of these political economies have ranged from totalitarian and oppressive (Betancourt 1976; Sigrid-Jalkotzy 1996) to minimalistic and underdeveloped (Sherratt 2001; Small 2007). Recent studies have begun to favour more of a middle-ground approach (e.g., Voutsaki and Killen 2001; Galaty and Parkinson 2007; Pullen 2010; Halstead 2011; Nakassis et al.
2011; Earle 2011), challenging earlier views of the palaces having been top-down redistribution centres that controlled all aspects of production, exchange, and consumption (e.g., Finley 1957; Desborough 1964:218; Renfrew 1972:296-7).

Textual and archaeological evidence instead seem to suggest that the palatial centres were selectively interested in only certain sectors of production. Pylos, for instance, ran a highly regulated and centralized system of perfumed oil production (Shelmerdine 1984, 1985), while Knossos focused mainly on exploiting wool textile production (Driessen 2001; Nosch 2011), and Mycenae specialized in ivory and glass production (Tournavitou 1995; Burns 1999). Conversely, ceramic and chipped stone production across the mainland remained largely unregulated and decentralized (Knappett 2001; Whitelaw 2001; Parkinson 2007), and most agricultural production appears to have been carried out beyond the administrative purview of the palaces (Halstead 1992, 2001; Foxhall 1995:239-44). The exchange of staples, services, and finished goods would have been equally as varied, occurring through both regular obligations and irregular transactions (Halstead 1992:71), and mostly following traditional, pre-existing channels of exchange (Palaima 2004:283). Although a general system of taxation has been inferred from the Linear B texts, it does not appear to have been regular or fixed (Halstead 1992:59; Dickinson 2006:41).

In effect, the term “mobilization” has been favoured over “redistribution” in characterizing LH IIIA-B political economies (Bennet 2007:207; Nakassis et al. 2011:180). While clearly playing a role in the direct and indirect mobilization of resources, the Mycenaean palace states did not exert full control over regional economies (Palaima 2004:269-70, Shelmerdine 2007:43). Rather, Mycenaean palatial elites seem to
have been mainly interested in the production of certain finished goods and prestige items, which were then circulated by means of ritual feasting, mortuary deposition, and ceremonial gift exchange, for the general purpose of promoting the centrality of the state and maintaining networks of political support (Wright 2004b; Schon 2010; Voutsaki 2010).

Much of this “network” strategy of political rule (Parkinson and Galaty 2007) depended on long-distance exchange between the mainland centres and those of Crete, Cyprus, and the Near East. Overseas exchange intensified by LH IIIA (Lambrou-Phillipson 1990; Cline 1994; Leonard 1994; Mee 2008), and although Linear B texts are generally quiet on long-distance trade, we find evidence in the widespread distribution of Mycenaean material culture throughout the Aegean, and even across the central and eastern Mediterranean (see Cline 1994). The palatial centres typically exported a selective range of commodities (e.g., ceramics, oil, textiles) to foreign markets, while also importing various finished goods (e.g., stone and faience bowls, cylinder seals, Canaanite amphorae) and exotic raw materials (e.g., metal, ivory, wood) for the local production of prestige items (Cline 1994; Burns 1999; Schon 2010). The extent to which long-distance exchange was regulated by the palaces is unknown, and surely smaller-scale independent or “entrepreneurial” forms of overseas trade continued to take place throughout the LBA (Tartaron 2013).

The Linear B texts reveal that an instituted social hierarchy had developed under the Mycenaean palatial states during LH IIIA-B. The most prominent figure, and perhaps closest to the notion of a Mycenaean “ruler”, was the wanax (Kilian 1988; Wright 1995; Palaima 2006:64-8; Shelmerdine and Bennet 2008:292-3). The wanax was likely
followed in rank by the lawagetas, who perhaps served as a kind of military leader, among other roles (Bennet 2007:192). Below these principle leaders was a “secondary elite” of palatial administrative officials—the eqetai (“followers”), “collectors”, and scribes—who each exercised delegated authority in economic, ceremonial, and military matters (Killen 1995; Bennet 2001; de Fidio 2001; Rougemont 2001; Palaima 2003). Beyond the palaces were also figures of local power—the qasireu, telestai, the damokoro (“provincial governor”), korete (“district governors”) and porokorete (“deputy governors”)—which represented variously ranking provincial leaders or officials, responsible for overseeing the collection of obligatory taxes and the mobilization of resources for palatial production (Shelmerdine and Bennet 2008:292-5). Finally, the “commoners” were referred to collectively as the damos, the body politic that paid annual taxes to the palaces, but also maintained a certain degree of legal standing and independent authority, at least with regard to land ownership (Dickinson 1994:84-5; Palaima 2004:298; Shelmerdine 2007:45).

These social positions and their various interrelations demonstrate that no simple palatial elite/non-elite dichotomy existed during the Mycenaean period, as had often been assumed (e.g., Chadwick 1976:77; Drews 1988:195). Our understanding is, of course, somewhat biased and limited, seeing as the Linear B sources and these various social titles solely reflect the views of the palaces, and reconstructions of Mycenaean social organization have typically relied on tablets from Pylos. Nevertheless, the social hierarchies of palatial society would likely have represented a complex network of individuals with various powers, duties, interests, and connections (Nakassis et al. 2010:246). Authority was exercised not only vertically but also horizontally, and it is also
important to recognize the heterarchical relations of power that may have existed among high-ranking individuals; even the wanax himself is thought to have secured and negotiated his power mainly through the enfranchisement of local leaders, who then constituted a “secondary elite” (Schon 2010).

The relations of power among LH IIIA-B communities are not as well understood. Linear B texts have only been effective in reconstructing the regional political geographies of Messenia and Boeotia under Pylos and Thebes, respectively (see Chapter 6, Sections 6.2.4 and 6.2.6). The political organization for other regions is less well-known, and site hierarchies have only been tentatively reconstructed through a limited number of systematic surveys. Still, it has become increasingly apparent that the “central-place” hierarchy under Pylos should not be assumed to have been typical for other regions at this time (Pantou 2010:398). The Mycenaean koine or standardization in material culture that developed across much of the Aegean in LH IIIA-B—most notably in architecture and pottery (Mountjoy 1986:11-18, 1999:27; Wright 2006a:23-5)—cannot be equated with a uniformity in social, political, and economic organization. Indeed, palatial state systems were not established everywhere in the Aegean, and the development towards state-level society was neither inevitable nor homogenous throughout the Aegean (see below).

2.2.3 Collapse of palatial society (LH IIIB-C)

Towards the end of LH IIIB, a series of destructions and abandonments occurred across much of the Aegean (Lewartowski 1989; Dickinson 2006:41-56, 2010; Deger-Jalkotzy 2008; Middleton 2010). This phenomenon was not limited to the palatial centres,
as it has also been observed among large non-palatial sites (e.g., Teichos Dymaion, Gla, Krisa, and Midea) and various minor settlements. Isolated and sporadic destructions had already begun to take place at certain major centres from LH IIIA1 onwards, which may simply reflect accidents or deliberate demolitions for rebuilding (Dickinson 2006:42; Middleton 2010:12). However, destructions by fire had become far more widespread and devastating by the end of LH IIIB2, and are generally seen as the physical indications of the collapse of the Mycenaean palatial system. Following these episodes of destruction, many sites were subsequently abandoned, much of the Aegean experienced a decrease in settlement, and the major indices of palatial activity—e.g., the use of Linear B, monumental construction, the industrial production of commodities and prestige items—declined or disappeared entirely (Rutter 1992:62; Dickinson 2006:43-6; Deger-Jalkotzy 2008:392).

Although this phenomenon was widespread, the evidence points to a certain degree of inter-site and regional variation in the scale and timing of these disruptions. Sites such as Pylos and Gla were thoroughly burned down and abandoned for much of LH IIIC, while the episodes of destruction at Thebes, Mycenae, Tiryns, Midea, and Dimini were soon followed by tentative efforts at resettlement and small-scale rebuilding (Deger-Jalkotzy 2008:394-7). Other settlements (e.g., Brauron, Berbati, Zygouries, Eutresis, Ayios Stephanos, Nichoria) were simply abandoned, without any signs of destruction (Middleton 2010:15). Despite the difficulties in establishing a precise chronology for the phases of destruction (Jung 2010), there is also nothing to suggest that these events occurred simultaneously; even if dated to the same ceramic sequence, the disruptions could have taken place anytime over a period of at least twenty-five years.
Indeed, they tended to be recurrent, with various episodes of devastation, abandonment, and reoccupation extending well into LH IIIC (Lewartowski 1989; Dickinson 2006:60-1; Middleton 2010:14-15). We also find regional differences in the demographic impact of these events. Changes in settlement between LH IIIB and LH IIIC show that much of Messenia was almost virtually abandoned (Harrison and Spencer 1998:148-9; Mountjoy 1999:301), while regions like Achaia, Euboea, and the Dodecanese experienced stability or growth in settlement (Dickinson 2006:62-7).

Several theories have been proposed for explaining these events, and for modeling the ultimate causes of palatial collapse. Traditional accounts have attributed the disruptions to invasive foreign groups, such as the Dorians (Bartonek 1974; Chadwick 1975; Winter 1977), the “Sea Peoples” (Popham 1994:287; Deger-Jalkotzy 1998a:117; Nowicki 2000:263-5), or newly-armed tribes from northern Greece (Drews 1993), citing observed changes in LH IIIC material culture. Other theories have attributed palatial collapse to natural disasters or environmental disruptions, such as earthquakes (G.A. Papadopoulos 1996; Stiros 1996; Nur and Cline 2000; Vanschoonwinkel 2002) and periods of sustained drought (Carpenter 1966; Bryson et al. 1974; Weiss 1982; Moody 2005; Roberts et al. 2011). A more endogenous view emphasizes the social and economic problems inherent in complex societies (e.g., Flannery 1972; Rappaport 1977; Renfrew 1979a; Tainter 1988), and promotes a systemic approach to explaining palatial collapse by outlining the structural weaknesses inherent in the palatial system itself (Betancourt 1976, 2000:301; Hutchinson 1977; Deger-Jalkotzy 1996:716-18; Maggidis 2009), or emphasizing how changes in the larger “world system” of Mediterranean trade and
exchange could have undermined palatial society (Sherratt 2001, 2003, 2010; Thompson 2006; Kardulias 2010).

In effect, all of these factors are likely to have contributed in some way to undermining the palatial states and creating an atmosphere of turmoil and instability—although different explanations might carry varying degrees of weight and relevance, depending on the site or region being considered and the nature of the observed disruptions. The result was not as a terminal break with the past that uniformly ushered in a “dark age”, but rather a more nuanced and continuous process of social reorganization and cultural transformation (Dickinson 2006). What is referred to as “palatial collapse” should mainly be seen as a political phenomenon, characterized by Middleton (2010:116) as a “fragmentation of overarching power structures into smaller units.” This restructuring, in turn, brought about developments in social organization and material culture that reflect varying degrees of continuity and change. Local and regional distinctions in these changes show how the disruptions differentially impacted the LBA population, resulting in patterns of both decline and growth throughout LH IIIC.

2.2.4 Regional variation in LBA development and political geography

These generalized trends offer a useful framework for understanding the major changes that occurred in the Aegean over the course of the LBA, specifically regarding the developments associated with emergence and decline of Mycenaean palatial states. Underlying these broad changes, however, were unique trajectories of regional development, which resulted in distinct political geographies and local variations in Mycenaean culture (Dabney and Wright 1990:48; Wright 2008:242; Middleton 2010:7).
Such diversity has already been alluded to in the above discussion, particularly with regard to the differences observed among the palatial systems of the Argolid, Messenia, and Boeotia. Despite their analogous development into state-level polities by LH IIIA, with comparable modes of production, exchange, and social control, each palatial centre emerged out of distinct patterns of regional growth, competition, and consolidation, which had brought about unique settlement systems and inter-site relations throughout the LH period.

It is also important to note that other regions in the Aegean never produced state-level polities in the LBA. There is a conspicuous absence of palatial centres or any pronounced settlement hierarchy in regions such as Achaia, Elis, Arcadia, Corinthia, Epirus, and inland Thessaly. The absence of a discernable palace in Corinthia is especially surprising, given its close proximity and ties to the centres of the Argolid (Pullen and Tartaron 2007). In the Cyclades, several major sites exhibit an extensive degree of Mycenaean influence in material culture during LH III, but it is unclear as to whether this necessarily implies the hegemony of one or many centres from the mainland, or if palatial-like modes of social, political, and economic organization had been adopted among any of the island sites (see Chapter 6, Section 6.2.5).

There is often a tendency to see these regions as “peripheral”, in relation to a supposed Mycenaean “core”—which has traditionally included the Argolid, Messenia, Laconia, Attika, Boeotia, and coastal Thessaly (Middleton 2010:4). Such a division represents an attempt to define the limits of a perceived “Mycenaean world”, but this in itself assumes that these core regions constituted a static, uniform, and integrated cultural and political entity. What should be referred to as “Mycenaean” is the cultural expression
of a particular mode of social, political, and economic organization that developed in LH IIIA-B—a culture that was fostered by an elite minority, became roughly standardized through competitive emulation, and was gradually appropriated by a broader cross-section of LBA population (Renfrew 1986:8; Wright 2006a:23-5; Feuer 2011). Hence, rather than assume a common identity or any kind of political unity across certain parts of the Aegean, we should consider each region’s development in its own right, in terms of a process of “Mycenaenization” (N. Papadimitriou 2008:101), or the extent to which an area or region effectively established a particular system of economy, administration, and social control.

Because of the observed differences in sociopolitical development, this thesis adopts a distinctly regional focus for measuring patterns in labour investment. In this way, the calculated labour costs for fortification construction can be assessed in more specific political contexts, and with more refinement in space and time. The developmental history of each region considered in this thesis will be outlined in more detail in Chapter 6.

2.3 The Mobilization of Labour for Construction: What We Know

The Linear B texts offer a direct line of evidence for how surplus labour for construction might have been mobilized under the palatial system, and how the actual work parties for construction were organized. Certain tablets from the Pylian archives—namely, from the An and Fn series (Nakassis 2012)—specifically concern architectural labour, and document the allocations of foodstuffs to specific groups and individuals associated with construction (although the intended projects are not specified). PY Fn 7
mentions twenty wall-builders (*to-ko-do-mo*), five sawyers (*pi-ri-e-te-re*), one “all-builder” (*pa-te-ko-to*), and two specifically-named individuals who are given the largest allocations (Melena 1998). The different scales of allocation likely speak to different roles in the organization of work; the wall-builders and sawyers received comparable rations as skilled labourers, while the single “all-builder” received at least three times as much, and presumably served as the foreman, who organized and supervised the activities of the work crew (Nakassis 2012:275). The two named individuals may simply have been “well-known specialists” (Melena 1998:175-6), but Nakassis (2012:276-9) suggests that their large rations may have gone towards recruiting unskilled labourers, who are absent in the tablets but nevertheless would have been necessary for menial tasks such as excavating foundations, moving earth, and procuring and transporting materials. This provisioning might then provide evidence for a system of *indirect*, negotiated conscription by the palaces through local intermediaries (Nakassis 2012:269), which would have supplemented other methods of *direct* conscription, such as statute or “*corvée*” labour (Killen 2006a, 2006b).

These levels of allocation accord with Wright’s (1980:82-3) earlier thoughts on the organization of work for constructing palatial terraces, drawn instead from the physical properties of the architecture itself. The division of the structures into separate units suggests that the process of construction may have been similarly compartmentalized, whereby multiple crews could work independently and simultaneously, each supervised by only a single foreman. This modular organization of work may also have been adopted for the construction of fortifications at the larger citadels, given the offsets and case-mate style observed in the circuit walls at Gla and
Tiryns (Wright 2005). Wright (1980:83, n.74) notes how given the use of offsets, and the coursing of the walls along the contour of the bedrock, “close supervision of the work was not necessary beyond the foreman of a work crew and technical advice from a general overseer.” This simple hierarchy in work organization is similar to that inferred from the Linear B allocations, so we might suppose that the levels of recruitment inferred from the An and Fn series could have been implemented for a broad range of large-scale construction projects.

The insights from the Linear B texts are admittedly limited, as they are not only restricted to the conditions of palatial society, but those of one specific polity (Pylos). Given the limited textual evidence from other palatial sites, it is not yet known how the palatial centres were alike or different in the system(s) of mobilization for construction—i.e., if they instituted a predominantly corvée system, adopted alternative systems of indirect paid conscription, or relied on more familial and reciprocal labour relations (cf., Udy 1959:56-9). It is also not known with any certainty how the recruitment of labourers for construction, either skilled or unskilled, had been organized beyond the palaces, at other major and minor settlements.

In tracing out basic patterns of labour investment from the structures themselves, this thesis will also explore the ways in which labour may have been mobilized among certain groups of sites. Following other energetics studies (e.g., Abrams 1994:96-108), an attempt is made in Chapter 7 to correlate the different scales of energy expenditure with basic labour systems that have been identified ethnographically.
2.4 Late Helladic Fortifications: Filling in the Gaps

2.4.1 Stylistic development of LH fortifications

Although fortified settlements were relatively widespread in EH and EC II (Broodbank 2008:55-65; Pullen 2008:30-2), fortifications appear only sporadically during the early and middle MH period, having been found only at the island settlements of Kolonna on Aegina and Ayia Irini on Kea (Davis 1979; Walter and Felten 1981) (Figures 1-3). An increasing number of sites had again become fortified towards the end of the MH period and during LH I-II, when expanding settlements began to construct “rudimentary but effective” defense works, with simple towers and gateways (Wright 1978:68-70; Iakovides 1999:199). The most noteworthy examples come from Messenia (Malthi Dorion, Peristeria, and Pylos) and Attika (Kiapha Thiti and Brauron).

These early fortifications tended to follow a uniform curved plan along the crest of a citadel’s bedrock, and were generally unbroken by any straight sections, offsets, or bastions (Wright 1978:68-9). The curtain wall consisted of two faces of unworked, uncoursed masonry, typically built with medium-sized, flat slabs of stone that were set without mortar, and reinforced with a loose rubble core. At Peristeria, Malthi Dorion, and Kiapha Thiti, rooms from the settlement were attached directly to the inner face of the walls (Figures 4-6). The last site stands out in particular for the highly variable changes in width observed throughout the course of the wall (2.1-6.0 m), representing a functional response to the uneven topography of the hillside, and a means for strengthening the corners and protrusions of the wall (Hagel 1992:49-50). Kiapha Thiti is also notable for the presence of auxiliary entryways or “sally ports”, a main ramp, and the use of vertical
orthostatic blocks along the outer face, which served to buttress the sections where the foundations did not reach down to bedrock.

During LH IIIA-B, there was a dramatic increase in fortification construction across much of the mainland, which coincided with the development and formalization of a distinctly “Cyclopean” masonry (Loader 1998:152-163). The term Cyclopean refers to structures built of massive rubble masonry, in which large unshaped blocks—averaging 0.70-1.50 m in length, 0.60-1.00 m in height, and 0.80-1.00 m in thickness—were fitted together with smaller interstice stones, and bonded with an outer layer of mud (Wright 1978:66-8; Hope Simpson and Hagel 2006:23-6). Cyclopean fortifications were generally uncoursed throughout most of curtain wall, but at visually prominent and structurally weak areas, such as gateways and corners, the blocks were hammered smooth and laid in distinct courses. Almost all LH III fortifications maintained the basic structure of their early LH predecessors, in consisting of two parallel faces that were filled with a thick core of stones and moist earth, and built directly onto solid bedrock that was either leveled off or evened out with a bed of pebbles and clay.

The label “Cyclopean” had traditionally been applied in a very inclusive manner to most LH fortifications that exhibited large stones (e.g., Mylonas 1966:14-21; Skoufopoulos 1971), but recent studies have shown more refinement in classifying such structures. The focus has shifted towards not only distinguishing more effectively between “Cyclopean” and “non-Cyclopean”, but also tracing out different types and regional variants of Cyclopean construction across the mainland. Loader (1998) has identified five distinct types of Cyclopean construction based on certain architectural
criteria—although this typology has been recently critiqued by Hope Simpson and Hagel (2006:23-9) as being perhaps too arbitrary and exclusive.

Some foreign influence in the form and style of Cyclopean fortifications has been suggested, but their overall development appears to have been grounded in mainland traditions—primarily from the Argolid and Boeotia (Loader 1998:123-154; Hope Simpson and Hagel 2006:26-8; Wright 2006a:35-7). A certain degree of standardization occurred throughout the Aegean in LH IIIA-B, where fortified settlements of varying size and status seem to have imitated the canonical Cyclopean form developed at Mycenae and the Argive citadels, perhaps out of competitive emulation or even through the direct sharing of masons (Wright 2006a:37, 41). Still, no two fortifications are the same, as differences in geology, topography, and distinct stylistic preferences ultimately resulted in localized adaptations and “provincial” variations on the Argive theme (Iakovides 1999:200; Hope Simpson and Hagel 2006:28; Wright 2006a:35).

LH fortifications first begin to exhibit Cyclopean features in LH IIIA1-2, at the earliest known construction phases at Tiryns and Mycenae (Figures 7-9). These preserved sections reflect the use of carefully selected blocks of regular size, a clear attempt at coursing, and heavier rubble fill with larger stones mixed in with clay (Wright 1978:74-6; Iakovides 1983:3-5, 27-9). Early Cyclopean construction is also evident at the somewhat contemporary circuit walls of Krisa and Thebes (Figures 10-12), in which large blocks—although uncoursed and of irregular size—were chinked with smaller stones (Wright 1978:72; Symeonoglou 1985:27).

Mycenaean fortifications reached their maturation in form and complexity during LH IIIB, where we see slight modifications to the masonry, such as a greater reliance on
chinking, and less emphasis on dressing the stone (Iakovides 1999:200). Notably, offsets were used in the circuit walls at Tiryns and Gla, as an innovation dictated by the rectangular nature of the local stone, which allowed builders to adapt more effectively to the irregular coursing of the bedrock (Wright 2005). Fortifications at this time also tended to exhibit more formalized defensive features, such as towers, guard houses, sally ports, bastions, and corbelled passageways (Figures 13-15), which show a relatively higher level of sophistication in construction than those of earlier phases (Wright 1978:76-98; Iakovides 1983:1-2; 1999:201-3). These various defensive features are observable not only at Mycenae and Tiryns, but also at Gla, Athens, and Midea (Iakovides 1983). They are less prominent or entirely absent at other LH III fortified sites, whose defense works are often of Cyclopean style, but with less elaboration and of lower-quality construction.

2.4.2 Construction materials, methods, and techniques

The stone for fortification construction almost always consisted of hard or poros limestone, which was readily available from the outcroppings that cover much of the Greek mainland (Wright 1978:66-7; Higgins and Higgins 1996; Loader 1998:42-6). Because of its relative abundance, using stone for the main body of the walls proved to be more economical than the preparation of mudbrick (Iakovides 1999:200), which was used more extensively in Hittite fortifications, such as those at Hattusa (Seeher 2007). Limestone also served as good building stone, given its low porosity, well-defined cleavage, and widely spaced joints, which often had the effect of producing large slabs (Loader 1998:44). An alternative to limestone was conglomerate, which is only found in certain sections of the walls at Mycenae and Tiryns (Wright 1978:99-102; Maran 2006a:
Conglomerates were favorable for aesthetic reasons, but were much less available and more difficult to extract and shape (Loader 1998:44-5; Nelson 2007:141). Although limestone was similarly employed among most LH fortifications, subtle differences in geology throughout the Aegean tended to affect block shape—i.e., rough polyhedrons at Midea (Figures 16-17), as opposed to the rectangular-shaped slabs at Teichos Dymaion and Gla (Figure 18-20)—which in turn influenced the style of masonry (Loader 1998:44).

Extracting the limestone for construction would have been relatively straightforward at most sites, given the properties of the rock formations across the mainland and the rough, undressed quality of Cyclopean blocks. “Quarrying” may have simply involved prying loose blocks from tilted, parallel beds—either by placing levers into the natural fissures of the rock, or using picks to cut channels of varying depths and prying off the blocks with wedges (Wright 1978:66-7, 1980:83 n.73; Loader 1998:50-4). Of course, physical evidence for systematic quarrying is lacking for mainland Greece (largely because of later quarrying activity and the absence of any dressing areas), and our understanding of Aegean Bronze Age quarrying comes mainly from Minoan Crete (e.g., MacGillivray et al. 1984:144-9; Tzedakis et al. 1989; Waelkens 1992; Loader 1998:50; Shaw 2009). Still, it is not unlikely that Minoan tools and techniques would have been adopted by mainland groups during the LH period (Cavanagh and Mee 1999:96), especially the much simpler methods associated with quarrying Cyclopean blocks.

Transporting building material to the construction area might have also been relatively basic, owing to the close proximity of limestone sources (Wright 1978:67).
most cases, the building stone would have likely been extracted directly from the building site or acropolis itself (Wright 1978: 67, 73; Iakovides 1999:200; Shaw 2009:38). Oxen are suggested to have provided the necessary draft power for transporting stone, which would have been loaded onto four-wheeled wagons (Loader 1998: 55-8, 69; Shaw 2009: 37-38). Although oxen are attested to in Linear B texts (Palaima 1989), evidence that draught-powered wagons were used for heavy transport in the LBA construction is lacking, and many early arguments often cite examples of vehicles and harnessing that date to much later periods in antiquity (e.g., Heizer 1966:827; Burford 1969:184-91; Coulton 1977:141). It is also difficult to identify which specific sites would or would not have used oxen or wagons for such construction efforts (see Chapter 4, Section 4.3.4 for other reasons oxen are not considered here as a means of heavy transport). Human-powered transport seems more probable for the majority of LH sites, where workers could have used simple wooden sledges to haul blocks of several tons (Atkinson 1961:297; Loader 1998:59).

It is not known with any certainty how the fortification walls were actually assembled. Earthen ramps may have been erected for moving stones into place, especially for fortifications that were several meters in height. Loader (1998:61-2) argues that such ramps would have been unlikely, given the excessive incline necessary for perpendicular ramps to reach any acropolis height, although Küpper (1996:49-52) has instead proposed a parallel ramp configuration. Here, workers could have used built-up fill as a functional ramp, while concurrently assembling the blocks on the inner and outer faces.

Other lifting devices and scaffolding arrangements have been hypothesized, such as movable wooden ramps, rope-and-pulley systems, and levering with a timber crib.
While certainly plausible, no direct archaeological evidence for any such techniques or devices has been recovered from LH contexts, and these claims are drawn mainly from Bronze Age contemporaries beyond the mainland, or later historical periods. Also, complex devices may have only been available or necessary at a few of the larger citadels with exceptional heights (> 5m) or block sizes. Elsewhere, at sites where blocks and walls are less massive, the logistics of assembly might have required no more than a few workers to lift and move each block into place by hand (see Appendix B).

2.4.3 Traditional approaches and interpretations

LH fortifications clearly served a defensive purpose, and accordingly, have been studied primarily in functional terms, regarding how changes in form and design related to the security of a particular settlement. The masonry itself was surely geared towards defense, as the use of large boulders and a thick, solid core had the effect of creating a stable and impregnable structure. Each circuit wall was also uniquely adapted to the terrain, reflecting certain strategic decisions in planning its course—either for strengthening the most exposed locations, or leaving certain precipitous areas unfortified (as at Midea, Krisa, and Teichos Dymaion; Figures 10, 21-22). Basic defensive features such as towers and sally ports can be observed among early fortifications, and show a greater degree of elaboration and complexity in LH IIIB. Gates were later reconfigured to reduce the maneuverability of an attacking enemy force and expose their flank, while added bastions allowed defenders to surround the enemy from both sides (Iakovides 1983:6). The excavation of underground cisterns within the walls of Mycenae, Tiryns,
and Athens towards the end of LH IIIB further speaks to the defensive concerns of the inhabitants (Iakovides 1999:202-3). In general, the very occurrence of fortification construction, and its escalation in LH IIIB, has traditionally been cited as a way of understanding the climate of competition and warfare that culminated in collapse, as they are seen mainly as a response to some human threat, either foreign or domestic (Popham 1994:279-80; Dickinson 2010).

Their construction has also been interpreted as “offensive”, with a focus instead on the semiotic and experiential properties of the fortifications as monumental architecture (e.g., Frizell 1998, 2003; Loader 1998; Dickinson 2006:40-42; Wright 2006b; Maran 2006a). These efforts aim to understand how the fortifications—especially those of the major Mycenaean citadels—served a more preemptive intention of displaying sovereignty, communicating power, and expressing political endurance (Iakovides 1983:108-9; Wright 2006b; Maran 2006a). Although monumentality surely has a great deal of communicative potential (see Chapter 3), this “offensive” perspective has often had the effect of downplaying the defensive nature of the fortifications, based on assumptions that they must have taken a long time to build, and therefore could not have been erected or renovated immediately to face an imminent threat (e.g., Loader 1998:157, 161-2; Dickinson 1994:160-3, 2006:42).

An energetics perspective has the potential to build on these interpretations, as a novel approach that specifically looks at fortifications as products of labour investment. Only Loader (1998:65-73) has attempted to calculate the costs of fortification construction in a formal manner. Her estimates, however, were limited to calculating only the time necessary for transporting the stone for one face of the walls at Tiryns, Gla, and
Midea. The time estimates were not matched with specific workforce sizes to provide true labour costs, and alternatively, the man-power estimates given for the tasks of quarrying, loading, transporting, unloading, and assembling individual stone blocks were not integrated with time rates. More broadly, Loader’s assessment of the labour costs involved only a limited consideration of the social, political, and economic implications of construction (cf., Loader 1998:152-163).

This thesis not only calculates such construction costs more systematically, but does so for a broader range of fortified sites. The labour costs are also assessed in a more contextual manner, in an effort to understand more effectively how the scale of construction relates to observed differences in political power, and the extent to which labour control might have been tied to regional authority. This basic connection between monumental architecture, labour control, and power is explored further in Chapter 3.
CHAPTER 3
POWER, LABOUR MOBILIZATION,
AND MONUMENTAL CONSTRUCTION

3.1 Introduction

Having reviewed the social and archaeological context of LH fortifications, this chapter explores how archaeologists have often used the scale of monumental construction to locate and model differences in political power—both locally and regionally—by reference to the implied degree of labour control. The following sections provide a theoretical framework for much of this study by reviewing a number of fundamental themes. Namely, what does the concept of “power” represent, and how has it been traditionally associated with the mobilization of labour? Can labour also be mobilized without any underlying hierarchies of power? In what ways can monumental architecture communicate power as a function of control over labour? And how have past studies treated the perceived relationship between monumental architecture and power?

Working inductively, I first outline the general nature and characteristics of political power, and the manner in which it is associated with the control and mobilization of large labour forces. Then, I discuss monumental architecture from an energetics perspective, which treats the scale of construction as a particular expression of labour control, and hence, as a relative proxy for social complexity and differences in power. I also address certain limitations with taking such an approach, and briefly review alternative interpretations of monumentality that may complement an energetics perspective.
3.2 The Nature of Political Power

The archaeological study of power has been heavily influenced by the ideas of Foucault (1978, 1979), who recognized how every human interaction contains some element of power—as a structured behavior that exists among all individuals and throughout society as a whole. At its most basic level, power involves a dissymmetry in social relations among individual agents or groups (R.N. Adams 1970:117, 1977:388; Balandier 1970:37-39; Haas 1982:156-158; Miller and Tilley 1984:7; Mann 1986). The actual exercise of such power generally concerns the ability or potential to limit behavioral alternatives, by varying means of force, threat, manipulation, or persuasion (Claessen 1983:214). As such, the expression of power can fall anywhere along a continuum between coercion (“power over”) and consensus (“power with”) (Moore 1996:3).

Wolf (1999:5) further refined the concept of power by identifying four progressive types, spanning from individual modes of interpersonal dominance to what he referred to as “structural power”. This latter type involves complete and active control over determining the very settings and conditions of social interaction for a wide range of individuals and groups. Notably, it often concerns the ability to direct and mobilize energy flows, resources, and labour on a large scale (Wolf 1999:5). This one particular manifestation of Wolf’s “structural power” may be otherwise identified as “political power”, following Price’s (1982:724) argument that the control of energy represents the basis of political power. In this regard, political power can be defined specifically by the relative control exercised by individuals or groups over access to resources, knowledge, or capital (R.N. Adams 1975:9-10). It is this conventional meaning of power that is
typically associated with “elites”, who are generally identified as the primary agents of social control within pre-modern hierarchical societies.

3.3 Power and the Mobilization of Labour

One way in which political power has been traditionally defined and expressed is through the mobilization of human labour, as a particular type of resource or energy (Price 1984; G. Webster 1990; Trigger 1990:125). The form of labour alluded to here typically concerns “surplus” labour, or that which is invested in activities beyond those necessary for the survival and subsistence of an individual or kinship unit (Saitta and Keene 1990:209). Access to and use of surplus labour implies a means of recruiting labour beyond the level of the household, and this has often been seen as requiring some form of hierarchical or centralized authority (Renfrew 1974; Yerkes 2002; Parkinson and Duffy 2007:127). Among the Tiwanaku, for instance, labour for major agricultural and construction projects was structured by a mit’a system, in which labour was controlled and mobilized primarily by elites under a hierarchical mode of political organization (Kolata 1991, 2003; Stanish 1994, 2003). Sufficient social control has often been considered necessary in order to organize large groups of workers effectively, and to carry out decisions regarding the allocation of labour. Haas (1987:32) expresses this traditionalist view plainly, stating that “people simply do not go out and build platform mounds without being told to do so by some authority figure”.

The control of labour is not only seen as requiring some degree of hierarchical authority, but also as something that reciprocally gives rise to such power. A number of studies have outlined how the ability to control and mobilize large bodies of surplus
labour may have been a critical factor in the formal emergence of elites and stratification among various societies (e.g., Friedman and Rolands 1977; Zeidler 1987; Webster 1990; Arnold 1991, 1993; Ames 2001). Disparities in political power and social status would have gradually developed and solidified, as kin-based and egalitarian relationships evolved into more asymmetrical, “patron-client” labour relations. As elite control over labour became more instituted and extensive in scale, more complex organizational structures would have emerged as a way of regulating and facilitating it (Earle 1987:68; Knapp 1990:198-199). In this regard, control over large scales of labour has also been associated with higher orders of social complexity, and archaeologists tend to observe a recursive and progressive relationship between elite hierarchical power, sociopolitical complexity, and the mobilization of labour (Webster 1990).

Others, however, have challenged this association of labour mobilization with hierarchical relations of power as being overly simplistic, and have sought to identify alternative modes of large-scale labour organization among prehistoric societies (e.g., Spielmann 1998; Parkinson 2002; Fowles 2002). Saitta (1997), for instance, suggests a possible model of “communalism” for the Chaco Phenomenon of the American southwest, in which political power and labour relations could have had a relative autonomy in social life. Similarly, Vega-Centeno Sara-Lafosse (2007) outlines a more fluid, networked means of large-scale labour mobilization in the central Andes, which appears to have preceded formal hierarchies of power and the emergence of more mature sociopolitical complexity. Here, surplus labour was often recruited by “prominent leaders” through ritual feasting, but such men were inherently limited in their capacity to exercise any permanent or institutional mode of elite power over commoners (see also
Dillehay 1990). There is also the possibility of sociopolitical hierarchies existing along with more heterarchical social relations (Crumley 1987), which may be observed in the organization of labour (e.g., Albarracin-Jordan 2003; Erickson 2006; Kristiansen 2007).

Both traditional and alternative perspectives on the connection between power and labour mobilization can be used as a framework for interpreting the observed differences in labour investment among LH fortifications. If there is a general correlation between the extent of fortification construction and what is known of regional site hierarchies and settlement systems, then this might suggest that the scale of labour mobilization may indeed have been a function of Mycenaean palatial power, whereby the hierarchical differences between the palatial elite and those of lower-order communities may have also extended into the realm of labour relations. Conversely, if the differences in labour costs contradict what is known of regional power structures, then perhaps labour relations need not have been tied to the hierarchies of the Mycenaean palaces. We might instead imagine alternative modes of labour organization among certain LH communities, in which large labour forces could have been mobilized without overarching structures of regional hierarchical authority.

It should be noted that exercising power in labour relations need not necessarily reflect any particular strategy of coercive (i.e., slave) labour, but simply the ability to mobilize and recruit workers. More power, then, would presumably translate to a higher degree of potential labour mobilization—which could have been achieved by various strategies of recruitment. Little is known of the exact strategies by which labour for construction was mobilized in LH Greece (see Chapter 2). But by looking for a correlation between site hierarchies and differences in labour costs, it is possible to
evaluate the extent to which the scale of labour mobilization could have been tied to palatial authority, and at least explore any general connection between labour control and elite power on a regional scale.

3.4 Monumental Architecture: An “Energetic” Expression of Power

The connection between elite power and labour mobilization has often been demonstrated through the presence and scale of monumental architecture, which represents a particularly visible and enduring expenditure of surplus labour. Specifically, the physical properties of the structures themselves can be matched with what is known of the building process, as a way to estimate the labour costs of construction. By measuring and comparing differences in such labour investment, archaeologists have used monumental architecture as an index for gauging differences in power among individuals, families, and whole settlements.

3.4.1 Traditional perspectives

Following L.H. Morgan (1881) and V. G. Childe (1950, 1958), early anthropological studies maintained a direct connection between monumental construction and social evolution, where a society’s ability to construct monumental features—and the scale of such monumentality—corresponded to its relative degree of sociopolitical complexity (Abrams 1989:50). Under a more formal neoevolutionary framework, architectural form and scale were often used to fit societies into discrete cultural stages (Sahlins and Service 1960; Service 1962, 1975; Fried 1967). This approach to architecture was further refined by the theories of Leslie White (1943, 1949), who
defined cultural systems and social evolution explicitly in terms of energy consumption. The development of this perspective under the New Archaeology was paralleled in architectural studies by what Abrams (1989:53) called the “energetic analysis of architecture”, where the expenditure of energy for construction could be used to model changes and differences in social complexity.

With architectural energetics, estimates of volume and various work rates can be used to translate scales of monumentality into scales of energy—in units of “person-days” or “person-hours” of labour—which, in turn, reflect the different energetic capacities of certain individuals, groups, or societies. Larger scales of labour invested in construction would tend to imply a greater control over labour, and ultimately denote the presence and extent of social stratification, hierarchical authority, and overall complexity (Price 1984:220; Abrams 1989; Webster 1990). In this way, monumental features could be directly “read” in terms of their energetic potential, and used accordingly as a way of gauging differences in organizational complexity and institutional authority. Even whole settlements may be read as energetic investments, and have been described by Price (1982:728) as representing “a virtual material isomorph of infrastructure and political economy”.

By quantifying monumental structures in a way that directly relates to labour, energetics has offered a more empirical and systematic method for understanding differences in construction, and assessing the social and political implications of such differences (see Chapter 4). Pioneering studies first applied this approach to sites and regions in Mesoamerica (e.g., Kaplan 1963; Erasmus 1965; Sanders and Price 1968) and Mesopotamia (e.g., Adams 1967), using the presence and scale of monumental
architecture as an index of labor access and control—and therefore, of sociopolitical
development (Abrams 1989:50). Subsequently, monumental features were compared and
assessed within a much broader range of cultural contexts, where the goal was often to
identify relative differences in sociopolitical complexity among sites, regions, or societies
(e.g., Aaberg and Bonsignore 1975; Peebles and Kus 1977:432; Renfrew 1973, 1979b,
1982a; Arnold and Ford 1980; Startin and Bradley 1981; Turner et al. 1981; Sanders and

As the influence of neoevolutionary thinking waned under an emergent wave of
criticism (e.g., Saxe 1970, Flannery 1972; Earle 1978), architectural studies shifted away
from using monumental architecture as a simple criterion for identifying cultural “stages”
of development and social evolution. Developing interests in the concepts of power,
control, and hegemony throughout the discipline (see Gledhill et al. 1985; Upham 1990;
Earle 1991, 1997; McGuire and Payner 1991; Price and Feinman 1995; Chapman 2003:
50-64, 69) were gradually adopted as a framework for rethinking aspects of prehistoric
construction and monumentality, and how they related to the development and expression
of inequality and hierarchical authority. Here, the differences in architectural
monumentality are seen as reflecting not just the larger, structural differences between
whole societies, but more nuanced differences in political power and/or social status
among various individuals or social groups (Abrams 1989).

In defining power by the ability to control energy, monumentality in construction
would then provide one of the most visible expressions and manifestations of power, as it
reflects the ability to recruit and coordinate large quantities of human labour. Trigger
(1990:125,127) elaborates on this concept in more detail:
Monumental [features] become symbols of power because they are seen as embodiments of large amounts of human energy, and hence symbolize the ability to control such energy to an unusual degree…Monumental architecture expresses in a public and enduring manner the ability of an authority to control the materials, specialized skills, and labour required to create and maintain such structures.

It is the implied conditions of leadership, coordination, and finance that make monumental architecture “one of the most remarkable expressions of social power” (Earle 1997:156-157). Moreover, the involvement and experience of labourers in the very act of construction itself serves to reaffirm or generate relations of power, in providing a personal and direct engagement with the process that may often emphasize their subordinate status (Price 1984; Trigger 1990:125; Demarest 1991; Abrams 1994:91).

The investment of labour and resources into monumental construction may be similarly understood as conspicuous consumption, a strategy in which elites enhance social prestige and power through the gratuitous and public expenditure of resources (Trigger 1990:124-126). Architecturally, this behavior can be expressed in the very property of “monumentality”, which may be defined as an excess, in size and elaboration, beyond the requirements of any practical function (Trigger 1990:119). In this regard, monumental features are direct manifestations of not just social structure, but specific elite behaviors; those with higher rank and status will often differentiate themselves by investing greater scales of labour and resources into architecture.

Of course, there may be other extenuating variables that can contribute to differences in monumentality, such as family size and the temporal duration of occupation or use. Yet when these variables are controlled for or absent, a positive correlation between the size and cost of architecture and the power of the associated group or individual has been consistently observed across a wide range of cultural
settings (Abrams and Bolland 1999:267-268). It has also been noted that the emergence or intensification of monumental construction often occurs in times of social stress or political decline (e.g., McGovern 1981; McGuire and Schiffer 1983; D. Webster 1985; Tainter 1988; Trigger 1990:127; Abrams 1994:92). Still, such patterns would not necessarily reflect the actual loss or decline of power, but rather a sense of insecurity towards such loss or decline. The scales of labour mobilized for such construction projects may still speak to the existing extent of social and political power—regardless of its vulnerability, or the intent and consequences of expressing it through monumental construction.

As with studies on social complexity, the energetics approach has also been used to demonstrate the connection between elite power and monumental architecture, by calculating and systematically comparing the different scales of labour expended for the construction of various features (e.g., Webster 1985; Abrams 1987, 1989, 1994; Carmean 1991; Webster and Kirker 1995; Kolb 1997; Blitz and Livingood 2004; Hooper 2004). Energetics estimates can be used to model relations of power on both a local and regional scale. Abrams’ (1984a, 1984b, 1987, 1994) research into the construction of Maya domestic architecture focused primarily on identifying social inequalities and political hierarchies for specific sites and communities. Alternatively, Kirch (1990) looked at monumentality in Tongan and Hawaiian chiefdoms, and saw the hierarchical distribution of monuments across the landscape—albeit on the basis of size rather than labour costs—as corresponding to the regional political hierarchy itself. In this way, he was able to demonstrate a strong link between monumental architecture, instituted elite authority, and complex sociopolitical structures.
3.4.2 Challenges, limitations, and alternatives

This study builds on the tradition of using monumental architecture as a potential measure of political power, by reference to the scale of labour mobilization. There are, however, certain conceptual limitations in taking this approach.

First, recent theoretical trends have sought to go beyond using monumental architecture as a simple index for social inequalities and hierarchical relations of power (Parkinson and Duffy 2007:112). The last few decades have witnessed an expansion in the interpretive potential of architecture, and archaeologists have been less inclined to study architecture as a “passive reflection” of past sociopolitical conditions (Moore 1996: 94). Rather, monumental features are being understood increasingly as active and meaningful spaces of performance and communication, in which power may be continually negotiated and challenged (e.g., Markus 1993; Moore 1996; Emerson 1997; Fisher 2006:125, 2009; Knapp 2009; Maran et al. 2006). Growing interests in the social construction of space and the phenomenology of the built environment have focused more on the communicative, semiotic, and experiential aspects of monumentality, and how they change over time or differ among individuals and groups (e.g., Lefebvre 1991; Tilley 1994, 2004; Day and Wilson 2002; McMahon 2013). In a strictly political sense, the use and design of monumental features—rather than their actual construction—may represent various and conflicting attempts to attain or reinforce social control. Massive structures can therefore reflect the varying agendas, strategies, and concerns of past rulers or communities, not just by indirect reference to labour control but through dynamic meanings and experiences.
Reading monuments as active communicative structures—as opposed to “passive” or fossilized manifestations of energy—offers a more humanistic and dynamic understanding of the past. It can also shed light on how the construction of specific monumental features (e.g., temples, palaces, defensive walls, burial chambers) can reflect different social realities, concerns, and priorities. Yet such an approach typically centers on questions of “why”, in addressing the underlying motives for construction from an exclusively etic perspective. It represents an attempt to interpret the many layers of meaning behind design and scale, and the implications of such meaning. For instance, we may ask: did a public structure represent a statement of group cohesion, a means of consolidating power for an individual or faction, or both?

This kind of inquiry, while certainly not unrelated, lies beyond the scope of this study, which is geared more towards exploring the extent to which instituted palatial authority was associated with the actual mobilization of labour for construction, through the scale and distribution of LH fortifications. While fortifications and defense works can adopt and express a wide range of functions and meanings, they are analyzed in this thesis mainly because they represent a particularly widespread and enduring instance of energetic investment in LH Greece. Indeed, most applications of architectural energetics are “intended better to describe the structure of political complexity rather than define the internalized cultural meaning of those positions” (Abrams and Bolland 1999:270). For this reason, the various meanings, functions, and direct objectives of fortification construction are explored only in a limited sense. Once patterns are identified and assessed against studies on the political geographies of each region, attention will be given mostly to what the fortifications represent with regard to labour relations and
regional political organization (see Chapter 6). This study will hopefully contribute to and open up a dialogue on how an energetics perspective might either complement or contradict the many functional and symbolic interpretations of LH fortifications as expressions of power, authority, and institutional complexity.

In addition to these growing theoretical concerns, there have also been exceptions observed among various cultures in which monumental construction appears to have occurred independently of institutional complexity or hierarchical structures of power. We find mature, complex polities—with powerful elite rulers controlling large populations—that exhibit no monumental architecture (Kolb 1997), and massive structures erected by comparably “simpler”, more egalitarian societies (Allen 1995). For example, Webster (1991) calculated the labour costs that would have been necessary for constructing the Bronze Age Sardinian nuraghi, and concluded that these costs belie the traditional model of a stratified, “medieval” hierarchy for Nuraghic society. His figures suggest neither high levels of specialization, nor hierarchical planning and centralized organization.

These alternative contexts for construction, which mirror the alternative modes of labour mobilization discussed above, do not necessarily negate the value of monumentality for inferring differences in power. Rather, they speak to the need for a more open understanding of the sociopolitical contexts in which monumental construction may be observed. A corresponding increase in scale should not be automatically assumed and anticipated in the archaeological record, seeing as there have been exceptions. At the same time, we find cross-culturally observed regularities in how
power becomes manifest architecturally, and the conditions under which monumental features are typically constructed.

For this reason, the perceived connection between power and labour mobilization is not automatically assumed here, and the differences in labour costs among the sites in my sample are not taken *de facto* as reflecting any regional political hierarchy. This thesis adopts a more contextual approach, by instead assessing labour costs against what is known of the trajectories of development for each region. In this way, it is possible to substantiate the implications of these different labour costs with independent evidence. Such an approach offers a more effective means for determining the extent to which the phenomenon of fortification construction during the LH period can be associated with structures of palatial power.
CHAPTER 4

METHODOLOGY: ARCHITECTURAL ENERGETICS
AND ITS APPLICATION TO LATE HELLADIC FORTIFICATIONS

4.1 Introduction

This chapter outlines the procedures and range of data necessary for estimating the construction costs of LH fortifications. I begin with a general review of the energetics method, and describe what lines of data are required for calculating labour investment from architecture, while also addressing the issues of accuracy and the underlying assumptions for such calculations. From here, I outline my own adapted approach for applying an energetics analysis to LH fortification construction, by discussing my sample of fortified LH sites, the availability and quality of volumetric measurements, the choice of relevant labour rates for certain construction tasks, and the limitations and assumptions associated with the calculated labour costs.

4.2 Architectural Energetics

As was discussed in Chapter 3, archaeologists have long used monumental architecture as a way to infer differences in political power among individuals, groups, or communities, through the implied differences in the mobilization of labour and resources. The means for demonstrating this relationship have evolved over time, becoming more refined to suit new theoretical concerns and methodological approaches. Under the neoevolutionary and Processual paradigms of the mid-20th century, the energetics perspective emerged in anthropology as a more systematic and empirical approach to demonstrating this connection, in measuring how the scale of labour mobilized for
construction can reflect developments in social complexity and political power. Its strong emphasis on positivist research meant that energetics could provide a more objective way to quantify and compare prehistoric architecture, and ultimately, to identify patterns of social organization and change.

4.2.1 Procedures and advantages

The basic energetics method for calculating labour costs from architecture requires two primary sets of data: (1) the total volume of raw materials that make up each feature of the building or structure, and (2) the rates of work for each task involved in the overall construction process. Volume is generally measured in cubic metres (m\(^3\)) of material, and the rates of work are presented in units of “person-hours” (p-h) or “person-days” (p-d). The total labour cost value of a structure can then be calculated by measuring the volumes of all known construction materials, and integrating them with the work rates that have been observed for acquiring, transporting, manufacturing, and/or assembling the quantity of each material.

The overall advantage of the energetics method is that it reduces the element of subjectivity that often underlies most assessments of monumental architecture. More often than not, references to size or scale will rely on qualitative and simplistically descriptive terms such as “large”, “massive”, or “monumental”. By instead quantifying architecture into standard, analogous units of energy (i.e., labour) through direct measurement of both volume and work rates, architectural features can be compared and assessed in a much more systematic fashion.
This particular method also improves upon earlier attempts to calculate the labour costs of prehistoric structures and monuments. Without any formal or standardized methodology, such estimates of human power or time tended to be highly speculative, and relied mainly on unsubstantiated assumptions of speed, efficiency, and the organization of pre-industrial work. Flinders Petrie, for instance, used only his measurements of the Pyramid of Khufu to substantiate the rough approximation given by Herodotus (Histories II.124) that 100,000 work men had been mobilized for the transport of stone; from here, he openly surmised that “not more than eight men could work well together on an average block of stone of 40 cubic feet or 2 ½ tons; and the levies [of workmen] would probably be divided into working parties of about that number” (1883:210). The energetics method reduces the need for such assumptions, by integrating real, observable rates of work for construction tasks that have been derived from ethnographic research, interviews, and replicative experiments.

Data on the work rates for basic construction tasks became extensively available by the mid-20th century, owing to investigations and research projects from both within and beyond the discipline. In the wake of World War II, a series of third-world developmental projects were carried out, in which civil engineers recorded the man-power and time necessary for excavating, transporting, and depositing different volumes of earth and stone under a range of working conditions (e.g., ECAFE 1957; ECAFE 1961; Indian Ministry of Irrigation and Power 1965). Subsequently, many ethnographic studies and experiments began to focus explicitly on measuring the capabilities of pre-industrial societies for constructing various types of structures and monuments (Pulver 1947; Singer et al. 1954; Forbes 1955; Atkinson 1956, 1961; Kirby et al. 1956; de Camp...
Among such studies was the work of Charles Erasmus (1965), who observed local Maya workers performing a range of building activities, and used these labour rates to calculate the necessary work force and timescale of construction for the Maya ceremonial center at Uxmal. Overall, such projects have allowed for more precise and plausible estimates of the human power required to carry out specific building activities. By integrating these observed work rates with known architectural measurements, the energetics method introduces a much higher degree of empiricism in the way labour costs are calculated from architecture.

Architectural energetics also offers an analytic advantage over the more traditional volumetric method for assessing monumental architecture in terms of scale. Because estimates of volume are relatively straightforward, they represented some of the earliest attempts at quantifying the prehistoric built environment (e.g., Squire and Davis 1848; Andrews 1877; Morris et al. 1931). Metric analyses have since become more systematic, and the use of architectural volume for inferring past sociopolitical conditions has been more or less maintained (e.g., Turner et al. 1981; Cheek 1986; Ringle and Andrews 1988; Kirch 1990; Tourtellot et al. 1992; Blitz and Livingood 2004).

However, volumetric studies often tend to equate volume directly with cost, thereby overlooking the more subtle variations in the actual labour requirements that would have been necessary for construction (Abrams 1994:38). Although buildings may be of similar size, variables such as terrain, weight of the raw material, distance to the source, architectural design, extent of decoration, and the techniques of construction may
lead to pronounced differences in the true cost of labour. In this regard, an energetics approach is of much greater analytic value, because labour-time measurements provide a more direct estimation of cost, and therefore serve as a more relevant measure of how architecture may relate to certain sociopolitical structures, processes, and changes. This is not to say that assessing architectural volume as a function of social structure or change is inadequate, but rather that it is limited in its analytic potential. By translating monumental structures into more comprehensible terms of human effort, the implications of construction can be more readily understood.

4.2.2 Addressing limitations and assumptions

There are, of course, certain limitations to the energetics method. One major issue concerns the degree to which these estimates can accurately represent the true cost of construction in terms of labour.

First, not all tasks involved in the construction process for a particular building or structure are considered in calculating the total labour cost, and low-energy tasks that are considered marginal are often omitted. Energetic assessments may be unable to account for maintenance after initial construction, which represents an added expenditure of labour but may be difficult to observe archaeologically (Abrams 1989:54). Certain building tasks might also have been carried out concurrently for the sake of efficiency, so that calculating separate labour costs for each task might be difficult, if not impossible.

In addition to building tasks, estimates also tend to overlook other economic or financial costs of construction that do not constitute manual labour, such as administrative costs, start-up or training costs, and subsistence or payment provided for
the workers (cf., Smith 2004:218-221). Even activities such as dedicatory rituals and feasts have been observed among a wide range of cultures as accompanying the construction of monuments or buildings (Friedel and Schele 1989; Hayden 1996; Dietler and Herbich 2001; Vega-Centeno Sara-Lafosse 2007), thereby representing an added expenditure of labour that is generally unaccounted for by most energetics studies. This incomplete record of construction costs not only underscores the issue of accuracy, but also calls attention to the selective and discriminatory nature in which certain “costs” are chosen over others. In other words, while the energetic method provides a more objective basis for calculating cost, it ultimately relies on a set of seemingly subjective and arbitrary decisions for which tasks and activities constitute the final cost estimate (Abrams and Bolland 1999:266).

Second, accuracy may be further constrained by the level of detail in published or available architectural data. The refinement of such data will, in turn, depend on the nature of archaeological excavation and preservation. The amount of architecture that has been systematically exposed and recorded at any particular site will influence the degree of precision in how well the measurements reflect the original dimensions, design, and adornment of that structure—all of which are relevant for determining the necessary investment of labour. Metric calculations have been done on unexcavated structures (e.g., Arnold and Ford 1980), but they present a much higher level of uncertainty than those having direct measurements (Abrams 1989:65). More architectural detail in excavation would also reveal the possible occurrence of multiple building episodes, thereby avoiding the conflation of these building phases, and allowing for more refined diachronic assessments of labour investment. The extent of preservation similarly affects the
precision of energetic estimates, in giving more or less indication of which raw materials were used for construction, how the feature was constructed, and its maximum size.

Although these limitations present challenges to achieving a truly complete picture of construction and labour organization, a perfect knowledge of the construction process is neither possible nor necessary for energetic analyses. As with any other archaeological reconstruction, it would be unreasonable to expect absolute values or to obtain all volumes and tasks in the construction process. Abrams (1989:68) concludes that “reasonable, standard estimates may be the best we will ever achieve, and such estimates in fact are valuable in a comparative analytic framework”. Despite the many uncertainties, all that is required is a general knowledge of the structure itself, an identification of the most costly activities associated with building that structure, and consistency in how specific building tasks are accounted for among all structures being compared (Abrams and Bolland 1999:267). In this way, accuracy is achieved within a general order of magnitude. Ignoring certain marginal costs therefore introduces little error, and does not affect the estimates “on a scale that matters” for comparison and interpretation (Webster and Kirker 1995:379). The labour costs generated are indeed only estimates, and are intended to represent hypothetical approximations of what is essentially an inaccessible and unknowable “truth” (Abrams 1989:65, 1994:40).

The energetics method can also be adjusted to suit any limitations in the data, as a means of achieving the highest possible degree of accuracy. The exact calculations and overall methodology will inevitably vary among different applications and analytic contexts (Abrams 1994:39). Accordingly, the use of the energetics method in this study has been adapted to suit both the precision of volumetric data for LH fortifications, and
the relevance of specific labour rates for calculating the costs of construction. Differences in excavation and preservation among the sites in my sample have directly influenced the degree of specificity in the labour cost estimates, and the choice of labour rates have been adjusted based on what is known of the construction process and design of LH fortifications (see below).

Another possible issue with the energetics method concerns the applicability of modern-day labour rates for generating estimates on prehistoric construction. Because there is no way of knowing how hard people worked in the distant past, we must inevitably rely on a “middle-range” theory for construction, which presupposes a general congruity in the efficiency of human labour over time. Accordingly, it is believed that labour rates drawn from ethnographic observation or archaeological experiment can at least suggest approximations of the human power and time required to complete basic, pre-industrial construction tasks.

There are also inconsistencies among the modern labour-rates that have been recorded for similar tasks. Discrepancies should be expected, however, owing to the behavioral variability that is inherent in the construction process (Shimada 1978; Zhu and Zhang 1990). Replicating any specific task will inevitably result in some degree of variation in speed and efficiency, even if environmental and technological variables are controlled for as much as possible. Indeed, the ergonomic efficiency of construction tasks can never be known in any complete sense (Abrams 1994:40), so it would be impossible to reach any kind of universal or absolute value for work efficiency that could be applied to all energetic analyses. Such variability should not be seen as a weakness, but rather as

4.3 Applying Architectural Energetics to LH fortifications

The application of architectural energetics to the Aegean Bronze Age has been relatively limited, with only a few studies having analyzed architecture and construction explicitly in terms of labour investment and mobilization (Wright 1987; Cavanagh and Mee 1999; Fitzsimons 2007, 2011, forthcoming; Devolder 2008, 2012). Although few in number, these applications have been insightful and diverse in scope, addressing the many social, economic, political, and symbolic implications of construction for different types of architecture.

The present study intends to build on this body of research, by adopting an energetics approach for assessing fortification construction in the LBA. While it maintains the same basic theoretical principles as other energetics studies, the methodology for calculating labour costs has been refined to suit the degree to which extant fortifications have been preserved or excavated, and the unique nature of the construction process.

4.3.1 Sample of fortified sites for analysis

The sample consists of thirty-six fortified sites from the Greek mainland and Cycladic islands (Map 1). They extend across seven distinct geographic zones of the Aegean, which roughly coincide with the regional administrative units of modern Greece: the Argolid, Messenia, Achaia, Attika and the Saronic Gulf, the Cyclades, and the central
Greek mainland (encompassing the districts of Boeotia, Phokis, and Lokris) (Maps 2-8).

All fortifications have been dated in use and construction to the LH period, although two sites in particular—Aegina: Kolonna and Kea: Ayia Irini—show evidence for fortification construction during the MBA as well. The selection of sites was facilitated, in part, by a recently published gazetteer of Mycenaean fortified sites by Hope Simpson and Hagel (2006), which was derived from earlier syntheses of a similar nature (Hope Simpson 1965, 1981; Hope Simpson and Dickinson 1979). Their catalogue lists over one hundred sites from the Aegean where potential LBA fortifications have been observed to some extent, and provides a brief description for each site regarding the history of excavation and current estimates of the chronology of construction and occupation.

The underlying rationale for selecting specific sites and regions for analysis, and for omitting others, is discussed in more detail in the Site Catalogue (Appendix A).

Overall, the extent of the sample was influenced by two constraining factors. First, poor preservation or a lack of excavation and field work meant that many sites with potential traces of fortifications did not have sufficient or reliable architectural data, and were therefore unsuitable for energetic assessment. The sites included in the sample represent only those that are at least partially preserved with regard to height, width, and/or circuit length, and which therefore allow for some degree of estimation. Nevertheless, although labour cost estimates will only be generated for the sample sites, settlements that exhibit traces of defense works will still be considered in discussing the sociopolitical context of each region (Chapter 6), with regard to the statuses of these sites within settlement systems and their possible relations with other major and minor sites.
The second issue concerns chronology, and how reliably the fortifications or defense works can be dated to the LH period (or in some cases, the late MBA). Many fortifications have traditionally been identified as “Mycenaean” on stylistic grounds, with regard to the Cyclopean style of masonry (Loader 1998). Such an approach, however, leaves much room for interpretation regarding what can be classified as “Cyclopean”, and is not chronologically specific. Hope Simpson and Hagel (2006:26, 28) instead rely on ceramic dating as a more reliable basis for chronology, in using the presence or extent of datable sherds found throughout the settlement and within the wall structures themselves. Consequently, many fortifications that have been conventionally interpreted as Mycenaean, but which show no artifactual basis for a MH or LH chronological assignment, have been omitted. It should be noted, however, that the absence of finds at many sites may also be due to erosion, or a general lack of systemic survey or excavation. As a result, secure dates for many potentially relevant sites are still lacking or may ultimately be impossible to attain.

Specific information on the history of excavation and the available architectural dimensions for each sample site is also provided in Appendix A, which outlines the sources that were used for obtaining the various measurements.

4.3.2 Interpolations and assumptions for architectural dimensions

In an effort to mitigate any deficiencies in the data (resulting from either poor preservation or a limited degree of excavation), I draw upon certain interpolations and assumptions, and apply them consistently to all sites where necessary. In Appendix A, it is explicitly stated for each site if and how such interpolations are applied.
First, wherever a circuit length is unknown, a hypothetical perimeter is calculated from the known area and extent of the settlement that is presumed to have been enclosed by the fortifications. If an area is given as a whole number (i.e., 10,000 m$^2$), then the formula for the perimeter of a circle is used; whenever the area given as two distinct axes of distance (i.e., 250 m NE-SW by 100 m), the formula for the perimeter of an ellipse is used. Since both settlement layouts and perimeters will tend to be far more irregular in reality, these measurements represent the minimum possible length for a fortification wall, if extended around the entire site. Accordingly, this measure presupposes that the observed area of the settlement was indeed fully enclosed by the defense works. Such an assumption may certainly lead to an overestimation of length in some cases, seeing as intact circuit walls at sites such as Mycenae and Tiryns enclosed only the acropolis proper, and did not extend to include the lower towns. Nevertheless, this approach offers the best available means for estimation, and one which might roughly balance out the more conservative measurements calculated with the two perimeter formulae. For sites where the fortification wall is known to have not extended around the entire settlement—due to constraints in the local topography, or the presence of natural barriers such as coastlines and cliffs—only the surviving stretch of wall is considered.

In most cases, the recorded area for a site was determined by means of a recorded artifact scatter, rather than from any intensive excavation or systematic mapping. For some sites, the area provided represents the estimated surface of an acropolis or hilltop where artifact concentrations have been recorded, rather than the presumed overall extent of the settlement. Accordingly, the areas as well as the circuit lengths will often represent approximations, based on the available artifactual and architectural remains.
Most measurements of height and width are often provided as a range, to account for variations observed throughout the course of the fortification wall. Here, calculations are made using the average of the given range for width, and the maximum preserved measurement for height. For sites where the width of the wall is missing or unknown, I use a value of 4.3 metres, which was calculated by Loader (1998:13) to represent the average width of Mycenaean fortifications. The use of maximum measurements for the preserved heights reflects the closest possible measure for the original dimensions, which are unknown but presumed to have been at least equal to or larger than the extant dimensions.

For defense works which lack preserved heights, calculations are provided for hypothetical height values of 3 m, 4 m, and 5 m, which are considered comparable to those observed elsewhere at LH fortified sites. This same procedure is also applied to sites with preserved heights of ca. 2 m or less. It is presumed that fortifications must have been at least as high as the gateway(s) through which people would have passed, and based on the dimensions observed at Mycenae—with the only gateways that have extant lintels among all preserved Mycenaean fortifications—they would have been slightly over ca. 2 m at the very minimum; the comparably modest North Gate measures 2.3 m in height, while the South and North sally ports measure 2.45 m and 1.95 m in height, respectively (Iakovides 1983:33, 35).

These adjustments and interpolations are a necessary measure for filling in the voids in the volumetric data for most sample sites. As was mentioned, the energetics approach allows for such methodological flexibility, where both the manipulation of the data and specific calculations can be customized to suit the quality and quantity of
architectural measurements. Interpolated measurements are applied equally to all sites where they are needed, so that although accuracy may be hindered by deficiencies in the data, the calculations are at least comparable on a general order of magnitude. The estimates derived from the architectural measurements—whether observed or inferred—are likely to be conservative, representing the lower limit of labour investment.

4.3.3 Labour rates of construction

The primary work tasks for the calculation of total labour costs have been selected on the basis of what is known of the process of fortification construction during the MH and LH periods—whether in Cyclopean masonry or otherwise. The specific rates used for each of these work tasks are listed below in Table 4.1. More information on these rates can be found in Appendix B, concerning the basis for their selection, the sources from which they were derived, and the availability of alternative labour rates. They are drawn from a variety of ethnographic studies, archaeological field experiments, and modern-day publications on building practices. In keeping consistent with the sources from which these rates were derived, the translation of person-hours to person-days presupposes an eight-hour work day. Erasmus (1965:283) argued instead for a five-hour work day, citing a marked decline in the productivity of his workers during the sixth hour. In maintaining that 1 p-d equals 8 p-h rather than 5-pd, the total labour costs (in p-d) that are derived from these rates are intended to represent conservative estimates of the true costs.
### Table 4.1. Labour rates for relevant work tasks, with original source.

<table>
<thead>
<tr>
<th>Task</th>
<th>Rate</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarrying</td>
<td>1.4 p-d per 1 m³</td>
<td>Lehner (1997)</td>
</tr>
<tr>
<td>Acquiring Field Stones</td>
<td>1 p-d per 7200 kg</td>
<td>Abrams (1994)</td>
</tr>
<tr>
<td>Transport</td>
<td>5 p-h per 950 kg (250 meters)</td>
<td>Erasmus (1965)</td>
</tr>
<tr>
<td>Transport (Conglomerate)</td>
<td>12 people/ton (2 meters/minute)</td>
<td>Smith (2004)</td>
</tr>
<tr>
<td>Wall Assembly (Cyclopean)</td>
<td>1.7 p-d per 1 m³</td>
<td>Adapted from Seeher (2007)</td>
</tr>
<tr>
<td>Wall Assembly (Non-Cyclopean)</td>
<td>6.89 p-h per 1 m³</td>
<td>Lekson (1984)</td>
</tr>
</tbody>
</table>

4.3.4 Assumptions and limitations in estimates

The value of these labour rates relies on certain assumptions regarding the nature of the Mycenaean construction process. First, the means for acquiring stone is assumed to have been adapted to suit the scale of masonry. Some degree of simple quarrying likely served as the primary means for obtaining building stone at most sites (see Chapter 2, Section 2.4 for the exact manner of quarrying implied here). Such efforts would have been especially necessary at the larger citadels, where the average block size could reach well over a cubic meter in volume (Wright 1978:67). As an exception, some walls, such as those from Kolonna and Messenia, are noticeably un-Cyclopean in style (e.g., Figures 2, 23), and it is assumed that most building stone would have instead been acquired mainly by pedestrian means, through the collection of field stones. The definition of a wall as either Cyclopean or non-Cyclopean follows from the designations that are given
by Hope-Simpson and Hagel (2006) for each site. Corresponding labour rates are provided for both methods of stone acquisition (see Appendix B).

Second, most of the stone that was quarried and collected for construction was likely to have been highly localized (i.e., within a 1 km radius) and readily available at most sites (Wright 1978:67; Shaw 2009:38), owing to the prevalence of outcroppings across much of the Aegean landmass (Marinos 1990; Higgins and Higgins 1996). Alternatively, some regions, such as the south-central Peloponnese, do not yield structurally useful building stone (Wright 1978; Marinos 1990:2188), so that for sites such as the Menelaion in Lakonia, large limestone blocks for construction would likely have been transported over considerable distances (Catling 1980:157). Similarly, limestone is rare among most of the Cycladic islands, which are instead comprised of metamorphic rock types such as schist, gneiss, and marble (Higgins and Higgins 1996:175-195). The nuances in the geological make-up of each region would be exceedingly difficult to take into account in attempting to locate stone sources, so the calculations for transport assume that the extent for the acquisition of stone for construction would have been well under 1 km. This range coincides well with the distance of ¼ km provided in Erasmus’ rate for transporting stone (Table 4.1). For Mycenae, Tiryns, and the Larissa Hill at Argos, the additionally calculated costs of transporting conglomerate are customized to suit their respective distances to the Panagia and Kalkani ridges, as the probable source of conglomerate for these sites (Wace 1949:136; Wright 1978:98-102; 1987:177; for an alternative source located further north of Mycenae, see Frizell 1998:114, 2003:17-18).
The labour rates used to calculate transportation costs also represent the movement of stone on relatively level ground, rather than for any particular incline or decline. Again, the actual source locations for building stone are generally unknown, and given the variable topography surrounding most sites, the necessary adjustments that would need to be made for workforce size and speed to accommodate the different inclines or declines would be highly difficult, if not impossible. Accordingly, estimates for the transportation of stone to the building areas likely represent the minimum costs for doing so, since moving stones up to the acropoleis from lower elevations would have surely demanded a proportional increase in labour expenditure.

The transport costs reflect only the human-powered movement of stone, and do not account for the added use of draft animal power, such as yoked oxen. First, certain constraints in LBA technology—specifically regarding axle strength and harnessing equipment—may have limited the efficiency of draft power at this time (Heizer 1966:827; Cavanagh and Mee 1999:95, n. 25; cf., Pullen 1992:49-52). Oxen or horse may have also been more costly and expensive as a means of transport in terms of food consumption (Forbes 1955; Heizer 1966:827), so that draft power would not have offered a clear economic advantage relative to human labour. The question of maneuverability reflects another technical or operational constraint in using oxen, as the spacing within and near the circuit walls may not have allowed for the easy movement of large draft-powered wagons. And given the assumption regarding locally-sourced building material, perhaps oxen were not considered necessary, as draft power may have been otherwise reserved for instances of long-distance transport (i.e., over 1 km). In a broader sense, we cannot know for sure when and where oxen were or were not used in construction, so all
work tasks here assume a reliance on human-powered labour, as a way of maintaining consistency in the labour costs.

Although not much is known of how MH and LH fortification walls were erected, I presuppose that the size of the wall and the stones employed would have influenced the manner of construction. For all non-Cyclopean walls, I use Lekson’s (1984) rate for wall assembly, which is derived from the reconstruction of pueblo structures at Chaco Canyon (see Appendix B). At the larger citadels, builders would likely have used the sloping mass of the internal fill—which was continually built up during the construction process—as an informal “ramp”, on which stones could have dragged up to the necessary heights and wedged into place (Küpper 1996:49-52). Unfortunately, a labour-time measurement for this specific mode of wall construction has not been observed or recorded elsewhere. An ideal alternative would be to generate custom calculations for the assembly of each stone, concerning the specific mass, weight, and height at which it was set into the wall. While this approach would adequately account for the necessary logistics of construction, it is impossible given the lack of such precision in the volumetric data for most LH fortifications, regarding the number of stones used and the specific variation in size and weight. Alternatively, Seeher’s rate for the construction of the large stone socle at Hattusa may offer the closest possible measure for such a manner of wall assembly (see Appendix B).

In following these assumptions, it is important to address how the calculated estimates may be limited in their representation of the original expenditure of energy into the construction of fortifications. Namely, the identified work tasks represent only a part of the overall building process, seeing as they are intended to reflect only those activities
that would have constituted the bulk of labour input for construction. The complete process would likely have extended to include countless other tasks and activities, either directly related to the manual labour or indirectly associated with the project in general (e.g., agricultural production to support workers, associated rituals and feasts, administrative work).

For those tasks that are associated directly with construction, the estimates do not include the costs of activities such as: the preparation and excavation of foundations; the acquisition and placement of clay mixture for the outer faces; the excavation of earth that would have constituted part of the fill for Cyclopean structures; and simple maintenance after initial construction. The exact depths of the foundations are not known for most sites, and where they are known, they are only recorded for certain locations along the course of the wall, thereby overlooking the variation in foundation construction that would have been potentially necessary to respond to an uneven topography. Estimates for the application of clay, interstice stones, and earthen fill to the structure of the wall are equally as unquantifiable. Concerning the latter, it is nearly impossible to differentiate the volume and composition of fill from that of the inner and outer faces of the walls, resulting from poor preservation and/or the lack of any systematic exposure of the fill by means of excavation. The volume of each wall is therefore calculated as though it represents a uniform body of material.

Although Cyclopean blocks are generally undressed, the major gateways and bastions of Mycenae and Tiryns were mostly built of pseudo-ashlar conglomerate blocks (e.g., Figure 13), which give these sections a more monumental appearance (Iakovides 1999:201-2). Shaping the blocks surely would have represented an added expenditure of
labour by skilled masons, who might have used a kind of “pendulum” saw that has been suggested for stone cutting at Tiryns (Küpper 1996:16-25). However, it is not currently possible to calculate such labour costs, as no applicable labour rate is available for such a device. A work rate for cutting simple ashlars was recorded by Abrams (1984a), but for much smaller blocks of volcanic tuff, and with different tools. Such calculations also would have required applying the labour rate on a per-block basis, but the specific number of shaped blocks made or used in construction remains unknown. Still, these sections constitute only a small fraction of overall volume of the fortifications (see Appendix C, Table 2), so basic stone-dressing here would have likely been negligible in relation to the overall cost.

The construction of additional architectural features is also not included in the total cost estimates. For instance, a mudbrick or timber superstructure may have been erected along the upper course of certain walls—as observed at Grotta (Lambrinoudakis and Philaniotou-Hadjianastasiou 2001:160-1), and possibly Thebes (Symeonoglou 1985:19-23) and the Lower Citadel of Tiryns (Iakovides 1999:201)—but this is not known with any certainty. Other possible features would have included ramps, terraces, staircases, cisterns, and gateway doors, many of which are not fully preserved. Although the Lion Gate at Mycenae has been comparably well-preserved, the work that would have gone into producing and erecting the associated sculpture is not calculated here. There is no knowledge of how the sculpture—as well as the associated lintel block—had originally been erected, and such an effort would likely have differed logistically and technically from the rest of wall’s construction. Likewise, there are no comparable labour rates for the unique effort that would have gone into both sculpture and adornment. It is,
of course, understood to have represented a notable investment of both specialized and non-specialized labour (cf., Blackwell 2014).

While these activities and features are omitted from the calculations, they are considered to represent unquantifiable or otherwise marginal aspects of the construction process. Their omission is not likely to affect the accuracy of the estimates on a scale that would substantially affect their relative differences or interpretive implications. As with the noted limits in volumetric data, this partial account of the labour process suggests that the estimated values represent conservative, minimal estimates of original labour costs.
CHAPTER 5

RESULTS: LABOUR-COST ESTIMATES FOR FORTIFICATION CONSTRUCTION

5.1 Introduction

Here, the results from the labour costs calculations are presented and discussed, with a focus on the patterns that can be discerned from the data on both an interregional and regional level. The sites are ranked ordinally by total labour cost, and hierarchical clusters are identified among the sites based on these data. Attention is also given to tracing out changes in labour investment over time, and considering the size of the work force that would have been mobilized for each site when given a range of possible durations for construction.

5.2 Overall Trends in the Labour Costs

All labour costs that have been calculated for the sample sites are tabulated in Appendix D (Tables 1-14), which lists the total costs, the constituent costs of each work task, and rankings of the sites based on labour investment. What follows here is a discussion of the patterns that can be observed among the estimates for all sample sites.

A pan-regional ranking of the sites by total labour cost is presented graphically in Graph 5.1. The bar chart shows that 28 sites (77.8% of total sample) exhibit a total labour cost value of less than 50,000 person-days, with most of these sites positioned well below half of that figure. Conversely, the top eight sites (22.2%) range between 77,913 p-d (for Midea) and 323,194 p-d (for Gla). This basic grouping was similarly observed after carrying out a hierarchical cluster analysis using the Ward method (Ward 1963),
following Abrams’ (1994) approach. The dendrogram in **Graph 5.2** presents the results of this analysis, and shows two main clusters among the sites. The first cluster includes the top eight sites from the sample, whose total labour costs amount to an average of 167,791 p-d. This cluster consists of four sites from Boeotia, Phokis, and Lokris (Gla, Krisa, Eutresis, and Thebes), three from the Argolid (Mycenae, Tiryns, and Midea) and one from Attika (Athens). A further division can be discerned between the cluster of Gla and Mycenae (mean=303,974 p-d) and the other six sites (mean=122,397 p-d).

The second cluster contains the remaining 28 sites (mean=16,731 p-d), which in turn fall into several nested clusters. Although the differences among these clusters are relatively low, the most pronounced division seems to occur at the next level of clustering, between sites ranked 9-26 (n=18, mean=22,477 p-d) and those ranked 27-36 (n=10, mean= 6,387 p-d). Within the first group, all seven regions are represented: the most come from Boeotia, Phokis, and Lokris (eight sites), followed by three sites from the Cyclades, three from the Argolid, and one each from Messenia, Achaia, Thessaly, and the Saronic Gulf. In the second group, all regions except Achaia and those from the central mainland are represented, with the most coming from Messenia and Attika and the Saronic Gulf (three sites each), followed by two sites from the Argolid, and one from Thessaly and the Cyclades.

Overall, these clusters point to a rough pan-regional hierarchy among the sites in relation to labour investment for fortification construction, with two pronounced levels of labour mobilization occurring across all seven regions. This statistical hierarchy of energy costs will be further assessed in Chapter 6, with regard to how it accords with the underlying systems of labour organization that may have been in place among the
Graph 5.1. Ranking of sites by total labour cost (in descending order)
Graph 5.2a-b. Dendrogram for cluster analysis of total labour costs. Sites listed along the bottom by reference to a) ordinal rank and b) site name.
different groups of sites. In an effort to achieve more meaningful insights into the implications of such an energy hierarchy, cluster analyses have also been carried out for each region, where sociopolitical relations and potential site hierarchies can be discerned with more refinement (see below).

The data also show a positive correlation between the size of the fortifications and the associated scale of labour investment. When the measurements for total volume are substituted in for the total labour costs, the sites exhibit a rank order that is nearly consistent with that for labour costs (Graph 5.3); the only sites that differ in rank are those with non-Cyclopean fortifications (colored in red). Plotting the values for total weight results in a similar trend (Graph 5.4), where most sites maintain their labour-cost rankings with the exception of the non-Cyclopean sites, as well as the Cycladic sites of Melos: Phylakopi and Siphnos: Ayios Andreas (which exhibit a higher rank for weight due to the use of alternative stone density values).

As was mentioned in Chapter 4, any such correlation between size and labour expenditure should never be automatically assumed. In this case, however, a nearly direct correlation occurs between volume and labour cost, owing mainly to the lack of refined data among the sites regarding architectural measurements, the volumes and types of building materials other than stone, differences in local geology, and topographical variation (see Chapter 4, Section 4.3.4). The availability of more refined data in the future should allow for the calculation of more refined labour-cost estimates, which could then account for variables beyond volume, weight, stone density, and masonry style.

When these sites are arranged chronologically, the associated differences in labour costs reflect a clear rise and decline in investment over time across the Aegean
Graph 5.3. Total volume for all sites (plotted against the rank order for labour costs)
Graph 5.4. Total weight for all sites (plotted against the rank order for labour costs)
(Graphs 5.5, 5.6). Most of the sites and/or their distinct building episodes can be divided into five rough chronological categories, based on the range of dates represented across the entire sample: 1) MH-LH I, 2) LH I-II, 3) LH IIIA1 or LH IIIA2-B, 4) LH IIIB, and 5) LH IIIB-C.

Some sites proved more difficult to place into these categories than others, owing to weak chronological resolution or a lack of certainty in the given dates. Namely, six of the sites have only been assigned a provisional date of “LH IIIA-B”, which represents too broad of a date range for the sites to be placed definitively in either Category 3 or 4; hence, they have been omitted from Graph 5.5. Two separate, alternative charts are provided in Graph 5.6, which represents the change in average labour cost over time among all sites. The first chart (Graph 5.6a) reflects the inclusion of the six “LH IIIA-B” sites with Category 3, and the second (Graph 5.6b) their inclusion with Category 4. The corresponding averages simply represent the potential extremes of the distribution of the sites between the two categories.

Argos: Aspis was placed in the first chronological group, based on the strong likelihood of a MH date for the construction of the wall—despite the alternative possibility of a LH III date (see Appendix A). Similarly, Argos: Larissa Hill has only been dated roughly to the LH III period, but here it is placed more specifically in the LH IIIB category by reference to the extant conglomerate lintel stone (Figure 24), which possibly suggests a concurrence in both form and date with the other three Argive citadels. Finally, the relative proportion of sites represented in each chronological group may be at least partially influenced by the limited nature of my sample, which by necessity could not include all possible fortified sites from the Aegean Late Bronze Age.
Despite the necessary omissions and tentative nature of these groupings, the overall differences still speak to a general trend over time, across all seven regions. In *Graph 5.5*, the number of sampled fortifications being erected or enlarged across the mainland and Cyclades rises gradually from the transition between late MH and early LH (n=4) to LH I-II (n=8), then nearly triples during the two successive LH III phases (n=22, or n=29 with the six omitted “LH IIIA-B” sites), finally declining by the end of LH IIIB and transition to LH IIIC (n=2). This trend of increasing frequency during the palatial period is comparable to that observed in *Graphs 5.6a-b*, which show the average values for the total labour costs represented in each chronological group; despite the comparable differences in the average cost for the categories LH IIIA1-B and LH IIIB, both charts reveal a sharp increase and a peak in average labour investment among all sites during the palatial period.

These changes mark an interesting relationship between labour investment and time that seems to correspond with the general chronology of development, expansion, and decline observed for Mycenaean palatial society across much of the Aegean. Of course, more nuanced and substantial insights are to be gained by assessing this relationship at the regional level, where changes in labour expenditure over time can be matched with specific sites or building episodes, adjusted to fit a more precise chronological framework, and interpreted within a more refined sociopolitical context.

Lastly, estimates were calculated for the size of the labour force that would have been mobilized for each site, when given a range of possible durations for construction (Appendix D, *Table 15*). Such figures are rare for any type of Mycenaean building project, having been inferred from only a few preserved Linear B tablets (cf., Nakassis
Graph 5.5. Total labour costs, ordered by chronological phase
Graphs 5.6a-b. Change in average labour cost over time (average values representing alternative placement of “LH IIIA-B” sites).
Fitzsimons (forthcoming) presents an alternative approach to estimating workforce size in his study on tholos tomb construction at Mycenae, drawing on the “theory of constraints” from operations management (Goldratt and Cox 1992; Dettmer 1997) and its previous application to architectural energetics by Abrams and Bolland (1999). He infers a probable work-group size from the number or labourers required to perform the most costly task of the building process. For tholos tomb construction, and perhaps also for fortification construction, this likely would have been the transportation of the massive lintel stones from quarry to site. Based on an average person-per-ton ratio, an estimate for workforce size can then be calculated from the weight of the lintel stone. While such a strategy can be valuable for calculating and discussing the size of the labour force as a function of operational constraints, it cannot be applied here for this study, seeing as original lintel stones are only preserved at three of the thirty-six fortifications from the sample.

Estimates for workforce size were instead calculated from the total labour-cost values by controlling for time. Despite the potential methodological weaknesses of deriving a workforce figure from labour costs by simply keeping time constant (Abrams 1989:66-68), calculations have been made to accommodate a range of potential time scales for the completion of construction, so that considerations of workforce size are not limited to any one particular duration; time intervals of 1 year, 5 years, and 10 years were randomly selected. Of course, the actual length of time during each year in which LBA people customarily engaged in surplus labour is also not known, and surely must have differed among sites and regions, or even from year to year. We can assume, however, that unskilled labour—which constituted the main workforce for fortification
construction—would not have been permanently active on a year-round basis (Nakassis 2012:277-8). The timing of construction was likely restricted to a specific period of time during the year, perhaps coinciding with a regular break in subsistence work.

Indeed, Abrams (1989:66) mentions that most agrarian societies typically build homes during the agricultural off-season so to avoid scheduling conflicts (cf., Redfield and Rojas 1964:77-86), and related energetics studies from Mesoamerica have noted that such an off-season would have typically lasted for 100-150 days per year, coinciding with the dry season (Abrams 1994:43; Webster and Kirker 1995:373, 376; Abrams and Bolland 1999:284). Other ethnographic studies of various chiefdoms (e.g., Kolb 1997:271; Hogbin 1939:148, cited in Erasmus 1965:280) and state-level societies such as the Han Dynasty and Inca (Loewe 1968:70; Moseley 1992:67; Malpass 1996:51) suggest that this period could have been even shorter, as levies of corvée labour for construction tended to range from only one month to 45 days per year.

In regards to a potential window of time for off-season labour in the ancient Aegean, historical sources such as Hesiod (Works and Days 501-625) and Xenophon (Oeconomicus 16.11, 17.12) indicate that a reduction in agricultural activity would have coincided with the rainy winter months, which typically lasts from November to late February for most of central and southern Greece (cf., Facaros and Theodorou 2003:88). Such a time frame might have also been preferable from a technical point of view, as the cooler and wetter conditions may have facilitated the quarrying and transport of building material (Burford 1969:190). Based on these considerations, one “year” for major construction projects in Mycenaean Greece is assumed here to represent an approximate maximum of 120 days.
The estimates for potential workforce size are listed in Table 15 in Appendix D. For sites with multiple building episodes, workforce estimates have been calculated separately for each episode. As would be expected, a wide range of figures are apparent for each of the possible durations, ranging from only 1-2 or 1-4 people for City X at Kolonna and Period IV at Phylakopi, respectively, to ca. 2,700 people for Gla (if completed in one year). These particularly extreme figures should certainly not be regarded as probable estimates in themselves, but rather, as signifying a high and low range of estimation, within which would be a more probable workforce size, corresponding to a particular length of time. The specific estimates for each site are assessed in more detail below, in terms of the relative differences that can be observed on a regional level.

In brief, it is worth remarking that such estimates effectively translate the labour-time measurements into more meaningful and comprehensible human terms. For some sites, these figures for workforce size make construction seem relatively manageable, where generally speaking, most of these structures required only a few dozen people to complete construction within the span of a couple seasons. Conversely, the scale of the workforce suggested for some of the larger, more costly sites—requiring several hundred to several thousand workers—implies not only a relative difference in political power for mobilizing the necessary labour and resources, but also a corresponding increase in the complexity of labour organization and work management.

From these workforce estimates, it was also possible to calculate a range of estimates for the size of the faction or segment of the population that may have been associated with construction at each site (Appendix D, Table 16). Different calculations
were made based on four of the potential strategies of labour recruitment outlined by Webster and Kirker (1995:375-379), which represent hypothetical modes of recruitment based on various strategies observed ethnographically and archaeologically across a range of cultures:

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategy A</strong></td>
<td>Each family unit of five people contributes 1 laborer annually</td>
</tr>
<tr>
<td><strong>Strategy B</strong></td>
<td>Each family unit of five people contributes 2 laborers annually</td>
</tr>
<tr>
<td><strong>Strategy C</strong></td>
<td>A flat annual levy of 10% on the total labourer population</td>
</tr>
<tr>
<td><strong>Strategy D</strong></td>
<td>A flat annual levy of 30% on the total labourer population</td>
</tr>
</tbody>
</table>

Table 5.1. Potential labour recruitment strategies.

Of course, it cannot be proven that any of these strategies directly represent the specific mechanism(s) by which labour was mobilized in the LH period, seeing as little is actually known of the system(s) of Mycenaean labour mobilization—which also may have varied over time, and among sites, regions, and the specific contexts of expenditure. Rather, they offer a preliminary and hypothetical basis for exploring possibilities of scale, and comparing how the amount of workers mobilized could also relate to potential figures for the size of the community or communities associated with construction.

Despite the absence of accurate or reliable population data for most of LH Greece that would otherwise serve as a baseline for comparison, these estimates can at least allow for open inferences on the extent to which labour mobilization would have occurred at any particular site (i.e., local or regional in scale). These differences, in turn, may further speak to the relative scope of political authority and control underlying the mobilization of labour for fortification construction at each site.
5.3 Regional Patterns

The following sections provide more focused descriptions of the labour-cost data on a regional level. Attention is given primarily to considering rankings and clusters among the sites by the total labour costs, the change in labour costs over time, and the various potential workforce sizes for each site. The graphs and charts referred to here can be found in Appendix D (Charts 1-21), which also includes tabulated estimates on workforce size and associated faction size (Tables 15-16).

5.3.1 Achaia

Teichos Dymaion is the only representative site from Achaia, so no comparative assessments can be made for the region in terms of rankings, differences in workforce size, or changes in labour investment among different sites over time.

5.3.2 The Argolid (Charts 1-4)

As was expected, the fortifications at Mycenae, Tiryns, and Midea rank as the three most costly in the Argolid, with the remaining five sites exhibiting costs of equal to or below ca. 20,000 p-d. Three distinct clusters can be identified in the sample, with Mycenae and Tiryns as the top cluster (n=2, mean=240,511 p-d), followed by Midea in its own cluster (n=1, 77,913 p-d), and then the remaining five sites (n=5, mean=12,667 p-d). This grouping reflects a three-tiered hierarchy among the sites based on energy expenditure for fortification construction.

Aside from the two sites at Argos that have been assigned tenuous dates (and hence their exclusion from Charts 3-4), the sites in the sample exhibit a somewhat
narrow chronological range for construction. The earliest evidence for fortification
construction considered here occurs at Tiryns during LH IIIA1, and is marked by a
relatively low labour investment (13,913 p-d). Subsequently, the transitional phase of LH
IIIA2-B witnesses the second phase of construction at Tiryns, along with construction
episodes at Mycenae and Prophitis Elias (n=6, mean=48, 592 p-d). The two sites of
Kandia: Kastro and Nea Epidavros: Vassa are dated more vaguely as “LH IIIA-B”, and
hence are grouped separately, and plotted between the LH IIIA2-B and LH IIIB1-2
categories. Mycenae’s second and Tiryns’ third construction phases likely occurred
sometime within the early or middle LH IIIB period (n=3, mean=107,744 p-d), and the
erection of the walls at Midea—as well as Mycenae’s final extension—have been dated
more specifically to LH IIIB2, as the latest observed phase of fortification construction.

Of course, no absolute dates are available to establish a specific order of
construction among all the sites, and distinguishing arbitrarily between such close
chronological phases (i.e., between dates given as “LH IIIA-B” and “LH IIIB”) may be
problematic. Nevertheless, we see in the Argolid a clear increase in energy investment
over the course of the palatial period at certain select sites, with the highest level of
investment occurring at Mycenae, Tiryns, and Midea in LH IIIA2-B and towards the end
of LH IIIB. This trajectory is framed by minimal investment at Tiryns and Mycenae both
early in the palatial period and during the last couple of decades, respectively. Tiryns
reflects a progressively increasing pattern of investment, rising modestly during the first
two phases and peaking sharply in the final phase at 144,789 p-d. Conversely, investment
at Mycenae declines after each preceding phase, although the first two major phases that
correspond roughly in time with Tiryns’ second and third phases still represent comparable costs of above ca. 100,000 p.-d.

The workforce estimates follow a similar ranking and trend of investment over time (Chart 4). The highest figures calculated for workforce size correspond with the top cluster—specifically, the first and second phases at Mycenae and the third phase at Tiryns. The other building episodes from Mycenae and Tiryns are much lower, and seem comparable to the sites from the third cluster. The estimates for Midea are nearly half of those calculated for Mycenae I and Tiryns III, but are nevertheless quite substantial in absolute terms (amounting to as many as ca. 650 labourers, if construction had been completed within 1 year). In contrast, the highest figures calculated for the remaining sites fall below ca. 200 workers.

Lastly, separate labour-cost estimates were calculated for the work associated with the massive conglomerate gateway blocks at three of the Argive sites (Appendix D, Table 2). For Mycenae’s second phase, the effort necessary for transporting the blocks seems negligible, representing only 0.6% of the total labour cost. The stones required for the Main Gate of Tiryns’ third phase were more costly in absolute terms (ca. 5,700 p.-d), owing to the long distance that was likely required for transport (see Appendix D, Table 2, note D). Still, this figure is also somewhat negligible in its proportion of the overall cost (3.98%). Conversely, the costs associated with the lintel stone at Argos: Larissa Hill are much more substantial in relation to the total figure, representing 28.8% of the overall cost. Such a surprisingly high proportion of total labour expenditure may be the result of having underestimated the extent and volume of the fortifications on the Larissa Hill, or overestimated the actual transport distance. Still, even a comparable level of investment
for transporting the conglomerate lintel relative to that at Mycenae or Tiryns might have meaningful implications for the political geography of the Argive Plain, given the conglomerate’s likely source from around Mycenae (Wace 1949:136; Wright 1978:98-102; 1987:177), and the possibility of this type of stone having been imbued with symbolic meanings or elite connotations (see Chapter 6).

5.3.3 Attika and the Saronic Gulf (Charts 5-8)

There is a sizable disparity in labour costs between Athens: Acropolis and the other four sites in the sample, which can be observed in both the bar chart and cluster dendrogram (Charts 5-6). Athens stands apart statistically as a distinct cluster, below which are the remaining sites that fall within a second cluster and exhibit a similar range of labour-cost estimates. Within this second group, the two sites from the Saronic Gulf—Aegina: Kolonna and Korhpos: Kalamianos—represent a distinct sub-cluster with a higher average labour cost (mean=12,166 p-d) than that for the two sites from Attika (mean=3,218 p-d).

This sample reflects a much broader chronological range, seeing as the building episodes examined for Kolonna alone span from MH I to LH I. Comparably speaking, the first four phases at Kolonna reflect a low level of labour expenditure for construction, which then drops substantially in its final phase (MH III-LH I). Contemporary construction activity at Ayios Yiorgos: Brauron—and then subsequently at Vari: Kiapha Thiti in LH I-II—reflects slightly higher scales of labour investment during the early LBA in Attika. By LH III, we see a drastic increase in construction costs, represented mostly by Athens: Acropolis (147,107 p-d), but also by the relatively sizable labour
investment at Korphos: Kalamianos (15,432 p-d), where construction occurred slightly earlier than at Athens.

The workforce estimates for Athens: Acropolis range between 1,226 (1 year), 245 (5 years), and 123 (10 years) labourers, which are comparable in scale to the estimates calculated for the contemporary phases of construction at Mycenae (I-II) and Tiryns (III). The second highest estimate was calculated for Korphos: Kalamianos for a duration of 1 year (129 labourers), although the estimates for 5 and 10 years coincided with the range of estimates calculated for the other sites (including all building episodes at Kolonna), where no more than 30 labourers would have been necessary for construction for any duration.

5.3.4 Boeotia, Phokis, and Lokris (Charts 9-12)

The sites from the central mainland fall into three distinct clusters (Chart 10). Gla visibly ranks as the highest and constitutes its own separate cluster, with a labour-cost value of 323,194 p-d. The second major cluster consists of Krisa, Eutresis, and Thebes (n=3, mean=104,364 p-d), and the third includes the remaining sites from all three regions (n=8, mean=24,461 p-d). Accordingly, the differences in total costs reflect a three-tiered hierarchy of labour expenditure for fortification construction.

As with the Argolid, the chronological divisions identified here were based mainly on the date ranges assigned to the sites, which varied in their specificity (Chart 11). Hence, these divisions may mask certain overlaps, and the actual order of construction among the sites may differ from that suggested here. Still, the sequence suggested by the given dates reflects a general trend. Ayios Ioannis and Thisbe:
Palaiokastro may possibly represent the earliest instances of construction—with date ranges reaching back into LH II—and amount to an average of 23,042 p-d. A noticeable increase occurs in the early years of LH IIIA with construction at Krisa (111,304 p-d), and the succeeding transitional phase reflects a substantially larger expenditure of energy (mean=152,181 p-d), largely influenced by construction at Gla and Thebes at this time. The three sites of Pyrgos, Ayios Vlasios: Panopeus, and Ayia Marina (mean=24,414 p-d) are dated more vaguely as “LH IIIA-B”, and are therefore plotted separately, seeing as these sites can fit into either the preceding or succeeding chronological groups. Lastly, the sites of Eutresis, Chalkis: Glypha, and Larymna: Kastri date more specifically to LH IIIB, and signify a significant drop in average labour expenditure (mean=48,268 p-d)—although Eutresis still represents a sizable investment of labour at this time (108,582 p-d).

The workforce estimates for Gla represent the highest among all fortified sites from the overall sample, ranging as high as 2,693 workers for 1 year and 269 for 10 years. Krisa and Eutresis each would have required just over ca. 900 labourers to complete construction within 1 year, or between ca. 180 and ca. 90 for durations of 5 or 10 years, respectively. Estimates for the potential fortifications at Thebes were slightly below these figures, but nevertheless reflect figures of several hundred workers for any duration of under 5 years. Sites from the third cluster range between 335-113 workers for 1 year, and most would have required fewer than 60 workers for durations of 5 or 10 years.
5.3.5 Cyclades (*Charts 13-16*)

The four sites from the Cyclades fall into two distinct clusters, with a clear division occurring between Phylakopi and Ayios Andreas (mean=23,747 p-d), and Ayia Irini and Koukounaries (mean=6,840 p-d).

There is no clear trajectory of change over time (*Charts 15, 16*), and instead, the levels of investment seem to fluctuate throughout the late MBA and LBA. The earliest instance of construction observed here occurs at Ayia Irini during Period V—dated to the late MBA—with a relatively modest scale of labour expenditure (8,183 p-d). A substantially larger investment occurs at Phase III Phylakopi (23,980 p-d) during LM I (coinciding with the Neopalatial period on Crete), which are somewhat concurrent with the less-extensive renovations that took place at Ayia Irini during Period VI. By contrast, the LH IIIA and LH IIIB periods show very low levels of labour expenditure for fortification construction in the Cyclades, represented only by the extensions to the wall at Phylakopi during Phase IV (LH IIIB1). The end of the LH III period is marked by both a large increase in investment at Siphnos: Ayios Andreas during LH IIIB-C (19,460 p-d) and a comparably minimal expenditure at Paros: Koukounaries.

The maximum workforce estimate was calculated for Phase III Phylakopi (200 labourers for 1 year of construction), with a comparable figure for Ayios Andreas (192 workers/1 year). The estimates for Ayia Irini fall well below ca. 100 for each of the various durations of construction, and Koukounaries would have only required a maximum workforce of ca. 10 labourers.
5.3.6 Messenia (Charts 17-20)

The site of Mouriatadha: Elliniko ranks first with the highest level of labour investment for fortification construction (25,052 p-d), while the remaining three sites exhibit significantly lower costs and fall into a separate statistical cluster (mean=8,578 p-d). This basic two-tiered division corresponds directly with the observed change in labour investment over time (Charts 19, 20). The circuit walls at Pylos, Malthi: Dorion, and Mirou: Peristeria all date to the early Mycenaean period (LH I-II), while construction at Mouriatadha: Elliniko has been securely dated to the later LH IIIB period.

The estimates for the number of labourers mobilized for construction are quite low, relative to the figures calculated for other regions. The highest figure amounts to 209 workers for Mouriatadha: Elliniko (1 year), while all other estimates for the various durations at Mirou: Peristeria, Malthi: Dorion, and Pylos fall well below this number.

5.3.7 Thessaly (Chart 21)

Comparative assessments for Thessaly are relatively limited, seeing as the sample consists only of two sites. No hierarchical clusters could be identified, and since both sites are similar in their probable date of construction (LH IIIA-B), no change in labour expenditure can be traced over time. A basic ranking is presented in Chart 21, in which Pyrgos Kieriou: Ancient Arne has a labour cost that is more than double the figure calculated for Ktouri. They are similarly ranked in regards to workforce estimates, with the highest figure calculated for Ancient Arne (168 workers for 1 year). All other estimates for both sites fall below ca. 100 workers.
6.1 Introduction

This chapter explores how the differences in the calculated labour costs identified in Chapter 5 relate to the regional trajectories of development and settlement systems that have been observed among the sampled sites, following the theoretical framework outlined in Chapter 3.

The discussions first focus on reviewing the available evidence for each region, regarding what is known of the sociopolitical differences that may have developed among both the sample sites and other relevant settlements not analyzed. These insights serve to contextualize the labour costs, which are then re-evaluated and discussed in relation to how the differences in labour investment correspond to proposed settlement systems and political geographies. The evaluations are qualitatively structured, and ultimately constrained by the nature, quality, and extent of the evidence available for each site and region. Nevertheless, they follow a similar, general analytic framework that is focused on determining the strength and nature of the connection between the scale of labour mobilization and the presence and nature of Mycenaean elite authority.

6.2 Evaluating Labour Costs within their Regional Context

6.2.1 Achaia

Due to a relative lack of systemic excavation and survey, not much is known of the LBA political organization of Achaia or how it developed over the course of the
Mycenaean period (Moschos 2002:20). Overall, there appears to have been an increase in settlement throughout the region during LH III, with most sites showing continuity from the preceding MH and LH I-II periods (Hope Simpson and Dickinson 1979:75-106; Papadopoulos 1979:172-6). The evidence also points to a sustained network of long-distance exchange with much the Aegean, as well as other more distant regions of the eastern and central Mediterranean (Papadopoulos 1979:177-182). Underlying these general trends, however, are pronounced intra-regional distinctions between western and eastern Achaea in settlement pattern, economy, material culture, and external contacts. Namely, the districts of western and central Achaea—consisting of Dyme, Patras, and Kalavryta—seem to have been oriented more towards the Ionian and Adriatic seas, while eastern Achaea was engaged mainly with the regions of the Corinthian Gulf and eastern Peloponnese (Papadopoulos 1979:184, 1991:36; Mountjoy 1999:403-4; Moschos 2002:19, 2009:345-6).

In the east, the coastal settlements of Aigion and Aigeira are presumed to have been among the largest and most substantial sites in the LH period, with long sequences of occupation and sustained contact with the northeastern Peloponnese (Papadopoulos 1979:174; Papazoglou-Manioudaki 2010; Alram-Stern 2010). Patras likely represented the major LH centre of the north-central region, whose fertile lands and proximity to the sea promoted a high density of settlement (Papadopoulos 1979:25,174; Moschous 2002:Fig. 1). The northwestern district of Dyme was considerably less populous, but the promontory site of Teichos Dynaion stands out as an extensively fortified citadel (Figures 20, 22), which had been continuously inhabited since the Neolithic and whose fortifications were likely built in LH IIIB (Hope Simpson and Hagel 2006:63). Despite
the presence of a walled citadel here—representing the only known LH settlement in Achaia to have been fortified (Papadopoulos 1979:175)—no evidence has yet come to light for administrative or palatial activity, and Teichos Dymaion has instead been interpreted as a refuge site for the local population (Moschos 2002:31, 2009: 347).

No major administrative centre of any kind has yet been identified anywhere in Achaia, although Moschos (2009:347) argues that if a palatial-like system had been established in Achaia, then a palace might be found elsewhere beyond Teichos Dymaion. Its destruction at the end of LH IIIB coincides chronologically with those of the major centres elsewhere in the Aegean, but it does not appear to have been targeted specifically; the settlements of Ayia Kyriaki: Voudeni and Pagona near Patras, for instance, were also burned down and abandoned at this time (Moschos 2002:17-18, n.7). Accordingly, if there had been a central power in western Achaia, another likely location would have been the district of Patras, which had already begun to surpass Dyme in settlement and activity by LH IIIB (Moschos 2007:9, 2009:348).

The LH IIIC period in Achaia witnessed a continued transformation of social, political, and military organization, which ultimately resulted in a phase of relative prosperity for much of the region—in contrast to the general trends of decline observed across most of the mainland in the wake of palatial collapse. A lack of centralized power is even more evident at this time (Moschos 2002:29-32), as social units and political structures likely contracted and became highly localized. Various communities fostered an emergent class of “warrior elites”, whose martial character and achieved status is reflected in the rich burials that became numerous by early LH IIIC (Papazoglou-Maniodakis 1994; Papadopoulos 1999; Moschos 2002:29-30, 2009; Deger-Jalkotzy
2006:168-176; Senn 2013). Warrior graves have been found mainly in the western
districts of Dyme and Patras (Deger-Jalkotzy 2006:168), and the assemblages are notable
in that most of the weapons interred were of ultimately “European types”, developed in
Italy and the Balkan regions (Papadopoulos 1999:273). The introduction of new styles
and forms into the local material culture, as well as the modest increase in settlement
density observed for LH IIIC (Papadopoulos 1979:185), has been traditionally attributed
to a major influx of refugees from the more disturbed areas of the mainland (e.g.,
Papadopoulos 1991:35; Papazoglou-Maniodakis 1994:200). This view has since been
tempered, as it is now believed that refugees were certainly present in Achaia but in small
numbers, and “exerted no great influence” on Achaean culture and social organization
(Papadopoulos 1979:174; Moschos 2002:29-31). The objects interred in the rich warrior
burials seem more indicative of prospering local communities, whose leaders were able
to acquire tools, weapons, and equipment from overseas, or sponsor local metallurgical
workshops (Moschos 2009).

This emergent warrior caste of LH IIIC Achaia reflects a period of intense
military preparation and organization (Moschos 2002:29-32), yet no fortifications were
apparently constructed or in use in LH IIIC. This seems contrary to the pattern observed
in the Cyclades, for instance, where an increase in fortification construction coincides
with a period of high mobility and a potential influx of refugees (see below). Despite the
relative prosperity witnessed in the western districts, the end of the LBA was still a
period of “general disorder” in Achaia (Moschos 2002:28), whereby any centralized
authority that might have been established in LH IIIA-B was likely fragmented in a
society ruled by “big-men” (Dickinson 2006:110-111). Hence, the social and political
structures might not have allowed for an effective mobilization of labour for such construction.

The labour-cost estimates for Achaia cannot be assessed in any comparative manner, seeing as Teichos Dymaion represents the only known fortified site. The exclusive occurrence of monumental fortifications here is notable, given that the settlement has produced no other evidence—beyond its relative size and monumental architecture—to suggest that it would have been more powerful than any other site in Achaia, or that it had functioned as a major administrative centre or the seat of a Mycenaean ruler. Other important settlements, such as Patras, Chalandritsa, Katarraktis, were situated in naturally defensive positions and may have been fortified (Papadopoulos 1979:184), but defensive structures have not yet been identified through excavation. Hence, a lack of systematic fieldwork has possibly produced a somewhat incomplete picture of monumental construction in Achaia.

In lieu of a comparative regional assessment, it may be informative to look at the workforce estimates for Teichos Dymaion in themselves, to consider their potential implications for the site’s function and regional political status. Based on the calculations, a completion time of one to five years would have required anywhere between 66-330 workers, perhaps drawn from a population of ca. 800-3,300 individuals (1 year) or ca. 170-660 individuals (5 years)—if based on the recruitment strategies listed in Appendix D. There are no population estimates available for Teichos Dymaion or the district as a whole, but given the various figures for population density proposed for LBA Greece—e.g., 150 per hectare (McDonald and Rapp 1972:128), 200 per hectare (French 2002:64), 300 per hectare (Renfrew 1972:251), or perhaps 400 per hectare for fortified settlements
(Frankfort 1950:103)—then such a workforce surely would have been readily available from any neighboring households or communities beyond the immediate settlement. Access to such a labour pool seems more plausible if we accept the interpretation of the site having served as a refuge centre for the district, where perhaps several hundred families would have benefited from its protection.

Parallels might be drawn with Gla in Boeotia, as another major citadel that has been interpreted as a refuge site (Mylonas 1966:85; Iakovides 1983:105-7). Gla, however, presents clearer evidence for having been a locus of administrative organization and instituted authority over the Kopais Basin—either independently, or under the ultimate authority of the palatial elite at Orchomenos (see below). Accordingly, it is far more likely that local leaders at Gla would have been capable of, and directly responsible for, drawing in labour from peripheral communities around the Kopais to meet workforce needs. Teichos Dymaion has yet to produce evidence for any such instituted, centralized authority or administrative organization, nor are there any potential candidates in Achaia for a dominant regional centre that may have sponsored construction here, as has been suggested for Orchomenos in the Kopais (e.g., Iakovides 2001:156). Still, although some indications of hierarchical authority should be expected at Teichos Dymaion given the calculated extent of labour recruitment (39,555 p-d), we should not expect the level of socioeconomic and political organization here to have been comparable to Gla, whose fortifications would have required approximately eight times more labour expenditure (ca. 323,000 p-d)—which itself may have required a higher degree of administrative complexity, wealth, and consolidated power.
Ultimately, the limited extent of fieldwork at Teichos Dymaion, and in Achaia as a whole, makes it difficult to arrive at any definitive interpretations on the implied scale of labour mobilized for construction here, either comparatively or in absolute terms. Still, in addition to the sole presence of a fortified acropolis here and its apparent monumentality, the potential size of the workforce estimated for various timescales—proposed as being supra-local in scale—gives further credence to the likelihood of a local elite having been established at Teichos Dymaion and exercising some degree of authority over surrounding settlements and the associated households. Such authority, however, need not have extended across the whole of Achaia.

6.2.2 The Argolid

Bintliff (1977) and Killian (1988) were among the first to establish a simple site hierarchy for the Argive Plain specifically, based on the sizes and perceived functions of known LBA sites. Bintliff (1977:345-7) placed Mycenae atop the settlement hierarchy as the dominant centre of the Argive Plain in LH III (with Argos and Tiryns serving as subsidiary centres), while Killian’s model (1988:296-7, Fig. 3) focused more on how smaller sites related to the “plurality of kingdoms” at this time, where Mycenae, Tiryns, Midea, Argos, Nauplion, and Asine would have each been independent centres that controlled lower ranking subcentres, villages, and hamlets within their vicinities.

This general view of how the larger sites related to one another and to smaller settlements within the Argive plain has since been refined by subsequent studies, which adopt a more diachronic perspective for development. It is now believed that during the early and middle phases of the MH period, coastal settlements at Tiryns, Argos, Lerna,
and Asine would likely have been the major centres of the plain, since they exhibit a higher concentration of both population and deposited funerary wealth (Hope Simpson 1981:9; Dietz 1991:292-3; Jameson et al. 1994:367; Sjöborg 2002, 2003; Philippa-Touchais 2010:792-7; Voutsaki 2010a:87-93). Towards end of the MH period, however, a shift in settlement occurred that tended to favor the hill zones of the plain, as growing settlements are observed further inland at Prophitis Elias, Midea, Prosymna, Mycenae, and Berbati (Hope Simpson 1981:9; Dietz 1991:293).

Indeed, this shift in settlement during the transition from MH III to LH II appears to have coincided with a shift in power from the west of the plain to the east (Voutsaki 2010a:97), which can be observed more closely in the mortuary record. The Grave Circles at Mycenae came into use at this time and reached their peak in terms of size and deposited wealth, while the shaft graves at Asine, Lerna, and Argos were of much simpler construction, and exhibit less diversity in exotic goods (Mylonas 1973; Graziadio 1991; Wright 1987; Voutsaki 1998:43, 2010a:93-97; Fitzsimons 2011:77-89). This escalation in funerary wealth and monumental construction is understood to have been a result of elite competition and self-aggrandizement through conspicuous consumption (occurring both within and between communities), in which local elites initiated or entered into exclusive networks of gift exchange and/or diplomatic alliance with elites outside the mainland, as a means of establishing and legitimizing their status and power at the local or regional level (Wright 1995; Graziadio 1998; Voutsaki 1998, 1999, 2001, 2010a; Schon 2010).

The spread of the monumental tholos tomb by LH IIA-B represents an elaboration of such competitive display. At this time, the most tholoi are constructed at Mycenae, but
others also come into use at the nearby sites of Berbati, Prosymna, Dendra: Midea, Kazarma, and Kokla during LH IIB-IIIA1 (Voutsaki 1998:48; Fitzsimons 2011:92). The appearance of tholoi at these satellite sites may indicate the aggrandizement of local elites as political allies, reflecting a strategy adopted by the faction(s) at Mycenae to strengthen their precarious position within the region (Voutsaki 2010a:97). By LH IIIA2-B1, however, tholoi are only constructed and in use at Mycenae (and possibly at Tiryns), reflecting a centralization of wealth (Burns 2010:168-90), while the abandonment of tholoi at all other non-palatial sites may signify their demotion under the hegemony of Mycenae (Hope Simpson 1981:11; Voutsaki 2001). LH IIIB then marks the crystallization of Mycenae’s control over the plain, where the centralization of wealth and authority is presumably maintained with the construction of the palace complex and fortifications (Dabney and Wright 1990:51; Wright 2006a; Shelmerdine and Bennet 2008; Voutsaki 2010b), as well as the intensification of production and exchange across much of the Aegean and eastern Mediterranean (e.g., Cline 1994:16, Burns 1999:87,105; Voutsaki 2010b:606). Overall, these patterns mark a general trajectory of social, political, and economic change, whereby Mycenae eventually emerged from a climate of regional elite competition among Argive sites, and eclipsed its earlier rivals at Tiryns, Argos, Lerna, and Asine by LH IIIA-B.

There is more uncertainty regarding the positions of Tiryns and Midea—as the other two major fortified citadels—within the political geography of the plain during the palatial period. Given the presence of administrative and storage facilities, Midea likely functioned as a craft-production centre that had close economic relations with Crete and the Levant; still, the acropolis “may not have provided more than a defensive keep for the
local nobility” (Wright 1978:72), and the settlement within the fortification walls appears to have been less extensive than those at Mycenae and Tiryns (Demakopoulou 1995, 2007; Demakopoulou and Divari-Valakou 1999; Walberg 2007). Hence, Midea is generally interpreted as having been the third-ranking centre of the Argolid during the palatial period, serving as an ally rather than a rival of Mycenae (Demakopoulou 2007:70; Voutsaki 2010a:100).

Tiryns is often given a higher relative status and is regarded to have been second only to Mycenae, given that it is the only other site in the Argolid to produce a recognizable palace and Linear B texts, and to have had fortifications contemporary with those at Mycenae. There is nothing to rule out the possibility that Tiryns was an independent polity in direct competition with Mycenae and the other major settlements (Killian 1988:297; Dabney and Wright 1990:50, n.47), and the phenomenon of escalating fortification construction in LH IIIA-B could indeed be interpreted as an “arms race” (Rutter 2004; Voutsaki 2010b:605-6). A more common interpretation has been to see Tiryns as either an independent polity in alliance with Mycenae, or as an administrative centre operating under its authority, perhaps functioning as its port (Hope Simpson 1981:9-11; French 2005:127; Crouwel 2008:269).

Certain parallels in architectural form and construction, such as the conspicuous use of conglomerate in the palace complexes, further suggest the possibility of alliance, or the allegiance of Tiryns to Mycenae (Müller 1930:37; Maran 2006a; Wright 1987:183, 2006b; Crouwel 2008:269). The presence of a conglomerate lintel stone at Argos: Larissa Hill (Figure 24) may indicate that Argos was comparable in status with the other two fortified sites (Crouwel 2008), owing to the stone’s potentially symbolic properties or
connotations of Mycenaean authority (Wright 2006b:59-60). The similarities in location between the Larissa Hill and Midea—directly opposite one another, on high rocky hills—might further suggest comparable functions as defensive fortresses, protecting the west and east sides of the plain, respectively (Hope Simpson 1981:11; Crouwel 2008:270). Such associations may ultimately speak to a coordinated defensive policy among the four fortified sites to protect the Argive Plain, reflecting an integrated political structure in which Tiryns, Midea, and Argos served complementary roles under a unified political entity likely centered at Mycenae.

Beyond the Argive Plain, a number of surveys have been carried out that broadly reflect the ascendancy of Mycenae as the dominant centre of the region. In the neighboring hinterland of the Berbati valley, and the subregions of the southern Argolid and Methana peninsula, there appears to have been a modest growth and peak in settlement during the LH IIIA-B periods that is generally ascribed to the expansion of Mycenae’s political and economic control across the Argolid (Runnels and van Andel 1987; 327; Jameson et al. 1994:368-72; Schallin 1996:170-3; Mee and Forbes 1997:54). There is also evidence that Mycenae’s influence extended into Nemea Valley to the north (Dickinson 1977:108,110; Wright et al. 1990:641-2, Cherry and Davis 2001:148-156), by potentially resettling the area for agricultural production and establishing loose diplomatic relations with local leaders at Tsoungiza (Rutter 1993:91; Wright 2004a:123-7; Tartaron 2010:165-6). Further to the east, ongoing research has also begun to outline the expansion of Mycenae’s control into the “small world” of the Saronic Gulf during LH IIIA and IIIB (Pullen and Tartaron 2007; Tartaron 2010:172-9).
Despite the complexities of piecing together the political geography of the Argolid (Tartaron 2010:164), survey evidence seems to indicate a four-tiered hierarchy of settlement and activity in LH IIIA-B across much of the Argolid and northeast Peloponnese (Cherry and Davis 2001:150, Wright 2004a:125), with Mycenae representing the highest level of settlement as the dominant regional centre. Without the aid of an extensive Linear B archive, it is difficult to identify specific sites as secondary or tertiary settlements on grounds other than size (Wright 2004a:127), although Tiryns, Midea, and potentially Argos are more easily identifiable as major centres. There is no consensus on whether they served as subordinate secondary centres, allied independent polities, or competing independent polities that each had their own surrounding territories (cf., Bintliff 1977:698-702; Killian 1988:298, Fig. 3; Hope Simpson 1981:11), and surely we must accept that circumstances may have fluctuated between these possibilities over time. By the end of LH IIIB, however, these major sites all show signs of destruction and/or abandonment (Middleton 2010:14-15). Despite evidence for modest reoccupation at Mycenae (French 2009), and a quite sizable LH IIIC population at Tiryns (Maran 2001, 2006b), there is a noticeable decline in wealth, production, and monumental construction. Most LBA settlements throughout the Argolid were abandoned by LH IIIC (Lewartowski 1989:41-3).

The differences among the calculated labour costs seem to conform to this picture of regional political power and how it evolved over time. First, the ranking of Mycenae, Tiryns, and Midea as having the three most costly fortifications corresponds to their relative statuses in the plain. Even the statistical division between Mycenae and Tiryns as one cluster, and Midea as a second, echoes the status of Mycenae and Tiryns as the two
canonically “palatial” sites, and Midea as presumably the third ranking administrative centre of the Argolid.

The change in labour investment over time among these three citadels similarly matches up with what is known of the trajectory of development for the Argive Plain. Although the earliest instance of fortification construction occurs at Tiryns (Iakovides 1983:3), the first two phases exhibit a relatively low level of labour investment. The second phase in particular is vastly overshadowed by the contemporaneous first circuit at Mycenae built in LH IIIA2-B, which surpasses all other sites and/or phases of construction in the Argolid. Such expenditure of labour at this time coincides with the presumed consolidation of power by Mycenae over the Argive plain and surrounding areas, which is manifested here in the ability to mobilize an unparalleled scale of labour for construction.

Surprisingly, however, the labour required for Mycenae’s most costly phase of construction need not have been mobilized on a supra-local or regional scale—one proportionate to the geographic scope of its potential political control. In comparing the various estimates of workforce size to a population estimate of ca. 6,400 proposed for Mycenae’s Lower Town in LH III (French 2002:64; Bennet 2007:187), we see that even the highest required workforce (ca. 1,400 workers) could have been met locally through any of the various potential structures of recruitment outlined in Appendix D (Table 16).

During LH IIIB1-2, the scale of fortification expansion at Tiryns exceeds that at Mycenae. The reasons and implications of this shift depend on how one views the political geography of the Argive plain, but what is worth noting here is that a vastly higher scale of labour investment at Tiryns coincides with the reconstruction of the
palace in LH IIIB (Iakovides 1983:6-19), so that there is an observable correlation between advanced palatial organization at Tiryns, and the scale of labour mobilized. Subsequent construction at Midea in LH IIIB2 is substantial and comparable to the scale observed earlier at Tiryns and Mycenae, and in fact overshadows the low investment for Mycenae’s Northeast Extension that also occurs at this time. From the sole perspective of labour control, this might be seen as Midea surpassing Mycenae in power, but construction here could also have resulted from an integrated and cooperative defense effort across the plain, with Midea acting in association with interests of Mycenae. Again, what is noteworthy is that such large scale construction is contemporaneous with the functioning of an administrative complex here—although perhaps not strictly “palatial” in character—so that the mobilization and management of labour for construction can be attributed a localized Mycenaean elite at Midea.

The other five fortifications in the sample constitute the third cluster, with total labour costs that are far below those for the top three sites. This patterning also accords well with their likely positions as lower-order sites within the regional hierarchy. Kandia: Kastro, Prophitis Elias, and Nea Epidavros: Vassa exhibit no evidence for administrative complexity or for having served as a seat of regional power for local elites. Surface finds instead indicate the presence of modest communities, which likely represented farming hamlets. Nea Epidavros: Vassa may have played a more significant role in the region, being situated on a communication and exchange route that linked the Argolid with the Saronic Gulf (Hope Simpson and Dickinson 1979:53; Dickinson 1994: Fig. 5.34; Siennicka 2002:184). All three sites are located in areas known to have been under the political and economic influence of Mycenae, but surely the degree of control must have
varied among the sites and over time, and it is not known how this was expressed in terms of administrative oversight or involvement in construction. Hence, there is no reason to presume that Mycenae would have had any direct involvement with construction, or acted as patrons for the investment of resources and labour. Indeed, the estimates for workforce size imply very low-cost projects, so that mobilization and management was likely a local effort by the community, with no need for palatial elite sponsorship or hierarchical administrative organization.

The tentative dating of the two fortifications at Argos (Figures 24-27) makes them more difficult to assess. Labour investment is more substantial on the Aspis (ca. 21,000 p-d) than the Larissa Hill (ca. 5,000 p-d), and if dated to MH, it would fit the contrast between Argos before and during the palatial period. The ability to mobilize a more extensive scale of labour would coincide with Argos’ status as a potentially major independent centre in the region during the MH period, while the much lower level of investment on the Larissa Hill sometime during LH IIIA-B may speak to the demotion of the site within the developing settlement hierarchy under the palace at Mycenae. The low level of investment on the Larissa Hill also belies the claims by Crouwel (2008) that Argos had a comparably high status as the “fourth citadel” of the plain, where the low expenditure of labour would instead suggest that the site served more as a watchtower rather than a seat of power for a local elite or Mycenaean administrator (cf., French 2005:127). Alternatively, the cost for transporting the conglomerate lintel stone is quite substantial in relation to the overall cost of construction; if we assume a source near Mycenae, and a certain degree of symbolic relevance in the type of stone and its use (see
above), then perhaps Argos may have retained some level of importance in LH III under the hegemony of Mycenae.

Overall, in the Argolid we can see a general correlation between palatial authority and organization, and the scale of labour mobilized for fortification construction. There are higher levels of labour expenditure at sites exhibiting evidence for palatial-administrative functions, and thus rank highest within the political geography of the LH period. In this regard, political power seems to have been closely associated with the ability to mobilize larger scales of labour more effectively (and vice-versa), thereby complementing functional and symbolic perspectives on how fortification construction can serve as an effective index for locating power in the Argive landscape.

6.2.3 Attika and the Saronic Gulf

Several settlements throughout Attika witnessed a steady growth in size and affluence during the MH period. Overseas trade relations are implied by the presence of ceramic imports from Aegina, Kea, and Melos at mainland sites such as Kiapha Thiti, Brauron, Eleusis, and probably Athens (Maran 1993; Kalogeropoulos 2010; Mountjoy 1995:69; Papadimitriou 2010:250-2). Conspicuously wealthy tombs also appear at sites such as Eleusis and Thorikos (Papadimitriou 2010:250), signifying the emergence of an early elite class within a developing social hierarchy. No clear settlement hierarchy can be observed among the communities of Attika at this time.

Kolonna on Aigina emerged as the dominant centre of the Saronic Gulf in the MBA, and seems to have exhibited a strong economic and sociopolitical influence on the surrounding coastal settlements of Attika and the Argolid (Niemeier 1995; Kilian-
Dirlmeier 1997; Rutter 2001:124-30; Tartaron 2010:172-4). In contrast to the “MH hiatus” observed throughout the mainland (e.g., Cherry and Davis 2001:155-6; Wright 2004a:119-28), Kolonna grew in prosperity and complexity at this time (Gauß and Smetana 2010; Tartaron 2013:220). It became a major exporter of the distinctive “Gold Mica” pottery (Mountjoy 1999:491), producing a wide variety of types that were distributed across a broad geographic range (Lindblom 2001:43, Table 9; Rutter 2001:127, Fig. 12; Siennicka 2002:181-2). A growing population is indicated by the continuous expansion of the settlement in several phases across most of the promontory, leading to the establishment of an “inner suburb” beyond the enclosure wall in MH I, and an “outer suburb” in the early LH period (e.g., Gauß and Smetana 2007:58, Fig. A). The most prominent structure is the “Large Building Complex” that was first built in early MH, and has been interpreted as a probable administrative centre and/or the “mansion” for an elite family or group (Gauß and Smetana 2007; Gauß et al. 2011). The wealth of such elites at this time is further signified by the contents of the Aigina Treasure and an MH II “warrior grave” (Higgins 1979; Fitton 2009; Kilian-Dirlmeier 1997). These developments all coincided with various phases of fortification construction, which spanned over half a millennium (Walter and Felten 1981; Walter 1983).

The growth of Kolonna’s influence continued into MH III and LH I-II, when it established economic and possibly political control over much of the Saronic “small world” that centered on Aegina (Pullen and Tartaron 2007:172-9; Tartaron 2010, 2013:220-232). Aeginetan imports became predominant throughout the Saronic Gulf (Lindblom 2001:41-2), compared to the relative paucity of imports from Mycenae found across Attika and the NE Peloponnese (Mountjoy 1999:59, 199, 485; Siennicka
2002:182), reflecting how Mycenae had yet to become connected with this network or exert any meaningful influence beyond its own hinterland (Tartaron 2013:228, 232-43).

At this time, Kolonna stood as the wealthiest and possibly most powerful urban centre of the region, and potentially played a significant role as a mediator for the transmission of Minoan and Cycladic ideas to the mainland (Niemeier 1995:77).

Between LH II-IIIA, Kolonna’s influence among circum-Saronic settlements began to decline, as indicated by the proportional decrease in the scale and extent of its exports (Tartaron 2010:175). Perhaps not coincidentally, this period corresponds with the rise of Mycenae, whose style of ceramics became more widely distributed throughout mainland and even on Aegina, which had likely been incorporated into the Mycenaean koine at this time (Tartaron 2013:242). This shift was essentially accomplished by LH IIIA2, when Mycenae had “swallowed the Saronic Gulf into its economic and political orbit” (Tartaron 2013:234).

In Attika, the transition from late MH to early LH is marked by the sustained growth and emergence of several important sites, which continued uninterrupted from the preceding MH phases (Hope Simpson 1981:41; Siennicka 2002:182-4). Kiapha Thiti is regarded to have been one of the most substantial (Siennicka 2002:182-3), with extensive overseas trade contacts with Aegina and the Cyclades (Maran 1993), and fortifications built sometime in LH I-II (Hagel 1992) (Figure 6). Alternatively, Thorikos is argued to have been the most powerful settlement (Papadimitriou 2010:254-6), by reference to the tholos tombs and “royal cemetery” located nearby, as well as its presumed control over the valuable mines at Laurion. Hope Simpson and Hagel (2006:64) further suggest that Thorikos had been the primary political centre of eastern Attika, maintaining control over
other subsidiary centres. Indeed, other sites also show signs of prosperity and evidence for an elite class or powerful families, including Brauron (Kalogeropoulos 2010) (Figure 28), Eleusis (Mylonas 1932, 1961; Cosmopoulos et al 1995; Siennicka 2002:183), Ayios Kosmas (Mylonas 1959), and possibly Marathon, Glyka Nera, Spata, and Vourvatsi (Sgouritsa 2007:266-71). Most of these sites are not well connected with Athens during the early Mycenaean period (Sgouritsa 2007:267), and there is scarce evidence for Athens having been a particularly important settlement at this time (Mountjoy 1995:69).

By LH IIIA, however, Athens stands out dramatically in terms of settlement size and material wealth. Although no tholos tombs have been found at Athens, many of the LH IIIA1 chamber tombs—especially those near the acropolis—are exceptionally wealthy (Mountjoy 1995:28-34). The presence of Canaanite and Syro-Palastinian amphorae also points to long-distance trade, as Athens also began to produce and export its own distinct Acropolis Burnished Ware (Mountjoy 1995:70). The so-called “Palatial Style” class of pottery that appears on the acropolis and south slope by LH IIA, as well as the remains of substantial terracing on the acropolis, have been interpreted by Mountjoy (1995:16, 22-27, 70) and Iakovides (2006:190-6) as evidence for a “palatial” residence belonging to a ruling family. By LH IIIB, the massive fortification wall that encircled the acropolis was constructed (Figure 29).

At this time, we also see a decline in settlement elsewhere in Attika. The settlement at Kiapha Thiti, for instance, is abandoned after LH IIA, and Thorikos shows evidence for decline by the beginning of LH III (Hope Simpson and Hagel 2006:64; Papadimitriou 2010:255). A number of LH IIIA-B cemeteries are known, but few settlements in southern Attika date to the palatial period (Siennicka 2002:187). Hence,
the 13th century has been suggested as a likely period for the Athenian *synoikism* alluded to in epic tradition (Sgouritsa 2007), and the elite at Athens may have at least controlled southern and eastern Attika during LH IIIA-B (Siennicka 2002:190). However, several other local political centres continue to prosper in this period—namely Eleusis, Ayios Kosmas, and Kanakia on Salamis (Dickinson 1994:157, Mylonas 1959:53-8, 1961; Lolos 2007)—and show no signs of subordination, alliance, or even intense contact with Athens. Kanakia in particular stands out as an important local centre in LH IIIA-B, given the presence of a terraced complex with rooms for storage and production (Lolos 2007); however, no truly “palatial” buildings or material culture have been discovered, and there is nothing to suggest extensive social control or the presence of a literate bureaucracy (Middleton 2010:6; Tartaron 2013:239). Ultimately, in the absence of Linear B texts, the possible presence and nature of a “palatial” elite at Athens, and the relationship between Athens and rest of Attika at this time, remains unclear (Mountjoy 1995:71). Nevertheless, Athens is seen as having been one of the largest and wealthiest settlements in Attika and the Saronic region during LH III, and one which exhibits substantial fortifications.

There are relatively few indications of disturbance throughout Attica at the end of the palatial period, although a concern for security is evident on the Acropolis of Athens, with the construction of a deep underground cistern in LH IIIB2-C (Broneer 1939; Iakovides 1983:82-4). By the end of LH IIIC, most Attic settlements had been abandoned, suggesting a sharp decrease in population (Lewartowski 1989:75). Following isolated destructions on the north slope of the Acropolis in LH IIIB2, Athens shows signs of continued occupation—albeit at modest levels—into later periods (Mountjoy 1995:72).
Since no clear hierarchical settlement pattern can yet be discerned for the LH period, it is difficult to assess how the differences in labour mobilization implied by the estimates correspond to the political geography of Mycenaean Attika and the Saronic Gulf. On the other hand, the occurrence of fortifications at certain sites, and the changes in the associated labour investment over time, seem to accord with what is known of the trajectory of sociopolitical development for this region.

For the majority of the MH period, substantial fortifications are only observed at Kolonna, the dominant regional centre. Certainly, the very presence of the fortifications and their continued renovation would have provided a visible statement of Kolonna’s power and affluence, while also serving more practical defensive functions. Yet despite the underlying complexity, regional control, and wealth suggested for Kolonna, the actual expenditure of energy for the construction of the fortifications is quite low. Construction during Phases VI-IX (MH I-III) averaged only ca. 2,150 p-d of labour, meaning that even if construction had been completed within a single season, each of the various building phases would only have required less than twenty-two labourers. The population of MBA Kolonna and/or its hinterland is not known with any certainty, but such a workforce surely would have represented a small fraction of a dense urban settlement that spanned at least 6,400 m² (Hope Simpson and Hagel 2006:72). In Phase X (MH III-LH I), labour expenditure for construction is even more modest, amounting to only 277 p-d. It is tempting to interpret this low investment in the context of Kolonna’s decline in power under the expansion of Mycenae, as this building phase represents only a minor addition to the fortification wall.
At this time, fortifications were also constructed at Kiapha Thiti and Brauron (Figures 6, 28)—two Attic sites which became distinguished in other ways as substantial early Mycenaean communities with an emergent elite. These sites are relatively comparable in terms of labour investment, although the exclusive presence of fortifications here makes them stand out from other Attic sites in terms of the very ability to mobilize labour for monumental construction. Still, these fortifications also reflect a very modest expenditure of labour in relation to the overall sample, requiring only ca. 3,500 p-d (Kiapha Thiti) and 2,900 p-d (Brauron). It is worth noting that fortifications have not been observed elsewhere at other significant LH I-II sites, such as Eleusis, Thorikos, or Marathon. In light of Hope Simpson and Hagel’s (2006:64) reconstruction of eastern Attika as an integrated sociopolitical unit under Thorikos, this is especially surprising, as defense works of any scale would perhaps be expected at the primary centre of Thorikos, or at other subsidiary sites (e.g., Kastro tou Christou and Marathon) that may have guarded points of access to the area. There is, of course, the possibility that they have yet to be discovered. But despite these absences, the known fortified sites of this period occur exclusively where powerful families or elite groups were being established, signifying that they had been more effective at mobilizing surplus labour than other more modest, lower ranking settlements.

LH III signals a dramatic increase in investment for fortification construction, and coincides with the establishment of Mycenaean culture and social organization within Attika and the Saronic region. The erection of the circuit wall at Korphos: Kalamianos in LH IIIA2-B (Figures 30-31)—amounting to ca. 15,000 p-d of labour—occurred during its abrupt emergence as a major port community and important economic node on the
Saronic coast. Preliminary investigations at this site suggest that its development into a large, walled urban centre was likely facilitated by the centralized power at Mycenae, who would have used it as an important harbour for accessing the Saronic Gulf and beyond (Tartaron 2010; Tartaron et al. 2011; Pullen 2013). Therefore, the construction of the Cyclopean circuit wall would likely have occurred under the auspices of a Mycenaean palatial elite—either under the direct authority of Mycenae itself or an aggrandized local elite, whose presence at the site has thus far been indicated architecturally by the scale and style of certain buildings and structures (Pullen 2013).

The LH IIIB fortification wall on the acropolis of Athens represents the most substantial scale of labour expenditure in Attika by far, and its construction is generally interpreted as signaling the consolidation of Athens’ power over the region (or at least eastern Attika). It was erected after the presumed construction of a “palace”—or at the very least, an extensive residence for an elite family, whose presence on the acropolis may date back to as early as LH IIA (Mountjoy 1995). The scale of labour mobilized here (ca. 150,000 p-d) far exceeds anything else observed in the region, and the clustering observed among the construction costs accords somewhat with the differentiation that can been seen between Athens and the rest of the region in LH III. No population estimates exist for Mycenaean Athens, but the calculations for workforce size may imply a level of labour recruitment beyond the settlement near the Acropolis. The completion of construction within one to five years would have required anywhere between ca. 250-1,200 workers. The higher end of mobilization might add to the likelihood of a synoikism at Athens, although establishing causality is problematic. The labour could have been recruited from the surrounding communities and households as a function of a synoikism
that had already occurred (Sgouritsa 2007:267), but we cannot rule out that it may have perhaps played causal role, where the means by which the elite at Athens mobilized labour from subsidiary communities could have been a part of the very process of political centralization and the consolidation of regional power.

Fortifications were not exclusively built at Athens in LH III, as the remains of a circuit wall have also been identified nearby at Ayios Kosmas (Mylonas 1959:53-8). They are poorly preserved, but the remains reflect a very simple and modest scale of construction—not at all comparable to that observed at Athens. The status of Ayios Kosmas within the political geography of Mycenaean Attika is uncertain, but regardless of whether it was subordinate or independent, it was undoubtedly a lower-order settlement that ranked below Athens.

For Attika and the Saronic Gulf, then, we find that some of the major settlements that emerged over the course of the MH and early LH periods became further distinguished by the construction of fortifications, suggesting that the ability to mobilize labour for such projects was tied exclusively to the interests and capabilities of an emergent elite class located at those sites. However, the calculated estimates for workforce size point to a surprisingly minimal scale of investment in absolute terms, so that although only the dominant sites were able to complete such construction projects, perhaps there had been certain socioeconomic, political, or demographic constraints in the scale of the labour that could be effectively mobilized at this time. In contrast, more substantial figures for labour expenditure coincide with the possible establishment of a Mycenaean palatial elite at Athens in LH IIIA-B. Based on the estimates, labour may have come from beyond the community situated on and around the acropolis, which
carries potential implications for the probability of an Athenian *synoikism* having occurred—either before fortification construction, or possibly as a result of it.

6.2.4 Boeotia, Phokis, and Lokris

During the early LH period, Thebes and Orchomenos show a rapid development in settlement size and deposited funerary wealth, emerging as the social and economic foci of eastern and western Boeotia, respectively (Hope Simpson and Dickinson 1979:235; Symeonoglou 1985:19-25; Misiewicz 1988:125; Aravantinos 1995:615; Dakouri-Hild 2001b, 2010). Although not much is known of early LH Orchomenos, evidence from both funerary and domestic contexts at Thebes speak to the emergent presence of a “warrior class” or early Mycenaean elite on the citadel of the Kadmeia (Aravantinos 1995:615-6). Architectural and mortuary remains at Chaironea and Eutresis similarly indicate substantial settlements in the MH and early LH periods (Goldman 1931; Fossey 1988:378,380); the latter site exhibits a particularly broad range of craft and agricultural production (Goldman 1931:42-64). A steady growth in regional settlement becomes more pronounced in LH IIIA-B, and habitation appears to have been concentrated mainly in the Kopais Basin, Theban plain, and Asopos Valley (Buck 1979:38; Hope Simpson 1981:59). Such growth may have been facilitated by the intensification of agriculture under the auspices of Thebes and Orchomenos (Dakouri-Hild 2010:619), where palatial modes of social, economic, and political organization had likely become established by LH IIIA.

The Mycenaean palace complex at Thebes—the “House of Kadmos”—was built sometime in LH II or LH IIIA, and by LH IIIIB exhibits evidence for elite architectural
features, the use of Linear B, and materials associated with the production of a wide range of finished goods (Symeonoglou 1985:41-6; Dakouri-Hild 2001a, 2005). Although the chronology of construction remains tentative, palatial-administrative activity here seems to have coincided with the construction of a fortification wall around the Kadmeia in LH IIIA2-B1 (Aravantinos 1988, 1991) (Figure 12), possibly replacing an earlier MH circuit wall (Symeonoglou 1985: 19-23). The fortifications encompassed a settlement of perhaps ca. 8,000 individuals (Aravantinos 1995:616), who may have lived exclusively on the Kadmeia, seeing as the surrounding plains and hills appear to have been relatively uninhabited.

The Linear B tablets, nodules, and seals recovered from the Kadmeia speak to the geographic extent of the Theban state in LH IIIA-B, where the palatial elite administered or controlled various aspects of a diverse and integrated political economy that spanned much of eastern and southern Boeotia (e.g., Aravantinos 1987, 1995; Dakouri-Hild 2005, 2010:619-20; Sacconi 2007; Del Freo 2009). The Theban texts contain twenty-five distinct toponyms and seventeen ethnic or ethnic-based anthroponyms, many of which are recognizable (Del Freo 2009:65). The majority of these toponyms correspond to Boeotian settlements in the southern and eastern provinces surrounding Thebes, although the appearance of names such as a-ma-ru-to (Amarynthos) and ka-ru-to (Karystos) suggest that certain communities in Euboea may have also been under the economic and political influence of Thebes (Del Freo 2009:66; Dakouri-Hild 2010:620). Across this presumed territory, the Theban palatial elite may have controlled or administered a population of ca. 30,000-50,000 (Aravantinos 1995:617). A site hierarchy between Thebes and the Linear B place-names is not directly evident, but it might be reasonable to
assume a three-tiered hierarchy of settlements in the region, with Thebes as the dominant centre, followed by potential secondary centres—e.g., Eutresis (eu-te-re-u), Eleon (e-re-o), Kreusis (ke-re-u-so), and Ptioa (po-to-a2-ja)—and then smaller villages or farmsteads distributed throughout the countryside (Aravantinos 1987:40; Dakouri-Hild 2005:208; Del Freo 2009:67).

A separate political district likely existed to the north and west of this territory, consisting of the Kopais Basin, the coast of the northern Euboean gulf, and areas of Eastern Lokris and Phokis (Buck 1979: 39-40; Aravantinos 1995:617; Eder 2007:39; Sacconi 2007; Dakouri-Hild 2010:620). Orchomenos, located on the western end of the Kopais, stands out as the only feasible settlement that would have been the principle economic and political centre of the area in LH IIIA-B—although evidence for the existence and activity of a “palace” here is limited. Excavations on and near the acropolis revealed numerous eroded LH structures (including a possible megaron with a hearth), and a few notable finds, such as fresco fragments, bronze weapons, and high-quality LH IIIA-B pottery (e.g., Bulle 1907; Spyropoulos 1972, 1973, 1974; Mountjoy 1983). No Linear B texts have been recovered, with the exception of a few inscribed stirrup jars (Raison 1968:118-120; Spyropoulos 1969:186). The site is more renowned for the “Treasury of Minyas”, representing the only known tholos tomb in the region, and which shows a degree of technical skill and architectural scale comparable to the Treasury of Atreus at Mycenae. No LH fortifications have been preserved here, potentially due to later episodes of construction on the site (Hope Simpson and Hagel 2006:75). Despite these deficiencies in the material record, Orchomenos likely exerted economic and political influence over surrounding subsidiary sites, especially within and around the
Kopais basin. As with Thebes, there is no direct evidence available to reconstruct a clear site hierarchy under Orchomenos, but we can suppose that Gla surely stood apart from other settlements as the seat of a local administrator (see below), as may have Kastri: Haliartos, whose population might have been substantial (Austin 1926; Buck 1979:38).

The extensive drainage of the Kopais basin in LH IIIB was a massive undertaking that is generally believed to have been carried out under the auspices of Orchomenos (Kenny 1935; Fossey 1980:162; Iakovides 1983:107, 2001:149-157; Knauss et al. 1984; Knauss 1989, 1991, 1995; Kountouri et al 2012). It would have benefited the most from the project agriculturally (Hope Simpson 1981:61), and the association of Orchomenos with the drainage project is well attested in Greek legend (Pausanias IX 38,7; Strabo IX, 415; see also Fossey 1980:161, Salowey 1994). Orchomenos was presumably the only site with the wealth and administrative complexity to provide the necessary oversight, management, and financing for the project and its maintenance. As a part of such maintenance, the palace might have also facilitated the construction of the defense works and fortresses observed at several sites around the periphery of the basin. These consist mainly of small hilltop communities, but which had been fortified in LH IIIA-B and are strategically located in a manner that suggests an intention of protecting the infrastructure of the drainage system (McConnell 1979; Loader 1998:154). This objective is especially evident in the northeast sector of the Kopais, where the sites of Kastro: Ancient Kopai, Kantza, Ayia Marina, Ayios Ioannis, and most notably Gla, seem to form a densely integrated network of defense aimed at protecting the katavothres, which would have been the most vulnerable point of the system (Buck 1979:38; Fossey 1980). Other sites
around the Kopais possibly fortified at this time include Pyrgos, Stroviki, Davlakis, and Kastri: Haliartos (Hope Simpson and Hagel 2006:76-81).

Gla stands out as the central hub of the Kopais defense system, exceeding all other sites in settlement size and scale of fortification construction (Figures 32-33). It is unique as a Mycenaean citadel, with four distinct gates, a residential building with two flanking megara (yet with no recognizably “palatial” features), and an “agora” area with storerooms, workshops, and living quarters (e.g., de Ridder 1894; Noack 1894; Threpsiades 1955; Iakovides 1983:91-107, 1989, 1998, 2001). Although its exact function and status remains debatable, Gla is generally regarded to have been a specialized administrative centre—not as the seat of a ruler, but of local officials or administrators operating under Orchomenos, managing the defense of both the drainage infrastructure and agricultural produce, and possibly providing refuge for the surrounding communities and their flocks in times of crisis (Mylonas 1966:85; Iakovides 1983:105-7).

Buck (1979:38-40) has identified other clusters of LH IIIA-B fortified settlements across Boeotia and the central mainland. In addition to those concentrated around the Kopais, another group of fortified sites appears further west in Phocis, with Ayios Vlasios: Panopeus, and possibly Chaeronea and Levendi. The large citadel at Krisa lies much further to the west, beyond Mt. Parnassus, and is unlikely to have been integrated with these sites. The group associated with Thebes includes Eutresis, Thisbe: Paleokastro, and possibly Chorsiae, Siphae, and Kreusis, which all would have guarded the passage between Thebes and the Corinthian Gulf. Further to the east lies a forth group consisting of Chalkis: Glypha and possibly Dramesi: Pyrgos, Aulis, and Eleon, which would have secured Thebes’ access to the Euboean Gulf. These distributions are surely a function of
the political and physical geographies of the LH III period, although the general absence of fortifications along the presumed east-west boundary between the territories of Thebes and Orchomenos is surprising (Dakouri-Hild 2010:620). The nature of the relationship between the two polities is not fully known, but Greek legend would suggest one of hostility (Buck 1979:39). The evidence nonetheless seems to contradict the notion of a unified “great Boeotia” (cf., Sargent 1994).

By the end of LH IIIB, almost all of the major sites were destroyed or abandoned (Lewartowski 1989:80-90). The complexes at Thebes, Orchomenos, and Gla experienced devastating conflagrations by LH IIIB2-C, although with some continued habitation at Thebes (Symeonoglou 1985:60-3; Middleton 2010:14-15). Much of the countryside remained abandoned throughout LH IIIC.

The calculated differences in labour expenditure among the sampled sites do not accord with the LH IIIA-B political landscape in any expected manner, and instead indicate a more complex and obscured relationship between settlement, power, and labour mobilization.

Poor preservation at the two palatial sites hinders a proper assessment of the scale of fortification construction that may have taken place, which would otherwise be expected to have exceeded the other subsidiary sites in the region. LH IIIA-B fortifications were undoubtedly erected at Thebes, but only the foundations remain, as the material was probably reused in later periods due to the absence of good building stone in the area (Symeonoglou 1985:21, 29). The labour-cost estimates are therefore based on a range of conjectural heights, and the average of these costs ranks only fourth among the
sampled sites—a ranking not commensurate with its status as perhaps the major palatial site in eastern Boeotia.

The absence of any fortifications at Orchomenos similarly challenges the presumed relationship between labour mobilization and regional political authority. The Treasury of Minyas represents the only extant example of LH III monumental construction at the site itself, perhaps suggesting that labour had been mobilized and channeled by the local elite into forms of architecture other than fortifications. The connection between palatial authority and labour control might also be seen in projects carried out beyond the settlement, such as Orchomenos’ presumed involvement in the labour intensive Kopais drainage project (Knauss et al. 1984), which may have extended to include the construction of the fortress of Gla (Iakovides 2001:156).

Labour investment for the LH IIIB fortifications at Gla (ca. 323,000 p-d) far exceeds any other figure calculated in the overall sample. Even when considering a range of potential timescales for construction, the necessary workforce would still have consisted of several hundred to several thousand labourers (Appendix D, Table 15), which surely must have been mobilized from beyond the settlement itself—perhaps from the northeast section of the basin, or across the greater Kopais area. This figure cannot currently be assessed against estimates of LBA population for this region, which are lacking, but based on the known sizes of most of the LH settlements around the basin (cf., Hope Simpson and Dickinson 1979:235-271; Hope Simpson 1981:59-84), we can assume that the workforce must have come from several distinct communities, suggesting perhaps some degree of centralized authority and organization (Iakovides 1983:107).
Again, no definitively palatial structures have been uncovered at Gla, and it has instead been interpreted as a subsidiary administrative centre of Orchomenos. This inversion of regional status and labour investment runs counter to what is observed in Attika and the Argolid (see above). Alternatively, the presumed connection between power and labour control can be maintained by assuming that the labour for Gla had been mobilized by the political elite at Orchomenos, and the relatively contemporaneous instances of fortification construction across the Kopais in LH IIIA-B might suggest at least some degree of external palatial involvement. Still, attributing the labour mobilized for construction elsewhere to the authority situated at Orchomenos remains difficult to prove, and the absence of fortifications at Orchomenos itself further obscures the manner in which labour mobilization in the Kopais was directly associated with regional political authority.

The second hierarchical cluster of labour costs consists of Krisa (ca. 111,000 p-d), Eutresis (ca. 109,000 p-d), and Thebes (ca. 93,000 p-d). Eutresis is known to have been an important secondary site in the Theban state, but exhibits a higher level of calculated labour expenditure than Thebes itself—again, an inversion of the presumed relationship between regional status and labour control. Krisa ranks second among the sites of central Greece and fifth overall in labour expenditure, yet no evidence for palatial activity has been recovered, and little is known of its settlement history, status within the region, or political affiliations. It was likely the predominant site in the Amphissa plain and controlled the Gulf of Krisa and Pleistos valley (Hope Simpson and Hagel 2006:95), although its location in Phokis may supposedly place it within the broader sphere of
influence of Orchomenos. The lack of evidence for Krisa having been comparable in regional power again makes the observed differences in labour investment problematic.

The remaining sample sites all similarly date to the palatial period (LH IIIA-B), and their placement within the third cluster—with labour costs ranging between ca. 14,000-40,000 p-d—coincides more or less with their relative statuses as secondary or lower order settlements, with varying or obscure functions. Within the second and third clusters, no significant difference in ranking occur between the sites known to have been under Theban hegemony (Eutresis, Thisbe: Palaiokastro, Chalkis: Glypha) and those under Orchomenos (Gla, Kastri: Haliartos, Pyrgos, Ayios Ioannis, Ayia Marina, and Larymna: Kastri), although there is a clear difference in the relative number of fortifications and total calculated scale of construction. The acropolis of Ayios Vlasios: Panopeus (ca. 25,000 p-d) lies to the west of the Kopais, and its relation to Orchomenos remains unknown, as its strategic location between Phokis and the Kopais can reflect concerns of defense either for Orchomenos, or against it (Buck 1979:38).

Overall, the intensified construction of fortifications across Boeotia and central Greece does correspond chronologically with the palatial period and the rise to power of Thebes and Orchomenos, but the correlation between the scale of such construction and the palatial elite themselves, or regional authority in general, is not at all clear. We see secondary sites such as Gla and Eutresis overshadowing the primary centres of Orchomenos and Thebes, respectively, in terms of labour expenditure. Hence, the scale of labour mobilized for fortification construction cannot be used effectively for spatially locating differences in regional political power across the Boeotian landscape. The connection between palatial authority and labour mobilization might still be maintained if
we allow for the possibility that the power of the palatial elite to mobilize a substantial workforce may have been expressed and channeled elsewhere at subsidiary sites. However, the absence of any direct evidence (i.e., Linear B) makes this connection difficult to prove.

6.2.5 Cyclades

By the onset of the LBA, much of the Cyclades appears to have fallen under the influence of Minoan Crete (see Davis 1979; Barber 1981:4-6, 1987:194-200; Branigan 1981, 1984; Schofield 1982; Sakellarakis 1996; Broodbank 2004; Knappett and Nikolakopoulou 2005). The nature of this contact is uncertain, regarding the extent to which such change in culture might also imply the political and economy hegemony of a Minoan “thalassocracy” (Thucydides I, 4; see Mountjoy and Ponting 2000; Broodbank 2004; Berg 2007; Davis and Gorogiannis 2008). Surely it must have also differed among specific sites and over time.

Nevertheless, the increased Minoan influence in the Cyclades is generally understood to have been a catalyst for the cultural and sociopolitical development of certain large, nucleated settlements such as Akrotiri on Thera, Ayia Irini on Kea, and Phylakopi on Melos, which became higher-order centres within the Cycladic settlement hierarchy (Schallin 1993:174). Here, following episodes of destruction or disruption in the middle to late MC period, we find a pronounced incorporation of Minoan architectural elements, a rise in Minoan imports, the local adoption of Cretan styles in various aspects of material culture, and possible changes in religious customs and social organization (Barber 1987:159-223; Davis 2008:189-197). In particular, the presence of
Linear A fragments at each site may hint at the development of some degree of administrative complexity, and the adoption of a bureaucratic mode of socioeconomic organization similar to that of the Minoan palaces (Owens 1996, 1997; Karnava and Nikolakopoulou 2005; Davis 2008:193-6; Karnava 2008). No defense works have been located at Akrotiri, but substantial fortifications appear first at Ayia Irini at the end of the MBA (Davis 1977) (Figure 3), and then at Phylakopi in LC I (Renfrew 1982b, 2007:53-64) (Figures 34-35).

By the end of LC II, Mycenaean culture became more pervasive across much of the Cyclades, following the decline of the Minoan palaces and coinciding with rise and expansion of Mycenaean society on the mainland (Barber 2010:164). This process intensified by early LC III, when Mycenaean pottery had become more widespread throughout the islands and tended to replace local decorated pottery styles, especially at Ayia Irini and Phylakopi (Cummer and Schofield 1984:146; Mee 2008:366; Mountjoy 2008; Barber 2010:164-5). Cycladic architecture and settlement layout remained largely unchanged, although at Phylakopi an impressive Mycenaean-style “megaron” was built over the earlier Phase III mansion, followed by the construction of a shrine complex that also seems Mycenaean in character (Renfrew 1978a, 1978b, 1985; Barber 1987:224-5; Schallin 1993:187). Mycenaean cult activity is also apparent on Delos, and at the temple at Ayia Irini (M.E. Caskey 1971; Barber 1987:240; Schallin 1993:184). Most Cycladic tombs from the LBA do not indicate a strong Mycenaean influence, although some tholos tombs have been identified on Mykonos, Tenos, and Naxos (Mee 2008:366: Barber 2010:165). Grotta on Naxos is established at this time as a flourishing coastal settlement (Lambrinoudakis and Philaniotou-Hadjianastasiou 2001:159-160), and the considerable
increase in Mycenaean imports here suggests a high degree of integration into the
Mycenaean *koine* (Cosmopoulos 1988:141).

It remains unclear as to whether Mycenaean presence across the Cyclades was
one of political domination and economic control (Desborough 1964:219; Schilardi
1992:622; Barber 1999) or simply one of cultural and religious influence (Schallin
1993:184-9), and again, the nature and degree of such contact must have differed among
the various Cycladic communities. A complete Mycenaean “thalassocracy” over the
Cyclades seems unlikely (Schallin 1993:172-7; Mee 2008:368; Earle 2012:5), but
Phylakopi in particular appears to have been incorporated to some extent into the political
domain of one or more Mycenaean polities (Barber 1981:9, Earle 2012:5). Accordingly,
it may have gained a regional status comparable to that of Akrotiri in the MBA as a main
seat of authority among the Cycladic islands (Schallin 1993:177; Barber 2010:165).

A marked decline in Mycenaean imports occurs by middle LC III (Mountjoy
2008:473) and suggests a general reduction in mainland connections at this time,
coinciding with the disturbances that intensified across much of the mainland in LH
IIB1-2 (Barber 1987:226-7, 2010:165). Such disruptions were surely felt in the Cyclades
(Deger-Jalkotzy 1998b), prompting an extended phase of fortification construction at
several locations, and settlement that more frequently tended to favor remote, defensive
locations (Barber 1987:234-5; Karageorghis and Morris 2001). Specifically, fortifications
were erected around the hilltop settlements of Koukounaries on Paros (Schilardi 1979,
1984, 1992) (*Figure 36*), Ayios Andreas on Siphnos (Philipaki 1973) (*Figure 37*), and
also possibly at Akroterion Ourion on Tenos (Scholes 1956:13). Grotta was abandoned at
the end of LH IIIB, but then resettled and fortified by early LH IIIC, with walls possibly
running from the coastal settlement up to the nearby Kastro hill (Lambrinoudakis and Philaniotou-Hadjianastasiou 2001). Renovations were also made to the fortifications at Phylakopi, although they appear to have been restricted to the area near the shrine complex (Renfrew 2007:53-64). Only Ayia Irini seems to differ from this trend, since the fortifications of Periods V-VI were likely not in active use in the later part of the LBA (Davis 1977:180).

Still, a pronounced defensive concern was shared among most Cycladic settlements, geared towards guarding against potential threats from the sea. These settlement and construction efforts could have been initiated not only by locals, but also refugee Mycenaeans who may have fled from the mainland and settled in the islands, either displacing or living with the locals. The presence of refugees from the mainland has been suggested—albeit on a speculative basis—for both Ayios Andreas (Televantou 2001:208) and Koukounaries (Schilardi 1984, 1992; Thomatos 2005). Mycenaean palatial elites may have occupied the latter site in particular, as the centrally-located LH IIIC “mansion” at Koukounaries has been interpreted as a kind of “provincial palace”, with vast storerooms of agricultural produce, Mycenaean fineware, and luxury items (Schilardi 1992). The impressive finds in the tombs at Grotta might also indicate the presence of prosperous settlers from the mainland on Naxos (Barber 1987:227-8). By the end of LC III, however, most of these settlements were eventually abandoned (Ayios Andreas, Phylakopi) or violently destroyed (Koukounaries) (Barber 1987:69). Ayia Irini shows evidence for continued occupation, but with gradual economic decline until its abandonment after Period VIII at the end of the LBA. Grotta stands out as a relatively
affluent site at this time, but is ultimately abandoned by the end of LH IIIC period (Lambrinoudakis and Philaniotou-Hadjianastasiou 2001:164-6).

Although the observed instances of fortification construction in the Cyclades tend to occur mainly among nucleated settlements with evidence for local elite figures, the calculated labour costs show no consistent correlation between the scale of labour expenditure and regional political status, or with the changing degree of Mycenaean palatial influence over time.

The construction of early defense works exclusively at Ayia Irini and Phylakopi—notwithstanding possibly undiscovered fortifications at Akrotiri—generally fits with their statuses as the major Cycladic settlements in late MBA and early LBA. Here, the conspicuous presence of a local elite and some degree of bureaucratic organization allowed for the effective mobilization of surplus labour necessary for construction. The absence of fortifications elsewhere at this time might then imply that such monumental fortifications provided a means of differentiating between higher- and lower-order settlements in the early LC period, and served as effective indices of regional power.

Despite their comparable statuses as affluent higher-order settlements, the calculated labour costs show a surprisingly large disparity in scale between these two sites. The LC I fortifications at Phylakopi (ca. 24,000 p-d) would have required approximately three times more labour than the earlier Period V defense works at Ayia Irini (8,000 p-d). Such a discrepancy is not likely to have resulted from technical constraints, as both settlements are of comparable size, and both fortifications were built in a similarly provincial style of “Cyclopean” masonry. The lower labour-cost estimate
for Ayia Irini may simply reflect the fact that the extant stretch of walling has only been preserved across the landward site of the promontory, whereas if the fortifications had encircled the entire settlement, the expenditure of labour might have been comparable to that for Phylakopi (see Appendix A).

Alternatively, we might ascribe the higher investment at Phylakopi in LC I to Minoan aggrandizement, with construction coinciding with the period of intensified Minoan contact. But there is nothing to suggest that the Minoan’s potential influence on the social, economic, and political organization at Phylakopi differed in such a degree from that at Ayia Irini in the late MBA and early LBA. In fact, the scale of labour mobilized at these two sites does not correlate very closely with the changing spheres of external influence that enveloped the Cyclades during the early and middle LBA.

One might expect an increase in potential labour expenditure for monumental construction under the influence of the more complex palatial systems of the Minoans or Mycenaeanse—especially if they had colonized these settlements and imposed direct political and economic control. If, for example, the Minoans had colonized Kea out of an interest in accessing the nearby Laurion mines of Attika more directly (cf., Gale et al. 1984), then fortifications at Ayia Irini might have been especially necessary in defense against nearby competitors such as Thorikos. However, the labour-cost estimates show a much larger scale of labour invested for the Great Fortifications of Period V (ca. 8,000 p-d), at a time that precedes the period that is thought to have witnessed a more intense level of Minoan contact and socioeconomic development (Period VI). The subsequent renovations made after the Period VI earthquake seem modest in comparison (ca. 4,500 p-d), and the later periods of habitation under Mycenaean influence show no evidence for
additional labour mobilization for construction; the fortifications appear to have gone out of use while the settlement expanded in size. At Phylakopi, the substantial investment of labour for the Phase III fortifications does match up with a period of settlement growth and increasing prosperity under Minoan influence. However, when it presumably becomes a dominant Cycladic site during the Mycenaean period, construction is extremely minimal in terms of investment (464 p-d).

Indeed, Mycenaean presence in the Cyclades appears to have had a varied effect on the scale of Cycladic fortification construction over time, differing widely between the palatial period (LH IIIA-B) and the ensuing phase of disruptions in the Aegean (LH IIIB2-C). Fortification construction falls into an apparent lull during the palatial period, and it is only in the wake of the palatial collapse across the mainland that labour is again expended in construction, but at newly settled and less prominent sites such as Ayios Andreas and Koukounaries. The increase in the number of fortified and defensive settlements across the region at this time is not surprising, but the scale of investment even among these two sites varies widely. On the one hand, labour mobilization for Ayios Andreas (ca. 23,000 p-d) is comparably high, second only to that for LC I Phylakopi. Not much is known of Ayios Andreas during its brief occupation in LH IIIB-C (Televantou 2001:208), but it does not appear to have been a particularly affluent site, or to have exerted any power or influence beyond the localities of Siphnos. Conversely, Koukounaries has been interpreted as a kind of palatial refugee settlement of emigrant Mycenaean elites, with evidence for stored wealth and walls that exhibit truly “Cyclopean” masonry; yet these fortifications seem to have required very minimal expenditure of labour for construction (ca. 1,000 p-d).
It therefore becomes apparent that no clear trajectory of change can be traced over time in terms of the scale of labour mobilized for construction, especially in the context of palatial involvement in the Cyclades. For some locations, a relatively high expenditure of labour occurs before the establishment of any potential regional hegemony (Ayia Irini, Period V) or following its decline (Ayios Andreas); elsewhere, the role of a Mycenaean elite in construction is more evident (Phylakopi Phase III, Koukounaries), but at different times, in different contexts, and with varying scales of labour expenditure.

The workforce size estimates reveal that the necessary labour could have been easily recruited from within the local settlements, perhaps from only a few households or families. Despite the assumption that the Great Fortifications of Ayia Irini would have been a particularly costly project (e.g., Davis 1986:101-2; Barber 1987:69), they would have only required a maximum of 68 workers to complete construction within a single season. When compared against the range of various population estimates for Ayia Irini—as low as 500 individuals (Wiener 1990:132, citing personal communication with E. Schofield) and as high as 780-1,250 (Davis and Cherry 1990:187)—this figure for surplus labour seems quite manageable, representing only 5.6%-14% of the total population.

Larger workforce sizes were calculated for Phylakopi (200 workers for 1 season, or 40 workers for five seasons), but a population estimate of 2,000-3,000 individuals for the height of LBA settlement (Wiener 1990:131) means that the largest workforce would represent barely 10% of the local community—indeed, the least burdensome of the four recruitment structures outlined in Appendix D (Table 16). No population estimates have been attempted for Ayios Andreas or Koukounaries, although the extremely low
workforce size for the latter site (<10 workers for a single season) gives credence to the interpretation of it having been a refugee settlement consisting of only one or several families from the mainland.

In sum, the differences in labour expenditure do not match up clearly with the known trajectory of development for the Cyclades. The construction of monumental fortifications tended to occur mainly at higher-order nucleated settlements (especially in the early LBA), but the calculated differences in labour expenditure vary dramatically, and because not much is known of the settlement hierarchy of the region for much of the LBA, it is difficult to assess how meaningful these differences are in relation to regional status. The changes in labour investment over time also do not match up well with the presumed changes in regional hegemony under either Minoan or Mycenaean palatial influence, whose presence in the region seems to have had a highly complex and varied effect on construction and labour control among Cycladic settlements. Essentially, the known instances of fortification construction tend to reflect sporadic concerns of defense that do not always correlate with regional status or authority (Wagstaff and Cherry 1982:261; Davis 1986:105), and the very scale of investment for such construction similarly shows no significant relationship with a site’s relative degree of regional power.

6.2.6 Messenia

By the early Mycenaean period, a number of communities across Messenia emerged as independent, competing higher-order settlements (McDonald and Hope Simpson 1972:130-143; Bennet 1999a:35-7, Shelmerdine 2001b:118-126, Wright 2008:245). This trajectory of growth can be seen not only in the survey record, but also in
the construction and use of tholos tombs, the distribution of which can be useful for identifying competing centres of power across the early Mycenaean landscape (Dickinson 1977:91-3; Cavanagh and Mee 1998:44-5).

Following the construction of the earliest known tholos at Koryphasion in MH III (Lolos 1989), tholoi begin to appear more frequently in LH I at sites such as Gourvalari, Nichoria, and Peristeria (Voutsaki 1998:53). At this time, a growing number of tholos tombs also come into use throughout the greater Pylos area, at Ano Englianios, Voidokoilia, Gourvalari, Routsi, and possibly Tragana (Bennet 1995:596-7). Despite this concentration in tholos construction, Pylos is not regarded to have been the dominant centre of Messenia in the early Mycenaean period (Bennet 1999a:35; Bennet and Shelmerdine 2001:136), as deposited wealth is distributed much more broadly throughout Messenia—contrary to the trajectory of centralization observed at Mycenae at this time (Voutsaki 1998:53-4). The settlement at Peristeria, for instance, stands out in LH II as an affluent settlement with three large tholoi, compared to the two contemporary tholoi (Tholos III and IV) in use at Pylos (Bennet 1995:597, 1998:129).

Survey data seem to complement the patterns inferred from tholos tomb construction and use (McDonald and Rapp 1972; Davis et al. 1997). By the onset of the LBA, Pylos was only one of several large settlements across Messenia, many of which show peak-density in the early Mycenaean period (Shelmerdine 2001b:118). One substantial LH I-II settlement was located near Pylos at Koryfasio: Beylerbey, which is seen as having been a competing independent centre at this time; it grew dramatically in size between the MH and early LH periods, exhibited quantities of fineware and coarseware ceramics comparable to those from Pylos, and possibly had its own LH I
tholos tomb in use at Osmanaga (Bennet 1999a:35; Bennet and Shelmerdine 2001:137-8). A third settlement to the north, Gargaliani: Ordines, is also of comparable size at this time, although it was likely not a significant competitor as a regional centre (Bennet and Shelmerdine 2001:138).

The evidence therefore points to the emergence of various competing peer-polities or “petty kingdoms” in the early Mycenaean period (Voutsaki 1998:54). The construction and incorporation of monumental tholoi at various locations points to the ascendancy of local lineages and the consolidation of their power at strategic locations (Wright 2006a:11), while the construction of LH I-II fortifications around certain nucleated settlements—namely, at Pylos, Malthi Dorion, and Peristeria (Figures 4, 5, 38)—speaks to an atmosphere of conflict and competition among such communities for territorial power.

By LH IIIA, however, Pylos quickly expanded and consolidated its power over much of the area to the north, west, and southwest of the Englianos ridge, on which an early palace may have also been constructed at this time (Nelson 2001:200-7). This expansion is signaled by the abandonment of tholos tombs throughout the hinterland of Pylos in LH III—with the sole exception of Tholos III at Ano Englianos (Bennet 1999a:36)—which has been interpreted as reflecting the “demotion” of these sites within the developing power hierarchy centered at Pylos (Bennet 1995:598, 1998:126). Pylos’ territorial growth continued into LH IIIA2, at which time it had extended its control eastward over the Aigeleon mountain range and into the Messenia Valley (Wright 2008:246). This trajectory of expansion, consolidation, and centralization reached its peak by LH IIIB, when a central-place hierarchy for Messenia had been fully established.
under Pylos. The palace at Ano Englianos was rebuilt at this time, and modeled as both the seat of a powerful ruler and the centre of a complex palatial administration, which mobilized a wide range of resources and goods within a diverse political economy that extended across a vast territory of ca. 2,300 sq. km (e.g., Shelmerdine and Palaima 1984; Bennet 1998, 2001; Davis 1998; Shelmerdine 1998, 2001b:128; Bendall 2003; Shelmerdine and Bennet 2008:299; Nakassis 2010). The site itself grew to a size of at least 12.4 ha by LH IIIB, although the settlement appears to have remained unfortified, as the LH I-II circuit wall had likely gone out of use at this time (Blegen et al. 1973:18).

The settlement patterns for Messenia in LH IIIA-B show varied trends in growth and decline, resulting from a strategy of selective aggrandizement and consolidation by Pylos, in which the palatial elite encouraged the growth of certain sites at the expense of others; some sites thrived as beneficiaries of palatial administration, while others were snuffed out as competitors (Shelmerdine 2001b:126-8). Locally, the hilltop coastal settlements at Beylerbey and Ordines became quite sizable in LH IIIA-B, but were ultimately subordinated under Pylos and likely functioned as strategically located taxation centres for the palace (Bennet 1999a:39; Bennet and Shelmerdine 2001:137). Further to the north, we see the sudden growth of Mouriatadha: Elliniko in LH IIIB, where the construction of a tholos tomb, a “megaron” structure with decorated rooms, and extensive fortifications (Figure 23) suggests its development into a provincial-type administrative post for the palace at Pylos (Bennet 1995:599). More importantly, it seems to have eclipsed the nearby settlement at Peristeria, where the abandonment of the monumental LH I-II tholoi suggests a decline in importance following palatial intervention (Hope Simpson and Dickinson 1979:167-8; Bennet 1995:599, 1998:129;
Voutsaki 1998:55; Shelmerdine 2001b:128). Conversely, the important LH I-II site of Nichoria was likely incorporated into the Pylian state as secondary centre; the abandonment of its central megaron by LH IIIA2 and the construction of a new tholos tomb are interpreted as reflecting the establishment of a new authority under the sponsorship of Pylos (McDonald and Wilkie 1992:260-84; Bennet 1995:598-9, 1998:127-8).

The Linear B archives from the palace shed further light on the LH IIIA-B political geography of Messenia under Pylos, and attempts have been made to map the geographic extent of the Pylian state by locating certain toponyms in the landscape (Chadwick 1963, 1972:101-112; Shelmerdine 1973; Cherry 1977; Lang 1988; Bennet 1988, 1998, 1999b; Carothers 1992). A series of tablets lists nine distinct place-names for the “Hither” Province, and seven or eight for the “Further” Province (Chadwick 1972:102-5, Bennet 1995:590-2, 1998), all of which likely represented district capitals and secondary centres headed by local “governors”, and which served as nodes for taxation and the mobilization of raw materials, finished goods, and agricultural produce. Several place-names potentially correspond to sites that have been identified through survey or excavation, such as Beylerbey (a-ke-re-wa), Ordines (pe-to-no), Nichoria (ti-mi-to-a-ke-e), Iklaina (a-pu2-we), and Mouriatadha: Elliniko (e-re-i or a-te-re-wi-ja).

More broadly, the context and nature of these names seems to complement the view from the archaeological record, pointing toward a four-tier settlement hierarchy for Messenia in LH IIIA-B: 1) the palace at Pylos as the dominant centre (and possibly a “second capital” at re-u-ko-to-ro, which governed the Further Province [Bennet 2002]), 2) sixteen or seventeen major sites that functioned as subsidiary administrative centres, 3)
villages with specialized economic activities, and 4) small farmsteads and hamlets
Cosmopoulos 2006; see Small 2007 for an argument against any such settlement
hierarchy). This political and economic system was maintained until the end of LH IIIB,
at which time Pylos was burned down and largely uninhabited until later in the Iron Age
(Mountjoy 1997; Griebel and Nelson 1998). Likewise, much of the region witnesses a
pronounced decline in settlement and population in LH IIIC (Mountjoy 1999:301;

The labour-cost estimates from the four sampled sites generally conform to the
LBA political geography of Messenia and how it developed over time, although the
absence of fortifications at Pylos for LH IIIA-B seems problematic with regard to its
dominant status at this time in the region.

The three sampled sites dating to LH I-II—Mirou: Peristeria (ca. 9,500 p-d),
Pylos (ca. 8,800 p-d), and Malthi: Dorion (ca. 7,500 p-d)—are the only known fortified
settlements from this period, and show a comparable degree of labour expenditure for
construction, constituting their own distinct statistical cluster. This patterning accords
with their relative statuses as contending peer-polities, whereby one site would not have
been significantly more powerful or dominant than the others. Of course, other seemingly
important sites at this time—e.g., Iklaina, Nichoria, and Beylerbey—do not appear to
have had contemporary fortifications, which would otherwise be expected in such a
climate of competitive growth. Barring issues of preservation and excavation, their
absence may be interpreted as reflecting the relative inability of the community or local
elite to mobilize the appropriate scale of labour for construction. Alternatively, surplus
labour could have been channeled into other building projects such as tholos tomb construction, which would have served similarly as manifestations of elite status, authority, and control over surplus labour (Wright 1987; Cavanagh and Mee 1998; Fitzsimons 2007, 2011).

The labour-cost estimate for Mouriatadha: Elliniko shows a substantial increase in investment for fortifications by LH IIIB. This period coincides not only with the floruit of the Pylian palatial state, but also with the site’s own transitory phase of political and economic development, when it was likely established as a district capital. While the site’s overall development was likely tied to the Pylian elite in some manner, it is difficult to determine the extent to which the palatial administration would have been directly responsible for the specific project of fortification construction here. Presumably, the scale of construction might have been influenced at least indirectly, through the aggrandizement of local elites who had likely been promoted as “provincial” administrators. As with Orchomenos and the sites of the Kopais (see above), the direct involvement of a major palatial site in the construction of defense works at subsidiary sites cannot yet be proven in any definitive sense, but is nevertheless highly probable given the likelihood of palatial intervention in this area.

In a more general sense, this increase in labour mobilization and its presumed connection to the palatial administration at Pylos cannot be assumed to have been the norm, given that this is the only known fortified site from the LH III period. Not only are comparable defense works absent at other secondary centres of the Pylian state at this time, but perhaps more importantly, there is no evidence for fortifications having been constructed or in use at Pylos itself in LH III. A subsurface anomaly to the northwest of
the palace has been interpreted as an LH III circuit wall, but this claim has not yet been confirmed through excavation (see Appendix A). The lack of monumental fortifications here runs contrary to the occurrence of substantial defense works at the other known palatial centres across the mainland (Mycenae, Tiryns, Thebes, and possibly Athens), which all seem to have eclipsed most lower-order settlements in terms of labour expenditure. The exception of Pylos from this trend has long proven difficult to reconcile (Dickinson 2006:36), as the palatial elite surely would have had the capacity to mobilize a sizable workforce for construction. Such is evidenced in the Linear B archives from Pylos, where the tablets Fn 7 and An 35 both refer to the allocation of provisions for “wall-builders” operating elsewhere in the region (Chadwick 1976:138; Nakassis 2012:275-9). Indirectly, we know from the presence of LH IIIA-B monumental architecture at Pylos (e.g., the palace complex itself), as well as traces of an artificial LBA harbor near Beylerbey (Zangger 1998), that surplus labour for construction had clearly been mobilized by the palatial elite.

There is, of course, the possibility that despite their capacity to mobilize and finance large scales of labour, the Pylian elite deemed fortifications to have been unnecessary, having already established full political control over its surrounding provinces. Still, it is surprising that no defense works of any kind were constructed even in the years leading up to the destruction of the palace, when a sense of anxiety over a perceived social threat has been discerned from certain changes at Pylos during LH IIIB (Hooker 1982; Baumbach 1983; Wright 1984; Shelmerdine 1987). Perhaps a different infrastructure of defense was instituted by the Pylians, in relying on the outlying secondary settlements to guard against any foreign threat. Such a system corresponds to
that identified by Arkush (2010:62) for centralized regional states, and we can see this in the establishment of a fortified centre at Mouriatadha: Elliniko. But again, fortifications have not been observed at other peripheral centres. The Pylian elite might also have relied on a more human-based defense network—something we see in the ο-κα or “rower” tablets, referring to the stationing of guards along the coast (Baumbach 1983; Wachsmann 1999)—but it is peculiar that this defense network would not have been complemented architecturally.

In general, the relationship between regional power and labour control for Messenia is more apparent in the early Mycenaean period, when competing peer-polity centres mobilized comparable scales of labour for construction. This connection, however, does not seem to have been maintained in the palatial period. A clear increase in investment is observed at Mouriatadha: Elliniko, where Pylian authority was presumably associated with construction, but such an increase is absent elsewhere, including Pylos itself.

6.2.7 Thessaly

The eastern coast around the Bay of Volos shows the earliest and strongest indications of Mycenaean development in Thessaly, likely as a result of its proximity to the sea (Feuer 1983:89, 1994; Papadimitriou 2008:103). Following a period of sustained growth and cultural continuity from the MH period into LH I-II, the transition from LH IIB-IIIA witnessed the emergence of three major sites around the Bay of Volos—Dimini, Kastro-Palaia: Volos, and Pefkakia—which became distinguished by the construction of large-scale buildings and wealthy tholos tombs, as well as the production and import of

Alternatively, Pantou (2010) dismisses any such central-place hierarchical model and argues that the evidence is too weak to classify Dimini as a regional palatial administrative centre. The absence of common palatial architectural features (e.g., ashlar masonry, dressed stones, dowel holes, mortises), figural wall paintings, or Linear B texts hinders any definitive inclusion of Dimini with other canonically palatial sites. Pantou instead cites similarities among the three major sites in terms of settlement size, architecture, burial types, and material culture, and proposes a more heterarchical and dynamic trajectory of development, in which power was not centralized but rather shifted among the settlements of the Bay of Volos over time (Pantou 2010:392-8). Underlying these short-term changes in political status was a long-lasting settlement system, and a stable natural and socioeconomic environment (Adrimi-Sismani 2007:174; Pantou 2010:392,395).

The western hinterland and interior of Thessaly exhibits a far lower degree of social complexity and material wealth than the coast. Mycenaean cultural traits only
appear during LH IIIA-B and are much less extensive, suggesting a weaker integration into the Mycenaean *koine* and a greater retention of local traditions (Feuer 1983:53-5, 1994). Some LH III sites within the Larisa Plain and Valley of Karla, such as Velestino: Ancient Pherai, Aerino, Mega Monastiri, Pteleos, and Petra are comparable to those from the Bay of Volos in size, and similarly exhibit wealthy burials with luxury goods and exotica (Adrimi-Sismani 2007:171-2; Papadimitriou 2008:104). Petra was by far the largest, and may have been extensively fortified in LH III (see Appendix A). Generally speaking, the relationship between these major sites and those of the Bay of Volos remains unknown, although the sub-regions had likely been politically independent from one other (Feuer 1994; Pantou 2010:395,397).

Other LH III sites are located further west in the Trikala-Karditsa Plain, but the nature and history of these settlements is not clearly understood (Adrimi-Sismani 2007:173-4; Papadimitriou 2008:104). The sample sites of Ktouri and Pyrgos Kieriou: Arne are included among these settlements, representing two of only a few isolated limestone outcrops in an otherwise open and flat expanse of land (Feuer 1983:34). They are notable for having been fortified, but there is nothing to suggest that they had been particularly large, powerful, or affluent sites within the region.

Overall, the evidence points to a relatively decentralized system of settlement and regional sociopolitical organization in LH III (Feuer 1983:44), which is further reflected in the identification of independent pottery workshops and distribution networks throughout Thessaly (Feuer and Schneider 2003). The end of the LBA brought about a wave of abandonments across coastal and inland Thessaly, coinciding with those occurring throughout the Aegean (Feuer 1983:51-3; Lewartowski 1989:90-5). Dimini
was destroyed and abandoned in early LH IIIC (Adrimi-Sismani 2006, 2007:165-8), but Kastro: Volos shows signs of continued habitation and even relative prosperity in the Protogeometric period (Pantou 2010:393).

Seeing as little is known of political geography for LBA Thessaly, and given the low number of possible LBA fortifications from this area, the interpretations of the calculated labour costs are rather limited and inconclusive. In comparing the two sites, the fortifications at Pyrgos Kieriou (ca. 20,000 p-d) required almost triple the expenditure of labour than for those at Ktouri (ca. 7,000 p-d), although there is no evidence to suggest any such hierarchical difference in regional political status. Indeed, the settlements seem comparable in status and function, as Hope Simpson and Hagel (2006:99-100) suggest that they likely would have served as small forts or watchtowers that provided refuge, rather than as sites of permanent occupation (which in LH IIIA-B was concentrated downslope, at the adjacent *magoulas*).

Within the broader context of Thessaly, the exclusive presence of possible LBA fortifications at these two sites does not accord with the supposed location of Mycenaean regional centres further east. None of the three major sites from the Volos area appear to have had fortifications of any scale, and in general, there is no evidence for any major public works “that would be indicative of a centralized government able to mobilize the regional material and human resources” (Pantou 2010:382). Some degree of labour mobilization is, however, evident in the construction of LH IIIA-B tholos tombs near Dimini, Pefkakia, and Kastro: Volos. They are far larger than the tholoi identified elsewhere in Thessaly at Aerino, Koriphoula, Tsigenina, and Pteleos (Adrimi-Sismani 2007:169-173), which possibly gives credence to the presumed difference in political,
social, and economic status between the sites of Volos area and those of the interior plains. Among these three sites, however, the tholoi show no substantial differences in size or deposited wealth (Pantou 2010:386), so again, we can infer no hierarchy among these particular communities and their associated elites. Still, monumental fortifications would be expected here more than anywhere else, given the observed capacity to mobilize labour to a greater extent than other sites in Thessaly. The lack of fortification construction in the Volos area is especially surprising, given the context of “heterarchical competition” suggested by Pantou (2010) and reflected in the conspicuous construction of tholos tombs. Rather, LBA fortifications have only been identified at the two sampled sites, which seem to have been politically insignificant settlements in the LBA.

Overall, even with our poor understanding of the LBA political geography of Thessaly, fortification construction does not seem to represent an effective proxy of regional power, which may have been relatively decentralized at this time. Fortifications have only been identified at the two lower-order sites sampled here and varied widely in the scale of labour investment, but seem equally modest in relation to the overall sample.
CHAPTER 7
CONCLUSIONS

7.1 Fortification Construction and LBA Political Geography

In bringing together the above discussions, we find different degrees of correspondence between the scale of labour mobilized for fortification construction, and the perceived differences in regional power and political status. This connection is most apparent in the Argolid and Attika, where the highest ranking sites—the palatial centres of Mycenae and Tiryns, the administrative centre of Midea, and the major settlement on the Athenian Acropolis—constitute distinct statistical clusters within each region and exhibit the highest labour costs, in contrast to the lower-ranking settlements that required relatively modest levels of mobilization. Labour-cost patterns for Messenia and Boeotia reveal a more moderate connection between regional political status and labour mobilization, but with certain incongruities. A much weaker connection is apparent for the Cyclades, where no coherent pattern can be discerned from the changes and differences in labour expenditure among the sampled sites. Achaia and Thessaly exhibit a similarly weak connection, although the interpretations proposed for these regions are much more tentative, given the small sample sizes and poorer understanding of regional political organization in the LH period.

This wide spectrum of correspondence shows how fortifications, as a particular manifestation of labour control and mobilization, are not a uniformly effective index for locating or defining palatial power and regional authority in Mycenaean Greece. Rather, each region seems to have been unique in how the organization and expenditure of surplus labour for monumental construction related to structures of power—especially
those that developed out of LH III palatial society. Such variability can also be observed among the different classes of settlement represented in the overall sample: the lower-order sites within the political geography of each region similarly exhibited the lowest construction costs, while the primary and secondary centres show much more of an incongruity between status and labour cost.

For sites where there is a clear correlation between labour expenditure and political status, the calculated costs offer an empirical and quantitative measure of how emergent or consolidated power had become manifest in the capacity to build more substantial fortifications. The recursive nature of this relationship can be best observed in the Argolid, for which we have a deep diachronic history of sociopolitical development, as well as sites with multiple building episodes (Mycenae and Tiryns). Here, in having calculated and traced out the changes in labour expenditure at the major citadels over time, we can better imagine how the mobilization of the local workforce fed into the nascent power of emerging elites, who sought to differentiate themselves from the surrounding communities in a period defined by regional competitive growth (cf., Fitzsimons 2007, 2011). In doing so, the elites of Mycenae, and perhaps to a lesser extent Tiryns, were ultimately able to consolidate power on a regional level through the development of the palatial system by LH IIIA. It was through the institutions of the state that the palatial elite of the Argolid were then able to mobilize even larger scales of labour more effectively for building projects, which continued to both manifest and promote their authority. Indeed, a similar pattern was identified by Fitzsimons (2011, forthcoming), whose calculations of labour investment for tomb construction at Mycenae
show a marked increase from ca. 5-500 p-d for the Shaft Graves of MH III-LH IB, to ca. 2,800-14,500 p-d for the later tholos tombs of LH II-III A.

This trajectory is less evident but perhaps equally applicable to Attika and Athens in LH IIIA-B. Here, the labour-cost patterns reflect how peer-polity competitive growth in LH I-II was transformed by LH IIIA-B through the potential consolidation of power at Athens—the famed synoikism alluded to in Greek legend, and possibly denoted by the substantial increase in labour expenditure on the acropolis at this time.

For the regions and sites that instead show a discrepancy between labour expenditure and regional status, several possible explanations have been considered. They may be summarized as follows:

1) Aside from accidents of discovery and preservation, the very absence of fortifications at certain major sites, such as Pylos and Thorikos, may be the result of factors other than the extent of political power, as there simply may not have been a need or incentive for their construction. The actual motives for why and how fortifications were built would surely have varied between each site and over time, and for most cases, inferring the intentions of construction remains a matter of speculation—one that lies beyond the scope of this study.

2) High-ranking sites that exhibit no fortifications or low labour costs for their construction may have instead channeled surplus labour into other construction projects not considered here. We see this, for example, in the massive drainage of the Kopais basin, likely organized and financed by Orchomenos; the LH III tholos tomb at Dimini and others constructed around the Volos area of Thessaly; the artificial harbour created at Beylerbey, near Pylos; the massive dam at Tiryns, built to divert floodwaters; and the
system of roads and bridges radiating out from Mycenae, as well as the construction of
the nearby Treasury of Atreus and Tomb of Klytemnestra in LH III. Accordingly, a
consideration of all known instances of monumental construction from the LBA might
otherwise account for some of these observed discrepancies, and provide a more
comprehensive and balanced assessment of the relationship between power and labour
control. On the other hand, such a study could risk obscuring any potential differences in
the exact context and mechanisms of labour recruitment that might have been associated
with each distinct type of architecture.

3) In the cases where subsidiary sites eclipsed contemporary palatial centres in
fortification construction, the instinct has often been to assume that the palatial elites
were still ultimately responsible for organizing and sponsoring such construction. This
explanation might be applied to the cases of Orchomenos and Gla, Thebes and Eutresis,
and Pylos and Mouriatadha: Elliniko. While these subsidiary sites are presumed to have
functioned under the authority of their higher-ranking palatial centre, to what extent did
such authority coincide with labour relations and with the construction process in
particular? As noted above, direct textual evidence for the external mobilization of
labourers for construction under the authority of a palace has come only from a few
Pylian texts, which nevertheless do not concern fortification construction specifically. In
the absence of any such direct evidence, the estimates calculated here cannot in
themselves reconcile these confounding inversions of status and expenditure. Rather, they
offer a perspective of scale with which to better assess and measure such differences.

These explanations force us to reconsider why certain sites exhibit unexpectedly
high or low labour costs for fortification construction, given what is known of their
political status, and thus, their presumed potential for mobilizing surplus labour. They underscore the varied contexts in which fortifications were built, and the wide range of social, economic, political, demographic, and environmental factors that conditioned their construction. While this makes it difficult to identify any broader, “universal” patterns in the very uses and meanings of Mycenaean fortifications, the focus of this thesis on their energetic properties has allowed for new insights into some of the basic sociopolitical implications of their construction. It has demonstrated, quantitatively and systematically, how the scale of labour mobilized for fortification construction was not always correlated with regional power in Mycenaean Greece (palatial or otherwise), as we find this connection expressed with different degrees of strength both within and among the seven regions sampled here. Ultimately, these findings reveal the complexities in using monumental architecture as a means of modeling LBA political geography and development, and reflect the nuanced ways in which labour relations were influenced by and tied to the emergence of Mycenaean elite authority.

7.2 Insights into Labour Organization for Fortification Construction

Given these calculated costs and their political contexts, is it possible to go further and identify the very systems of mobilization that might have been in place?

A useful starting point may be Stanley Udy’s (1959) classic study on the organization of labour among preindustrial societies. Here, he outlined the two broad categories of *familial* and *custodial* recruitment; the former concerns the mutual exchange of labour among approximate social equals, whereas the latter involves a more unbalanced exchange between people of different social status and unequal power (Udy
1959:55-70). Each category, in turn, can be broken down into different subcategories. Under the familial category is familial reciprocal, familial contractual, and community contractual, with each system representing progressively larger social units and more distance in kinship relations (nuclear, extended, community), as well as longer timescales of reciprocity (immediate vs. delayed). Custodial recruitment can be described as either festive custodial, in which labour is provided for a socially more powerful individual or group in exchange for some kind of feast, and corvée, where labour is provided by lower status individuals and groups as an instituted obligation, such as a tax.

Abrams (1994:96-103) elaborated on Udy’s typology by outlining the general ethnographic link between these labour systems and energy expenditure, showing a rough correlation between the familial system and low expenditures of energy in construction, and conversely, extremely high expenditures of energy with the corvée systems of powerful states. From here, he associated different groups of domestic Maya structures at Copán—and the associated families—with specific systems of labour organization based on the average labour costs calculated for construction, with different groups ranging from familial reciprocal to festive custodial to corvée (Abrams 1994:102-108).

This approach offers a useful framework for considering the possible range of labour systems for fortification construction represented among the sampled sites, by following the calculated differences in labour cost. First, some system of corvée would likely have been instituted for most of the sites within the top hierarchical cluster (ca. 78,000-323,000 p-d): Mycenae, Tiryns, Midea, Athens, Thebes, Eutresis, and Gla. All of these sites required extensive workforces, and independently show evidence for centralized, bureaucratic organization as palatial sites or secondary centres. To this we
might also add Mouriatadha: Elliniko, which also functioned as a secondary centre within the Pylian state, but exhibits a lower cost relative to the other major centres.

Festive custodial arrangements may also have been in place at these sites, and could have complemented any instituted corvée system for labour mobilization. The occurrence of feasting in Mycenaean palatial society is well documented, as it represented a means by which the local elite could secure services and strengthen social and political bonds (Wright 2004b; Fox and Harrell 2008). Accordingly, it could have been adopted as a strategy by which palatial elites secured and reciprocated the labour provided by the various households of one or several communities. The basic exchange of food for labour is somewhat maintained—at least in principle—in the provisioning of architectural labourers referred to in some of the previously discussed Pylian texts (see Chapter 2). These accounts speak to the acquisition of part-time labour through the payment of foodstuffs, rather than any kind of obligatory taxation. They are also notable in that such labour may have been recruited through local intermediaries (Nakassis 2012), which suggests that the provisioning of surplus labour may have been a somewhat negotiated process, rather than something directly enforced by palatial administrators. This alternative system of mobilization is not likely to have been implemented for fortification construction at Pylos itself, which lacks LH III defense works, but may have existed in some form at other contemporary fortified palatial sites.

It is more difficult to ascribe a corvée system to the apparently non-palatial and independent settlements of Krisa and Teichos Dymaion. They rank fifth and tenth overall in labour expenditure, respectively, but lack any substantial evidence for centralized authority or complex administrative organization of any kind. Hence, we might instead
posit a modest form of a festive custodial system, or at least a community contractual system of familial recruitment. Each system would still have involved a larger number of people with varying degrees of kin distance, as well as an increase in internal organizational complexity from other familial-type systems—but not to the extent of an instituted social and political hierarchy that would otherwise be associated with corvée.

Most sites within the second hierarchical cluster—particularly those of the higher sub-cluster, of sites ranked 9 to 26 (ca. 12,000-40,000 p-d)—may have also been characterized by some modest form of festive custodial recruitment, as the workforce size estimates suggest the mobilization of workers from several dozen to perhaps several hundred households. Such a recruitment system would have surely been in place at Kolonna, Ayia Irini, and Phylakopi, but for reasons opposite those of Krisa and Teichos Dymaion; they rank considerably lower in labour cost, but had likely been major island centres during their respective periods of construction, with evidence for an established social hierarchy, centralized wealth, and perhaps some manner of bureaucratic organization. Alternatively, if we accept that construction at some of these sites had been financed and organized through higher ranking palatial sites—namely, Kastri: Haliartos and the other sites of the Kopais—then a corvée system would perhaps have been more likely.

The ten sites that constitute the lower sub-cluster (ca. 1,000-10,000 p-d) may have only required a familial system of mobilization, either community contractual or familial contractual. The workforce size estimates indicate that, at most, labour would have only come from a few dozen households; the lower end of these estimates suggest that workers could have been provided by only a few households. And seeing as most of these
fortifications would have served the collective interests of the settlement as a whole, a community contractual system seems to be the more likely option, where labour would have been drawn equally among all households but under the guidance of a community leader or hereditary head (cf., Abrams 1994:99).

Again, these categories merely provide a suggestive framework for imagining the various modes of labour organization that might have existed among the sampled sites, based on the labour cost patterns outlined above. They do not necessarily conflict with the specific strategies of labour recruitment considered in Appendix D (Table 16), which focus more on the intensity of such recruitment at the household and community level.

7.3 Labour Mobilization and Collapse?

The workforce size estimates might also be useful for addressing the possible connection between the monumental building programs that were carried out during LH IIIA-B, and the subsequent period of collapse observed throughout the Aegean. In relation to the “systems collapse” theories outlined in Chapter 2, some have argued that the recruitment of labour for monumental construction might have been particularly burdensome for local populations, thereby contributing to the social, economic, and political stress that would have undermined palatial society and brought about collapse (e.g., Tainter 1988:202; Loader 1998:162; Deger-Jalkotzy 2008:389).

When measured against independent population estimates, the calculated workforce sizes do not suggest that fortification construction would have been particularly onerous for LBA communities. Population figures were only available for a limited number of the sample sites, but the above discussions show they tend to
correspond roughly with the largest population sizes extrapolated from the workforce estimates. This overlap seems to indicate that even the largest necessary workforce for sites such as Mycenae, Thebes, and Ayia Irini could certainly have been mobilized from the local population by any of the four potential recruitment strategies.

Likewise, even the largest citadels in the sample could have been completed realistically within only a few years, which runs contrary to the assumption that they would have taken long to construct. Such a possibility has implications for how the fortifications are primarily interpreted, since accounts that argue for the fortifications having served a primarily “offensive” function often cite claims of a long completion time (e.g., Loader 1998:157, 161-2; Dickinson 1994:160-3, 2006:42). Surely, their relative monumentality and specific features of design (e.g., the Lion Gate relief at Mycenae) can be seen as having exceeded functional requirements, and allowed for individuals or groups to convey certain implicit social messages. Yet any “offensive” intention need not overshadow the underlying and inherently defensive nature of their form and construction, as the labour costs show that they certainly could have been erected in direct response to any perceived human threat—perhaps within two or three seasons of construction. The phenomenon of intensified, monumental fortification construction across the mainland in LH IIIA-B is therefore not likely to have been a cause of collapse, but was instead a symptom of the already unstable conditions and competitive environment that culminated in the eventual destructions and abandonments.

This account does not consider the investment of labour and resources into other monumental construction projects, which cumulatively may have exacted a greater social and economic toll on certain communities and regions. Only an extended energetics study
can further outline the extent of energy expenditure for construction during the LH period, and any conclusions regarding the perceived burden of building projects would require more thorough and precise population estimates—something that is exceptionally difficult to attain for Aegean Bronze Age communities. Still, these insights into workforce size and timescale offer the advantage of substantiating previous assumptions on the social and political implications of fortification construction for collapse, as the calculated labour costs allow for more informed inferences than simple, subjective impressions given solely by the size of the structures.

7.4 Suggestions for Future Research

Any future energetics study could extend beyond fortifications to include other forms of monumental architecture, in order to achieve a more comprehensive account of regional labour expenditure for construction during the LBA. Such studies might also achieve more accurate labour-cost estimates by incorporating more precise volumetric measurements, which can be collected or updated through either systemic excavation—using direct measurement, photogrammetry, and laser scanning—or non-intensive means such as simple photo-mosaicking (e.g., Pickett forthcoming). Digital measurements in particular can be integrated with architectural plans or photo-mosaics for the purpose of 3-D modeling, which would allow researchers to create virtual reconstructions and examine the spatial data more systematically.

Volumetric and spatial data could also be analyzed within a GIS format, as a way to account for potentially relevant variables from the surrounding landscape. Factors such as slope and distance to natural resources surely would have influenced labour
expenditure, either increasing or lessening the necessary labour for acquiring and transporting building material. GIS might then allow for a closer approximation of the true work required in LBA construction.

Energetics has a long tradition in both Old and New World archaeology, as a unique approach for analyzing architecture. Although its application here represents only a preliminary effort, it can continue to provide an especially promising avenue of research for Aegean Bronze Age studies, as a framework for using the built environment to better understand the connection between labour mobilization and regional power in Mycenaean society.
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APPENDIX A
SITE CATALOGUE

This catalogue provides more specific information on the sampled sites and the extent of data available for calculating labour costs. Under each regional heading is a brief general discussion regarding the underlying rationale for selecting specific sites, and omitting others. Each sample site is then presented with bibliographic references and notes concerning the sources for the volumetric measurements, the availability and precision of such measurements, and means for interpolating missing or incomplete measurements. The table numbers given for each region refer to those listed in Appendix C for the volumetric measurements.

Following Hope Simpson and Hagel (2006), several of the sites are listed as double names, whereby the first represents the modern town or village, and second represents the toponym or ancient site name.
Achaia (Table 1)

Site: Teichos Dymaion (n=1)

Notes for Achaia

The citadel at Teichos Dymaion represents the only fortified site from Achaia that can be securely dated to the Mycenaean period. There is a notable absence of fortifications in the northwestern and central Peloponnesus, owing to a relative dearth of identified Mycenaean settlements in general (in contrast to the phase of repopulation and brief floruit in material culture witnessed during LH IIIC period). A possible circuit wall was identified on the hill of Gourtsouli in the nearby region of Arkadia, adjacent to classical Mantinea (Hope Simpson and Hagel 2006:60-61). Surface finds indicate occupation throughout the EH, MH, and LH periods, but a Mycenaean date cannot yet be securely assigned to the wall itself.

Teichos Dymaion (Figures 20, 22)

Dimensions for the walls were derived from the excavation reports by E. Mastrokostas, which were summarized by Daux (1963:767-8, 1964:760-62, 1966:832-34) and Papadopoulos (1979:24), and discussed in more detail by Scoufopoulos (1971:60), Wright (1978:70-1) and Hope Simpson and Hagel (2006:63). The total circuit length given in Table 1 represents the course that is observed along the northeast, northwest, and southeast; the southwest side is met by precipitous cliffside that drops directly into the sea, so fortifications were likely not necessary in this section. The walls were originally dated to the early LH III period by Mastrokostas, but most of the Mycenaean pottery from the excavations date to the LH IIIB and IIIC periods, and Hope
Simpson and Hagel (2006:63) argue that the fortifications were not likely constructed before LH IIIB.

**Argolid (Table 2)**

Sites: Argos: Aspis, Argos: Larissa Hill, Kandia: Kastro, Midea, Mycenae, Nea Epidavros: Vassa, Prophitis Elias, Tiryns (n=8)

*Notes for the Argolid*

The three Argive citadels of Mycenae, Tiryns, and Midea represent the most well-known fortifications of the Mycenaean world. Their monumentality, both in overall size and in the size of Cyclopean blocks employed for construction, is readily apparent. They also represent some of the best-preserved and extensively excavated Bronze Age sites in the Argolid, thereby allowing for a significantly higher level of refinement in the detail of labour cost estimation than most other sites. For Mycenae and Tiryns, additional costs can be generated for the construction of extant gateways, the quarrying and transport of conglomerate stone (in addition to the local limestone), and the shaping of pseudo-ashlars for more conspicuous sections of the walls. Systematic excavation at these sites has also allowed for more diachronic refinement, as multiple building episodes have been observed during the LH III period at Mycenae and Tiryns (Mylonas 1966:19-33; Müller 1930). As a result, construction costs have been calculated separately for each stage.

In addition to the three major citadels of the Argolid are the fortified sites of Kandia: Kastro, Nea Epidavros: Vassa, Prophitis Elias, and Argos at the Aspis and the Larissa Hill. Extant stretches of Mycenaean circuit walls have been observed and measured at these locations, but are less well preserved. The Larissa hill at Argos would
presumably have represented the fourth Mycenaean fortress of the Argive plain, but the structures on the Aspis are more securely dated to the MH rather than LH period (Touchais 1975:707-708; 1976:755-758; Philippa-Touchais 2010:792-786, Fig. 9-10). Alternatively, Crouwel (2008) argues for a LH III date to the fortified site on the Larissa, where Mycenaean walls were first identified by Vollgraff (1928). The evidence for a Mycenaean fortification here is more tenuous (see Hope Simpson and Hagel 2006:39), but calculations are still generated based on the recorded dimensions of a circuit wall, which may be associated with the occupation and activity of the Late Helladic community at Argos. A massive lintel stone of conglomerate, which was incorporated into the later Byzantine fortification walls, was also identified on the Larissa Hill and is likely Mycenaean in date (Crouwel 2008:267-8). Additional costs are also calculated for transporting this block from the Kalkani ridge near Mycenae, as the probable source of the stone.

Other potentially fortified sites from this region and the surrounding areas are not included in the sample. The acropolis of Asine near the Argive Plain was likely the site of an extensive Mycenaean settlement, but most of the extant walls observed there have been dated to the Hellenistic period (Frödin and Persson 1938: 48-58; Wells 1992). A stretch of walling along the north slope of the hill was referred to excavators as being “Cyclopean”, although Hope-Simpson and Hagel (2006:40) note that it has not been conclusively dated to the LH period. A large Mycenaean settlement has also been identified at the site of Korakou in Corinthia, north-northeast of the Argolid. A stretch of walling built in Cyclopean masonry was uncovered by Blegen (1921:98) during his original investigations at the site, but the exposed structures were poorly preserved, and
the extent of the wall and the total area of the site remains unknown. Although a hypothetical circuit length might otherwise be calculated from the area of the hill as the presumed locus of the LH III settlement, subsequent excavations by A. Banaka-Demaki revealed LH IIIB-C structures at a distance of over ca. 700 m from the hill (Hope Simpson and Hagel 2006:42), thereby complicating any potential interpolation for circuit length. A preliminary geophysical survey at Korakou appears to have revealed the course of a massive circuit wall around the settlement (Tzonou-Herbst and Boyd 2007), but Tartaron (2010:271) notes that both the form of the anomaly and geography of the site instead suggest an EH date for the wall, which is further supported by the recovery of EH II sherds from an exposed section of mudbrick walling.

*Argos: Aspis (Figure 27)*

The fortifications considered here represent the larger of the two circuit walls observed on the Aspis (Vollgraff 1906), for which Skoufopoulos (1971:34) records a width of 2.6 m, and a preserved height of 3 rough courses (which is approximated here as ca. 2 m, based on the photographs provided in the site reports). Because this value for height is likely below what would have been the original minimum height for the walls (see Chapter 4, Section 4.3.2), estimates of total volume and weight were also calculated for hypothetical heights of 3 m, 4 m, and 5 m, in addition to the preserved dimensions. Skoufopoulos also speculates that the inner circuit would have followed a total length of approximately 300 m, so that the outer circuit would have been well over this length; indeed, the total circuit length calculated from the surface area of the hill—as listed by Hope Simpson and Hagel (2006:39)—is just under double this length. Both circuit walls
are thought to have come from successive MH settlements (Vollgraff 1906:43), based on the overall predominance of MH remains across the Aspis (cf., Phillipa-Touchais 2010:792-6). At the same time, the Cyclopean-like character of the outer wall would otherwise suggest an LH III date for construction (Hope Simpson and Dickinson 1979:43-45), despite the scarcity of Mycenaean remains. Because of this ambivalence in the chronology for the outer circuit wall, both a MH and LH III date is listed for the Aspis.

*Argos: Larissa Hill (Figures 24-26)*

Measurements for the height and width of the proposed Mycenaean fortification wall on the Larissa Hill, as well as the area of the hilltop, were obtained from Piteros (2003:370-3, 376-77) and Crouwel (2008:268-9), who both suggested a highly approximate date of “LH III” for construction. Although the eastern stretch of the walling was followed for ca. 10-14 m, a total circuit length was calculated from the area provided.

*Kandia: Kastro*

The width of the Cyclopean wall at Kandia: Kastro and the area of the settlement likely enclosed by it were obtained from Hope Simpson and Hagel (2006:40-41). A date of LH IIIB is assigned to the wall, based on the prevalence of LH IIIB sherds across the site. The wall is best preserved along the eastern and northeastern sections, where five to six irregular courses remain preserved for up to a height of approximately 2 m (Hope Simpson and Hagel 2006: Pl. 5a). Calculations were also made for heights of 3 m, 4 m,
and 5 m. Loader’s (1998) average value is used for the width, and a total circuit length was calculated from the given area.

**Midea: Palaikastro (Figures 17, 21)**

The circuit length for the fortifications walls at Midea is listed by Demakopoulou and Divari-Valakou (1999:206), and again by Demakopoulou (2007:65) and Crouwel (2008:270). This represents the length observed along the northeastern, northwestern, and southwestern sides of the acropolis; most of the southern extent is lined by a steep cliffside, and was therefore likely undefended. Dimensions for height and width are listed by Iakovides (1983:22) in his brief review of the fortification wall. Regarding the date of construction, Wright (1978:71) and Iakovides (1983:22) argued for placing it within first half of the 14th century, based on stylistic similarities with the early walls at Teichos Dymaion and the first enceinte at Mycenae—specifically, the northern wall—and the presence of a tholos tomb at Dendra dating to LH IIIA:1. Subsequently, Demakopoulou and Divari-Valakou (1999-207,210; also Demakopoulou 2007:65) have dated the wall’s construction to the middle of the 13th century, based on the pottery found in the wall’s foundation trenches. They further suggest that construction here would have been contemporary with the final building programs and extensions observed at Mycenae and Tiryns, so a date of LH IIIB2 seems most likely. This date has since been confirmed, in light of foundation trenches dug along the exposed sections of the wall (cf., Walberg 2007; Åström 2009).
Mycenae (Figures 8, 9, 13)

Details on the chronology of fortification construction at Mycenae, as well as the various measurements for height and width observed along the course of the wall, were obtained mainly from Mylonas (1966:15-35), Wright (1978:74-5, 78-84), and Iakovides (1983:23-37). The different circuit lengths provided here for all three phases of construction represent approximations derived from the scaled plan given by Iakovides (1983:25). The sequence of construction was originally outlined by Tsountas (Tsountas and Manatt 1897:113), but was subsequently modified by Mylonas (1966:19-33), whose chronology has since been widely accepted.

For Enceinte 1, the length consists of the northwest stretch of the citadel (originally the western face of the earlier main gate), the northern wall, the surviving section of the southeast wall (terminating where the acropolis brow bends south), and a hypothetical southern stretch that continues along the brow of the rock and meets the northwest stretch. Most of this latter section—spanning 160-170 m—has not survived, but the circuit wall would likely have taken this course. Other sections of the wall from this phase follow the brow of the acropolis consistently, and much of this stretch shows evidence for foundation leveling, as well as a retaining wall that may have originally been a part of the early fortification circuit (Mylonas 1966:22-5; Iakovides 1983:27-9). For volume, this length was multiplied by the preserved width and maximum height observed along the southeast section.

The measurements for Enceinte 2 consist of the expansion of the west wall—which was shifted ca. 50-60 m down the slope, increasing the area of the citadel by about 40% (Iakovides 1983:29)—and the construction of both the Lion Gate and the North
Gate. A maximum height of ca. 12 m can be observed along the southwest stretch of the wall (Mylonas 1973:10). The circuit length for this second phase represents the extension of the west wall downslope, which would have added to the ca. 520 m of surviving walling from the first phase, which was maintained along the north and southeast side. Additional volumetric calculations were made separately for the Lion Gate bastion (l=14.8 m, w= 7.23, h= c. 8, not including the section of Hellenistic rebuilding), the eastern facing of the Lion Gate (l= 45 m, w= 0.9 m, h= c. 7 m), the North Gate bastion (l= 6.5 m, w= 3.25, h= c. 3 m), and the southern facing of the North Gate (l= 7.62 m, w= 0.09 m, h= c. 5 m). These features are distinguished by the use of conglomerate, shaped in a pseudo-ashlar style (in contrast to the limestone employed elsewhere along the circuit). The specific dimensions were listed by Iakovides (1983:29-35). An additional tower had also been added to the sharp angle in the southeastern section of the wall, where conglomerate was further employed as building material; however, the dimensions for this tower were not provided in the sources. The total volume given in Table 2 represents the sum of the volumes for the circuit wall extension and these constituent features. The total weight is also differentiated by stone type, owing to the different densities of conglomerate and limestone.

The measurements for Enceinte 3 represent the addition of the Northeast Extension. Iakovides (1983:35) provides a range of thickness for the walling here, and the height was inferred from various photographs, in which the height of the south sally port (2.45 m) was used as a point of reference for the maximum height. The total weight reflects the primary use of limestone in this section.
Nea Epidavros: Vassa

Measurements for the height of the fortification wall, and the area of Mycenaean settlement likely enclosed by the circuit, were given by Hope Simpson and Hagel (2006:41). They note that the original width could not be accurately determined, but surmise that it would have been “considerably less than the 5 to 7 m width of the three great fortresses” (2006:41). On this basis, I use Loader’s (1998) value of 4.3 m, which is below this range and comparable to the widths observed at Kandia: Kastro, Prophitis Elias, and the Aspis and Larissa Hill at Argos. A circuit length was calculated from the given area. An abundance of LH IIIB sherds in the area of the walls and along the ridge suggest a Mycenaean date for construction.

Prophitis Ilias

Cyclopean walls were first observed here through trial excavations on the south slope of an Archaic temple (Megaw 1962-3:16; Balcer 1974:149). They have not been well preserved or excavated, yet Hope Simpson and Hagel (2006:41) note the presence of one to two irregular courses, and suggest a preserved height of ca. 2 m. Accordingly, additional calculations were made for hypothetical heights of 3 m, 4 m, and 5 m. Hope Simpson and Hagel (2006) also provide an area for the surface of the hill that had likely been occupied, and a total circuit length was calculated from this area. Loader’s (1998) average value was used for width. Sherds from LH IIIA2-B are predominant across the surface of the hilltop and around the base of the walls, thereby suggesting a Mycenaean date for construction.
Tiryns (Figures 7, 14, 15)

Measurements for the fortifications walls at Tiryns, and details on the chronology of construction, were obtained mainly from Müller (1930), Mylonas (1966:11-15), Wright (1978:75-6, 84-94), and Iakovides (1983:3-13, 1999). As with Mycenae, the volumetric data were gathered and calculated separately for each of the three phases of construction. The circuit lengths for various sections of the walls were adapted from the scaled plans provided by Iakovides (1983:4, 11).

The measurements for Citadel 1 represent the dimensions for the earliest walls on the Upper Citadel. Differing widths of 1-3 m were recorded from the site plan provided by Iakovides (1983:4) for the southern and northern walls; hence, the total volume represents the sum of the volumes calculated separately for these sections. The measurements of width for many of these sections likely represent only the outer face of the wall, and seeing as no explicit measurements have been made for total width, the total volume here likely represents a conservative estimate. A height of 7.5 m was observed for the sections of extant walling that date to this phase of construction, and is applied as a uniform maximum height throughout the length of the wall.

The dimensions for Citadel 2 reflect the extensions to the Upper Citadel, which can be observed to the north, south, and east of the original circuit. A width of 5-7 m was observed for the north and east extensions, and a width of 7-8 m for the southern extensions. The total volume given in Table 2 represents the sum of the constituent volumes calculated for each of the extensions, consisting of the distinct values for length and width, and a value of 7.5 m as the maximum height observed throughout the circuit.
Citadel 3 is represented by additions to both the Upper and Lower Citadel. Dimensions for the length, height, and width of the Lower Citadel were obtained from Iakovides (1983:10-12; 1999:200). The circuit length for the Upper Citadel during this phase consists of the extension of the east gate, the southern façade, and the western bastion, which exhibit a maximum height of 8 m and a width ranging between 5 and 8 m. Alternatively, the south wall has been measured as being 17 m in thickness, but this value includes the 8 m thick corner-walling from Citadel 2, and the extension is not a solid structure of material. The total circuit length calculated for Citadel 3 is approximately 100 m less than the total length of 725 m that was listed by Mylonas (1966:11), because some of the façade from this final phase derives from earlier phases of construction. Similarly, the sum of the constituent circuit lengths for all three phases does not add up to Mylonas’ figure, because the original north and east walls were no longer a part of the outer circuit by Citadel 3.

The volumes provided here may likely represent an over-approximation, because they do not take into account the empty space of the various storerooms, niches, and vaulted galleries built into the wall (such as those along the southern and southeastern stretches of the Upper Citadel, and the eastern extent of the Lower Citadel). Still, the construction of the vaulted galleries in particular may have required a proportionally larger input of labour than most sections of solid walling (given the more complicated logistics of their construction), which may roughly balance out any such over-approximation.
Attika and the Saronic Gulf (Table 3)

Sites: Aegina: Kolonna, Athens: Acropolis, Ayios Yiorgos: Brauron, Korphos: Kalamianos, Vari: Kiapha Thiti (n=5)

Notes of Attika and the Saronic Gulf

The acropolis at Athens stands out as the major fortress of Attika during the Mycenaean period. Much of the LH IIIB fortification wall has not been well preserved, owing to extensive use of the acropolis in later periods, but excavations have revealed the probable circuit length, width, and height. The sites of Vari: Kiapha Thiti and Ayios Yiorgos: Brauron are also included, and exhibit dates of construction slightly earlier that of the Acropolis at Athens. Although traces of a LH III circuit wall were uncovered at Ayios Kosmas, they are too fragmented for a labour-cost estimation, as neither the original height nor width could be determined (Mylonas 1959:58).

Two sites from the neighboring Saronic Gulf have also been included in the sample, given the especially close connections between much of Attika and the Gulf settlements during the MH and early LH periods. The settlement at Kolonna on Aegina is generally recognized as having been a significant pre-Mycenaean site in the region, and has a long history of fortification construction extending throughout the EH, MH and LH I-II period. In addition, the newly discovered coastal settlement at Korphos: Kalamianos has been identified as a potential Mycenaean harbor site, which rapidly grew into a walled urban settlement by the early LH IIIB period (Tartaron et al. 2011; Pullen 2013).
Aegina: Kolonna (Figures 1-2)

Dimensions for the heights, widths, and lengths of the fortifications walls at Kolonna were recorded in extensive detail by Walter and Felten (1981) and Walter (1985). Architectural plans and measurements were available for each of the observed construction sequences for the prehistoric fortification system, spanning the end of the EH (City V), throughout the MH (City VI-IX) and up until the early LH period (City X). Remains of the MH fortification walls were uncovered for a length of 72 m (Hope Simpson and Hagel 2006:72), which extends NW-S across most of the width of the Kolonna hill (Walter and Felten 1981:8-9, Fig. 1). The prehistoric fortifications are only preserved along this stretch of the settlement—dividing the city proper from the Vorstadt—which is located on an elevated mound and surrounded by the sea to the north, south, and west. Seeing as the surrounding coastline may have likely served as a natural defense in itself, and because the fortification system has only been observed across this extent, a length of 72 m is applied to phases VI-IX.

Specific measurements for height and width were available for the structures built during phases VI-IX, by reference to Walter and Felten (1981:43-48, 50-53, 58-70, 72-77). For City VIII in particular, a height of 4.2 m was used instead of the 4 m cited by Walter and Felten (1981:70), in light of the image given by Walter (1983:75, Fig.75) that gives a measurement of 4.2 m. For the early LH extension of City X, the dimensions given by Hope Simpson and Hagel (2006:72) were used; here, the LH proteichisma was only built for a length of ca. 23 m, which is used instead as the measurement for length.
The date ranges for each of the construction phases—given in the publications as absolute dates, and listed in Table 3 by their respective cultural phases—coincide with the chronology established for the sequence of occupation at the site.

**Athens: Acropolis (Figure 29)**

The dimensions for the height and width of the fortification walls at Athens are listed by Mylonas (1966:35-43) and Iakovides (1983:79-86, 2006:234-9), who both carried out extensive excavations on the Acropolis during the 1960s. The Mycenaean enceinte has only been preserved at a few locations along the perimeter of the acropolis, yet its course has been reconstructed with a fair degree of certainty, by reference to the topography of the acropolis, surface cuttings on the bedrock, and the remains of buildings whose orientation and construction suggest an adjustment to the Cyclopean wall (Iakovides 1983:79). The best preserved height is mentioned by Mylonas (1966:37) as reaching 4 m, observed at the southwest corner of the Propylaia. Based on the evidence outlined in his synthesis of the Mycenaean acropolis, Iakovides (2006:239) argues for an original height of ca. 8-10 m, which coincides with Mylonas’ (1966:37) earlier estimate of 9-10 m. Loader (1998: Appendix B) gives a total circuit length of 793 m, which is slightly higher and more precise than Mylonas’ (1966:37) more general estimate of 700 m. Although not much has been preserved, there is no evidence to suggest that the Cyclopean wall was the product of multiple building phases. Its construction has been reliably dated to LH IIIB1, on the basis of pottery collected from across the Acropolis and from the North Fountain (Iakovides 1983:86).
Ayios Yiorgos: Brauron (Figure 28)

Measurements for the fortification wall at Ancient Brauron were first published by Papademetriou (1956a:79, 1956b:33-34, 1957, 1962) and later by Eustratiou (2001). The wall was uncovered along the northwest side of the summit for a length of 168 m, and bent towards the slope at right angles at the northeastern and southwestern ends for a length of 6.8 and 3.2 m, respectively (Eustratiou 2001:22-3). The sum of these lengths is provided in Table 3 as the value for the total length. The walls were noted to have defined an area of ca. 1,000 m$^2$ at the highest part of the hill (Eustratiou 2001:22), although Mycenaean surface sherds were recovered across the entire hill and indicate a broader settlement area of ca. 16,000 m$^2$ (Hope Simpson and Hagel 2006:68). The width is given as a range, based on measurements listed by Eustratiou (2001:22) and Loader (1998: Appendix 2). Because only the foundations of the wall are preserved, estimates of volume and weight were calculated for a range of probable heights (3 m, 4 m, and 5 m). The wall is dated roughly to the late MH-LH I-II, based on the recovery of MH and early Mycenaean sherds from the wall foundations (Eustratiou 2001:22-3).

A second stretch of wall had also been uncovered along the southeast slope, running for a length of ca. 20 m and reaching a height of up to ca. 3 m in some sections (Papademetriou 1956:79). However, the manner of construction is much less formal than that observed on the northwest slope, and likely served as a terrace wall rather than as a part of the fortifications. (Hope Simpson and Hagel 2006:68).
Korphos: Kalamianos (Figures 30-31)

Preliminary measurements and dates for the circuit walls at Kalamianos were published by Tartaron et al. (2011:598-602) and Pullen (2013). Members of the Saronic Harbors Archaeological Research Project (SHARP) have thus far been able to digitally map over 500 m of the extant circuit wall, including the total preserved length of the eastern circuit (ca. 320 m), and several stretches of the western extension, which were followed for ca. 70 m west of the “main gate”, again for another ca. 275 along the southwestern extent of the settlement (Tartaron et al. 2011:598, 600, 602). The probable course of the western circuit along sections between the extant stretches was outlined in a scaled map by Tartaron et al. (2011:599, Fig. 28), from which approximate lengths were inferred and added to the total length. Although the walls could have continued further beyond the points along the coastline at which they currently terminate, much of the settlement likely remains underwater, and whether or not the site was also fortified along the coastline is not yet known with any certainty. Accordingly, the circuit length listed in Table 3 represents the walls observed along the landward areas of the site.

The style of masonry was noted as being “Cyclopean” in appearance for both the circuit walls and other structures within the settlement, with limestone blocks typically measuring over 1 m in length, and often set upright in a pseudo-orthostate fashion (Tartaron et al. 2011:584, 598). However, because little rubble was observed along extant stretches of the walls, the researchers surmised that the fortifications would not have been “monumental” in size, and questioned whether the walls were ever completed (Tartaron et al. 2011:598). Indeed, the width was only observed as being ca. 1.10 m, and the maximum height for structures among the entire site as ca. 1.75 m. Although the walls
may have thus been limited in their original height, additional volumetric estimates are still calculated for a range of alternative heights.

Despite the lack of any systemic excavation at site, the construction of most structures and buildings across the site has been dated securely to the LH IIIA2-B period. Based on the ceramics collected from within the walls of the settlement, Pullen (2013) argues that Kalamianos had been a small harbor community in LH IIIA, and was transformed quite rapidly into a urban town within a single episode at the end of LH IIIA2 and the beginning of LH IIIB. This trajectory of development appears to be consistent with the sequence of construction observed for the two circuit walls, where the eastern circuit was likely built first (enclosing only two modest but seemingly important house structures at the highest part of the hill), and the western circuit was built subsequently off of the western face of the eastern circuit, enclosing a much larger settlement. Although this sequence of construction for the two circuits seems to coincide with the current chronology for the site’s growth, the walls themselves have not yet been dated, so they are treated here as contemporaneous structures whose construction falls within the transition between LH IIIA2-B.

**Vari: Kiapha Thiti (Figure 6)**

Measurements for the height, width, and length of the fortification wall at Kiapha Thiti were published by Hagel (1992) and Lauter (1995). The width provided in Table 3 reflects a high range of measurements, which is observed in the wall as a response to the unevenness of the terrain. Hagel (1992:47) originally noted the length of the fortification wall as 145 m, which was then subsequently modified to ca. 160 m (Hope Simpson and
Hagel 2006:66), as the total portion of the wall uncovered along the northwest slope. Calculations have also been provided for an alternative length of c. 200 m, which represents a conjectural continuation of the wall if it had been maintained across the entire span of the northwest slope. Its course has not been observed along the southern and eastern slopes, which are far steeper; either fortifications were not necessary at these locations, or have not been preserved.

**Boeotia, Phokis, and Lokris (Table 4)**


*Notes on Boeotia, Phokis, and Lokris*

Aside from the Argolid, the central Greek mainland exhibits the highest known concentration of fortified Mycenaean sites. Most notable is the area of the Kopais Basin in the region of Boeotia, in which the massive citadel of Gla occupies the northeast corner of the basin and is surrounded by a series of smaller satellite fortifications. Out of the larger assemblage of fortified sites identified around the periphery of the Kopais, only five sites are included in the sample for labour-cost estimation, as those which have been sufficiently preserved or for which there are recorded measurements: Gla, Ayia, Marina, Ayia Ioannis, Kastri: Haliartos, and Pyrgos. Beyond the Kopais, four other fortified sites have been identified from across Boeotia, as well as two sites from Phokis and one site from Lokris. All selected sites have been dated to the LH period, on the basis of ceramic finds.
Equally, a number of sites—both major and minor—have been omitted from the sample. The settlement at Orchomenos was likely a major Mycenaean centre in Boeotia, but exhibits no extant fortification walls from the LBA (which may otherwise have been destroyed by later building activity). Also, traces of Mycenaean circuit walls have been observed at other sites around the Kopais—such as Kastro: Kopai, Stroviki, Kantza, and Davlosis: Kastraki—but the remains are too fragmentary for analysis. A Mycenaean ramp and stretch of Cyclopean walling was recently uncovered at the site of Eleon in eastern Boeotia (Burke, Burns, and Charami forthcoming). It has only been partially excavated, however, and is disrupted by the superimposed remains an Archaic or Classical polygonal wall.

*Ayia Marina and Ayios Ioannis*

Measurements for the width of the circuit wall at Ayia Marina, and area of the settlement likely enclosed by the wall, were obtained from Hope Simpson and Hagel (2006:79). The preserved height was inferred from Fossey (1980:158, Fig. 6), where images of the walling on the southwest side show up to four courses—reaching a height of ca. 2 m—in a style of Cyclopean construction similar to that observed at Gla and Ayios Ioannis. Seeing as this is below the probable minimum height of the original fortification walls, addition calculations of volume and weight were made for hypothetical heights of 3 m, 4 m, and 5 m. A total circuit length was calculated from the area provided. The settlement and construction of the wall was dated to LH IIIA-B, by reference to the abundant surface finds observed throughout the walled area (Fossey 1980:158).
As with Ayia Marina, the width of the circuit wall and area of settlement at Ayios Ioannis were given by Hope Simpson and Hagel (2006:79). The preserved height was likewise inferred from reports and images by Fossey (1980:158, 1988:190), with estimates of volume and weight also given for a range of alternative heights. A total circuit length was calculated from the given area.

_Ayios Vlasios: Panopeus_

The circuit wall is best preserved along the south side, and its remains were traced by Fossey (1986:63-7, Pl.46), who noted the possible presence of two bastions at the southwest and southeast corners. The width of the wall, and the area of the settlement likely enclosed by the wall, was obtained from Hope Simpson and Hagel (2006:93). They note that in addition to the summit, the circuit walls would likely have enclosed much of the southern and eastern slopes as well (i.e., outside the later Hellenistic fortifications), but such an area could not be properly estimated. Hence, the circuit length calculated from the area of the summit of the hill represents a highly conservative estimate. The preserved height was inferred from images that show the preservation of three to four courses (measuring over ca. 2 m), and alternative calculations for volume and weight were also made for a range of heights. The date for the wall was assigned roughly to the LH IIIA-B period, on the basis of its Cyclopean style of masonry and the presence of Mycenaean pottery in the southeast area of the site.
Chalkis: Glypha

The preserved height and width of the circuit wall here was recorded by Sapouna-Sakellaraki (1987), who classified the wall as being of Cyclopean construction. Its construction was dated to the LH IIIB period, on the basis of the extensive presence of LH IIIB sherds along both sides of the wall. This suggestion is repeated by Mountjoy (1983:103), who notes how the LH IIIA2-LH IIIB1 phase is well-represented among the ceramics recovered. The area of the Mycenaean settlement was given by Hope Simpson and Hagel (2006:87), and a total circuit length was calculated from this area. Additional calculations of volume and weight are provided for alternative heights.

Eutresis

The circuit wall is best preserved along the southern end of the site, and its course was documented by Goldman (1931) as enclosing an area of approximately 213,000 m². The preserved height and width were inferred from a section of preserved walling along the south. Although only one course was preserved here—to a height of 0.90 m—an adjacent section to the east exhibited two preserved courses, presumably doubling the minimum height of the wall (Goldman 1931:71, Fig. 80-81). Nevertheless, estimates of volume and weight were also calculated for an alternative range of probable heights. A total circuit length was calculated from the given area.

Although the site has revealed some sherds from LH IIIA1-2, most of the assemblage from the Late Helladic period dates to LH IIIB. This date was also the latest for sherds which were collected directly from the fill of the wall, and represents the most
substantial phase of Mycenaean construction at the site. On this basis, the construction of the circuit wall is dated to LH IIIB.

**Gla (Figures 32-33)**

The dimensions and architectural features of Gla were provided and discussed in detail by Iakovides (1983:92-6, 1989, 1998, 2001). The fortification wall presents an unbroken circuit length, built as a single unit and presumably within a single phase of construction. It has been dated to sometime between LH IIIA2 and LH IIIB. Iakovides (1983:92) follows de Ridder (1894:272) and Thepsiades (1955:123) in estimating the circuit length as 3 km (or 3,000 m), while Noack (1894) had originally measured the circuit length more closely as 2,500-2,600 m. Because of this discrepancy in the recorded measurements, I have used 2,800 m for the length of the wall, which represents the average value from this range.

**Kastri: Haliartos**

The height of the circuit walls and area of the settlement enclosed by them were noted by Mountjoy (1983:105), Fossey (1988:300-308), and Hope Simpson and Hagel (2006:80-81). The fortification wall is preserved mainly to the south of the site, and along the southern half of the west side. Because only one face of the wall is preserved, the width could not be determined, so I have used Loader’s (1998) average value for width. Estimates of volume and weight are also given for a range of alternative heights, and a total circuit length was calculated from the given area. The construction of the wall was
given a *terminus post quem* of LH IIIA2, based on the recovery of a painted Mycenaean sherd from within the fabric of the wall (Austin 1926:82).

*Krisa (Figures 10-11)*

The width and circuit length of the fortifications at Krisa were recorded by van Effenterre and Jannoray (1937:323-326). The circuit length provided in Table 4 represents the northern, northeastern, and northwestern extent of the wall. Although this only constitutes approximately three-fifths of the overall perimeter, fortifications would likely have been unnecessary along the southern and southeastern sections, which are marked by a precipitous drop in elevation. The height was inferred from a section of the wall exposed along the northwest (van Effenterre and Jannoray 1937: Fig. 26), which is preserved to a height of well over 3 m. The likely date for the construction of the circuit wall was listed by Hope Simpson and Hagel (2006:94-95) as LH IIIA1-B.

*Larymna: Kastri*

The preserved dimensions for the height and width of the wall were given by Oldfather (1916:32-61), who originally outlined the course of the wall for a stretch of ca. 80 m. Hope Simpson and Hagel (2006:81-82) give the probable area of the site enclosed by the walls, from which a total circuit length was calculated. They also note that LH IIIB sherds were recovered from the wall itself, thereby giving a *terminus post quem* for its construction.
Pyrgos

Probable dates and measurements for the circuit wall were obtained from Hope Simpson and Hagel (2006:76), who note that the Mycenaean enceinte is preserved for a length of approximately 30 m, with four courses reaching a height of over 3 m. The area for the settlement was derived from the surface scatter, described by Mountjoy (1983:105), Fossey (1988:366-369), and Hope Simpson and Hagel (2006:76). A total circuit length was calculated from this area. The width was not provided in the literature, so I use Loader’s (1998) value for the average width.

Thebes (Figure 12)

The Mycenaean circuit wall at Thebes is preserved at various locations along the northern and western section of the Kadmeia. Here, Symeonoglou (1985:26-32) estimated the probable length of the circuit, the area of the settlement enclosed, and the likely location of its main gates. The width was given as a range, to account for the variation in thickness observed at the different sections. Due to poor preservation, only the foundations of the wall survive, so no height could be determined; for this reason, a range of possible heights is considered, and volumetric measurements and labour costs are calculated for these potential heights. Aravantinos (1995:615) has dated the construction of the wall to either the end of LH IIIA2 or early LH IIIB.

Thisbe: Paliokastro

The width of the circuit wall, preserved mainly along the northwest side of the site, was provided by Hope Simpson and Hagel (2006:84-85). A preserved height of ca. 2
m is inferred from the presence of two courses for the walling, although Hope Simpson and Hagel (2006:84) note that the minimum height would likely have been higher, since the foundations are obscured by the build-up of soil and stones. Accordingly, alternative estimates of volume and weight were calculated for a range of probable heights. A circuit length was calculated from the area of the top of the hill of Paleokastro, which represents the likely extent of the Mycenaean settlement. On the basis of artifactual finds, Hope Simpson and Hagel date the wall roughly to the Mycenaean period (LH IIA-IIIB), which is further supported by stylistic similarities with the masonry observed at Gla, Ayia Marina, and Ayios Ioannis.

**Cyclades (Table 5)**

Sites: Kea: Ayia Irini, Melos: Phylakopi, Paros: Koukounaries, Siphnos: Ayios Andreas (n=4)

*Notes on the Cyclades*

In addition to the sites from the mainland, a sample of fortifications from the Cycladic islands has also been included for analysis. The sites of Ayia Irini, Phylakopi, Ayios Andreas, and Koukounaries represent the only sufficiently preserved fortifications that can be dated to the late MH and/or LH periods. These fortified sites differ noticeably from the defense works of the mainland in both the style and scale of construction, and those at Koukounaries and Ayios Andreas exhibit later dates of construction than most other sites in the sample.

A section of a LH IIIC circuit wall was uncovered at the Mycenaean town of Grotta on Naxos, but has not been sufficiently excavated to allow for a volumetric or
labour cost estimate. It exhibits a width of 3.1 m and a total height of 1.8 m, which consists of a stone socle and a mudbrick superstructure (Kontoleon 1965:180-7; Lambrinoudakis and Zapheiropoulos 1984:74-9, 1985:162-7). However, it was only exposed for a length of ca. 14.6 m, and other sections of the circuit wall have not been identified elsewhere near the settlement. The total area of the site is also unknown (Lambrinoudakis 1979: Pl. 155; Hadjianastasiou 1989:207-8), so estimating a potential circuit length for the wall is not yet possible.

An LBA circuit wall was also identified at the site of Akroterion Ourion (also known as Vyrokastro) on the island of Tenos (Scholes 1956), but there is insufficient volumetric data for a labour-cost estimate. No circuit length or area has been recorded for the site, and wall heights can only be roughly made out from a single photograph taken by Scholes (1956: Pl. 2b). Alternatively, an extensive Cyclopean wall was identified and excavated at the nearby hill of Xobourgo, which likely served as a refugee settlement; yet dating for the construction of the wall has proven difficult, and can only be placed to sometime between late LBA and Protogeometric period (Kourou 2002:258).

Kea: Ayia Irini (Figure 3)

Details on the “Great Fortifications” from Period V at Ayia Irini were drawn mainly from Davis (1977, 1986), who provided measurements for the average width of the walls (1977:5) and the preserved height of the inner face (1977:12). The value of 2.1 m for height represents what has been preserved, while Davis (1986:101) surmised that the walls would have originally been at least ca. 5 m in height; the calculations of volume and weight presented in Table 5 are based on this latter value. The circuit length was
inferred from the scaled plans provided in both works (1977: Fig.3, 1986: Pl. 3), which present the course of the wall along the northern section of the site, across the neck of the promontory. Caskey (1971:377) assumed that the fortifications would have turned south at Tower X (the western most part of the wall), and followed the coastline to join with Tower Y to the east, thereby surrounding the entire site. This interpretation may certainly be feasible, given that the costs for Ayia Irini would be comparable to those of LC I Phylakopi if calculated from a full circuit wall (see Chapter 6, Section 6.2.5). However, I follow Davis’ (1977:3) view that the fortifications would not have likely enclosed the site on all sides (see also Shaw 1990:423). He argues:

The inhabitants of Ayia Irini had more to fear from a concentrated onslaught by land than an attack from the sea. Steep banks and house walls on the sea side could probably have provided adequate protection. A fortification wall would have been necessary only on the land side, to defend the settlement against an enemy host disembarked and marshaled before the city (Davis 1977:3).

For this reason, the measurement of the wall along the northern stretch of the settlement is used as the total length for the fortifications.

Measurements for the Period VI additions to the fortification wall were obtained from Caskey (1971) and Davis (1977). A total length was estimated from the scaled plan provided by Davis (1977, 1986), and represents a cumulative measurement for each of the constituent repairs or additions to the original Period V wall that have been dated to Period VI: the re-facing of the western section of the wall (ca. 15 m), the extension of the northern wall (ca. 15 m running E-W), the revetment against the east face of the east wall in the northeast section (ca. 10 m running N-S), the “Northeast Bastion” complex (ca. 40 m), and the entire stretch of walling east of the Main Gate, continuing towards the coastline (ca. 45 m, including Tower G but not Tower Y, which is underwater). The
maximum height was observed at the Northeast Bastion, which was preserved at a height of up to six courses of masonry, with blocks measuring ca. 0.80 m in height; hence, this section would have been approximately 4.8 m in height, which is comparable to the estimate given by Davis (1986:101) for the original height of the Period V walls. The value for width was maintained from the preceding period.

Although limestone was available locally on the island, Davis (1986:8) notes that the stone most used in constructing the fortifications was “blue or grey marble”. Accordingly, the density for marble (1570 kg/m$^3$) was used in calculating total weight from volume, which is comparable to that for limestone (1554 kg/m$^3$), seeing as marble is essentially a metamorphose type of limestone. Some sections of the wall were also constructed with blocks of schist, but these sections could not be differentiated volumetrically from the rest of the wall, for the purpose of calculating a separate weight. This difference in building material should not affect the estimate for weight significantly, seeing as schist is only slightly more dense than marble at 1,680 kg per 1 m$^3$.

The date of construction for Period V at Ayia Irini was originally identified by Davis (1977) as the “late Middle Bronze Age”, which corresponds roughly with the MM IIIA period on Crete (Davis 1986). The additions and repairs of Period VI (or Caskey’s Period “G”) were dated to the early Late Bronze Age, or the LM IA period on Crete (LH I-II on the mainland).
Melos: Phylakopi (Figures 34-35)

Measurements for the height, width, and length of the fortifications at Phylakopi were obtained from Atkinson et al. (1904) and Renfrew (1978b, 1982b, 2007:53-64). During the original excavations undertaken by Mackenzie and his colleagues, the LB I “Town Wall” from Period III was uncovered along the southern extent of the settlement. The date for the construction of this wall was subsequently refined by Renfrew (2007:64) as LM IA-B. The southwestern section was more substantially preserved than that to the east, yielding the figures for height and width that are listed in the table. However, Mackenzie was also able to follow the inner face of the wall further east, terminating at what was likely a corner bastion (square L5 in the map provided by Atkinson et al. 1904, and square WK in Renfrew 2007: Fig. 2.1), where the fortification wall may have turned north toward the sea coast. Following the scaled maps from both monographs, the total course of the southern extent was measured as ca. 210 m, which is used here as the total length for the LB I walls.

Fortifications have not been observed elsewhere other than this southern course, nor would they have been necessary. The settlement is bordered by the sea to the west and north, and geomorphological research has demonstrated that the site would also have been surrounded by the sea on its eastern and southeastern sides during the Bronze Age (Davidson and Tasker 1982:88). Hence, the settlement would have formed a promontory projecting eastward, with a sheltered inlet or harbor to the south. In this regard, strong fortifications may only have been necessary along the western end of the settlement’s southern flank, to guard against the hinterland (as with Ayia Irini; see above). This layout
may also explain why the fortifications are strongest in the southwestern section, and less evident in the southeast.

Dimensions for the subsequent Period IV fortification wall were provided by Renfrew (1985, 2007:53-64), who was able to securely date their construction to the LH IIIB1 period (Renfrew 1985:32, 81). It was uncovered for a length of ca. 13 m along the south and southeast of the shrine area (Renfrew 1985:34-5). It likely did not extend much farther, and may have simply served as a supplementary section for the earlier wall, in response to the silting up of the harbor and an increase in promontory land (Hope Simpson and Hagel 2006:112).

**Paros: Koukounaries (Figure 36)**

Measurements for the fortification wall surrounding the complex at Koukounaries were obtained from publications by Schilardi (1979, 1984, 1992), which summarized the field reports given in Praktika and Ergon between 1974 and 1991. Although the wall is only preserved to a height of 3 m, Schilardi (1984:188) inferred an initial height of 8-9 m, based on the evidence of an upper story having existed for the warehouses directly behind the wall, and the likelihood that the fortifications adjacent to these structures would have been at least as high to offer the maximum level of protection (cf., Davis 1986:101). The fortifications were also only observed along the southern side of the plateau, which opens towards a sloping ascent; the rest of the plateau is bordered by steep rock formations (Schilardi 1984:187), where the construction of fortifications would have been neither necessary nor feasible. Extensive Cyclopean wall remains were also identified at the foot of the hill and along the lower terraces (Schilardi 1979:159, 1984:187), but these have not
been thoroughly excavated or recorded. He dated the construction of the wall to the early LH IIIC, on the basis of pottery recovered from a test trench dug along the face of the wall. Although the island is dominated by marble and schist, the primary building material here was granite (Higgins and Higgins 1996:180-1), which was likely quarried from the hill itself. Accordingly, a value for the density of granite was used to calculate weight from volume.

**Sifnos: Ayios Andreas** (*Figure 37*)

The height and width of both the outer and inner circuit walls on the summit of Ayios Andreas were obtained from Philippaki (1973) and Televantou (2001). The total lengths for the two contemporary circuit walls were taken from Televantou (2001), and compared against the scaled plan provided by Philippaki (1973:95, Fig. 1). In addition to the volumes calculated for both circuits, a measurement of volume was also calculated for the eight contemporary towers identified along the inner wall. Because they are all of similar size, I used the dimensions recorded for Tower B (h= 2.3 m, w= 2.85 m, l= 2 m) to calculate an approximate volume for each of the towers (V= 13.11 m³). The total volume recorded for the fortification system therefore includes the cumulative volume for all eight towers, in addition to the values calculated for the inner and outer circuit walls.

**Messenia** (*Table 6*)

Sites: Malthi Dorion, Mirou: Peristeria, Mouriatadha: Elliniko, Pylos (n=4)
Notes on Messenia

Pylos represents the major palatial centre of Messenia, but in contrast to the palaces observed elsewhere—especially in the Argolid—there is a noticeable lack of substantial defense works. The only visible remains of a circuit wall date to ca. LH I-IIA, and therefore precede the construction of the palace complex in LH III. Geophysical exploration by the Pylos Regional Archaeological Project (PRAP) detected the possible remains of a later and much more substantial fortification wall, located ca. 60 m northwest of the palace, and which may have enclosed the LH IIIB Lower Town (Davis et al. 1997:427-430; Zangger et al. 1997:604-613). However, seeing as it has not been directly excavated, no reliable architectural dimensions can be provided. Therefore, a labour-cost estimate has only been attempted for the earlier circuit wall.

In addition, the three fortified sites of Mouriatadha: Elliniko, Mirou: Peristeria, and Malthi Dorion are included as well. They are located to the north of Pylos, and differ noticeably from other regions of the mainland in the style, scale, and dating of their construction; the latter two sites in particular represent some of the earliest extant Mycenaean fortifications from the mainland, dating to the late MH or early LH period.

No other defense works have been identified in Messenia that can be reliably dated to the MBA or LBA.

Malthi: Dorion (Figure 5)

Measurements for the circuit length, width, and height of the fortifications walls were original recorded by Valmin (1938:16-25, Pl. 3), who was able to uncover the entire course of the walls surrounding the settlement. The dimensions were also provided by
Scoufopoulos (1971:20-21). Davis (1998:56) gives a broader range for the width of the walls, which is included in Table 6. The walls were preserved mainly along their inner face, against which large rooms had been attached throughout the course. Although the walls were preserved to a height of approximately 1 m, additional calculations were made for an alternative range of probable heights. Despite the complex stratigraphy of the site, a date of LH I-IIA for the completion of the walls has been generally accepted (Lauter 1995:82-86, cited in Hope Simpson and Hagel 2006:56).

*Mirou: Peristeria (Figure 4)*

Measurements for the height and width of the circuit wall at Peristeria were obtained from Daux (1965:739-43) and Lauter (1995:87). Because little more than the foundations survive, volumetric estimates were calculated for a range of probable heights. The wall is preserved for a stretch of ca. 30 m on the southwest side of the summit, and presumably enclosed an area on the acropolis of 200 m north to south by 100 m (Hope Simpson and Hagel 2006:55). A total circuit length for the fortification was derived from this figure. Its construction was dated to the early Mycenaean period (LH I-II), which coincides with the period of use and occupation for most of the other structures on site. LH IIIA-B material was also recovered from across the hill and especially to the north, but it is likely that the settlement had already declined in activity and occupation by this time (Bennet 1998:129). Furthermore, the uncoursed and distinctly non-Cyclopean masonry resembles that of the other early Mycenaean walls in Messenia (see below), and the attachment of small rooms to the inner wall (Daux 1965:741, Fig. 17)
seems to parallel those observed at Kiapha Thiti in Attika, which is also of early Mycenaean date.

*Mouriadha: Elliniko (Figure 23)*

Although the dimensions for the preserved stretch of fortifications at Mouriatadha were not provided in any of the published field reports, a height of ca. 5 m was inferred from some of the images provided (especially Daux 1961:707, Fig. 11), which show around 16 rough courses of non-Cyclopean, “provincial” masonry (Hope Simpson and Hagel 2006:54). For the width, I used Loader’s (1998) average value of 4.3 m. A total circuit length was calculated from the area given by Hope Simpson and Hagel (2006:54). According to Bennet (1998:129), the site is dated exclusively to the LH IIIB phase, and is contemporary with the final phase of the palace at Pylos.

*Pylos (Figure 38)*

The LH I-II circuit wall at the hill of Epano Englianos is poorly preserved. The only remaining structures that have been identified are those of the Northeast Gateway, the stretch of the curtain wall that is joined to the Gateway (for a length of ca. 10 m), and various sections of walling observed along the scarp of the hill to the northwest, southwest, and northeast (see Blegen et al. 1973: Fig. 302). Over 50 soundings and trial trenches were laid into the hillside of Epano Englianos along its perimeter, which revealed that the curtain wall would have likely followed the brow of the ridgeline in a consistent fashion (Blegen et al. 1973:8-18). Accordingly, a conjectural circuit length was
calculated from the area of the hill, recorded as 170 m northwest to southeast by 90 m (Blegen and Rawson 1967:4).

The dimensions for the preserved height and width of these structures were noted by Blegen and Lang (1960:155-6) and Blegen et al. (1973:4-18). The height ranged from 0.60 m, observed in four rough courses along the southeast side of the Gateway (Blegen et al. 1973:5), to ca. 1.10 m, observed at a section of the wall exposed west of the Gateway, and another uncovered along the southwestern scarp of the acropolis (Blegen et al. 1973:8,12, Fig. 10 and 21). Since these measurements are well below the probable minimum height of the original fortification wall, calculations were also made for heights of 3 m, 4 m, and 5 m.

The width, measured as 1.40 m, was recorded for the northwest section of the Gateway and a stretch of wall further to the west (Blegen et al. 1973:6,8). Alternatively, Blegen and Lang (1960:156) remark that “the fortification itself may have been twice or thrice as thick, perhaps having been built in two or three parallel units”, in response to the steeply rising slope along the edge of the hill. For this reason, estimates of volume, weight, and labour costs are not only calculated for various possible heights, but are also made for both the preserved width and the conjectural width (which is roughly equivalent to Loader’s average value).

The construction of the wall has been quite securely dated to LH I-IIA, with no evidence to suggest that it had still been in use by LH IIIB (Blegen and Lang 1960:155-6; Blegen and Rawson 1967:30; Blegen et al. 1973:7,13,18; Davis 1998:68). Indeed, when the final palace was constructed in the LH IIIB period, the remains of the circuit wall
were buried in soil, and in one section, had been covered by the superimposing outer wall of the Southwest Building (Blegen and Lang 1960:156; Blegen et al. 1973: Fig. 306).

**Thessaly** (Table 7)

Sites: Ktouri, Pyrgos Kieriou: Ancient Arne (n=2)

*Notes on Thessaly*

The Thessalian defense works at Ktouri and Pyrgos Kieriou: Ancient Arne represent the only known Mycenaean fortifications in the region. Of the two walls observed at Ktouri, the inner enceinte has been identified as Mycenaean on the basis of ceramic finds across the site and within the wall itself (Béquignon 1932). Likewise, the citadel of Ancient Arne-Kierion exhibits a circuit wall composed of large stones—although not “Cyclopean” in overall style—and has been dated to the LH III period through the presence of diagnostic sherds. At both sites, the actual settlements may have been located across the adjacent foothills, where the citadels served rather as defensive keeps whenever necessary (Hope Simpson and Hagel 2006:99-100).

The site of Stephanovikeion: Petra might also qualify as an important Mycenaean site (Feuer 1983:44). Here, V.Milojčić carried out trial excavations in the 1950s and identified an extensive circuit wall—reaching a total perimeter length of over 4,000 m—that was then classified as “Cyclopean” (Hope Simpson and Hagel 2006:98). Although the site exhibits a large quantity of Mycenaean material, dating the circuit walls to the LBA could be problematic. The walls are not sufficiently preserved for the nature and style of construction to be ascertained, and the enclosure of such a large expanse of flat land—something uncharacteristic for most Mycenaean fortified sites—might
alternatively suggest a Classical or Hellenistic date for much of the wall (Hope Simpson and Hagel 2006:98). They instead suggest that the smaller walls around the northeastern and southwestern hills, located within the larger circuit, would likely have been built in Mycenaean times. However, no volumetric measurements or architectural plans are available for these walls, and such a date for them remains only speculative.

**Ktouri**

The inner enceinte of the two circuit walls at Ktouri was excavated by Bequignon (1932:126-130, Fig. 23-29), who measured the length and the range of thickness observed throughout the course of the wall. The height was inferred from his trial excavations, which followed the circuit wall to a depth of 2.3 m below the modern ground level. Five small towers were also uncovered, each projecting ca. 4-5 m from the wall, and measuring ca. 5-6 m broad. The volume for each tower was then calculated—using 2.3 m as the value for height—and the cumulative volume for all five towers was added to the volume for the circuit wall, thereby giving a figure for total volume.

LH IIIB sherds were collected from beside the wall of the upper enclosure during Bequignon’s trial excavations, and Hope Simpson and Hagel (2006:99) note that a LH IIIB sherd had been picked from within the fabric of the wall in 1958, thereby providing a *terminus post quem* for the construction of the wall (Küpper 1996:30).

**Pyrgos Kieriou: Arne**

Measurements for the width of the fortification wall, and the area of the settlement likely enclosed by the circuit, are given by Loader (1998: Appendix B) and
Hope Simpson and Hagel (2006:100), respectively. No measurement of height was available for the walls, so calculations are made for three alternative heights (as with Thebes). A LH IIIA-B date for the construction of the wall is likely, based on the presence of Mycenaean sherds on the hill, and the noticeably Cyclopean style of masonry for the wall.

**Notes for Conglomerate Gateway Blocks (Table 8)**

Dimensions for the conglomerate blocks used in the Lion Gate and North Gate at Mycenae were obtained from Iakovides (1983:30-33). For the threshold block of the Main Gate at Tiryns, Müller (1930:70) provides only the length and width. The height range listed in Table 8 for this block represents the range of heights observed for the two gate thresholds at Mycenae; the average of this range was used to calculate an estimate for total volume and weight. These blocks are considered to have been comparable in size, owing to the comparable style and nearly contemporaneous date of construction; Müller (1930:73) even surmised that the same architect had been responsible for the construction of both the Lion Gate and the Main Gate at Tiryns (cf., Maran 2006:81).

Similarly, Dörpfeld’s measurements for the width and length of the two door jambs of the Main Gate are roughly equivalent to the average of the values observed for the Lion Gate and North Gate at Mycenae (Schliemann, Adler, and Dörpfeld 1885:193).

Measurements for the dimensions of the lintel stone observed on the Larissa Hill at Argos were provided by Crouwel (2008). Although the block has been incorporated into the outer face of the later Byzantine fortification wall, it likely dates to the Mycenaean period; all other building structures on the Larissa Hill are constructed of
local poros limestone (Crouwel 2008:268), and conglomerate was rarely used in Argos in post-Bronze Age times (Piteros 2003:374). The dimensions of the lintel stone are also comparable to those observed for the lintel stones at Mycenae, further suggesting a contemporary date.
APPENDIX B

LABOUR RATES FOR CONSTRUCTION AND THEIR SOURCES

I. Labour Rates for Each Construction Task

<table>
<thead>
<tr>
<th>Task</th>
<th>Rate</th>
<th>Source(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarrying</td>
<td>1.4 p-d per 1 m³</td>
<td>Lehner (1997)</td>
</tr>
<tr>
<td>Acquiring Field Stones</td>
<td>1 p-d per 7200 kg</td>
<td>Abrams (1994)</td>
</tr>
<tr>
<td>Transport</td>
<td>5 p-h per 950 kg (250 meters)</td>
<td>Erasmus (1965)</td>
</tr>
<tr>
<td>Transport (Conglomerate)</td>
<td>12 people/ton (2 meters/minute)</td>
<td>Smith (2004)</td>
</tr>
<tr>
<td>Wall Assembly (Cyclopean)</td>
<td>1.7 p-d per 1 m³</td>
<td>Adapted from Seeher (2007)</td>
</tr>
<tr>
<td>Wall Assembly (Non-Cyclopean)</td>
<td>6.89 p-h per 1 m³</td>
<td>Lekson (1984)</td>
</tr>
</tbody>
</table>

II. Notes on the Selection of Specific Labour Rates

Quarrying

Studies on Egyptian pyramid construction have yielded useful work rates for the quarrying of limestone, concerning blocks similar in size to those employed in Cyclopean construction. Based on his 1992 NOVA pyramid building experiment, Lehner (1997:206) produced a figure of 1.4 p-d for the quarrying of approximately 1 m³ of limestone. Smith (2004:178-9, 184) draws on similar logistics for Egyptian quarrying, but gives a figure of 2 p-d per 1 m³ of stone. These rates are comparable to those observed for local Maya workers by Erasmus (1965:286), who recorded a rate of 1 p-d per 1,700 kg of rock. A modern-day estimate for quarrying without the aid of mechanized equipment yielded a
slightly more efficient rate of 1 p-d per ca. 2 metric tons or 2,000 kg of stone (Pulver 1947, cited in Pickett forthcoming, Table 3). It should be noted, however, that most of these attempts involved the use of metal crowbars, and given the relative limitations in equipment available to Mycenaeans for quarrying, such efficiency was likely not achieved. At the same time, the prevalence and nature of limestone outcroppings across much of the Aegean suggests that the task of “quarrying” may have simply required the breaking-away of blocks from tilted, parallel beds (Wright 1978:67)—indeed, a task that was surely less labour intensive than the type of quarrying carried out for Egyptian limestone. I believe that these two factors (equipment and process) would likely balance out in such a way that Lehner’s (1997) figure of 1.4 p-d per 1 m³ can be applied, as it represents an appropriate average within the observed range of labour rates for basic quarrying.

For non-Cyclopean walls, any such extensive quarrying likely did not take place (see Chapter 4, Section 4.3.4). Rather, field stones may have been collected locally, either from the site itself or from within close proximity to the site. For the collection of field stones, I apply Abrams’ (1994:46-7) rate of 1 p-d per 7.2 tons or 7,200 kg.

Transport

It is possible to determine transport costs in an abstract manner, by calculating the force necessary to drag a particular weight or volume of building material, and dividing this by the pulling strength of an average person. The force required to drag a block of stone along a surface—either level or inclined—follows the general formula:

\[ F_k = f \cdot P \cdot \cos (a) \pm P \cdot \sin (a) \]
Here, $F_k$ represents the kinetic force in newtons (N), $f$ is the coefficient of friction\(^1\), $P$ is the weight of the material (calculated as $mg$, or the mass multiplied by the force of gravity), and $\alpha$ represents the slope angle. The added range given by $[+/-\ P\ \sin\ (\alpha)]$ accounts for any incline or decline. The calculated force can then be divided by the average pulling strength of a man, measurements of which range between 231 N (Agrawal et al 2010) and 300-350 N (Cotterell and Kamminga 1990:219; Smith 2004), or approximately 50 kg of mass. Such calculations, however, provide estimates of gross manpower, and do not account for the speed at which such movement would take place. In this regard, they are unsuitable for calculating the proper labour-time measurements necessary for an energetics analysis.

Alternatively, numerous ethnographic and experimental studies have been carried out on the human-powered transport of megalithic stone (see Chapter 4, Section 4.2.1), which have had the advantage of putting theory to practice. Yet most of these experiments were concerned with the transport of truly megalithic stones, with weights ranging between 10 and 120 tons—indeed, far larger than the average Cyclopean stone, which was measured as weighing ca. 1.9 metric tons for the largest citadels\(^2\), and perhaps closer to ca. 1 metric ton for the unworked stones used in most other circuit walls. Also, as with the more abstract calculations, most experiments were only concerned with measurements of gross manpower, and did not offer precise considerations of time or speed. Only a few publications have yielded applicable figures and rates, which allow for

\(^1\) The coefficient of friction of compact dirt was measured by Protzen (1993) as $f = .75$.

\(^2\) Based on measurements taken from the major citadels of Mycenae, Tiryns, Gla, and Midea, Wright (1978:67) was able to calculate a rough average for the dimensions of a canonical “Cyclopean” block: 0.70-1.50 m in length, 0.60-1.00 m in height, and 0.80-1.00 m in thickness. Loader (1998: Appendix 2), in turn, used the average values for these ranges ($l=1.025, h=0.80, w=0.90$) to arrive at a volume of 0.74 m\(^3\). Following the conversions outlined by *Le Systeme International d’Unites* (SI), this translates to approximately 1930 kg for solid limestone, or 1.9 metric tons.
a more refined labour-time measurement to be calculated for different weights or volumes of stone.

Sidrys (1978) carried out a unique study on the caloric cost of construction, in observing native workmen from the American Southwest and measuring the energy expended in reconstructing prehistoric pueblos. From his data, he calculated that 40 kg per 1 p-h could be carried over a distance of 1 km (Sidrys 1978:159). A slightly more efficient rate was reached by Pulver (1969:23), who estimated that the average workman could carry 100 lbs. (ca. 45 kg) at a speed of 100 feet per minute, or approximately 28 metres per minute. At this rate, 1.68 km could be covered in 1 p-h, not accounting for resting time or any cumulative exhaustion.

Concerning the transport of larger stones, Smith (2004:204-213) calculated that 6 men could drag a block of approximately 1,000 kg at a rate of 4 metres per minute; from this rate, it would presumably take 6 p-h to transport it 240 m, or about a quarter of a kilometre. Smith’s figure is surprisingly comparable to Erasmus’ (1965:287) observations, where a nearly similar labour rate of 5 p-h (listed by Erasmus as 1 p-d) was required to move a total of 950 kg of stone a distance of 250 m. The latter rate has been applied here for calculating transportation costs, seeing as it reflects the simplest mode of unaided, human-powered transport—although its similarity with Smith’s rate for moving larger stones via sledge means that it can be applied equally to all sites for the transport of local stone, regardless of whether or not Cyclopean blocks had been used in construction.

An alternative figure is still required for the truly megalithic conglomerate stones used in the monumental gateways of some of the Argive citadels, which were not only far
larger than the stones typically used in the fortification walls, but were also transported over longer distances than the more local and readily available limestone. Conglomerate is only located in a few select outcroppings in and around the Argive Plain (Higgins and Higgins 1996:45-50). Following Wace (1949:136) and Wright (1978:98-102, 1987:177), it is likely that the conglomerate used at these sites would have been quarried from the Kalkani and/or Panagia ridges, adjacent to and west of the citadel at Mycenae. Assuming the workers had followed the local topography, a one-way trip would equal a distance of approximately 20 km to Tiryns, 16 km to Argos, and between 500 metres and 1 km to the citadel of Mycenae. The efficiency and work-load represented by Erasmus’ figure is only applicable to distances of ca. 250 m, therefore making it unsuitable as a labour rate for longer distances and much heavier loads. Alternatively, Smith (2004:172) modifies his estimates for much larger blocks of stone, and instead suggests a rate of 2 metres per minute for blocks weighing over 3,000 kg (equivalent to just over 8 hours for a distance of ca. 1 km, not accounting for rest stops or breaks). He also proposes a minimum work force of 12 people per ton of stone, which represents a rough average of the estimates of man-power for pulling megalithic stone that have been observed elsewhere.  

Smith’s figure is adopted here in calculating the costs of transporting the three gateways stones to Tiryns, the lintel stone to Argos: Larissa Hill, and all conglomerate observed in the fortifications at Mycenae. Although the conglomerate blocks used in the bastions and facings of the Lion Gate and North Gate at Mycenae are not as monumental  

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3 Such estimates range from 2 men/ton (Atkinson 1961:297) and 6 people/ton (Lehner 1997:224) to larger work forces of 18 (Heyerdahl 1958:148-152; Cotterell and Kamminga 1990:218) and 22 men/ton (Atkinson 1956:115). Sidrys (1978:172) cites an ethnographic experiment from Sumba, in which it took 525 men 2 days to transport an 11 ton stone and sledge for 3 km, which is roughly equivalent to 32 person-days per ton. The figure of 12 people per ton used here is comparable to that of 10 men/ton used by Cavanagh and Mee (1999:96) and Fitzsimons (forthcoming).
in size as the actual gateway stones (threshold, lintel, and two door jambs), they are calculated together under the same transport rate because of the increased distance to the citadel; the transport costs for conglomerate blocks of even “average” Cyclopean size (see above) would likely have been higher than that implied by Erasmus’s rate, due to the increase in distance.

**Wall Assembly**

Rates for the erection of simple stone walls—i.e., with average blocks smaller than ca. 0.5 m$^3$—are more widely available than those for megalithic stone walls. They are drawn from a range of cultural contexts, and derived from both reconstruction efforts and experimental studies that have been carried out on different architectural types. From his study on Maya domestic residences, Abrams (1984a:175-176) provides a widely-cited figure of 0.8 m$^3$ per 1 p-h, or approximately 1.25 p-h per 1 m$^3$ of masonry. This rate is nearly equivalent to that given by Pulver (1969:167), who estimated 0.75 m$^3$ of masonry per 1 p-h, or again, 1.25 p-h per 1 m$^3$. A much higher rate of 13.25 p-h per 1 m$^3$ was cited by Lekson (1984:278) for the reconstruction of pueblo structures at Chaco Canyon, but he was able to achieve a more moderate figure of 6.89 p-h per 1 m$^3$ for the construction of comparable “Type III” pueblo walls. This value seems to represent a reasonable average between the observed extremes.

Labour-time measurements for erecting walls with larger stones are scarce, given the general lack of experiments into constructing megalithic fortifications, and our imperfect understanding of the exact manner in which the stones were positioned for construction. Energetic studies by Webster (1991) and Cavanagh and Mee (1999) both
use Abrams’ (1984a) rate of 0.8 m$^3$ per 1 p-h for the construction of Sardinian nuraghi and a Cyclopean tholos tomb, respectively. However, the applicability of Abrams’ rate for such structures is questionable, given the differences in stone size from that of Maya domestic architecture, and the logistics that would have been required for raising and setting such stones.

The labour-time rate used in this study is derived from the work carried out by Jurgen Seeher (2007) and the DAI at Hattusa, in reconstructing a section of the original Bronze Age mudbrick fortification wall. Specifically, it concerns the construction of the massive stone socle on which the larger mudbrick superstructure was built (Seeher 2007: Fig. 16). The stones used at Hattusa are certainly not “Cyclopean” or comparable to the blocks observed at the larger citadels; nevertheless, it was observed that at least four workmen at the reconstruction were required to lift an average stone, which was accomplished by means of rolling and lifting the stone step-wise up a wood-post ladder (Seeher, personal communication). A similar method may have been employed by Mycenaeans for most of a fortification wall’s length—albeit on a grander scale—by pulling and dragging stones step-wise up successive courses diagonally, either along the wall face itself or up the sloping internal fill. A similar work group of 3-4 men would likely have been necessary for Cyclopean walls (cf., French 2002:56), although Wilhelm Dörpfeld originally proposed that even for Tiryns, “many of the stones of the citadel walls might be moved by a single workman” (Schliemann, Adler, and Dörpfeld 1885:178). To be sure, more effort must have been expended in erecting the more monumental corner stones that are observed prominent locations along the circuits of the
major citadels, so the labour costs derived from this rate surely represents a conservative minimum estimate for wall assembly.

The rate used in this study was not explicitly given by Seeher, but rather was derived from my own calculations, based on Seeher’s published data. A total of 982 p-d was listed for the construction of the stone socle (Seeher 2007: Fig. 191), but the volume of the socle itself was not directly measured. Based on the images and plan of the reconstructed wall section (Seeher 2007: Fig. 16), I estimated an approximate volume of 587 m$^3$ (which takes into account the descending slope from SW to NE), and from here, it was possible to calculate a rough average of 1.7 p-d per 1 m$^3$. 
APPENDIX C

VOLUMETRIC MEASUREMENTS FOR SAMPLE SITES

This appendix presents the volumetric data for the sample of fortified sites, which are tabulated by region. The measurements represent approximations of preserved dimensions, and were acquired indirectly through field reports and publications (see Appendix A). The measurements listed here for each site were either provided explicitly in the associated publications, or were estimated from scaled site plans and available photographs. A number of interpolations have been made to account for measurements that are missing in the literature, such as perimeter length and width (see Chapter 4, Section 4.3.2). It is stated in the Site Catalogue where and how such interpolative measures are applied.

Sites with fortifications that are constructed of a material other than limestone, such as those in the Cyclades (Table 5), are provided with alternative densities for stone, which are applied in calculating the total weight from volume. For the sites in the Argolid that exhibit both limestone and conglomerate, separate calculations are provided for the latter. All density values are adapted from the metric SI system (Le système international d‘unités). The lower SI density value for “broken” material is used here instead of the more commonly used value for “solid” material, seeing as the fortifications themselves are not solid but composite structures of constituent stones (and would therefore exhibit a lower density than a single block that has an equivalent mass).
Table 1: Volumetric Measurements for Achaia

<table>
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<tr>
<th>Site</th>
<th>Probable Dates</th>
<th>Masonry Style</th>
<th>Circuit Length (m)</th>
<th>Max. Area (m²)</th>
<th>Height (m)</th>
<th>Width (m)</th>
<th>Total Volume (m³)</th>
<th>Total Weight (kg)</th>
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<td>Teichos Dymaion</td>
<td>LH IIIB</td>
<td>Cyclopean</td>
<td>190</td>
<td>9,500 m²</td>
<td>ca. 8-10</td>
<td>4.90-5.20</td>
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<td>14,910,630</td>
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A  Weight for 1 m³ of limestone equals 1554 kg (broken)
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<th>Height (m)</th>
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<th>Total Volume (m³)</th>
<th>Total Weight (kg)</th>
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<tr>
<td>Aspis</td>
<td>MH; LH III</td>
<td>Cyclopean (?)</td>
<td>555° 200 m by 150 m</td>
<td>200 m by 150 m</td>
<td>ca. 2</td>
<td>2.6</td>
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<td>Larissa Hill</td>
<td>LH III (?)</td>
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<td>172° 2,350 m²</td>
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<td>Kastro</td>
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<td>LH IIIB2</td>
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<td>450 ca. 24,000 m²</td>
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<td>7</td>
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<td><strong>Enceinte 1</strong></td>
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<td>680</td>
<td>8.25</td>
<td>7-7.5</td>
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<td><strong>Enceinte 2</strong></td>
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<td>Cyclopean</td>
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<td>320</td>
<td>12</td>
<td>3.80-6.20</td>
<td>Circuit wall: 19,200</td>
<td>Limestone 29,836,800</td>
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<td>Enceinte 3</td>
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<td>ca. 105 (NE ext.)</td>
<td>ca. 30,000 m²</td>
<td>ca. 6</td>
<td>5.50-7.25</td>
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<td>64,871 101,247,218</td>
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<td>Nea Epidavros Vassa</td>
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<td>518°</td>
<td>200 m by 120 m</td>
<td>3</td>
<td>ca. 2-3</td>
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<td>Prophitis Ilias</td>
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<td>160°</td>
<td>60 m by 40 m</td>
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<td>Citadel 1</td>
<td>LH IIIA1</td>
<td>Cyclopean</td>
<td>ca. 260</td>
<td>60 x 70 m (4,200 m²)</td>
<td>7.5 (?)</td>
<td>1-3</td>
<td>Swalls: 2,137.5</td>
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<td>Layer</td>
<td>Type</td>
<td>Length</td>
<td>Width</td>
<td>Circuit Length</td>
<td>Weight for 1 m³ of stone</td>
<td>Notes</td>
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<td><strong>Citadel 2</strong></td>
<td>LH IIIA2-B1</td>
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<td>ca. 225</td>
<td>ca. 7,200 m²</td>
<td>7.5</td>
<td>5.8</td>
<td>3,375</td>
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<td><strong>Next:</strong> 5,175, <strong>S ext:</strong> 3,375, <strong>E ext:</strong> 562.5, <strong>Total:</strong> 9,112.5</td>
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<td><strong>Citadel 3 (Upper)</strong></td>
<td>LH IIIB</td>
<td>Cyclopean</td>
<td>ca. 275</td>
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<td>8</td>
<td>5.8</td>
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<td><strong>Citadel 3 (Lower)</strong></td>
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<td>Cyclopean</td>
<td>ca. 350</td>
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<td>7.4</td>
<td>7.8</td>
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* Weight for 1 m³ of stone equals 1554 kg (broken) for limestone, and approximately 2000 kg for conglomerate
* Denotes a circuit length calculated from area
Table 3: Volumetric Measurements for Attika and the Saronic Gulf

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<th>Site</th>
<th>Probable Dates</th>
<th>Masonry Style</th>
<th>Circuit Length (m)</th>
<th>Max. Area</th>
<th>Height (m)</th>
<th>Width (m)</th>
<th>Total Volume (m³)</th>
<th>Total Weight (kg)</th>
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<tr>
<td>City VI</td>
<td>MH I</td>
<td>Non-Cyclopean</td>
<td>ca. 72</td>
<td>6,400 m²</td>
<td>3.4</td>
<td>4.25</td>
<td>1,101.6</td>
<td>1,711,886</td>
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<tr>
<td>City VII</td>
<td>MH I</td>
<td>Non-Cyclopean</td>
<td>ca. 72</td>
<td>6,400 m²</td>
<td>2-2.5</td>
<td>2.50</td>
<td>450</td>
<td>699,300</td>
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<tr>
<td>City VIII</td>
<td>MH II</td>
<td>Non-Cyclopean</td>
<td>ca. 72</td>
<td>6,400 m²</td>
<td>4-4.2</td>
<td>4.20</td>
<td>1,270.1</td>
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<td>City IX</td>
<td>MH II-III</td>
<td>Non-Cyclopean</td>
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<td>6,400 m²</td>
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<td>4.20</td>
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<td>1,997,201</td>
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<td>City X</td>
<td>MH III-LH I</td>
<td>Non-Cyclopean</td>
<td>ca. 23</td>
<td>6,400 m²</td>
<td>4.25</td>
<td>1.2-5</td>
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<td>Vari: Kiapha Thiti</td>
<td>LH I-II</td>
<td>Non-Cyclopean</td>
<td>ca. 160</td>
<td>ca. 10,000 m²</td>
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*A Weight for 1m³ of limestone equals 1554 kg (broken)*
Table 4: Volumetric Measurements for Boeotia, Phokis, and Lokris

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<th>Site</th>
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<th>Masonry Style</th>
<th>Circuit Length (m)</th>
<th>Max. Area</th>
<th>Height (m)</th>
<th>Width (m)</th>
<th>Total Volume (m$^3$)</th>
<th>Total Weight (kg$^3$)</th>
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<tbody>
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<td>Ayia Marina</td>
<td>LH IIIA-B</td>
<td>Cyclopean</td>
<td>377*</td>
<td>150 m by 80 m</td>
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<td>2-3</td>
<td>1,885</td>
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<td>Cyclopean</td>
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<td>3,588</td>
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<td>Haliartos</td>
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<th>1500</th>
<th>235,000 m²</th>
<th>3-4</th>
<th>4-5</th>
<th>27,000</th>
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<td>Kastri</td>
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<td>LH IIIA2-B</td>
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<td>192,000 m²</td>
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<td>3.15-3.50</td>
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| Thise:   | Palaiokas | LH IIA- | Cyclopean | 400* | 150 m by 100 m | ca. 2 | 3-4 | 2,800 | 4,351,200 |
|----------|------------|IIIB     |           |       |            |       |     |       |            |
|          |            |          |           |       |            |       |     |       |            |

Thebes:   | Palaiokas | LH IIA- | Cyclopean | 400* | 150 m by 100 m | ca. 2 | 3-4 | 2,800 | 4,351,200 |
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<td>7,614,600</td>
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\(^{\Lambda}\) Weight for 1 m\(^3\) of limestone equals 1554 kg (broken)

\(^{*}\) Denotes a circuit length calculated from area
Table 5: Volumetric Measurements for the Cyclades

<table>
<thead>
<tr>
<th>Site</th>
<th>Probable Dates</th>
<th>Masonry Style</th>
<th>Circuit Length (m)</th>
<th>Max. Area</th>
<th>Height (m)</th>
<th>Width (m)</th>
<th>Total Volume (m$^3$)</th>
<th>Total Wgt (kg)$^*$</th>
<th>Type of Stone Used</th>
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<td><strong>Period V</strong></td>
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<tr>
<td>Late MBA (MM IIIA)</td>
<td></td>
<td>Cyclopean</td>
<td>ca. 220</td>
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<td>2.1-5.0</td>
<td>1.8</td>
<td>1,980</td>
<td>3,108,600</td>
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<td><strong>Period VI</strong></td>
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<td>ca. 125</td>
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<td><strong>Total</strong></td>
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<td>Rhyolite</td>
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<td><strong>Period IV</strong></td>
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<td><strong>Paros: Koukounaries</strong></td>
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<td>LH IIIB-2-C</td>
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<td>Cyclopean</td>
<td><strong>Outer</strong>: ca. 300</td>
<td>110 by 100 m</td>
<td><strong>Outer</strong>: 2.5</td>
<td><strong>Outer</strong>: 1.4</td>
<td><strong>Outer</strong>: 1,050</td>
<td>9,208,080</td>
<td>Schist</td>
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<td><strong>Inner</strong>: ca. 330</td>
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$^*$ Weight for 1 m$^2$ equals 1,650 kg for granite (broken), 1,570 kg for marble (broken), 1,680 kg for schist, and 2,520 kg for rhyolite

$^*$ Denotes a circuit length calculated from area
Table 6: Volumetric Measurements for Messenia

<table>
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<tr>
<th>Site</th>
<th>Probable Dates</th>
<th>Masonry Style</th>
<th>Circuit Length (m)</th>
<th>Max. Area</th>
<th>Height (m)</th>
<th>Width (m)</th>
<th>Total Volume (m$^3$)</th>
<th>Total Weight (kg$^3$)</th>
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<td>Non-Cyclopean</td>
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<td>Non-Cyclopean</td>
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<td>Pylos: LH I-IIA</td>
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<td>1.5</td>
<td>704.55</td>
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<td>3,284,612.1</td>
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<td>2,986,011</td>
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<td>4.5</td>
<td>5,764.5</td>
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<td>4.5</td>
<td>7,686</td>
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<td>3,202.5</td>
<td>4,976,685</td>
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<td>-----</td>
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<td>-----------</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>4.5</td>
<td>9,607.5</td>
<td>14,930,055</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>4,195.28</td>
<td>6,519,582</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A Weight for 1 m$^3$ of limestone equals 1554 kg (broken)

* Denotes a circuit length calculated from area
Table 7: Volumetric Measurements for Thessaly

<table>
<thead>
<tr>
<th>Site</th>
<th>Probable Dates</th>
<th>Masonry Style</th>
<th>Circuit Length (m)</th>
<th>Max. Area</th>
<th>Height (m)</th>
<th>Width (m)</th>
<th>Total Volume (m$^3$)</th>
<th>Total Weight (kg)$^A$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ktouri</td>
<td>LH IIIB</td>
<td>Cyclopean (?)</td>
<td>247.96</td>
<td>ca. 5,671</td>
<td>2.3</td>
<td>2.25-2.70</td>
<td>2,657,954</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>m$^3$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Circuit: 1,425.77</td>
<td>Towers: 284.63</td>
<td>1,710.40</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>Total:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2,657,954</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyrgos Kieriou: Ancient Arne</td>
<td>LH IIIA- B?</td>
<td>Cyclopean (?)</td>
<td>542*</td>
<td>200 m by 140 m</td>
<td>--</td>
<td>2.25</td>
<td>3,659</td>
<td>5,686,086</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>h = 3 m</td>
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<td></td>
<td></td>
<td>3</td>
<td>3,659</td>
<td>5,686,086</td>
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<tr>
<td>h = 4 m</td>
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<td></td>
<td></td>
<td>4</td>
<td>4,878</td>
<td>7,580,412</td>
</tr>
<tr>
<td>h = 5 m</td>
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<td></td>
<td></td>
<td></td>
<td>5</td>
<td>6,098</td>
<td>9,475,515</td>
</tr>
</tbody>
</table>

$^A$ Weight for 1 m$^3$ of limestone equals 1554 kg (broken)

* Denotes a circuit length calculated from area
Table 8: Volumetric Measurements for Gateway Conglomerate Blocks at Mycenae, Tiryns, and Argos: Larissa Hill

<table>
<thead>
<tr>
<th>Stone</th>
<th>Length (m)</th>
<th>Height (m)</th>
<th>Width (m)</th>
<th>Total Volume (m$^3$)</th>
<th>Total Weight$^A$ (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mycenae</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lion Gate, Lintel</td>
<td>4.50</td>
<td>1.00</td>
<td>2.10</td>
<td>9.45</td>
<td>18,900</td>
</tr>
<tr>
<td>Lion Gate, Door Jamb</td>
<td>0.50</td>
<td>3.10</td>
<td>1.95</td>
<td>3.02</td>
<td>6,040</td>
</tr>
<tr>
<td>Lion Gate, Door Jamb</td>
<td>0.50</td>
<td>3.10</td>
<td>1.95</td>
<td>3.02</td>
<td>6,040</td>
</tr>
<tr>
<td>Lion Gate, Threshold</td>
<td>4.60</td>
<td>0.85</td>
<td>2.40</td>
<td>9.38</td>
<td>18,760</td>
</tr>
<tr>
<td>North Gate, Lintel</td>
<td>2.99</td>
<td>0.53-0.64</td>
<td>1.41</td>
<td>2.47</td>
<td>4,940</td>
</tr>
<tr>
<td>North Gate, Door Jamb</td>
<td>1.40</td>
<td>2.30</td>
<td>0.43-0.52</td>
<td>1.53</td>
<td>3,060</td>
</tr>
<tr>
<td>North Gate, Door Jamb</td>
<td>1.40</td>
<td>2.30</td>
<td>0.43-0.52</td>
<td>1.53</td>
<td>3,060</td>
</tr>
<tr>
<td>North Gate, Threshold</td>
<td>3.62</td>
<td>0.12-0.55</td>
<td>1.50</td>
<td>3.64</td>
<td>7,280</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>34.04</td>
<td>68,080</td>
</tr>
<tr>
<td><strong>Tiryns</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main Gate, Threshold</td>
<td>c. 4</td>
<td>0.34-0.85</td>
<td>1.45</td>
<td>3.45</td>
<td>6,900</td>
</tr>
<tr>
<td>Main Gate, Door Jamb</td>
<td>0.95</td>
<td>3.20</td>
<td>1.40</td>
<td>4.26</td>
<td>8,520</td>
</tr>
<tr>
<td>Main Gate, Door Jamb</td>
<td>0.95</td>
<td>3.20</td>
<td>1.40</td>
<td>4.26</td>
<td>8,520</td>
</tr>
<tr>
<td>Main Gate, Lintel Stone</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>11.97</td>
<td>23,940</td>
</tr>
<tr>
<td><strong>Argos: Larissa Hill</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lintel Stone</td>
<td>3.85</td>
<td>0.85</td>
<td>0.85</td>
<td>2.78</td>
<td>5,560</td>
</tr>
</tbody>
</table>

$^A$ Weight for 1 m$^3$ of conglomerate (solid) equals approximately 2000 kg
APPENDIX D
LABOUR-COST ESTIMATES FOR SAMPLE SITES

Total labour-cost estimates for all sample sites are presented here in Tables 1-7, which also include the constituent costs for the three major work tasks of quarrying, transport, and wall assembly (in units of person-days). The sites are tabulated by region and listed alphabetically. The values that appear next to each site name are those which have been calculated using the preserved dimensions, or those inferred from the excavator (see notes in Appendix C). Additional labour-cost estimates have also been calculated for sites with alternative volumetric measurements. The designation of a fortified site as “non-Cyclopean” (cf., Hope Simpson and Hagel 2006) is indicated by the letters “Nn” next to the site name.

Tables 8-13 present regional rankings of the sites by total labour cost. Sites that had multiple labour costs generated from alternative volumetric measurements are ranked by reference to the average of the calculated estimates, and sites with multiple building phases are ranked by reference to the sum of the costs from their constituent phases. A ranking table is not provided for Achaia, since Teichos Dymaion represents the only site analyzed from this region. A pan-regional ranking for total labour cost is also provided in Table 14, which presents the sites in descending order from highest to lowest cost value.

From the total labour costs, a series of estimates have been calculated for the size of the work force that would have been mobilized for construction, when given a range of various durations (Table 15). Following the labour recruitment strategies outlined by Webster and Kirker (1995:375), calculations are also made for the size of the faction or social segment that would have been associated with construction at each site (Table 16).
I. Total Labour Costs, with Constituent Work Tasks

Table 1. Achaia

<table>
<thead>
<tr>
<th>Site</th>
<th>Quarrying</th>
<th>Transport</th>
<th>Assembly</th>
<th>Total (p-d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teichos Dymaion</td>
<td>13,433</td>
<td>9,810</td>
<td>16,312</td>
<td>39,555</td>
</tr>
</tbody>
</table>

Table 2. Argolid

<table>
<thead>
<tr>
<th>Site</th>
<th>Quarrying</th>
<th>Transport</th>
<th>Assembly</th>
<th>Total (p-d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argos: Aspis</td>
<td>4,040.40</td>
<td>2,950.56</td>
<td>4,906.20</td>
<td>11,897</td>
</tr>
<tr>
<td>h = 3 m</td>
<td>6,060.60</td>
<td>4,425.83</td>
<td>7,359.30</td>
<td>17,846</td>
</tr>
<tr>
<td>h = 4 m</td>
<td>8,080.80</td>
<td>5,901.11</td>
<td>9,812.40</td>
<td>23,794</td>
</tr>
<tr>
<td>h = 5 m</td>
<td>10,101</td>
<td>7,376.39</td>
<td>12,265.50</td>
<td>29,743</td>
</tr>
<tr>
<td>Argos: Larissa Hill</td>
<td>1,264.20</td>
<td>923.20</td>
<td>1,535.10</td>
<td>3,722</td>
</tr>
<tr>
<td>Lintel Stone</td>
<td>3.89</td>
<td>1,067.52</td>
<td>--</td>
<td>1,071</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>4,793</td>
</tr>
<tr>
<td>Kandia: Kastro</td>
<td>2,287.60</td>
<td>1,670.55</td>
<td>2,778</td>
<td>6,736</td>
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<tr>
<td>h = 3 m</td>
<td>3,431.40</td>
<td>2,505.83</td>
<td>4,167</td>
<td>10,104</td>
</tr>
<tr>
<td>h = 4 m</td>
<td>4,575.20</td>
<td>3,341.10</td>
<td>5,556</td>
<td>13,472</td>
</tr>
<tr>
<td>h = 5 m</td>
<td>5,719</td>
<td>4,176.38</td>
<td>6,945</td>
<td>16,840</td>
</tr>
<tr>
<td>Midea</td>
<td>26,460</td>
<td>19,322.76</td>
<td>32,130</td>
<td>77,913</td>
</tr>
<tr>
<td>Mycenae</td>
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<td></td>
</tr>
<tr>
<td>Enceinte I</td>
<td>56,941.50</td>
<td>41,582.28</td>
<td>69,143.25</td>
<td>167,667</td>
</tr>
<tr>
<td>Limestone:</td>
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<tr>
<td>19,629.47</td>
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<tr>
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<tr>
<td>17,676.9</td>
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<tr>
<td>Gateway Blocks:</td>
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<td></td>
</tr>
<tr>
<td>612.72</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td></td>
<td></td>
<td></td>
<td>100,531</td>
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<tr>
<td>Enceinte II</td>
<td>28,302.53</td>
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<td></td>
</tr>
<tr>
<td>Total:</td>
<td>34,309.49</td>
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<td></td>
</tr>
<tr>
<td>Enceinte III</td>
<td>5,622.75</td>
<td>4,106.09</td>
<td>6827.63</td>
<td>16,556</td>
</tr>
<tr>
<td>Nea Epidavros: Vassa</td>
<td>5,439</td>
<td>3,971.90</td>
<td>6,604.50</td>
<td>16,015</td>
</tr>
<tr>
<td>Prophitis Elias</td>
<td>1,926.40</td>
<td>1,406.78</td>
<td>2,339</td>
<td>5,672</td>
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<tr>
<td>h = 3 m</td>
<td>2,889.60</td>
<td>2,110.17</td>
<td>3,509</td>
<td>8,059</td>
</tr>
<tr>
<td>h = 4 m</td>
<td>3,852.80</td>
<td>2,813.56</td>
<td>4,678</td>
<td>11,345</td>
</tr>
<tr>
<td>h = 5 m</td>
<td>4,816</td>
<td>3,516.95</td>
<td>5,848</td>
<td>14,181</td>
</tr>
<tr>
<td>Tiryns</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citadel I</td>
<td>4,725</td>
<td>3,450.49</td>
<td>5,737.50</td>
<td>13,913</td>
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<tr>
<td>Citadel II</td>
<td>12,757.50</td>
<td>9,316.33</td>
<td>15,491.25</td>
<td>37,565</td>
</tr>
</tbody>
</table>
Using Smith's (2004:172) figure of a minimum of 12 men/ton at a rate of 2 metres per minute (see Appendix B), and a specific distance of 16 km (representing the approximate distance between Argos and the Kalkani and/or Panagia Ridge).

Using Smith's (2004:172) figure, and a specific distance of 750 m (representing the approximate distance between the citadel and Kalkani and/or Panagia ridge).

Assembly cost only is for only for the circuit wall, and does not include the erection of the gateway blocks.

Using Smith's (2004:172) figure, and a specific distance of 20 km (representing the approximate distance between Tiryns and the Kalkani and/or Panagia Ridge).

### Table 3. Attika and the Saronic Gulf

<table>
<thead>
<tr>
<th>Site</th>
<th>Quarrying</th>
<th>Transport</th>
<th>Assembly</th>
<th>Total (p-d)</th>
</tr>
</thead>
<tbody>
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<td>Aegina: Kolonna (Nn)</td>
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<td></td>
</tr>
<tr>
<td>City VI</td>
<td>237.76</td>
<td>1,126.24</td>
<td>948.75</td>
<td>2,313</td>
</tr>
<tr>
<td>City VII</td>
<td>97.13</td>
<td>460.07</td>
<td>387.56</td>
<td>945</td>
</tr>
<tr>
<td>City VIII</td>
<td>274.13</td>
<td>1,298.51</td>
<td>1,093.87</td>
<td>2,667</td>
</tr>
<tr>
<td>City IX</td>
<td>277.39</td>
<td>1,313.95</td>
<td>1,106.88</td>
<td>2,698</td>
</tr>
<tr>
<td>City X</td>
<td>28.48</td>
<td>134.91</td>
<td>113.65</td>
<td>277</td>
</tr>
<tr>
<td>Athens: Acropolis</td>
<td>49,959</td>
<td>36,483.22</td>
<td>60,664.50</td>
<td>147,107</td>
</tr>
<tr>
<td>Ayios Yiorgios: Brauron (Nn)</td>
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<tr>
<td>h = 3 m</td>
<td>224.75</td>
<td>1,064.59</td>
<td>896.82</td>
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<tr>
<td>h = 4 m</td>
<td>299.66</td>
<td>1,419.46</td>
<td>1,195.76</td>
<td>2,915</td>
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<tr>
<td>h = 5 m</td>
<td>374.58</td>
<td>1,774.32</td>
<td>1,494.70</td>
<td>3,644</td>
</tr>
<tr>
<td>Korphos: Kalamianos</td>
<td>2,668.05</td>
<td>1,948.38</td>
<td>3,239.78</td>
<td>7,856</td>
</tr>
<tr>
<td>h = 3 m</td>
<td>4,573.80</td>
<td>3,340.08</td>
<td>5,553.90</td>
<td>13,468</td>
</tr>
<tr>
<td>h = 4 m</td>
<td>6,098.40</td>
<td>4,453.44</td>
<td>7,405.20</td>
<td>17,957</td>
</tr>
<tr>
<td>h = 5 m</td>
<td>7,623</td>
<td>5,566.80</td>
<td>9,256.50</td>
<td>22,446</td>
</tr>
<tr>
<td>Vari: Kiapha Thiti (Nn)</td>
<td>321.68</td>
<td>1,523.74</td>
<td>1,283.61</td>
<td>3,129</td>
</tr>
<tr>
<td>Circuit= 200 m</td>
<td>402.10</td>
<td>1,904.67</td>
<td>1,604.51</td>
<td>3,911</td>
</tr>
</tbody>
</table>
## Table 4. Boeotia, Phokis, and Lokris

<table>
<thead>
<tr>
<th>Site</th>
<th>Quarrying (p-d)</th>
<th>Transport (p-d)</th>
<th>Assembly (p-d)</th>
<th>Total (p-d)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ayia Marina</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h = 3 m</td>
<td>2,639</td>
<td>1,927.16</td>
<td>3,204.50</td>
<td>7,771</td>
</tr>
<tr>
<td>h = 4 m</td>
<td>3,959</td>
<td>2,890.75</td>
<td>4,806.75</td>
<td>11,656</td>
</tr>
<tr>
<td>h = 5 m</td>
<td>5,278</td>
<td>3,854.33</td>
<td>6,409</td>
<td>15,541</td>
</tr>
<tr>
<td><strong>Ayios Ioannis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h = 3 m</td>
<td>5,023</td>
<td>3,668.26</td>
<td>6,099.60</td>
<td>14,791</td>
</tr>
<tr>
<td>h = 4 m</td>
<td>7,535</td>
<td>5,502.39</td>
<td>9,149.40</td>
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<td>34,407</td>
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<td>9,459.14</td>
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<td>14,188.71</td>
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<td>Kea: Ayia Irini</td>
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<td>2,045.13</td>
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<td>1,512.00</td>
<td>1,115.53</td>
<td>1,836.00</td>
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<td>Melos: Phylakopi</td>
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<td><strong>23,980</strong></td>
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<tr>
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<td>161.64</td>
<td>165.75</td>
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<td>345.11</td>
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<td>419.07</td>
<td><strong>1,032</strong></td>
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### Table 6. Messenia

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<th>Assembly</th>
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<td>942.76</td>
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<td>3,761.94</td>
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<td>Mirou: Peristeria (Nn)</td>
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<td>Mouriatadha: Elliniko (Nn)</td>
<td>2,575.43</td>
<td>12,199.41</td>
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<td>Pylos (Nn)</td>
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<td>2,758.15</td>
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Table 7. Thessaly

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<th>Assembly</th>
<th>Total (p-d)</th>
</tr>
</thead>
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<td>Pyrgos Kieriou: Ancient Arne</td>
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II. Regional and Pan-regional Ranking of Sites by Total Labour Costs

Table 8. Ranking of Sites from the Argolid

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<tr>
<th>Ranking</th>
<th>Site</th>
<th>Date</th>
<th>Masonry</th>
<th>Total Labour Cost (p-d)</th>
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</thead>
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</tr>
<tr>
<td></td>
<td>Enceinte I</td>
<td>LH IIIA2-B1</td>
<td>Cyclopean</td>
<td>167,667</td>
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<tr>
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<td>Enceinte II</td>
<td>LH IIIB1-B2</td>
<td>Cyclopean</td>
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<td>LH IIIB2</td>
<td>Cyclopean</td>
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<td>Tiryns</td>
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<td>LH IIIA1</td>
<td>Cyclopean</td>
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<td>Cyclopean</td>
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<td>LH IIIB</td>
<td>Cyclopean</td>
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<td>Cyclopean (?)</td>
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<td>Nea Epidavros: Vassa</td>
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<td>MH I</td>
<td>Non-Cyclopean</td>
</tr>
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<td>City VII</td>
<td>MH I</td>
<td>Non-Cyclopean</td>
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<tr>
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<td>MH II</td>
<td>Non-Cyclopean</td>
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<td>MH II-III</td>
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<td>MH III-LH I</td>
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Table 10. Ranking of Sites from Boeotia, Phokis, and Lokris

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<th>Total Labour Cost (p-d)</th>
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<td>Cyclopean</td>
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<td>LH IIIA1-B</td>
<td>Cyclopean</td>
<td>111,304</td>
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<td>Eutresis</td>
<td>LH IIIB</td>
<td>Cyclopean</td>
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</tr>
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<td></td>
<td>93,070</td>
</tr>
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<td>93,207</td>
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<tr>
<td></td>
<td>h = 5 m</td>
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<td>116,508</td>
</tr>
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<td></td>
<td></td>
<td><strong>93,207</strong></td>
</tr>
<tr>
<td>5</td>
<td>Kastri: Haliartos</td>
<td>LH IIIA2-B</td>
<td>Cyclopean</td>
<td></td>
</tr>
<tr>
<td></td>
<td>h = 3 m</td>
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<td></td>
<td>34,407</td>
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<td>h = 4 m</td>
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<td></td>
<td>45,875</td>
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<td>57,344</td>
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<td>Average</td>
<td></td>
<td></td>
<td><strong>40,141</strong></td>
</tr>
<tr>
<td>6</td>
<td>Pyrgos</td>
<td>LH IIIA-B</td>
<td>Cyclopean</td>
<td>34,407</td>
</tr>
<tr>
<td>7</td>
<td>Ayios Ioannis</td>
<td>LH IIIB-IIIIB</td>
<td>Cyclopean</td>
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<td>22,187</td>
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<td>Average</td>
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<td></td>
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</tr>
<tr>
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<td>LH IIIA-B</td>
<td>Cyclopean</td>
<td>14,420</td>
</tr>
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<td>21,630</td>
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<td>h = 5 m</td>
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<td>36,050</td>
</tr>
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<td></td>
<td>Average</td>
<td></td>
<td></td>
<td><strong>25,235</strong></td>
</tr>
<tr>
<td>9</td>
<td>Thisbe: Palaiokastro</td>
<td>LH IIA-IIIB</td>
<td>Cyclopean</td>
<td>11,543</td>
</tr>
<tr>
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<td>h = 3 m</td>
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<td></td>
<td>17,314</td>
</tr>
<tr>
<td></td>
<td>h = 4 m</td>
<td></td>
<td></td>
<td>23,085</td>
</tr>
<tr>
<td></td>
<td>h = 5 m</td>
<td></td>
<td></td>
<td>28,857</td>
</tr>
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<td>Average</td>
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Table 11. Ranking of Sites from the Cyclades

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Site</th>
<th>Date</th>
<th>Masonry</th>
<th>Total Labour Cost (p-d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Melos: Phylakopi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Period III</td>
<td>LM I/LH I-II</td>
<td>Cyclopean</td>
<td>23,980</td>
</tr>
<tr>
<td></td>
<td>Period IV</td>
<td>LH IIIB</td>
<td>Cyclopean</td>
<td>464</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>24,444</td>
</tr>
<tr>
<td>2</td>
<td>Siphnos: Ayios Andreas</td>
<td>LH IIIB-C</td>
<td>Cyclopean</td>
<td>23,049</td>
</tr>
<tr>
<td>3</td>
<td>Kea: Ayia Irini</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Period V</td>
<td>MM IIIA</td>
<td>Cyclopean</td>
<td>8,183</td>
</tr>
<tr>
<td></td>
<td>Period VI</td>
<td>LM IA/LH I</td>
<td>Cyclopean</td>
<td>4,464</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>12,647</td>
</tr>
<tr>
<td>4</td>
<td>Paros: Koukounaries</td>
<td>early LH III</td>
<td>Cyclopean</td>
<td>1,032</td>
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Table 12. Ranking of Sites from Messenia

<table>
<thead>
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<th>Site</th>
<th>Date</th>
<th>Masonry</th>
<th>Total Labour Cost (p-d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mouriatadha: Elliniko</td>
<td>LH IIIB</td>
<td>Non-Cyclopean</td>
<td>25,052</td>
</tr>
<tr>
<td>2</td>
<td>Mirou: Peristeria</td>
<td>LH I-II</td>
<td>Non-Cyclopean</td>
<td>2,916</td>
</tr>
<tr>
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<td>h = 3 m</td>
<td></td>
<td></td>
<td>8,747</td>
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<tr>
<td></td>
<td>h = 4 m</td>
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<td></td>
<td></td>
<td>14,579</td>
</tr>
<tr>
<td>Ranking</td>
<td>Site</td>
<td>Date</td>
<td>Masonry</td>
<td>Total Labour Cost (p-d)</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------</td>
<td>---------------</td>
<td>---------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>1</td>
<td><strong>Pyrgos Kieriou:</strong> Ancient Arne</td>
<td>LH IIIA-B (?)</td>
<td>Cyclopean</td>
<td>20,136</td>
</tr>
<tr>
<td></td>
<td></td>
<td>h = 3 m</td>
<td></td>
<td>20,109</td>
</tr>
<tr>
<td></td>
<td></td>
<td>h = 4 m</td>
<td></td>
<td>25,136</td>
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<tr>
<td></td>
<td></td>
<td>h = 5 m</td>
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</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td>20,109</td>
</tr>
<tr>
<td>2</td>
<td><strong>Ktouri</strong></td>
<td>LH IIIB</td>
<td>Cyclopean</td>
<td>7,051</td>
</tr>
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</table>

Table 13. Ranking of Sites from Thessaly
<table>
<thead>
<tr>
<th>Rank</th>
<th>Site</th>
<th>Region</th>
<th>Date</th>
<th>Masonry</th>
<th>Total Labour Cost (p-d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gla</td>
<td>Boeotia</td>
<td>LH IIIA2-B</td>
<td>Cyclopean</td>
<td>323,194</td>
</tr>
<tr>
<td>2</td>
<td>Mycenae</td>
<td>Argolid</td>
<td>LH IIIA2-B2</td>
<td>Cyclopean</td>
<td>284,754</td>
</tr>
<tr>
<td>3</td>
<td>Tiryns</td>
<td>Argolid</td>
<td>LH IIIA1-B</td>
<td>Cyclopean</td>
<td>196,267</td>
</tr>
<tr>
<td>4</td>
<td>Athens: Acropolis</td>
<td>Attika</td>
<td>LH IIIB1</td>
<td>Cyclopean</td>
<td>147,107</td>
</tr>
<tr>
<td>5</td>
<td>Krisa</td>
<td>Boeotia</td>
<td>LH IIIA1-B</td>
<td>Cyclopean</td>
<td>111,304</td>
</tr>
<tr>
<td>6</td>
<td>Eutresis</td>
<td>Boeotia</td>
<td>LH IIIB</td>
<td>Cyclopean</td>
<td>108,582</td>
</tr>
<tr>
<td>7</td>
<td>Thebes</td>
<td>Boeotia</td>
<td>LH IIIA2-B</td>
<td>Cyclopean</td>
<td>93,207</td>
</tr>
<tr>
<td>8</td>
<td>Midea</td>
<td>Argolid</td>
<td>LH IIIB2</td>
<td>Cyclopean</td>
<td>77,913</td>
</tr>
<tr>
<td>9</td>
<td>Kastri: Halartos</td>
<td>Boeotia</td>
<td>LH IIIA2-B</td>
<td>Cyclopean</td>
<td>40,141</td>
</tr>
<tr>
<td>10</td>
<td>Teichos Dymaion</td>
<td>Achaia</td>
<td>LH IIIB</td>
<td>Cyclopean</td>
<td>39,555</td>
</tr>
<tr>
<td>11</td>
<td>Pyrgos</td>
<td>Boeotia</td>
<td>LH IIIA-B</td>
<td>Cyclopean</td>
<td>34,407</td>
</tr>
<tr>
<td>12</td>
<td>Ayios Ioannis</td>
<td>Boeotia</td>
<td>LH IIIB-IIIB</td>
<td>Cyclopean</td>
<td>25,884</td>
</tr>
<tr>
<td>13</td>
<td>Ayios Vlasios: Panopaeus</td>
<td>Boeotia</td>
<td>LH IIIA-B</td>
<td>Cyclopean</td>
<td>25,235</td>
</tr>
<tr>
<td>14</td>
<td>Mouriadadha: Elliniko</td>
<td>Messenia</td>
<td>LH IIIB</td>
<td>Non-Cyclopean</td>
<td>25,052</td>
</tr>
<tr>
<td>15</td>
<td>Melos: Phylakopi</td>
<td>Cyclades</td>
<td>LM I (LH I-II); LH IIIB1</td>
<td>Cyclopean</td>
<td>24,444</td>
</tr>
<tr>
<td>16</td>
<td>Siphnos: Ayios Andreas</td>
<td>Cyclades</td>
<td>LH IIIB-C</td>
<td>Cyclopean</td>
<td>23,049</td>
</tr>
<tr>
<td>17</td>
<td>Argos: Aspis</td>
<td>Argolid</td>
<td>MH; LH III</td>
<td>Cyclopean (?)</td>
<td>20,820</td>
</tr>
<tr>
<td>18</td>
<td>Thisbe: Palaiokastro</td>
<td>Boeotia</td>
<td>LH IIA-IIIB</td>
<td>Cyclopean</td>
<td>20,200</td>
</tr>
<tr>
<td>19</td>
<td>Pyrgos Kieriou: Ancient Arne</td>
<td>Thessaly</td>
<td>LH IIIA-B (?)</td>
<td>Cyclopean</td>
<td>20,109</td>
</tr>
<tr>
<td>20</td>
<td>Chalkis: Glypha</td>
<td>Boeotia</td>
<td>LH IIIB</td>
<td>Cyclopean</td>
<td>18,738</td>
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<tr>
<td>21</td>
<td>Larymna: Kastri</td>
<td>Boeotia</td>
<td>LH IIIB</td>
<td>Cyclopean</td>
<td>17,484</td>
</tr>
<tr>
<td>22</td>
<td>Nea Epidavros: Vassa</td>
<td>Argolid</td>
<td>LH IIIA-B</td>
<td>Cyclopean</td>
<td>16,015</td>
</tr>
<tr>
<td>23</td>
<td>Korphos: Kalamianos</td>
<td>Saronic Gulf</td>
<td>LH IIIA2-B</td>
<td>Cyclopean (?)</td>
<td>15,432</td>
</tr>
<tr>
<td>24</td>
<td>Ayia Marina</td>
<td>Boeotia</td>
<td>LH IIIA-B</td>
<td>Cyclopean</td>
<td>13,599</td>
</tr>
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<td></td>
<td>Site</td>
<td>Region</td>
<td>Culture</td>
<td>Phase</td>
<td>Type</td>
</tr>
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<td>--------</td>
<td>---------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>25</td>
<td>Kea: Ayia Irini</td>
<td>Cyclades</td>
<td>Late MBA-LH I</td>
<td>Cyclopean</td>
<td>12,647</td>
</tr>
<tr>
<td>26</td>
<td>Kandia: Kastro</td>
<td>Argolid</td>
<td>LH IIIA-B</td>
<td>Cyclopean</td>
<td>11,788</td>
</tr>
<tr>
<td>27</td>
<td>Prophitis Elias</td>
<td>Argolid</td>
<td>LH IIIA2-B</td>
<td>Cyclopean (?)</td>
<td>9,927</td>
</tr>
<tr>
<td>28</td>
<td>Mirou: Peristeria</td>
<td>Messenia</td>
<td>LH I-II</td>
<td>Non-Cyclopean</td>
<td>9,476</td>
</tr>
<tr>
<td>29</td>
<td>Aegina: Kolonna</td>
<td>Saronic Gulf</td>
<td>MH I-LH I</td>
<td>Non-Cyclopean</td>
<td>8,899</td>
</tr>
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<td>30</td>
<td>Pylos</td>
<td>Messenia</td>
<td>LH I-IIA</td>
<td>Non-Cyclopean</td>
<td>8,808</td>
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<tr>
<td>31</td>
<td>Ktouri</td>
<td>Thessaly</td>
<td>LH IIIB</td>
<td>Cyclopean</td>
<td>7,051</td>
</tr>
<tr>
<td>32</td>
<td>Malthi Dorion</td>
<td>Messenia</td>
<td>LH I-IIA</td>
<td>Non-Cyclopean</td>
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<tr>
<td>33</td>
<td>Argos: Larissa Hill</td>
<td>Argolid</td>
<td>LH III (?)</td>
<td>Cyclopean (?)</td>
<td>4,793</td>
</tr>
<tr>
<td>34</td>
<td>Vari: Kiapha Thiti</td>
<td>Attika</td>
<td>LH I-II</td>
<td>Non-Cyclopean</td>
<td>3,520</td>
</tr>
<tr>
<td>35</td>
<td>Ayios Yiorgos: Brauron</td>
<td>Attika</td>
<td>MH, LH I-II</td>
<td>Non-Cyclopean</td>
<td>2,915</td>
</tr>
<tr>
<td>36</td>
<td>Paros: Koukounaries</td>
<td>Cyclades</td>
<td>early LH IIIC</td>
<td>Cyclopean</td>
<td>1,032</td>
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</table>
### III. Estimates of Workforce Size and Available Labour Force

#### Table 15. Estimated Size of Work Force (for durations of 1 year, 5 years, and 10 years)

<table>
<thead>
<tr>
<th>Site</th>
<th>Labour Cost (p-d)</th>
<th>Necessary number of workers: 1 year&lt;sup&gt;A&lt;/sup&gt;</th>
<th>Necessary number of workers: 5 years&lt;sup&gt;A&lt;/sup&gt;</th>
<th>Necessary number of workers: 10 years&lt;sup&gt;A&lt;/sup&gt;</th>
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<tr>
<td><strong>Achaia</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teichos Dymaion</td>
<td>39,555</td>
<td>330</td>
<td>66</td>
<td>33</td>
</tr>
<tr>
<td><strong>Argolid</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mycenae</td>
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</tr>
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<td>Enceinte I</td>
<td>167,667</td>
<td>1,397</td>
<td>279</td>
<td>140</td>
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<td>Enceinte II</td>
<td>100,531</td>
<td>838</td>
<td>168</td>
<td>84</td>
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<tr>
<td>Enceinte III</td>
<td>16,556</td>
<td>138</td>
<td>28</td>
<td>14</td>
</tr>
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<td><strong>Tiryns</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citadel I</td>
<td>13,913</td>
<td>116</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Citadel II</td>
<td>37,565</td>
<td>313</td>
<td>63</td>
<td>31</td>
</tr>
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<td>Citadel III</td>
<td>144,789</td>
<td>1,207</td>
<td>241</td>
<td>121</td>
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<td><strong>Midea</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Argos: Aspis</td>
<td>20,820</td>
<td>174</td>
<td>35</td>
<td>17</td>
</tr>
<tr>
<td>Nea Epidavros: Vassa</td>
<td>16,015</td>
<td>133</td>
<td>27</td>
<td>13</td>
</tr>
<tr>
<td>Kandia: Kastro</td>
<td>11,788</td>
<td>98</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Prophitis Elias</td>
<td>9,927</td>
<td>83</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Argos: Larissa Hill</td>
<td>4,793</td>
<td>40</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td><strong>Attika and the Saronic Gulf</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athens: Acropolis</td>
<td>147,107</td>
<td>1,226</td>
<td>245</td>
<td>123</td>
</tr>
<tr>
<td>Korphos: Kalamianos</td>
<td>15,432</td>
<td>129</td>
<td>26</td>
<td>13</td>
</tr>
</tbody>
</table>
| Aegina:                
| Kolonna               |
| City VI   | 2,313 | 19  | 4   | 2   |
| City VII  | 945   | 8   | 2   | 1   |
| City VIII | 2,667 | 22  | 4   | 2   |
| City IX   | 2,698 | 22  | 4   | 2   |
| City X    | 277   | 2   | 1   | 1   |
| Vari: Kiapha Thiti |
| City     | 3,520 | 29  | 6   | 3   |
| Ayios Yiorgos: Brauron |
| City     | 2,915 | 24  | 5   | 2   |

| Boeotia, Phokis, and Lokris |
| Gla                     | 323,194 | 2,693 | 539 | 269 |
| Krisa                   | 111,304 | 928   | 186 | 93  |
| Eutresis                | 108,582 | 905   | 181 | 90  |
| Thebes                  | 93,207  | 777   | 155 | 78  |
| Kastri: Haliartos       | 40,141  | 335   | 67  | 33  |
| Pyrgos                  | 34,407  | 287   | 57  | 29  |
| Ayios Ioannis           | 25,884  | 216   | 43  | 22  |
| Ayios Vlasios: Panopaeus| 25,235  | 210   | 42  | 21  |
| Thisbe: Palaiokastro    | 20,200  | 168   | 34  | 17  |
| Chalkis: Glypha         | 18,738  | 156   | 31  | 16  |
| Larymna: Kastri         | 17,484  | 146   | 29  | 15  |
| Ayia Marina             | 13,599  | 113   | 23  | 11  |

<p>| Cyclades |
| Melos: Phylakopi |
| Period III | 23,980 | 200 | 40  | 20  |
| Period IV  | 464   | 4   | 1   | 1   |</p>
<table>
<thead>
<tr>
<th>Location</th>
<th>Population</th>
<th>Days</th>
<th>Workers</th>
<th>Average Work Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siphnos: Ayios Andreas</td>
<td>23,049</td>
<td>192</td>
<td>38</td>
<td>19</td>
</tr>
<tr>
<td>Kea: Ayia Irini</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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^ Assuming 1 “year” as a work season equals approximately 120 day (see Chapter 5, Section 5.2)
Table 16. Estimated Faction Size based on Work Force Estimates

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### Boeotia, Phokis, and Lokris

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### Cyclades

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**Messenia**

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**Thessaly**

| Pyrgos: | 838 | 168 | 84  | 419 | 84  | 42 | 1,676 | 335 | 168 | 559 | 112 | 56 |
| Ancient Arne |        |     |     |     |     |    |       |     |     |     |     |    |
| Ktouri   | 294  | 59  | 29  | 147 | 29  | 15 | 588   | 118 | 59  | 196 | 39  | 20 |

^ Figures are modeled after the labour recruitment strategies outlined by Webster and Kirker (1995) (see Chapter 5, Section 5.2).
IV. Charts and Graphs for Each Sampled Region

Presented below are the charts and graphs cited in Chapter 5, Section 5.3, which are provided for all regions except Achaia. They include labour-cost rankings, the dendrograms produced by cluster analysis, changes in labour costs plotted over time, and the range of estimates for workforce mobilized over time.
The Argolid

Chart 1. Total Labour Costs for Sites (in descending order).

Chart 2. Cluster Dendrogram for Sites in the Argolid.
Chart 3. Labour Investment for the Argolid over Time.

Chart 4. Size of Workforce Mobilized for Each Site (plotted in chronological order).
**Attika and the Saronic Gulf**

**Chart 5.** Total Labour Costs for Sites (in descending order).

**Chart 6.** Cluster Dendrogram for Sites in Attika and the Saronic Gulf.
Chart 7. Labour Investment for Attika and the Saronic Gulf over Time.

Chart 8. Size of Workforce Mobilized for Each Site (plotted in chronological order).
Boeotia, Phokis, and Lokris


**Chart 11.** Labour Investment for Boeotia, Phokis, and Lokris over Time.

**Chart 12.** Size of Workforce Mobilized at Each Site (plotted in chronological order).
**Chart 13.** Total Labour Costs for Sites (in descending order).

**Chart 14.** Cluster Dendrogram for Sites in the Cyclades.
Chart 15. Labour Investment for the Cyclades over Time.

Chart 16. Size of Workforce Mobilized at Each Site (plotted in chronological order).
Messenia

Chart 17. Total Labour Costs for Sites (in descending order).

Chart 18. Cluster Dendrogram for Sites in Messenia.
**Chart 19.** Labour Investment for Messenia over Time.

**Chart 20.** Size of Workforce Mobilized at Each Site (plotted in chronological order).
Map 1. Distribution of sample sites across the Aegean
Map 2. Sample Site from Achaia (in bold).
Map 3. Sample sites from the Argolid (in bold).
Map 4. Sample sites from Attika and the Saronic Gulf (in bold).
Map 5. Sample sites from Boeotia, Phokis, and Lokris (in bold).
Map 6. Sample sites from the Cyclades (in bold).
Map 7. Sample sites from Messenia (in bold).
Map 8. Sample sites from Thessaly (in bold).
Figure 1. Plan of fortifications at Aegina: Kolonna, with colored sections representing the various phases of construction (after Gauss et al. 2011:77, Fig. 1.1).

Figure 2. Exposed section of City VIII fortification wall at Aegina: Kolonna, showing preserved height and style of masonry (from Walter 1983:104)
Figure 3. Plan of fortifications at Kea: Ayia Irini, showing the extant remains of the Period V circuit wall (from Davis 1986, Pl. 3).
Figure 4. Plan of fortifications at Mirou: Peristeria, showing preserved section and projected course of the wall (from Wright 1978, Pl. 7).

Figure 5. Plan of fortifications at Malthi Dorion, showing the course of the wall, the location of gates, and the main features of the settlement (after Valmin 1938).
Figure 6. Plan of fortifications walls at Vari: Kiapha Thiti, showing the excavated sections along the northeast slope of the settlement (from Hagel 1992:48).
Figure 7. The three identified building phases of the LH IIIA-B fortifications at Tiryns (after Iakovides 1983:4).
Figure 8. The three identified building phases of the LH IIIA-B fortifications at Mycenae (after Iakovides 1983:29).
Figure 9. Stretch of the North Wall at Mycenae (facing east), showing the course of the wall following the contours of the acropolis bedrock (from Rutter 2004).

Figure 10. Plan of fortifications at Krisa, showing the preserved course of the circuit wall (from Wright 1978, Pl. 9).
Figure 11. Preserved western section of fortifications at Krisa (facing southwest), showing an early form of Cyclopean construction (from Rutter 2004).
Figure 12. Plan of fortifications at Thebes, showing the LH III settlement and proposed locations for the original gates (from Symeonoglou 1985:30).
Figure 13. Lion Gate at Mycenae, showing the use of pseudo-ashlar conglomerate for the gateway and bastion (from Rutter 2004).

Figure 14. Western bastion at Tiryns, with curving staircase leading into the citadel (from Rutter 2004).
Figure 15. South Galleries at Tiryns (facing west), showing corbelled archways (from Rutter 2004).
Figure 16. Natural limestone outcroppings, located downslope from Midea acropolis (from Wright 1978, Fig. 87).

Figure 17. Eastern section of fortification wall at Midea, showing natural polyhedron block shape (from Wright 1978, Fig. 112).
Figure 18. Natural limestone outcroppings, located along the citadel slope of Gla (from Wright 1978, Fig. 87).

Figure 19. South Gate at Gla (eastern half, from interior), showing natural rectangular block shape (from Rutter 2004).
Figure 20. Section of western wall at Teichos Dymaion (from exterior), showing natural rectangular block shape (from Wright 1978, Fig. 104).

Figure 21. Plan of fortifications at Midea, showing extant course of walls (from Demakopoulou and Divari-Valakou 2010:41).
Figure 22. Plan of fortifications at Teichos Dymaion (from Wright 1978, Pl. 8).
Figure 23. Section of fortification wall at Mouriatadha: Elliniko, showing preserved height and non-Cyclopean style of masonry (from Daux 1961:707, Fig. 11).

Figure 24. Mycenaean lintel stone embedded in later Byzantine fortifications at Argos: Larissa Hill (photograph taken by author).
Figure 25. Section of preserved walling from Argos: Larissa Hill, facing north (photograph taken by author).
Figure 26. Plan of fortifications at Argos: Larissa Hill, showing preserved sections of LH IIIA-B circuit wall (from Wright 1978, Fig. 184).
Figure 27. Plan of fortifications on the Aspis of Argos, showing circuit wall enclosing the MH settlement (from Phillipa-Touchais 2010:801).
Figure 28. Plan of fortifications at Ayios Yiorgos: Brauron, showing exposed stretch of walling along NW slope (from Eustratiou 2001:23).
Figure 29. Plan of fortifications on the Acropolis of Athens, showing preserved sections and proposed course of LH IIIB circuit wall (after Iakovides 2006:110).
Figure 30. Plan of fortifications at Korphos: Kalamianos, showing observed sections and proposed course of circuit walls (from Tartaron et al. 2011:599, Fig. 28).
Figure 31. Section of exposed circuit wall at Korphos: Kalamianos (from Tartaron et al. 2011:600, Fig. 29).
Figure 32. Plan of fortifications at Gla, showing main gates and administrative complex (after Iakovides 1983:91).

Figure 33. Aerial image of fortification circuit at Gla (from http://glas-excavations.org/about.html).
Figure 34. Plan of fortifications at Phylakopi, showing preserved sections along the southern and southwestern area of the settlement (from Renfrew et al. 2007:7, Fig. 2.1).

Figure 35. Southwestern corner of fortification wall at Phylakopi (facing northeast), showing provincial style of Cyclopean masonry (from Renfrew et al. 2007, Pl. 9).
Figure 36. Plan of LH IIIC “mansion” and defense wall at Paros: Koukounaries (from Schilardi 1992:630, Pl. 3).
Figure 37. Plan of fortifications at Siphnos: Ayios Andreas, showing course of circuit wall and projecting towers (from Televantou 2001:193, Fig. 2).
Figure 38. Preserved stretch of LH I-II fortification wall at Pylos, northwest of Northeast Gateway (from Blegen and Lang 1960, Fig. 12).