Labouring with large stones: A study into the investment and impact of construction projects on Mycenaean communities in Late Bronze Age Greece

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8 Interpreting the results of a labour cost study

In the previous chapter the labour cost calculations of the fortifications at Mycenae and Teichos Dymaion were presented, as well as the building costs of domestic structures of various sizes from Mycenae and Kalamianos. In this chapter these numbers will be further evaluated. The calculation of the labour costs was not an end in and of itself, it is a means to try to understand what the impact was of taking on such building projects for the Mycenaean communities considered in this study. As such, the comparative strength of labour cost studies is utilised to show what these calculated numbers *mean* in section 8.1. Moreover, the calculated costs are evaluated by means of looking at the number of people involved and the potential number of people available at the studied sites, in section 8.2. Section 8.3 contains a broader discussion of the results in the socio-economic context of the Mycenaean world.

8.1 Comparison of labour costs

As has been pointed out in chapter 5, labour cost studies are primarily a comparative tool. In order to compare one structure or section to another, similar approaches were used for all the examined buildings, which are compared to one another here. Comparisons of the costs of various sections and structures are presented in section 8.1.1. Section 8.1.2 compares the labour investment required for the individual sub-processes, which will help to understand how these sub-processes influence the total costs and therefore what sub-processes are more expensive than others and where certain bottle-necks may be present in the process, in terms of required work-force. Finally in 8.1.3 the building *style* of the fortification is studied in terms of labour cost. By distilling a building price per set volume for various building styles, one can get a better understanding of how expensive a certain style is. This will provide some insight into whether the decision to build in a particular style should have further implications in interpreting the structures themselves in relation to concepts like conspicuous consumption (see sections 2.2.2 and 3.2).

8.1.1 Comparing the total costs.

As pointed out in chapter 7, the total cost for each of the studied fortification sections is largely dependent on the size of these sections. Similarly, the costs for the domestic structures are also tied to their size. The use of scenarios and ranges of rates resulted in ranges of labour costs for the various sections (see figure 8.1). However, to compare the actual structures, rather than arbitrary parts of structures, the labour cost calculations done for the fortification sections need to be extrapolated to include the entire (segment of the) fortification. Section 3, for example is only a 20m section of the much larger West Wall and section 4 at the same site is only one section of the North East Extension. Each of these larger segments is considered to have been built as one project (see chapter 4). In order to compare these projects to each other as well as to the domestic structures, the calculated costs should therefore be extrapolated to include the entirety of each of these projects. However, since they are built in sequence, they should be considered independent projects and the costs are therefore not extrapolated to include the entire fortification at Mycenae (as shown in chapter 4). For Teichos Dymaion, each of the sections will be extrapolated to include the entire fortification as this is considered to have been built in one phase (see also chapter 4). Moreover, the extrapolations are limited to the maximum preserved height, rather than any reconstructed height. The results of the extrapolated labour costs, based on the volume, are shown in figure 8.2.

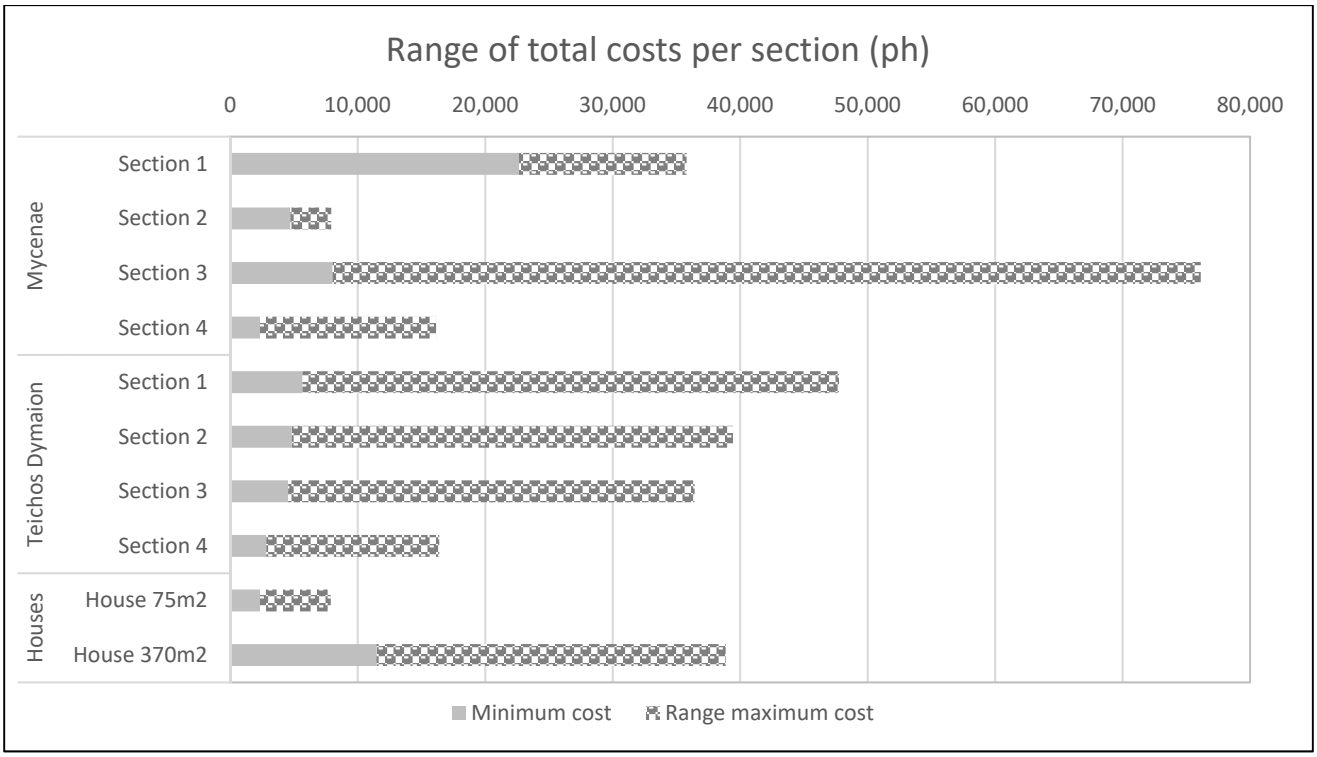

Figure 8.1 Graph of the labour costs of the sections at both sites as well as two domestic structures of 75 and 370m² respectively (graph by author). [91]

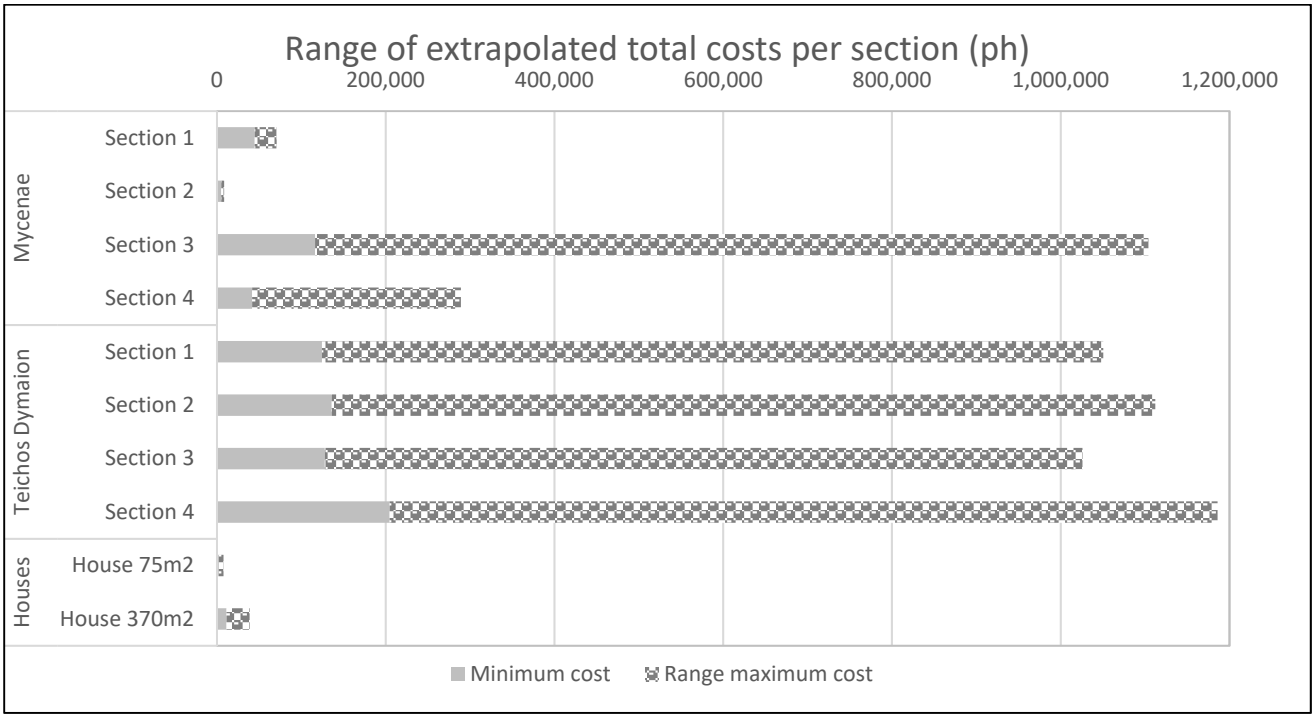

Figure 8.2 Graph of the total labour costs (as ranges) of the segments of fortifications at Mycenae and of the total fortifications based on 4 sections at Teichos Dymaion. Also the labour costs of two domestic structures of 75 and 370m² respectively (graph by author).

[91] The extrapolation is done on the basis of volume. The costs for the documented section are thus multiplied by the factor that describes the volume difference between the documented section and the (segment of the) fortification.

Based on these graphs some observations can be made:

1. In general the larger the size of the section or structure studied, the larger the range of the costs is. This is particularly noticeable when looking at sections 3 and 4 at Mycenae in figures 8.1 and 8.2. For sections 1 and 2 at Mycenae (the façades), the range of the costs is far more restricted. This is the result of the fact that for these sections there was no need to use the scenarios to reconstruct the size of the blocks, thus reducing the uncertainties.

2. The total fortifications, or complete segments of fortifications demand far more labour investment than any domestic structure, except for the façades at Mycenae (sections 1 and 2), as shown in figure 8.2. Even if one would take the average costs of the larger sections of fortifications (which would be about 600,000ph for section 3 at Mycenae and the entire fortification at Teichos Dymaion), rather than the extreme values of the range, the investment for the fortifications would still be many times that of a domestic structure (see also below).

3. The cost of the façades at Mycenae, despite being labour intensive due to the dressing of the blocks and the source of material being further away than for the other sections at Mycenae, is only a fraction of the cost of the larger cyclopean-style sections (see figure 8.2).

4. The cost of the entire fortification at Teichos Dymaion is comparable to the investment required for the West Wall at Mycenae.

5. The large range of the costs is not just due to the use of ranges of rates, but also due to the used scenarios; the block sizes therefore have a noteworthy effect on the labour costs. This, in combination with extrapolating the calculations to larger entities, result in variations visible in the results for Teichos Dymaion where the costs of each section is extrapolated to include the entire fortification and thus the same total volume. However, each of these extrapolations show different final costs. The small variations and the stacking of assumptions in the calculations for each section results in the shown differences for the total costs.

Regardless of any secondary function the fortifications may have had (see chapter 3), a fortification wall is used to enclose a certain area. It is therefore, informative to also look at the calculated costs in relation to the size of the area the (segments of) fortifications enclose. Since sections 1 and 2 at Mycenae are façades, these are not considered here. Rather the focus is on sections 3 (West Wall) and 4 (North East Extension) at Mycenae and the fortification at Teichos Dymaion as a whole, which enclose areas of 600, 11,000 and 8,000m^2 respectively (see chapter 4). If the costs of these *entire* sections are then divided by the area they encompass, the cost of the fortification per square metre area fortified is the result (see table 8.1). This comparison thus says something about the *efficiency* of the fortification in terms of enclosing an area.

The results show that the West Wall (section 3) at Mycenae, in terms of efficient fortifying an area, is the least expensive section. Following closely, is the cost per fortified area of the fortification at Teichos Dymaion, while the North East Extension (section 4) at Mycenae is much more expensive. This shows that fortifying small areas is much costlier and there must have been a very specific reason to extend the fortified area at Mycenae for a relatively high price. If this extension was to

secure a water source, through the use of the cistern (see 4.1.2), this would be a strong argument for a military reason for constructing such fortifications.

Table 8.1 Overview of the minimum and maximum cost of the fortification per square metre fortified.

Cost of fortification in ph/m^2 fortified.	Mycenae		Teichos Dymaion
	Section 3	Section 4	Total fortification (average)
	ph/m^2	ph/m^2	ph/m^2
Min	10.6	69.8	18.5
Max	100.4	482.0	136.7

Considering that most houses from the Mycenaean period have a ground surface area of between 50 – 100m^2 (Tartaron et al. 2011: 589; see also 6.5) a comparison with the costs for a, hypothetical, 75m^2 house is justifiable. A house of this size costs between 2,333 and 7,889ph with an average of 4,905ph. This means that for the same kind of labour investment that it took to construct the West Wall, between 50 and 473 houses (using the lowest value) or between 15 and 140 houses (using the highest value) could be built. Alternatively, assuming that a mix of houses was built of this size and the average cost of 4,905ph is used, between 24 and 225 houses could be constructed. There are other house sizes as well though. It has also been commented that 75% of all Mycenaean houses are smaller than 200m^2 (Tartaron et al. 2011: 589). The costs for a house of that size (200m^2) is between 6,228 and 21,044ph, with an average of 13,087ph. Taking these costs, between 9 and 84 houses (using the average cost) could be built for the same investment as the entire West Wall. Table 8.2 gives an overview of the amount of houses that could be built of a specific size for the same investment as was required for the sections at Mycenae and the fortification at Teichos Dymaion (considered to be built in one phase). The examples of domestic structures used in chapter 7, House 7-X from Kalamianos and the West House from Mycenae, correspond with the second size category and the final size category in the table, respectively.

Table 8.2 Overview of the amount of houses that could be built for the same investment as some of the (sections of the) fortifications. In the case of 'sections', the labour costs are extrapolated to include the entire section, rather than just the documented part of it. The average cost per house is taken for each size category to allow for a variety of houses of that size to be built.

Cost of houses		**Number of houses built**									
Surface area (m2)	Average total cost	North Gate		Lion Gate		West Wall		NE extension		Teichos Dymaion	
		min	max	min	max	min	max	min	max	min	max
75	4,905	1	2	9	14	24	225	9	59	25	242
110	7,201	1	1	6	10	16	153	6	40	17	165
160	10,468	0	1	4	7	11	105	4	28	12	113
200	13,087	0	1	3	5	9	84	3	22	10	91
250	16,354	0	1	3	4	7	68	3	18	8	73
300	19,620	0	0	2	4	6	56	2	15	6	60
370	24,151	0	0	2	3	5	46	2	12	5	49

From the table it is clear that when the *scale* (the size, in this case the volume) of the fortifications, or sections thereof, is considered, they are indeed expensive. The façade at the Lion Gate is, due to its limited size, not as expensive as one might have thought based on the elaborate dressing involved (see also section 8.1.3). The larger West Wall at Mycenae and the entire stretch of the wall at Teichos

Dymaion show that their size means that it requires quite an investment, compared to ordinary houses. An average of ± 130 of the smallest (but most common) houses could be built for the investment of these fortifications.[92]

8.1.2 Magnitude of the sub-processes.

To gain a better understanding of the building processes, a comparison is made between the processes in relation to the total cost of each of the studied structures. This is summarised in figure 8.3 below. In this graph, the *average* cost for each process is used and expressed as a percentage of the total to be able to better compare the results. Using averages completely ignores the ranges that exist in the calculated costs due to the use of various rates and scenarios. In the graph in figure 8.4 the actual ranges of the costs of each process and section are therefore shown. They show (1) the impact that each process has on the total cost of each section (as the graph with the average values does) and (2) the large range that exists for some processes.

Immediately a few things stand out from the graphs in figure 8.3 and 8.4. First, the distinct position the conglomerate façade at Mycenae (sections 1 and 2) takes in terms of the spread of the cost over its processes is obvious. Not only are these the only sections that include dressing of the blocks, but it takes up a large amount of the total costs as well (between 37 – 57%). Yet, the assembly, which is the most expensive process for the other sections, only makes up about 15% for the façades.

The differences between the sections built in limestone at both sites are minimal and mostly due to size differences. This is, for example, visible in the influence of the ramp on the total costs. For each section one ramp was assumed of the same size and the *absolute* costs of the ramps is thus the same. However, the sections are of varying sizes, so the *relative* costs (or percentage of the cost of the ramp) vary depending on the total cost of the section. This is clearly visible in figure 8.4. The part of the bar representing the ramp (green) is very small for section 3 at Mycenae, but far larger for section 4 at the same site. The reason is, as mentioned above, that section 3 is a very large section (costing 43,398ph, average), while section 4 is much smaller (8,920ph, average). However, the cost for a three-meter high ramp is for both sections 1,089ph and thus a much larger part of the total cost for section 4 than for section 3.[93] Obviously it can be questioned whether a single ramp would suffice for the larger section, but one should remember that this larger section is still only roughly 20m long.[94]

The same issue with the relative costs for ramps also goes for the levelling costs, at least for some sections. For instance, the Lion Gate (section 1) is preserved to a much higher level than the North Gate (section 2). The relative costs for levelling are thus higher for the North Gate than for the Lion Gate. Moreover, the influence of the transport costs on the overall total depends on the assumed distance that is travelled. As this distance is largest for the conglomerate façades at Mycenae, these form a larger percentage of the costs. If, for example, a distance of 1,000m instead of 100m is assumed as the distance for the transport at Teichos Dymaion, the costs of this step increases by a

[92] 125 and 133 are the average values for West Wall and Teichos Dymaion, respectively.

[93] For the building of ramps, only 2 scenarios are used: one where the transport is done by humans and one, which involves oxen transport. The average cost of these two methods for a 3m high ramp is 1089ph.

[94] One ramp is considered per *documented* section. This is smaller than the actual wall section, as described in chapter 4. This means that for the extrapolated costs, the costs for additional ramps are also included.

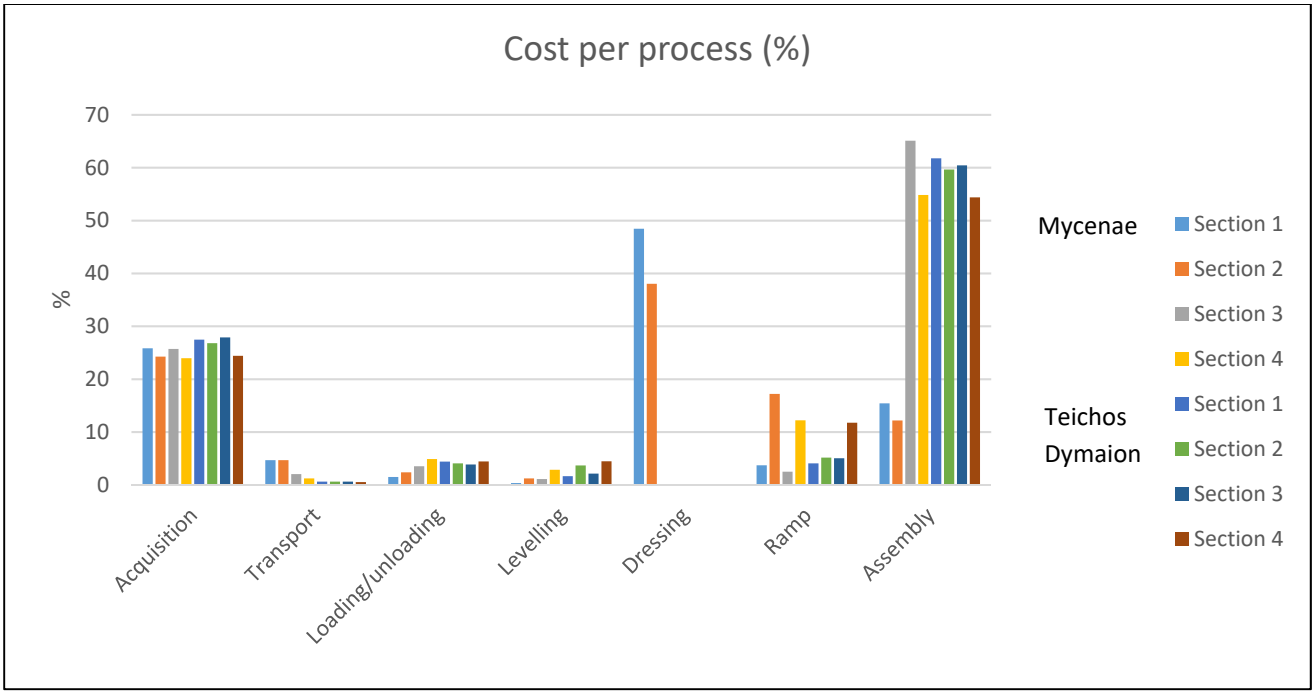

Figure 8.3. Graph of the cost per sub-building process as percentage of the total cost per section (graph by author).

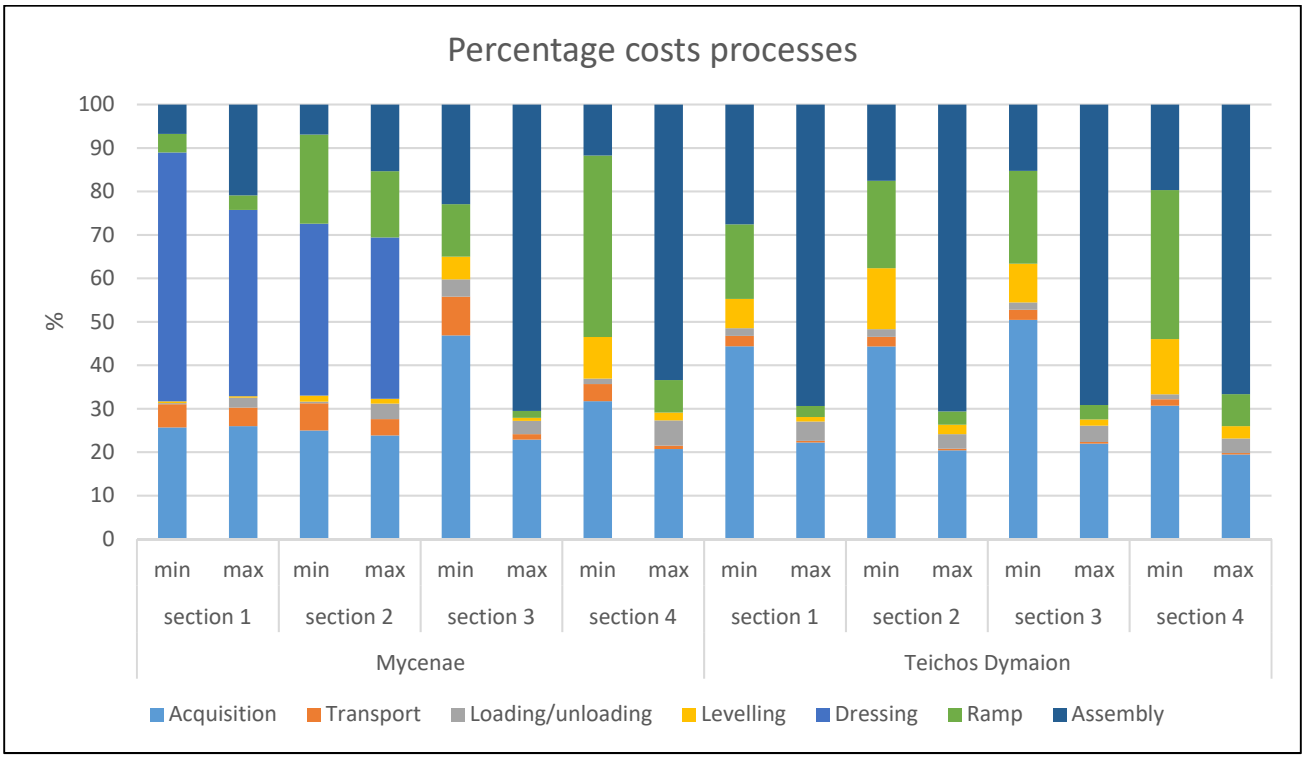

Figure 8.4 Overview of the costs of each of the processes as a percentage of the total costs of each studied section. For each section the scenario that provided the minimum total costs and the scenario that provided the maximum total costs are shown (graph by author).

factor 10 and this would, for section 1 at that site, increase the transport cost from 0.6% to about 18% of the total cost. Another factor is the maximum weight allowed per trip. As argued in chapters 3 and 7, it is assumed that this maximum was quite high, up to 10 tonnes (although most loads are

considered up to 5 tonnes). In comparison, Devolder (2013) and Harper (2016) only allow loads up to 2,100kg. Therefore, in their studies transport represents a far higher percentage of the total costs. In general, though, it is clear from this study that acquisition and assembly are the most costly steps in the building process of the limestone walls. As figure 8.4 shows, the range for the assembly is very large, which means that in those instances where a low rate is considered for the assembly, the second most expensive process (acquisition), whose range is slightly less, but whose overall cost is still significant for the total costs, thus takes up a much larger part of those total costs. In the graph in figure 8.3, which uses the averages, these variations are less extreme. This has to do with the fact that for the assembly process three sets of rates are considered (see chapter 7). Two of these sets are relatively close together, whereas the third (in which the rate is determined by attempting to consider the cost for each sub-process of the assembly separately), is much lower. In the average costs for each section, these lower figures are therefore only marginally taken on board, as they are, in a way, outliers. Another noteworthy detail in figure 8.4 is that for most processes the range for the conglomerate façades at Mycenae (sections 1 and 2 at that site) is quite small. The cause of this is the lack of the use of scenarios for reconstructing the depth of the blocks at these sections. This means that there is a lot less uncertainty and therefore less variety and smaller ranges. The largest varieties for these façade sections are in the processes of dressing and assembly. For both these processes, this has to do with the relatively large variance in the used work rates.

8.1.3 Comparison of the investment per cubic metre.

Similar approaches and parameters were used in the calculations of the various sections. However, because these sections have different dimensions, comparing the values presented in chapter 7 shows mostly the difference in *scale* and thus allows the comparison between buildings themselves (see 8.1.1). By calculating the average cost per cubic meter for each of the sections something can be said about *the way* something was built and thus what the costs were of using certain methods. It says therefore more about the *activity*, and the cost of a building style. This is particularly interesting in light of Pausanias' descriptions about the construction in cyclopean style (see chapter 3). He mentioned that the blocks are so heavy that a lot of force is required. This also implies the difficulties imagined for building in such a style. Therefore, by calculating the costs per cubic metre for the cyclopean-style sections, the conglomerate façades and the rubble/mudbrick construction (used in the domestic structures), the price for each of these building methods can be evaluated. The result for the fortifications is shown in table 8.3.

The most notable feature is the fact that the conglomerate façades (Mycenae sections 1 and 2) are much more expensive per cubic metre to build than the cyclopean-style walls. This underlines the idea that these façades were a special feature and therefore only used at specific, very visible, locations (see chapter 3). Other than that, the cost per cubic metre is quite similar for the various sections, as is to be expected, considering the fact that the same rates and assumptions are used for all of them although the costs for section 4 (especially the minimum costs) at both Mycenae and Teichos Dymaion are higher. This is because these are both relatively small sections, yet some costs (the ramps) are considered the same for all sections (see also section 8.1.2 above). The costs are then divided over the total volume which means that for smaller sections the costs per cubic metre is higher.

Table 8.3 Simplifying the cost of the studied sections to a cost per cubic meter to make the results comparable. All costs are in person-hours (ph). The size factor *shows by what number the costs of the documented part are multiplied to come to the total cost of a particular section. For example, the documented part of section 3 at Mycenae is part of a larger section (the so-called West Wall), which is 14,5 times larger than the documented section.*

		Mycenae				**Teichos Dymaion**			
		Section 1	Section 2	Section 3	Section 4	Section 1	Section 2	Section 3	Section 4
Total (ph)	**min**	22,652	4,729	8,028	2,340	5,663	4,826	4,544	2,832
	max	35,809	7,925	76,142	16,155	47,752	39,441	36,427	16,407
Size factor		1.98	1.1	14.5	17.9	1.1	2	1.6	5.2
Total (ph)	**min**	44,851	5,202	116,399	41,882	6,229	9,651	7,271	14,728
	max	70,902	8,717	1,104,056	289,175	52,527	78,882	58,283	85,318
Volume (m^3)		469	52	17,357	4,409	784	1,117	894	1,134
Cost/m3 (ph)	***min***	95.7	99.5	6.7	9.5	7.9	8.6	8.1	13.0
	max	151.2	166.7	63.6	65.6	67.0	70.7	65.2	75.2

In comparison, the domestic structures cost between 11.3 and 19.1 ph per cubic meter. Of course the volume of the houses involves a lot of non-built space (the rooms themselves) so the actual cost per cubic meter of *construction* is higher (22.9 – 39.9 ph/m^3).[95] This may seem counter intuitive, in that the costs then become more comparable to the large fortifications (see also figure 8.5). However, it must be noted that (1) the construction of houses involves certain very labour intensive tasks (e.g. mudbricks, making wooden roofs) and (2) the *total* costs of the fortifications were many times those of houses due to the enormity of the walls themselves (see 8.1.1). Thus, the results of comparing the cost per cubic meter between houses and the fortifications should be interpreted carefully. As mentioned above this difference has to do with the fact that the price per cubic meter says something about *the way* something was built and thus what the costs were of using certain methods. It says therefore more about the *activity*, while the total costs inform about *scale*.

Based on the cost per cubic metre (see again, figure 8.5 above) it can be stated that building with larger material might require some extra effort, but depending on the used strategy and the build-up of the wall (especially the fill), it may not be so expensive as perhaps assumed beforehand, based on Pausanias' description. Of course, building with larger material does require more people to be present at the same time to deal with the larger weight. In contrast, building with dressed blocks requires a far larger investment per cubic metre than building with cyclopean-style stonework or constructing domestic buildings. This is partly due, in this case, to the difference in quarry technique, but mostly to the dressing of the blocks (see also above 8.1.2).

Two things are thus clear from the calculated cost in figure 8.5. The first one is that the chosen building style for the fortifications (cyclopean) did in and of itself not necessarily make the structures inconceivably expensive, in comparison to the cost/m^3 of a house. The second thing that is clear is that the conglomerate façades, present at the Lion- and North Gates at Mycenae, are expensive elaborations. The fact that the façades are, on top of that, structurally unnecessary, makes them an interesting investment.

[95] The difference is due to the used volume: for the first range (11.3 – 19.1ph/m^3) the volume is taken as the total volume of the house as a cube (surface area x total height). The second range (22.9 – 39.9ph/m^3) is the result of adding up the volume of all the individual materials used in the construction. This second method thus represents the actual built volume better and because it is a smaller volume, the cost per cubic metre is higher.

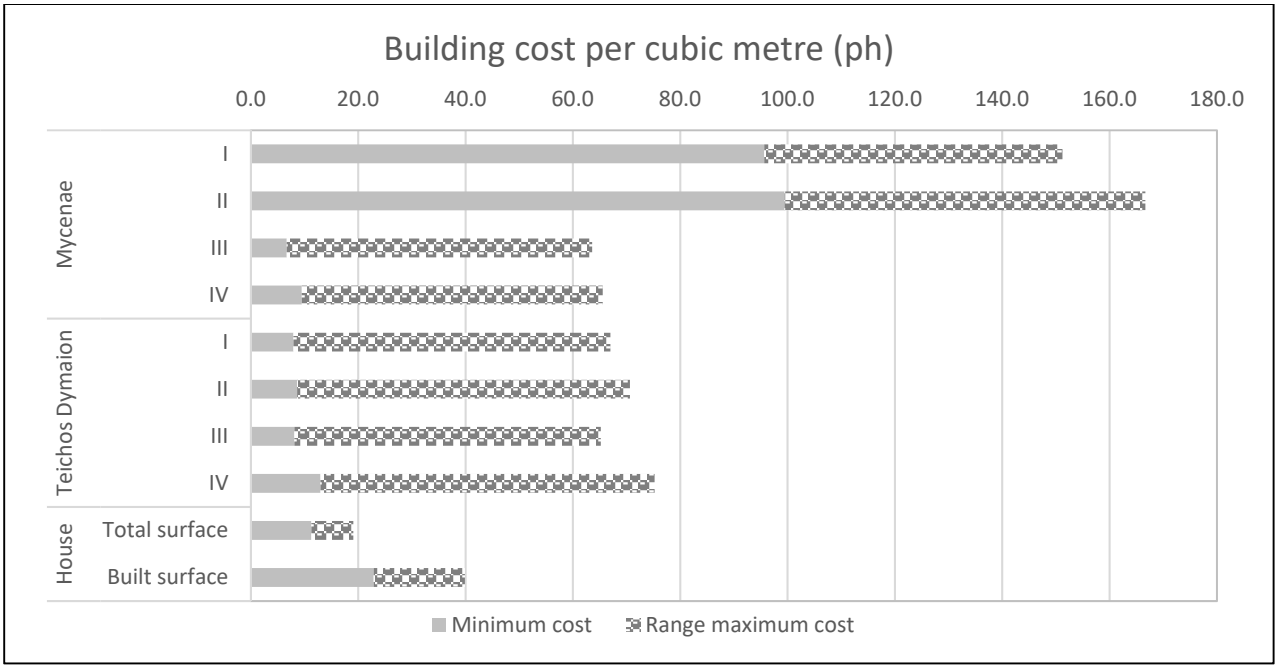

Figure 8.5 Cost per cubic metre of the various sections and the domestic structures (graph by author).

8.2 Implications of the calculated labour costs on communities

In the previous section the labour costs were compared to each other, between sections, between steps in the building process, and with the cost of building houses. The latter was used to put the cost of the fortification walls in perspective, since a list of numbers in and of itself says very little. In the following section the labour costs of the fortifications will be put in other perspectives. Firstly, an attempt is made to see how long these building projects may have taken and how large a part of the population may have been involved. Based on these analyses it is evaluated what impact the construction of the fortifications may have had on the communities in which they were built.

8.2.1 The duration of the building projects.

In order to gain insight into the organisation of large complex construction projects, it is helpful to study the length of the project as well as the number of people involved. To do so, a number of assumptions will need to be made: first of all, the length of a workday and the number of people *available* for construction projects (the potential workforce). These factors are related in terms of the project's duration (see figure 8.6 below).

A variety of lengths for workdays is used in the literature. Erasmus (1965: 283), describes that workers in Latin America, generally start early and work until the heat of midday, covering about 5 hours. He (1965: 283) writes that "most writers" (not specified) apply an 8-hour workday, but that this can be somewhat ethnocentric. DeLaine (1997: 106), on the other hand, assumes a 12-hour workday, which includes 2 hours for breaks and thus works with 10 effective hours per day. She bases this on descriptions about this subject by Pegoretti (I: 13), De Marchi (*Cave*: 12-13), Columella (*RR* 11.2.90-91) and Hurst (1905), mostly founded on the idea that people worked from dusk till dawn, which would be about 12 hours in summer. Burford (1969: 247), de Haan (2009: 3) and Abrams and Bolland (1999: 264–5) argue that heavy work may perhaps only be sustained for 5

hours/day, although they use 8-hour workdays. There is thus a range of 5 – 10 hours of work per day to work with.

When considering the duration of a, potentially, long-term project, it might be more telling to consider the number of years it takes, rather than days. It is extremely difficult to say anything definitive about how many days a year it is realistic to assume people may have worked, in general, but in particular on these kind of communal building projects. Often cited in this case is DeLaine's (1997: 105) figure of 220 days per year. She (1997: 106) mentions though, that for some work, "outside the building site, such as the working of stone and timber, and for quarrying around Rome" 290 days per year are more likely. The number of days per year is limited by extreme heat, other weather conditions, which would also apply to the Greek context and specific Roman "holidays" (DeLaine 1997: 106). The latter might be particularly relevant in Rome itself and therefore influence the construction, but whether Mycenae, or in broader sense, the Mycenaean communities, had a similar concept of having days off that could influence the construction is hard to say.[96] More importantly it is impossible to say *how many* of such days would be realistic. Another issue is whether people and animals were available all year, even if weather and cultural obligations allowed. This depends on whether workforce is seen as a temporary force, who would normally work the fields, herd cattle or have other day jobs. In which case, their normal jobs might require a certain amount of time each year as well (during harvest season, for example, but see also above and Timonen in prep.). If a range of 220 – 290 days is taken for construction, then the number of years it took can be determined (see table 8.4). Figure 8.6 gives an impression of the effect the number of people and the hours per workday have on the duration of the building project. Obviously, with 5-hour workdays the construction takes twice as long as with 10-hour workdays. Moreover, with twice as many people the construction takes half the time. That is why the decrease in construction time is larger at the lower number of workers, while this decrease becomes less with more workers, but will obviously never reach zero. Additionally, this does not take into account the actual efficiency of an increased workforce: there is only limited space, so there is a maximum number of people that could work simultaneously. Within the parameters of this research it is not possible to ascertain this maximum. Nevertheless, the graph does show how difficult is to determine the length of the project as it is very challenging to determine the amount of people working on the project.

Table 8.4 Overview of the amount of time, in years, it would take to build each section with the results taken from table 8.5. The minimum values thus represent 10-hour workdays and 500 workers, the maximum values comprise 5-hour workdays and 200 workers (see for a discussion on the number of workers section 8.2.2).

	Mycenae				Teichos Dymaion - total fortification			
	Section1	*Section2*	*Section3*	*Section4*	*Section1*	*Section2*	*Section3*	*Section4*
min. days	12	4	126	32	117	119	122	134
max. days	58	18	629	160	586	594	608	669
number of years								
220 days/year	0.05	0.02	0.57	0.15	0.53	0.54	0.55	0.61
	0.26	0.08	2.86	0.73	2.67	2.70	2.76	3.04
290 days/year	0.04	0.01	0.43	0.11	0.40	0.41	0.42	0.46
	0.20	0.06	2.17	0.55	2.02	2.05	2.10	2.31

[96] There are indications that there were religious festivals, which also included communal feasting (see 2.3.4).

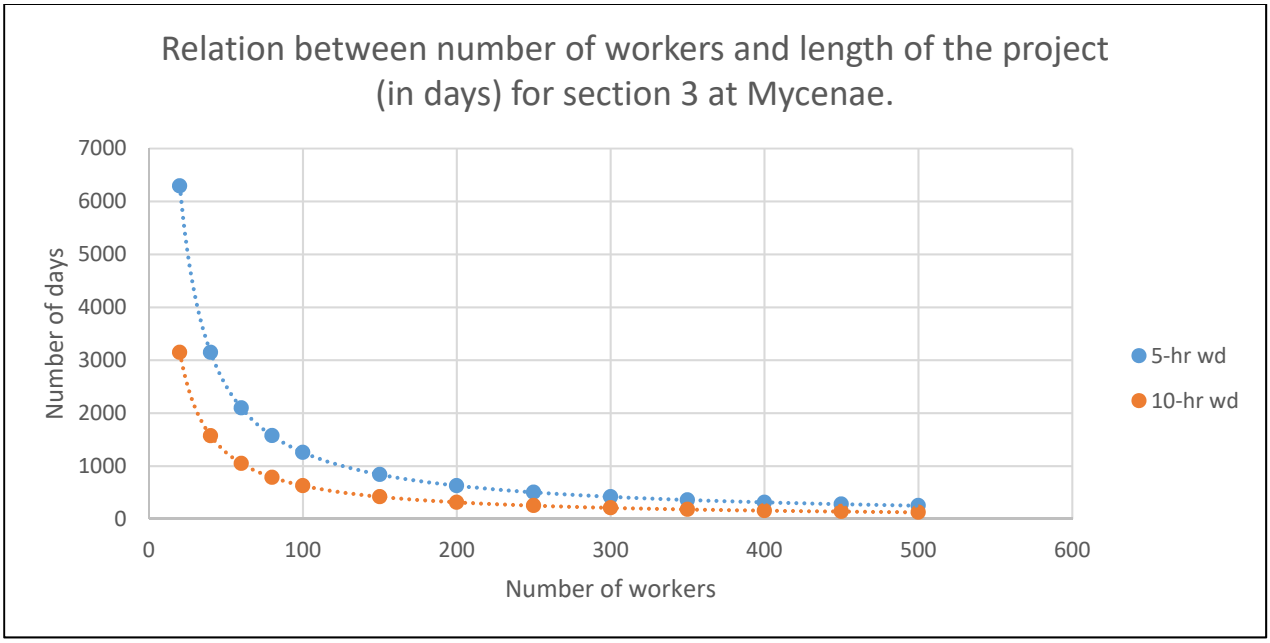

Figure 8.6 Graph of the relation between the number of workers and the amount of time (days) it would take to build section 3 (West Wall) at Mycenae (graph by author).

In order to understand whether the estimated amount of time to complete the fortifications should be considered long, it is useful to compare it to the duration of the construction of the domestic structures. The domestic structures are of a much smaller scale, and it would be strange to expect hundreds of people involved in the construction of a single house. If similar workdays are assumed for the construction of houses (5-10 hours per day), the amount of person-hours can be converted to workdays. Subsequently, if a range of 20 – 33% of the population is *potentially* involved in construction, as suggested by Abrams (Abrams 1987: 493; see also 8.2.2), and 5 – 15 people are assumed per house (see below), this would mean that between 1 (20% of 5) and 5 (33% of 15) people would be involved in the construction. This allows to make an estimate of the amount of time it took to build a house (see table 8.5). In this example it is assumed that a household is responsible for building its own house. If, however, it is assumed that also domestic structures were built in a more communal way, e.g. with an extended family, neighbours or other external people *not* living in the house, the building time can be cut dramatically (see bottom part of the table). The latter seems to be more on par with what Harper (2016: 461) assumes for the construction of the houses at Kalamianos. He assumes a build-time of 90 days, with a varying number of people (up to 31) at any point. He estimates that house to cost 5,930ph (2016: 436), so it is in a similar range.

Thus, besides the higher costs of the fortifications in comparison to domestic structures, there was also a much higher degree of organisation required for the construction of the fortification walls (see also 8.2.4). Moreover, due to the limited number of people involved in the construction of the houses, they take quite some time to be built. As such, the estimated number of days it took 10 – 30 people to build a 75m^2 house may have been similar as the number of days it may have taken to build sections 1, 2 or 4 at Mycenae (although more people were used at those sections). Building a house should therefore perhaps also not be seen as a small task.

Table 8.5 Amount of days required to build a house, based on the described parameters. If Abrams' figures were used for calculating the pool of people from which the larger group of workers came in the bottom part of the table, this would result in a range of 30-50, 60-100 and 90-150 people respectively.

Houses	*Average* house	
ph	4905	
	5hr wd	10hr wd
workdays	981	491
5 people/house - 20 %	981	491
5 people/house - 33 %	491	245
15 people/house - 20 %	327	164
15 people/house - 33 %	196	98
Larger group of people		
10 people building	98	49
20 people building	49	25
30 people building	33	16

8.2.2 The number of people involved in construction.

The second issue to resolve is the number of people involved in the project. The number of people required for the various processes discussed in this study are based on the required *force*. For some rates that are used it is assumed that a certain expertise was present. Whether this expertise was locally available or had to be brought in, is not taken into account here.

Brysbaert (2013: 82, 2015b: 98) uses 100-people strong "work gangs" for translating her calculated labour costs (in man-days) into a period of time over which the construction took place and how large a part of the population was required. For most of the tasks as described in this study, 100 people will suffice, although for some of the heavier blocks in the cyclopean-style walls up to 120 are required.[97] However, assuming that only 100 people would be working on these walls at the same time means that when it came to handling these larger blocks all other activities would have to be put on hold. That is even without taking into account the heaviest blocks used at the Lion Gate, which required between 276 (Lion relief) and 479 (lintel) people to put into place. These are obviously extremes and for most other sections there is no need for that excessive amount of people at any one moment, but it shows that 100 people as a *total* workforce, however useful to calculate with, is not realistic.[98]

Assuming too large a workforce though, would also cause potential issues. Due to the close proximity of the quarries, the transportation takes relatively little time. Supply of material is therefore almost immediate and too much material piled up at the building site could potentially be problematic. Perhaps a 200-strong workforce might be suitable for most sections. Moreover, the sections at Mycenae were not built at the same time, so there may also not be a need for an enormous amount

[97] The number of people needed are calculated based on the same parameters used in chapter 7 in terms of strength per person, slope of ramp (if used) and a friction coefficient for moving blocks over the ground. The large group of people will have had to use ropes in order to be able to work together on moving single blocks.
[98] This was also not what Brysbaert intended, however, it is used here as an example of possible sizes of workforces and how these influence the organisation and duration of the building process.

of people. If a maximum workforce of 200 (for most sections) – 500 (for specific segments as described above) people is assumed for Mycenae, the maximum required people at any one moment are covered and, for most of the time, most of the activities could happen side by side, if needed. The latter is also important to keep into account, as some activities cannot happen simultaneously, whereas others are required to be done at the same time. The site preparation obviously needed to be done *before* assembly could begin, just as the acquisition of material had to begin before the assembly. Yet, the acquisition also had to continue during the assembly to keep up the supply of material, without cluttering the building site. Thus, if *at least* 100 – 120 people are required for the assembly alone, a total workforce of 200 would allow additional people be involved in the quarrying and transportation of the material.

It needs to be verified if the range of 200 – 500 people required for the construction of the fortification, is realistic in relation to the available workforce. This depends on the population size at both sites and what part of those populations might be considered part of the *potential* workforce. After all, for a small population 200 – 500 people might be a substantial part. Moreover, the very young and the very old might not have been part of the (potential) workforce. Brysbaert (2013: 82) for example argues that her 100 men workforce comprises 8% of the "active workforce", of a total population of 4900. This means that the total active workforce is ¼ of the population.[99] This is based on the assumption that only adult men were involved in the building process and that adult males form one quarter of the population (DeLaine 1997: 201). DeLaine further specifies that *if* the male population is considered the potential workforce and *if* this can be considered a quarter of the population, *then* the builders would "represent some 15-24% of these". However, for some subsidiary tasks that were physically less demanding, DeLaine (1997: 202) also considers that women and children might have been involved. This would thus, for some tasks at least, increase the potential workforce beyond the suggested 25% of the *total* population.

Abrams (1987: 493) assumes, for his case-study in the Americas, that 20% (adult males or household heads) to 33% (adult males as well as some females and sub-adult males) of the population may have formed the pool from which labourers were drawn.[100] In his labour cost analysis of a structure (10L-22) at Copan, Honduras, the labourers only comprised 9.3% of the potential workforce and the full-time "specialists" only 1% (Abrams 1987: 493). Abrams' 9.3% is not unlike Brysbaert's 8% suggested workforce of 100 people (but see footnote 99 for potential issues with this number). However, as pointed out above, a workforce of 100 people seems too low from a practical and logistical point of view. Nevertheless, there are thus two important considerations: (1) of the total population there is

[99] 100 men forming 8% of the workforce, means that the total workforce is 1250 people. This is a bit over 25% of 4900. This population number is based on the idea that the site is 24.5ha and has a population density of 200 p/ha. As shown in 4.3 this density seems unrealistic. Moreover, it seems that Tiryns reached this size in LH IIIC and it was smaller in LH IIIB (Maran 2010: 730). If, Whitelaw (2001:29, fig 2.10), is correct in stating that Tiryns was more likely to be around 18ha and the population size is calculated according to the method of Hanson and Ortman, the total population would be 1990 people. Following Brysbaert's and Delaine's argument that the active workforce comprised 25% of the population, then the 100 men workforce actually comprises about 20.1% of the active workforce, rather than 8%. Even if Tiryns is 24.5ha, the population would more realistically be about 3004 people based on Hanson and Ortman, which would mean that the 100 people be 13.3% of the active workforce (if the latter is taken as 25% of the total population).

[100] Unlike Fotou (2016: 78) states, this does not refer to construction of their own dwelling, but rather communal building activities, ordered by (an) elite(s).

a certain percentage that forms the overall *potential workforce* and (2) of that potential workforce there is a percentage that may have worked in construction. This is an important consideration, as those people in the potential workforce would also have to cover all other types of work, like food production. Subsequently, it means that if a large part of the *potential workforce* was working on other tasks than construction most of the time (estimates for food production range from 160 – 240 days per year (e.g. Timonen & Brysbaert, n.d. in prep.)), this obviously limits the possible labour pool for the construction work. It may, therefore, not be strange to consider that only up to about 10% of the potential workforce (which would mean 2 – 3.3% of the *total* population if Abrams' 20-33% range is used) may have been involved in construction. This is slightly lower than DeLaine's (1997: 201) figure of 4 – 6% of the *total* population being involved in construction work. This means that substantial populations must have existed at Mycenae and Teichos Dymaion, if a 200 – 500-strong construction workforce is required (see table 8.6).

Table 8.6 Overview of the workforce and population sizes when the above-described percentages are used. In the calculation of the population based on the potential workforce, the construction *workforce is taken as 10% of the* potential *workforce.*

Workforce in construction	Percentage potential workforce of total population	Population		Percentage of total population	Population
200	20	10,000		4	5,000
200	33	6,000		6	3,333
500	20	25,000		4	12,500
500	33	15,000		6	8,333

However, a different approach might be taken here as well. Perhaps it could be argued that a smaller group of people worked on the construction *full-time* and additional workers were drawn from the larger *potential workforce* pool (not unlike Abrams' (1987: 493) suggestion for construction work organisation). These additional workers would then rotate shifts and work, as it were, *part-time*. This could be either segments of workdays or a number of days per larger time unit (week/month/year). This way, even smaller communities could potentially provide larger construction labour pools, without necessarily encroaching on other, essential work. In table 8.7, below, an overview is provided what amount of extra people would be required, based on the population numbers provided in section 4.3 and the percentages of potential workforce as presented above, if a total construction force of 200 people is required and the construction force is taken as a fixed part of the population.

Table 8.7 Overview of the extra people required to get to 200 construction workers, based on various population estimates and potential workforce estimates. It shows that if the above described parameters are taken into account, what percentage of the potential workforce (top) or total population (bottom) is required on top *of the assumed percentage of that group involved in the construction. It is meant to show how realistic a 200 people strong workforce is dependent on the variables discussed.*

Calculations below based on the idea that the construction force is a fixed percentage of the potential workforce.				
Mycenae				
Population	Percentage potential workforce of total population (%)	Construction workforce (as 10% of the potential workforce) (# people)	Required extra people from potential workforce (# people)	Required extra people as % of potential workforce
6,400	20	128	72	6
6,400	33	213	0	0
4,291	20	86	114	13
4,291	33	143	57	7
2,120	20	42	158	37
2,120	33	71	129	31
Teichos Dymaion				
980	20	20	180	92
980	33	33	167	85
350	20	7	193	276
350	33	12	188	269
359	20	7	193	269
359	33	12	188	262
Calculations below based on the idea that the construction force is a fixed percentage of the total population				
Mycenae				
Population	Construction force as percentage of total population (%)	Construction force (# people)	Required extra people from potential workforce (# people)	Required extra people as % of potential workforce
6,400	4	256	0	0
6,400	6	384	0	0
4,291	4	172	28	0.7
4,291	6	257	0	0
2,120	4	85	115	5.4
2,120	6	127	73	3.4
Teichos Dymaion				
980	4	39	161	16
980	6	59	141	14
350	4	14	186	53
350	6	21	179	51
359	4	14	186	52
359	6	22	178	50

This shows the above-described approach might work for Mycenae if the population figure of 4,291 is considered (see section 4.3). Although it may seem that only for one scenario (construction force as 6% of the total population) the desired 200 construction workers is reached, in the other scenarios for this population figure it only takes 0.7% of the total population or between 7 – 13% of the *potential* workforce, to step in to reach 200 people. These may be acceptable figures if the above-described rotational, part-time approach is used. However, for Teichos Dymaion this is a different matter. With its estimated population of about 350 (see section 4.3), reaching 200 workers is nearly impossible as that makes up 57% of the *total* population. Thus, for Teichos Dymaion either the population was a lot bigger than estimated, or a large part of the construction workers came from elsewhere. The latter seems more likely, since even with an increased population of about 980 people (if 200 people/ha is used as a population density, see section 4.3), an additional 14 – 16% of the *total population* would have been required to reach that 200 people (see table 8.7 above). This also shows that a construction force of 500 people is out of the question for Teichos Dymaion, unless these are *all* brought in from beyond the settlement itself. For Mycenae a workforce of 500 people would bring some serious pressure on the *potential* workforce as it would require an additional 42 – 48% of that pool (assuming a population size of 4,291 people), or an additional 5.7 – 7.7% of the *total population*. Perhaps, such a construction force was manageable for short periods (for only putting in the largest blocks of the Lion Gate) if organised purely locally, or even for longer periods if extra workers were brought in from outside Mycenae itself. The results of using a larger 500 people strong construction force is thus taken into account in the results below, but it is important to note that this would thus mean that the project was most likely (and for Teichos Dymaion, definitively) not a *local*, but a *regional* project. The results of these assumptions are shown in table 8.8 for all sections.

Table 8.8 Overview of the amount of time it would take a set number of people to build the fortifications. 'wd' stands for workday. Note that for Teichos Dymaion the costs of the individual sections are extrapolated to the entire fortification. The total costs for the fortifications at this site are therefore one *of the results from the sections, and should not be added up. For Mycenae each section is considered a separate project and the costs are thus separate investments.*

	Mycenae				Teichos Dymaion - total fortification			
Average values / section	*Section1*	*Section2*	*Section3*	*Section4*	*Section1*	*Section2*	*Section3*	*Section4*
Total (average) cost of complete section	57,876	17,589	629,263	159,668	586,499	594,106	607,996	669,359
number of 5hr wd	11,575	3,518	125,853	31,934	117,300	118,821	121,599	133,872
number of 10hr wd	5,788	1,759	62,926	15,967	58,650	59,411	60,800	66,936
Number of days								
5hr wd / 200 people	58	18	629	160	586	594	608	669
5hr wd / 500 people	23	7	252	64	235	238	243	268
10hr wd / 200 people	29	9	315	80	293	297	304	335
10hr wd / 500 people	12	4	126	32	117	119	122	134

To put the numbers of the potential workforce above in further perspective, it is worthwhile to study how many people could be housed for the same investment that the fortifications require. This way, something can also be said about how many people potentially could be affected by this level of investment. The number of people per house is difficult to ascertain, however various researchers have made estimates from 5 (Gallant, 1991), 5 – 7 (Bogaard et al. 2009: 566; Hansen 2006: 60;

Hanson and Ortman 2017: 308) to up to 10 – 15 people (Knappett 2009: 18),[101] and everything in between, based on the size of the house (e.g. Casselberry, 1974; Cook & Heizer, 1968; Naroll, 1962).[102] Thus, using a range of 5 – 15 people per 75m^2 house (and note that 15 should be considered a high maximum), and using the number of houses that could be built for the same investment as the sections of fortifications studied at the sites, it can be estimated how many people could potentially be housed for that same investment.

Thus, if the average of 130 houses that could be built for the same investment as the West Wall (section 3) at Mycenae or the entire fortification at Teichos Dymaion (see 8.1.1), is taken as an example, these would house, on average, between 650 – 1950 people for the same labour investment required for that fortification wall. If the minimum and maximum number of houses were considered (rather than the average 130; see table 8.2), the range would be far greater (see table 8.9).

Table 8.9 The number of people that could be housed, based on the minimum and maximum costs of each section of fortification, the number of houses that could be constructed for that investment (table 8.2) and the number of people per house.

Section	Number of people housed	
	min	**max**
Lion Gate	45	217
North Gate	5	27
West Wall	119	3376
North East Extension	43	884
Teichos Dymaion	127	3627

8.2.3 The impact of building

The numbers presented in the previous section provide an opportunity to make some statements about the potential impact that the construction of the large fortification walls may have had on the communities that built them.

For Mycenae, the impact seems to be manageable. Since the sections studied in this research were built in succession, rather than simultaneously, their potential effect should also be considered independently. In chronological order, it is section 3 (West Wall), sections 1 and 2 (Lion and North Gates) and finally section 4 (North East extension) (see also chapter 4). The West Wall is the largest section studied and thus required the largest investment. It took between 0.43 and 2.86 years (126 – 629 days) to build, depending on the amount of workdays per year, amount of hours per day and the size of the workforce (see table 8.8 and figure 8.6). If only a workforce of 200 people is considered, it would take between 1.09 – 2.86 years. This seems more realistic, since even considering the larger

[101] Knappett mentions 100-150 people "..composed of c. 10 extended families..". Which implies 10-15 people/family.

[102] A house with a 75m^2 footprint, has 46.5m^2 of floor space. Using the formulas by Casselberry (P = 1/6 x F), Naroll (P = 1/10 x F) or Cook and Heizer (1.9m^2/person for the first 6 people and 9.3m^2 for any additional person), the number of people per house would be 8 – 16 (Casselberry), 5 – 10 (Naroll) and 10 – 15 (Cook and Heizer), depending on whether there was a second storey with the same floor space as the ground floor. In the formulas P stands for population and F for the floor space in square metres.

population at Mycenae, a workforce of 500 people might be too large (see 8.2.2). If, as suggested in chapter 2, construction work such as this was ordered by some sort of elite and was executed through corvée, it means that these people had other *regular jobs* as well. Depending on how much time these *jobs* required that could not be missed (e.g. during harvest time, see Timonen and Brysbaert in prep.), this might influence the amount of time that could be spent on the construction work. This can on one hand lengthen the total construction time, and on the other hand put more pressure on the potential workforce pool. As pointed out in chapters 2 and 4, the population figures used are based on the urban population *only*. Additional people from the rural hinterland, could increase the size of the labour pool, decreasing the pressure of the construction projects. However, as mentioned in previous chapters, it is beyond the scope of this study to reconstruct the rural population.

Sections 1 and 2 are much smaller and as such require a lot less investment, in absolute costs. Section 1 (the Lion Gate) would take between 0.04 – 0.26 years (12 – 58 days) and section 2 (the North Gate) 0.01 – 0.08 years (4 – 18 days), depending on the same parameters as mentioned above. As described earlier, a work force of 500 might well be too large, although in the case of the Lion Gate, required. It thus seems that the higher end of the range for the time to build these sections might be more realistic (0.10 – 0.26 years for the Lion Gate and 0.03 – 0.08 years for the North Gate with 200 people). This would require a short-term influx of workers when the largest blocks of the Lion Gate had to be put in place (see 7.6). The overall building time would make that the construction should not be an issue, even when the construction crew also performed other jobs. Despite the fact that it is an expensive building *method* (see 8.1.3), the absolute costs seem manageable. Please note, though, that the costs presented here only cover the façades.

The final section at Mycenae, section 4 (the North East extension), sits in between the gates and the West Wall in terms of required investment. Based on the same parameters as above, it takes between 0.11 and 0.73 years (32 – 160 days) to construct. If only 200 people are considered as a workforce, it would take between 0.28 and 0.73 years. With the same factors taken into account for the other sections at Mycenae, this does not seem a problematic investment. It also shows that only the West Wall took longer than one year to construct, whereas the other sections were potentially built in less than a year. Moreover, the required workforce to do it in the timeframes constructed here, does not seem problematic for the 200-strong workforce and such a group might point to the construction of the fortification as a local endeavour.

For Teichos Dymaion the results are similar, with some subtle, yet crucial differences. First, it takes longer to build the fortification (it is slightly larger than the West Wall at Mycenae), between 0.4 and 3 years (117 – 669 days). This is based on the same parameters as used for Mycenae. However, as shown above, a 500-person workforce is too large for the assumed population at Teichos Dymaion. Even the hypothesis of 200 people would require additional people from beyond the site itself. Hence, the amount of time it took to construct the fortification will be towards the higher end of the range (between 1 and 3 years with 200 people). Besides the project itself taking longer, the limited amount of people in the potential workforce suggests such a venture had a larger impact. In effect, the fortification at Teichos Dymaion was thus *relatively* a larger investment than the fortification at Mycenae. If the population size at Teichos Dymaion is within the range as postulated here (around 350 people, see 4.3), and the amount of time is acceptable, then the construction of the fortification at this site is, at the very least, a *regional* undertaking.

One thing that must be emphasized once more, is that the calculated costs and the subsequent estimated length of the building projects are a direct result of the choices made in this study. While an attempt is made to reduce the effect of these choices, by using ranges, multiple rates and a variety of scenarios, it cannot be avoided. Furthermore, some factors have not been taken into account in the current calculations. For example, the clay that may have been used in the cyclopean-style walls (see also chapter 3), is not taken into consideration. This is partly due to the unknown extent to which it was used and how it was applied. If it was used, then it definitely would have resulted in an increase in labour costs. Moreover, the choice to calculate the labour cost mostly based on the required force, particularly for transport, loading/unloading and to some degree the assembly as well, means that the resulting costs are a minimum based on maximum efficiency. It does not, for example, take into account small breaks between jobs, or people idling due to delays in previous steps in the process. This would most definitely have happened, which increases the time required and thus the labour costs. Factors like these would have influenced the calculated required investment, it is, however, very difficult to assess to what extent. Nevertheless, these results say something about the *scale* of the required investment, and, as such, help evaluate if the communities could have supported these kinds of investments.

8.2.4 Implications for management and organisation

Unlike the relatively small groups of people required for the construction of *ordinary* domestic structures, the large(r) groups necessary for the fortifications need more organisation and a certain amount of power is essential to mobilise this number of people. Considering the difference in status that existed in Mycenaean society between people (see chapter 2), an elite would likely have enough power to order or initiate the construction of these larger construction projects. If, for example, construction work was organised through corvée (see 2.3.1), people were simply drafted for the work for a certain amount of time or (part of) a project. This corvée work should be seen as a "direct 'tax' on communities", which in turn was most likely tied to landholding (Nakassis 2010: 273; see also 2.3.1).

If instead, people were *hired* for this work, quite decent amounts of supplies (likely staple goods) would have to be saved up in order to pay the workers (Nakassis 2010: 273). Crop failures could have potentially made the construction endeavours more problematic in those cases. For both methods (corvée labour and hiring workers) it is important to realise that the Mycenaean society had a strong hierarchical character (see chapter 2) and the palatial elites had a control over the population and parts of the economy. This has been used to suggest that the mobilisation of workforces was an important part of how the elites governed (see 2.2 and 2.3). Hence, the organisation of a workforce for the construction of the fortifications may very well be an extension of this control.

As proposed above, the current figures indicate that these projects were likely regional in nature. It is thus interesting to question to what degree elites controlled surrounding territories and whether they could muster construction crews from further away. If the mobilisation of labour was indeed for an important part tied to landholding, the influence of the elites would need to reach far to be able to conscript enough workers. As shown in 2.3.1, there are indications on some Pylos Linear B tablets (the so-called "Ac records"), that there were people recruited from various "taxation districts" (Killen 2006: 77). This could indicate that people were drafted from a larger region than just the citadel of Pylos itself. Moreover, it can be imagined that not just unskilled workers were brought in from

beyond the community itself, but also expertise may have been acquired from further away or even shared between the various citadels. This can be the result of hiring experts like masons or perhaps experienced overseers from other places. In the Near East and Egypt there are texts that describe that certain experts were send to friendly rulers as gifts or on loan for a project (see 2.3.3; information derived from tablets such as the Amarna letters (e.g. Monroe 2011: 93; Burns 2010: 18; 2016: 90; Pullen 2016: 81)).

As described in chapter 3 there are some differences in style between the fortifications in this period, but these seem to be mostly due to local geological circumstances. As it seems that at most sites the stone material is quarried locally, the limestone beds dictate a lot in terms of the shape of the used blocks (see also chapters 3 and 4). Thus, the overall *style* of large, mostly unworked, blocks with smaller stones in between is applied in many regions regardless of the specific local geological circumstances. Moreover, as shown in 8.1.3 (in particular figure 8.5), the estimated cost per cubic metre is very similar for the two case studies, despite the fact that on average the blocks are (slightly) larger at Mycenae than at Teichos Dymaion (see chapter 6). Expertise in the *general* building style and organisation of the required workforce could therefore have been applied everywhere. Considering this, as well as the necessity to bring in workers from outside the community, these building projects should be viewed as regional, or at least not solely local, ventures.

Another factor in terms of organising labour forces is the subject of supervision. Other labour cost studies such as those by DeLaine (1997: studying the baths of Caracalla in Rome, Italy) and Abrams (1987: studying buildings in Classical Copan, Honduras) have also tried to take such skilled or supervision tasks on board in their calculations. DeLaine (1997: 268), basing herself on Pegoretti's (1869) building manual, assumed a 10% skilled and/or supervisory task as an addition to the labour force. Subsequent labour cost studies like those by Pakkanen (2013) and Brysbaert (2015) used DeLaine's ratio as well. Abrams (1987: 492), however assumed a much lower portion of the labour force for supervision, of only 3%. As described in section 2.3.1, there are Pylos Linear B tablets concerned with a number of different specialties associated with construction labour (e.g. Nakassis 2010: 275). One of these, the so-called *all-builder*, has been interpreted as some sort of foreman or master builder (Nakassis 2010: 275). On the tablet containing this inscription, this *all-builder* is mentioned alongside 20 *wall-builders* (interpreted as unskilled labourers) and 5 *sawyers* (Nakassis 2010: 275). If this would be the work crew for a certain project, it means that one supervisor had 25 workers, which would mean that this supervisor only comprised 4% of the workforce. There is thus quite some discrepancy between the possible impact of supervision on the overall labour costs.

If supervision and/or expertise was to be taken into account, it would be safest to add it to the total costs, rather than to each individual step. Not only would it result in the same increase, but also it would allow for the theoretical variation of the amount of supervision required for each individual step in the construction process. After all, some tasks might require more supervision or a higher percentage of skilled workers than others. The addition of any percentage, however, remains a guess. As pointed out in section 8.2.2, it has been attempted to calculate the labour costs, mostly, based on the required force, which means certain things are omitted from the calculations. Considering the potential impact as described in this chapter, adding a hypothetical percentage for supervision (which was surely part of these building projects) would not alter these interpretations, only perhaps some of the numbers themselves.

Besides the organisation of the human labour, the organisation of the oxen in the transport of the material to the building site should also be considered. The use of oxen for this type of work has been well attested for Classical times in Greece (see e.g. Burford, 1960, 1963, 1969; see also 3.4.2) and it has been assumed to be similar for the Mycenaean era as well . In Classical times it were farmers who owned the oxen and did this transport work on the side (Burford, 1969). In Mycenaean times, the elites owned oxen, which they sometimes loaned out for agricultural work (e.g. Killen 1998: 20; Lupack 2011: 214). So the question then rises whether the elites owned enough oxen to cover all the required traction for the transport, or did others outside the palace also own oxen, which they may have lent/rented to the palatial elites during such construction projects? As pointed out in chapter 2, our knowledge from the Linear B tablets is limited, but gives rise to the belief that the palace controlled a restricted set of precious goods which fuelled the palatial economy. Livestock, including oxen, seem to have been also directly owned (but not only) by the palace (Halstead 1992: 60). If the elites indeed controlled most, if not all, oxen, then allocating them for construction work may have been straightforward, as long as it did not interfere with any requirements of the beasts in agricultural settings, which would likely trump the construction work.

8.3 Discussion

As described in section 3.3, the building *style* of the studied fortifications is called *cyclopean*. This name refers back to the ancient myths in which the mighty one-eyed giants, called cyclops, built these walls. Although this is obviously considered a myth today, the name stuck and is still widely used today. Considering the analyses presented in the dissertation, it may be possible to say something about whether the costs (rather than the required force to lift a stone as the myth refers to) involved with building the fortifications are truly *gigantic*.

In section 8.1.3 above it has been shown that as a building *style*, cyclopean construction is not necessarily more expensive than other studied styles, based on the calculated labour cost per cubic metre. In comparison, the cost for the used building styles for domestic structures (a combination of rubble and mudbrick) falls within the same range, albeit with fewer extremes and a somewhat lower overall (average) cost. In contrast, the pseudo-ashlar (see chapter 3) style of the conglomerate façades at the Lion- and North Gates at Mycenae is much more expensive (see again section 8.1.3). These results show that indeed a building *style* can influence the labour costs, but that the *cyclopean style* is not overly expensive.

As structures of formidable size, the *fortifications* themselves do end up requiring quite an investment to be built. Although the costs per cubic metre might not, on average, differ dramatically from that of domestic structures, due to their much larger size, the fortifications as a whole cost a lot more than houses. As shown in section 8.1.1 depending on the size of the section of the fortification that is used for comparison, numerous houses could be constructed for the same investment. If these numbers are taken a bit further by using estimates of the number of inhabitants per house, it shows that large parts of the population could be housed for the same expenditure as some sections of the fortifications. This is especially the case for Teichos Dymaion, where the estimations show that the costs for the fortification *exceeds* the costs for building the required number of houses to accommodate the entire (projected) population.

The analyses in section 8.1.2 show that the steps in the building process that are taken into consideration for the labour cost calculations, have varying effects on the total labour costs. First, for

those sections that dressing is taken into account (sections 1 and 2 at Mycenae), it is shown that this is a very laborious activity. The fact that it is used sparingly shows the conscious decision to only use this elaboration at specific locations.

Secondly, for the cyclopean style sections, the quarrying and assembly steps are the most expensive (see figure 8.4). Depending on the scenario used for reconstructing the volume of the blocks, one or the other is the most expensive. This has to do with the fact that in the scenarios in which the maximum total cost is reached the volume of the blocks is larger and thus the costs for the assembly are larger as well. This is because the assembly costs are directly related to the size of the blocks. Hence, the stone size is certainly of influence on the labour costs. Moreover, the fact that some scenarios were usable for Mycenae, but not for Teichos Dymaion shows that there is a different ratio between the surface area and the depth of the blocks for both sites. This has most likely to do with the shape of the blocks, which are more or less boulder-like for Mycenae and slab-like for Teichos Dymaion. This difference has been dealt with by the various scenarios. However, a more thorough study into the actual size of the blocks would therefore be welcome to be able to create an even more nuanced idea about the actual costs of the construction of the fortifications.

Thirdly, it is shown that the size of the documented section has a direct influence on the effect that individual steps in the building process have on the total costs. This is, however, also the effect of the assumptions made by the author to generalize certain steps. The first of those is to begin with calculating the labour costs based on the *preserved* section and use one ramp per such section. Since the sections are of varying size, the fixed cost of a ramp thus has a greater influence on a small section than it has on a large section. Moreover, the cost of levelling is also relatively higher for sections that have a smaller preserved height, as the cost of levelling is taken per ground surface area of the wall, regardless of height.

In line with this though, it is more economic to fortify larger areas than small ones, as shown in 8.1.1. The cost per fortified area is larger for a small section like section 4 at Mycenae than it is for the larger areas fortified by section 3 at Mycenae or the fortification at Teichos Dymaion. One thing to take into account though, is that for sections 3 and 4 at Mycenae the earlier fortification wall that was present near these locations is not taken into account in the building costs. While there were extra costs involved with breaking down the earlier wall, the available material could be used in the new walls. By doing so the costs of transport and quarrying would be reduced. In particular having to quarry less material could have a significant impact on the total labour costs (as shown above). This might alter the cost per area for section 4.

Since the fortifications are expensive in comparison to other structures (houses), it should be explored what this signifies. In this light it might be worthwhile to consider the monumentality of the fortifications. As discussed in section 3.2, there are two reasons for considering this: (1) what influence the monumental status might have for interpreting the fortifications and (2) how the calculated costs may say something about this monumental status.

If monumental constructions are considered a form of conspicuous consumption this may provide further insights into the construction of these fortifications. The higher cost of the pseudo-ashlar style of the façades is a good example of this. First, it is important to realize that the calculated costs cover the façade only, the actual wall it covers is not considered in the costs. Secondly, the choice to only put this type of façade in place at the two gates (thus not counting the two small entrances at

the North East Extension), indicates that it is a way to show off the façades. Moreover, if the higher investment that this type of construction requires and the lack of a structural need for the façades are taken into account, it seems logical to place them in highly visible locations. Considering the features of monumentality as described by Trigger (1990; see 3.2), in particular the elaboration of a structure without structural need, the façades fit the description perfectly. Furthermore, they could thus be seen as a form of conspicuous consumption (see 2.2.2 and 3.2) and as such, the façades are used to show, and perhaps gain, power by flaunting the ability to build such elaborations. This style of building should thus indeed be labelled as monumental or monumentalizing. At the very least it can be stated that the elaborations in the form of the façades are not necessary for the primary function of the fortification (protection) as the less expensive cyclopean style was sufficient for that at all other sections of the fortification. This latter point also shows that there was a conscious decision for "economizing", or a form of efficiency in the building process (see also section 5.1.2). This thus fits very well with Trigger's considerations of building processes in which he argues people will take the course that takes the least effort (Trigger 1990: 123; see also section 3.2).

Additionally, the differences between the cyclopean style sections and the façades may indicate that the cyclopean style itself, was not seen as a monumental, or special, style. This is corroborated by the fact that from a labour cost perspective the cyclopean style is not overly expensive. That being said, the total required investment for the cyclopean style fortifications are large; some sections of fortifications (or in the case of Teichos Dymaion, the entire fortification) might be over 400 times more expensive than a single house (see 8.1.1). This comparison certainly provided the scale to put the calculated costs on (see 3.2), and as such one could argue that the fortifications as a whole were monumental. However, such a statement should be further corroborated by researching a larger sample of structures that provided a more diverse range than just two (fortifications and domestic structures).

As discussed in section 3.1 the military nature (their primary function) of the constructions is well established. In light of the discussion on conspicuous consumption, a secondary function of conveying messages as suggested by Maran (2006: 79; see also section 3.2) should also be considered. If the façades (which certainly should) and the fortifications as a whole (which might) are considered monumental and this was taken as an argument that these constructions were indeed a form of conspicuous consumption, then it should be considered what this secondary function signifies. First, if the fortifications were built to counter an imminent (external) threat, there would have been no (structural) need to elaborate the fortifications in the way they were. Second, it would suggest that there was an ongoing need for the elites to keep displaying their wealth (and with that, their power) to stay in control. Clearly though, this could be done in such a way that a very specific use of conspicuous consumption (the façades) was sufficient. If that is the case, however, what does this mean for Teichos Dymaion, where no such elaborations were found? This may signify a number of things; first, it is indeed the façades that are an elaboration and the cyclopean style was not considered an elaborate way of construction. Second, such elaborations where only worthy of palatial sites.

The first conclusion has already been discussed above. The second conclusion shows once more the limitations of what is known about Achaea as a Mycenaean region. Should in the light of these results, Teichos Dymaion be seen as an outpost of a palatial centre elsewhere in Achaea? Or was it a safe haven for the surrounding region, simply built in the style common in the period? While it lacks

the, as above described, monumentalizing elements, these are lacking in most other Mycenaean fortifications. Moreover, the required investment for the fortification itself is still impressive and for a purely military function, a less massive wall would possibly suffice. Hence, to be able to be more conclusive about the status and function of Teichos Dymaion, a more thorough study of the region itself is needed. Furthermore, a more diversified study of Mycenaean fortifications including smaller (e.g. Tiryns) as well as larger (e.g. Gla) samples, could provide an even more balanced view on the labour costs of fortifications in general.

Finally, as pointed out above, the fortifications were a large undertaking when compared to the construction of domestic buildings and this difference would be even larger if the task of supervision and the use of skilled workers were also taken into account (see 8.2.2 and 8.2.4). This is confirmed when the population estimates are taken into account as well. Although it is important to acknowledge that these conclusions are based on various estimates that each have difficulties in terms of reliability, their consistent use throughout the analyses makes that their relative values are functional. It is thus important to put the labour costs in context of the Mycenaean social and economic situation.

As discussed in chapter 2, various means may have been employed by people or groups of people to gain influence over others. The existence of this social stratification within Mycenaean society is an important feature of how the large buildings are interpreted. First of all, it was the elites that ordered the construction of the fortifications and organised the required workforce. As pointed out in section 2.3.1, there is evidence from the Linear B tablets that labour was organised by the palatial elite for various tasks, amongst which, construction work (Nakassis 2010: 277). Moreover, it was also described that the mobilisation of such workforces seemed to have been part of a form of tax collection by the palatial elites, likely tied to landholding (e.g. Killen 2008: 463; Nakassis 2010: 273). It is slightly more complicated to determine who ends up performing this form of corvée labour, since Killen (1998: 21) has pointed out that from the Linear B tablets it is clear that those who could hold land were all tied to the palace. Yet, it is difficult to assume that it was the elite that performed the actual construction work. It is therefore, more likely that these elites' subservient people executed the work. However, two other parties seem to have been able to hold land: sanctuaries and the *damos* (e.g. Lupack 2011; see also chapter 2). Based on Linear B tablets, both parties also paid taxes to the palace. From this it might follow that the *damos* might also have paid taxes in the form of workers for palatial driven projects. To what degree these people might also be specialists (like architects or builders) is unclear. As discussed in 8.2.2 these might be brought in from elsewhere for their expertise, or they may have been local specialists.

The social stratification, as mentioned above, also influenced the economic system of Mycenaean society. This system can be best described as a political economy, as described in chapter 2. This means that goods and labour are directed at creating "wealth and to finance institutions of rule" (Earle 2002: 1). As described above the palatial influence allowed the elites to collect taxes not just in the form of goods but also in the form of workforces. However, it has also been pointed out that this palatial system heavily depended on the production of surpluses of subsistence goods. Hence, overtaxing the people producing these by forcing them to perform labour other than farming or herding would potentially disrupt the flow of surplus products to the palace and as such undermine the stability of the hierarchical structure. Certainly, if at the same time other aspects of the economy that were important, such as trade also reduced in profits, serious harm could have been done to the

economic system. Moreover, the trading of goods is only possible if primary goods, as produced by farming and herding, are kept up being produced in sufficient numbers. The calculated labour costs and the associated required workforce are therefore aimed at taking into account what part of the overall workforce at the communities are needed to actually construct the fortifications (8.2). This has shown that the local potential workforce at Mycenae might have been sufficient, but at Teichos Dymaion people would have had to be brought in from beyond the community itself. How this may have affected the need for additional subsistence goods, though, is not taken into account.

The inclusion of the Peloponnese in Mediterranean-wide exchange networks (see 2.3.3), has arguably had a positive effect on its economy (e.g. Sherratt 2017: 608, 613). However, as Sherratt (2017, 602) points out that in a 'globalized' (Mediterranean) world, individual localities are linked and local events shape, and are shaped by, events occurring in other, sometimes faraway, localities. Furthermore, she argues that the reason for peoples to search for such connections comes from the desire to acquire previously unknown materials and/or products (Sherratt 2017: 603). Eventually, the exchange network changed, due to the divergence (or lack thereof) of exchanged materials and the change of routes. These might undercut certain nodes in the network with varying effects. The possible effects from events outside of the Peloponnese have not been taken into proper account here. However taking the results from this study it is possible to put these in a Mediterranean, rather than a Peloponnesian, context, in a future study.

The question remains whether the impact of these investments would have been enough to drain the economic resources to such a degree to disrupt the way of life at the end of the Mycenaean period. The palaces were surely able to draft people from beyond the citadel sites themselves and even with a (relatively) limited amount of people, these fortifications could be constructed. Even though they might still be considered large undertakings, especially in comparison to other types of constructions, like houses, it seems to have been within the capabilities of the communities to carry these burdens. This is somewhat more difficult to assess for Teichos Dymaion, as less is known about the region and its possible connection to an actual palatial site (see chapter 4). As pointed out, the population of the rural hinterland of the settlements is not taken into account. These people may have been a serious addition to the potential labour force of both settlements and thus further limiting the effect the construction of the fortifications may have had on the communities. Further studies into reliable reconstructions of the rural populations would add greatly to the interpretations of this study.

The assumption that the communities at the citadels (and beyond) could carry the burdens of the constructions is based on a secondary assumption: that no other (large) disruptions of any kind were taking place around the same time. If there was indeed the threat of, or actual, war combined with circumstances that put pressure on the economic system (as discussed in chapter 2 and above) due to draughts and/or changes to the exchange network(s), on top of the elaborate building programmes, it might pose a credible threat to a stable society. However, as shown in section 2.4, there is no definitive proof for any of these possibilities. It is, therefore, perhaps best to follow Deger-Jalkotzy (2008: 392) in concluding that many factors probably had an influence, and that internal factors (like straining the local economies by taking on these large building programmes) laid the groundwork for a destabilisation of the Mycenaean communities, which were therefore weakened after which further complications of any kind could be enough to bring about this final "collapse" (see also Bennet, 2013; Middleton, 2010). The construction of the fortifications on their

own and focussing on a Peloponnesian context, though, does not seem to have been the (immediate) cause for the large-scale decline at Mycenaean settlements.

8.4 Concluding remarks

In this chapter the calculated labour costs, as presented in chapter 7, were analysed. This was done through various comparisons, which show that various characteristics of the fortification walls have diverse effects on the required investments. Furthermore, it has been shown that the cyclopean style of construction is not an overly expensive style, while the conglomerate façade is. The latter is clearly an elaborate adornment placed in very visible locations. However, due to the sheer size of the fortifications they are serious investments, this is underlined by comparing these investments to the expenditure required for domestic structures. Finally, these results were analysed in connection to the Mycenaean social and economic structure, in which these fortifications were built. In the concluding chapter the final thoughts on the topic will be presented, the research questions, as introduced in chapter 1, will be answered and ideas for future research will be shared.