

Chapter 4

The Topography of the Piraean Shipsheds

This chapter discusses the topographical arrangement of shipshed groups within the harbour environments of Zea and Mounichia (Figs. 3, 21). The topography of the shipsheds at Kantharos is also discussed, but because of the limited evidence, a topographical reconstruction of this harbour is not attempted in the present study.

The individual groups are defined by all the structural remains (recorded shipsheds including possible shipsheds and possible slipways) that have roughly the same orientation in a given area of each harbour. The widths of the individual groups are based on the measured (Groups 1 and 2 at Zea) and estimated (all other groups) total length of shoreline that these structures occupy. It is important to point out that there are in all probability more than one building phase within each group and that some structures are likely to be the remains of slipways, as seen in Group 1 of Zea Harbour (Area 1; Pls. 40–42). Although the submerged parallel structures documented by earlier researchers along the shorelines of Zea and Mounichia (see Sections 3.1.1–3.1.2 and below) probably belong to shipsheds and slipways, it must be stressed that most of the structures are not identified as shipsheds and slipways according to the terminology used in the present study (see Chapter 1.2). These structures could also belong to other harbour installations or they may be quarries. As a result, the widths presented here are approximations only.

At Zea, the estimated number of shipsheds within a given group is based on the average interaxial spacing between the load-bearing elements of the superstructures in Area 1: 6.50 m (Phase 2: 6.48 m and Phase 3: 6.51 m).¹ At Mounichia, the number of shipsheds within a given group is based on an interaxial spacing of 6.25 m.² In the topographical reconstruction of Zea Harbour (Fig. 3) and Mounichia Harbour (Fig. 21) the single-unit shipsheds (designed to store one ship) are tentatively reconstructed to a length of about 50 m based on the measurements of Groups 1 and 7 at Mounichia; this length is also supported by the length extrapolations of the Phase 1 slipways and Phase 3 shipsheds to the hypothetical *maximum* sea level

1. See pp. 101–103, 116. Rounding all numbers down (10.92 = 10).

2. See p. 51.

change of -2.90 m (see Chapters 8.1.1, 8.2.1, 8.2.3; Pl. 43).³ The double-unit shipsheds (designed to store two ships, one in front of the other) are based on the reconstructed *maximum* length of 88.98 m of the Phase 3 shipsheds in Area 1 at Zea (pp. 159–162).

4.1. The Topography of the Zea Shipsheds

The shipshed complexes in Zea Harbour have been subdivided into five groups labelled Groups 1–5 and abbreviated Z-G1 (Zea, shipshed Group 1) to Z-G5 (Fig. 3). The investigations of Area 1 within Group 1 (Fig. 2) have provided detailed evidence of the architecture of the slipways and shipsheds, and the topographical layout of the shipsheds (see below and Chapters 5–8).⁴ It is important to stress that although some archaeological remains are discernible, the orientation (with the exception of Groups 2–3 and 5), size (except Group 2 and to some extent Group 3) and position of Groups 2–5 in Fig. 3 are hypothetical: their discussion here is to provide a rudimentary schematic of the topographical layout of the shipshed complexes at Zea.

In order to discuss the topography of ancient Zea, analysis of the two most important sources on this subject, the publications of Graser and von Alten, must be made.

Graser, 1872

Graser's 1872 publication contains no maps but does include a highly-descriptive text.⁵ In his table, Graser sorts, in ascending order, the structures he interprets as shipsheds in Zea and Mounichia by the free space (“width of the open bedding”) between two *wangen* (literally “cheeks” or “jowls”, but also meaning “lateral structures/walls/side-walls”) which he recognises as the structures delineating one shipshed.⁶ Graser recorded the ancient remains from left to right facing the harbour basin.⁷ When his data are sorted numerically using his Roman numeral system, it also becomes apparent that he systematically surveyed Zea counter-clockwise, starting on the southeast side, proceeding to the northeast and northwest sides, and ending on the southwest side of the harbour (Vol. I.2, Appendix 1). In Graser's table, the Roman numerals in the first column represent what he identifies as shipsheds, the sec-

ond names the harbour, the third the compass direction, the fourth the width between the two structures (*wangen*) identified as delineating one shipshed, and the fifth column indicates the width of the two structures in question. The sixth and final column gives the “maximum width of a ship without an oar-box” that could be housed in the shipshed according to Graser's reconstructed dimensions of ancient warships.⁸

It must be stressed that the ‘shipsheds’ mentioned by Graser cannot be positively identified as shipsheds according to terminology used in this study (see Chapter 1.2), and when his identifications are listed here, for example shipshed XXI, it is possible that the structures in question could be ‘slipways’ or the remains of other structures.

Graser recorded 40 possible shipsheds in Zea: 13 on the southeastern and eastern side, six on the northeastern side, six on the northwestern side and 15 on the western side. It appears that Graser lost track of where and in which of the harbours he recorded shipshed XXXXIX (Vol. I.2, Appendix 1). Shipsheds XXXXVII and XXXXVIII are also listed with question marks in his table, but Graser mentions them in the main text as found in the western part of Zea.⁹ In addition to the 40 possible shipsheds, he also mentions a total of at least 27 unidentified structures also called *wangen*: eight on the eastern side, two on the northeastern side, three on the northern side, seven on the northwestern side and seven on the western side of the harbour.¹⁰ Graser

3. See pp. 46, 50. A measurement also supported by the total length of shipshed 4 at Carthage (45 m) and the excavated length of the Oiniadaí shipsheds (48 m). Scaled from Hurst 1979: fig. 1; Sears 1904: pl. IX.

4. The Zea Harbour map in Figs. 2–3 was commissioned by Marina Zeas A/S in 2003. Greek Geodetic Reference System (G.G.R.S. 1987). B.A. Barshefsky was responsible for the survey, and the present author wishes to thank Marina Zeas A/S for making this valuable map available to the ZHP. This map is hereafter referred to as ‘Marina Zeas map (2003)’.

5. See also Chapter 3.1.1, p. 17.

6. Graser 1872: table following page 65, “Breite der bettung im lichten”. Graser does not capitalise nouns in his text.

7. Graser 1872: 62.

8. Graser 1872: 22, table following page 65, “Grösste breite des schiffs ohne πάροδος”.

9. Graser 1872: 51, table following page 65.

10. Graser 1872: 45–51. In the eastern part the ‘double-block’ (page 47) is counted as one structure; Graser mentions ten *wangen* on the

estimates that one quarter of the 196 shipsheds listed in the 330/29 BC Naval Inventories were preserved at Zea.¹¹

As mentioned in Chapter 1.3, Graser was the first researcher to record the gradient of these structures.¹² As the gradient is an important element in the identification of a shipshed or a slipway, many of the structures he recorded were most likely remains of these building types. Graser's investigations have proven very important because they demonstrate that in the late 19th century, material remains, with the exception of the eastern and parts of the southeastern sides of Zea, existed in the same areas of the harbour where Schaubert (Curtius 1841; Fig. 8) and especially von Alten (1876/77; Fig. 10; 1881; Fig. 13) illustrate structures on their topographical maps of the Piraeus. Von Strantz, on the other hand, marks shipsheds in the eastern, south-eastern, southwestern and western parts of Zea, but none in the north-west or north-east (1862; Fig. 9).

Graser describes the beach around Zea's almost circular harbour basin thus:

"The stone escarpments by which the hilly plateau around Zea descends to the water leave an approximately 30 foot wide flat sandy beach around the surface of the water, which does not, however, form a circular line around the basin, as it initially appeared to me, but rather encloses something about the shape of a regular polygon with fairly obtuse angles. In the direction of these polygonal sides I now found, upon closer investigation, numerous remains of walls of ashlar blocks emerging here and there from the sand, and these finally brought me around to the opinion that in antiquity the basin was enclosed all around by such an ashlar block wall, whose ground plan displays as a polygon but which now for the most part lies buried in sand that has been washed up and that sort of thing at the level of the beach ... Now, from each polygonal side of this wall, which now looks like a quay wall, goes out toward about the middle of the basin a number of other lower walls (now just about two feet high), which run collectively at a right angle to the side of the polygon, thus parallel and with fairly even intervening spaces (about 14-20 feet), diagonally out from the beach into the water and, gradually sinking toward the middle of the basin, become invisible; from the elevation of the edge of the plateau, however, the eye can follow them fairly far in the clear water as stout stone beams lying on the bottom".¹³

On the beach in several parts of the harbour, within 30 feet (*ca* 0.0–9.1 m) of the shore, Graser identifies walls built of ashlar blocks laid parallel to the shoreline as the back-walls of the shipsheds. His description of structures that extend perpendicular from this wall into the sea supports Graser's notion that they belong to the shipsheds.

The information provided in Graser's table is presented in Appendix 1 (Vol. I.2) where it is organised according to compass directions in the same sequence in which he collected the data.¹⁴ Furthermore, Graser's investigations can be tracked around the harbour basin to locate exactly where he worked, so that his data can be used as evidence in the relevant areas.

Von Alten, 1876/77, 1881

Von Alten published two maps in 1876/77: *Die Halbinsel Peiraiens* (1:12,500 scale; Fig. 10) and *Athen-Peiraiens* (1:25,000 scale).¹⁵ The former includes more printed

northeastern side. Shipsheds XXI–XXII and XXIII–XXVI are formed by three and five adjacent structures, leaving two unidentified structures in this area. In the northwestern side, one feature (*bettung*) counted as one structure. In the western area Graser saw two possible *wangen*, which are not included in this structure count.

11. Graser 1872: 10–11; IG *IP* 1627, 398–405; see Chapter 2, p. 13.

12. Graser 1872: 48; see Chapter 1.3, p. 5.

13. Graser 1872: 12–13, "Die felsböschungen, in welchen das hügelige plateau rings um Zea sich zum wasser herniedersenkt, lassen rings um den wasserspiegel noch einen etwa 30 fuss breiten flachen sandigen strand übrig, der aber nicht, wie es mir zuerst erschien, eine kreislinie um das bassin bildet, sondern dasselbe etwa in der form eines regelmässigen polygones von ziemlich stumpfen winkeln einschliesst. In der richtung dieser polygonseiten fand ich nun bei genauerer untersuchung aus dem sande hier und da auftauchende mehrfache reste von mauern aus quaderblöcken, und diese haben mich am ende auf die ansicht gebracht, dass im alterthum das bassin ringsum durch eine solche quaderblockmauer eingeschlossen war, deren grundriss ein polygon zeigt, die aber jetzt grösstentheils durch angeschwemmten sand u. dgl. auf der strandebene verschüttet liegt ... Von jeder polygonseite dieser mauer nun, welche jetzt einer quaimauer gleicht, geht etwa nach der mitte des bassins hin eine anzahl anderer niedriger (jetzt nur noch etwa zwei fuss hoher) mauern, welche sämmtlich rechtwinklig zur polygonseite, also parallel und mit ziemlich gleichen zwischenräumen (etwa 14–20 fuss) von dem strande schräg abwärts in das wasser hinauslaufen, und allmählig sich senkend nach der mitte des bassins zu unsichtbar werden, von der höhe des plateaurandes aber noch ziemlich weit in dem klaren wasser wie mächtige auf dem grunde liegende steinbalken mit dem auge verfolgt werden können". Translation: S. Kennell. Graser used the English foot (0.3048 m).

14. Graser 1872: table following page 65.

15. Von Alten 1881: pl. II; 1883: pl. III; see Chapter 3.1.1, p. 17.

information, including spot-heights, and is the one employed in this study. The streets on this map correspond relatively well with the Marina Zeas map (2003), namely the location of Philellinon St., Skouze St. and the southwest side of Merarchias St. (Fig. 2). The possible shipsheds (or possible slipways) are illustrated as lines indicating structures (hereafter referred to as ‘structure lines’). The fact that von Alten drew the lines at various lengths in all probability means that the structures varied in length (Fig. 10). If the ancient structures were also drawn relatively close to scale, the map would be quite valuable, but this does not appear to be the case.

The partly submerged foundations of Tower 1 (Z-T1, Fig. 3) on the southeast side of Zea Harbour is marked as a red square on von Alten’s map (Fig. 10). According to its dimensions on the map, the structure is *ca* 21 m wide (measurement taken north-south), but on a later plan from 1881 (Fig. 13), also by von Alten’s hand, the same structure is *ca* 7.4–7.5 m wide (north-south),¹⁶ which is close to the north-south width of Z-T1 observable today (*ca* 7.2–7.3 m).

The fact that the tower foundation is almost three times wider on the 1876/77 map than on a plan published a few years later makes it impossible to obtain scale measurements from the ancient structures he illustrated in 1876/77. Despite this, the map is still useful for understanding the topography of the naval harbour, primarily because von Alten clearly sketched in submerged possible shipsheds (or possible slipways) to the south-east, north-east, north-west, west and south-west at Zea.

On his 1876/77 map von Alten illustrates structures north-east of the tower foundation of Z-T1 (Fig. 10). These are identified as part of a shipshed (*Schiffshaus*) in his 1881 publication (Figs. 3, 13).¹⁷ Curiously, von Alten did not record any shipsheds between the aforementioned structures and the northeast side of Zea, where he illustrates remains of shipsheds with six structure lines. Six years prior to von Alten’s investigations Graser identified ten possible shipsheds (X to XIX; Vol. I.2, Appendix 1) and eight unidentified structures in the same area (Groups 1 and 2).¹⁸ Eight years later, Dragátsis and Dörpfeld recorded the submerged parts of a wall (W16/26(λ)), a feature in the colonnade dividing Shipsheds 16/17(η), the southern

side of ramp 17(η), a feature in the colonnade dividing Shipsheds 23(Π)/24(Φ) and a feature in the colonnade dividing Shipsheds 14/15 in the northern half of Group 1 (Pls. 2, 13, 15–17).¹⁹ It is possible, though unlikely, that these structures were covered with sediment or otherwise not visible in the winter of 1876/77.

It is clear that von Alten did not base his map of 1876/77 (Fig. 10) on the information provided by Schaubert (1841; Fig. 8), Ulrichs (1843; Fig. 5; 1863: Fig. 6) or von Strantz (1862; Fig. 9). Since Graser recorded more structures at Zea (40 possible shipsheds, 27+ unidentifiable structures) than are illustrated on von Alten’s map (25), it is safe to assume that von Alten recorded the information in the field. It should also be noted that he recorded submerged remains in the same areas where the map published by Leake in 1841 are marked with “+” symbols for ‘dangerous underwater rock of uncertain depth’ and structure lines (Fig. 7).

Analysis of Zea Shipshed Groups 1–5

After this overview of early topographical research carried out in Zea, the material evidence from each of the sections in the Zea complex can be presented. A detailed architectural analysis of the evidence from the northern part of Z-G1 (Area 1) is presented in Chapters 5–7 and 8.2 and is summarised in Chapter 9.

4.1.1. Zea Shipshed Group 1 (Z-G1, East)

Z-G1 is located in the eastern part of the harbour (Fig. 3). In the northern half of Group 1 (in Area 1; Fig. 2), five Phase 1 slipways (1–3, 5–6; Pl. 3), five identified and four possible Phase 2 shipsheds (7–15; Pl. 13), ten Phase 3 double-unit shipsheds (16–25; Pls. 15–16) and two possible Phase 4 double-unit shipsheds (26–27; Pl.

16. Von Alten 1881: fig. 3.

17. Von Alten 1881: 12, figs. 2–3.

18. Graser 1872: 46–47. Shipshed IX is identical to the possible shipshed von Alten documented next to Tower M (see Fig. 13); Graser describes XX as oriented towards the harbour mouth (i.e. towards the south-west), a detail that helps differentiate XX from the shipsheds that he found to the south of here in Z-G1 (see p. 43).

19. Dragátsis 1885: pl. 2. The Greek letters cross-reference the feature names on Dörpfelds plan, see p. 4, and Vol. I.2, p. 74.

15) have been securely identified by the author during the continuation and expansion of Dragátsis' and Dörpfeld's 1885 excavations.

On Aldenhoven's map of 1837 there is a 'wall' located near the shoreline in the southern part of ZHP's Group 1 (Figs. 3–4).²⁰ This 'wall' joins another wall at an angle; this second wall section is located farther to the south in roughly the same area of Zea Harbour where the ZHP has documented a change in the orientation between Groups 1 and 2 in the sea. These two 'walls' are possibly related to the back-wall of the shipsheds, or to a wall delineating a passageway behind the shipsheds (and possibly also fortifying the naval installations towards the city).²¹

The first definite recording of possible shipsheds (or possible slipways) in this area can be traced to von Strantz's 1862 map (Fig. 9). Here shipshed foundations are marked along most of the shoreline of Group 1, and they extend into the northern half of Group 2.

In 1872, Graser recorded four *wangen*, which he identifies as three shipsheds (XIII, XIV, and XXXXVI) north of a triangular feature (Graser's η ; see below and Fig. 124) located in the northern part of Group 2. To the north of these structures the ground plan of the back-wall is described as "stepped" (*stufenförmig*), going inland.²² A quarry (Quarry 1, in this study noted as Q:1), whose shape in plan view can be described as stepped, was excavated by the ZHP at the intersection between Group 1 and Group 2.²³ The left-hand structure delineating Graser's shipshed XIII is 7.366 feet (*ca* 2.3 m) wide, which led Graser to suggest that it was a retaining wall bounding one end of a section of shipsheds. Proceeding to the north, there was a wide area where he saw only two adjacent blocks out in the harbour basin.²⁴ When he picks up the ancient remains again he was in all probability in the vicinity of the southern-most part of Area 1, and here he identifies five shipsheds: XV, XVI, XVII, XVIII and XIX. This corresponds roughly with the ZHP's findings north of the so-called triangular feature, and in the area between the wall dividing possible Shipsheds 28/29 in the southern half of Group 1 and the southern-most shipsheds in the northern half of this group, where only one eroded rock-cutting was located over the intervening 31.93 m.

The structures making up shipsheds XV–XIX are described as "perpendicular to the polygon side" and

parallel to each other, which lends some support to Graser's shipshed identification.²⁵

As mentioned above, there are no shipsheds illustrated in the Group 1 area on von Alten's map drafted a few years later in 1876/77 (Fig. 10).²⁶ Graser does note, however, that Curtius did not record any structures in this area,²⁷ and we can only speculate why both Curtius and von Alten failed to do so.

The northern half of the Group 1 shipsheds and slipways (Area 1) has undergone intensive investigations by the ZHP from 2001 to 2006. The architecture of four identified building phases (Phases 1–4) are presented in Chapters 5–7, and the small finds, roof tiles and a reconstruction of the roof of the Phase 2 and 3 shipsheds are presented in Vol. I.2, Chapters 1–2. Dragátsis' and Dörpfeld's 1885 excavations,²⁸ and the March 1891 photograph PIR 6 (Pl. 32) of shipsheds 20(π), 21(Δ), 22(N) and 23(Π) (left to right), are also analysed in detail in Chapters 6–7.

Investigations were carried out in the southern part of Group 1 in 2001, 2004–2005 and 2007–2010. The building phase of shipsheds remains under investigation, the results of which will be published in a future study in this series.

Shipshed structures with the same alignment, but of different building phases, have been documented by the ZHP over a distance of about 143 m in Group 1. This area could have accommodated a maximum of 22 single- or double-unit shipsheds, or about the same number of slipways.

4.1.2. Zea Shipshed Group 2 (Z-G2, South-east)

As mentioned above, Aldenhoven (1837; Fig. 4) documented a 'wall' in Group 2 that may be related to the back-wall of the shipsheds or a wall delineating a pas-

20. A rare map reproduced by Papageorgiou-Venetas 2001: fig. 60.

21. See Chapter 8.1.3.

22. Graser 1872: 47.

23. Plans of this area will be published in the forthcoming volume, *The Ancient Harbours of the Piraeus, Vol. II*.

24. Graser 1872: 47.

25. Graser 1872: 47, "rechtwinklig auf die polygonalseite gerichtet".

26. Curtius & Kaupert 1881: pl. II; 1883, pl. III.

27. Graser 1872: 44.

28. Dragátsis 1885: 63–71, pls. 2–3.

sage behind the shipsheds (and possibly also fortifying the naval installations towards the city).²⁹ Von Strantz's 1862 map represents the first instance of structural remains identified as shipsheds in Group 2 (Figs. 3, 9).

Graser (1872) walked west along the coast from Mounichia to Zea and began his investigations of Zea near the partly-submerged tower (referred to as Z-T1 in this study) on the southeast side of the harbour basin (Fig. 3). He then worked his way counter-clockwise around the harbour basin. The Z-T1 tower is located at the topographical key point where the eastern coastal fortification wall connects with the fortified harbour entrance. The Group 2 shipshed complex began north of this tower, but precisely how far north has not yet been securely determined. The investigation of this area is ongoing and the results will be published in a future study.

Graser found a number of possible shipsheds (or less likely, slipways) in the area to the north of the tower. He locates two rows of blocks that made up the south wall of the first shipshed IX, located 27.33 feet (*ca* 8.3 m) north-east of the tower. A wall with a similar arrangement is illustrated on von Alten's 1881 plan (Fig. 13);³⁰ it was located during a survey of this area by the ZHP. Both Graser and von Alten identify this structure as part of a shipshed. Graser, in his text, records the wall width as 3.28 feet (1.00 m); in his table the wall width is listed as 1.64 feet (0.50 m) because only half the wall belongs to one shipshed. According to von Alten's plan it is *ca* 1.8–1.9 m wide, and the ZHP's width measurements (1.74–2.13 m) are also wider than Graser's. Graser found the north wall of shipshed IX to be 13.38 feet (*ca* 4.1 m) farther north (to the right when looking out from shore), and another wall was located 24.4 feet (*ca* 7.4 m) north of the southern-most wall mentioned at the beginning. The first two structures, interpreted by Graser as the walls of shipshed IX, continued into the sea and were followed for a total length of 70.357 feet (*ca* 21.4 m) and 70.350 feet (*ca* 21.4 m), respectively. According to Graser, the lower, seaward ends of the two structures had been destroyed.³¹

Graser suggests that the southern-most (left) wall could be the retaining wall of the shipshed complex, and von Alten identifies these features as belonging to the first shipshed north of the tower (von Alten's

Tower M, Z-T1; see Figs. 3, 13).³² The orientation of shipshed structures found by the ZHP farther to the north in Group 2 is slightly different when compared with the aforementioned wall, and at present this author classifies the structure as the likely remains of the southern-most retaining wall of Group 2 and the possible remains of shipsheds. The investigation of this area is ongoing.

Graser speculates that the third wall, counting north from Z-T1, instead of the second wall, may have been the northern (or right) delineation of shipshed IX. Graser was unable to access the third wall and a fourth wall farther to the north, thus indicating that they were preserved to a greater depth than the other structures.³³

Von Alten's plan of the area on the southeastern side of Zea shows the partly-submerged foundation for Tower M (Z-T1), parts of the fortification walls (H, J) and what is probably a curtain wall that runs south along the harbour mouth (Fig. 13). A partly-submerged wall (K) runs north from Tower M and appears to interconnect with the partly-submerged structure that von Alten identifies as the first shipshed at this end of the harbour; perhaps this short wall fortified the space between Z-T1 and the shipshed complex.³⁴

Von Alten's plan, according to the printed text, is at 1:500 scale and the 10 m horizontal bar scale reproduced in the publication is within close range of this (1:507). Several of the ancient structures on von Alten's plan are still *in situ*, and so it is possible to evaluate the precision of his survey. According to the ZHP survey, the north-south width of the tower foundations is *ca* 7.2–7.3 m (see above). On von Alten's plan the north-south width is *ca* 7.4–7.5 m. The wall projecting northwards from Z-T1, measured by ZHP, is *ca* 1.44–1.61 m wide. According to von Alten, the same wall is *ca* 1.8–1.9 m. The southern-most wall in the possible shipshed is *ca* 1.9 m wide according to von Alten; according to the ZHP survey, the same fea-

29. See also Chapter 8.1.3.

30. Von Alten 1881: 12, fig. 3.

31. Graser 1872: 45.

32. Von Alten 1881: 12, fig. 3. "Thurm M" (Tower M) = Z-T1.

33. Graser 1872: 46.

34. Von Alten 1881: 12, fig. 3.

ture is 1.74–2.13 m wide. The discrepancy between the ZHP and von Alten’s measurements suggests that he surveyed Z-T1 with reasonable precision on land, but may have simply sketched sections of the other partly-submerged structures based on a few measurements.

When Graser investigated the structure in 1872 the seaward end was already destroyed.³⁵ On von Alten’s plan of 1881 the possible shipshed is preserved to a length of *ca* 29 m (of which *ca* 24.5 m is illustrated in the sea) and the walls have a clear width of *ca* 6 m. When von Alten’s 1881 plan is overlaid on the ZHP survey plan of this area, the result indicates that the possible shipshed would have stretched about 18 m from the modern quay towards the west. Since von Alten’s investigations the structure has suffered further damage and is presently preserved for a length of 8.83 m in the sea. The eastern part is covered by a modern concrete quay. Excavations of the structures are ongoing; at present it is not possible to identify it as part of a shipshed. However, if the structure is indeed part of a shipshed, it is likely to be the retaining wall, or less likely a ramp, belonging to the outer-most, or southwestern-most part of the shipshed complex, and thus von Alten’s identification could be correct. A continuation of the fortified mole was found by the ZHP in the sea west of Z-T1 (von Alten’s Tower M), and there was probably another tower at the end of this.

Graser’s shipsheds X, XI and XII were recorded before he reaches “... a worked outcrop of rock, triangular in plan view, which on the average stuck up ½ foot above the water ...”.³⁶ In the northern part of Group 2 a triangular-shaped area of worked bedrock matches this description; it also protrudes out of the water (see above and Fig. 124).

The identification of this feature, called η by Graser, is supported by his report of three shipsheds and a wall to the north of η . He then surveyed a wide area in which he found only a double block in the sea, before he continued with the shipsheds again. This description roughly matches the ZHP findings in this area (see above).³⁷ The reference point provided by the triangular feature in the northwestern-most part of Area 3 was formed by a ramp feature and quarries on the northern side (Quarry 2, called Q:2), and the southern (Q:3) and eastern (Q:5) sides (Fig. 124), placing the location of

shipsheds X, XI and XII south of this feature. Graser describes “... two places in which hollows with a jagged ground plan/outline...have been quarried/chiseled into the bedrock ...”; these, he suggests, could be the foundations of more important buildings.³⁸ In this area was found evidence of later quarrying within the shipsheds, and Graser’s description of the features as having “a jagged outline/multiple angles” (*mannichfach gezackelt*) fits well with the appearance of Quarries 4 (Q:4; Fig. 125) and 8 (Q:8) located here. The features probably represent later quarrying that post-dates the use of the shipsheds. On the beach behind shipshed XI Graser located a rock-cutting running parallel to the beach, which he identifies as the foundation of the back-wall.

In the northern half of Group 2 the remains of one identified and two possible rock-cut ramps, a rock-cut column base foundation trench and other unidentified rock-cut structures that run on exactly the same orientation have been excavated by the ZHP. To date it has not been possible to define an individual shipshed (i.e. two parallel load-bearing structures and a central ramp). It appears that there is more than one building phase. The area has been heavily quarried to a maximum depth of -1.36 m, close to the modern dredging cut. Apart from the walls near von Alten’s Tower M, there are no structural lines in the sea on his 1876/77 map (Fig. 10). As in Group 1, he apparently saw no further shipshed remains in Group 2.³⁹

Arvanitopoulou describes a wall preserved to a height of two courses found in the mid-1960s during demolition work at Akti Moutsopoulou 33 (Fig. 3). Based on the Marina Zeas map (2003), it is estimated that the wall is located about 40–45 m from the present shoreline. Arvanitopoulou identifies the wall as part of the shipsheds in this area (i.e. the back-wall). Ar-

35. Graser 1872: 45.

36. Graser 1872: 46, “... ein bearbeitetes felsstück von dreieckigem grundriss, welches durchschnittlich ½ fuss über wasser hervorragt ...”. Translation: S. Kennell.

37. Graser 1872: 47. A detailed study of this area will be published in the forthcoming volume, *The Ancient Harbours of the Piraeus, Vol. II*.

38. Graser 1872: 46, “... zwei stellen, an welchen höhlungen von mannichfach gezacktem grundriss ... in den felsgrund hineingearbeitet sind ...”. Translation: S. Kennell.

39. Von Alten 1881: pl. II; 1883: pl. III.

vanitopoulou also reports that the shipsheds continued under the street, and that their remains could be seen in the sea in front of the building lot.⁴⁰ In 1899 Dragátsis mentions in passing that he found the back-wall of the shipsheds here, in an area he describes as next to the ‘Ziller neighbourhood’, located in this part of Zea (see Figs. 3, 10).⁴¹ Dragátsis’ brief report and the ‘wall’ on Aldenhoven’s 1837 map (Fig. 4) lend support to Arvanitopoulou’s shipshed identification, but here the structures are classified as possible shipsheds. It is noted that the structure could be a wall behind the shipsheds, as seen in Area 1 Phase 3 shipsheds (Pl. 17).

The distance between the possible retaining wall just to the north of the tower Z-T1 and the demarcation between Groups 1 and 2 is *ca* 71 m, thus allowing room for a maximum of 10 single- or double-unit shipsheds, or about the same number of slipways. The investigations of Group 2 are ongoing, and these delineations may change as a better understanding of this area is gained.

4.1.3. Zea Shipshed Group 3 (Z-G3, West/South-west)

Aldenhoven’s map of 1837 shows the coastal fortifications extending into the southeastern-most area of ZHP’s Group 3 (Figs. 3–4). In this area the ‘wall’ may be related to the back-wall of the shipsheds or to a wall delineating a passageway behind the shipsheds. Since it is clearly related to the coastal fortifications, it most probably served to protect the naval installations towards the city.

In 1841, Curtius (on Schaubert’s map; Fig. 8) was the first researcher to identify naval installations in Zea. In this part of the harbour on his accompanying map a number of structure lines are marked as *neoria* in the caption (probably used here to describe remains of ‘shipsheds’ and/or ‘slipways’; see also p. 3). The ancient structures on the map do not appear to be drawn to scale. Today the observable width of the tower Z-T1 in the southeastern part of Zea is *ca* 7.2–7.3 m (north-south), whereas it is about twice as wide (about 15 m, north-south) on Schaubert’s map.

Ulrichs’ 1843 map also shows structure lines in this area (Fig. 5).⁴² Leake’s map published in 1841 shows two structure lines here in the sea parallel to the shore.

A short perpendicular line forms a corner with the western-most structure line (Fig. 7). Later, in 1862, von Strantz also marked this area as containing remains of shipsheds (Fig. 9).

Graser identifies 15 shipsheds in the Group 3 area, demonstrating an abundance of ancient structures here.⁴³ In the northwestern part of Zea (between Groups 3 and 4; see below) Graser proceeded along a wide area with no shipsheds and observed only a few dislocated blocks before he came to a very thick wall two blocks wide. The structure is described in the text as “red C” (*roth C*) on his plan, but, as mentioned in Chapter 3.1.1, this plan is missing from the publication. Graser suggests that it may be the retaining wall of a shipshed complex starting with shipshed XXXIII, then XXXIV, XXXV, and XXXVI (perhaps the northwestern end of Z-G3; Fig. 3). Behind the right-hand side delineating a structure in XXXVI he found a part of the back-wall. Next, he saw some structures that were not perpendicular to the back-wall, and then found four structures he identifies as three shipsheds, XXXVII, XXXVIII and XXXIX. Behind these were found more traces of the back-wall.⁴⁴

Graser then traced a wide area with dislocated blocks that ends with two walls (“red D”, *roth D* in the text and on the missing plan) constructed on a different alignment. Based on the observation of a few blocks he speculates that there may have been two structures in this area. He recorded two additional walls, each two blocks wide, and identifies them as shipsheds XXXX, XXXXVII and XXXXVIII.⁴⁵

From this point in the southeastern area of Group 3, Graser describes the ground plan of the back-wall as staggered in several steps towards the sea, ending with

40. Arvanitopoulou 1966: 27–42, esp. 38–39 and fig. 9 (p. 36). On the possible back-wall of the shipsheds, see p. 38.

41. Dragátsis 1899: 38.

42. Curtius 1841: 1–49; Ulrichs 1843: 664 and plan I.

43. Graser 1872: 50–51. Shipshed XXXXI is not mentioned in the text, but it is listed as found on the western side of Zea in the table following page 65.

44. Graser 1872: 50.

45. The locations of shipsheds XXXXVII and XXXXVIII are listed with a question mark in the table following page 65, but were found in the western side of Zea according to the main text (Graser 1872: 51).

an ancient square structure constructed of blocks. To the right of this area (proceeding anti-clockwise) he identifies shipshed XXXXII, some blocks, and finally four structures noted as shipsheds XXXXIII, XXXXIV and XXXXV. Close to the last structure in XXXXV he locates the remains of the southwest fortified mole, which he describes as extending very far into the harbour basin.⁴⁶ It is interesting that von Alten (1876/77) recorded what appears to be a part of the back-wall staggered in only one step forward into the harbour basin in this part of Group 3 (Fig. 10), but it is possible that Graser is describing parts of a quarry. In Fig. 3, Group 3 is reconstructed staggered in one step.

Von Alten (1876/77) illustrates a total of nine parallel structure lines in the harbour basin on his map and identifies them as shipsheds (Fig. 10). In the north-western part of Group 3 von Alten recorded four submerged parallel structure lines. In front of the two northwestern-most structures he drew a perpendicular line and recorded a spot-height of 1.2, in all probability meaning -1.2 m, i.e. below sea level. Several ancient structures with a similar orientation to those illustrated by Schaubert in Curtius 1841 (Fig. 8) and von Alten (Fig. 10) were located under water in this area in 2004 and 2006. The only identifiable part of a possible shipshed (or slipway) is the southern side of a ramp found by the ZHP in 2004 in the northern-most part of Group 3, preserved to a maximum depth of -1.20 m.

In the southwest part of Group 3 von Alten mapped a structure in the sea that lay approximately parallel to the shoreline (Fig. 10). From this structure run four structure lines towards the middle of the harbour basin, identified as shipsheds by von Alten. These structures could be identical to the four structures forming shipsheds XXXXIII, XXXXIV and XXXXV, described by Graser (see above). On von Alten's map, a structure connects the northwest end of that in the sea to the shoreline, and to the north-west of this point runs another parallel structure (Fig. 10). Today, this area is covered to a large extent by two *Olympiakos* basketball courts (Fig. 3), but promising structures have been located during recent ZHP survey dives just to the north-west of the basketball court area. Finally, von Alten illustrates the western part of the fortified harbour entrance.

The area to the south-east of Group 3 is delineated by possible shipshed structures documented by the ZHP, and from this point possible shipshed (or possible slipway) structures were found over a shoreline length of *ca* 165 m. Based on the maps of Schaubert (Curtius 1841), von Alten (1876/77) and Marina Zeas (2003), it is cautiously estimated that this group continued about 15 m farther to the north-west (Figs. 3, 8, 10). The total shoreline length of the Group 3 shipsheds is estimated tentatively at about 180 m, a dimension that would allow for a maximum of about 27 single-unit shipsheds or about the same number of slipways. The presence of possible single-unit shipsheds in this group is supported by Graser's reports of what he identifies as the back-wall of the shipsheds on the shore (Z-G3, north-west), and by von Alten's map showing a wall in the sea that may well have been the back-wall of a section of the shipshed complex (Z-G3, south-east; Fig. 10).

Area between Zea Shipshed Group 3 (Z-G3) and Zea Shipshed Group 4 (Z-G4)

On von Alten's 1876/77 map the northwest structure lines in Group 3 and the first three structure lines in Group 4 form a 90° angle (Fig. 10). If these possible shipsheds were in use at the same time, none could have been accommodated on the shoreline that forms this corner (Fig. 3). This also fits well with the fact that Graser only saw a few dislocated blocks here.⁴⁷

4.1.4. Zea Shipshed Group 4 (Z-G4, North-west)

Both Schaubert's (Fig. 8) and Ulrichs' (Fig. 5) maps show structure lines running into the sea in this area (Fig. 3).⁴⁸ On Leake's map, the symbol "+", indicating 'dangerous underwater rock of uncertain depth', extends from the shore for a distance of roughly 35 m (Fig. 7). In addition, the map shows a structure line in the sea set parallel to the shoreline, from which a perpendicular structure line runs seaward for roughly 30 m.⁴⁹

46. Graser 1872: 51.

47. Graser 1872: 50.

48. Curtius 1841: 1-49; Ulrichs 1843: pl. I.

49. Measurements scaled from Leake 1841: pl. 4.

In the northwest part of the harbour to the left (west) of the bathing piers (see von Alten's 1876/77 map, Fig. 10), Graser investigated first a few blocks in the sea that he interprets as the possible remains of two walls, then three blocks in the sand that he describes as the probable upper ends of three walls belonging to two shipsheds, XXVII and XXVIII.⁵⁰ After surveying a wide area with no material remains he found three rows of blocks in the sea that did not run towards the middle of the harbour basin, but, as in Mounichia, ran obliquely to the beach in a southwesterly direction.⁵¹ After observing another wide area with only a few blocks, Graser found a narrow cliff, or reef, running out into the harbour basin; it had the appearance of a *wange*, but without any apparent man-made features. To the west and parallel to the reef, and similar in length, ran a man-made "stone beam" (*steinbalken*). From the seaward end of the reef the back-wall of the shipsheds protruded a foot out of the water and ran perpendicular towards the right (west), past the "stone beam" and onto the beach. Perpendicular to the back-wall stretched ten *wangen* into the sea, which Graser identifies as four shipsheds, XXIX, XXX, XXXI and XXXII. Graser speculates: "Perhaps right here in the back of the harbour one put heavy ships, *fives* and *fours*, so that they could sail out toward the harbour entrance in a straighter line".⁵²

There is little evidence to support Graser's suggestion, as only the widest of these structures, XXX (IA: 6.83 m; clear width: 5.83 m), is possibly wider than the Phase 2 (IA 6.48 m) and Phase 3 (IA 6.51 m; IC 5.87 m) *trireme* shipsheds identified in Area 1 (see pp. 172–173).⁵³ If Graser's identification of the back-wall of the shipsheds is correct, it strongly indicates that these were the remains of single-unit shipsheds. It is also a clear indication of sea level rise, which will be discussed in detail in Chapter 8.1.1.

In the northwestern part of the harbour, to the left of the bathing piers, von Alten illustrates a wall on shore that parallels the coastline on his 1876/77 map. In front of it, towards the harbour basin, lies a parallel wall from which four perpendicular structure lines, noted as shipsheds, stretch into the harbour basin (Fig. 10; see also Aldenhoven 1837: Fig. 4). Von Alten may have illustrated the remains of the back-wall of the shipsheds in the sea, with a parallel wall behind it. If his

shipshed identification is correct, he may have found a group of the single-unit type (see Chapter 8.1.2), and the two walls may represent the delineation of a passageway running behind the shipsheds, as probably shown in Dörpfeld's plan (Pl. 17; see Chapter 8.1.3).

South-west of this location, von Alten mapped two structure lines with the same southeast orientation as those discussed above; the northern-most of these two is the structure that runs farthest into the harbour basin at Zea (Fig. 10). To the south-west run three structure lines on a different orientation (south/south-east).

In 1882 A. Meletopoulos mentions the remains of two shipsheds found during the excavation of foundations for a house to be built by one Mr. Loizos.⁵⁴ His sketch plan of the Piraeus includes the possible shipsheds located on the northwestern side of Zea Harbour. By merging Meletopoulos' 1882 map (Fig. 16) with those of von Alten (1876/77; Fig. 10) and Marina Zeas (2003), it is possible to see that the excavated site is located roughly in front of Skouze St. (Fig. 3), and that the back-wall is oriented south-west to north-east (Fig. 16). On his sketch map of Zea, Meletopoulos also labels the eastern and southeastern coastline of Zea with the caption *ΝΕΩΣΟΙΚΟΙ* ("shipsheds").

Meletopoulos' architectural drawings are of reasonable quality. The 10 m bar scale is exactly 10.00 cm on the 1:100 plan, and the drawings are considered to have a margin of precision of *ca* 0.10 m. All measurements have been scaled directly on the plan and section drawings of the site (Figs. 14–15), and according to the sections (E–Z, Γ–Δ), the exposed area is about 14.2 x 14.2 m. Meletopoulos found a wall and what appear to be the remains of three pier colonnades. Although the plan lacks a north arrow, Meletopoulos describes the baulk on the left-hand side of the plan as being to the south, and the right one to the north.

50. Graser 1872: 49.

51. Graser 1872: 49.

52. Graser 1872: 50, "Vielleicht hat man gerade hier in den fond des hafens schwerere schiffe, penteren und tetreren gelegt, um diese gerader nach dem hafeneingang auslaufen lassen zu können". Translation: S. Kennell.

53. Graser 1872: table following page 65.

54. Meletopoulos 1882: 1–15, esp. 15.

On the architectural drawings, the wall and the piers appear to be standing directly on level bedrock. (The surface of the ‘bedrock’ on the right-hand side of cross-sections A–B and Γ–Δ is irregular, and probably indicates that this area was not fully excavated.) The wall, approximately 1.3 m wide, was preserved to a height of five courses (*ca* 2.3 m) and was exposed for a length of *ca* 11.9 m (Figs. 14–15). It is described as constructed of “Piraeus stone”, which is in all probability the local yellow/grey limestone.

On the wall Meletopoulos found symbols in red paint – Greek letters, arrows, semicircles (Fig. 15) – which he believes identified the owner of the quarried stones or the location of the quarry.⁵⁵ In 1885 Dragát-sis and Dörpfeld found similar markings on the back-wall of the shipsheds (belonging to Phase 3) excavated in the eastern part of Zea (Area 1), and the ZHP survey has found two similar markings on the Phase 3 Spur-wall 17/18(γ) in Area 1 (Figs. 79–80).⁵⁶

On the plan the distance from inside of the back-wall to the beach is *ca* 9.7 m (Fig. 14). Although the structures are shown directly on the shoreline on the topographical map (Fig. 16), Meletopoulos in all probability illustrated the landward beginning of the beach on the site plan, and not the actual shoreline. It would be very difficult to dig a *ca* 2.6 m-deep trench closer to the sea (see Figs. 14–15, section E–Z). Perpendicular to the wall was found a colonnade of four piers or built-up column foundations preserved to a maximum height of five courses (maximum height *ca* 2.5 m, section E–Z).⁵⁷ Each course of these piers was constructed of two rectangular blocks that were laid using the header-stretcher method. The piers are *ca* 1.3 m long and *ca* 1.4 m wide. The colonnade has an intercolumniation of *ca* 0.9–1.0 m and an interaxial spacing of *ca* 2.2–2.3 m. In the bottom part of the plan, what appear to be remains of another pier protrude *ca* 0.2 m from the baulk. The intercolumniation between this feature and the fourth pier is narrower (*ca* 0.4 m) than between the other four (*ca* 0.9–1.0 m).

In each of the baulks to the left-hand and right-hand side of the plan are also architectural remains that appear to have been constructed in the header-stretcher technique. They may be parts of two pier colonnades or built up foundations for columns. Two presumed piers protrude through the left baulk. The

corner of a third presumed pier is shown in the left bottom corner of the plan (Fig. 14). The piers are *ca* 1.2–1.3 m long, preserved to a maximum height of five courses (*ca* 2.2 m), and have an intercolumniation of *ca* 2.1–2.2 m. The interaxial spacing between the two first piers, counting from the wall, is *ca* 3.3 m.

In the right baulk, parts of two presumed piers are exposed, and a corner of a third is visible in the bottom right of the plan (Fig. 14). These piers are *ca* 1.2–1.3 m long. The bottom part of the pier in cross-section Γ–Δ was not fully excavated but exposed to a height of five courses (*ca* 2.1 m; Fig. 15). The intercolumniation is *ca* 2.0–2.1 m, and the interaxial spacing between the two first piers measuring from the wall is *ca* 3.3 m. The intercolumniation between the possible colonnade to the left and the central colonnade is *ca* 5.8 m and the interaxial spacing *ca* 7.2 m. The intercolumniation between the central colonnade and that to the right is narrower at *ca* 4.4 m; the interaxial spacing is *ca* 5.7 m.

Meletopoulos identifies the buildings as shipsheds, and there is evidence that supports this interpretation. The wall runs parallel to the shoreline and is located close to the sea. The presumed colonnades run perpendicular to the shoreline and the intercolumniation between the central and left-hand side colonnades is *ca* 5.7 m. It is also interesting to note that these pier colonnades appear to have alternating interaxial spacings of *ca* 2.2–2.3 m and 3.3 m, which are roughly comparable with the Phase 3 shipsheds in Area 1 (2.16 m/3.38–3.39 m; see pp. 101–102). The intercolumniation between the colonnade on the right-hand side and the central one, however, is narrower at *ca* 4.4 m. If Meletopoulos’ identification is correct, this is evidence of a narrower shipshed type. There is no opening in the back-wall behind this narrower structure, so it is therefore clearly not a passageway leading to the harbour front.

The architectural structures are standing on level bedrock, and there is no evidence of inclination in the presumed colonnades. Evidence of shipsheds constructed on near-level bedrock, however, was exposed

55. Meletopoulos 1882: 15.

56. Dragát-sis 1885: 67.

57. Meletopoulos 1882: section E–Z.

in Group 1 (see, for example, Pl. 24), and the level foundations found by Meletopoulos cannot be used as a strong argument against his identification. As mentioned in Chapter 3 (p. 22), Dragátsis may have compared similarly-constructed colonnades in what he identifies as shipsheds at Mounichia with the colonnades excavated by Meletopoulos.⁵⁸ No remains of ramps or side-passages are evident on Meletopoulos' plan and sections. Since it is not possible to identify the buildings as shipsheds, they are classified here as possible shipsheds. Another (less likely) alternative is that the structures were part of a storage building. With no material to adduce a date, the structures may be assigned very tentatively to the 5th or 4th centuries BC.

In 1892 Dragátsis identified the remains of shipsheds during the excavations of a Roman bath on the corner of Philellinon St. and Akti Moutsopoulou (Figs. 3, 18). The excavated area runs parallel with Akti Moutsopoulou towards the north where it widens towards the west. Dragátsis published no sections, and there are no spot-heights on the 1:200 scale site plan.⁵⁹

The three features identified as parts of shipsheds, μ , ν and ξ , were found in the northwestern part of the excavated area (Fig. 18). The length (8.4 m) and width (1.5 m) of feature ξ is printed on the plan, and these have been verified using the plan's scale (1:200). The site plan is considered to be precise, and measurements scaled from the plan have an estimated margin of precision of *ca* 0.10 m. Feature μ is described as an *in-situ* square base related to the colonnades of the shipsheds; feature ν is described as similar to feature μ , although it is clearly rectangular on the plan. Both structures are constructed of two parallel blocks. Feature ξ is labelled as a shipshed on the plan.⁶⁰

Feature μ was found in *Room AA* and is partly overbuilt by a wall λ belonging to the Roman bath complex (Fig. 18). This demonstrates that feature μ is at a lower elevation than the bath wall and may have been included in the foundations of wall λ . In any case, μ is considered to be earlier than the bath. Feature μ protrudes *ca* 1.3 m from wall λ and appears to be constructed of two parallel rectangular blocks with a total width of *ca* 1.1 m (each block is *ca* 0.5–0.6 m wide). The western side of μ is located *ca* 28.3 m from the 1892 shoreline.

Features ν and ξ were found outside the Roman bath. Feature ν is also constructed of two parallel

rectangular blocks and is *ca* 1.2 m wide and *ca* 2.1 m long. The individual blocks are *ca* 0.6 m in width. The distance to the 1892 shoreline is 28.3 m. Feature ξ is described as a wall, with a length of 8.4 m and a width of 1.5 m. Its western end is located *ca* 36.7 m from the 1892 shoreline.

Dragátsis does not explicitly state his reasons for identifying the features as shipsheds, but, taking his experience from the 1885 excavation into consideration, it is likely that the identification is correct. The distance between the southern sides of μ and ν is *ca* 6.4 m, which is close to the roughly 6.50 m distance between interrelated structures in the Area 1 shipsheds (i.e. between the southern side of a ramp or a column base, to the southern side of the adjacent ramp or column base; Pls. 15–16). On the other hand, the three features are constructed at varying angles: feature μ at *ca* 110°, feature ν at 108° and feature ξ at 112°. ⁶¹ The 4° difference between ξ and ν is especially problematic since it is unlikely that these two features are related to shipsheds constructed parallel to each other. Consequently, features μ , ν and ξ are classified in this study as belonging to possible shipsheds.

There is no evidence of the construction date of these structures, but as feature μ is covered by an exterior wall of the Roman bath (wall λ) it is clear that the possible shipshed was not in use when the bath was built. Dragátsis dates the bath to after Sulla's destruction of the Piraeus in 86 BC. M. McCallum suggests an Augustan/1st century AD date.⁶²

During intrusive dredging in Zea, in preparation for the construction of the marina in 1964, 13 column drums probably belonging to the Group 4 shipsheds were found in the sea near the *Rowers' Club* (Όμιλος Εργετών; Fig. 3).⁶³ These are discussed in Chapter 6.3.4.

In the area corresponding to Z-G4, Graser describes structures on two different angles (south and south-west), and von Alten (1876/77) illustrates two groups of structure lines on a different alignment (east/

58. Dragátsis 1899: 38.

59. Dragátsis 1892: 22–23, pl. A.

60. Dragátsis 1892: 22–23, pl. A.

61. Using North as 0 degrees.

62. Dr. M. McCallum, pers. comm., 2009.

63. Arvanitopoulou 1966: 38–39, fig. 10.

south-east and south-east; Fig. 10). Graser probably misunderstood or confused the compass directions, as it is unlikely that the shipsheds (or slipways) were running directly to the south and south-west, west of the bathing piers (Figs. 3, 10),⁶⁴ and therefore Graser and von Alten may have documented the very same change in orientation. The variation in direction may point towards two groups of shipsheds or slipways (and more than one building phase) within Group 4, but at the present there is not enough evidence to subdivide this group. The existence of single-unit shipsheds is strongly supported by Graser's reports of extensive remains of what he identifies as the back-wall of the shipsheds partly submerged in the sea. Furthermore, von Alten documented a wall in the sea that may well have been the back-wall of a section of the shipshed complex (probably located north-east of the structures described by Graser; Fig. 10). Since Dragátsis found shipshed remains 36.7 m inland from the 1892 shoreline, and Graser found possible shipshed (or slipway) remains in the sea here, and von Alten illustrates parallel structure lines running far into the harbour basin in the same area, a building phase of double-unit shipsheds may have lined a part of the Group 4 shoreline in the area of Dragátsis' 1892 excavation.

The width of the Z-G4 complex is tentatively estimated at 190 m, based on von Alten's map of 1876/77 (Fig. 10) and the Marina Zeas map of 2003 (Fig. 3). This width could accommodate a maximum of 29 single-unit or double-unit shipsheds, or about the same number of slipways.⁶⁵

Area between Zea Shipshed Group 4 (Z-G4) and Zea Shipshed Group 5 (Z-G5)

Graser identifies no shipsheds in the northern part of the harbour. He assumes that the area was covered by sediment, owing to its location directly opposite the harbour mouth. Near the eastern side of the "bathing piers" (*badeanstalt*), however, he identifies three walls.⁶⁶

Between the structure lines in Z-G4 and Z-G5, there is a wide section of the northern part of Zea where von Alten did not map ancient structures in 1876/77. Instead, he illustrates two modern bathing piers (Fig. 10), which were in all probability identical to the structures already described by Graser.⁶⁷

4.1.5. Zea Shipshed Group 5 (Z-G5, North-east)

Graser describes structure XX, located in the south-eastern part of Group 5, as oriented towards the harbour mouth (i.e. towards the south-west, and at a different angle than the shipsheds he found to the south of here), a detail that helps differentiate it from the structures in Z-G1, which face west/north-west (Fig. 3). Graser is not certain that XX is a shipshed. In the northeastern part of the harbour Graser found ten parallel walls lying partly on the beach and partly in the sea; these he identifies as seven shipsheds: XX, XXI, XXII, XXIII, XXIV, XXV and XXVI. Graser estimates the longest structure to be 90 feet (*ca* 27.4 m). After taking Graser's width of the beach (30 feet or *ca* 9.1 m) into account, the submerged length of the structures appears to have been in the range of *ca* 18.3–27.4 m.⁶⁸ Schaubert (Curtius 1841) also documented ten parallel structures that ran into the harbour basin from the shore (Fig. 8).⁶⁹ Graser records the gradient (1:9) of a particularly steep structure on the beach in the north and northwest part of Group 5 and notes that it was twice as steep as the other structures (about 1:18/3.2°).⁷⁰ Several of the Phase 1 structures surveyed by the ZHP in Area 1 have a comparable gradient (average 1:19/3.0°; see Chapter 5). Von Alten's map of 1876/77 shows a total of six structure lines in this area (Fig. 10).

Most of the information about Z-G5 derives from the rescue excavations on the corner of Akti Moutsopoulou 7 and Neorion St. They were conducted by Alexandri in 1973 and published in 1979 (Figs. 3, 20).⁷¹ The excavated area measures 25.7 x 28.3 m;⁷² the north arrow is incorrectly oriented on the plan and

64. Graser 1872: 49.

65. The implications of the Arsenal of Philon *syngraphé*, IG *IF* 1668 (347/6 BC), on the topography of this area of Zea Harbour, are discussed briefly in Chapter 8.1, pp. 155–156.

66. Graser 1872: 49.

67. Graser 1872: 49.

68. Graser 1872: 48.

69. Curtius 1841.

70. Graser 1872: 48.

71. Alexandri 1979a.

72. Alexandri 1979a: 152, fig. 35.

should be rotated 19° clockwise.⁷³ The distance from the southwest side of the building plot to the harbour basin (i.e. across Akti Moutsopoulou and the sea wall) is *ca* 37.2 m. From here Alexandri follows the shipsheds to the north-east for a distance of *ca* 23.8 m, which means that structures were preserved over a distance of about 61 m from the present shoreline. Alexandri identifies a long rock-cutting as a slipway, measuring 20 m long, 4.70 m wide and 0.55–0.75 m deep. On the longitudinal-section this rock-cutting has an inclination of *ca* 1:9.5 (6.0°; Fig. 19).⁷⁴ This, along with the fact that Graser reports structures submerged for 18.3–27.4 m, and that Schaubert (Curtius 1841; Fig. 8) and von Alten (1876/77; Fig. 10) also illustrate submerged structures in this part of the harbour basin, supports their classification as possible double-unit shipsheds. This will be discussed in greater detail in Chapter 8.1.

An analysis of the plan and sections reveals a number of topographical and architectural details.⁷⁵ First, however, a note on Alexandri's sections and their reference points: cross-section A–A was drawn with the top surface of Akti Moutsopoulou as the zero baseline. The excavation did not extend to the street (Figs. 3, 19–20), so Alexandri probably levelled and drew the features to the top surface of the eastern sidewalk of Akti Moutsopoulou. In 2010, the elevation of the sidewalk was +3.05 to +3.13 m (87DZ), and the approximate level of the architectural features excavated by Alexandri can be deduced from it (although it must be noted that it is not known if the elevation of the 2010 sidewalk is the same as that in 1973). Alexandri drew and levelled the longitudinal-section Γ – Γ with Neorion St. as an inclining zero baseline. Cross-section B–B is also drawn with this street as a baseline. The margin of precision of Alexandri's plan and cross-sections A–A and B–B is estimated to be 0.10 m, and for Γ – Γ it is estimated to be 0.15 m.

Based on the adjustment of the plans of this area, it is clear these shipsheds were constructed at a different angle from those excavated in Group 1 (Area 1, Phases 2–3, 4(?)), and thus provide vital information on the topographical layout of this part of the shipshed complex (Fig. 3).

Alexandri found the remains of a wall running in a southwesterly direction towards the sea. The wall has

been destroyed inside the building lot and is only preserved in the vicinity of the southwest and north-east baulks, where it continues into unexcavated areas (Figs. 19–20). In the excavated area, the northern side of the wall can be followed for a total length of *ca* 23.8 m.⁷⁶ The two parts of the wall are constructed in level foundation trenches, but unfortunately Alexandri's longitudinal-section offers no information on the foundations (or the extent of their destruction) in the *ca* 18 m space that separate them.⁷⁷

In the northeast baulk, five courses of the wall were found preserved to a height of *ca* 2.8 m. The wall, which is composed of blocks set in a rock-cut foundation trench, was exposed for a length of *ca* 5.2 m.⁷⁸ According to Alexandri, the parallel wall just to the south of the aforementioned structure belongs to a later phase. An area north of the first mentioned wall was quarried.

Four courses of the wall are preserved in the southwest baulk to a height of *ca* 1.8 m.⁷⁹ On the plan the excavated part of the wall is *ca* 0.8 m long and *ca* 1.3 m wide;⁸⁰ on the cross-section it is also *ca* 1.3 m wide,⁸¹ and in the report the width of the wall is listed as 1.35 m.⁸² The wall is set in a rock-cut foundation trench about 0.3 m deep.⁸³ Alexandri levelled the foundation trench of the wall at 2.7 m below the sidewalk. On the section the deepest feature in the western part is *ca* 2.4 m below sidewalk level, which is about +0.65 to +0.66 m (calibrated to the 87DZ).

73. The building lot and the streets in the plan are based on a legal surveyed map, and they allow the north arrow to be readjusted to the Marina Zeas map (2003).

74. Alexandri 1979a: fig. 35. The gradient and length of ramp are scaled from longitudinal-section Γ – Γ .

75. According to the 5 m bar scale, the site plan in the publication is close to 1:150 scale (actually 1:158); the plan was likely meant to be reproduced at 1:150. The 5 m bar scales on the two cross-sections and the longitudinal-section are scaled to 1:198 in the publication, which is very close to the intended scale of 1:200.

76. Alexandri 1979a: fig. 34, scaled from the plan. Alexandri does not mention the stone type(s) at any point in the article.

77. Alexandri 1979a: figs. 34–35.

78. Alexandri 1979a: fig. 34, scaled from the plan.

79. Alexandri 1979a: fig. 35, scaled from cross-section A–A.

80. Alexandri 1979a: fig. 34, scaled from the plan.

81. Alexandri 1979a: fig. 35, scaled from cross-section A–A.

82. Alexandri 1979a: 151.

83. Alexandri 1979a: fig. 35, scaled from cross-section A–A.

Alexandri identifies a long rock cutting as a slipway, measuring 20 m long, 4.7 m wide and 0.55–0.75 m deep.⁸⁴ These are in all probability the foundations of the side-passages and the ramp. The roughly 2 m-wide raised rock-cut platform running parallel with this cutting may have accommodated the next colonnade or side-wall, using the average interaxial width derived from the Area 1 shipsheds (6.50 m). It must be stressed that this cutting is on an inclination, whereas the wall appears to rest in horizontal foundation trenches.

The rock-cutting to the south is also identified as a ramp by Alexandri. The feature was excavated for a length of 12 m, is 0.55–0.75 m deep, and is reported to be 4 m wide.⁸⁵ On the plan and in cross-section A–A, the northwestern side of the rock-cutting is evident, but there is no visible trace of it to the south-east. The distance to the southeast boundary of the excavated area is about 4 m on the plan, but the structure probably continued into the unexcavated area (Fig. 20).

North of the wall section were found a column drum (diameter: 0.9 m) and a block protruding from the baulk. Both are set on a fill and form a level top surface. On cross-section A–A, the block appears to have *anathyrosis*; this block and column drum may have been spolia re-used in the construction of the shipsheds (Fig. 19). It is not possible to determine the degree of inclination, if any.

Alexandri's identification of the buildings and the individual structures as two ramps and a side-wall appears to be correct.⁸⁶ Today the shipsheds are completely built over and were in all probability destroyed by the construction of an underground garage. No dating evidence is available, but the shipsheds possibly belong to the same period as the Phase 3 building phase identified in the Area 1 shipsheds (*terminus post quem* 375–350 BC). They could also belong to a later phase or to an earlier building phase in the 5th century BC.

Combining and interpolating the information contained in the maps of Schaubert (Curtius 1841), von Alten (1876/77) and Marina Zeas (2003) (for the northwestern-most part of Z-G5) to the intersection with northern structures found in Group 1 (in the south-east), a width for Group 5 can be cautiously estimated at about 95 m (Fig. 3). The maximum number

of single- or double-unit shipsheds (or slipways) that may be assigned to this group is therefore 14.

4.2. The Topography of the Mounichia Shipsheds

On Aldenhoven's map of 1837, the two 'walls' on the shore in the western and southwestern side of Mounichia Harbour could be related to shipsheds in Groups 4 and 5 (Figs. 4, 21).⁸⁷ Ulrichs' 1843 map shows lines running into the sea in the north/northwestern, southwestern and southern areas of Mounichia (Fig. 5).⁸⁸ They are not labelled, but it is likely that they indicate shipshed or slipway remains. No shipshed (or slipway) structures are visible in Mounichia on the maps of Schaubert (1841; Fig. 23) or von Strantz (1862; Fig. 24).

In 1872 Graser identifies the remains of nine shipsheds in Mounichia: three on the eastern side of the harbour, three on the northeastern side and three on the northwestern side.⁸⁹ Graser's compass directions, however, are incorrect: he describes the harbour entrance as facing south and the harbour fortifications as being on the eastern and western sides of the entrance. The ancient harbour entrance is, in fact, to the east. The two fortified moles are located more or less to the north and south. Therefore, for the purposes of this study, Graser's compass directions are adjusted. He thus recorded three shipsheds on the northern side of the harbour, three on the northwestern side and three on the southwestern side.

Von Alten (1876/77) identifies shipsheds in the same areas of Mounichia as Graser does (Fig. 25).⁹⁰ He probably conducted investigations in the sea at some point in order to prepare the plan and the section of the possible shipsheds in the north/northwestern part of Mounichia published in 1881 (Figs. 29–30).⁹¹ It will

84. Alexandri 1979a: 151.

85. Alexandri 1979a: 151.

86. Alexandri 1979a: 151.

87. Reproduced by Papageorgiou-Venetas 2001: fig. 60.

88. Ulrichs 1843: pl. I.

89. Graser 1872: 40–41, table following page 65.

90. Von Alten 1881: pl. II.

91. Von Alten 1881: figs. 7–8.

never be known who, if not von Alten himself, entered the water and took first-hand measurements of the shipshed remains.

No submerged shipsheds or slipways have yet been identified with certainty during the ZHP's underwater investigations in Mounichia Harbour in 2005–2006, and 2008–2010, but promising remains of possible shipsheds have been found in the northern, north-western and southern areas of the harbour basin. More work here is planned in the coming years.

Analysis of Mounichia Groups 1–7

The shipsheds in Mounichia are divided into seven separate groups based on location and orientation, following the guidelines mentioned in the introduction to this chapter (Fig. 21; pp. 31–32).⁹² It is important to stress that the orientation (except M-G1 and M-G7), size and position of Groups 1–7 on Fig. 21 are hypothetical; the purpose of delineating them here is only to sketch a rough topographical layout of the shipshed complexes at Mounichia.

4.2.1. Mounichia Shipshed Group 1 (M-G1, North)

Graser found 13 structures in this area and interpreted two walls that ran parallel to the ancient northern fortified mole as shipshed I.⁹³ Interestingly, he described the second wall as submerged and running parallel to the fortified mole for a length of *ca* 148 feet (*ca* 45.1 m). Graser measured it on land with an off-set from the fortified mole and notes that it had a very gentle gradient.⁹⁴ The gradient indicates that the structure may have been related to a shipshed (or slipway). If it is indeed the case, it is among the longest submerged shipshed (or slipway) structures recorded in the Piraeus. Graser found a third wall 47 feet (*ca* 14.3 m) to the west of the aforementioned wall and suggests that there were two shipsheds between them (shipsheds II and III) with a reconstructed interaxial width of *ca* 6.66 m.

Graser's identification of three individual shipsheds in this area is not wholly convincing, but it is likely that the structures were related to shipsheds (or slipways). Graser reports that the structures were not oriented

towards the middle of the harbour basin, but towards the harbour mouth.⁹⁵ This information is supported by von Alten's topographical map of 1876/77 (Fig. 25). Further, Graser reports that “the grooves/furrows in the bedrock” (*die rillen im felsboden*) also ran towards the harbour mouth. These “grooves/furrows” (*rillen*) may have been rock-cut slots for transverse timber sleepers or evidence of quarrying.

On von Alten's 1876/77 map seven structure lines indicating shipshed structures run from the northern shore into the harbour basin (Fig. 25). The structure lines vary in length and are oriented to the south. The information provided by von Alten differs from that of Graser, as Graser records six additional structures. Furthermore, von Alten's illustrated shipshed structures are clearly not parallel to the northern fortified mole, as described by Graser. The presence of submerged remains in this area is also augmented by Leake's 1841 map (Fig. 22). Here the symbol “+” (indicating ‘dangerous underwater rock of uncertain depth’) is shown out to a distance of roughly 25 m from the shore.⁹⁶

In 2005 and 2010 the ZHP carried out underwater investigations of this area and found several structures that extends for a maximum distance of 32.5 m from the modern shoreline to a depth of -1.93 m. They are very probably related to the Group 1 shipsheds. The structures documented by the ZHP, how-

92. The map of modern Mikrolimano Harbour used in the topographical reconstruction of the ancient Mounichia Harbour was traced from: Map fragment from the Geographical Service of the Military, Municipality of the Piraeus, Directorship of Architectural Service – General City Planning, Department of City Planning – Topography. Location: Bay of Mikrolimano; Scale: 1:500; Date: August 2003; Responsible for mapping: P. Kastrisios. Greek Geodetic Reference System (G.G.R.S. 1987). Απόσπασμα Χάρτου Γεωγραφικής Υπηρεσίας Στρατού, Δήμος Πειραιά, Διεύθυνση Αρχιτεκτονικού – Γενικό Σχέδιο Πόλης, Τμήμα Σχεδίου Πόλης – Τοπογραφικό. Θέση: Κόλπος Μικρολίμανου; Κλίμακα: 1:500; Ημερομηνία: Αύγουστος 2003; Υπεύθυνος αποτύπωσης: Π. Καστρίσιος. Ελληνικό Γεωδαιτικό Σύστημα Αναφοράς (Ε.Γ.Σ.Α. 87). This map is hereafter referred to as ‘map of Mikrolimano (2003)’.

93. Graser 1872: 40. The Roman numerals refer to the table following page 65.

94. Graser 1872: 40–41.

95. Graser 1872: 40.

96. Measurements scaled from Leake 1841: pl. 4.

ever, are neither oriented toward the middle of the harbour or the harbour mouth (Fig. 21).⁹⁷

In the eastern part of Group 1 the shipsheds could not have extended very far north because of a steep escarpment here. In this area Graser convincingly describes a *ca* 45 m-long submerged and inclined structure next to the fortified mole, and he mentions other structures in this area running from the back-wall on the shore 60 feet (*ca* 18.3 m) out into the sea.⁹⁸ Taking the steep escarpment into consideration, the first structure mentioned above, documented by Graser, strongly indicates the presence of single-unit shipsheds (or slipways) in this area.

The shipsheds (or slipways) were probably staggered to accommodate the curve of the coastline running north-west and south-east across this group (Fig. 21). The width of Group 1 is reconstructed at *ca* 45 m based on ZHP survey results. This length of shoreline could have accommodated a maximum of seven single-unit shipsheds.⁹⁹

4.2.2. Mounichia Shipshed Group 2 (M-G2, North/North-west)

Ulrichs' 1843 map shows four structure lines in the north/northwestern part of the harbour (Fig. 5),¹⁰⁰ and Graser discovered five structures here, three of which he interprets as shipsheds IV, V and VI. Graser interpolates the outlines between V and VI, and therefore his derived interaxial widths (6.23 m, 6.14 m) must be used with caution. Shipshed IV is reported to have had an interaxial width of 6.23 m and a width between the load-carrying elements of 5.20 m. The structures connect to the back-wall, which then changes direction to the south-west of shipshed VI,¹⁰¹ which was in all probability located in the southwestern-most part of Group 2 near the shore.

Von Alten's 1876/77 map shows a wall on the beach parallel to the shoreline and a shorter wall behind it (Fig. 25). These walls may represent the delineation of a passageway running behind the shipsheds, as seen in Dörpfeld's plan of the Area 1 shipsheds in Zea (Pl. 17). Eight structure lines of various lengths run perpendicular from the first wall out into the harbour basin. It seems odd that only seven structure lines run from the back-wall on the sketch map showing the

location of these structures in von Alten's 1881 publication (Fig. 30); either the eighth structure had been covered with sediment or von Alten was imprecise in his work.¹⁰² On this topographical map the shipshed structures are situated in the north/northwestern part of the harbour (Fig. 25), whereas the text describes them as located in the northern part of the harbour.

According to the printed scale on the plan and section (Fig. 29), it was drawn at 1:500 (the bar scale is scaled at 1:497).¹⁰³ On von Alten's plan the 'back-wall' is *ca* 1.5 m wide, whereas it is *ca* 2.3 m wide on the section (Fig. 29). On the plan structure 7 is *ca* 11.4 m long. According to the section, structure 7 is *ca* 22 m long. The interaxial width of 6.25 m printed on the plan is at 1:504 scale, and so von Alten's plan can be considered to be reasonably precise. It may be concluded, then, that the section is not a scaled drawing.

Von Alten identifies structure 7 as a ramp. It was constructed of very long blocks laid on a gradient. Von Alten reports that structure 7 has a gradient of 2°–3° (1:19 to 1:29), but on his section the structure has a gradient of *ca* 1:16 (3.5°) (Fig. 29); again, it is not a scaled drawing.¹⁰⁴

The back-wall of the possible shipsheds is located directly on the shoreline and runs roughly parallel with it (Fig. 30). This position is also evident on the section of structure 7 (Fig. 29). The wall has eight spur-wall-like features spaced at regular intervals. According to von Alten's plan, the interaxial width of the possible shipsheds is 6.25 m – a measurement very close to the interaxial width that Graser assigns to his shipshed IV (6.23 m).

It is interesting to observe that structure 7 is mostly submerged, and that von Alten, like Graser in 1872, documented structures in the sea.¹⁰⁵ On the site plan he shows stippled lines running seaward for almost twice the distance as structure 7, which could signify

97. The investigations of this area are ongoing, and the results will be published in a future volume of this series.

98. Graser 1872: 40–41.

99. Based on a 6.25 m interaxial width.

100. Ulrichs 1843: pl. I.

101. Graser 1872: 41, table following page 65.

102. Von Alten 1881: 13–15, figs. 5, 7–9.

103. Von Alten 1881: figs. 7–8.

104. Von Alten 1881: 14; scaled: fig. 8.

105. Von Alten 1881: fig. 8.

that von Alten saw structures in the sea further out than he was able to record.

In the opposite landward direction, structure 7 runs into the area of the likely ‘back-wall’, so it is unlikely to be a ramp. Given its position in front of the possible ‘spur-wall’, it could be the remains of an inclined side-wall, as seen in the Phase 3 shipsheds at Zea (see Pls. 6, 15, 34a, 35a; Fig. 173a). What appears to be a wall is located in front of spurs 1 to 4. If the shipshed identification is correct, this ‘wall’ has no logical relation with the other structures, and thus it could belong to a later building. The structures investigated by von Alten in Group 2 are most probably shipsheds, but since there is no evidence of ramps or side-passages they are classified as possible shipsheds.

On the right-hand side of spur-wall 4 von Alten found a unique bollard-like stone (feature *a* on the plan Fig. 29; see detail sketch Fig. 28a), which he describes in the caption as “a stone for tying up or winching up a ship”. He also illustrates two similar circular features (labelled *c*) on the site plan (Fig. 29), which he explains in the same way. Von Alten found another stone element, *b*, in front of spur-wall 4 that he and later Wachsmuth, describe as “a support/holder/prop for the keel of a ship” (see detail sketch Fig. 28b).¹⁰⁶ Milchöfer, on the other hand, identifies this element as part of a rain gutter (see below).¹⁰⁷

In 1967, Liangouras conducted rescue excavations in the northwestern side of Mounichia at the intersection of Navarchou Votsi St. and Akti Koumoundourou, *ca* 18 m from the 1967 shoreline (Figs. 21, 31).¹⁰⁸ Liangouras excavated wall T_2 for a length of 6.68 m, and reports that it possibly belonged to a shipshed. It was found to be constructed of perfectly matching limestone blocks (*ca* 0.5–0.7 m long, *ca* 1.08 m wide and *ca* 0.29–0.38 m high), placed directly on worked bedrock. In the report it was not mentioned whether the wall was constructed on a gradient, and therefore it is not possible at present to identify firmly the structure as a shipshed. Graser, in fact, recorded a number of walls ranging between 0.92 m and 1.14 m in width in this part of the harbour and interprets them as elements of shipsheds (see above).¹⁰⁹ Liangouras’ wall falls within this range, and since the wall runs perpendicular to the harbour basin it is reasonable to classify it as the possible remains of a shipshed.

Another wall, T_1 , which lies perpendicular to T_2 , was exposed for a length of 6.50 m; it is 0.84 m wide and between 0.80–0.90 m high (Fig. 31). It is positioned above wall T_2 and appears to be a later feature. A column drum with a diameter of *ca* 0.65 m¹¹⁰ was re-used in T_1 ; it may have belonged to the shipshed complex.

In 1997, 1999 and 2006, M. Petritaki excavated remains of four shipsheds on land in the region of M-G2; these excavations established a distance of *ca* 44.5 m between the back-wall and the present harbour front.¹¹¹ This measurement is important for understanding the topography of Group 2. In Group 2 Petritaki securely identifies the back-wall in the shipshed complex about 44.5 m from the present shoreline. Liangouras found part of a possible shipshed about 18 m inland from the 1967 shoreline.

In the same area of the harbour von Alten (1881) drafted the plan of possible shipsheds, running *ca* 11.4 m into the sea. In 1876/77 he also documented two walls parallel to the shoreline (Fig. 25; see above): one is probably the back-wall and the other could have delineated a passageway as seen in Dörpfeld’s plan behind the Phase 3 shipsheds in Area 1 at Zea (Pl. 17) and perhaps also in the Group 4 shipsheds at Zea (Fig. 10).

Although the present harbour front is located some metres further seaward than the 1870s shoreline, it is likely that Group 2 can be classified as a single-unit shipshed phase, recorded on the shore and in the sea by von Alten, and a later double-unit shipsheds phase excavated by Petritaki. The remains documented by von Alten probably represent an earlier phase; it is likely that structures of the later phase passed above it and were robbed and/or eroded away over time, thus exposing the earlier phase (see, i.e. Pl. 43). However, it must be stressed that the structures documented by von Alten cannot be positively identified as shipsheds.

106. Von Alten 1881: 15, figs. 7, 9, “Stein zum Anbinden oder Hinaufwinden eines Schiffes”; “Lager für einen Schiffskiel”; Wachsmuth 1890: 70. Translation: S. Kennell.

107. Milchöfer 1881: 62. This element is discussed in connection with the roof arrangement of Area 1 of Zea (see Vol. I.2, p. 65)

108. Liangouras 1968: 142–143, fig. 9, pl. 108b.

109. Graser 1872: 41, table following page 65.

110. Liangouras 1968: pl. 9, scaled from the section of T_1 .

111. M. Petritaki, pers. comm., 2007; the present author would like to thank her for allowing him to publish this information here.

The ZHP has also located the submerged remains of possible shipsheds (or possible slipways) in M-G2. This part of the harbour will be investigated further in 2011–2014.

The width of Group 2 is about 80 m. It is delineated to the north-east by the ZHP survey results, and to the south-west by the possible shipsheds found by Liangouras. Therefore, the maximum number of shipsheds in Group 2 is 12 of the single- or double-unit type (Fig. 21).

4.2.3. Mounichia Shipshed Group 3 (M-G3, West/North-west)

For M-G3, the sole information derives from Dragátsis and Angelopoulos, who excavated here in 1898–1900.¹¹² The compass directions they provide in their reports, however, are confusing.¹¹³ Dragátsis locates the shipsheds in the northwestern part of the harbour, whereas Angelopoulos locates them on the western side. Group 3 is in fact located to the west/north-west (Fig. 21). According to Angelopoulos, the back-wall was located 60 m from the shoreline. Today a part of this back-wall is still visible at a distance of *ca* 60 m from the present shoreline.

The load-bearing elements of the superstructure are described by Dragátsis as constructed of “square column bases” placed on top of each other (i.e. they are either pier elements or more likely built-up colonnade foundations). The shipsheds here are reported to be of similar construction to those already excavated on the western side of Zea, but it is not clear whether Dragátsis means the buildings interpreted as shipsheds found in his own 1892 excavation or the possible shipsheds recorded by A. Meletopoulos in 1882.¹¹⁴

Angelopoulos reports that the back-wall was 62.30 m long, and that the shipsheds have an interaxial spacing of 6.25 m. He concludes that there were ten shipsheds, as well as a paved road sloping towards the sea on their north side.¹¹⁵ The width of Group 3 is approximated at 62.3 m+, based on the back-wall length reported by Angelopoulos. The buildings are classified as shipsheds in the present study, and Group 3 consisted of a minimum of ten shipsheds, reconstructed as double-unit types.

4.2.4. Mounichia Shipshed Group 4 (M-G4, West)

In 1837 Aldenhoven illustrated a ‘wall’ on the shore in this area that perhaps is related to the back-wall of the shipsheds, or a wall delineating a passageway behind the shipsheds and possibly also fortifying the naval installations towards the city (Fig. 4).¹¹⁶ Graser saw no remains of shipsheds in the western part of the harbour; as in the northern part of Zea, he assumes that the area was covered in sediment owing to its location directly opposite the harbour mouth.¹¹⁷

Judeich illustrates a group of shipsheds in this area on his 1905 map (Fig. 26). In 1947, I.A. Meletopoulos (the grandson of A. Meletopoulos) briefly reports that remains of shipsheds had been found at two sites during road work related to house construction. The first site is described as north of Epidavrou St., and the back-wall runs parallel to Sangariou St. (Fig. 17).¹¹⁸ The wall was exposed for 27 m with a preserved maximum height of 2.4 m. In the wall was discovered a 1.3 m-wide opening – this is the *only* published possible entrance found into any of the back-walls of shipshed complexes in the Piraeus (see Chapter 8.1.3). On both Judeich’s and I.A. Meletopoulos’ maps five perpendicular stippled structure lines of various lengths run from the wall towards the harbour basin (Figs. 17, 26).¹¹⁹ Today, the western-most part of where these possible shipsheds were found is located about 75–80 m from the shoreline (Fig. 21). Judeich and I.A. Meletopoulos are the only sources of evidence for M-G4.¹²⁰ Based on the 27 m length of the back-wall reported by I.A. Meletopoulos, Group 4 is tentatively reconstructed as four double-unit shipsheds.

112. Dragátsis 1899; 1900; Angelopoulos 1899.

113. Dragátsis 1899: 37–39; 1900: 35–36; Angelopoulos 1899: 39–41.

114. Dragátsis 1899: 37–38.

115. Angelopoulos 1899: 40.

116. See Chapter 8.1.3.

117. Graser 1872: 41.

118. Meletopoulos 1947: 72–73, fig. Δ.

119. Meletopoulos 1947: 72–73, fig. Δ.

120. Hoepfner & Schwandner based their reconstruction of a shipshed group in this area on Judeich (1931) or Meletopoulos (1947) (Figs. 17, 26–27) but do not present the data on which this reconstruction is based.

Nos.	Intercolumnar width of possible shipshed (m)	Width of left delineating structure (m)	Width of right delineating structure (m)	Interaxial width of possible shipshed (m)
VII	5.20	1.14	1.14	6.34
VIII	5.70	1.14	0.66	6.60
L	5.20	1.14	1.14	6.34

Table 4.1. Graser's measurements for the structures found in the southwest part of Mounichia Harbour (M-G6).

4.2.5. Mounichia Shipshed Group 5 (M-G5, South-west)

The second possible shipshed site described by I.A. Meletopoulos is located south of Epidaourou St. (Fig. 21). On his sketch plan a structure parallels the shoreline and four perpendicular structures run towards the harbour basin (Fig. 17).¹²¹ On Aldenhoven's map of 1837 (Fig. 4), there is a structure line on the shore in the southwestern part of the harbour that perhaps is related to the back-wall of these possible shipsheds (or it may be a wall delineating a passageway behind the shipsheds and possibly also fortifying the naval installations towards the city). Ulrichs' 1843 map shows three structure lines in this part of the harbour basin (Fig. 5).¹²²

Today the area is covered by a tarmac parking lot flanked by Epidaourou St. and Akti Koumoundourou. It is not possible to identify the structures as shipsheds on the basis of the available information, and they are very tentatively reconstructed, on the grounds of I.A. Meletopoulos' slim evidence, as three single-unit shipsheds (Fig. 21).

4.2.6. Mounichia Shipshed Group 6 (M-G6, South/South-west)

In this area Graser found four structures, which he interprets as three shipsheds: VII, VIII and L. The information he provides is presented in Table 4.1.

In 1876/77 von Alten also recorded remains that he identifies as shipsheds in the south/southwestern side of the harbour. He shows a structure paralleling the shoreline, intersected by six perpendicular structure

lines of various lengths that run into the harbour basin (Fig. 25). The possible shipsheds (or less likely slipways) in this area were probably single-unit structures, as the Koumoundourou Hill clearly delineates the area to the south. On Leake's 1841 map the area covered by the eastern part of Group 6 and the western part of Group 7 is marked with "+" (Fig. 22), thus indicating the presence of submerged obstructions here.

The 60 m width of Group 6 is cautiously estimated by combining von Alten's 1876/77 map (Fig. 25) and the map of Mikrolimano (2003) (Fig. 21). This area could have accommodated a maximum of nine single-unit shipsheds.

4.2.7. Mounichia Shipshed Group 7 (M-G7, South)

In 2006 the ZHP located two rectangular blocks *ca* 40 m from the inside of the extrapolated ancient fortified mole in the southern part of the harbour. They probably form the foundations for a column base or pier (top surface: -1.75 m). Another structure was found farther to the north-east, *ca* 54 m from the extrapolated fortified mole. The structures are most probably related to shipsheds. Future investigations will shed more light on this area; the structures are presently classified as possible shipsheds.

The width of Group 7 is cautiously estimated at roughly 50 m on the basis of the ZHP survey data. This area could have accommodated a maximum of eight single-unit shipsheds (Fig. 21).

121. Meletopoulos 1947: 72–3, fig. Δ.

122. Ulrichs 1843: pl. I.

Summary

According to von Alten (1881; Fig. 29), the interaxial width of the structures in M-G2 is 6.25 m, and Angelopoulos recorded shipsheds in M-G3 that exhibited the same interaxial width.¹²³ According to Graser, shipsheds VII and L in M-G6 have a slightly wider interaxial width (6.34 m) than shipsheds IV–V (6.23 m) and VI (6.14 m) that he investigated in M-G2 (Vol. I.2, Appendix 1). Based on their research, the interaxial width of the Mounichia shipsheds and possible shipsheds can be approximated at *ca* 6.25 m. According to Graser the clear width between the load-bearing elements of the superstructure in shipsheds IV, VII and L is *ca* 5.20 m, and 5.16 m in shipsheds V and VI.¹²⁴ The clear widths of these possible shipsheds are markedly different (0.67–0.71 m or 11.4–12.1% narrower) from those of the Phase 3 shipsheds in Group 1 at Zea, which are wider at an average of 5.87 m (Dörpfeld: 5.81 m). The difference in interaxial spacing (Zea, Phase 3: 6.51 m and Mounichia: 6.25 m) is smaller: the possible Mounichia shipsheds are 0.26 m (or 4.0%) narrower. This strongly suggests that the clear width (or intercolumniation) between the load-bearing elements of the superstructure (side-walls or colonnades) at original ramp level was wider than the space between their foundations. The difference in clear width and interaxial spacing at Zea and Mounichia may indicate a difference in chronology, ship type and/or ship design. However, they were in all probability built for *triremes* (pp. 172–173).

Very little is known about the architecture of the Mounichia shipsheds. Groups 1, 3 and 7 appear to have had colonnades of either piers or columns.¹²⁵ According to von Alten the gradient of structure 7 in Group 2 is 2° (1:29) to 3° (1:19). The higher range of this gradient, and the inclination of structure 7 on von Alten's sketched section (1:16/3.5°; Fig. 29), are roughly comparable to the average gradient of Phase 1 slipways at Zea (1:19/3.0°), and to the approximate gradient quoted by Graser for “all remaining side-walls” (1:18/3.2°).¹²⁶ Since structure 7 includes a feature that resembles a spur-wall, it is probably part of the load-bearing elements of the superstructure.¹²⁷ This indicates that some of these possible shipsheds were divided by inclined side-walls. At Zea, shipsheds divided by inclining walls have been found in the southern part of Group 1, and an inclined wall divides Shipsheds 16

and 26(?) in the northern part of this group (Pls. 15, 34a).

The three unique bollard-like stone elements found at the upper ends of two Group 2 possible single-unit shipsheds were in all probability related to slipping and hauling operations. They comprise the only convincing evidence of hauling apparatus published from the Piraeus (Figs. 28a, 29).¹²⁸ Although von Alten misunderstood architectural element *b*, he is the only researcher to have published a probable gutter incorporated into an architrave that is possibly from a shipshed (*b* on the plan Fig. 29; see detail sketch Fig. 28b).¹²⁹

4.3. The Topography of the Kantharos Shipsheds

Along the southern shore of Kantharos Harbour, Curtius (Schaubert's map of 1841) notes eight structure lines as *neoria* (Fig. 33).¹³⁰ On Ulrichs' 1843 map, four short lines run from the shoreline roughly into the same area of the harbour basin (Fig. 5). To the west are four additional structure lines that project into the harbour. Leake marks this part of the shoreline with the symbol “+” (“dangerous underwater rock of uncertain depth”; Fig. 32).¹³¹ In Ulrichs' 1843 publication (and again in the 1863 edition) he mentions submerged parallel stone structures similar to those at Zea along the southern coast of Kantharos.¹³² Ulrichs did not identify the structures as shipsheds definitively, but speculates that it would have been a logical area to place a part of the naval installations. No structures are visible in Kantharos on Aldenhoven's map of 1837 or on von Altens' pl. II, 1876/77.¹³³ On another

123. Angelopoulos 1899: 40.

124. Graser 1872: 41, table following page 65.

125. The investigations of these areas are ongoing, and the results will be published in a future volume of this series.

126. Graser 1872: 48, “allen übrigen wangen”; see p. 72.

127. Von Alten 1881: 14, figs. 7–8.

128. Von Alten 1881: 15, figs. 7, 9.

129. Von Alten 1881: 15, figs. 7, 9.

130. Schaubert 1841: map *Peninsula Piraeica cum portubus subjectis*.

131. Ulrichs 1843: pl. I.

132. Ulrichs 1843: 672; 1863: 180–181.

133. These maps are not reproduced here.

map, von Alten (pl. IIa, 1876/77; Fig. 34) marks this area as “shipyards” (*Werften*), and an area farther to the west is marked “shipsheds belonging to 7 trittytes” (*Schiffshäuser von 7 Trittyten*). It must be borne in mind, however, that he may have based this placement on Schaubert’s and Ulrichs’ work.¹³⁴ Graser reports that he briefly investigated Kantharos and saw three to four structures on the southern part of the coast that could have been the remains of shipsheds, and he mentions that Curtius’ map (1841) shows structures in the same area.¹³⁵

During rescue excavations carried out at Kantharos in 1973, Alexandri identified a wall as part of a shipshed.¹³⁶ The excavated area is described as “between Zaime and Flessa streets”, but since these streets are parallel to each other and perpendicular to the sea it is not possible to estimate the distance to the shoreline. Von Eickstedt, perhaps on the basis of unpublished information, places the area near their intersection with Akti Miaouli.¹³⁷

Alexandri’s wall is 0.80 m wide and set on bedrock at a depth of 3 m under the 1973 street level. Two parts of the wall (5.25 m long and 5.80 m long) were excavated for a total length of 14.55 m. Five courses constructed in the header-stretcher method are preserved to a height of 2.20 m. The wall runs in an east-west direction, roughly parallel to the shoreline in this area. If the wall is related to the shipshed complex, it is in all probability the back-wall.¹³⁸ It is also unclear from the report whether Alexandri bases this identification on material evidence or on the fact that the excavation was located in the area where Schaubert (Curtius 1841), Ulrichs (1843, tentatively) and von Alten (1876/77) report remains of shipsheds. Alexandri was familiar with the general layout of this building type from her shipshed excavations at Zea, and so her experience speaks in favour of the identification. In

the present study they are classified as possible shipsheds.

On their topographical map of the Piraeus, Hoepfner and Schwandner definitely allocate too little space for the 94 shipsheds listed in the 4th-century inscriptions of Naval Inventories (Fig. 35). Except for four structure lines on Ulrichs’ map (Fig. 5), a few “+” symbols on Leake’s map (Fig. 32), and von Alten’s caption “shipsheds belonging to 7 trittytes” (Fig. 34), there is no tangible evidence for Hoepfner and Schwandner’s western-most group.¹³⁹

Although the 94 shipsheds in Kantharos would have covered an area in the region of 25,000–30,000 m² in the 330s BC, not a single shipshed has yet been securely identified here. The scant evidence of these structures does not allow for an architectural description of the buildings, and only an approximate location of the shipsheds is known.

Closing remarks

What emerges from this detailed survey of the investigations into the Piraeian shipsheds over the last century and a half is an enormous amount of architectural and topographical data, most of which has not previously been clarified, confirmed, compared or synthesised with other studies. A systematic programme of research combining analyses of previous investigations with new excavations has been sorely needed to construct a meaningful framework for understanding the foundation and development of these three harbours.

The results of the topographical analysis of Zea, Mounichia and Kantharos presented here will be compared with the detailed study of the architecture of the Phase 1 slipways and Phase 2 and 3 shipsheds found in Area 1 of Zea, presented in the following Chapters 5–7; the interpretations based on this examination will be presented in Chapter 8.1.

134. Schaubert’s map (Curtius 1841: fig. 33); Ulrichs 1843: 672; 1863: 180–181.

135. Graser 1872: 58.

136. Alexandri 1979b: 144–145.

137. Von Eickstedt 1991: 147.

138. Alexandri 1979b: 144–145.

139. Hoepfner & Schwandner 1994: scaled from fig. 14: 243 m + 130 m = 373 m of shoreline; this distance would accommodate 57 6.5 m-wide single-unit shipsheds.