Chapter 1 Introduction

1.1. Introduction

O Athens, queen of cities!
How fair your naval base! How fair your Parthenon!
How fair your Piraeus! [1]

At the Piraeus today one can still see the remains of some of the most important but little-known monuments of the Classical period. These are the shipsheds built by the Athenians during their periods of naval hegemony in the 5th and 4th centuries BC. The wealth and power of Athens at the time rested on these gigantic structures that housed their fleet of *triremes*.

The development and adoption of the *trireme* as the main ship-of-the-line by the Archaic and Classical cities of Greece had a ripple effect in economic, social and political terms. Those city-states on or near the coast that invested in building fleets of these powerful, fast and sophisticated warships could now defend themselves from predatory neighbours, protect their sea lanes from piracy, and extend their power overseas. In Athens, in the early years of the 5th century BC, the effect of this adoption was profound. Athens had not been among the traditional sea-powers of Archaic Greece. The city possessed only a few warships and was overshadowed by her neighbours, such as Aegina and Corinth. In 483/2 BC, however, with an enormous Persian army and navy gathering on the horizon, Athens was galvanised by the far-sighted statesman Themistocles to use the rich strike of silver at Laurion to finance the construction of a large fleet of *triremes*, thus turning the city into a first-rate naval power. The Greek allied naval victory over the Persians at Salamis in 480 BC, in which Athens played a critical part, consolidated the city's status as one of the Mediterranean's premiere maritime powers.

An important result of becoming a naval power was the substantial investment in the architecturally-complex, shore-side structures required to protect Athens' equally substantial investment in warships. *Triremes* were prone to damage not only at sea and in battle, but also while lying at anchor or pulled up onto a beach.

1. Fragment of a lost Athenian comedy: Edmonds 1957, *Com. Adespot.* 340. Translation after Hale 2009: 125.

During inactive periods, *triremes* had two essential requirements: dry storage and shelter. Keeping the hulls out of the water during periods of inactivity was critical to minimising waterlogging, which added weight and therefore reduced a vessel's speed and manoeuvrability, and in preventing their slender, softwood timbers from being attacked by wood-boring marine mollusks (*Teredo navalis*, commonly known as shipworm), a perennial threat to all wooden seagoing ships. There is no better example of this danger than with the *trireme* reconstruction, *Olympias,* whose waterlogged timbers deteriorated appreciably after having been berthed for only a couple of months.[2] Thucydides (7.12.3–4) describes the rapid decay of Athenian *triremes* stationed at Syracuse during the fatal Sicilian expedition of 415–413 BC:

> "Our fleet was originally in first-class condition; the timbers were sound and the crews were in good shape. Now, however, the ships have been at sea so long that the timbers have rotted, and the crews are not what they were. We cannot drag our ships on shore to dry and clean them, because the enemy has as many or more ships than we have, and keeps us in the constant expectation of having to face an attack."

But keeping the vessels out of the water was not enough; without provision for covered shelter, *triremes* quickly became victims of the fierce Mediterranean sun. The intense heat and sunlight of late spring, summer and early autumn could thoroughly dry and shrink the hull timbers, thus causing warships to leak and rendering them unseaworthy. Ships left uncovered during inactive periods also easily collected rainwater, which caused damage internally through fungal decay. Without substantial protective measures, a fleet would be rendered useless in a relatively short period of time.

The solution that Athens adopted to minimise these environmental hazards and to house and maintain her enormous fleet was to build shipsheds in the Piraeus in the 5th century BC. The shipsheds at Zea Harbour in the Piraeus were long, parallel, and roofed structures consisting of stone and timber ramps sloping up and away from the water's edge. The ramp itself supported the keel of the ship during slipping and hauling operations, and passages on each side of the ramp offered access for hauling and maintenance crews (Fig. 240; see Vol. I.2). A monumental superstructure consisting of limestone colonnades, walls and a tiled roof provided protection from the elements. Their length was sufficient to ensure that ships could be drawn completely out of the water. By the late 330s BC, the three harbours of the Piraeus – Zea, Mounichia and Kantharos – could house 372 *triremes*. The shipshed complexes in the Piraeus must have been among the largest roofed structures of antiquity.

The extensive excavations and topographical surveys undertaken by the Zea Harbour Project (ZHP) in the two ancient Piraean harbours of Zea (since 2001) and Mounichia (since 2005) have confirmed and corrected the findings of previous surveys, and have added new data which enable a reconstruction of the original terrain and shoreline of these naval harbours. Based on the investigations of Area 1 at Zea (Fig. 2) between 2001 and 2006, it is now possible to identify the presence of four construction phases where previously only two were known. The ZHP has also identified a previously undocumented shipshed design that could accommodate two *triremes* arranged end-to-end.

The first phase of construction, Phase 1, tentatively dated to the early 5th century BC, consisted of unroofed slipways designed to facilitate hauling and slipping operations (Pl. 11). These slipways, presumably, proved uneconomical and impractical because they offered inadequate protection of the warships and thus did not effectively prolong their lifespan. At some point in the 5th century BC, Phase 2 was initiated, whereby the slipways were built over by monumental shipsheds composed of parallel stone colonnades that supported roofs (Pl. 14). These new structures provided much better protection from the elements and thus prolonged the lifespan of the warships. The Phase 2 shipsheds, and in all probability the Phase 1 slipways, constitute the *only* solid archaeological evidence of the Piraean naval bases of the 5th century BC, a time when the Athenians were virtually in complete control of the Aegean Sea. At some point after the second quarter of the 4th century BC, a number of Phase 2 shipsheds were completely built over by the double-unit ship-

2. J.F. Coates, pers. comm., 2003. For the *Olympias trireme* reconstruction see Morrison, Coates & Rankov 2000.

sheds that constitute Phase 3 (Pl. 37). These shipsheds were designed to house two ships stored end-to-end on a single extended ramp. The new layout permitted the storage of many more warships on the available harbour front than the single-unit shipshed design had allowed. Less clear is the identification of structures currently designated as Phase 4. These may be the vestiges of a section of double-unit shipsheds built after Phase 3 (Pl. 15).

This study focuses exclusively on the archaeology and history of the Athenian shipsheds and slipways of the 5th and 4th centuries BC. It is organised into one volume comprised of two fascicules. Volume I.1 offers a historical introduction that contextualises these structures within the history of Athens and the Piraeus in the 5th and 4th centuries BC (Chapter 2); an assessment of previous research published since 1821 on such structures in both the Piraean harbours and the wider Mediterranean world of antiquity (Chapter 3); an examination of the arrangement and topography of the shipsheds in the Piraeus (Chapters 4, 8.1); a detailed analysis of the architecture of the Area 1 slipways and shipsheds in Zea Harbour (Chapters 5–7, 8.2); and a summary of the results of this study (Chapter 9). Volume I.2 presents a study and catalogue of the ceramics and other small finds found during the ZHP excavations in Area 1 of Zea Harbour (Chapter 1); and a presentation of the roof tile material together with hypothetical reconstructions of the roof arrangements of the Phase 2 and Phase 3 shipsheds (Chapter 2). These are followed by a catalogue of the architectural features documented in Area 1 (Chapter 3). Appendices, figures and plates complete the second volume.

Future volumes in *The Ancient Harbours of the Piraeus* series will present detailed studies of the topography of the harbours of Zea[3] and Mounichia and the architecture and topography of the fortifications encircling these harbours. These studies will be based on extensive fieldwork that has taken place since 2005, and will incorporate the results of future fieldwork planned at Zea (until 2011) and Mounichia (until 2014). They will also treat the operations of warships within the naval harbours, as well as touch on the history of the Piraean naval bases in the Hellenistic and Roman periods.

1.2. Terminology

The criteria traditionally used in previous research for identifying and classifying structures as shipsheds or slipways have often been either ambiguous or inconsistently applied. It is therefore necessary to define the terminology and methodology that will be used throughout this study.

The Attic Greek term νεώσοικος (*neosoikos*), formed from ναῦς ("ship") and οἶκος ("house"), has traditionally been translated imprecisely in English as "shipshed". The German *Schiffshaus* ("ship house") correctly translates the ancient term and is a more accurate description of these monumental and permanent buildings. This study, however, has chosen to employ the traditional term 'shipshed' to avoid confusion. In ancient sources the noun is primarily used in the plural νεώσοικοι (*neosoikoi*) – "shipsheds"; the singular νεώσοικον appears only once in Aristophanes' *Acharnians* (96). There is no known ancient term for slipway.

The noun νεώριον (*neorion*) is translated in this work as "naval base". It describes the protected naval zone of an ancient harbour (including shipsheds and/or slipways). In ancient historical sources the term is sometimes used as a synonym for νεώσοικοι,[4] although it is incorrect to assume that a *neorion* always contained 'shipsheds'.

Shipshed

In this study, a structure is identified as a shipshed when there is evidence of a ramp preserved roughly in the centre between two parallel lines of superstructure, with both elements having been in use at the same time. The best examples include the shipsheds at Oiniadai in western Greece (Fig. 44), the Phase 3 shipsheds at Zea (Pls. 15–16), Phoenician Kition, and the Punic shipsheds on Ilôt de l'Amirauté at Carthage (Fig. 37).[5]

3. *The Ancient Harbours of the Piraeus*, *Vol. II* will present the architecture and topography of the slipways and shipsheds in Group 2 and the southern part of Group 1 at Zea (see Fig. 3). This forthcoming volume will also include a detailed study of the harbour and coastal fortifications in and around Zea.

4. *LSJ*, s.v.; Blackman 1968: 181, note *.

5. These and other parallels are discussed further in Chapters 3, 5–8.

A shipshed also includes the following elements and characteristics (Figs. 240–241):

1) A keel-supporting ramp section. This main ramp element maintains a relatively linear gradient in order to support the keel during hauling, storage and slipping. The various ramp designs are discussed in detail in Chapters 5 and 7.

2) A stern-supporting ramp section. In some shipsheds the upper ends of the ramps curve more steeply upward to provide support for the upward curving sterns of warships in order to prevent them from sagging here during storage (see Chapter 7.3). It should be stressed that a structure may still be identified as a shipshed if it lacks this stern-supporting ramp feature, and of course there could be no such feature for the lower of the two ships accommodated in a double-unit shipshed. There is no evidence of unroofed slipways with this feature.

3) Side-passages. Narrow, longitudinal passages positioned on either side of the ramp and designed to provide access and working space for the crew and workers in the shipsheds. This term, the author's own, will be discussed at length in Chapter 7.

4) Columns, piers (square pillars), walls and wooden posts. These comprise the load-bearing elements of the shipshed superstructure (see Chapter 6).

5) A roof. At most shipshed sites a tiled roof provided protection from the damaging effects of sun and rain. The various roof designs are discussed at length in Vol. I.2, Chapter 2.

Slipway
A slipway is defined as an unroofed ramp with open-passages on either side. Since there were no obstructing load-carrying elements of superstructure such as colonnades or walls between two adjacent ramps, they could share a common open-passage between them. The term 'open-passage', coined by the author, is used in this study for these spaces required for hauling and maintenance operations. (Open-passages will be discussed at length in Chapter 5.) Examples include the slipways at Place Jules-Verne in Marseille (see pp. 64–65 and Fig. 54) and the Phase 1 slipways at Zea (see Chapter 5 and Pls. 3, 11–12). At these two sites the ramps are defined by transverse timber sleepers set in sand (Place Jules-Verne) and rock-cut slots for transverse timber sleepers (Zea, Area 1).

Possible Shipshed
A structure is classified as a 'possible shipshed' if there is evidence of parallel walls or colonnades but no clear evidence of a ramp structure and/or side-passages. A good example is the first building phase of the two colonnades found at Hyllaikos Harbour on Corfu (Corfu A, see p. 123). Sites where the ramp and superstructure cannot be identified convincingly as belonging to the same building phase, or as having been in use at the same time (such as the off-centre ramps at Place Villeneuve-Bargemon in Marseille), are also classified as 'possible shipsheds' (see pp. 64–65 and Fig. 53). Possible shipsheds are noted in this study with a question mark, e.g. Shipshed 26(?).

Possible Slipway
'Possible slipway' is the term used if there is evidence of an inclined structure near or on a shoreline but no evidence of an actual ramp or superstructure. For example, the two waterfront sites on the island of Alimnia off Rhodes are either severely eroded slipways, remains of an unfinished initial construction phase of slipways (or shipsheds), or they may be quarries; they are consequently classified as 'possible slipways' (see pp. 24, 27).

A number of abbreviations are used to describe the individual elements and architectural features of these structures: S: shipshed; SW: slipway; R: ramp; C: colonnade; Q: quarry; U: unidentified feature, etc. For example, SW3:R3 designates 'Slipway 3, Ramp feature 3'. C16/17:2(Θ) designates the 'Colonnade dividing Shipsheds 16 and 17, feature 2' (cross-referenced to Θ in Wilhelm Dörpfeld's plan of Area 1 at Zea; see Pls. 6, 15, 17). The individual feature codes cross-reference directly to the feature catalogue in Vol. I.2, Chapter 3. A full list of abbreviations is also found there.

1.3. Methodology

Comparanda

The methodological approach employed in this study includes a critical evaluation of comparable evidence relevant to the study of the slipways of Phase 1 and the shipsheds of Phases 2–3 in Area 1 of Zea Harbour (see Chapters 3–7). The aim of this evaluation is to clarify the quality, and therefore relevance, of the material evidence bearing on naval installations that have been published to date. Included in the corpus of comparable evidence are the shipsheds, possible shipsheds and slipways within the three Piraean harbours (Zea, Mounichia and Kantharos), and those in the wider Mediterranean world that are relevant to the study of the Piraean structures. These include such sites as Oiniadai, Kos, Mandraki (Rhodes), Phoenician Kition and Punic Carthage. These shipshed sites and a single slipway site at Marseille represent the direct comparanda outside the Piraeus. Other shipshed and slipway sites that provide indirect parallels to this study are analysed and included in the relevant discussions.

Fieldwork at most of these sites has been completed, at least for the present (see Chapter 3). However, aside from Carthage (north/northeastern edge of the Circular Harbour) and Mandraki, the results from these sites are currently available only in preliminary publications. Consequently, essential information from these sites can only be deduced from published architectural drawings whose quality reflects the state of survey and recording technologies that were utilised at the time the data were collected. A brief assessment of survey and recording methods is presented in Vol. I.2, Appendix 6.

Use and Reliability of Extrapolations

The precise inclinations of ramps, open-passages, side-passages and superstructures in all phases are a critical factor in interpreting the architecture of slipways and shipsheds. Since none of the investigated slipways and shipsheds at Zea are preserved to their full length, their carefully measured inclinations provide an all important parameter in the reconstruction by extrapolation of their total lengths. The precision of the extrapolations relies on the accuracy of the data on which the calculations are based. The data are primarily affected by two main factors – the accuracy with which the archaeological survey data were recorded (including the state of preservation of the individual ancient structures in question), and the accuracy with which the location of the ancient shoreline can be established.

Data recording accuracy. A number of researchers have used various means to calculate structural gradients. Towards the end of the 19th century, B. Graser (see Chapter 3) was the first to define the gradient in terms of the ratio between the change in vertical height and the horizontal length of a possible slipway or shipshed structure.[6] More recently, scholars such as D.J. Blackman, H. Hurst, K. Kantzia, P. Knoblauch and J.F. Coates have also used this method.[7] Others, however, have calculated the gradient in degrees,[8] and E. Kenny employs both degrees and the change in height over horizontal length.[9] In this study, the gradient is listed as a height/horizontal length relationship and in degrees, for example 1:12.3 (4.65º).

Since slipways and shipsheds are built on an inclination that slopes towards the sea, it is important to keep in mind that the height (or depth) of an original surface (or near original surface) of a feature, such as a rock-cut slot for a ramp's transverse timber sleeper or a column base (always measured in this study in relation to the Ε.Γ.Σ.Α. 87 Datum Zero, henceforth abbreviated 87DZ),[10] is just as important as the distance to the shoreline defined by that datum. Once the range of inclination of a particular structure or group of structures is known, the height (or depth) can be used to calculate their relation to other structures and to the

6. Graser 1872: 72.
7. Blackman 1968: 181 (Zea); Hurst 1979: 24 (Carthage); Kantzia 1992: 634 (Kos); Blackman, Knoblauch & Yiannikouri 1996: 380 (Mandraki); Coates 2002: 269 (Zea). Blackman uses degrees once in one article (1996b: 38, Kition), and both degrees and height/length in another (1973b: 14, Matala).
8. Von Alten 1881: 133 (Mounichia); Davaras 1967: 85 (Sitea); Flemming 1971: 103 (Apollonia); Cooper 1972: 360 (Arcadia); Raban & Linder 1978: 243 (Dor); Samiou 1999: 364 (Abdera); Callot 1997: 72 (Kition).
9. Kenny 1947: 196.
10. Ελληνικό Γεωδαιτικό Σύστημα Αναφοράς (Ε.Γ.Σ.Α. 87), or Greek Geodetic Reference System (G.G.R.S. 1987).

87DZ. Thus these data are critical for reconstructing the length of slipway and shipshed structures.

Ancient structures are very rarely found in pristine condition, so it is important to document inclined structures with numerous height measurements (spot-heights) or survey points (i.e. X, Y, Z coordinates recorded with a theodolite, total station or laser scanner) in order to obtain accurate sections and a sound data set. The inclination should be calculated using linear regression based on the best preserved surfaces of the structure (see, for example, the inclination calculations of the wall dividing Shipsheds 16 and 26(?); Fig. 220).[11]

The measuring methodology and the recording system employed by the ZHP together with the nature of the remains all bear directly on any attempted analysis of these structures. For measurements in the sea thousands of individual points were surveyed digitally with an X, Y accuracy of *ca* ± 0.005 m to create very detailed models of what was being surveyed. The 0.005 m margin of precision was caused primarily by the inevitable wobbling of the prism pole used during shallow-water surveys (at depths mainly between -0.01 m to -1.00 m, but as deep as -2.20 m). Both on land and in the sea the Z margin of precision is 0.003 m. All values include the instrument precision of the Leica TCR 407 total station (0.002 m + 2 parts per million) used to record the coordinates. This instrument precision represents the X, Y accuracy on land, where the individual points in most cases can be surveyed directly without using a prism pole (see Vol. I.2, Appendix 6). It is important to note that most features are eroded and have suffered various kinds and degrees of damage. Considering all of the above, the measurements are listed to two decimal places.[12] In this study, elevations are not noted on plans, but given in the feature catalogue under the individual features (see Vol. I.2, Chapter 3).

Slipways and shipsheds are very long structures. When extrapolating or reconstructing partially preserved ramps, side-passages, open-passages and superstructures it is very important to calculate the gradient by recording the data with the highest precision attainable given the state of preservation of the individual structures. In this study, the gradients of the Phase 1 slipways and the shipsheds of Phases 2, 3 and 4(?) at Zea were calculated using a combination of linear regression methods laid out in Chapter 5 (see pp. 55–56). The gradients are calculated in accordance with the number of significant digits that would be allowed by the accuracy of the recorded measurements. For example, the spot-height Δ2 on the ramp of Shipshed 21(Δ) (+3.17 m, calibrated +3.10 m, Pl. 18) can be extrapolated to the 87DZ using a more precise inclination of 1:12.4 (4.61°). Using these values, the ramp would meet the 87DZ at a distance of 38.44 m; using the approximate value of 1:12 or 4.8° in the calculation, the ramp would meet the 87DZ at a distance of 37.2 m. The resulting difference in length yields a substantial 1.24 m in variation, thus demonstrating the importance of recording with the highest possible precision.

At sites where the inclination calculation is based on very few spot-heights, such as ramps 16 and F762 in the Circular Harbour at Carthage, and the side-passages at Mandraki (see pp. 65–66, 143), a marked inaccuracy in the inclination calculation is almost inevitable. Inclinations can also be scaled off sections with various degrees of reliability. At Oiniadai, for example, the upper end of ramp 2 (Fig. 45) represents a section based on too few data, whereas ramp F762 represents a high quality section (Fig. 41). Consequently, such calculations are considered as approximate, or guides. When the data used to calculate the inclination remain unpublished, the results must be treated with extreme caution because the evidence cannot be verified, and any extrapolations based on these are scientifically invalid.

Position of the ancient shoreline. The total length of a shipshed has been established only at Apollonia (p. 26, Figs. 50–51) and at Ilôt de l'Amirauté, Carthage (shipshed 4; p. 25, Fig. 37). In Area 1 at Zea the lower ends

11. The methods were developed by B. Klejn-Christensen and the author. In the analysis of the Phase 1 ramps a selective calculation method, G1-HB, was also used (see pp. 55–56).
12. There are two exceptions in which the remains were recorded to three decimal places: the two column drums found in Area 1, and and the 13 column drums found in Area 6 (see Chapter 6, pp. 90–96).

of all slipways and shipsheds have been destroyed by intrusive dredging at maximum depths between -0.99 m (southern part) and -1.07 m (northern part) (Figs. 184a, 216a; Pl. 40).[13] Their lengths can be reconstructed only by extrapolation to the reconstructed Classical period sea level. At most archaeological coastal sites the ancient sea level is a very fluid figure. In the Piraeus it is possible to establish a *minimum* relative sea level change of *ca* -1.90 m since the Classical period, but there are very strong indications of a *maximum* relative sea level change of around *ca* -2.90 m (see Chapter 8.1). The variation of 1.00 m between the established *minimum* and hypothetical *maximum* relative sea level leaves a wide range of possible reconstructed lengths for the slipways and shipsheds. The length extrapolations to the established *minimum* relative sea level, derived from the Phase 1 slipway and Phase 3 superstructure inclination, are theoretically based, as the data can be tested. Although the length extrapolations to the *maximum* sea level are likely to be correct, they are still hypothetical, and can only be refuted or verified through future investigations of the coastal landscape of the Piraeus.

Relative Chronology and Sequencing

The Area 1 excavations at Zea produced only one closed deposit containing diagnostic finds, found in the upper ramp area of Phase 3 Shipshed 17 (U:2, see Pl. 6 and Vol. I.2, pp. 2, 39).[14] For this reason the relative chronology of building Phases 1–4 is based primarily on an analysis of the sequence of rock-cut and built structures. In contrast to a relative chronology based on *layers*, this type of chronology based on *feature sequence* creates more open-ended questions and the need to be extremely careful and specific in the presentation of the relative chronology. Accordingly, the evidence used to construct the key relative chronology is presented at the start of those chapters that deal with the building phases and their architecture (Chapters 5–7).[15]

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13. Measured at the point where the dredging has cut though colonnade foundations C23/24:10 (south) and C16/17:10 (north).
14. See Vol. I.2, Appendix 7 for a description of the sedimentation in Area 1 of Zea Harbour.
15. For an overview of the relative chronology and sequencing of Phases 1–4 see:
Phase 1 slipways: pp. 53–54, 168–169;
Phase 2 shipsheds: pp. 73–75, 130, 169–171;
Phase 3 shipsheds: pp. 73–75, 130, 172–173; Vol. I.2, pp. 39.
Phase 4 shipsheds(?): pp. 108–109, 128, 173.