The reconstruction of ships on the basis of their actual remains has only recently emerged as one of the most important and rewarding aspects of nautical archaeology. Early shipwreck excavations were mainly concerned with the artifacts that made up the cargo and ship’s inventory, but the ship itself remained largely a mystery until recently. The study and reconstruction of excavated vessels, when properly executed, yield far more than mere hull shapes and sizes. The tools, techniques and procedures of construction, regional differences and social and economic changes reflected in shipbuilding, metalurgy, and methods of rigging and sailing are but a few examples of the many and varied facets of knowledge to be gained.

AINA staff members have been studying and developing ship reconstruction methods since the early 1960’s. Such methods must vary to suit excavation conditions and state of hull preservation, and run the gamut from plans and models to completely rebuilt hulls (the Kyrenia ship). The first AINA ship reconstruction was completed this spring when J. Richard Steffy and Frederick H. van Doorninck, Jr. drew up ship’s plans for the final publication of the 7th century Byzantine ship excavated at Yassi Ada, Turkey, during 1961-1964. Although less than ten percent of the hull survived (and even this was in a badly deteriorated condition), it proved possible to develop a full set of plans for this just under 70 ft. long merchantman. Three of the plans are here published for the first time. The accompanying text briefly describes some important new insights about the ship acquired while the plans were developed and the evidence on which they are based was reviewed.

Old Problems, New Evidence

Work on reconstructing the 7th century Byzantine ship at Yassi Ada was begun in 1966 when a graphic, three-dimensional reassembly of the hull remains was made. A series of models and draughts based on this reassembly was then undertaken over a number of years to determine the ship’s overall shape. A set of lines plans was finally published in 1972 in Chapter 6 of A History of Seafaring Based on Underwater Archaeology, edited by George F. Bass. Even then some fundamental questions about the hull remained unresolved. So little of the framing had survived that we had been unable to discern the basic framing plan employed. Nor had we succeeded in developing from the hull planking remains a full planking plan that was mechanically feasible for shell-first construction. However, some comparative material newly available within the past two years has led to a resolution of these questions.

The Pantano Longarini ship, a slightly earlier Byzantine vessel excavated in Sicily by Peter Throckmorton, was constructed very much like the Yassi Ada ship, and detailed drawings of its remains recently published has afforded some information on contemporaneous framing practices that makes the framing plan for the Yassi Ada ship intelligible for the first time. An even more fruitful source of useful information has been the Kyrenia ship excavated in Cyprus by Michael Katzev. The work of restoring its well-preserved hull, now about completed, has unlocked many of the secrets of ancient shell-first construction, and we have found that many of the construction techniques involved apply to the Byzantine ship at Yassi Ada as well. This new knowledge has now enabled us to develop a complete planking plan of the Byzantine ship that is fully in harmony with the construction techniques employed in building the hull.

Construction Plan

The construction plan (Fig. 1) has confirmed the already published lines plans of the hull except at the bow and stern above the waterline, where it proved necessary to modify the lines giving both bow and stern a somewhat greater overhang and amplitude. Much of the construction is curious by modern standards. Every third frame consists of two half-frames barely reaching the keel and top timbers. Half of these have short floors that extend out to just below the turn of the bilge. The rest have long floors that extend out to just above the bilge turn. Heavy beams penetrate the ship’s sides at points of greatest stress—at the mast, anchor storage, and steering area. These beams and smaller intermediate beams support the deck.

We believe the most likely hull construction sequence would have been the following. Several strakes of edge-joined outer planking were first installed on either side of the keel and the short floors then inserted. Another four or five strakes were added to bring the hull shell to the turn of the bilge, and the long floors were inserted. The shell was then completed to the waterline and half-frames and futtocks inserted. Internal hull planking (ceiling) was installed next. Finally, the heavy-timbered hull sides—wales, top timbers, beams, and clamps—were erected to complete the construction.
Fig. 1. Construction Plan.

Fig. 2. Deck Plan.
The 7th Century Byzantine Merchant Ship at Yassi Ada
Our new deck plan (Fig. 2) illustrates in greater detail than heretofore how the ship's iron anchors had been stowed. The ship was carrying four bower anchors on the bulwarks in the forward quarter when she sank. The captain must have occasionally found it necessary to use all four anchors simultaneously due to their extreme lightness. Three had weighed about 173 lb.; the fourth, about 243 lb. The shanks and arms of the anchors were quite thin and the flukes poorly developed. Such anchors were undoubtedly often broken. Consequently, the captain carried four spare bowers, one again of the heaviest weight, piled on the deck nearby. At the bottom of the pile lay three heavier sheet anchors of about 312 lb. to be used as a last resort.

Stock remnants were not found with the four bower anchors. This has led us to conclude that the stocks were of wood that had perished, for bower anchors normally are ready for instant use. We know that at least two or perhaps three iron stocks were stowed with the anchors piled on the deck. These iron stocks were probably used to facilitate setting anchors when short cable was employed, such as when kedging.

How stocks were mounted on the anchors is another question that was not completely resolved to our satisfaction until this spring. There was an elliptically-shaped aperture in the shank of each anchor near its upper end which caused a marked swelling in the shank's width at this point. The two iron stocks stowed with the anchor pile, each roughly elliptical in section and having a shoulder about midway along its length, were so designed that they could be inserted and seated within the apertures of many of the anchors. However, no pin ran through either stock to hold it in place once it was seated, nor, as we learned by making an anchor model, was there any way to keep the stock rigidly perpendicular to the shank. The iron stocks simply would not have functioned properly as they were. We believe for this and other reasons that the iron stocks must have been sheathed in wood when in use and have now devised a common design for wooden sheaths and all wood stocks alike that would have worked well. We have hypothesized in either case a wooden member divided lengthwise into two halves which when lashed together fit snugly over the aperture swelling which then held the stock rigidly in place.

As already noted, the development of a complete planking plan for the hull has resulted in an enlargement of the stern area, where a tile-roofed galley was located. In our earlier reconstruction of the hull with a smaller stern area, the number and size of the galley roof tiles recovered from the wreck made it necessary to hypothesize a rather poorly designed roof which spanned the entire width of the hull at the very stern and made deck-level access to the sternmost area of the ship extremely difficult. However, as the new deck plan shows, we now have been able with the same tiles to roof a free-standing deckhouse large enough to give access to the galley and illumination both to the galley itself and to known storage areas located just forward and aft of it but small enough to permit free deck-level access to the sternmost area.
Galley Interior

The hypothesized access and lighting arrangements for the galley complex are illustrated by Fig. 3. This side view of the galley interior also shows a new reconstruction of the galley’s hearth remains. An earlier reconstruction of this hearth has been rightly criticized as being impractical for shipboard use, nor was it in full agreement with the evidence provided by the remains themselves. These deficiencies, we believe, have now been corrected. The hearth as now restored consists of a tile firebox open at the front erected on a bed of clay and fragments of thick tiles. The firebox is re-enforced by an inner and outer iron band embedded in clay. A large iron bar spanning the open end of the firebox and the back wall of the firebox support a number of smaller iron bars which form a grill. The interval between the smaller bars of the grill can be adjusted, and the smaller bars can be removed and securely stowed when the hearth is not in use. All of the tiles, the large bar, and substantial portions of the other elements of the reconstructed hearth were actually recovered from the galley area.

A model, one-tenth full size, is presently under construction and should be finished by the end of the year. It will be complete in every detail—nails, bolts, tenons and timbers will exactly duplicate originals where they survived. This model is more than just a three-dimensional record of our work. It can be used to instruct students on the fine points of the shipwright’s craft and will be a physical reference by which future scholars and excavators can compare their discoveries. A photographic record of each step in building the model is being made. Hopefully, some future issue of the newsletter will contain several of the photographs.

-J. Richard Steffy
Frederick H. van Doorninck, Jr.

Further Reading


Summer Excavation

As we go to press, AINA's 1974 summer excavation is just getting under way. During the first part of the excavation season, a small team will complete work on the Roman shipwreck at Yassi Ada. Following that, a larger group will begin excavation of the Archaic wreck discovered by AINA last year. Work will continue into September.

Recent Grants

AINA is pleased to acknowledge gifts in support of the summer project from the following donors: The Alcoa Foundation; Harrison Eiteljorg, II; the National Geographic Society; SCM Corporation; and the Triopian Foundation.

Field School

AINA is conducting its first summer field school during the months of July and August. Participating in the excavation of the Archaic shipwreck are Pierre Bikai, manager of excavations at Tyre, Lebanon; Karen Cannon, undergraduate classics major, University of Texas at Austin; Brian Fugler, graduate student in Archaeology, University of Toronto; Faith Hentschel, graduate student in Archaeology, Yale University; Jack Iron, B.A. in Classics (1974), University of Texas at Austin; Bradley Marshall, undergraduate student in Anthropology at Boston University; Fredericus Meijer, instructor of Ancient History and Archaeology at the University of Amsterdam; Mary Strouse, B.A. in Classics (1974), Washington University; Owen Sutton, graduate student in Geologic Oceanography, Old Dominion University; David Switzer, Associate Professor of History, Plymouth State College.

The students will receive training and experience in techniques of underwater excavation and classroom instruction in the history of seafaring in the Mediterranean and the history of naval architecture.
The American Institute of Nautical Archaeology is a nonprofit scientific/educational organization whose purpose is to gather knowledge of man’s past as left in the physical remains of his maritime activities and to disseminate this knowledge through scientific and popular publications, seminars, and lectures. The AINA Newsletter is published periodically by AINA and is distributed to its members and Supporting Institutions, to inform them of AINA’s current activities.

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