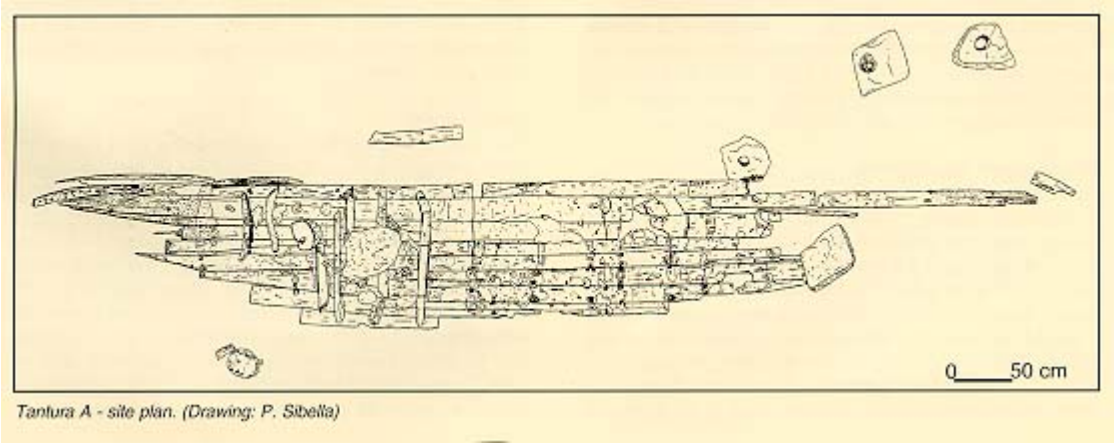
THE 1995 INA/CMS TANTURA A BYZANTINE SHIPWRECK EXCAVATION HULL CONSTRUCTION REPORT



Tantura A - site plan. (Drawing: P. Sibella)

The study of the Byzantine shipwreck was initiated at Tantura Lagoon in the 1994 field season (CMS 22, INA 22.2). The second season saw the continuation of our research in Trench VI on the remaining timbers of the vessel and associated artifacts. A month of excellent weather and calm seas permitted us to further excavate the remains, and a greater area of the hull was revealed for investigation. This seasonÕs analysis of hull components and their fastenings has confirmed our previous hypothesis that no mortises or tenons were used in the construction of the vessel. Investigation of the 9 m length of preserved remains did, however, reveal nail and bolt attachments. Byzantine pottery from the vessel's cargo and Carbon-14 analysis of various timbers, place this vessel in the 6th century CE. Thus, we have evidence for what is at present the earliest example of Mediterranean hull construction in which frames preceded planks. Our reasons for this conclusion are presented below.

Recording Methods

Hull and artifact measurements were taken directly and with the assistance of WEB relational measurement software. In addition, selected timbers were traced underwater on mylar sheets. All timbers were recorded fully in black and white prints and a color video was taken of the entire site, with close-ups of significant features.

The Keel

A 5.2 m length of keel was preserved. It lay oriented SE to NW on a magnetic compass bearing of 130º-310º. The keel terminates in the NW at its junction with the post, while its SE terminus exhibits signs of a perpendicular break. The keel timbers were taken from the central portions of an Aleppo pine. Saw marks are discernible upon the surfaces of both keel timbers. The keel curves downwards, maybe due to

stresses following its deposition. It is also twisted 20º toward the SW and is further distorted at the post junction to the SW. The keel has a rectangular cross-section with average dimensions of 11.0 cm sided (wide) and 18.0 cm molded (high), though this dimension varies significantly along its length. There was no keel rabbet nor were chamfered edges for the garboard or a false keel apparent. Two hook scarfs are present in the keel section, both cut in the same direction. The first is 3.5 m from the keel's SE terminus, and is 26.0 cm in length. The second is located 1.7 m further NW, and is a more complex, 26.0 cm long, hook scarf that served to attach the keel to the post.

The Post

A transition timber that formed the change in attitude between keel and post, was attached to the NW end of the keel. No convincing evidence has yet been found to indicate whether this end was the bow or the stern. This timber was cut from a naturally curving Aleppo pine. From the keel / post scarf, the post rises at a curving angle of about 55º. The post is 1.16 m in length and 0.52 m high, with a curved length of 1.32 m on its upper surface. Its average sided dimension is 9.5 cm, narrowing from 10.0 cm at the keel / post scarf to 8.5 cm at its terminus. The molded dimension at the keel / post scarf is 16.5 cm, tapering to 14.7 cm for the majority of its length. The back rabbet carved into the postÕs upper surface is 5.0 cm high and has a width of 1.2 cm. Upwards of the rabbet, the molded dimension narrows to 6.0 cm at its end. In addition to the keel / post scarf, the post has a second hook scarf which is located at the uppermost extremity of the timber. Here, however, there is no connecting timber. This hook scarf, aligned in the same direction as the previous two hook scarfs, has a bolt hole 1.5 cm in diameter which probably housed the bolt that secured the scarf.

Frames

On the SW side of the keel, fragments of eight frames have been preserved, situated in seven framing stations. Linear staining patterns, imprinted on the inner surfaces of the planking and the upper surface of the keel, indicate 17 additional frame stations whose timbers did not survive. Nail holes and these stained surfaces attest to the method of attachment. We believe this discoloration has resulted from the use of pitch or resin between the planks and the frames. In all, 24 contiguous frame stations were evident. The average frame dimensions are: 9.0 cm sided (ranging between 4.5 to 16 cm) and 9.5 cm molded (ranging between 4.5 to 12.5 cm). Average center-to-center spacing is 32.4 cm (ranging from 15 to 48 cm). The extant frames differed widely in dimension and wood type. Each was either broken at the keel or was severely truncated in length, leaving no remains on the NE side of the keel and making original frame length measurements unobtainable. All the frames (aside from frame 2 - a small olive branch showing no signs of fastening), were worked flat on their upper and lower surfaces to form a rectangular cross-section. Each possesses a 1.0 cm deep mortise for seating the frames atop the keel. Limber holes measuring 4.0 cm by 4.0 cm were found in the frames near the keel and at the turn of the bilge. We have no direct evidence of floors, nor of the use of full or half frames.

Planking and Attachments

NE of the keel, only a 1.475 m section of garboard near the post, and a loose strake

fragment have survived. SW of the keel, eight strakes have been preserved, including the garboard which is 8.78 m in length and 2.5 cm thick. The garboard widens from 19.5 cm at the post to 23.0 cm, and narrows to 15.5 cm at its terminus. It is comprised of three Aleppo pine planks which are joined by two butt joints. The garboards were seated in rabbets cut into the post timber and not nailed to either the post or the keel. Nail holes probably represent an attachment to frames or inner reinforcement timbers. The inner edges of the garboards rest 5.0 cm below the upper surface of the keel, and continue 14.0 cm into the post where they have been especially carved to sit in the post's 5.0 cm deep back rabbet. Hence, the garboards bend on all three axes to create a deadrise angle, nearly horizontal at midships and vertical at the post. All other strakes were made of Aleppo pine, to a thickness of 2.5 cm. Plank widths vary greatly, from 3.8 cm at the post to 26.0 cm amidships. Midship, there are nine strakes, decreasing to five at the post through the use of drop strakes. The narrowing of the hull on the opposite side, also through the use of drop strakes, indicates that the middle of the ship may lie near the widest preserved framing timber. The only evidence for the use of butt scarfs is in the joining of the planks. Each of these was located together with a framing station and each plank was secured with nails. Iron nails, driven from the outside, were used to fasten the planks to the frames and to attach the frames to the keel. A typical nail hole was 0.6 cm by 0.6 cm. Depending on the width of the plank, one to three nails fastened it to the frame at a frame station, with a typical spacing of 8.0 cm between nails. There is no evidence of nails penetrating the upper surface of the extant frames, usually indicative of ceiling attachment. However, a loose ceiling could have been utilized with only the ends secured, if at all. There were no mortises or tenons observed on any planking edges or scarf seams. Evidence of charring on the NW extremities of the strakes and on the SE extremity of the garboard, indicate bending through a heating process. Additionally, some charring was found on the outer surfaces of the centrally located strakes, possibly indicating treatment for invasive wood worms. Charring was not present on the frames or keel. Caulking was evident in the planking seams in several areas, and samples were taken for analysis. Pitch was adhered to the frame-plank junctions, probably to protect against dry rot. A yellowish resin was also payed on the inner surfaces of the strakes. This may have provided further protection against rotting.

Repairs by means of two narrow strips of planking, were made to the hull around the midship area. These lead us to think that perhaps the shipowner had made an attempt to conserve as much of the original planking material as possible, by replacing the barest minimum. Hence, our shipowner was probably an independent operator, not too wealthy, who gave a lot of thought to his ship's repairs.

Conclusions

The preserved hull remains provide us with a good impression of the overall dimensions and shape of the vessel. With regard to the total length of the hull, four observed features support our estimate: the framing and planking patterns, the charring of the garboards, and the keel dimensions. As discussed above, the frame station SE of the widest preserved frame provides the best indication of the midship, and is located 3.94 m from the remaining edge of the post. In relation to the framing pattern, the strakes reduce in number and the hull width decreases both fore and aft of this framing station. Charring is apparent over an approximately 2.0 m length on the post end of the SW garboard and on the entire NE garboard. The presence of charring

along 1.5 m of the opposite end of the SW garboard indicates its proximity to the other post. Furthermore, the small sided and molded dimensions of the keel indicate a rather small vessel. The total preserved archaeological wooden finds measure 9.02 m from the post to the broken end of a nearly complete garboard. Overall, this evidence leads to an estimate of 12.0 m for the total length of this vessel. From the angle of deadrise and the cross-sectional shape of the hull, and by projecting a practical curvature beyond hull survival, we estimate the beam of this vessel to have been 4.0 m. Both carbon-14 and pottery analysis place this vessel between the end of the 5th and the beginning of the 7th century CE. All evidence indicates that at least some frames preceded planks in the construction process. The plank edges were not connected to one another and there is no evidence of mortise-and-tenon joints used in either plank joining or alignment. Planks were fastened to frames with iron nails. This vessel therefore, represents the earliest known example of a form of skeletal construction in the Mediterranean. As this vessel predates any previously known example, it shows the earliest evidence for the transition from mortise-and-tenon to frame based construction. It is likely that this local coaster, being a smaller vessel, would experience this transition before larger craft.

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