Hull characteristics of the Yenikapı 16 galley

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Abstract
The Theodosian harbour, unearthed during salvage excavations at Yenikapı by the Istanbul Archaeology Museums, has revealed many archaeological artefacts that have enriched the cultural history of Istanbul, in addition to 37 shipwrecks, which sank at different moments over a time span of approximately 600 years. The Byzantine galeai discovered are particularly important, as they constitute the first archaeological evidence of galleys in the early medieval age. In this article, we shall describe the construction characteristics of one of these galleys, YK16, within the context of the other galleys.

Keywords
Byzantine shipbuilding, galley, Istanbul, Theodosian harbour, Yenikapı shipwrecks,

Résumé
Le port de Théodose, mis au jour lors des fouilles de sauvetage à Yenikapı par les équipes des musées d’archéologie d’Istanbul, a révélé de nombreux objets archéologiques qui ont grandement enrichi la connaissance de l’histoire d’Istanbul. Parmi ces découvertes on compte 37 épaves, qui ont coulé à différents moments sur une période d’environ 600 ans. Les galeai byzantines découvertes sont particulièrement importantes, car elles constituent le premier témoignage archéologique de galères du début du Moyen Âge. Dans cet article, nous allons décrire les caractéristiques de construction de l’une de ces galères, baptisée YK16, tout en tenant compte d’observations effectuées sur d’autres galères découvertes sur le même site.

Mots clés
Construction navale byzantine, galère, Istanbul, port de Théodose, épaves de Yenikapı,

1. THE HULL CHARACTERISTICS

The preserved dimensions of YK16 are 22.5 m in length and 2.4 m in width. Only one side of the hull survived. It is preserved from the garboard to above the third wale on the starboard side, while the stern and port sides have been partially destroyed. Extant elements of YK16 comprise the central keel timber and a curved keel timber, pieces of keelson, most of the frames, two stringers, three wales, planking, a knee and elements of rowing thwarts (fig. 2).

1.1. KEEL TIMBERS

YK16’s central keel timber is rectangular in section. Its dimensions are on average 16 cm moulded and 14 cm sided. The curved keel timber was scarfed to its end at the bow. The central keel and curved keel timbers have rabbits.

1.2. PLANKING

Preserved hull planking is composed of nine strakes on the starboard side and four strakes on the port side. The garboards (PP1, PS1) were made from three planks. The garboard planks were fastened in the keel rabbits with closely spaced iron nails, driven from the outer surface towards the keel. The planks were on average 3 cm thick and varied from 24 to 30 cm in width, except planks placed between wales (Planks PS8 and PS9 are about 5.5 cm); and their original length over 10 m. Each strake is made up of three planks. The planks were joined by S-shaped
scarfs and span four or five frames each. Scarf lengths varied from 60 to 105 cm. Hull planking has an alternating arrangement of the plank placement and scarf orientation. Plank seams with luting were fastened with dowels up to the first wale. Spaces between the widely spaced dowels range from 44 to 140 cm.

1.3. WALES

Three wales were found in situ on the starboard side of the YK16 hull. Between these wales, there are narrow planking strakes. The first wale (Wale 1) was thicker than the others and almost square in cross section. It was 13 cm moulded and 15 cm sided, and its preserved length was 14.7 m. Wale 1 has 16 sockets cut into its upper face. These sockets were 12-13 cm in width and 1.5-2 cm in depth. The distances between the centres of these sockets vary from 90 to 97 cm. These are likely for fitting the rowing thwarts.

1.4. THWARTS AND KNEES

Thwart pieces were preserved in some sockets on Wale 1. Dovetail joints were identified on some rowing thwart-wale joints. Similar rowing thwarts have been identified on the galley YK13. Some of the rowing thwarts had to be placed where frames were: a groove was then cut to place the thwarts.

Only one knee sample supporting a rowing thwart was found. But sites of the other knees can be identified from marks on the planks.

1.5. FRAMES

Frame timbers were preserved on the shipwreck at 139 frame stations (fig. 3). They are thin and fragile. Frames were on average 5 cm sided and 6 cm moulded. They were closely spaced, with room and space ranging from 20 to 24 cm. YK16 was built with a framing pattern of alternating floor timbers and paired half-frames. The futtocks were positioned on the fore or after sides of the floor timbers. They were fastened to the planking, but not attached to the floor timbers. Frames were fastened to planking...
with treenails and iron nails. These consisted of four to five closely spaced treenails (approximately at intervals of 6–7 cm) and one or two iron nails per strake. All floor timbers and half-frames were nailed to the keel with a single iron nail.

1.6. KEELSON

The keelson’s bow and stern ends were broken. Its preserved length is about 604 cm. It has shallow notches cut on the undersides that fit on the floor timbers. Also, there are two mortises on the upper surface of the keelson.

1.7. STRINGERS

Two stringers extended across the frames. These stringers were slightly rounded on the top surface and flat on the lower surface. Their ends are broken. They were 16-20 cm wide and 30 mm thick. The preserved lengths of these stringers were 820 cm (stringer 1) and 1270 cm (stringer 2). The stringers were fastened to the frames with short iron nails.

2. TREE SPECIES

A total of 239 wood samples were taken from YK16’s hull for genus or species identification. YK16 was mainly built with black pine (Pinus nigra Arn.), eastern plane (Platanus orientalis L.), elm (Ulmus L.) and fir (Abies L.). The keel members and keelson pieces were identified as eastern plane (Platanus orientalis L.). Wales, stringers and a few planks were fir (Abies L.). Planks were black pine (Pinus nigra Arn.). Frames were mainly from elm (Ulmus L.) and eastern plane (Platanus orientalis L.). Treanails were oak or red oak and dowels were from Spanish broom (Spartium junceum L.) (Akkemik, Kocabaş 2013, p. 34).

3. CONSTRUCTION AND RECONSTRUCTION

The galleys are easily distinguished from merchantmen at the Yenikapı site by their long, slender hulls, thwarts for oarsmen, oar ports, and the types of timber used. The galleys that have been studied by Istanbul University are dated between the 8th and 10th century and their preserved lengths vary from 19 to 23 m (except YK36). Preliminary evidence shows that galleys YK13, YK16, YK25 and YK36 have dowels joining the plank edges, while planks within a strake are joined with long S-shaped scarfbs. They have thick planks and delicate frames. Frames were attached to the planking with treenails and iron nails. Long and wide stringers running along the hull were attached to the frames. Wales are thick and robust (Kocabaş 2015b, p. 91, 95-97, 115, 135). The main wood species used in the galleys are Pinus nigra, Cedrus libani, Platanus orientalis, Ulmus sp and Castanea sativa (Akkemik, Kocabaş 2013, p. 33).

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Long, narrow hulls built of light frame timbers and strong planking timbers would have provided the galleys with the required high speed and manoeuvrability, along with robustness (Özsait-Kocabaş, Kocabaş 2008, p. 176-82).

Information derived from other Yenikapi galleys with similar dimensions and building characteristics have contributed to the reconstruction of YK16. Fragments of thwarts have been identified on YK13 (Kocabaş 2015a, p. 22), YK25 (Kocabaş 2015a, p. 23) and YK4 (Pulak et al. 2015, p. 66). Also, one complete thwart timber was found on YK2 and was studied by INA (Pulak et al. 2015, p. 63). YK16 has 16 preserved sockets on its first wale, and pieces of thwarts in these sockets. According to these, the location of thwarts and the distance between the upper side of the thwarts and upper side of the floor timbers of YK16 could be determined. With the additional archaeological evidence of YK4 (Pulak et al. 2015, p. 67) and YK6 (Kocabaş 2015a, p. 27), it may be supposed with great probability that an oar port strake was located on the third wale of YK16. Based on these details and the required measurements for rowing, the distance between thwart and rowlock were determined. Moreover, abrasions related to the pressure caused by the oarsmen’s feet were detected on the floor timbers. This finding indicates the accuracy of the measurements obtained (fig. 4). Referring to the evidence and analyses, the original dimensions of the galley YK16 is estimated to be approximately 28–30 m in length and 4 m in breadth. It is thought to have been single banked, having one row of oarsmen on each side. It probably had 25 oars on either side based on the spacing of the rowing thwarts and estimated hull dimensions, adding up to 50 oars in total. This oared ship may be connected with the galeai mentioned in Byzantine texts (Pryor, Jeffreys 2006, p. 188-189); the single banked scout ships that led the way for the principal Byzantine warships called dromons in the Byzantine navy (Casson 1994, p. 98; Sakellides 1997, p. 47–54; Pryor, Jeffreys 2006, p. 190). The galeai were used for surveillance or as support ships for dromons and this particular one had 25 oars on either side, with 50 oars in total (Pryor, Jeffreys 2006, p. 254-255). In medieval sources, small galleys are described with a single mast and lateen sail (Pryor, Jeffreys 2006, p. 188-89, 246, 564). The mortises on the inner surface of the YK16’s keelson may be evidence pointing to the presence of this equipment.
4. CONCLUSIONS

The recovered Byzantine galeai are particularly important, being the first archaeological evidence of galleys used in the Byzantine navy. Moreover, they now provide the bulk of the archaeological evidence for galleys throughout the Mediterranean region for Byzantine periods. When YK16 is evaluated with other Yenikapı galleys, very important knowledge about the design and ergonomics of Byzantine galleys has been obtained such as the dimensions and the seating order and seating intervals, heights of the rowers and construction techniques.

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