

The Shipbuilding Techniques of 9th Century East Roman Merchant Ship YENiKAPI 12



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Overview YK 10 YK 25 YK 37 MUSTAFA YK 27 YK 7 YK 19 YK 20 YK 17 YK 18 УК 32 YK 16 YK 34 YK 6 YK 5 YK 28 **ҮК 9** CADDESİ KEMAL YK 15 YK 26 YK 29 NAMIK YK 22 YK 13 YK 21 YK 24 YK 12 YK 3 YK 1 YK 2 YK 23 YK 35 AZINOSU YK 8 PALPLANS BÖLGESI **ҮК 33** YK 14 YK 30 T 2

Theodosian Harbour







Galley YK36 Survived dimensions: 30x10m scattered across an area

Galley YK13 Survived dimensions: 20.80x2.80 Date: AD 690-890

Galley YK16 Survived dimensions: 22.50x2.40m Date: AD 721-895

Galley YK25 Survived dimensions: 19x1.50m Date:10th century AD





Yenikapı Galleys, Istanbul University

Flat-floored at the cross-section amidships

4 wrecks with planking edge-dowels



Yenikapı Cargo Ships and Boats, Istanbul University

Flat-floored or wineglass-shaped at the cross-section amidships

4 wrecks with mortise-and-tenon13 wrecks with planking edge-dowels6 wrecks without planking fasteners



Vessel	Level (m)	Date (AD)	Extant Length (m)	Cross-section amidships	Planking edge-joints
Small m	erchantmen				
YK6	-0.67/-0.90	Str.10th	6.20	Flat-floored	Dowels
YK7	-0.91/-1.02	Str.10th	6.60	Flat-floored	Dowels
YK8	-0.90/-1.26	Str.10th	5.00	Flat-floored	Dowels
YK9	-1.40	Str.10th	6.54	Flat-floored	Dowels
YK12	-1.30	14C: 672-876	7.00	Flat-floored with hollow garboards	Dowels
YK18	-1.42/-1.50	Str.10th	8.25	Flat-floored with hollow garboards	Dowels
YK19	-1.40	Str.8th	7.30	Flat-floored	No edge-fastener
YK20	-0.70/-1.00	14C: 687-975	8.76	Flat-floored	Dowels
YK26	-3.50	Str.5th-6th	2.60	?	Unpegged mortise-and-tenon
YK30	-2.20	Str.8th-9th	scattered	?	?
Medium	merchantmer	i i			
YK3	-0.69	14C: 668-987	9.12	Flat-floored with hollow garboards	Dowels
YK10	-2.29/-2.37	Str.8th	8.90	Flat-floored	No edge-fastener
YK15	-1.90	Str.8th-9th	11.45	Flat-floored	Dowels
YK17	-2.18/-2.40	14C: 652-870	8.20	Flat-floored	No edge-fastener
YK21	-0.70/-0.60	Str.9th-10th	11	Flat-floored with hollow garboards	Dowels
YK27	-2.20/-3.15	14C: 672-869	12.00	Flat-floored	No edge-fastener
YK28	-2.00/-2.40	a.	scattered	?	No edge-fastener
YK29	-2.40	Str.8th	7.90	Flat-floored with hollow garboards	No edge-fastener
YK31	-1.50/-2.20	Str.9th	5.00	°,	No edge-fastener
YK32	-1.55	Str.8th-9th	9.30	Shallow wineglass-shaped	Dowels
YK34	-2.30	Str.5th	7.60	Wineglass-shaped	Pegged & unpegged mortise-and-tenon
Large m	erchantmen				
YK22	-3.60/-4.00	14C: 430-606	15.00	Wineglass-shaped	Unpegged mortise-and-tenon
YK35	-4.11/-5.23	Finds: 5th	15.00	Wineglass-shaped	Unpegged mortise-and-tenon
				menung son mit med 2005 Nobel 2018 Card Stranding and	AND BARDER OF THE OWNER

Yenikapı merchantmen with planking edge-dowels

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Localization









Calibrated date (calAD)

¹⁴**C**: 672 - 876 AD Coin: 9th century AD

Sample ID	Timber type	14C age years BP	Calibrated	Probability	Wood species
OxA-23836	Floor timber 11	1246 ± 25 BP	cal AD 681–870	95.4%	White oak
OxA-23837	Plank PS7-2	1233 ± 24 BP	cal AD 690–876	95.4%	Anatolian chestnut
			cal AD 762–876	60.1%	
OxA-23838	Keel 3	1258 ± 25 BP	cal AD 672–859	95.4%	Oriental beech
			cal AD 672–818	93.4%	

Excavation of YK12







Finds

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Characteristic features of the YK12 hull











Keel and Posts

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Transverse holes

Keyed hook scarf

Edge-dowels between the planks













Framing pattern





Bulkheads



Through-beams

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Mast-step timber

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Two mortises are on the upper surface of the YK12's mast-step timber. One is the step for the mast, the other a small rectangular mortise forward of the step. The small mortise is made for the mast-partner through-beam's stanchion.



Ceiling planks









Wood species of YK12				
Oak	Some floor-timbers, ceiling, wales, treenails			
Hornbeam	Posts, some floor-timbers, dowels			
Beach	Central keel timber			
Chestnut	Planks			
Walnut	Some floor-timbers			
Ash	Futtocks, bulkheads, mast-step			
Plane	A repair ceiling timber			



Reconstruction studies of the YK12







Documentation of YK12

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Preserved hull remains and missing parts

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Missing parts The majority of the futtocks The upper parts of the hull Deck and upper elements Mast, rigging and steering components

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Preserved parts

The central keel timber, two curved keel timbers and pieces of stem and stern post

17 planks

25 floor-timbers

15 futtocks

2 wales and a piece of caprail

41 ceiling planks

Bulkhead members



How to develop the hypotheses regarding the missing parts of YK12? YENKAP PROJECT

A. Evidences from archaeological remains of YK12

- Identification of the missing parts based on the proofs of original hull members
- Replication of the symmetries of the original parts
- Extention of the strakes' ends and planking seams

B. Corroborated acceptable suggestions

(for the vessel members which their locations are determined but upper parts are missing)

- Completion based on Yenikapı shipwrecks
- Completion based on traditional vessels from Marmara and Black Sea regions
- Reconstructed hulls of the Mediterranean shipwrecks

C. Entirely hypothetic suggestions

- Based on the image depicted on a 9th-century amphora found in a ship with a Lateen sail in the Yenikapı site
- Based on ship images on 9th-century manuscripts
- Based on the Byzantine sources

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Stages of the hull reconstruction









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Aft

Forward

Evidences from archaeological remains of YK12 Missing frames-frame stations

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25 preserved floor timbers, all remained in their original location. Room & space: c. 25 cm



Location of wale 3 and caprail



The original location of the wale 3 and caprail are proposed by matching the nail holes, intervals of frames stations and sheer line curvature.



YK12





Based on Yenikapı shipwrecks Determination of the dimensions and the forms of the posts

Shipwreck	Survived keel parts	Date	Type of edge joint
YK32	Central keel timber, curved keel timbers, a post	8-9th	Dowels
YK29	Piece of the keel, a curved keel timber, piece of stem	8-9th	No edge-joint
YK18	Keel, curved keel timbers, piece of stem	10th	Dowels
ҮК5	Keel, curved keel timber, piece of stem	10th	Dowels





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Based on Yenikapı shipwrecks and Byzantine ship depictions

For the post shapes, especially YK32's post, and the double-ended vessels in iconographic depictions were taken as references.



The post end of the YK32





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> Omont, H.A., 1929, Miniatures des Plus Ancients Manuscrits Grecs de la Bibliotheque Nationale. Plate CXVII.16, LII. Paris. Shchepkina, M.V., Miniature of the Chludov Plaster. Fig.96. Moscow.

Physical 3D models

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The rigging evidences based on the archaeological artifacts and the Byzantine ship images











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Line plan & hold volume of the YK12

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: 9,24 m
: 2,64 m
: 1.10 m
: 3.5:1
: 3,20 m
: 3.26 tons (WL3)
: c.5.2 tons



Reconstruction of YK12







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Yenikapı 12 Rekonstruction

Propulsion: Lateen sail Steering: A pair of quarter rudders Deck: Half decks at the bow and stern Hold: Open hold Hull shape: Flat-floored Navigation: Coastal waters Date of construction: 9th century AD Construction tradition: Mediterranean-Black Sea Building method: Mixed construction



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YK12 publications



International Journal of Nautical Archaeology Volume47, Issue2/September 2018/Pages 357-390

> The International Journal of Autoral Industries NAUTICAL ARCHAEOLOGY The International Journal of Nautical Archaeology (2018) 47.2: 357-390 doi: 10.1111/1095-9270.12325 The Yenikapı 12 Shipwreck, a 9th-Century Merchantman from the Theodosian Harbour in Istanbul, Turkey: construction and reconstruction Isil Özsait-Kocabaş Istanbul University, Department of Conservation of Marine Archaeological Objects, Ordu Cad. Laleli, Fatih, İstanbul, Turkey, isilozsait@gmail.com Shipwreek Yenikapı 12 was discovered in Yenikapı, İstanbul, Turkey in 2007 during rescue excavations carried out by Istanbul Archaeological Museums. The majority of the bottom of the shipwreek, found within the sediment-filled Theodosian Harbour, is intact and part of the cargo was found in situ. According to the results of reconstruction studies, YK12 was a small merchantman working coastal waters, approximately 9.24m in length and 2.64m in breadth. The shipwreck is dated to the 9th century AD and was built with a mixed construction using the shell-based method for the lower hull. © 2018 The Author Key words: Yenikapi shipwreeks, Theodosian Harbour, mixed construction, ship reconstruction, plank-edge dowels rchaeological excavations in Yenikani were digitizer (FaroArm) drawings, documentation and conducted within the scope of the Marmaray cataloguing of the hull members were completed, and A and Metro projects and were carried out nonconstruction techniques and reconstruction studied stop by Istanbul Archaeological Museums (IAM) from (Özsait-Kocabaş, 2013: 45-50). In this article, the basic construction features, design, and building philosophy of YK12 are discussed, along with its structural 2004 to 2013. A 12m-thick deposit was excavated with stratigraphic layers dating from the end of the Ottoman Empire to the Neolithic Age (Kızıltan, 2010; Kocabaş, 2015b). The Theodosian Harbour, which similarities to other Yenikapi vessels. In order to understand the original form and dimensions of vessel, was discovered during the excavations, produced many archaeological finds that have enriched the cultural reconstruction studies are briefly outlined. history of Istanbul, most notably the remains of 37 vessels that sank at different times from the 5th to Finds and dating 11th centuries AD.1 The excavation of the Theodosian YK12 was one of four shipwrecks that contained cargo when found. As well as the amphoras and a Harbour and the recording methods used have been previously published (Kocabaş, 2008; Kızıltan, 2010; Kocabaş, 2010; Kocabaş, 2015a; Kocabaş, 2015b, Pulak large number of amphora fragments spread around et al., 2015) the hold, cooking utensils were found in the stern Yenikapi 12 shipwreck (YK 12) with a cargo of amphoras was discovered by IAM archaeologists in area (Fig. 2), including a stove-like brazier and its lid, a cooking pot, two cups, a trefoil juglet, glass the east part of the harbour in February 2007. The shipwreck was located in the fifth sediment layer, in (Denker et al., 2013: 204, 209). Furthermore, gaming grid squares F-G/13-14 at the Yenikapı site (Fig. 1) pieces made of ivory, a wooden comb, a bronze needle (Perinçek, 2010: 210). After the amphoras had been removed, an Istanbul University (IU) team started and a thimble found inside the shinwreck inform us about daily life aboard. Also, two toggles were found to study the wreck. The shipwreck was documented in sttu with 3D measurements and drawings, full-scale as rigging equipment (Denker et al., 2013: 198-203). Cherry seeds that were found in a basket, and olive hand drawings, photography, and photo-mosaics. Then the hull members were dismantled and placed and peach seeds provide information about the crew's food supplies. The amphoras and the wreck itself in wooden chests. In July 2007 they were moved to were dated to the 9th century AD (Denker et al. 2013). Additionally, a 9th-century AD coin was found storage tanks in the IUI Yenikani Shipwrecks Research Centre directed by Ufuk Kocabaş. At the Centre, 3D in the shipwreck. The shipwreck has been dated t © 2018 The Authors. International Journal of Nautical Archaeology © 2018 The Nautical Archaeology Society. Published by John Wiley & Sons Ltd. 9600 Garsington Road, Oxtord OX4 2DO, UK and 350 Main Street, Maiden, MA 02148, USA.

Yenikapı 12. An Early Medieval Merchantman Istanbul, 2022, Ege Publications/342 pages

YENIKAPI SHIPWRECKS / YENIKAPI BATIKLARI

VOLUME / CIET III

YENİKAPI 12

AN EARLY MEDIEVAL MERCHANTMAN

ERKEN ORTA ÇAĞ TİCARET TEKNESİ

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Excavation, Documentation, Construction and Technology

Kazı, Belgeleme, Konstrüksiyon ve Teknoloji

ISIL ÖZSALT-KOCABAS

Thanks to TINA Turkish Underwater Archaeology Foundation for supporting book publication...





Building of YK 12 Replica















Building of YK 12 Replica

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The full-scale sailing reconstruction of YK 12 was built at the RMK Marine shipyard. It was built according to the original hull shape, dimensions, wood types.







IME









Construction of YK 12 Replica



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Launching of YK 12 Replica

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Sailing with Yenikapı 12

YENIKAPI SHIPWRECKS PROJECT

The first sailing 22 knot wind







Fair winds and following seas Yenikapi

Sailing with YK12 full-scale Reconstruction

YENIKAPI SHIPWRECKS PROJECT





It was launched in 2017 and tested its buoyancy, maneuverability, quarter rudders, and rigging.





YK12 Reconstruction

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Istanbul Archaeological Museums

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Rahmi M. Koç Museum





Main differences between Mediterranean and Nordic shipbuilding Yenikapı 12 & Viking Ships

- Planking construction
- Fastenings
- Frame shape
- Inner construction of the hull
- Post shape
- Processing of wood
- Rigging





Yenikapı 12 & Viking Ships Planking construction and fastenings



Yenikapı 12 Vessel

Carvel planking Wooden edge-dowels







Viking Ships

Clinker planking Copper or iron rivets



Yenikapı 12 & Viking Ships Frame shapes







Yenikapı 12 & Skuldelev Ships, 9th century AD Internal structures of hulls

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Yenikapı 12 Vessel

The straight floor, narrow stringers, mast-step timber and ceiling planks



Viking Ships

The gradual structure, construction suitable for square sail rigging





Yenikapı 12 & Skuldelev Ships, 9th century AD The stem and stern post shapes

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Viking Ships

Posts with step edge





Yenikapı 12 Vessel

Rectangular section posts





Yenikapı 12 & Skuldelev Ships, 9th century AD Slicing a log

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Yenikapı 12 Vessel

Parallel sawing by frame saws





Viking Ships

Triangular slicing by hewing axes



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Yenikapı 12 & Skuldelev Ships, 9th century AD Sail and rigging types

Yenikapı 12 Vessel

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Viking Ships

Lateen sail



Square sail



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Istanbul Archaeological Museum Istanbul University Yenikapı Shipwrecks Project Team

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Thanks for your time and interest...

