

Reinterpretation of the third sewn boat from the ancient port of Zaton in the vicinity of ancient Nin (*Aenona*), Croatia

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Abstract: The port of Zaton was an ancient port of the municipium *Aenona*, in the province of *Dalmatia*. Intense port activity was recorded from the middle of the 1st until the end of the 3rd century AD. An underwater structure, either a breakwater or a pier, is visible in the maritime environment. On the inner/eastern side of this structure three sewn boats were found sunken. This paper concerns the only remaining boat at the site, Zaton 3, discovered in 2002 and recently reinvestigated. The paper presents the hull construction features.

Keywords: sewn boat, port, *Aenona*, Zaton 3, boat structure

1. Introduction

The Roman-period port in Zaton near Nin is located some 17 km northwest of Zadar and was discovered in the mid-1960s (Brusić 1968). The Roman city of Nin (ancient *Aenona*), although located on the coast, had its port 2.5 km to the southwest, at Cape Kremenjača (Fig. 1). There were a number of reasons for dislocating the port: *Aenona* was located on a small island in the shallow waters of Gulf of Nin, whose shore was unsuitable for a larger port due to the sandbars and shallows in front of it; reaching *Aenona* by circumnavigating the present-day island of Vir (which was connected with the mainland in the Roman times) was an arduous and time-consuming feat because of the strong winds and numerous shallows and hidden rocks along the route (Ilakovac 1997).

Zaton was a sizable port in the Roman times that consisted of a breakwater or a pier with a cargo-handling wharf and landing place on its eastern (inner) side. Today, the remains of that structure – what's left of it after it had collapsed and after the sea level had risen – can be seen 1.5 to 4 m under the surface. The ancient port in Zaton was operational for as long as three centuries. The first use of the port dates back in mid-1st century AD, it was intensively used until late 3rd century, and most probably it ceased to exist in early or mid-4th century AD. The remains of three sewn boats (Zaton 1, 2 and 3) – called *serilia* by the ancient authors (Pacuvius and Verrius Flaccus apud Festus, *Epitoma*, 508, 33)¹ – constitute the most interesting and certainly the most valuable finds in the port (Fig. 2). The technique used for shipbuilding can be positively identified as Liburnian tradition. The fact that they were found in the layer which contained the Roman finds can be seen as evidence that the Liburnian shipbuilding tradition technique persisted during Roman rule.

¹ Sextus Pompeius Festus – *Sexti Pompei Festi De verborum significatu quae supersunt cum Pauli epitome*. Edidit Aemilius Thewrewk De Ponor. Pars I. Budapestini 1889.



Fig. 1 Position of the site (map: D. Romanović)



Fig. 2 Aerial photo from the north-east of Cape Kremenjača with position of the three sewn boats (photo: D. Grosman)

2. Excavation

There have been several excavation campaigns at the port since its discovery. Boats Zaton 1 and 2 were discovered very close to each other, where the seabed is now 1.5 meters deep. Zaton 1 wreck was discovered in 1966 and recorded and recovered in 1979 (Brusić 1968; 1995; Brusić, Domijan 1985; Radić Rossi, Brusić 2014). Zaton 2 wreck was discovered in 1982 and recorded and salvaged in 1987 (Glušćević 1984; 1986; 1987; Brusić, Domijan 1985; Brusić 1995; Radić Rossi, Brusić 2014). All these excavation campaigns were directed by Zdenko Brusić and Miljenko Domijan. The systematic archaeological excavations at the port were resumed in 2002 when a third sewn boat, Zaton 3, was discovered, some 40-50 m further south along the breakwater, where the seabed is now 3 m deep. Between 2002 and 2013, during eight campaigns, the excavations were directed by Smiljan Glušćević (Glušćević 2002; 2004; 2005; Pydyn, Glušćević 2011). Since during the previous campaigns the boat was not fully excavated, in 2019 the boat was reinvestigated, revealing the full dimensions of the boat's structure. The campaign was carried out in cooperation of the Archaeological Museum Zadar represented by Dušanka Romanović and Department of Archaeology of the University of Zadar represented by Irena Radić Rossi and Katarina Batur.

The best researched of the three sewn boats from the Roman-period port in Zaton is the third boat (Fig. 3). Data about Zaton boats 1 and 2 is very scarce. Only a few reports on the underwater excavations were found in the archives, and many questions about Zaton 1 and 2 remain unsolved (Romanović 2021). The remains of this third boat are in better condition than the remains of the other two. The boat's structure was explored by sections in four campaigns from 2002 to 2007, but not entirely and it was not documented in detail. During the 2019 excavations, the entire preserved boat's structure with its periphery was cleaned up and documented, providing new data on its construction.



Fig. 3 Orthoimage of the first phase of Zaton 3 boat excavations in 2019: the inner carpentry (ceiling and keelson are still in place) (author: K. Yamafune)

After the boat's structure had been uncovered, multiphase recording ensued. The first phase focused on thorough cleaning of all the boat structure elements and marking them for the first recording phase. The second phase included the lifting of the ceiling, thorough removal of the sediment from the boat structure, and marking its elements for the second recording phase. The third phase included extraction of dislocated elements for detailed recording and lifting the keelson for the third recording phase.²

Detailed descriptive records and photographs were performed, followed by the elaboration of georeferenced photogrammetric models in all excavation phases. All elements of the boat's structure were measured, and samples were taken in order to establish the type of wood used in the construction, and for dendrochronological and ¹⁴C analysis.

3. Hull remains

The total area of the researched part of the boat's structure, with all of its extremities, measured approx. 40 m². Dislocated elements that belonged to the boat's framing and planking were found around the main structure. The seabed on which the boat lies slopes slightly towards the east. The structure lost its original shape by the weight of the sand and silt layers that had deposited on it over centuries. Based on the information from the previous excavation reports, the cultural layer above the boat was almost sterile. The boat is oriented in direction of SW-NE and is preserved in the length of 6.7 m and width of 2.7 m (Fig. 4). The starboard side and bow are in better condition than the stern and port side. The stern is poorly preserved due to devastating shipworms.

3.1. Keel

The boat rests on its keel (K) that is preserved in length of 6.13 m. The total length of the keel and its original shape remain unknown. The eastern extremity is entirely preserved, while the western extremity was damaged heavily by degradation process. The eastern extremity (the bow) ends with a finely processed scarf for attaching the stem or transitional timber (Fig. 5). The cross-section of the keel is visible on the eastern side, where it is almost rectangular and chamfered. The oblique channels for the stitches were drilled perpendicular to the keel edges, along both sides of the upper part of the keel.

² The photogrammetric recording was performed by Kotaro Yamafune from A.P.P.A.R.A.T.U.S. LLC, Japan.

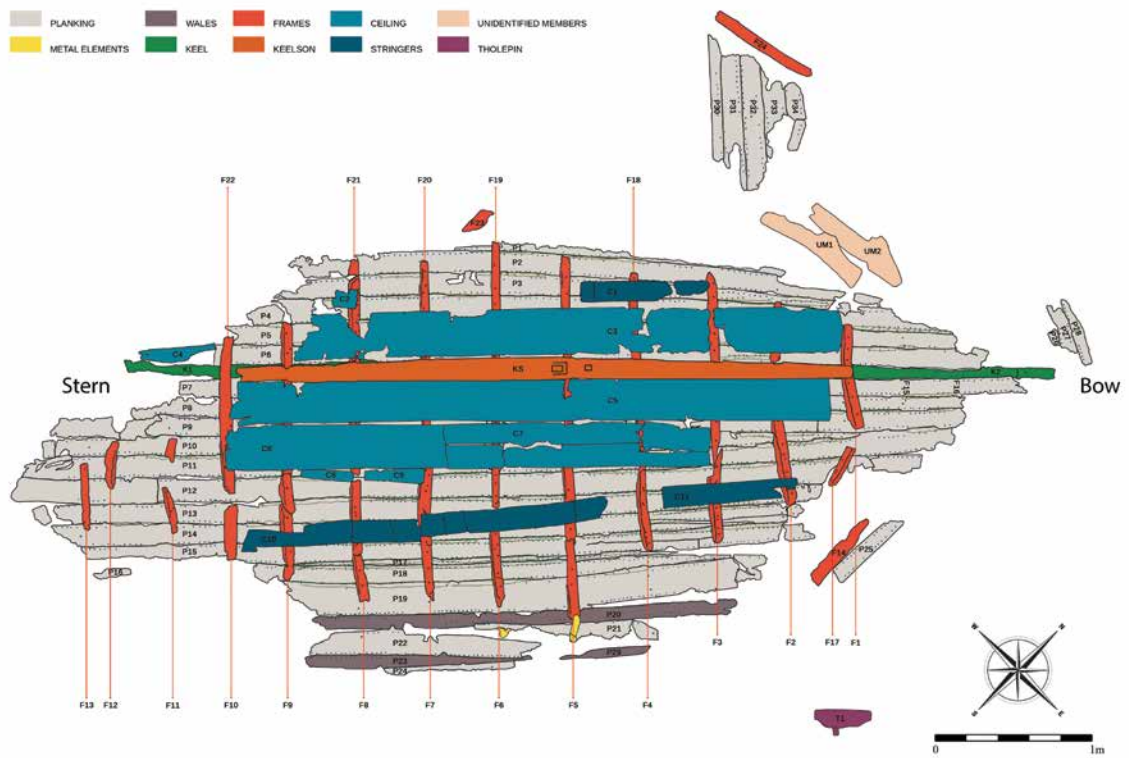


Fig. 4 Zaton 3 boat, plan view (drawing: R. Maršić, D. Romanović)

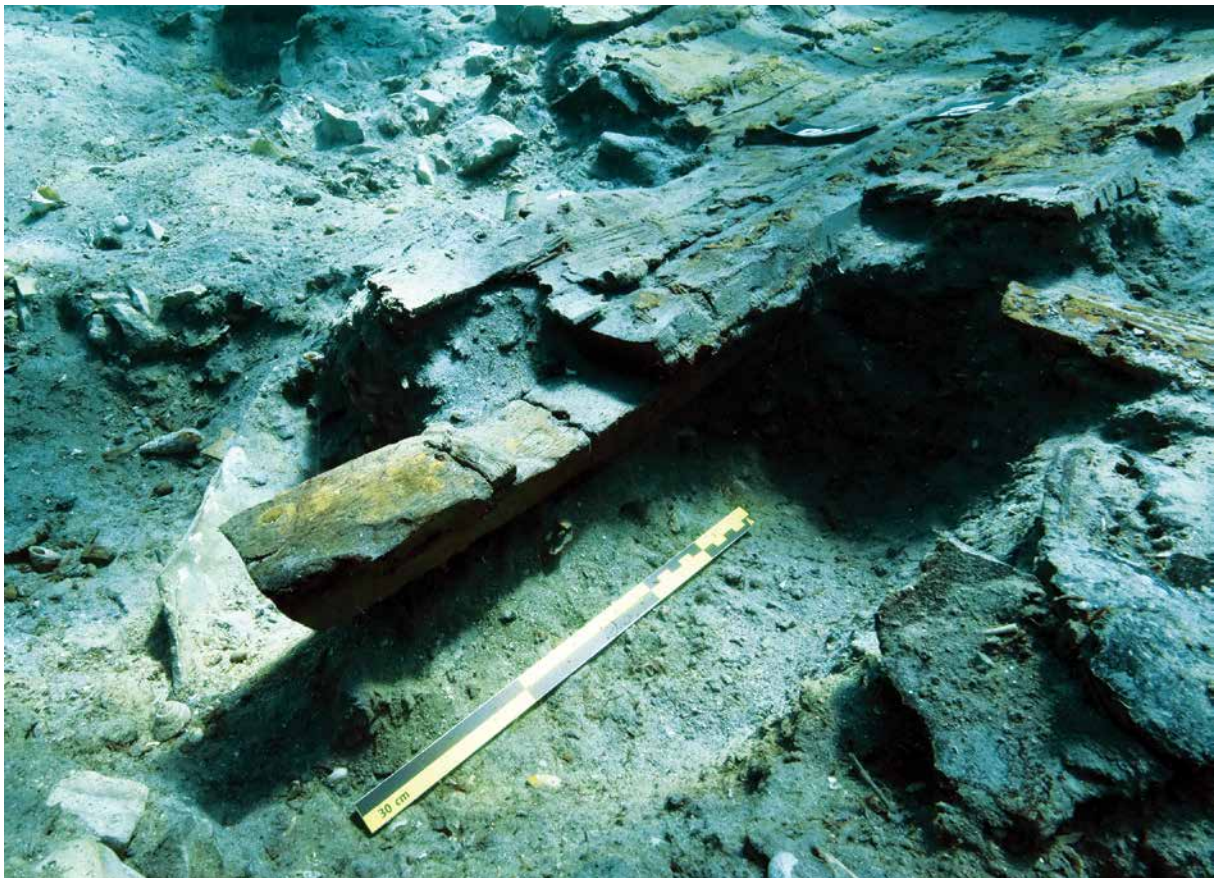


Fig. 5 Keel end with scarf for attaching the stem or transitional timber at the bow (photo: M. Martinčak)

3.2. Strakes and wales

The remains included a total of 23 strakes – six on the on the port side (P1 – P6) and 17 on the starboard side of the boat (P7 – P15 and P17 – P24). There were also several dislocated elements of the planking (P16, P25 – P34). The average strake width was 12-15 cm. The sewing pattern with simple overedge stitches is typical for most of the sewn boats preserved in the Eastern Adriatic (Pomey, Boetto 2019). The same sewing system was used for all three Zaton boats (Zaton 1, 2 and 3). The planks were sewn together longitudinally through the small channels set perpendicular to the edges of the plank. Small notches for inserting the stitch were made on the lower inner edge of the planks so that the stitches would be protected from wear and tear. A wadding pad was placed along the upper side of the seams. This sewing system included simple parallel stitches, created by spanning the sewing thread over the wadding pad diagonally only one time. The stitches run through small angled channels (in the cross-section) and perpendicular towards the edge of every plank (in the plan view). Stitches connecting planks were then immobilized with pegs that were placed in each hole.

No planks connected with oblique scarfs have been noticed. We can single out three strakes that narrow towards the bow as stealers, P3 and P10, the fourth strake on each side of the keel, and strake P18. Plank P17 is only 4 cm wide. After lifting the ceiling, plank repairs were noticed on two spots on strake P14, in the vicinity of frames F3 and F7.

The starboard side is preserved to the second wale (P23, P24 and P29). Dislocated plank P25, given that it is made of oak, may also be part of the wale. In the area of the first lower wale (P20), from the middle towards the stern of the boat, some metallic heavily corroded elements were noticed at the position of the frames F5, F6 and F7. Those could be the remains of metal fastenings that once connected the frames to the lower wale. Due to the wales' thickness, the channels with small pegs were drilled perpendicular to the plank edges.

3.3. Ceiling

The boat Zaton 3 had partially preserved ceiling planks (C1 – C11) above the frames. A total of 11 ceiling planks were recorded, some of them fragmented. Based on their position and shape, we can assume that the elements marked C1, C10 and C11 had the function of stringers. As traces of nails can be seen on a few places on the ceiling planks, it is believed that nails once connected them to the frames.

3.4. Frames

Framing is composed of floor timbers and futtocks (F1 – F13, F18 – F22), that are not joined but simply butted, and attached to the planks by treenails. There are 13 frame stations in various conditions, found *in situ*. Five dislocated frame fragments (F14, F23 and F24) were also discovered, as well as traces of two imprints (F15 and F16) with one row of treenails (F15) where the frames once stood. The frames measure from 5 to 8 cm sided, and from 5 to 8.2 cm moulded. The distance between frames center-to-center is 41 to 49 cm. The recesses on the floor timbers and futtocks, cut above the seams, vary in shape and size.

A dislocated element found in the southern part of the grid was initially marked as F17, but the analogy with the Herculaneum boat (Steffy 1985; 2005) changed the interpretation to a tholepin, and the element was remarked on the plan from F17 to T1.³

3.5. Keelson

A massive keelson (KS) placed above the keel and frames represents one of the longitudinal reinforcements of the boat structure. The 2019 excavation campaign established that the bow was oriented to the east. The preserved length of the keelson is 3.75 m. It extends from frame F1 at the bow to frame F10 at the stern, where it is quite damaged so its full length cannot be established. The dimensions of the keelson are 7.6 to 14.2 cm sided and 7.1 to 7.9 cm moulded, with the widest part in the central section of the boat. On the lower side of the keelson there are recesses for accommodating it on the frames, as well as slight arch-shaped indentations between the recesses which allow circulation of bilge water. On the upper side, on its central (and widest) section, there is the mast mortise (Fig. 6). The mast mortise is rectangular, and the north-east edge is cut obliquely to facilitate lowering of the mast towards the stern. The mast mortise is flanked by rectangular recesses on three sides, for hosting vertical planks to support the mast. To enable the final part of the third recording phase, the keelson was lifted and photogrammetrically recorded. On the upper side

³ We are grateful to Elisa Costa for suggesting the original function of this element.

of the keelson, at the position of frame F20, a trace of a nail that once joined it to the keel and frames is visible. After removing the keelson, on its lower side, at the position of frames F3, F20, and F21, traces of nails were observed, which were probably hammered in from the bottom of the keel, passing through the keel and entering the frames and keelson.



Fig. 6 Orthoimage of the four sides of the keelson: a) top view; b) view from the south-east; c) bottom view; d) view from the north-west (author: K. Yamafune)

3.6. Wood analyses

A total of 74 wood samples were taken in 2019. The samples were sent to the Faculty of Forestry and Wood Technology of the University of Zagreb for xylological and dendrochronological determination, and to the Ruđer Bošković Institute for the ¹⁴C analysis, with analyses carried out in 2020. The xylological analysis established that the samples belong to five different tree species: *Quercus sp.* (oak), *Fraxinus sp.* (ash), *Fagus sp.* (beech), *Ulmus sp.* (elm) and possibly *Cedrus sp.* (cedar). As cedar is not a common tree species in the Adriatic area, the result of the analysis should be taken with caution and the analysis should be repeated.⁴

Xylological analysis showed that the keel was made of oak; the planking was made of two types of wood, mostly beech, and a few made of elm; the wales were made of oak; the ceiling was made of two types of wood, beech and possibly cedar (?); the frames were made of two types of wood, mostly oak, one made of ash, and few remained undetermined; the keelson was made of possibly cedar (?); the tholepin was made of beech; and two unidentified members were made of oak (Table 1).

The samples were also submitted to dendrochronological analysis, but unfortunately, the number of tree rings did not allow any accurate dating. The Laboratory for Low-level Radioactivities at the Ruđer Bošković Institute in Zagreb, carried out a ¹⁴C analysis in 2020, using the Accelerator Mass Spectrometry technique. The result for the Z-7391 sample of the Zaton 3 boat provided the date of 74–127 cal AD (68.3%). The sample was taken from one part of the planking (P5).

⁴ The samples were sent for analysis to the Faculty of Forestry and Wood Technology in Zagreb at the end of 2019, before the corona pandemic. At the beginning of 2020, beside corona pandemic, Zagreb was hit by a big earthquake that damaged the laboratory, so the analyses were not carried out according to all standards. Some samples remained undetermined, and some samples gave unusual results. Given these circumstances, the samples were resent for analysis in 2023. The results will be presented at the next ISBSA congress.

SAMPLES	NO. OF SAMPLES	TYPE OF WOOD
FRAMES		
Frames F1 – F4, F6, F8, F11 – F12, F14, F18 – F24	16	Oak (<i>Quercus sp.</i>)
Frames F5, F7, F9	3	not determined
Frame F10	1	Ash (<i>Fraxinus sp.</i>)
Frame F13	1	not determined
KEEL		
Keel K	2	Oak (<i>Quercus sp.</i>)
KEELSON		
Keelson KS1	1	Cedar (<i>Cedrus sp.</i>) (?)
PLANKING		
Planks P1 – P15, P17 – P18, P26 – P28, P30 – P34	25	Beech (<i>Fagus sp.</i>)
Planks P16, P19, P21 – P22	4	Elm (<i>Ulmus sp.</i>)
Planks P20, P23 – P25, P29	5	Oak (<i>Quercus sp.</i>)
CEILING		
Ceilings C1, C8 – C11	5	Beech (<i>Fagus sp.</i>)
Ceilings C3 – C7	5	Cedar (<i>Cedrus sp.</i>) (?)
OTHER		
Unidentified members UM1 – UM2	2	Oak (<i>Quercus sp.</i>)
Tholepin T1	1	Beech (<i>Fagus sp.</i>)
Peg	1	not determined

Table 1 Results of xylological analysis of Zaton 3 boat done in 2019 at the Faculty of Forestry and Wood Technology of the University of Zagreb

4. Conclusion

As the documentation of the first two sewn boats recovered from the Port of Zaton is lost, and the boats are disassembled and stored in the deposit of the Archaeological Museum Zadar, the remains of Zaton 3 give us a more detailed glimpse into construction characteristics of the sewn boats used in the 1st century AD. Their original purpose remains unclear. They probably sailed in the neighbouring area, and maybe to the islands of Zadar Archipelago. They could have been used in loading and unloading of the cargo in the port, fishing, and short-distance transport of passengers or cargo. Based on the keelson with mast mortise, it can be concluded that the Zaton 3 boat had a mixed propulsion and harnessed the power of wind, using probably a square sail, and also used oars. Considering the other finds of sewn boats in the north-eastern Adriatic, like Caska, Pula, Poreč and Zambratija (Radić Rossi, Boetto 2020; Koncani Uhač *et al.* 2017; 2019, 162–166; Boetto *et al.* 2017; 2023), the boats of Zaton could be attributed to the north-eastern Adriatic tradition, preserved by Liburni and Istri in the Late Roman Republican and Early Imperial period (Pomey, Boetto 2019; Boetto *et al.* 2023, 16–18).

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