

An extraordinary find? Boa Vista 5, a new early modern ship discovered in Lisbon waterfront (Portugal)

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Abstract: Discovered in August 2020 and excavated until February 2021, Boa Vista 5 is the best-preserved ship ever found in the riverside area of Lisbon. The wreck was discovered in the limits of an anchorage used since Roman times, abandoned on the beach in the intertidal area sometime in the last quarter of the 17th century. The presence of coconuts suggests an operation area on the Atlantic, probably on the Brazilian routes, a rare example of a merchant ship of this period. In this paper we present the excavation and a first analysis of the ship construction features.

Keywords: early modern shipbuilding, Lisbon, waterfront, Portugal, Atlantic

Introduction

The central district of Lisbon has changed considerably over the years through riverside urban design, modified by successive landfills that allowed conquering land for the city. In the last decades, modern construction projects in that area have exposed several structures related to the port use of the Tagus River. Several ships stand out. The older are the 16th century ships, such as Corpo Santo and Cais do Sodré, but for more recent times, from the late 17th or early 18th century, are the Boa Vista ships, discovered since 2012 (Bettencourt *et al.* 2021a).

In this paper we present the first results on the research on Boa Vista 5, discovered during the construction of a new building, intended for a hotel and apartments, between Avenida 24 de Julho and Rua Dom Luís I, in the occidental area of the city. The ship was found during the monitoring of the digging works inside the pre-built molded walls, at an advanced stage of the construction operations. It was excavated from August 2020 to March 2021, during rescue archaeological works, by the company ERA ARQUEOLOGIA, which requested the contribution of Centre for the Humanities (CHAM) of NOVA University Lisbon to ensure the necessary expertise in nautical archaeology.

Site location

Boa Vista 5 was found buried in the early Boavista beach, like Boa Vista 2 and Boa Vista 1, that were just fifteen meters east (Fig. 1). That had been a submerged zone until the beginning of the 19th century, according to ancient cartography, located on the area occupied by the logistics facilities of the *Junta de Comércio do Brasil* (a State Merchant Company), from the 17th century onwards (Bettencourt *et al.* 2021a; Sarrazola *et al.* 2014).

The archaeological excavation revealed a long stratigraphic sequence, similar to the one recorded during Boa Vista 1 and 2 excavations, on the contiguous city block (Bettencourt *et al.* 2021a). The ship was on a port area, located at depths between 2 and 7 m (mean sea level), featuring ceramics ranging from the Roman period to the 18th century as well as several items of nautical equipment, like iron anchors from the Early Modern period or a small river boat, Boa Vista 4. Above these levels, formed by silty sediments, several landfills were made, which became the foundations for the construction of commercial and industrial buildings in the 19th century.

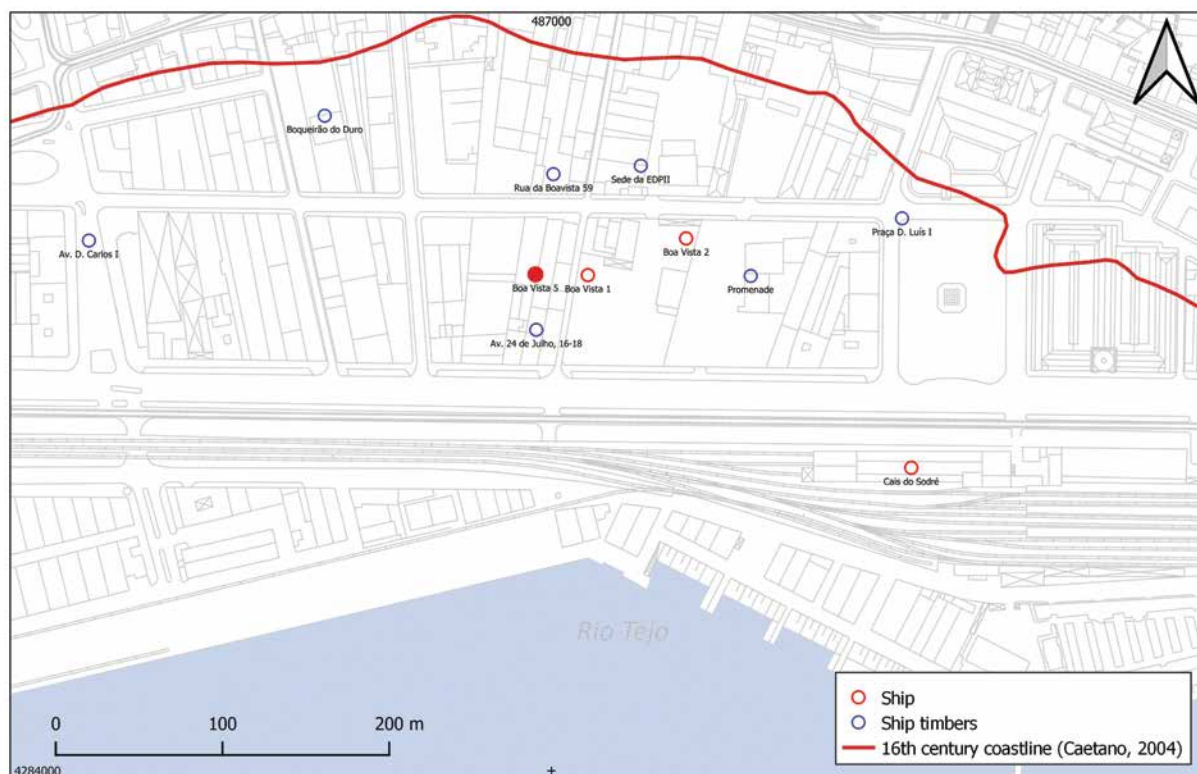


Fig. 1 Site location, in relation to other ship finds on the area (map: J. Bettencourt)

The ship excavation and timbers documentation

Time constraints, related to the engineering works, forced the team to adopt a simplified documentation methodology. All archaeological layers with materials or structures considered relevant to interpret the site and ship hull were recorded by structure via photogrammetry. The digital models were georeferenced based on control points, fixed on the hull, positioned with a total station, seeking to use the same points throughout the entire work.

The different outputs of photogrammetry – models, Digital Elevation Models (DEM's) and orthomosaics were used to produce the site plan and control the descriptive data about the hull and other finds. They were complemented with field observations, noted directly in the orthomosaics or in the draft versions of the site plan.

That strategy was particularly useful during the ship's dismantling phases when the constructive details were revealed. The dismantling was accompanied by an inventory and detailed photography and video records. All the timbers were removed to tanks built from shipping containers, a task that involved the use of engineering resources available on the construction, namely pneumatic hammers, to dismantle structures such as pillars and other support structures that had cut the ship before the excavation, and cranes, to lift most of the pieces, which weighed between a few dozen and hundreds of kilos.

The post-excavation work, in progress, includes the analysis and systematization of the field data and the individual recording of the timbers. Again, due to time constraints, the documentation of the ship timbers follows a very simplified protocol. The structural timbers, like the frames, are being digitized with a hand scanner, following the procedures proposed by Van Damme *et al.* (2020). As on previous projects, we recognize that the texture quality obtained by the scan is not good enough; therefore, all the timbers are also recorded by photogrammetry, which allow a systematic photo coverage and the application of photo textures on the 3D models, if necessary. The photogrammetry is also the basic method on the documentation of planks and other longitudinal timbers that bend during the work.

The descriptive catalogue is supported on this graphic record. 3D models were used to produce prints where construction details or/and timbers interpretation were annotated. These are also used on the preparation of the final drawings.

Finally, the field data and the information from the individual timbers are being organized into a GIS project, which includes raster data (site orthomosaics and DEM's) and vector data (e.g., polygons with the limits of the ship timbers; or points with the position of the artifacts).



Fig. 2 Boa Vista 5 ship general site map (map: CHAM/ERA)

The ship

Boa Vista 5 remains are 24 m long and 17 m in width, maximum dimensions, from the bow to the stern and from the keel to the level of a deck (Fig. 2). The hull was oriented northwest/southeast, with the stern to the southeast, with both ends partially cut by the walls of the engineering work. Scattered timbers could be found under the hull and the structure was open, with the starboard side connected and the port side fallen to southwest.

When discovered, the ship remains were sealed by silted fluvial deposits, but a ballast mound dominated on the central section of the hull. The excavation has shown that the ballast was well arranged in timber compartments that divided and organized the hold of the ship. It is composed of pebbles, cobbles and boulders, with a large variation in shape and size. It includes several petrological types, for example basalt and limestone, most of them available on the coast between Lisbon and Cascais, according to a first observation of a geology team from the Faculty of Sciences of the University of Lisbon.

The artifacts found during the excavation clearly related to the ship were scarce, but include, for example, round iron shots, concentrated in the centre of the hull next to the mast step, and wooden blocks and coconuts, entrapped below and between the ballast. The ceramics are more difficult to relate to some context because some could also be linked to the use of this area as a port. They give, however, a global idea of the site chronology, including materials from the second half of the 17th century to the first half of the 18th century. Also, a level with several artifacts was sealed under the ceiling, between a primary ballast of sand, pebbles and some cobbles. This level includes, for example, a kaolin Dutch pipe, with the EB mark, similar to the ones found in Burgzand Noord wreck 2 (BZ2), lost c. 1670–1675 (Vos 2012: 132–133), the most likely chronology for the ship use.

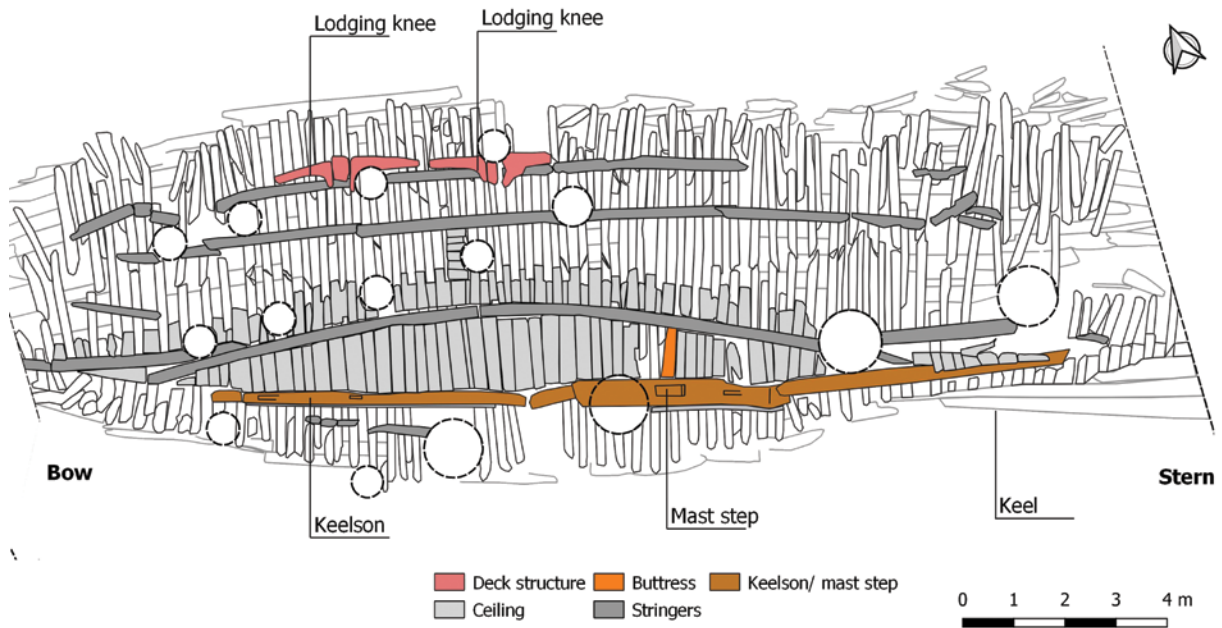


Fig. 3 Boa Vista 5 main section site map (map: CHAM/ERA)



Fig. 4 The stern assembly with the keel, the deadwood, the Y shaped-frames and the filling pieces (photo: J. Bettencourt)

The main section hull corresponds to starboard side, from the keel to the level of the first deck, including frames up to the third futtock, the keelson, the maststep, stringers, ceiling, lodging knees and the planking (Fig. 3). Their analysis, in an initial phase, is an opportunity to understand the anatomy and ship design of their period.

The keel sections are joined with a hooked vertical scarf joint, displaying all along their width several semi-circular notches, filled with stop-waters. A similar scarf was used to connect the stem, which received a stemson and a long deadwood on the top. The deadwood had carved recesses to receive the floor-timbers. The sternpost was not preserved but the aft extremity of the keel received the deadwood, where the Y-shaped frames were also embedded. On the stern the space between the floor-timbers was occupied with filling pieces, shaped similarly to the Y-shaped timbers (Fig. 4).

The frames were preserved from bow to stern, in some parts, until the third futtock, on the beginning of the first deck or false deck, where lodging knees were found. The frames could clearly be divided in two different groups – central frames and filling floor-timbers (Fig. 5).

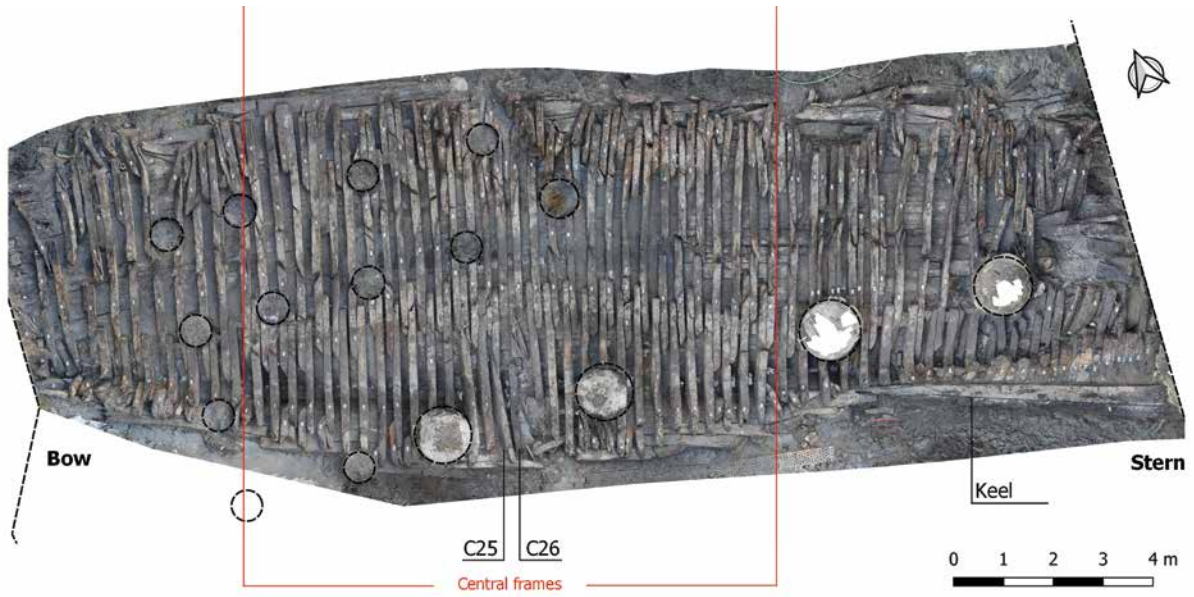


Fig. 5 Boa Vista 5 main section ortomosaic of the frames (ortomosaic: CHAM/ERA)

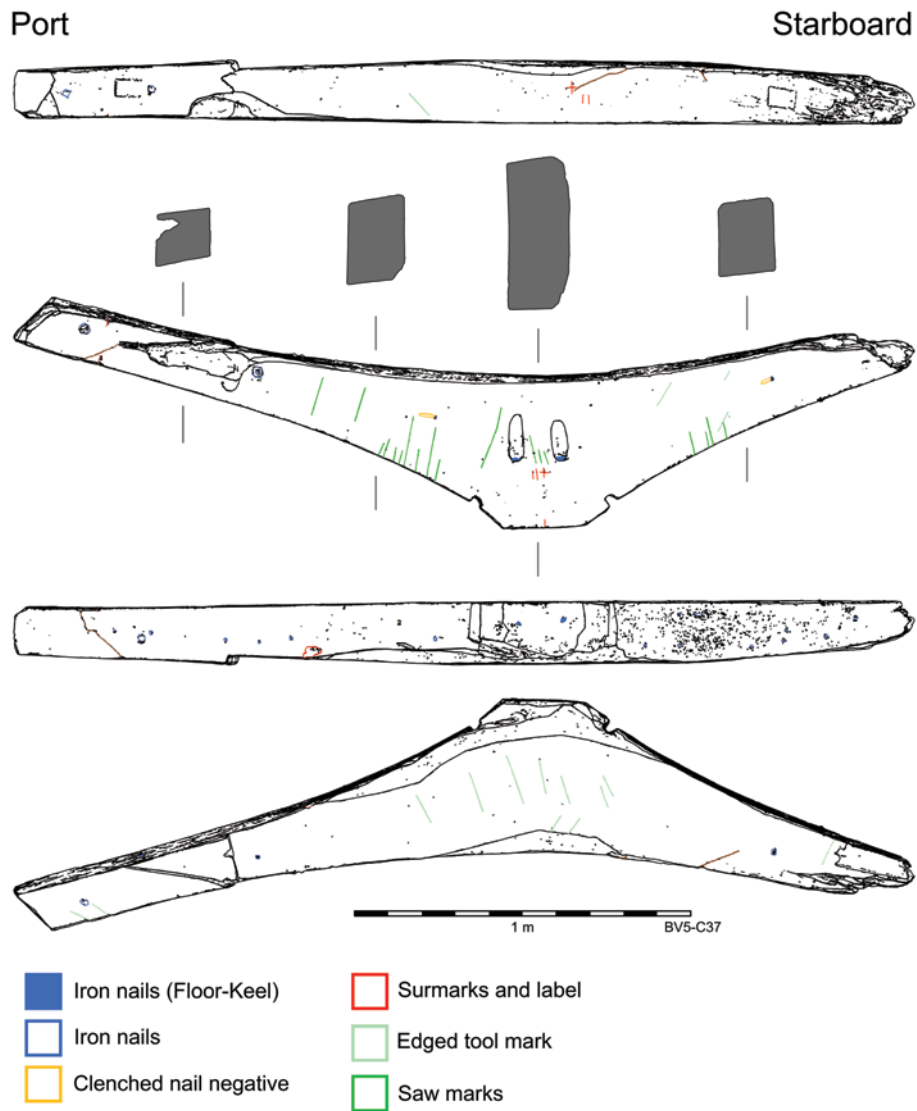


Fig. 6 In red, the design and label marks on C37 floor-timber (drawing: CHAM/ERA)

The 30 central frames show evidence of assembling before they were set up on the keel. Those frames are composed of one floor-timber and two futtocks joined with a kind of hooked scarfs, with the top of the floor-timbers embedded on the futtocks in a recess, like a non-trapezoidal dovetail joint. This characteristic seems to correspond to a hybrid model, between the shape of the scarves documented on ships built in the Ibero-Atlantic area and in the Mediterranean, between the Middle Ages and at least the 17th century (Oertling 2001; Rieth 1998). They were fastened with three iron nails, some of them clenched back into the timber, a feature that has no parallel in other Atlantic ship.

Those central frames were carefully positioned during the ship construction. The floor-timbers were fastened to the keel with two iron nails, inserted through recesses cut on the forward or aft faces, depending on their position on the keel. The space between some floor-timbers was controlled by filling pieces that maintained the distance between them.

The general pattern of the central frames suggests that the middle frames, or master frames, are the C25 and C26. In fact, between the C25 and C26 the futtocks position pattern changes. From C25, towards the bow, the futtocks were attached to the forward side of the floor-timbers; from C26, towards the stern, the futtocks were attached on the aft side of the floor-timbers. Another construction detail pointing to this hypothesis is that the futtock between C25 and C26 is a floating timber, not connected to any of the contiguous floor-timbers.

Unfortunately, C25 and C26 are the floor-timbers in the worst state of preservation, but the crucial role of the central frames was confirmed in the first days of post-excavation work, when several design marks were identified. They correspond to straight lines carved into the floor-timbers, pointing to the centerline on the keel, and surmarks in the zone of the turn of the bilge, similar to the ones recorded in the Cais do Sodré shipwreck (Nicolardi, Castro 2015). Some floor-timbers also preserve location labels, corresponding to their position of the midship frames. For example, the C37 is numbered XII (Roman numeral) and corresponds to the twelfth floor-timber towards the stern from the master frame C26 (Fig. 6).

The internal structures include part of the keelson, the stringers, and the ceiling. Both keelson and first stringer are notched over the top of the floor-timbers. In the ship axis the maststep was partially preserved. The maststep was an independent timber, joined to the keelson through a dovetail mortise, apparently reinforced with only one buttress in each board. The space between the keelson and the first stringer was protected by a transversal ceiling, with most planks not fastened to the frames. The tops of the floor-timbers were also protected by filling timbers.

Finally, the carvel hull planking was nailed to the frames with square iron nails, which had round countersinks in the outer face, some of them clenched over the top of the frames. There are no treenails in the hull planking. No caulking was found during the excavation.

Concluding remarks

Until the 2010s, Portuguese naval archaeology focused mainly on ships from the 16th–early 17th century, of Ibero-Atlantic tradition (Alves 2001). The investigation showed that these ships, with a frame-first construction, shared construction techniques with ships used in transoceanic navigation, built in several shipyards in the Iberian Peninsula. Cross-referencing the archaeological data with historical sources, especially with technical texts written in Portugal and Spain between the end of the 16th century and the first decades of the 17th century, place the design of hulls in this period in a clear area of Mediterranean influence (Castro 2008; Domingues 2004).

Knowledge about ships from the second half of the 17th century is scarce. The absence of archaeological studies is not overcome by historical studies. Naval construction treatises are not known in Portugal for this period and the study of the documentation that might exist in national archives remains to be done. The discovery of the Boa Vista ships (Boa Vista 1 and Boa Vista 2) brought to light the weaknesses in our knowledge regarding shipbuilding from the second half of the 17th century onwards. These ships did not present clear parallels in any known case on an international scale to date, although Boa Vista 1 presented characteristics that appear in Mediterranean and others that could be found in Atlantic space, which could suggest hybrid models, still to be determined (Bettencourt *et al.* 2021b).

The discovery of Boa Vista 5 reinforces the hypotheses of filling the gap in the study of this period of European shipbuilding history. The finds suggests that she was deposited on the beach between the last quarter of the 17th century and beginning of the 18th century. The location in the *Junta de Comércio do Brasil* logistic area and the presence of coconuts between and under the ballast suggests an operation area for Boa Vista 5 on the Atlantic, being a rare example of a probable merchant ship of this period in that region.

To our knowledge, the assemblage of construction features has no close parallel in any other medium to large sized hull published to date in Portuguese and Atlantic contexts. There are, however, construction features possibly from Mediterranean influence, among which we highlight the shape of the scarfs joining the floor-timbers and the futtocks, or the presence of design marks, known in the Mediterranean since the Middle Ages, related to a non-graphic design of the hull (Rieth 1996). The presence of design marks, rare, but known on other vessels from the same period, like the Cais do Sodré (Nicolardi, Castro 2015) and *La Belle*, which seems to demonstrate evidences of a transition to graphic design (Pevny 2017), provides direct evidence of the hull design. The general good preservation of the floor-timbers and futtocks will also allow us to analyze the curvature of frames. The number and characteristics of the arcs used to determine the shape of the hull have not yet been determined, but a very preliminary analysis shows that the floor-timbers use an inverted arc on the base of the floor-timber (there are no floor-timbers with a flat bottom).

To conclude, together with Boa Vista 1 and Boa Vista 2 from the same period, Boa Vista 5 is an extraordinary find, with a very high scientific potential. Assuming the hypothesis that she was built on the Iberian Peninsula, it is an important starting point to review the available sources on later 17th century ship construction for the Atlantic.

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