

An 18th-century timber wharf in Copenhagen Harbour

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SUMMARY: An archaeological investigation prior to the building of Copenhagen's new Opera House examined an impressive wooden wharf built in the 1780s around Ankerøen, the island on which the Danish navy stored its anchor stocks. When considered with documentary evidence, the excavated structure can be shown to employ a distinctive method of construction, comparable to that used in the so-called 'Hamburg' type of wharf, with a heavy box-like frame fronted with slanting storm posts. It was abandoned by the mid-19th century, when the shape of ships' hulls changed.

The term *bolværk*, the Danish word for 'wharf', comes originally from the old Danish word *bulvirke*, in which *bul* means 'beam' and *virke* means 'built structure'.¹ Originally the term referred to a defensive work made of wood. Today it is used of all quay structures that are driven down and fixed in place, whether they are made of wood, stone, steel or concrete. A wharf has two functions. It should keep the water out and retain in place the mass of earth lying behind it. Depending on their size, wharfs may be more or less complicated in their construction, ranging from simple wattle structures to major undertakings with multiple elements. This paper will deal with an example of the latter type, encountered during the excavation of an 18th-century mooring island in the Holmen area of Copenhagen Harbour.²

In the summer of 2001 the Copenhagen City Museum undertook an archaeological investigation prior to excavations for Copenhagen's new Opera House. The site is on the island named 'Dokøen' (Dock Island) in the area of Holmen, on the west side of Copenhagen Harbour, opposite the Amalienborg Palace, and about 600m south-east of the excavation of the rubbish dump described by the writer in *Post-Medieval Archaeology* in 2005 (Fig. 1).³ Holmen is an area consisting of several large and small linked artificial islands,

constructed on open water. Until a few years ago, it was Copenhagen's main naval station. Its building history is long and complex: construction began at the end of the 17th century and did not finish until the 1880s.

Ankerøen, the mooring island which forms the subject of this article, will be referred to as Anchor Island; its original position and plan are known from several contemporary paintings and engravings (Fig. 2). According to written sources, it was built in open water in 1781–87 and was reported to be *c.* 124m long and 43m wide.⁴ The anchor stocks of naval ships were kept on the island; at its centre was the Anchor Stock House, built in 1788, a stone building about 34m long and 11m wide, with gates on each side and a hipped roof. The design and construction work for the Stock House were carried out by a builder named Melchior Pettermann, whose plans are preserved in the Danish State Archives.⁵ A second island named Ballast Island — so named because ballast stones for the Navy's ships were kept on it — formed an extension to Anchor Island. In 1835 these two islands were joined together to save the expense of repairs to their wharfs.⁶ By 1854 the two were absorbed within a larger construction known as Dock Island, which provided new mooring facilities on Holmen. At that time the southern

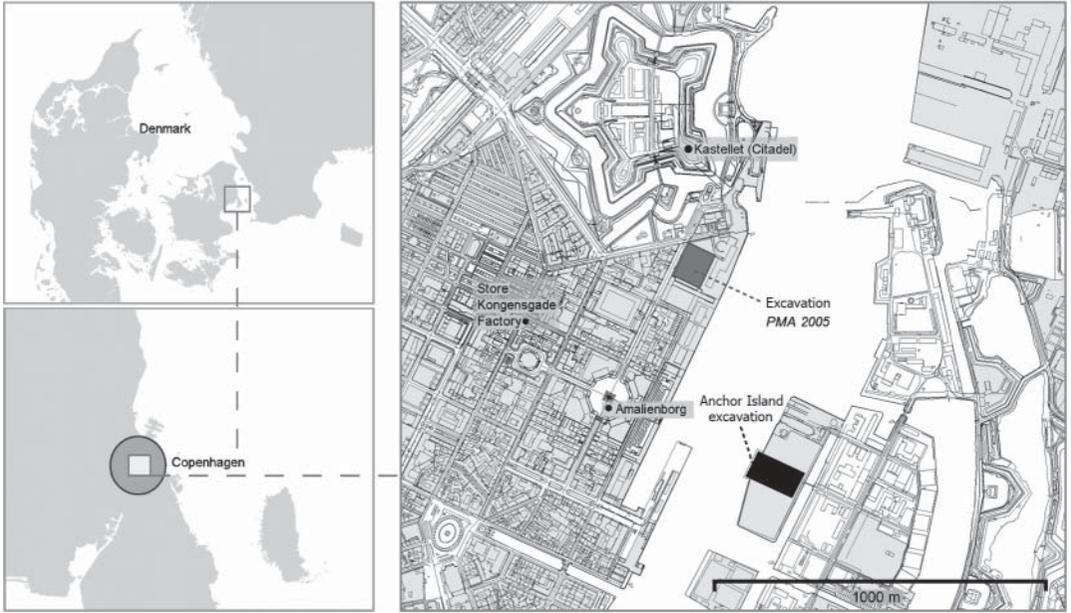


FIG. 1

Anchor Island, Copenhagen: site location.

wharf of Anchor Island and a small section of the south-western corner of the island were still free-standing, but gradually the area south of Anchor Island was filled in. The precise timescale for this operation is not known, but it was evidently protracted; a photograph of 1868 shows that part of the southern island was still incomplete.⁷ By that stage, however, it must be assumed that Anchor Island had been incorporated completely in the newly infilled land.

Substantial map evidence and other source material are available concerning the buildings and other structures on Holmen; it has not proved possible, however, to find detailed drawings of the construction or form of Anchor Island. Searches in the State Archives related to Holmen revealed a construction drawing of 1804; it depicts two wharfs in section and in ground plan (Fig. 3). One of them, more sturdy than the other, closely resembles the wharf excavated on Anchor Island (see below). It bears the following description: 'Drawing of the wharf between the Nyholm Crane and the Main Guard Building. The pier has been set in place instead of the previous double wharf or open careening bay'. Above the drawing is added: 'This wharf is situated at a depth of 12 to 14 feet' (i.e. c. 4m below sea level). The other wharf on the drawing is accompanied by the following text:

Drawing of the wharf that enclosed the area between the old Anchor Island and the Stone Trough, and which, when it was filled in, subsided some two to three feet [0.6–0.9m], so that some anchoring timbers of double length had to be set in, with two rows of cross-anchors and posts to support them. Some additional storm posts had to be hammered down on the outside to support the wharf.

Above the drawing it is noted that the wharf stood on the sea bed about 8–10 feet [c. 3m] below sea level. The word 'old' shows that the drawing must be later in date than the construction of the wharf on Anchor Island; 'the Stone Trough' must refer to Ballast Island. The information that the wharf subsided when the infill was added, and that it had to be strengthened, is interesting. This may mean that the construction drawing (Fig. 3) was used to illustrate both a viable and an unsound type of wharf.⁸

Wooden wharf structures have been in use in the harbour from that day to this, but sources relating to their design and construction are not easily found. In 1924 the harbour builder G. Lorenz discussed various quay structures in Copenhagen Harbour.⁹ He mentioned briefly the

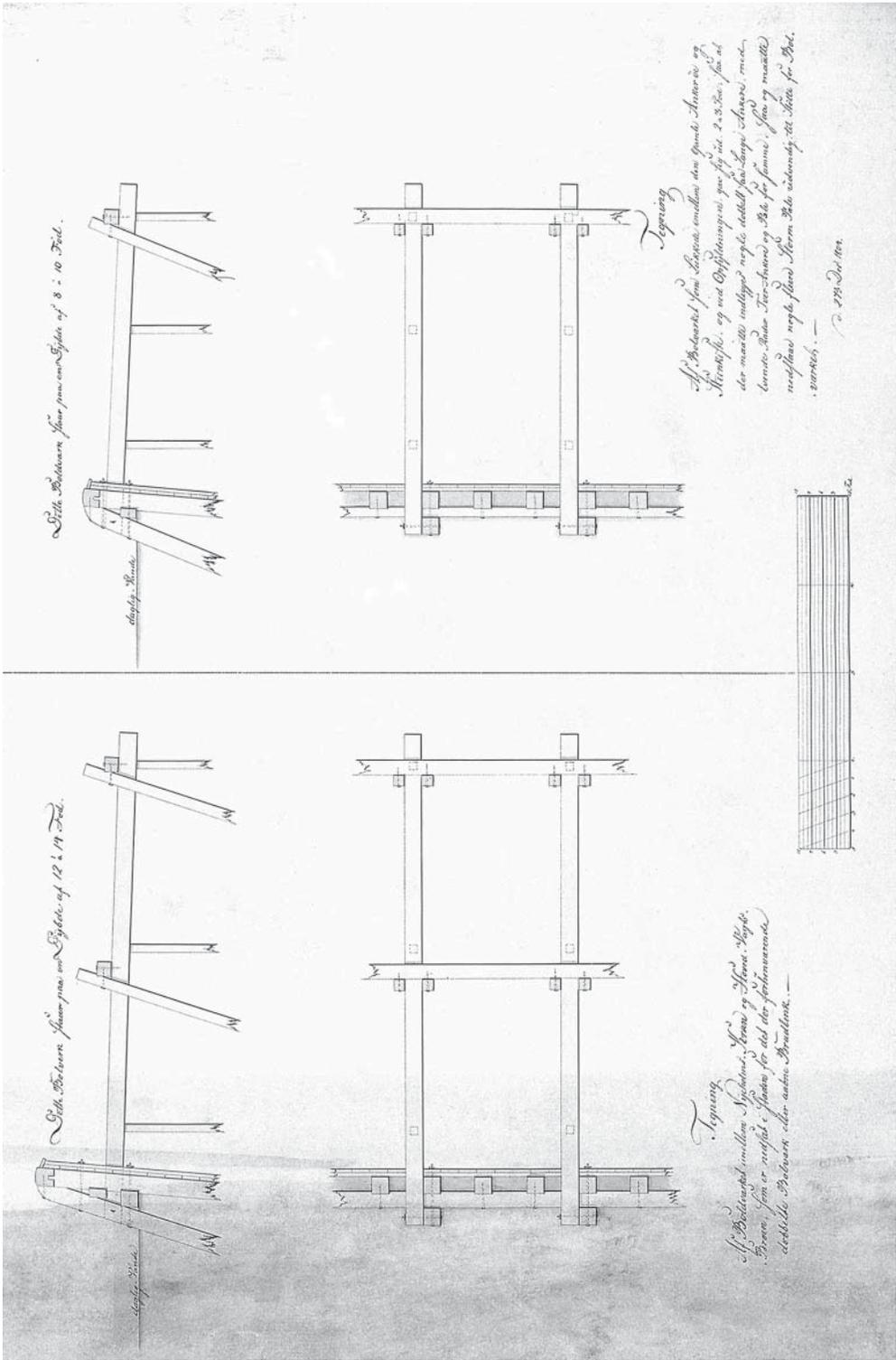


FIG. 3 Copenhagen Harbour. Construction drawing of two types of wharf of 1804 (Danish State Archives, Søetatens Restsamling).

greater opportunities for fraud open to workers using a hammering machine rather than a tread-wheel. In his book there is a very detailed account of the structure of wooden wharfs of a form which he calls the 'Hamburg type', this is very similar to the wharf excavated on Anchor Island. As it was written only 20 years after the construction of Anchor Island, it is almost a contemporary source. It is therefore probable that Anchor Island was built with wharfs of the Hamburg type, even though they were primarily intended for use in areas of tidal water. The following account of the wharf on Anchor Island will start from a consideration of the archaeological evidence, which will be interpreted in the light of the construction drawing in the State Archives, the accounts in Erling Møller's book, and the descriptions in *Salmonsens Konversationsleksikon*.

The construction work for the Opera House affected the south-western part of Anchor Island. When archaeological work on the site started, large parts of the upper structural timbers of the island had already been dug away (Figs 4–5). Excavation then continued to expose the rest of the wharf in order to gain an overview of the way it had been built. The island was measured by a surveyor using System 34, the official coordinate system used in Denmark for geographical reference; the timberwork was recorded in plan and with selected sections at the scale 1:20. In addition, Lars Nissen surveyed the area with a metal detector and found many metal objects. Once the individual structural components had been recorded, a section was dug through the island from south to north to ensure that there were no sunken ships under it.

The wharf turned out to be an impressive piece of work. The wood was entirely Pomeranian pine of large dimensions. The timbers had been numbered in several places with Roman numerals, incised beside the joints. This practice, also known from log cabins and timber-framed buildings, suggests that parts of the structure had first been assembled on land. The presence of a coherent numbering system throughout the wharf and the absence of clear evidence of reused members indicate that the timbers were all newly cut.

The harbour is not tidal. As the timbers were preserved to only just above sea level, no archaeological evidence survives about the upper parts of the structure. Although the lower parts of the wharf had been badly damaged by machine excavation, most of the significant information they might provide could still be recovered (Fig. 6).

The sequence of construction of the wharf was as follows. First the main vertical members of

the wharf were pile-driven into the sea bed; they consisted of three rows of posts, arranged parallel to the wharf (Fig. 6, Rows 1–3). The bases of some of these posts were seen in a test trench; they stood about 3m high. These uprights will be called support posts; their tops were at about sea level. The row of posts nearest the wharf had been used to build up the wall of the wharf (Fig. 6, Row 1). The second row (Fig. 6, Row 2) lay *c.* 2.90m from the first; the third (Fig. 6, Row 3) stood about 2m from Row 2 at the eastern end of the wharf and 3.20m from the western end. The posts were *c.* 0.26m thick. Above them, at right-angles to the wharf, long anchor beams had been morticed into them; they were *c.* 5.70m long and 0.28m wide (Fig. 7: b). Following their installation, posts slanting away from the wall of the wharf had been driven down at an angle of about 75 degrees on both sides of each anchor, beside each of the posts in support-post rows 2 and 3 (Fig. 7: c). These were *c.* 0.26m wide; their function was to strengthen the anchoring of the wall of the wharf. Next, three rows of cross-beams known as stretchers (Fig. 7: d1–d3) had been laid at right-angles to the anchors and directly on top of the rows of support posts 1–3. The stretchers had been placed so that the slanting posts rested on them; it is therefore difficult to say whether the stretchers or the slanting posts had been put in position first. The wall of the wharf extended *c.* 0.40m in front of the stretcher which overlaid Row 1 of the support posts (Fig. 7: d1). This wall had been fixed to the stretcher with iron bolts running through wooden blocks (Fig. 7: e), and had been made by driving down posts (Fig. 7: f), at intervals of *c.* 3.30m, staggered in relation to the anchors. These posts, known as bulwark posts, were *c.* 0.26m wide. Slanting storm posts, also *c.* 0.26m wide, had been mounted on the bulwark posts (Fig. 7: g). The storm posts had the same function as the slanting posts, preventing the wharf from slipping out of position. They had been fixed to the stretchers with long metal bolts that ran through the first row of posts (Fig. 7: h). The wharf wall was fastened between the bulwark posts and the storm posts. It was constructed of cross-beams known as battens, placed between the driven posts (Fig. 7: i). The lowest battens presumably lay on the seabed. The next would have been about 1m above that; between them were vertical posts, *c.* 0.26m thick, morticed in and spaced 0.50–0.70m apart (Fig. 7: k). On the back of this frame was fastened a cladding which consisted of horizontally placed boards *c.* 0.40m wide and *c.* 60mm thick. Upon completion of the structure, its visible parts would have been the storm posts, the battens, the vertical timbers and the board cladding behind (Figs 8–10).



FIG. 4

Anchor Island, Copenhagen, showing the extent of damage before the archaeological investigation began (photograph, Vivi Lena Andersen, Copenhagen City Museum).



FIG. 5

Anchor Island, Copenhagen: the island seen from the south-west (photograph, Vivi Lena Andersen, Copenhagen City Museum).

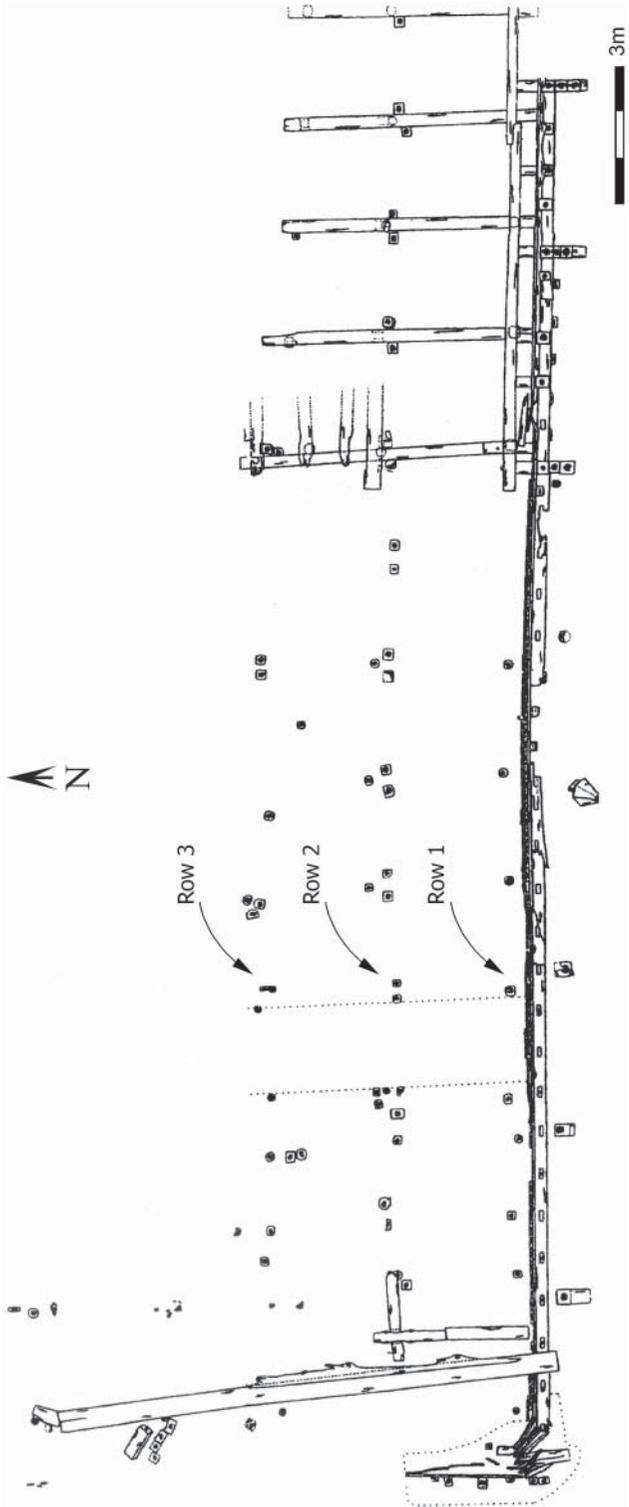


FIG. 6
Anchor Island, Copenhagen: ground plan of the wharf.

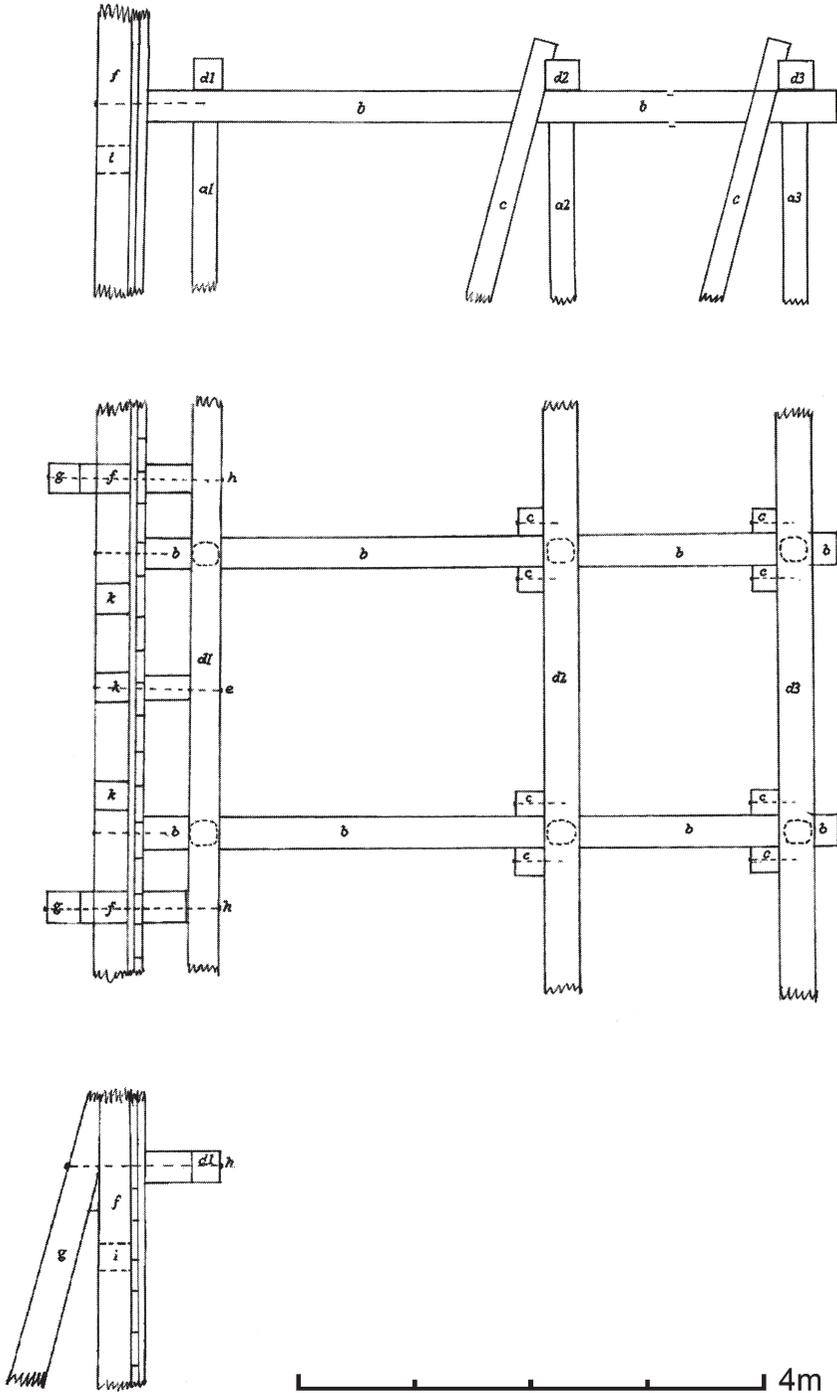


FIG. 7

Anchor Island, Copenhagen: reconstruction drawings of the shape of the wharf in section and plan (drawn by Lene Høst-Madsen, Copenhagen City Museum).

Behind the outer cladding, a second board cladding was found. Its timbers had the same dimensions as the first, but it had been made of two rows of vertically placed boards running from the seabed up to just above the surface of the water. The bottom board had been shaped to a point and hammered into the seabed. Above that, a third row of boards was found, wedged behind the bottom row. Finally the board cladding had been sealed with blue clay.

Comparison of the wharf on Anchor Island with the drawing of the sturdy wharf in the State Archives leaves no doubt that there are close similarities in construction, and that taken overall it belongs to the same type of wharf. The dimensions of the timber are almost the same, although the support posts at Anchor Island seem slightly stouter. The bulwark posts are placed at the same distance from the storm posts — 3.30m (Figs 7, 9). The inner construction also shows many similar features. Both structures have three rows of support posts, with slanting posts in the second and third rows, and stretchers lying across the support posts in Rows 2 and 3. The distance between the support posts and the stretchers and anchors is not exactly the same — it is less at Anchor Island; but the main lines of the structure are the same. There are, however, a few significant points where the Anchor Island wharf differs from the drawing. Above Row 1 of the support posts at Anchor Island there is a piece of stretcher-timber, while on the drawing from the State Archives there are only stretchers above Rows 2 and 3 of the support posts. This leads to another significant difference: the bulwark posts on Anchor Island are not directly fixed to the anchors in the inner construction in the manner shown on the drawing in the State Archives. The distance between the anchors on Anchor Island is less than the distance between the bulwark posts. The anchors are therefore fixed unevenly in relation to the bulwark posts, directly on the wall of the wharf, while the bulwark posts and the storm posts are fastened to stretchers that run over the row of posts. This may be the explanation for the stretcher-timber above Row 1. In his summary of the construction of wooden wharfs of the Hamburg type, Møller draws attention to the fact that ‘the anchor runs in front of the side, both of the wharf and of the storm-post, so that it does not meet them in a timber joint, but is fixed to the storm-post with an iron bolt’.¹³ There is no doubt that the direct connection between the anchors and the bulwark posts/storm posts gives added strength to the construction. Why was this procedure not followed on Anchor Island? The most probable explanation is that at some

point it became necessary to change the cladding of the wharf, while the inner construction, which is less exposed, remained intact. Stretchers were therefore added on top of Row 1 of the support posts and the new cladding of the wharf was built on them.

In an attempt to establish whether there was a difference between the dates of the anchors and the wharf cladding, samples were taken from each of them for dendrochronological dating, but unfortunately the samples could not be dated. The cladding may have been replaced in 1835, when Anchor Island was united with Ballast Island. Alternatively, it may have been the need to make savings that caused the increase in distance between the bulwark posts. If it was renewed in 1835, Anchor Island’s new wharf cladding would have been in use for only 20 years before it was buried within the new Dock Island. A further indication that adjustments were made during the lifetime of the island is that Row 3 of the support posts is not straight. Along the western side of the island and *c.* 30m to the east, the row lies *c.* 3.20m from Row 2 of the support posts. In the remaining 8m of wharf that have been investigated, the distance was reduced to *c.* 2m. (The form of construction of a further short length is unknown, because it was not excavated.) There is no obvious explanation for this difference in construction, but the support posts and anchors may have been replaced in part of the wharf. Another possibility is that there was a scarcity of timber of the right length, and therefore the anchors were made shorter. Unfortunately these timbers also were not datable by dendrochronology.

It is also interesting to note that the construction drawing for the sturdy wharf in the State Archives shows it standing in about 2m of water. The depth of water prior to the building of Anchor Island was only about 1m; the excavated wharf may have been so solid because a lighter type of wharf had been rejected. The drawing shows that the latter had been used for joining the old Anchor Island to Ballast Island but, according to the note added to the drawing, it had not lasted.

In the course of the excavation a number of significant 17th- and 18th-century finds came to light. No fewer than 32 buttons were found, including a uniform button with the royal coat of arms of England; two identical buttons with Frederik IV in profile and an inscription; a button with an anchor motif, from a naval officer’s dress (Fig. 11); several plain uniform buttons, curved and flat, and a large number of ordinary buttons. There were also several lead seals, two weights, the pommel of a 17th-century copper-alloy dagger in



FIG. 8

Anchor Island, Copenhagen: the wharf seen from the south (photograph, Vivi Lena Andersen, Copenhagen City Museum).



FIG. 9

Anchor Island, Copenhagen: registration of the anchor beams in the inner construction (photograph, Lene Høst-Madsen, Copenhagen City Museum).



FIG. 10

Anchor Island, Copenhagen: storm post and bulwark post seen from the side (photograph, Vivi Lene Andersen, Copenhagen City Museum).

the form of an eagle head (Fig. 12), and quantities of clay pipes, pottery and glass fragments. The finds were probably redeposited with the soil added to the island as infill. The weights, lead seals, and the buttons indicate that at least part of the infill came from an area where there had been activities of an official nature — probably an area on Holmen.

There is no tradition of undertaking archaeological investigation of structures of historic periods in Denmark — unlike the situation in

countries such as Britain and the USA. Can such investigations contribute anything significant and new when written sources and drawings are available? The investigation of Anchor Island demonstrates that many things were not recorded at the time of building or use, and have therefore been lost. They include the evidence of its structure, and of the subsequent repairs. Wharfs with storm posts are no longer used in Copenhagen harbour, and sources providing information about this type of wharf have proved to be extremely



FIG. 11

Anchor Island, Copenhagen: button with an anchor motif. Diameter 52mm (photograph, Henning Nielsen, Copenhagen City Museum).

scarce. Anchor Island may represent one of the last opportunities to investigate this type of wharf by modern methods. The finds from Anchor Island are at present unique. Buttons with the anchor motif are otherwise known only from contemporary depictions of naval officers. The only parallel to the eagle head that probably came from a dagger is from the excavation of a shipwreck of the end of the 17th century in Schleswig-Holstein.¹⁴ The excavation also raised some unresolved problems. For unknown reasons the inner construction of the island with anchors and support posts is not consistent; the island may at some stage have been extended to the east. More important than this specific information, the project has demonstrated the great potential value of archaeological investigation of structures from more recent historic periods.

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NOTES

¹ The present form of the word has been influenced by the German *Bollwerk*. The Danish word *bolværk*



FIG. 12

Anchor Island, Copenhagen: dagger pommel in the form of an eagle head. Width across base: 28mm (photograph, Henning Nielsen, Copenhagen City Museum).

also retains the sense of a defensive structure, particularly in literary sources, where it is often used more in the English sense of 'bulwark', meaning a defence against an enemy (Nielsen 1989, 60).

² A version of this paper was first presented in Roland 2005 (Høst-Madsen 2005a).

³ Høst-Madsen 2005b.

⁴ Elling & Stern 1933; Thostrup 1989.

⁵ Danish State Archives, Naval Map Collection, C187.

⁶ Thostrup 1989, 114.

⁷ Thostrup 1989, 118, 135.

⁸ Danish State Archives, Søetatens restsamling.

⁹ Lorenz 1924.

¹⁰ Gnudsmann 1939; Rode 1950.

¹¹ Blangstrup 1915, 607.

¹² Møller 1800.

¹³ Møller 1800, 46.

¹⁴ Englert 1997, 91, fig. 17.

BIBLIOGRAPHY

- Blangstrup, C. (ed.) 1915, *Salmonsens Konversationsleksikon* 3, 2nd edn, Copenhagen: J.H. Schultz.
- Bramsen, B. (ed.) 1989, *København før og nu — og Aldrig* 8, Princeton (VA): Princeton Architectural Press.
- Elling, C. & Stern, V. 1933, *Holmens Bygningshistorie 1880–1930*, Copenhagen: Koppel.
- Englert, A. 1997, 'Das neuzeitliche Wrack aus dem Hedwigenkoog, Kr. Dithmarschen', *Universitätsforschungen zur Prähistorischen Archäologie* 41, 7–106.
- Gnudsmann, K.S. 1939, 'Kajindfatningskonstruktioner Københavns Havn', *Ingeniøren* 2, 1–8.

- Høst-Madsen, L. 2005a, 'En 1700-tals ankerø på Holmen i København', in Roland 2005, 91–100.
- Høst-Madsen, L. 2005b, 'Eighteenth-century Copenhagen viewed from a refuse dump', *Post-Medieval Archaeol.* **39**:2, 311–27.
- Lorenz, G.M. 1924, 'Forskellige kajindfatninger anvendt ved Københavns Havn', *Ingeniøren* **51**, 593–600.
- Møller, E. 1800, *Nogle Anmærkninger Havnebygningsvæsenet Vedkommende Isærangående Træ- og Stenbolverkens Fysiske og Oeconomiske Fortrin og Mangler med Hensyn på København*, Copenhagen: J.F. Schultz.
- Nielsen, N.Å. 1989, 'Ordenes historie', *Dansk Etymologisk Ordbog*, Supplement to *Den Store Danske Encyklopædi*, Copenhagen: Gyldendal.
- Rode, J.G. 1950, 'Bolværkstyper og kajprofiler, Københavns Havn', *Stads- og Havneingeniøren* **41**, 130–3.
- Roland, T. (ed.) 2005, *Bolværk — fra Middelalderen og nyere tid. Beretning fra et seminar afholdt 24. maj 2002 på Næstved Museum*, Næstved: Næstved Museum.
- Thostrup, S. 1989, 'Holmen og Orlogsværftet. København', in Bramsen 1989, 11–136.

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