



ARCHAEOLOGICAL INVESTIGATIONS IN THE ZONE OF EARTHEN FORTIFICATIONS OF PÄRNU

RÜNNO VISSAK

MTÜ AEG, Lutsu 16-26, 51006 Tartu, Estonia

rynno.vissak@gmail.com

INTRODUCTION

Archaeological monitoring and research during the preliminary investigations (May – June 2009) and renovation work (December 2009 – June 2010) of the bastions Venus and Luna and their connecting curtain area in Pärnu Vallikäär offered us an opportunity to gather various data about the supporting constructions of the earthen body of the zone of fortifications from the second half of the 17th century as well as the bank fortifications of the moat in the same place (Vissak 2010a–b). In the course of archaeological excavations the structures of the bank fortifications by the moat, built in the second half of the 17th and in the second half of the 18th century, were discovered. Accordingly, the wooden and stone constructions were unearthed and documented. The present paper deals with the results of the mentioned investigations. In addition some data are presented about the location of the earthen fortifications and the construction of the structures of the zone of bastions, gathered during the monitoring work in Lõuna and Ringi streets in Pärnu. In the area of the Vallikäär bastions investigations and monitoring were carried out by the author, substituted by archaeologist Eero Heinloo for a shorter period. Monitoring and investigations in Lõuna and Ringi streets were carried out by archaeologist Peeter Piirits, who kindly allowed his results (Piirits 2010) to be referred to in the current overview.

Of the seven bastions from the zone of fortifications around the town Pärnu only the bastions of Luna and Venus from the second half of the 17th century located in the park area of Vallikäär have preserved until today. On the western and southern side of the bastions a section of the moat has also preserved. The rest of the moat was filled in during the levelling of the ramparts while dissolving the earthen fortifications in the 1860s (see Fig. 1). The area of the opposite bank of the moat (the so-called shallow bank) has remained mostly as a park and green area without any buildings. Historically the outworks of



Fig. 1. The plan of Pärnu from 1699.

Jn 1. Pärnu plaan aastast 1699.

(Detail of the map, RKA 0406-28-039-005.)

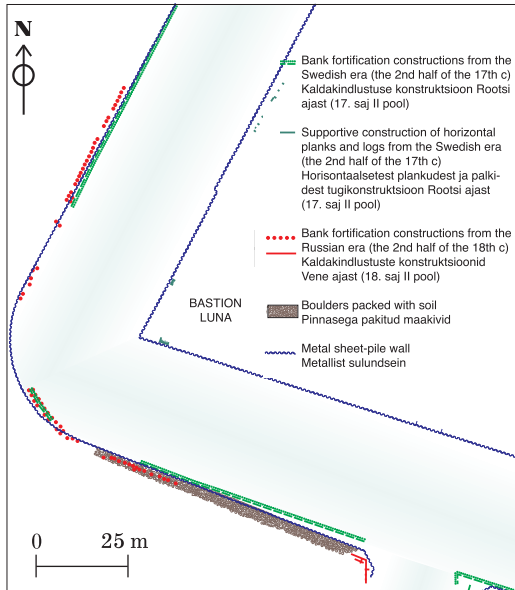


Fig. 2. Fragments of the structures discovered on the banks of the moat.

Jn 2. Vallikraavi kallastel avastatud rajatiste fragmendid.

Drawing / Joonis: Andres Tepper

2009), where the wooden constructions documented in the area of ca. 200 m² at the plot of Aida Street 5 suggest interesting results for future analysis. Ground-penetrating radar surveys of the bastions Venus and Luna area to locate buried remains of constructions were carried out in 2007 (Vunk 2007).

PRELIMINARY INVESTIGATIONS

Prior to the renovation work, preliminary archaeological investigations took place in May and June 2009. The main purpose of the survey was to find out if the erecting of a sheet-pile wall planned at the waterline at the side of earthen fortifications might damage the constructions preserved on the northern and eastern bank of the moat (Vissak 2009).

Preliminary investigations established parts of the substruction of horizontal logs and planks located on the edge of the moat in water and water-saturated sand by the western side of the bastion Luna during shallow water level above the absolute height of -0.14 to -0.35 m. However, no constructions could be identified by the southern face of the bastion. A few short vertical posts located individually or in a row, which can neither be considered the supportive structures of the earthen fortifications nor the palisade, were discovered from the bank edge by the western side of the curtain and the bastion Venus. The National Heritage Board¹ advised to conduct underwater archaeological studies before the project of the construction of the fortifications of the

the bastions and the area of the esplanade were located there and until 1804, when a new bridge (Germ. *Floss-Brücke* or Est. *Nahksild* (Leather Bridge)), situated on the northern side of the town in front of the Watergate (Est. *Vee värav*), was completed. The road running through the Tallinn Gate and over the moat was leading to the crossing-place of the Pärnu River (Parek 1971, 14). The Gate itself went through the curtain erected between the bastions of Luna and Mercurius. In addition to the moat in front of the bastions, which was dredged and connected to the Pärnu River, to be used as a winter harbour in 1881, a short section of the tributary of the moat running around the ravelin Abendstern in front of the Tallinn Gate has been preserved (see Fig. 2).

During the research of the bastion zone of Pärnu in 2007–2009, archaeological investigations were also carried out on the northern side of the town in the area of the curtain between the bastions Mars and Saturnus (Bernotas *et al.*

¹ According to the 19.02.2009 resolution which is quoted in “Pärnu Vallikäärü pargiala eelprojekt”, page 12.



Fig. 3. New construction at the waterline shifted away from the wooden constructions by the western side of the bastion Luna.

Jn 3. Puitkonstruktsioonidest eemale nihutatud uus kaldakindlustus bastion Luna lääneküljel.

Photo / Foto: Rünno Vissak

bank should be specified. Unfortunately, investigations of the constructions in water in 2009 gave no results.

RESEARCH IN 2010

During the renovation work in Vallikäär, the focus of the archaeological studies was foremost directed towards the bank of the moat, where a metal sheet-pile wall was thrust into the soil and a pedestrian bridge erected over the tributary of the moat. In connection with the mentioned work, soil was sporadically removed from the opposite bank of the bastions by the waterline, as a result of which earlier bank fortifications were unearthed (see also Vissak 2011). Depending on the direction of the wind the water level of the moat is changing and can fluctuate up to 0.5 m a day. Thick vegetation grows in the shallow water of the bank area and the water is dark and poorly transparent, therefore as a rule wooden parts of the construction could not be observed before the construction work.

An exception was the above-mentioned section of a supportive construction of planks near the vertex (at the corner of the southern and western faces of the bastion) by the western side of bastion Luna. There a section of a supportive construction, composed of up to six horizontal parallel planks attached to the baulks and situated on the edge of the earthen fortifications was successfully revealed in the 30 cm deep water at the absolute height of -0.35 m. According to the project, the line of the metal sheet-pile wall in the named section of the bank had to be shifted to a certain degree towards water, in order

to prevent the earlier preserved constructions from damaging. However, in winter 2010, while thrusting the sheet-pile wall, it appeared that somewhat to the north of the fixed planks the line of new bank fortifications intersected with the vertical posts and planks on the edge of the wooden constructions. In order to avoid damages to the wooden constructions, a decision was made in the course of the works to shift the new sheet-pile wall partly away from the bastion by one more meter (Fig. 3).

THE SOUTHERN BANK OF THE MOAT

Boulders packed with soil were unearthed on the southern bank of the moat on the first day of the monitoring work from the absolute height of 1.25 up to 0.80 m (upper horizon) and under them constructions of horizontal logs supported by vertical posts up to the absolute height of 0.36 m. Unfortunately, in 2009 there had been no requirement for preliminary archaeological investigations in that area and therefore the archaeological work was subsequently conducted in relatively harsh winter weather and the arising problems had to be solved on the fly.

In the first stage of the works, the modules of the sheet-pile wall were thrust through the ice that covered the moat, and the parts of constructions located at the waterline could only sporadically be seen. These could be observed more thoroughly only after the riverside end of the moat was closed and the water level was lowered by approximately half a meter. This was necessary in order to cast the concrete belt over by the sheet-pile wall. In the area of the southern and western banks of the moat, west of the auxiliary pond, the constructions of two non-contemporaneous and differently built wooden and stone bank fortifications were exposed.

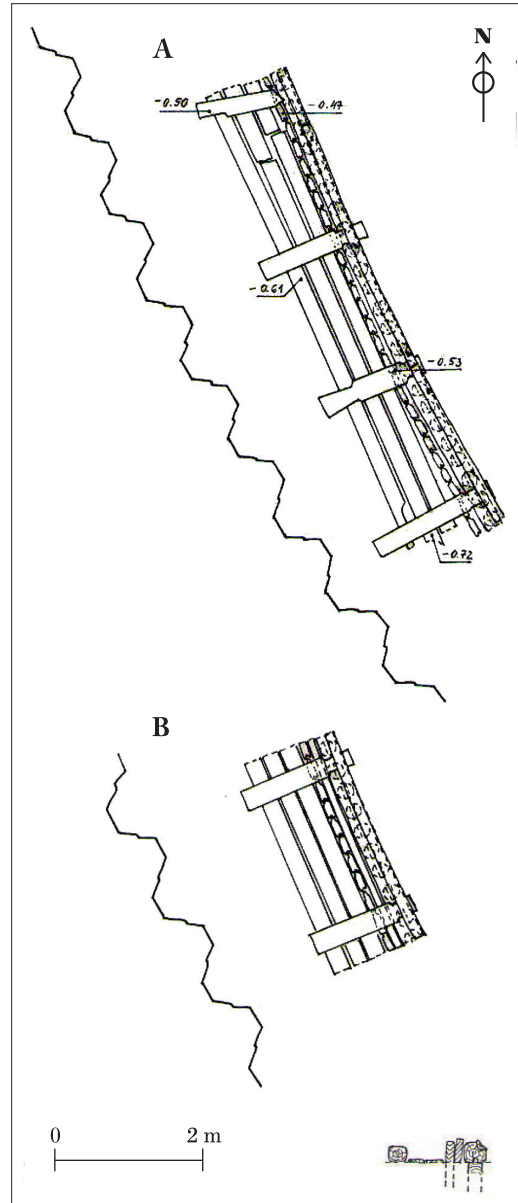


Fig. 4. A – construction of the second half of the 17th c bank fortifications, B – construction of the second half of the 17th c bank fortifications with the edgewise placed plank.

Jn 4. A – 17. saj teise poole kaldakindlustuste konstruksioon, B – 17. saj teise poole kaldakindlustuste konstruksioon serviti paigutatud planguga.

Drawing / Joonis: Ave Avalo



Fig. 5. Corner of the southern and western bank of the moat, the 17th c construction and the upright posts from the later construction period.

Jn 5. Vallikraavi lõuna- ja läänekalda nurk, 17. saj konstruksioon ja hilisema ehitusperioodi püstpostid.

Photo / Foto: Eero Heinloo

wooden pegs. The moulding additionally fastened the ends of the transversely located logs, attached by dovetail. The upper part of the described construction started in the corner of the southern and western bank of the moat from the absolute height of -0.50 m, while the ends of the upright posts rammed into the bank fortifications from the later construction period lay at the absolute height of $+0.08$ up to -0.23 m (Fig. 5).

On the eastern side of the southern bank of the moat, above the corner of the tributary moat and directly east of it, the upper part of the sheet-pile wall was documented at the absolute height from -0.43 to -0.82 m and the edge log supported by the upright posts at the absolute height of -0.34 m. On the western bank of the moat similar edge logs at the waterline were documented at the absolute height of -0.16 and -0.23 m.

During the later bank construction, from which a relatively well preserved section was unearthed (at the absolute height of 0.36 – 0.19 m) above the foundation trench of

The waterside edge of earlier bank fortifications were formed by the row of upright posts rammed into the soil alongside the bank. On the average 30 cm wide hewn logs situated horizontally on the row of posts were attached to the posts by simple tenons. 136 – 145 cm long logs, joined together by dovetail, were transversely (with the gap of 156 – 178 cm between them) attached to the upper side of the hewn logs. Those logs helped to attach the edge log to the parallel framing log near the bank. In parts, a longer log was attached to the waterside edge log. An intersecting log, attached to the lower section of the bankside end of the longer log, had been anchored to the upright posts located in the distant part of the bank. In parallel to the waterside row of logs a sheet-pile wall, made of 10 – 12 cm thick and up to 30 cm wide upright planks (Fig. 4: A), was situated towards the bank (to the distance of 10 – 15 cm from the logs). In some passages an edgewise (6 – 8 cm thick and 22 cm wide) plank had been placed to the inner side of the edge log between the row of upright posts and the sheet-pile wall (Fig. 4: B). Similarly to the edge log, mortices were situated on the upper side of the plank. In the outer edge of the waterside log, a wooden element (edge moulding) with a triangular cross-section was attached to the upper side of the log by

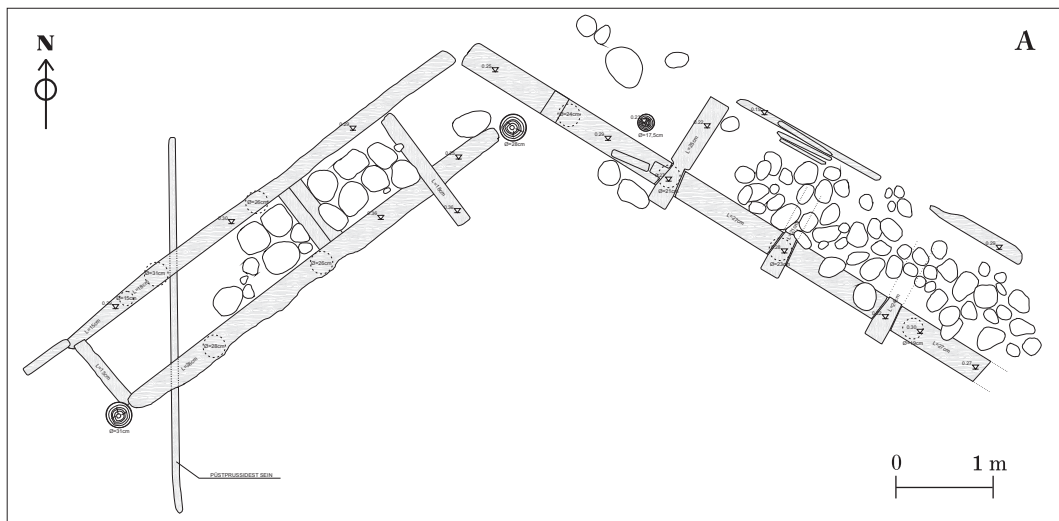


Fig. 6. A – construction of the second half of the 18th c bank fortifications, B – the 18th c bank construction at the corner of the southern bank of the moat and the western bank of the tributary moat.

Jn 6. A – 18. saj II poole kaldakindlustuste konstruktsioon, B – 18. saj konstruktsioon vallikraavi lõunakalda ja harukraavi läänekalda nurgal.

Drawing / Joonis: Andres Tepper

Photo / Foto: Rünno Vissak

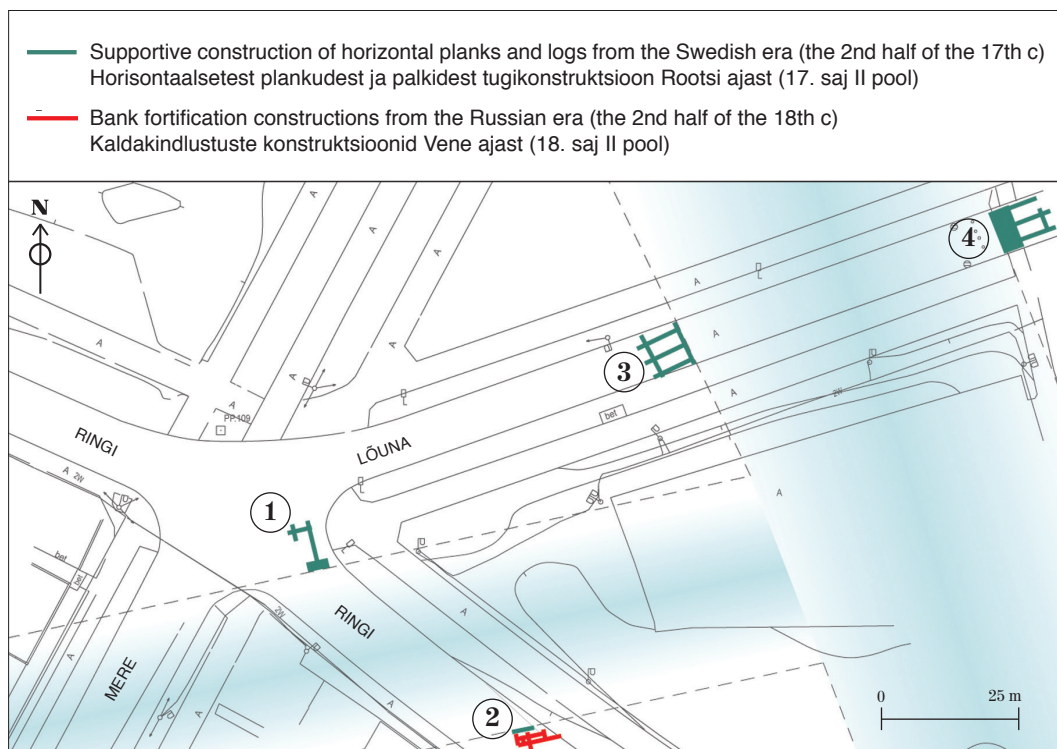


Fig. 7. Constructions unearthed in Ringi and Lõuna streets. 1–4 – excavated fortification structures.

Jn 7. Ringi ja Lõuna tänaval välja kaevatud konstruktsioonid. 1–4 – uuritud kindlustusrajatised.

Drawing / Joonis: Peeter Piirits, Andres Tepper

the bridge erected on the corner of the southern bank of the moat and the western bank of the tributary moat, stout vertical posts (with the diameter between 28–32 cm and the average length between 1.7–1.8 m) were rammed into the ground on the average distance of 1.2–1.3 m from each other in two rows parallel to the bank (the distance between the rows being 80–90 cm). The upright posts supported the longer horizontal logs hewn on the upper side and shorter logs with hewn lower side, located in two rows alongside the bank. The logs were joined together directly above the posts or at a slightly shifted position by the transversely located logs. Shorter transverse logs had been joined together with the longer logs by dovetails located at the upper side of the latter. Boulders packed with soil were situated between and on top of the logs (Fig. 6: A, B).

The dendrochronological dates obtained from the wooden parts of the later bank fortifications resulted in 1776 and 1788 years AD.² According to the data from archives it is known that extensive renovation work was carried out near the earthen fortifications in the second half of the 18th century and both timber and stones were needed for this (Parek 1971, 12–13).

² Identified by Rivo Bernotas (University of Turku), the report is in preparation.



Fig. 8. Supportive walls in front of the outer side orifice of the sally port.

Jn 8. Poterni välimise ava ees paiknevad tugimüürid.

Photo / Foto: Rünno Vissak

RINGI STREET

A construction was unearthed 2.65 m deeper from the present street level in the excavation plot of the pipeline planned to Lõuna street at the crossing of Ringi and Lõuna streets with the Mere avenue (Fig. 7: 1). The construction was composed of an edge log supported by a row of vertical posts rammed into the ground and the edge element with characteristic triangular cross-section attached to the outer edge of the edge log. The sheet-pile wall, which ran in parallel to the edge element and was made of vertical planks that were joined together with timber joggles, was rammed into the ground. Horizontal logs were situated crosswise to the planks and had been attached to the other elements (see Piirits 2010, 4, figs 1–3, photos 13–36). The north-east – south-west directed construction was situated on the brim of the ravelin in front of the Tallinn Gates on the northern bank of the tributary moat surrounding the ravelin. Two slightly over 5 m long logs were documented at the construction. The south-western ends of the logs had been placed between the upright posts and attached to the horizontal log on the south-western side of the posts. The south-eastern ends of the

described anchor logs had been attached to the waterside edge log with dovetails and 4 × 4 cm wooden pegs.

The construction of the fortification on the opposite bank (outer bank) of the tributary moat was exposed 24 m south-east from the above described bank structure in the excavation of a trench of Ringi street (Fig. 7: 2). Here, similarly to the situation in the southern bank of the moat opposite to the bastion Luna, in the outer side of the tributary moat a later bank fortification supported by stakes and with two parallel rows of logs joined together by cross-beams and stones between and on top of the logs had been erected above the earlier construction in the distance of ca. 1 m from the water-line. The earlier construction originated from the 17th century and had been laid above the waterside row of posts and the sheet-pile wall of upright planks running in parallel to the posts and horizontal logs connected to the posts and planks.

THE FRONT RAMPART OF THE CURTAIN

In addition to the structures documented in the vicinity of the moat, investigations took place on the front rampart of the curtain and the passageway behind it. As a result of the planning of the park founded above the earthen fortifications, the slope at the given area had been levelled, but two trenches helped us to locate the passageway and the brim towards the passage of the front rampart. The width of the passageway filled with dark soil was 3.2–4.2 m in its upper part. Neither wooden nor stone constructions were discovered in the given area.

THE SALLY PORT

By the opening (on the outer side) of the sally port passing through the curtain two



Fig. 9. Supportive walls in front of the sally port by the inner side of the earthen rampart.

Jn 9. Tugimüürid poterni muldkindlustuste siseküljel paikneva sissepääsu ees.

Photo / Foto: Rünno Vissak



Fig. 10. Supportive construction, composed of horizontal planks and baulks at the southern face of the bastion Luna.

Jn 10. Horisontaalsetest plankudest ja prussidest tugikonstruktsioon bastion Luna lõunafassil.

Photo / Foto: Rünno Vissak

meters long supportive walls located in front of the orifice of the tunnel were unearthed. The angle of the upper side of the supportive walls, triangular in side view, was approximately 45 degrees, which apparently corresponds to the earlier inclination angle of the upper part of the outer side of the earthen body of the curtain (Fig. 8). The lower preserved part of the six meters long supportive walls was exposed in front of the opening to the sally port by the inner side of the earthen rampart. The supportive walls with their extraordinary length nearly extended to the line of Õhtu street (Fig. 9). Since the upper part of the walls has been destroyed, it is not possible to draw direct conclusions about the initial extent and the inclination of the inner side of the earthen rampart.

The sally port concealed a trench of a sewage pipe dug in the 20th century that traversed the tunnel and drained into the moat. Unfortunately the previous layers had been destroyed in the course of digging the trench. However, the test-pits dug during the investigations revealed that sporadically wooden joists with the ends attached into the sockets in the southern and northern wall of the passage had been preserved. Since the mentioned sockets had been deepened into the walls secondarily, which is why the joists were not always lying transversely with the axle of the passage but in places with a relatively obvious deviation, these apparently originated from a later period of the passage and it is possible that the initial sally port lacked a wooden floor entirely or it was located on another level.

THE SUPPORTIVE CONSTRUCTION OF THE SOUTHERN EDGE OF BASTION LUNA

As mentioned above, in 2009 wooden constructions were revealed on the western edge of bastion Luna. However, none of the four test pits dug to the southern side of the bastion, to the edge of the earthen body and extending to the waterline with the absolute depth of -0.09 m (Vissak 2009, excavation 3, section 3), revealed any wooden or stone constructions.

After the installation of the sheet-pile wall, the wooden supportive construction of the earthen body could be partly exposed near the vertex of the bastion on its southern face. Eight (160 cm long, 28–34 cm wide and 6.5–7.5 cm thick) planks situated alongside each other could be documented in a three meters long section from the absolute height of -0.43 m. The ends of the planks had been attached to the baulks located transversely underneath the planks by a wooden peg with the diameter of 2.5 cm (Fig. 8). Due to pouring mud and water, the construction located deeper under the planks could not be unearthed. No traces of a stone wall supported by the wooden construction could be found.

THE ESCARPMENT WALL OF THE BASTION MERCURIUS IN LÕUNA STREET

In the course of monitoring that took place in Lõuna street, a 17th century bank fortification of the above-described construction type was discovered in the north-eastern side of the ravelin on the bank with the outworks of the moat (Fig. 7: 3). 38 m east of the fortification on the opposite bank of the tributary of the moat the north-western – south-eastern escarpment wall of the bastion Mercurius was found (Fig. 7: 4). The length



Fig. 11. Escarpment wall of the bastion Mercurius in Lõuna street.

Jn 11. Bastioni Mercurius eskarpmüür Lõuna tänaval.

Photo / Foto: Peeter Piirits

of the unearthed wall section traversing the trench was 3.5 m, the width of the wall was 2 m on the average and its preserved height reached 1.5 m (the higher part started at the absolute height of 0.94 m). The wall had been laid of limestones and boulders joined with lime mortar (Fig. 11).

After dismantling the wall a wooden supporting raft underneath was unearthed. Three parallel logs (length up to 640 cm, width 25–35 cm, thickness 30 cm) with the interval of 168 cm were situated crosswise to the wall. The western ends of the logs had been attached to the north-western – south-eastern directed frame log by dovetail, eastern ends had been fixed with cross-beams placed behind the vertical posts (Fig. 12). In addition to logs and dovetails the connection between the logs had been fixed with wooden pegs (4 × 4 cm in cross section). The ends of the dovetails located on the outer side had been sawn lower and an edge element with triangular cross-section had been attached above them (similarly to the construction of the bank fortifications). A baulk (11 cm wide and 35 cm thick) had been placed against the inner side of the log situated under the outer edge of the wall. A wall made of 10 cm thick vertical planks connected by joggle and rammed into the ground was located directly on the eastern side of the baulk. The wall was identical to the above-described sheet-pile wall found by the bank

constructions. In addition to the frame log located at the outer side of the escarpment wall, two parallel logs running alongside the longitudinal axis of the wall were concealed below the wall (Piirits 2010, 6–7).

FIND MATERIAL

The find material gathered during archaeological investigations and monitoring is scarce. Considering that the remarkable amount of finds was obtained from the sand layers of the bodies of the outworks or bastions and curtains, it is risky to provide substantial dates on the basis of them. Since single human bones were gathered sporadically from sand layers, it might be suggested that in order to erect the earthen fortifications sand was brought from the areas of a cemetery and other places of human activity. Among the finds a small fragment of a vessel similar to a glazed redware tripod pipkin with a wavy outer surface is worth mentioning. It was found from the lower sand in the direct vicinity of the earlier construction of vertical planks, somewhat deeper than the later bank construction exposed on the western bank of the tributary moat. The pottery shard is very likely simultaneous with the earlier bank fortification.

A handle of a tripod pipkin was found from the dark organic-rich layer under the stratum of yellow filler sand near the crossing place of Sadama and Ringi streets on the territory of the outworks. The pipkin handle might have got there from the territory of the town during the period when the area was (after the erecting of earlier fortifications and before the renovation works of fortifications in the 18th century) an unorganized wasteland used by the citizens who dumped their household remains there. A handle of a later glazed clay vessel was found from the mentioned layer of yellow sand from the same area. The find can be considered as dating the sand layer of new fortifications brought to the site after the completion of the later bank construction in the second half of the 18th century.

The moat has been repeatedly cleaned of mud (excluding the tributary moat) since the foundation of the winter harbour and in connection with several later dredging. Therefore very little find material from earlier periods can be expected there. Above the mentioned tributary moat where no dredging has been carried out, mud layers were not removed during the discussed renovation works.

The layer of household remains originating from the area of the town was documented in the section of Lõuna street between the streets of Akadeemia and Vee, where more than 2000 items of finds mostly including fragments of the 18th century glazed redware vessels were obtained.³

CONCLUSION

The primary purpose of archaeological monitoring during the renovation works that took place in Pärnu Vallikäär was, in collaboration with the designer and the builder, to minimize the damage caused to the earlier constructions preserved in the ground and at the waterline. As a result of the investigations the structure of two different wooden supportive constructions located at the edge of the bank of the moat, built in the second half of the 17th and the second half of the 18th century correspondingly,

³ The finds in Pärnu Museum, PäMu 24936 A 2649.

were explained. The positions of the mentioned facilities as well as the constructions of the earthen fortifications documented in Ringi and Lõuna streets remarkably help to specify the location of the earlier and for now mainly destroyed earthen fortifications. The investigations also provided a clearer understanding of the supportive walls of the sally port that is going to be renovated and taken into use, as well as the details originating from different construction stages.

REFERENCES

- Bernotas, R., Kriiska, A. & Vunk, A. 2009.** Archaeological fieldwork at Pärnu medieval and early modern fortifications from 2007 to 2009. – AVE, 2008, 155–165.
- Parek, E. 1971.** Ajalooline ülevaade Pärnu Tallinna väravast. Tallinn. (*Manuscript in MA.*)
- Piirits, P. 2010.** Arheoloogilised uuringud Pärnus Lõuna tn. trasside rajamisel. Tartu. (*Manuscript in MA.*)
- RKA 0406-28-039-005.** Pernau. Översiktsbild. 1699. (*Map in Riksarkivet Krigsarkivet, Sweden.*)
- Vissak, R. 2009.** Arheoloogilised uuringud bastionide Luna ja Venus ning nende vahel paikneva kurtiini alal Pärnus 2009. aastal. Tartu. (*Manuscript in MA.*)
- Vissak, R. 2010a.** Arheoloogilised uuringud bastionide Luna ja Venus vahel paikneva kurtiini alal Pärnus 2010. aastal. Tartu. (*Manuscript in MA.*)
- Vissak, R. 2010b.** Pärnu Vallikääru arheoloogiline järelevalve. Uuringud poterni alal. Vahearuanne. Tartu. (*Manuscript in MA.*)
- Vissak, R. 2011.** Pärnu Vallikäär: arheologia renoveerimistöodel. – Muinsuskaitseraamat 2010, 54–56.
- Vunk, A. 2007.** Uurimistööd Pärnu 17.–19. sajandi bastionaalvööndi vallides paiknevate rajatiste asukoha ja olukorra hindamiseks Tallinna väravatest kuni bastion Luna ja Venus vahelise väravakäiguni. Aruanne. Pärnu. (*Manuscript in MA.*)

ARHEOLOOGILISED UURINGUD PÄRNU MULDKINDLUSTUSTE VÖÖNDIS

Rünno Vissak

Käesolev artikkel käsitleb Pärnu Vallikraavis bastionide Venus ja Luna (jn 1) ning neid ühendava kurtiini alal aset leidnud arheoloogilisi välitöid, mis toimusid kahes etapis: eeluuringud 2009. a maist juunini ning arheoloogiline järelevalve muldkindlustuste renoveerimistöodel detsembrist 2009 kuni juunini 2010. Uuringutega koguti andmeid **vanemast, 17. saj teisest poolest** pärineva kindlustusvööndi muldkehandite tugikonstruktsioonidest ja samas paikneva vallikraavi kaldakindlustustest. Paiguti tuvastati ka vallikraavi äärde **18. saj teisel poolel rajatud hilisema ehitusperioodi** kaldakindlustuste konstruktsioone (jn 2). Koostöös projekteerija ja ehitajaga õnnestus tööde ajal korrigeerida mitmete uute konstruktsioonide kõrgusi ja asendit, vältimaks varasemate rajatiste kahjustamist (jn 3).

Varasema kaldakindlustuse veepoolse serva moodustas piki kaallast kulgev sisserammitud püstpostide rida, mille külge olid postide otsas asuvate lihttappide abil kinnitatud 30 cm laiused tahatud horisontaalsed palgid. Palkidele kinnitusid omakorda ristisuunas poomkantpalgid, mille abil oli välimine palgirida fikseeritud kaldapoolse paralleelse raampalgi külge (jn 4 A–B; 5). Mitmel juhul oli veepoolse raampalgi külge kinnitatud pikemad ristpalgid, mille kaldapoolsed otsad küündisid kaldapoolsete püstpostide taha ning oli seal ankurdatud eraldiseisva palgiga.

Ringi ja Lõuna tänavate ning Mere pst ristumiskohal tuvastati 2,65 m sügavusel püstpostidest horisontaalsete poomkantpalkidega ankurdatud puitkonstruktsioon. Lõuna tänavale rajatud torustikutrassi läbinud kirde – edela-sihiline konstruktsioon paiknes Tallinna väravate ees asunud raveliini servas seda ümbritsenud vallikraaviharu põhjapoolsel kaldal (jn 7: 1). Sellest kaldarajatisest 24 m kagus leiti Ringi tänava trassikaev harukraavi vastaskalda (väliskalda) kindlustuse konstruktsioon (jn 7: 2). Nagu vallikraavi lõunakaldal bastion Luna vastas tuvastati siingi, et 17. saj pärinevale puitkonstruktsioonile on rajatud hilisem kaldakonstruktsioon.

Lisaks vallikraavi läheduses fikseeritud rajatistele hõlmasid uuringud ka kurtiini eesvali ning selle taga asunud kaitsekäiku. 19. saj muldkindlustustele rajatud pargi kujundamisel oli pinnast tasandatud, kuid kahe tranšee abil

lokaliseeriti kaitsekäigu asukoht ning eesvali käigu pool paiknenud serv. Tumeda pinnasega täidetud kaitsekäigu laiuseks mõõdeti ülaosas 3,2–4,2 m. Kurtiini läbiva poterni kaitsekäigu poolse (st väliskülje) ava juures puhastati välja tunneli ava ees paiknenud kahe meetri pikkused tugimüürid. Kurtiinivalli siseküljel puhastati poterni ava ees välja 6 m pikkuste tugimüüride alumine säilinud osa. Tugimüürid ulatusid peaaegu Öhtu tänava jooneni (jn 8–9).

Pärast sulundseina paigaldamist ja vallikraavi veetaseme alandamist õnnestus bastion Luna tipu lähedal lõunapoolse faasi servas välja puhastada muldkehandi puidust tugikonstruktsiooni fragment. Kolme meetri pikkusel lõigul fikseeriti alates absoluutkõrgusest -0,42 m kaheksa kõrvuti asetsevat (160 cm pikkust, 28–34 cm laiust ja 6,5–7,5 cm paksust) planku, mis olid otsest 2,5 cm läbimõduga puidust tihvtiga kinnitatud nende all asuvate risti paiknevate prusside külge (jn 10).

Lõuna tänava välitöödel leiti ka raveliini kirdeküljel vallikraavi eelkindlustuse poolsel kaldal paiknenud 17. saj kaldakindlustus ning sellest 38 m ida pool, vallikraavi haru vastaskaldal, bastioni Mercurius loode – kagu-sihiline eskarpmüür (jn 6: 3, 4). Väljapuhastatud müüriõigu pikkus oli 3,5 m, müüri laius keskmiselt 2 m ning kõrgus 1,5 m (alates kõrgusest 0,94 m ü.m.p.). Müür oli laotud lubimördiga seotud pae- ja maakividest (jn 11). Pärast müüri lammutamist puhastati välja selle all paiknenud puidust alusparv (jn 12).

Hilisemast kaldakonstruktsioonist fikseeriti vallikraavi lõunakalda ja harukraavi läänekalda nurgal kaks rida kaldaservaga paralleelselt ning 1,2–1,3 m sammuga kulgevaid jämedaid sisserammitud püstposte (diameeter 28–32 cm, pikkus keskmiselt 1,7–1,8 m). Püstpostidele toetusid kahes reas piki kaldaserva paiknevad pikemad rõhtsad poomkantpalgid; read olid omavahel ühendatud lühemate ristisuunas palkidega. Ristisuunas palgid olid pikemate palkidega ühendatud kalasabatappide abil, mis asusid pikemate palkide üllemisel küljel. Palkide vahel ning peal paiknesid mullaga pakitud maakivid (jn 6: A, B). Hilisema kaldakindlustuse puitosadest võetud dendrokronoloogiliste proovide dateeringud langesid aastatesse 1776 ja 1788.