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ORIGINAL RESEARCH PAPER



Brick and tile kilns in Roman Pannonia – A state of research

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ABSTRACT

Dozens of Roman tile kilns have come to light in Pannonia during the last one hundred years. This paper summarizes the published tile manufacturing workshops of Pannonia in present-day Hungary, Austria, Slovenia, Croatia, and Serbia. In the first part it gives a short general overview of the structure of a workshop, discusses the problems of defining tile kilns, describes the parts of the kilns themselves and outlines the systems of classifications. The second part gives a description and catalogue of the Pannonian tile kilns.

KEYWORDS

Roman brick and tile kilns, Roman brick and tile production, pottery workshops, tile stamps, Pannonia

INTRODUCTION

Forty years have passed since Barnabás Lőrincz wrote his short paper on Roman tile kilns in Pannonia where he assessed information about the tile kilns of sixteen settlements.¹ Several tile kilns have been found ever since and our knowledge on Roman brick and tile production has multiplied. It seems therefore reasonable to write an overview about the results of the latest research.

Ceramic building material was introduced to Pannonia by the Romans. The architectural culture of the Roman conquerors in the 1st century AD was fundamentally different from that of the Celtic and Pannon tribes living in the area. The Roman way of building, the tiled roofs and rooms heated with hypocausts brought the necessity of the mass-production of ceramic building material by the middle of the second century AD.² New, rectangular kiln-types were introduced for firing different kinds of bricks and tiles. *Tegulae*, *imbrices* and *antefixa* covered roofs, *tubuli*, *tegulae mammate* and *lateres* in different shapes and sizes were used in hypocaust heating systems, purpose-made floor tiles decorated floors and drain-pipes were built in aqueducts.³

Roman tile kilns were built and operated by military or civilian workshops or belonged to villas. The average workshop needed a good clay source, plenty of water and wood and a large piece of land with enough space for all stages of the production process.⁴ The workshops had several parts corresponding to the stages of production (Fig. 1), though in most cases only the kilns have been found on excavations.

The clay pits were the source of raw material, also called clay quarry or mine. The extracted clay was transported to mud pools, pools dug in the ground where large amounts of clay were poured with water, then mixed and kneaded until the mixture reached optimal consistency. After the bricks or tiles were shaped with the aid of moulds at the moulding area,

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¹LŐRINCZ 1981a.

²The case was similar in other northwestern provinces, like Britannia, Gallia, Germania, Raetia or Noricum. LE NY 1988, 9; FEDERHOFER 2007, 5–7.

³The use of fired brick in masonry walls had not become widespread in Pannonia.

⁴The stages of production are discussed in detail for example in FEDERHOFER 2007, 11–19; BRANDL–FEDERHOFER 2010, 13–37.

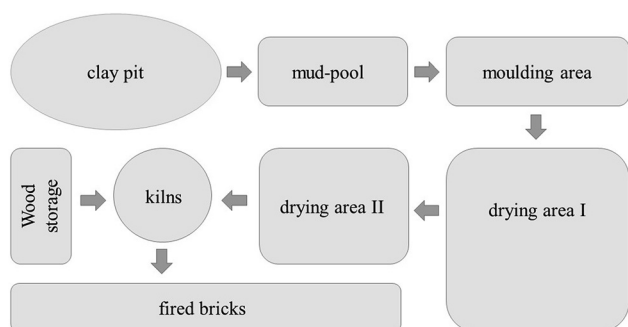


Fig. 1. Schematic overview of the spatial needs of a tile manufacturing workshop

they were laid out to dry. In the first stage of drying the tiles were placed on the ground in rows,⁵ sometimes in an area covered with roof (i.e. in a drying shed).⁶ This was the most space-consuming stage of the production process, and the amount of space available for drying limited the size of the whole workshop. Several days later the green tiles were stacked in drying area II for further drying before the firing. There was an area near the kiln where wood could be prepared and stored for the firing, and another storage for the end products.

Experiments conducted to reconstruct the procedure of Roman ceramic building material production help to get a better understanding of the manufacturing process. Several experiments were carried out in reconstructed tile kilns, for example in Flintsbach, Germany,⁷ and a well-published experiment performed in Catalonia in 2013 described the experiences collected via the handcrafting of 150 *tegulae* and 50 *imbrices* (Fig. 2). The whole project took 43 days and included the preparation of 3,000 kg of clay and 2,000 kg of dry wood.⁸

Roman ceramic building material was produced in Pannonia from the end of the 1st century AD to the late 4th century. Due to the general lack of datable finds in or around the kilns, the workshops and kilns are usually hard to date.

Purpose-built Roman tile kilns were mostly rectangular in shape, as opposed to the typically round or oval pottery kilns. However, based exclusively on the shape of the kiln, it cannot be reliably decided if pottery or building material were fired in it,⁹ and many kilns were used for multiple purposes. Most workshops produced both pottery and building ceramics, sometimes using numerous kilns

concurrently, and it is not always evident which kilns were used for what purpose. In Pannonia, the coexistence of round and rectangular kilns for firing pottery could be observed for example in the large municipal workshop of Aquincum-Gázgyár, in the legionary pottery workshop of Brigetio-Gerhát or in a smaller pottery workshop in Scarbantia (Sopron, Árpád Street).¹⁰ In the case of Sopron Árpád Street three kilns were discovered, two circular and one small, rectangular kiln. The dishes found *in situ* in the rectangular kiln testified that the kiln was used for firing pottery rather than bricks and tiles.¹¹ Moreover, large, rectangular tile kilns are known to have been used for firing *amphorae* and *dolia*, as well as a wide range of ceramic building material¹² and the existence of large circular tile kilns is also known.¹³

The best way to distinguish between tile and pottery kilns, therefore, would be on the basis of the finds inside and around the kiln, if there were any. In this paper, those kilns were collected, that were defined as tile kilns by the excavator.

There seems to be confusion in the nomenclature of the kiln parts in some languages. For better understanding, the parts of an average Roman kiln are listed in Fig. 3 and Table 1.

The kilns were usually sunk in the ground, so that the combustion chamber and the *prae-furnium* were below ground level. For that reason, the opening of the *prae-furnium* was accessible from the stokehole. In some cases, several kilns were arranged around the same stokehole. The kilns were heated by the fire set in the *prae-furnium*, which usually consisted of a vaulted tunnel which ended in the combustion chamber. The combustion and the oven itself were separated by the perforated oven floor. The oven floor was supported by cross walls or vaults depending on the structure of the combustion chamber. The hot air entered the combustion chamber in the main flue, then circulated in the cross flues eventually rising to the oven through the vent holes of the oven floor. The oven had walls built of clay, bricks or on rare occasions of stone. The top of the oven was usually not a permanent structure but was covered temporarily for each firing.¹⁴

Tile kilns, just as pottery kilns, are categorized based on the characteristics of their combustion chamber, since it is frequently the only part of the kiln to survive. The most noticeable feature is always the general form of the combustion chamber: circular/oval or rectangular/square. Then comes the support system of the oven floor: by walls or vaults. Sometimes the construction material is also

⁵A large number of raw *tegulae* were laid out to dry on the ground came to light in Catalonia in 1980–1981. They covered the whole surface of the 2.2 × 2.4 m large sondage. The 400–440 × 600 mm large green tiles were laid out in 8 rows and 14 columns. NOLLA *et al.* 1982, 152–156.

⁶Traces of drying-sheds in the form of postholes were found on several excavations, for example in Xanten, Dormagen or Rheinzabern. FEDERHOFER 2007, 15.

⁷The experimental firing is described by E. Federhofer in FEDERHOFER 2007, 16–19.

⁸TREMOLEDA *et al.* 2017.

⁹MCWHIRR 1979, 98; JEREMIĆ 2000, 133–134.

¹⁰BÓNIS 1981, 11–12. and note 16; BÓNIS 1979, 99–104.

¹¹GÖMÖRI 1984, 111–113. The size of the rectangular kiln was only 1.30 × 1.30 m.

¹²VIKIĆ-BELANČIĆ 1970, 30.

¹³JEREMIĆ 2000, 134.

¹⁴The parts of a Roman tile kiln are described in several publications, for example: FEDERHOFER 2007, 33–37; MCWHIRR 1979, 98–100; LE NY 1988, 19–23. For more, see Table 1.

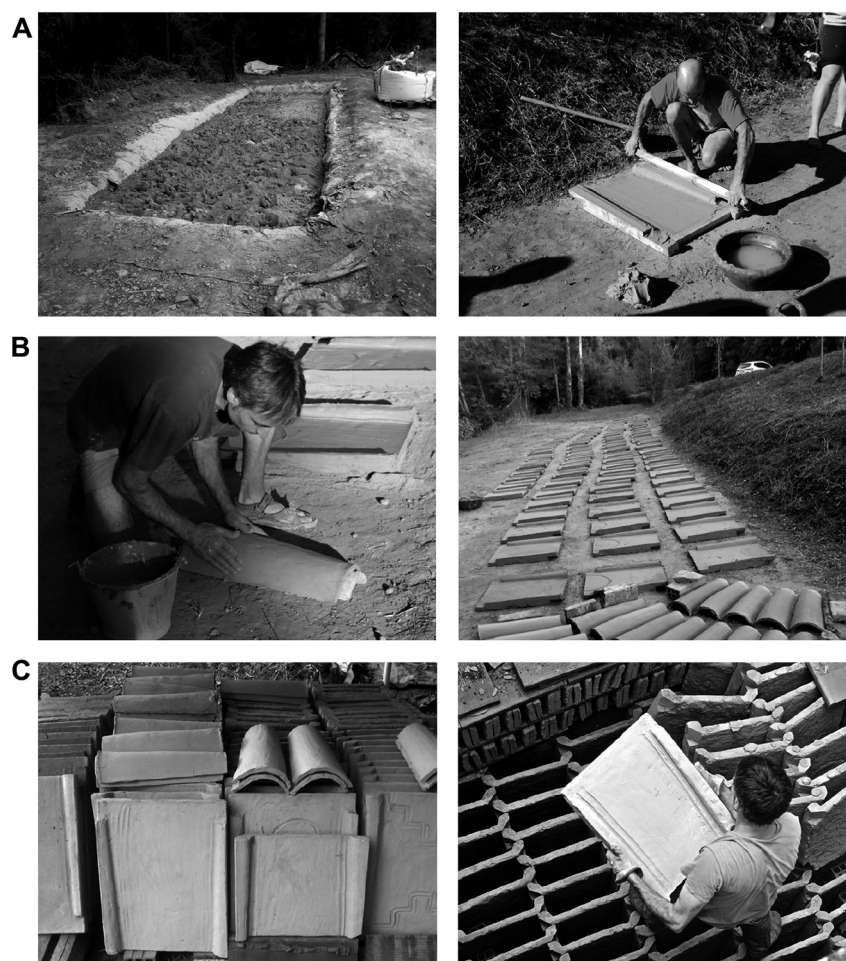


Fig. 2. Stages of the production of *tegulae* and *imbrices* reconstructed in an experiment in Catalonia (Tremoleda et al. 2017, figs 2–7)

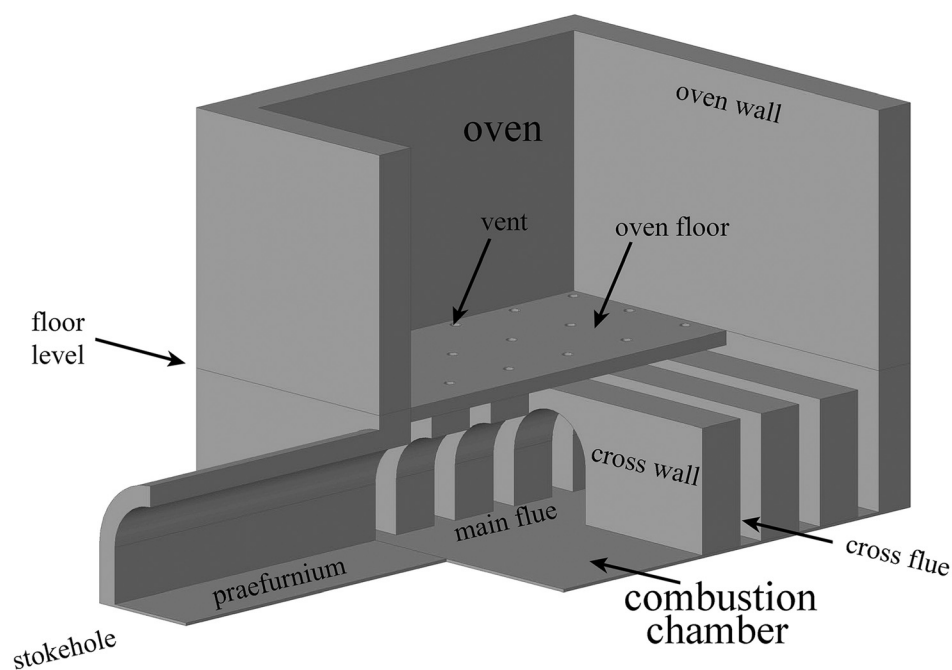


Fig. 3. Parts of a tile kiln



Table 1. Parts of a Roman tile kiln

	A	B	C	D	E	F	G	H	I	J	
English	stokehole	flue, fire tunnel, praefurnium	combustion chamber	main central flue	cross flue	cross wall	oven floor	vent	kiln-wall	oven, firing chamber	McWHIRR 1979
	stokepit	praefurnium	combustion chamber	central corridor, main flue	cross flue	cross wall	oven floor		oven walls	oven	CUOMO DI CAPRIO 1979
Italian		prefurnio	camera di combustione				piano forato		muri perimetrali	camera di cottura	CUOMO DI CAPRIO 1978
German	Arbeitsgrube	Schürkanal, Schürhals, Praefurnium	Heizraum, Heizkammer, Feuerkammer		Querzug	Stützen-einrichtungen	Brenntenne		Brenn-kammer-wand	Brennraum, Brenn-kammer, Einsetzraum	FEDERHOFER 2007
	Bedienungs-grube	Schürhals	Heizkammer	Mittelkanal	Zug	Zungenmauer	Lochtenne	Pfeife	Aussen-wand	Brenn-kammer	ALLEMANN 2014
	Arbeitsgrube	Schürkanal	Heizkammer		Querzug		Lochtenne	Loch		Brenn-kammer	MOSSER 2015
French	aire de chauffe	alandier	chambre de chauffe	couloir central	conduit de chaleur	le muret de soutènement	la sole	les carneaux		chambre de cuisson, le laboratoire	LE NY 1988
Spanish	el área de caldeamiento	praefurnium, boca	cámara de combustión, cámara de fuego	corredor central	conduccion	muretes de sustentación	parilla, solera	conduccion, orificios		cámara de cocción, laboratorio	TREMOLADA I TRILLA 2000
Hungarian		tüzelőnyílás	tüzelőhelyiség, tűztér, tüzelőtér,	fűtőkamra, tüzelőcsatorna	lángvezető köz		rostély	légnýílás		égetőtér	LŐRINCZ 1981a
	munkagödör	tüzelőcsatorna, tüzelőnyílás	égetőtér, tüzelőtér	tűzcsatorna, fűtőcsatorna	meleg-vezető járatok		rostély	rostély-lyuk			MLADONICZKY 2012
		tüzelőcsatorna kemencén kívüli szakasza, tüzelőnyílás	tűztér, tüzelőtér		oldalsó fűtő-/tüzelő-csatorna	osztófalak	rostély	rostély-lyuk		égetőtér	PALÁGYI 1993-1994
Slovenian	predprostor	kurišče, toplovodni kanal	prostor za žganje	kurišče	toplotne reže		rešetka			soba za žganje	LAZAR et al. 2006

considered: clay, bricks, or stone.¹⁵ The best known and most widely used classification of pottery and tile kilns was made by N. Cuomo di Caprio based on the Italian finds and illustrated with schematic drawings. Since her classification did not always fit all the kilns found in other areas of the Roman Empire, several other classifications were made by researchers of other provinces.¹⁶ B. Lőrincz suggested a classification specific to the Pannonian tile kilns collected in his paper (Fig. 4).¹⁷

TILE KILNS IN PANNONIA

Pannonia was rich in good quality clay which led to a network of thriving pottery and tile manufacturing workshops from the turn of the 1st and 2nd centuries AD to the late 4th century. The large workshops of military bases and civilian towns were either situated along the rivers Danube, Drava, and Sava, or along the Amber Road. Most kilns belonging to villa estates were found around Lake Balaton and Lake Neusiedl, but this may mirror the state of research rather than the actual spatial distribution of the kilns (Fig. 5).

I. MILITARY TILERIES

Military tileries belonged either to a legion or an auxiliary unit. Pannonia had four legionary fortresses: Vindobona (Vienna, Austria), Carnuntum (Bad Deutsch-Altenburg, Austria), Brigetio (Komárom-Szőny, Hungary) and Aquincum (Budapest-Óbuda, Hungary). With the exception of Carnuntum, all legionary tileries have been found and partly excavated. They usually lay a few hundred meters away from the legionary fortresses and had several rectangular tile kilns. Apart from the tileries connected to the legionary fortresses there is another tile manufacturing workshop in Dömös (Hungary) that belonged to a legion, namely the *legio I Adiutrix* which stationed in Brigetio. Three other workshops, Solva, Lugio and Progar were operated by auxiliary units.

Vindobona (Vienna-Hernals, Austria) – legionary tilerie (Cat. 1–4.)

The legionary tilerie lay 2.5–3 km to the west of the legionary fortress of Vindobona, in present-day Vienna-Hernals, where the so-called “*Hernalser Tegel*” meant a good quality raw material for ceramic and tile production. Roman bricks and tiles kept appearing in this area since the 1740s but the first unambiguous signs of a tile kiln have not been found until 1975. Up to the present day, an about 3.3 ha large segment of the tile manufacturing workshop has been

investigated, and the remains of four rectangular kilns, the post holes of a probable drying shed, a clay pit and a narrow water canal have been documented.¹⁸

The first tile kiln was found in 1953 at 13 Steinergerasse, when workers stumbled upon the surrounding wall of a Roman tile kiln. As the kiln itself was not uncovered, there is no information about it.¹⁹

The second rectangular kiln came to light in 1975, when the house at 15 Steinergerasse was rebuilt. The combustion chamber with two vaulted main flues and the oven floor with vents were well preserved, and the remains of a trough-shaped stokehole on the east side of the kiln could also be documented. The combined length of the combustion chamber with the stokehole was reconstructed to 5.60 m and the combustion chamber was dug 3 m deep into the soil. Both main flues of the combustion chamber were lined with clay.²⁰ The remains of another stokehole were seen to the east, which would mean another kiln under the road.²¹

In 2012 two more tile kilns were excavated near the others, on the corner of Steinergerasse and Geblergasse (16 Steinergerasse/47 Geblergasse).

Kiln I had a combustion chamber with one central flue, measuring 2.60×2.20 m on the inside and dug 2 m deep into the soil (Fig. 6). The walls of the chamber were built of mud bricks and its floor was covered with *bipedales*. Two low banks ran along the longer sides of the chamber which served as the pier of the vault that supported the oven floor, while the remains of a small pier stood by the middle of the southern wall of the combustion chamber. A 4.30×4.30 m large and 1.70 m deep stokehole lay on the northern side of the kiln. The stokehole and the combustion chamber were connected through a 1.40 m long fire tunnel or *prae-furnium*. The whole kiln with the stokehole measured about 9.0×4.0 m. The kiln had at least two phases.²²

The other kiln, Kiln II was very much like Kiln I, only in a much better condition (Fig. 6). The combustion chamber built of mud bricks had one main flue and five cross flues. Banks 0.6 m high and 0.44 m wide ran along the longer sides of the chamber, which supported the vaults of the cross walls made of *sesquipediales*. There was also a small pier in the middle of the southern wall just like in Kiln I. The floor of the combustion chamber was covered with bricks of 0.56×0.42 m, but they only survived in the back of the chamber. The oven floor was built of rectangular bricks of $440 \times 260 \times 40$ mm with a small, square shaped vent hole (65×70 mm) in the middle of each brick. The stokehole attached to the northern side of the kiln was 4.50×4.40 m large and 1.70 m deep.²³

Both kilns were dated on the basis of stamped tiles: they were in use from the beginning of the 2nd century AD to at

¹⁵FEDERHOFER 2007, 122–126.

¹⁶Italy: CUOMO DI CAPRIO 1978–1979; Gallia: DUHAMEL 1978–1979, LE NY 1988; Britannia: MCWHIRR 1979; Switzerland: BERGER 1969; Middle Danube region: HENNING 1977.

¹⁷LŐRINCZ 1981a, 90.

¹⁸MOSSER 2013, 144–147.

¹⁹MOSSER 2013, 146; LŐRINCZ 1981a, 78.

²⁰MOSSER 2013, 146–147; LŐRINCZ 1981a, 78.

²¹MOSSER 2013, 147.

²²MOSSER 2013, 149–150; MOSSER 2014, 1.

²³MOSSER 2013, 151–156; MOSSER 2014, 1–2.

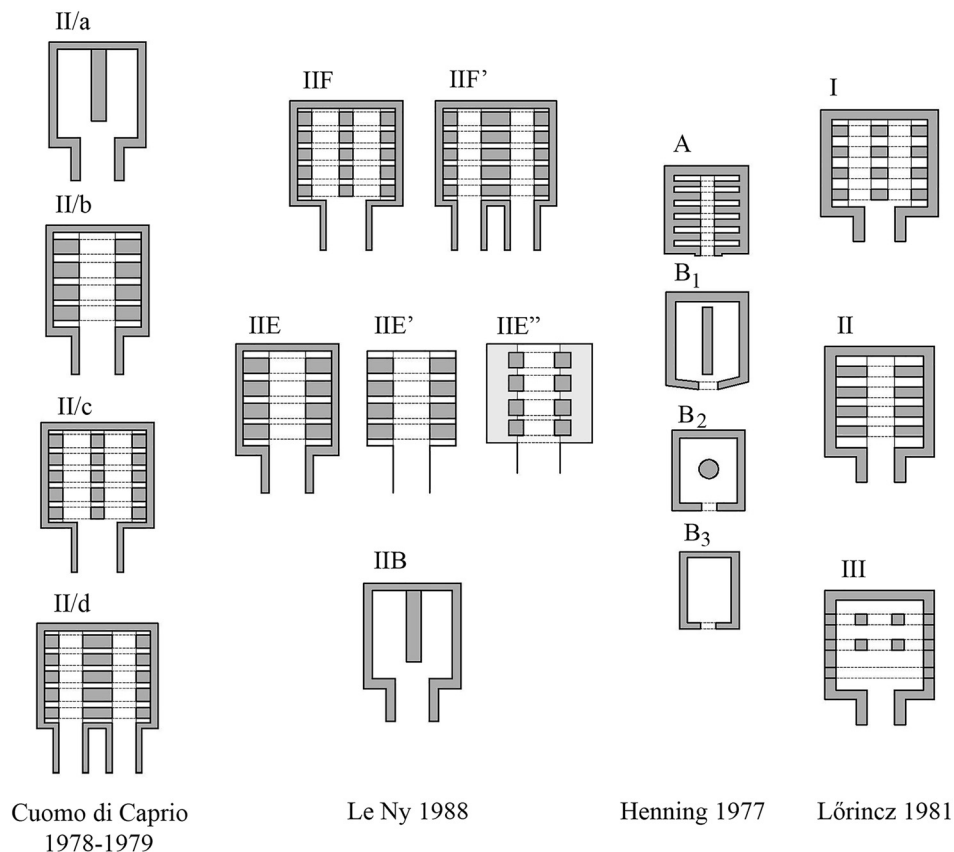


Fig. 4. Classification of tile kilns. a: CUOMO DI CAPRIO, 1978; b: LE NY 1988; c: HENNING 1977; d: LŐRINCZ 1981

least the 3rd century.²⁴ Numerous stamped tiles of the *legio XIII Gemina*, the *legio XIII Gemina Martia Victrix* were found in the construction of both kilns, and stamped tiles of the *legio X Gemina* in the second phase of Kiln I.²⁵

To the north of the kilns the post holes of a large building, the remains of a probable drying shed were documented. Between the kilns and the shed a circular pit (diameter: 3.0 m, depth: 0.90 m) served for the preparation of the raw material, and on the west side of the kilns a canal brought water to the workshop.²⁶

The whole of the workshop was in use from the turn of the 1st and 2nd centuries AD to the middle of the 3rd century AD.²⁷ Almost two thousand stamped tiles were collected mostly sporting the stamps of the *legio X Gemina*, the permanent legion of Vindobona from 114 to the end of the Roman rule. Beside the tile stamps of the *legio XIII Gemina*, *legio XIII Gemina*, *legio XV Apollinaris*, the *legio XXX Ulpia Victrix* and the *cohors I Aelia milliaria sagittaria equitata* six civilian tile stamps were also recovered: FEARORI ANIS, ADRI[- -], Atilia Firma, C V (S), G F () P () SE (). The range of ceramic building material types manufactured in the tilerly includes *tegulae*, *imbrices*, *lateres*, *antefixa*,

small rectangular floor tiles. The probable production of oil lamps is indicated by two lamp moulds.²⁸

Brigetio (Komárom-Szőny, Hungary) – legionary pottery and tile workshop (Cat. 5–6.)

The legionary tile kilns of Brigetio lay 1.2 km to the east of the legionary fortress on the so-called Kurucdomb and were unearthed by István Paulovics in 1934. He found the remains of two square kilns and workshop dump under a fortlet built around 371. Based on the numerous stamped tiles found here, the tilerly must have been producing ceramic building material from the turn of the 1st and 2nd centuries AD to the middle of the 4th century AD. The sequence of the brick stamps started with the stamps of the three legionary vexillations that built the fortress from 97 AD, continued with the stamps of the *legio XI Claudia* (stationed in Brigetio from 101/104 to 104/105 AD), the *legio XXX Ulpia Victrix* (stationed in Brigetio from 105 to 114), the *legio I Adiutrix* (stationed in Brigetio from 114/118 until the end of the Roman rule in Pannonia) and ended with the stamps of Lupicinus *tribunus* (*tribunus* in the province of Valeria from 369 to 376).²⁹

We know little about the kilns themselves (Fig. 6). The better-preserved Kiln I faced south and measured about 4.0 ×

²⁴MOSSER 2013, 158–159.

²⁵MOSSER 2014, 2.

²⁶MOSSER 2013, 156–157; MOSSER 2014, 2.

²⁷MOSSER 2018, 176.

²⁸MOSSER 2018, 176.

²⁹PAULOVICS 1934, 138–140; PAULOVICS 1938, 7; LŐRINCZ 1975, 349–350; LŐRINCZ 1981a, 78.

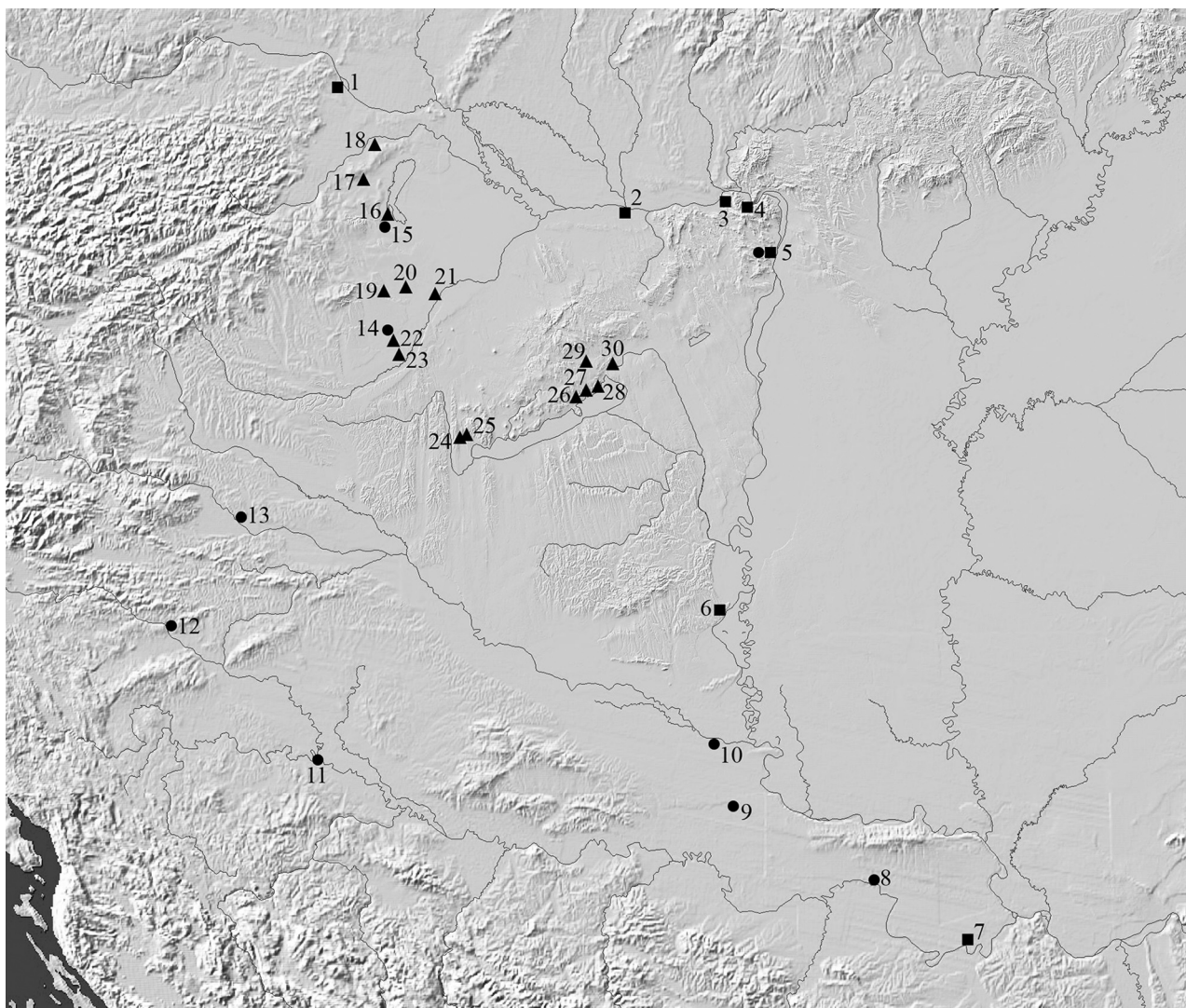


Fig. 5. Map of the known tile kilns in Pannonia. 1: Vindobona (Vienna-Hernals); 2: Brigetio (Komárom-Szőny); 3: Solva (Esztergom); 4: Dömös; 5: Aquincum (Budapest-Óbuda); 6: Lugio (Dunaszekcső); 7: Progar; 8: Sirmium (Sremska Mitrovica); 9: Cibalae (Vinkovci); 10: Mursa (Osijek); 11: Siscia (Sisak); 12: Neviodunum (Dmovo); 13: Poetovio (Ptuj); 14: Savaria (Szombathely); 15: Scarbantia (Sopron); 16: Fertőrákos; 17: Eisenstadt; 18: Wolfsbrunn-Sommerein; 19: Kőszegfalva; 20: Csepreg; 21: Uraiújfalu; 22: Balogunyom; 23: Nemesrempehollós; 24: Szentgyörgyvár; 25: Hévíz-Egereg; 26: Balatonfüred; 27: Csopak; 28: Alsóörs; 29: Gyulafirátót; 30: Berhida

5.0 m. The combustion chamber was 2.90×2.80 m large on the inside and the fire tunnel 0.70 m wide. Kiln II was a little larger, measuring about 6.80×6.0 m on the outside.³⁰

The tile kilns in fact belonged to a large tile and pottery workshop, the so-called Kurucdomb and Gerhát workshops of Brigetio. Apart from the two tile kilns it had at least 8–9 smaller pottery kilns and a drying kiln. A storage building for dishes and some of the clay pits were also found.³¹

Aquincum (Budapest-Óbuda, Hungary) – legionary pottery and tile workshop (Cat. 7–9.)

The legionary tile production in Aquincum took place in a large, combined pottery and tile workshop under the present day 120–126 Bécsi Road and 77–79 Kiscelli Street, 350 m southwest of the legionary fortress. Apart from numerous pottery kilns three rectangular tile kilns, a long section of a water channel and the remains of a probable drying shed were found.³² The three tile kilns were excavated by Györgyi Parragi in 1967 and 1970 and before their conservation by Mária Pető in 1980.

³⁰LŐRINCZ 1981a, 78.

³¹The Gerhát and Kurucdomb workshops were the two parts of the same workshop. BÓNIS 1975, 86–88; BÓNIS 1976, 73; BÓNIS 1977, 105–106. BÓNIS 1979, 99–104. The clay pits were identified in 1988 by Endre Bíró. SZÁMADÓ 1997, 159.

³²VÁMOS 2014, 31–38; LŐRINCZ 1981a, 82; PARRAGI 1971; PARRAGI 1976; PARRAGI 1981. The drying shed was found 50 m from the tile kilns at 48–50. San Marco Street in 2006. BALÁZS–HABLE 2007.

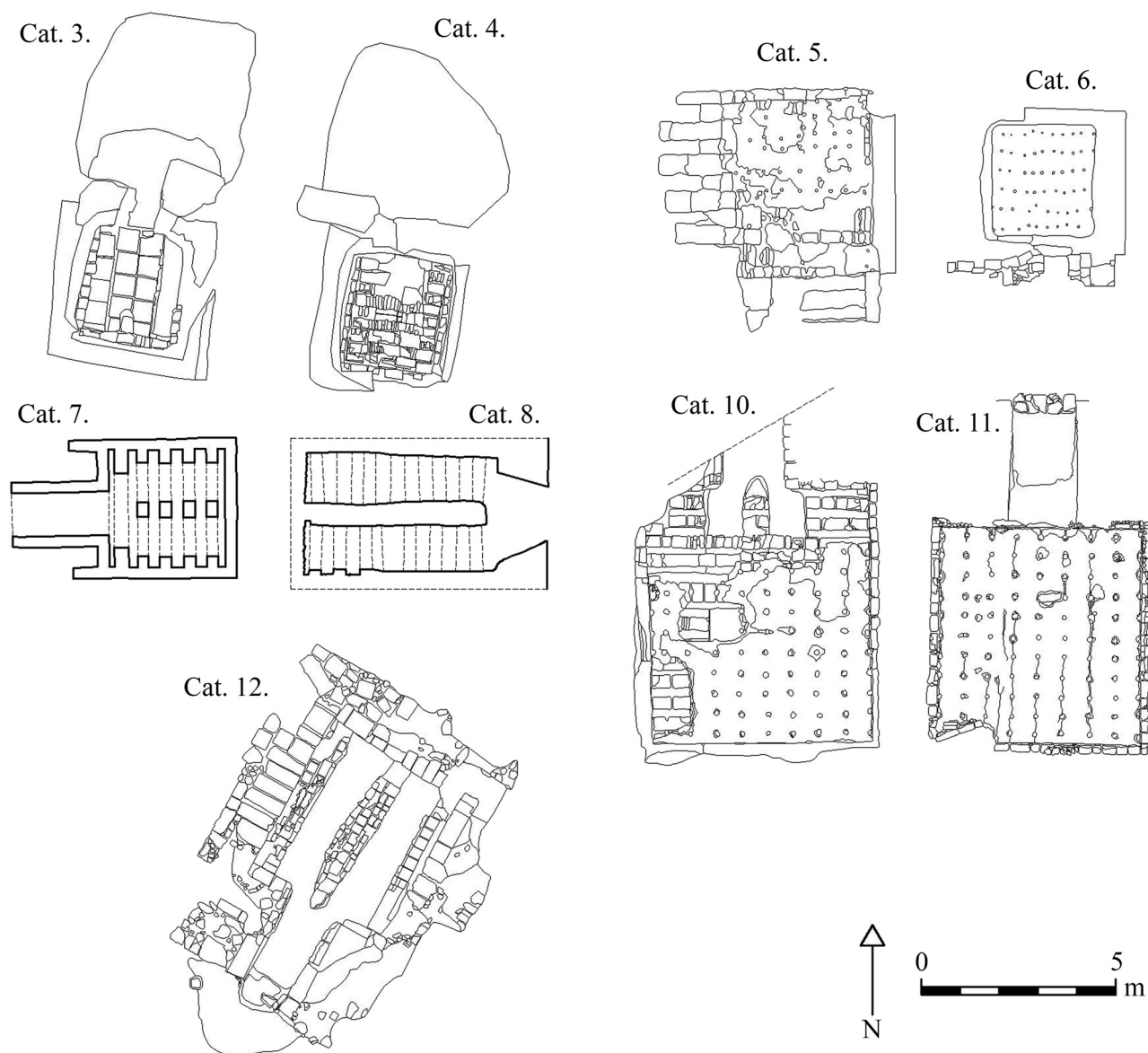


Fig. 6. Plan of the military tile kilns

Kiln 1967/3. (128 Bécsi Road) was well preserved, the walls of its oven stood up to a height of 0.40–1.10 m (Fig. 6). Its combustion chamber had two main flues separated by a central wall and 8 cross flues. The walls of the chamber and the vaults over the 1.48 m wide main flues were built of bricks and lined with clay. The vaulted fire tunnel was attached to the east side of the combustion chamber and was 1.40 m long and 1.30 m high. The oven floor was made of bricks with vent holes of 50–70 mm in diameter. The walls on the inside of the oven were built of mud bricks and fired bricks lined with clay which was followed by an outer layer of large limestone slabs. The 0.45 m wide gap between the two layers of the wall was filled with mud. The entrance of the 4.0×4.0 m large oven faced south.³³ The remains of the oven were full of broken bricks and tiles some of which bore

the stamps of the *legio II Adiutrix*. Although no datable finds were uncovered in the kiln, B. Lőrincz dated it to the 2nd–3rd centuries AD based on the stamped tiles. That tile production continued in the 3rd century as well, is attested by a stamp that reads: *leg(ionis) II Ad(iutricis) M(aximiana)*.³⁴ Near the kiln an early, crescent-shaped die of the *legio II Adiutrix* made of clay was found, along with a rectangular one reading [.]CAE[---]/BINI[---].³⁵

Kiln 1970/1. (120–124 Bécsi Road) was found when construction works started at 124 Bécsi Road (Fig. 6). The combustion chamber had two main flues separated by a row of four piers that supported the vaults over the main flues. The piers and the vaults were built of bricks, while the outer walls of the combustion chamber were partly made of

³⁴LŐRINCZ 1981a, 84.

³⁵PARRAGI 1971, 79; VÁMOS 2014, 37.

³³PARRAGI 1971, 63.

trachyte stone blocks. The main flues were 1.60 m wide and 1.00 m high. The vaulted fire tunnel looked to the west. Most of the oven floor survived and the brick walls of the 3.20×2.80 m large oven stood up to a height of 0.50 m.³⁶

Kiln 1970/2. (120–124 Bécsi Road) was on the west side of Kiln 1970/1., mostly destroyed by the dozer (Fig. 6). It was built of mud bricks and the length of the combustion chamber measured about 6 m. The entrance of the oven was a double vaulted opening. The oven was fully packed with the stamped tiles of the *legio II Adiutrix* which were not unloaded after the last firing. A stamped tile dated to the reign of Valentinian I (364–375) indicates that the kiln still operated in the second half of the 4th century.³⁷

Behind the house at 126 Bécsi Road another test pit was dug in 1971 and 4 antefixes were uncovered. The finds point to another tile kiln, but it has not been excavated yet.³⁸

The workshop probably started producing tiles from the turn of the 1st and 2nd centuries AD and continued until the second half of the 4th century AD, while pottery production seized in the second half of the 2nd century.³⁹ In the workshop dump stamped tiles of the *legio II Adiutrix*, *legio X Gemina* and *legio IIII Flavia* were found along with late stamped tiles dated to the reign of Valentinian I (364–375) with the stamps of Frigeridus *dux*, Iovinus *tribunus*, Valentinus *centurio* or with the letters APIVINI.⁴⁰ The ceramic building material found around the kilns included *tegulae*, *imbrices*, *lateres*, *tegulae mammatae*, *antefixa* and sexagonal and dog-bone shaped floor tiles.⁴¹

Dömös (Hungary) – military tiler (Cat. 10–11.)

Another tiler of the *legio I Adiutrix*, garrisoned in Brigetio (Komárom-Szőny, Hungary), was found in Dömös, roughly 70 km east from Komárom. Its two rectangular kilns were excavated by Márta Kelemen in 1987–1988. In the kilns, which operated in the second half of the 2nd century AD, *tegulae*, *imbrices*, *lateres* and *tubuli* were fired. During the excavation 18 stamped tiles were recovered, all belonging to the *legio I Adiutrix*.⁴²

The larger Kiln I (Cat. 10.) was built of 300×440 – 480×140 mm large bricks (Fig. 6). The combustion chamber had two main flues and 13 cross flues. The main flues were 0.90–1.0 m wide, 6.0 m long and 1.66 m high, while the central wall separating the main flues and supporting the vault over them measured 0.65 m in width and 1.30 m in height. The walls and the floor of the combustion chamber were lined with clay. The oven floor was also made of 300×440 – 480×140 mm large bricks which were, however,

furnished with holes in the shape of a half circle in the middle of the longer sides of the bricks. Thus, two bricks laid beside each other made one circular vent hole of 80–120 mm in diameter. The vaulted fire tunnel projected from the north side of the kiln and was 1.50 m wide and at least 0.90 m long (the rest of it was destroyed by modern construction works). The oven itself measured 6.20×5.44 m and was also built of bricks. Its 0.30 m thick walls survived to a height of 0.57 m in the southeastern corner. A bronze coin of Marcus Aurelius (161–180) and fragments of pottery date the kiln to around 140–170 AD.⁴³

Kiln II (Cat. 11.) lay 4 m to the east from Kiln I and was preserved in a much better state (Fig. 6). The construction of its combustion chamber was similar to that of Kiln I with 2 main flues and 11 cross flues. The main flues were 5.20 m long, 0.75 m wide and 1.66 m high. The central wall between them was 0.70–0.80 m high. Both the walls and the floor of the combustion chamber were lined with clay. The oven floor was built of $550 \times 360 \times 140$ mm large bricks that had a semi-circular hole in the middle of their shorter sides, making vent holes of 80–100 mm. The oven measured 5.45×5.10 m with its wall standing up to a height of 0.70 m on the eastern side of the kiln. The 200 mm thick walls of the oven were built of $300 \times 200 \times 100$ mm and 450 – $500 \times 200 \times 100$ mm large bricks and were lined with clay. The vaulted fire tunnel was attached to the north side of the combustion chamber and was 3.20 m long, 1.60 m wide and 1.66 m high. Kiln II was probably built a few decades later than Kiln I, most likely after the Marcomannic Wars.⁴⁴

Solva (Esztergom-Szentgyörgymező, Hungary) – military tiler (Cat. 12.)

A rectangular tile kiln built mostly of stone slabs was found in 2005 in Esztergom on a building site near the Danube (Fig. 6). The development-led excavation was led by M. Kelemen who published the finds in Hungarian. The upper part of the kiln, the oven and oven floor were destroyed, but the combustion chamber survived.

The combustion chamber of the kiln had two main flues separated by a central wall. The outer side of the walls were built of irregular limestone blocks, whereas the inside of the northwestern and southeastern walls were built of rectangular limestone blocks 0.35×1.00 m and 0.45×0.45 m large, respectively. The lower part of the 4.35 m long and 0.70 m wide central wall was also built of limestone, but its upper part was made of bricks. Two low benches 0.40–0.45 m in height and 0.50–0.60 m in width ran along the longer sides of the combustion chamber, which supported the vaults over the main flues. The upper part of the benches was built of 300×260 mm large *lateres*, while the bricks used in the vaults were only 150×120 mm large. All walls and the floor of the combustion chamber were lined with clay. The two main flues were 4.00–4.10 m long, 0.90–1.15 m

³⁶PARRAGI 1976, 163; LÓRINCZ 1981a, 84; BENDE 1976.

³⁷PARRAGI 1976, 163; PARRAGI 1981, 97; LÓRINCZ 1981a, 84–85.

³⁸PARRAGI 1976, 164.

³⁹PARRAGI 1971, 78–79; PARRAGI 1976, 165; PARRAGI 1981, 97.

⁴⁰NAGY 1942, 628; PARRAGI 1981, 97; VÁMOS 2014, 37; PETŐ 1981, 462.

⁴¹VÁMOS 2014, 37.

⁴²KELEMEN 1994–1995, 101–110.

⁴³KELEMEN 1994–1995, 97–99 and 109.

⁴⁴KELEMEN 1994–1995, 99–101 and 109.

wide and about 1.00 m high. The 2.80 m long and 1.10–1.20 m wide fire tunnel projected from the southwestern wall, its one-time vault was ruined. Two post holes were found on the southwestern side of the fire tunnel which might mean that a small roof covered the entrance of the fire tunnel. The size of the combustion chamber measured 3.80×4.10 m. In the debris fragments of *tegulae*, *imbrices* and *lateres* were found, obviously the products of the tiler.⁴⁵

Some of the limestone blocks used for the building of the kiln were *spoliae* with inscriptions on them. Twenty-five of the stone slabs were Roman altar inscriptions dedicated to Iuppiter by the members of the *cohors I Ulpia Pannoniorum milliaria equitata*, the 2nd–3rd-century garrison of the *castellum* of Solva. The altar stones must have stood in the shrine of the *principia*, which must have been already in ruins by the time the tile kiln was built. Four stamped tiles were also found, one in the construction of the kiln with a [QVADRI]B[R]ASA stamp, and three *lateres* in the debris with QVADRI]BVRASA, TERENTIANVS [TRIB] and [TER] ENTIAN[I TRB] stamps. The *spoliae* and the tile stamps together date the kiln to the 4th century AD.⁴⁶

This kiln must have been part of a fourth-century tile manufacturing workshop in Solva, where bricks and tiles with the stamps of Terentianus *tribunus* and *Quadriburgium* were made. Based on the location, size, and type of the kiln (two main flues) M. Kelemen classified it as a military tile kiln. The kiln and workshop probably belonged to the *castellum* of Solva, which was first built at the end of the 1st century AD and remained in use until the 430s AD. It was garrisoned by the *equites Mauri* from the end of the 3rd century AD, and by the *cuneus equitum scutariorum* from sometime in the 4th century.⁴⁷

Lugio (Dunaszekcső-Halena, Hungary) - military tiler (Cat. 13.)

The tile manufacturing workshop of Lugio was located and partly excavated in recent years by Olivér Gábor and the researchers of the Archaeological Department of the University of Pécs. Field walks and geomagnetic surveys revealed the existence of a minimum of four large rectangular tile kilns from which one was partly unearthed in 2012.⁴⁸ The kiln measured about 6.0 m in width. The stamped tiles found during the excavation mostly belonged to the *cohors VII Breucorum* which stationed in Lugio from the middle of the 2nd century AD to the second half of the 3rd century AD. The cohort is believed to have specialized in the production of ceramic building materials.⁴⁹ The workshop in Lugio operated from the 1st century AD to at least the middle of the 3rd century AD with a peak in production in the first half of the 3rd century. The name of the *cohors VII Breucorum* appears on the tile stamps with or without Imperial epithets, such as

Antoniniana, *Severiana*, *Alexandriana*, *Gordiana*, *Maximiniana* and *Philippiana*. In the surrounding area of the kiln several other stamped tiles were found with the following stamps: *cohors I Raetorum*, *cohors VIII Raetorum*, *ala I Siliana*, *ala I Dalmatarum*, *ala I Brittonum*, *exercitus Pannoniae inferioris*, *Lupicinus tribunus*, *Terentianus tribunus*, *magister Ursicinus*, *magister Maxentius*, *Vincentius* and *Adrianis*.⁵⁰

Progar (by Zemun, Serbia) - military tiler (Cat. 14.)

In 1967–1968 a pottery workshop with several pottery kilns and a brick kiln were unearthed in Progar. Several stamped tiles of the *Classis Flavia Pannonica* were found on the site.⁵¹ The complex was dated to the 4th century in earlier publications, but a review of the finds shifted the period of its usage to the 2nd–3rd centuries AD.⁵² The size of the tile kiln is unknown, but its combustion chamber had one main flue and several cross flues.⁵³

The existence of small military pottery and tile workshops are known or suspected in a number of South Pannonian *castella*, such as Teutoburgium (Dalj, Croatia), Rittium (Surduk, Croatia), Burgenae (Novi Banovci, Croatia), Cornacum (Sotin, Croatia) and Brest by Beška (Serbia).⁵⁴ The tile kilns of these *castella*, however, have not been published in detail or at all.

II. CIVILIAN TILERIES

Civilian tileries can be put in two large categories: workshops situated in towns, which aim at supplying a larger area with their products, and tile kilns that were part of villa estates and served the needs of their immediate environments.

II.a Tile kilns in Roman towns

Aquincum-Gázgyár (Budapest-Óbuda, Hungary) - pottery and tile workshop (Cat. 15–19.)

One of the largest known Roman pottery and tile production sites of Pannonia lay in Aquincum, on the eastern side of the *municipium*. With 35 kilns on an area of about 150,000 m², it was excavated by Bálint Kuzsinszky in 1910–1911 and published in detail in 1932. Most of the kilns were circular pottery kilns, while five were big, rectangular tile kilns, and a few were small, circular lime kilns. In the north-western corner of this immense pottery workshop a group of at least 30 wells was discovered.⁵⁵ Northeast from this area, four more pottery kilns were found by Paula Zsidi in 1977, which

⁴⁵KELEMEN 2011, 135–140.

⁴⁶KELEMEN 2011, 141–149.

⁴⁷KELEMEN 2003, 86–87.

⁴⁸GÁBOR 2019, 40; FARKAS 2013, 101–103.

⁴⁹LŐRINCZ 2001, 31; KOVÁCS 2005, 245.

⁵⁰FARKAS 2013, 106–119.

⁵¹DIMITRIJEVIĆ 1967, 96–98; VIKIĆ-BELANČIĆ 1970, 32; PETRU 1976, 228; ČERNAČ-RATKOVIĆ 2009, 313.

⁵²STOJANOVIĆ 2013.

⁵³DIMITRIJEVIĆ 1967, 96.

⁵⁴LŐRINCZ 1981a, 77; ČERNAČ-RATKOVIĆ 2009, 313.

⁵⁵KUZSINSZKY 1932, 7–8, 20 and 75.



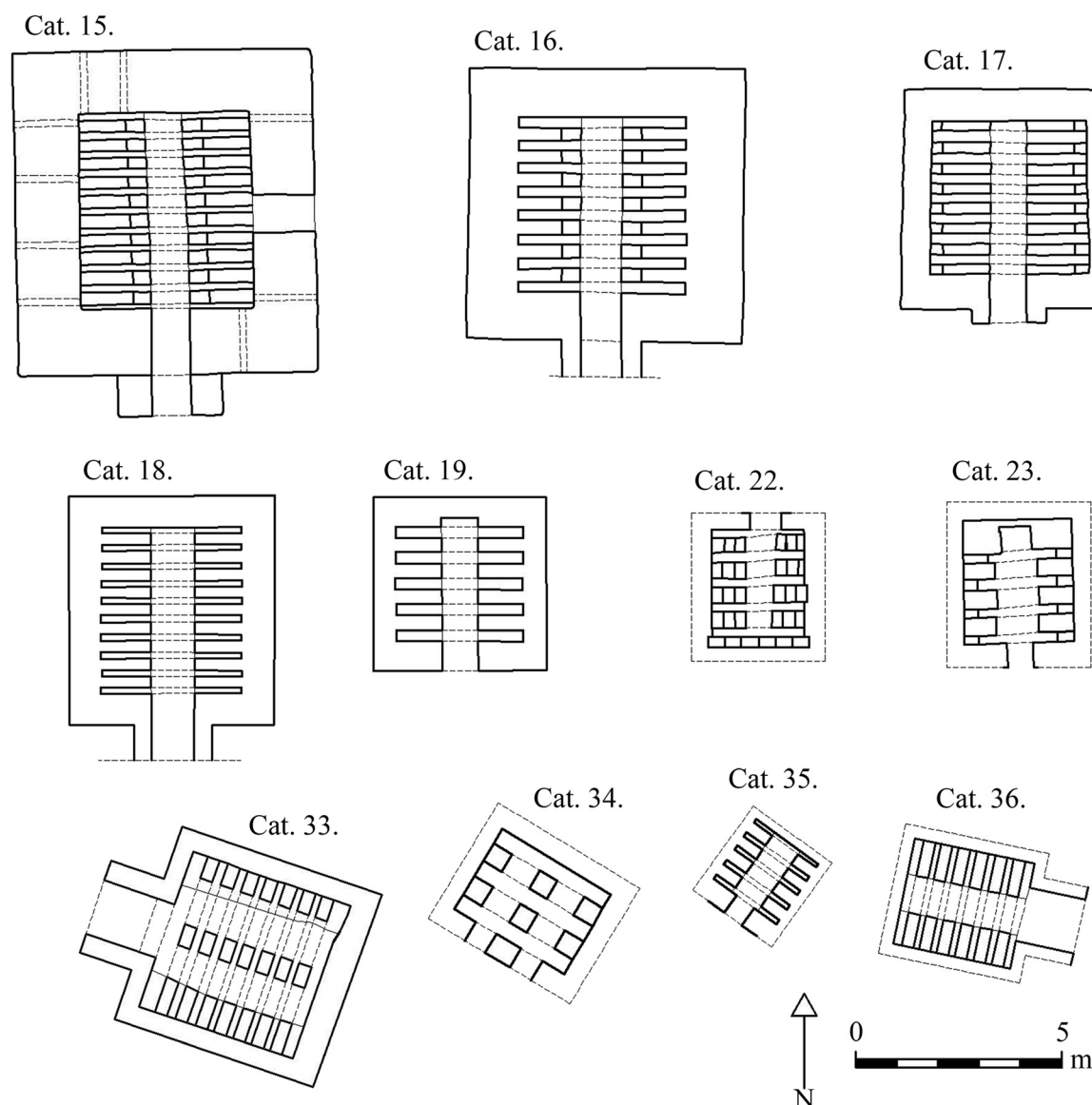


Fig. 7. Plan of the civilian tile kilns in Roman towns

means, that the workshop was even bigger than thought earlier.⁵⁶ In 1931 a foot-shaped die made of clay, used for stamping bricks and tiles was found in the area of the pottery workshop. The retrograde stamp read *D [quarta] of [ficina] Vindo/nis Ak[vincensis]* and must have been the property of the owner of the workshop. The name Vindo points to a person of Celtic origin.⁵⁷

Kiln I was a large, rectangular kiln which had a combustion chamber with one main flue and 11 cross flues (Fig. 7). The walls and vaults of the combustion chamber were built of mud bricks and fired bricks, and both the walls and the floor were lined with clay. The main flue was 1.00 m wide and 1.32 m high. The vaults of the cross flues stood on

two benches that ran along the longer sides of the combustion chamber. The top of the benches sloped towards the inside, thus they were 0.75 m high on the side of the main flue and 1.30 m high by the walls. The fire tunnel projected from the southern side of the combustion chamber and its walls were built of trachyte stone blocks. The oven floor collapsed into the combustion chamber, but it was built of $420 \times 300 \times 110$ mm large bricks with a semi-circular vent hole in the middle of either long side of the bricks. The oven measured 4.80×4.80 m on the inside and 7.90×7.35 m on the outside. The walls, which were built of $450 \times 290 \times 120$ mm large mud bricks and were 1.60 m thick, survived to a considerable height, the western wall being 0.85 m high and the eastern 1.35 m high. The 0.88 m wide entrance of the oven looked to the east. In addition to the entrance, a row of small openings supported the sufficient air flow inside the kiln. Two of the 0.25×0.15 m large openings lay on either side of the

⁵⁶ZSIDI 1984, 367–372.

⁵⁷KUZSINSZKY 1932, 46–47.

entrance and four in the opposite wall. Their sill was 0.55 m high. The kiln was completely destroyed after the excavation due to the construction of the Gas Factory at the site.⁵⁸

Kiln II looked very much like Kiln I, only a little smaller with an oven measuring 6.65×6.85 m on the outside and 4.35×4.35 m on the inside (Fig. 7). The combustion chamber built of mud bricks had one main flue and 8 cross flues. Along the longer sides of the combustion chamber two benches supported the vaults of the main flue. The benches sloped to the inside and were 0.65 m high by the main flue and about 1.20 m high by the walls. The walls and the floor of the chamber were lined with clay. The 1.00 m wide and 1.30 m high fire tunnel lay on the northern side of the kiln, its walls and vault were built of trachyte stone blocks. The fully survived oven floor had an interesting construction made of two layers of $450 \times 270 \times 80$ – 100 mm large mud bricks. The bricks were laid with 100 mm wide gaps in both layers, so that the vent holes punctured in the top layer of bricks were over the gaps of the bottom layer. The 1.20 m wide walls of the oven stood up to a height of 0.70 m and were also made mud bricks. The 0.80 m wide entrance looked to the east. After the excavation, the kiln was reburied and spared during the construction.⁵⁹

Kiln III was the same kind of rectangular kiln as Kiln I and II with one, 0.88 m wide main flue and 8 cross flues in the combustion chamber (Fig. 7). The inclined benches along the longer sides of the chamber were 0.72 m high on the side of the main flue and around 1.30 m high beside the walls. The 0.88 m wide and 1.05 m high vaulted fire tunnel was attached to the northern side of the combustion chamber. Although its walls were built of trachyte stone blocks, its vault was made of mud bricks. The oven floor survived intact, with its two layers of $500 \times 300 \times 100$ mm large bricks, which had a semi-circular hole in the middle of each and every side, thus creating a network of circular vent holes. The 0.80–0.85 m wide walls of the oven were constructed of $450 \times 280 \times 100$ mm large mud bricks and were pierced by an opening on the eastern side. The oven itself measured 4.05×3.70 m on the inside.⁶⁰

Another tile kiln lay further away to the north, the rectangular Kiln VIII (Fig. 7). This kiln was also partly destroyed, only its combustion chamber survived, which measured 5.60×5.00 m on the outside. The combustion chamber had one main flue and 10 cross flues, as the other tile kilns listed above. However, in this case, only the 0.80 m thick walls were built of $410 \times 270 \times 100$ mm large mud bricks, the benches that ran along two sides of the chamber, and the vaults over the main flue were made of sandstone blocks. The main flue was 0.90 m wide and the inclined benches on either side of it that supported the vaults were 0.63 m high on the side of the main flue and 1.42 m high beside the walls. The vaulted fire tunnel projected from the eastern side of the combustion chamber, measured 1.05 m in

width and 1.10 in height, and both its walls and vault were built of sandstone blocks. The oven floor collapsed, but it was most probably built of two layers of $480 \times 300 \times 120$ mm large mud bricks laid with 100 mm gaps between them to give place to the vent holes, in much the same way as in Kiln II.⁶¹

The square-shaped Kiln XII is the only kiln at the site that had broken *imbrices* and *tegulae* inside it, as evidence to what it had been used for (Fig. 7). The 4.25×4.20 m large combustion chamber had one 0.90 m wide main flue and 5 cross flues, and its 0.55 m thick outer walls of the chamber were built of sandstone. The benches that supported the vaults over the main flue were 0.35 m high. The vaulted fire tunnel was attached to the western side of the combustion chamber and measured 0.90 m in width. The oven floor was built of two layers of $450 \times 300 \times 100$ mm large mud bricks with gaps in between them, its construction was the same as in the case of Kiln II and VIII. The oven itself did not survive.⁶²

Apart from the tile kilns identified by Kuzsinszky as such, there were other rectangular kilns on the site. Kiln IV stood about 2 m south of Kiln III. It had the same construction as Kilns I–III but only its combustion chamber survived its oven and oven floor were completely destroyed. B. Kuzsinszky was a little uncertain as to its purpose: based on its somewhat smaller size (4.15×3.40 m) he held it a pottery kiln, although he acknowledged that it stood near the other tile kilns. There is now no way to decide what was actually fired in this kiln. The combustion chamber had a main flue and 7 cross flues. The main flues widened towards the inside of the chamber: it was 0.70 m wide at the entrance of the chamber and 0.93 m wide at the end. The 0.30–0.36 m thick walls of the chamber were built of mud bricks, just as the vaults, which were made of wedge-shaped bricks, and started from 0.80 m high benches. The fire tunnel looked to the east but was ruined, just as the oven floor.⁶³ A few more rectangular, but much smaller kilns were scattered around the area of the workshop (Kilns IX–X–XI). These were identified as pottery kilns by Kuzsinszky, based on their size. Beside Kiln XI a pit full of *mortaria* was found.⁶⁴

The pottery workshop at Aquincum-Gázgyár started production at the beginning of the 2nd century AD until the end of the 2nd century.⁶⁵

Aquincum-Canabae (Budapest-Óbuda, Hungary) – civilian pottery and tile workshop (Cat. 20–21.)

Another tile manufacturing workshop was found in the *canabae* of Aquincum, 1.5 km south of the legionary tiler. The two rectangular tile kilns at 12 Bécsi Road – 11 Ürömi Street were unearthed by Annamária Facsády in 1996 during

⁵⁸KUZSINSZKY 1932, 26–32; LŐRINCZ 1981a, 78–79.

⁵⁹KUZSINSZKY 1932, 34–38; LŐRINCZ 1981a, 79.

⁶⁰KUZSINSZKY 1932, 38–40; LŐRINCZ 1981a, 79–81.

⁶¹KUZSINSZKY 1932, 45–46; LŐRINCZ 1981a, 81–82.

⁶²KUZSINSZKY 1932, 51–52; LŐRINCZ 1981a, 82.

⁶³KUZSINSZKY 1932, 40–43.

⁶⁴KUZSINSZKY 1932, 47–51.

⁶⁵ZSIDI 1984, 372.

a development-led excavation.⁶⁶ In 2004 a small circular pottery kiln came to light only a few blocks away at 4–6 Ürömi Street,⁶⁷ which means that a combined pottery and tile workshop was operating here at the late 3rd century–early 4th century AD.⁶⁸ Both tile kilns were preserved in a good condition, but only Kiln 2 was completely unearthed.

Kiln 2 had an oven built of bricks with an internal size of 3.20×2.40 m. Its opening faced south, while the *praefurnium* of the combustion chamber protruded to the east. The intact oven floor was not demolished during the excavation, so the structure of the combustion chamber remains uncertain. The stokehole in front of the *praefurnium* was partly roofed over.⁶⁹

Kiln 1 must have been very much like Kiln 2, but only a small section of its northern part lay in the excavated area.⁷⁰

A large number of broken tiles and over fired bricks were scattered around the kilns, but no sign of tile stamps came to light.⁷¹

Scarbantia (Sopron-Kányaszurdok, Hungary) – civilian tiler (Cat. 22–23.)

The municipal tile manufacturing workshop of Scarbantia lay 2–3 km south of the *colonia*. Tile kilns were found in three different archaeological sites: at Harka, Jezsuita-szántók; Harka, Katonai Lövölde and Harka, Kányaszurdok sites.⁷²

In Kányaszurdok two Roman tile kilns were unearthed by János Gömöri in 1981.

Kiln 1 had two construction phases (Fig. 7). In phase 2 the kiln had a rectangular combustion chamber of 2.64×2.3 m and its floor was lined with bricks. It had one main flue and four vaulted cross walls built of $400 \times 280 \times 60$ mm large sun-dried bricks. The *praefurnium* faced north. The oven floor and the oven of the kiln had not survived. In phase 1 kiln was in the exact same spot, but the *praefurnium* and the stokehole were on the southern side of the kiln.⁷³

The other rectangular kiln, Kiln 2, was similar if a bit larger (Fig. 7). Its combustion chamber was 2.60×3.00 m big and had one main flue and four vaulted cross walls. The *praefurnium* opened to the south, and the stokehole was filled with tegulae. According to J. Gömöri this might have meant that there was a roof over the stokehole. Only a small part of the oven floor survived, it was made of bricks.⁷⁴ Based on the few pottery shards, the kilns were already in use in the early Principate.⁷⁵

The other two sites were observed before 1937. Alfred Romwalter wrote about one of the kilns at the Katonai

Lövölde site years after he saw it, from memory. According to him, the rectangular kiln might have been 4.0×1.5 m large. He also stated that lots of fired pipes were found near a kiln at Kányaszurdok.⁷⁶

The whole extent of the workshop is unknown and the time period in which it operated stays uncertain.

Savaria (Szombathely, Hungary) – civilian pottery and tile workshop (Cat. 24.)

Outside the city walls of Savaria, northwest from the town lay an industrial quarter of the town with a pottery workshop. In the vicinity of several pottery kilns unearthed by Terézia Buocz, a rectangular tile kiln was found by Tihámér Szentlélek in 1968 under the corner of Bolyai Street and Engels Street. The combustion chamber and the oven floor were in good condition. The oven floor of the kiln measured 3.2×3.1 m and was three times renewed.⁷⁷

Another possible tile kiln in Csordahajtó Street is mentioned by Endre Tóth. The kiln was found in 1869.⁷⁸

Neviodunum (Drnovo, Velika vas near Krško, Slovenia) – civilian tiler (Cat. 25.)

The tile manufacturing workshop of Neviodunum was found in the 1960s, as a result of a series of test excavations the aim of which was to shed more light on the topography of the Roman town. A large amount of broken tiles and two or three destructed kilns indicated the presence of a tile manufacturing workshop in this area.⁷⁹

The rectangular tile kiln found in Velika Vas had a surface of $3.5\text{--}4$ m². Its combustion chamber was dug in the soil and had one main flue and six cross flues. The five vaulted cross walls built of bricks were 0.29 m wide. The broken *tegulae* and *imbrices* around the kiln were probably fired in it. A depot of fired clay pipes was found near the kiln. They were 640 mm long each, with a mouth of 185 mm in diameter. The pipes were marked with the letters SIS scratched on their surface, which is thought to have meant that the pipes were produced for the town of Siscia or a customer from Siscia.⁸⁰

Beside the tile kiln, a pottery kiln and a huge clay pit were found. Based on the dimensions of the clay pit, which was about $250 \times 300 \times 2$ m, some 150,000 m³ of clay was consumed by the workshop over the decades or centuries.⁸¹

The exact dating and the extent of the workshop remain unknown.

⁶⁶FACSÁDY 1997, 14.

⁶⁷FACSÁDY-KÁRPÁTI 2005, 212–213.

⁶⁸FACSÁDY 1997, 14.

⁶⁹FACSÁDY 1997, 15–16.

⁷⁰FACSÁDY 1997, 15.

⁷¹FACSÁDY 1997, 16.

⁷²GÖMÖRI 1984, 126.

⁷³GÖMÖRI 1984, 126–132.

⁷⁴GÖMÖRI 1984, 132.

⁷⁵GÖMÖRI 1984, 132.

⁷⁶ROMWALTER 1937, 224–225.

⁷⁷MLADONICZKI 2012, 164; T. Szentlélek published only short reports about it: ArchÉrt 96 (1969) 257. and RégFüz 22 (1969) 34.

⁷⁸MLADONICZKI 2012, 164; TÓTH 2011, 19.

⁷⁹PETRU *et al.* 1966, 491.

⁸⁰VIKIĆ-BELANČIĆ 1970, 30; PETRU *et al.* 1966, 491–492.

⁸¹PETRU *et al.* 1966, 492–493; PETRU 1976, 229.



Poetovio (Ptuj, Slovenia) – civilian pottery and tile workshops (Cat. 26–31.)

The municipal pottery and tile manufacturing workshops of Poetovio along with metallurgical and marble carving workshops were located in the eastern outskirts of the Roman town, which was reserved for industrial activities. More than 100 pottery and tile kilns were documented, which were part of the many different, short-lived workshops mainly from the 2nd and 3rd centuries AD.⁸² Most of the kilns were not published properly or at all, but there are a few sites worth mentioning.

The best-known kilns were found in 1967 at 2 Ciril-Metodov Avenue. The three rectangular tile kilns placed around one stokehole were excavated by Z. Šubic.⁸³

The smallest Kiln A measured 3.7×3.9 m, had one main flue and six cross-flues. The vaulted cross walls and the perimeter walls of the kiln were made of sundried bricks. The $430 \times 310 \times 70$ mm large bricks of the oven floor had semi-circular cut-outs on their longer sides, thus forming circular vent holes of 70 mm diameter. The inside of the oven measured 2.3×2.5 m.⁸⁴

The somewhat larger Kiln B was 3.7×4.2 m big and had a similar structure. Its combustion chamber had one main flue and six cross flues. Its walls and oven floor were built of bricks the same size as the walls and oven floor of Kiln A. The area oven of Kiln B measured 3.1×3.0 m on the inside.⁸⁵

Kiln C was not unearthed but must have been very much like the other two.⁸⁶

Most of the bricks used for the construction of all three kilns were stamped: M IVN FIR or CCC. A charcoal analysis showed that the wood used for fuelling the kilns came predominantly from beech trees, but oak, pine, spruce, and maple was also used. No datable finds were found at the site.⁸⁷ Based on the tile stamp, the workshop must have been owned by *Marcus Iunius Firmus*, whose products were found along the Poetovio–Savaria road and the Drava River. The kilns were dated to the late 2nd or early 3rd AD, based on the tile stamps.⁸⁸

Another rectangular tile kiln was found a few hundred meters away in 1974 along with circular pottery kilns. Bricks, *tegulae* and *imbrices* were fired in the tile kiln.⁸⁹

In 1975–1976 five potter and two tile kilns and four wells were found yet again at 7–10 Rimska ploščad.⁹⁰

⁸²ŠAŠEL-KOS 2014, 152; HORVAT 1999, 223; HORVAT-VIČIČ 2010, 210. Now the Rabelčja vas part of Ptuj.

⁸³HORVAT-VIČIČ 2010, 112–113; VIKIĆ-BELANČIĆ 1970, 30.

⁸⁴ŠUBIČ 1968, 457–460 and 470.

⁸⁵ŠUBIČ 1968, 460–463 and 470–471.

⁸⁶ŠUBIČ 1968, 463–464 and 471.

⁸⁷ŠUBIČ 1968, 463–464 and 472.

⁸⁸PETRU 1976, 229; HORVAT-VIČIČ 2010, 113.

⁸⁹VIKIĆ-BELANČIĆ 1970, 30; HORVAT-VIČIČ 2010, 87. The kilns were under the corner of Kržišče Kraigherjeve Street and Rimske ploščadi.

⁹⁰HORVAT-VIČIČ 2010, 94–95.

Between 1989 and 1991 parts of a large pottery and tile manufacturing workshop was unearthed at Porodnišnica with several oval pottery and rectangular tile kilns. The three tile kilns lay around one stokehole, covered with roof. Tiles with QSP stamps were found in Kiln 1. The workshop can be dated to the 2nd and 3rd centuries AD.⁹¹

Sirmium (Sremska Mitrovica, Serbia) – municipal tiler (Cat. 32–38.)

Another large and well-known pottery and tile manufacturing workshop lay in Sirmium along the Sava River. Scattered in the area north and east from the city walls of Sirmium more than 30 pottery kilns have been found, that operated from the 1st century AD onwards. The seven Roman brick kilns unearthed so far, however, are concentrated in a smaller area called Ciglana (Brickyard) in Sremska Mitrovica, where brick production started again at the beginning of the 19th century and went on until the early 1990's. The location lay on the periphery of the eastern necropolis of Sirmium, where the kilns were found during three campaigns in 1969, 1985 and 1997.⁹²

The square-shaped Kiln 1 was excavated in 1985 (Fig. 7). Its combustion chamber had two main flues and eight cross flues. The vaults over the main flues started from two benches that ran along the sides of the combustion chamber and were supported by a row of piers in the middle of the chamber. The 0.45–0.55 m thick outer walls and the cross walls were built of $290\text{--}300 \times 400\text{--}430 \times 50\text{--}70$ mm large mud bricks and the floor was plastered with clay, while the piers in the middle were set on a line of unbaked *bipedales*. The 1.40 m wide and 1.50 m long vaulted fire tunnel projected from the east side of the combustion chamber and was 1.20 m high. The oven and the oven floor were mostly destroyed, but the size of the oven measured 4.10×3.95 m on the inside.⁹³

Kiln 2 was found in 1997 when a sewer ditch was dug at Stanka Vraza Street (Fig. 7). Unfortunately, most of the kiln was destroyed by machinery, only parts of the combustion chamber and a small part of the oven floor survived. The 3.20×2.20 m large combustion chamber had two main flues and 3 wide cross flues. The 0.50 m thick cross walls were built of $390 \times 390 \times 250$ mm, while the vaults of $340 \times 340 \times 90$ mm large mud bricks. The cross flues were so wide (0.40 m) that they were also vaulted in order to be able to hold the oven floor made of 2 layers of bricks. The combustion chamber was operated from one of the longer sides of the kiln, which makes it probable that the kiln had two fire tunnels in the axis of either main flue.⁹⁴

Kiln 3 was the first brick kiln found in the area, in 1969 when clay was being extracted for the modern brickyard. Luckily, the kiln was discovered before the machines

⁹¹HORVAT-VIČIČ 2010, 120.

⁹²JEREMIĆ 2000, 131, 135 and 137–140.

⁹³JEREMIĆ 2000, 141–143.

⁹⁴JEREMIĆ 2000, 143–144.



destroyed it (Fig. 7). The kiln was unusually small, its oven measuring only 1.90×1.90 m on the inside. The combustion chamber had one main flue and 5 cross flues. The vaults over the main flue rested on benches that ran along the longer sides of the chamber. The cross walls were built of $300 \times 350 \times 50$ mm large mud bricks and all walls and the floor was lined with clay. The fire tunnel projected from the southwestern side of the combustion chamber. The oven floor was made of a single layer of $320 \times 450 \times 50$ mm large bricks, with large, rectangular vent holes measuring 80×150 mm each.⁹⁵

Kiln 4 was one of the five kilns discovered in 1985 in the course construction works (Fig. 7). Its oven being 2.95×2.65 m large on the inside, it was slightly bigger than Kiln 3. The combustion chamber had one main flue and 7 cross flues. The vaults over the main flue were built of $270 \times 270 \times 60$ – 70 mm large mud bricks which were supported by mud brick piers standing along two benches that ran along the longer sides of the combustion chamber. The vaulted fire tunnel was attached to the eastern side of the chamber and measured 1.30 m in width, 1.22 m in length and 1.36 m in height. It was built by hollowing out a block of earth which became a monolithic structure of fired earth after the first firing. The floor of the fire tunnel, however, was 0.50 m higher than the floor of the combustion chamber.⁹⁶

Kiln 5 was operated from the same stokehole as Kiln 4. Its internal dimensions measured 1.9×2.80 m and it had a 0.45 m thick wall. The combustion chamber had one main flue 0.8 m wide and 1.15 m high and six cross flues. Its vaulted cross walls were made of $400 \times 300 \times 60$ mm large bricks. The *praefurnium* of the kiln faced north. There were no traces left from its oven floor.

Kiln 6 and Kiln 7 also shared the same stokehole. Little was left of the elongated Kiln 6, the internal measurements of which were about 1.8×3.0 m. Its *praefurnium* opened to the west.⁹⁷

Most of Kiln 7 was likewise destroyed. Its internal length was 3.95 m, while its width must have been about 1.8 m. The combustion chamber had one main flue, and its *praefurnium* faced south.⁹⁸

Based on the find material a wide range of ceramic building material was fired in the kilns including *tegulae*, *imbrices*, *tubuli*, *tegulae mammatae* and hexagonal and dog-bone shaped floor tiles. The workshop operated in the 3rd and 4th centuries AD.⁹⁹

Siscia (Sisak, Croatia) – civilian tilery (Cat. 39.)

A large tile manufacturing workshop in Siscia is attested by a series of bricks with the SISC stamps.¹⁰⁰ Furthermore, an

unusually large number of tiles are known from Siscia with graffito concerning the daily production of the tile makers.¹⁰¹

Nevertheless, we only know one of the kilns, discovered, but not fully unearthed at 3 Vinogradska Street. The length of the rectangular kiln measured 3.15 m and its incomplete width was 1.80 m. The oven floor was made of 300×400 mm large brick shifted so, that 10 cm^2 large rectangular vent holes were formed. A *tegula mammata* was found among the ruins of the oven.¹⁰²

Cibale (Vinkovci, Croatia) – civilian pottery and tile workshops (Cat. 40.)

More than fifty kilns are known from the pottery and tile workshops of Cibale. Most of the kilns were circular pottery kilns, but few big, rectangular kilns were used for tile production.¹⁰³

Mursa (Osijek, Croatia) – imperial, military and civilian pottery and tile workshops (Cat. 41.)

Pottery and tile production was also thriving in Mursa, where about 20 kilns were discovered. Some of them belonged to imperial, military and civilian tile manufacturing workshops.¹⁰⁴

II.b Tile kilns of Roman villas

Fertőrákos-Golgota (Hungary) – kiln of a villa (Cat. 42.)

In 1964–1965 parts of a Roman villa were excavated by Dénes Gabler at the site Fertőrákos-Golgota. The unearthed remains included a rectangular building of 22.50×18.50 m and a tile kiln c. 30 m northwest from the building.¹⁰⁵ The rectangular kiln measured 5.50×4.20 m on the outside and was used to produce ceramic building material for the villa (Fig. 8).

Only the lower parts of the kiln survived, including the stokehole and the combustion chamber. Both were lined with $450 \times 300 \times 60$ mm large bricks. No remains of the oven floor and the upper parts of the kiln were found. The *praefurnium* opened to the west. The combustion chamber had one main flue measuring 3.0 m in length and 1.2 m in width, and six cross walls with a vault in the middle, each built of bricks $420 \times 300 \times 80$ mm large.¹⁰⁶

According to the observations of D. Gabler, this tile kiln was probably not the only kiln of the villa. As there was no datable find material in or near the kiln itself, we can only date it on the basis of the finds of the villa. The uncovered

⁹⁵JEREMIĆ 2000, 144–145.

⁹⁶JEREMIĆ 2000, 145–146.

⁹⁷JEREMIĆ 2000, 148.

⁹⁸JEREMIĆ 2000, 148–149.

⁹⁹JEREMIĆ 2000, 149.

¹⁰⁰LŐRINCZ 1981a, 77; PETRU 1976, 229; VIKIĆ-BELANČIĆ 1970, 31 and 36.

¹⁰¹MATIJAŠIĆ 1986.

¹⁰²VIKIĆ-BELANČIĆ 1970, 31.

¹⁰³ISKRA-JANOŠIĆ 2004, 187–188.

¹⁰⁴FILIPOVIĆ 2004, 164.

¹⁰⁵GABLER 1973, 140–141.

¹⁰⁶GABLER 1973, 149.

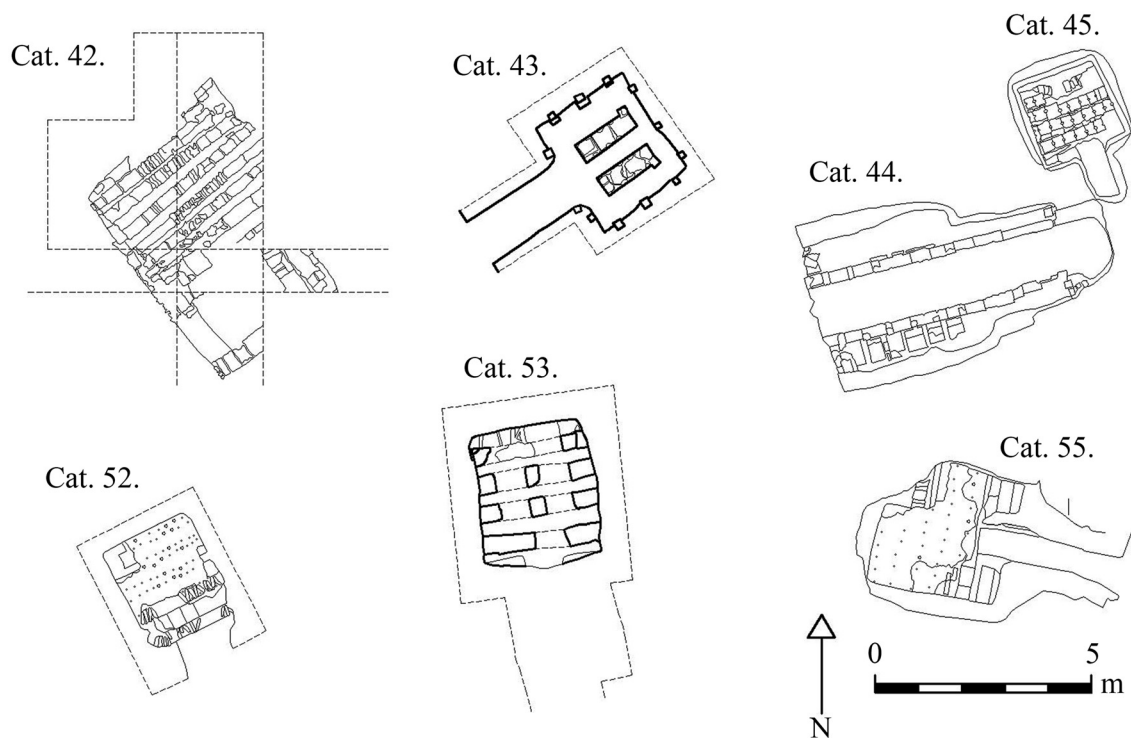


Fig. 8. Plan of the civilian tile kilns of Roman villas

building was in use from the 1st century AD to at least the first half of the 3rd century AD with a hey-day in the 2nd century. No stamped tiles were found.¹⁰⁷

Fertőrákos-Alsöültetvény dűlő (Hungary) – kiln of a villa (Cat. 43.)

Southwest from the Roman villa in Fertőrákos-Golgota another Roman villa was found and investigated by J. Gömöri in 1979. The buildings of the villa were badly damaged but 70 m north from the central building a tile kiln was found. The rectangular kiln was small, it measured only 2.80×2.40 m (Fig. 8).

The combustion chamber of the kiln was divided into three main flues with two walls. All flues were fuelled from one *praefurnium* which opened to the west and had a length of 2.5 m. The oven floor was supported by three triplets of vaults built of 200×200 mm large *lateres*. The construction method of the dividing walls in the combustion chamber constitutes an interesting detail of the kiln. The walls in question were built of rows of sun-dried and fired bricks alternately. The fired bricks had three knobs that could sink in the sun-dried bricks, while some of the sun-dried bricks had several goat footprints on their surfaces each. According to J. Gömöri, these imprinted tiles were used to make a steadier connection between the rows.

The kiln was dated to the second half of the 4th century based on a coin of the Valentinian dynasty.¹⁰⁸

Kőszegfalvi rétek (Hungary) – kiln of a villa (Cat. 44-45.)

In 2012 two rectangular tile kilns and a circular pottery kiln were excavated by Réka Mladoniczki just outside Kőszegfalva, on the *territorium* of Savaria (Szombathely, Hungary). The workshop was located 2–3 km from the Amber Road and probably belonged to one of the supposed Roman villas in the vicinity of the site. All three kilns opened from the same stokehole.

The oblong Kiln 1 was partly destroyed (Fig. 8). The remaining part of its combustion chamber was 3.50 m long and 1.16 m wide. Only small parts of its walls and none of the oven floor survived. The walls and the vaults of the combustion chamber were built from bricks measuring $460 \times 360 \times 70$ mm and $420 \times 250 \times 70$ mm. The internal measurements of the fire tunnel were 1.20×2.44 m.

Kiln 2 was smaller, almost square shaped, its combustion chamber was 1.94×1.80 m large (Fig. 8). The oven floor was supported by five cross walls and was built from $250 \times 250 \times 60$ mm large *lateres*, each with a half-circle shaped cut in the middle of two sides. The holes thus created in the oven floor were of 70–80 mm diameter. One of the *lateres* bore a graffiti in cursive Latin.

¹⁰⁷GABLER 1973, 149–150; LŐRINCZ 1981a, 85.

¹⁰⁸GÖMÖRI 1981, 62–65; LŐRINCZ 1981a, 85.

Based on the finds, the tile kilns produced all kinds of ceramic building materials including *tegulae*, *imbrices*, *lateres* and rhombus shaped floor tiles, none with tile stamps. The kilns were dated to the 2nd–3rd centuries AD.¹⁰⁹

Uraiújfalu, Kavicsbánya (Hungary) – kiln of a villa (Cat. 46.)

In Uraiújfalu a tile kiln was unearthed in 1959 by T. Buocz. Uraiújfalu lay on the *territorium* of Savaria and the kiln might have belonged to a nearby Roman villa.¹¹⁰

Csepreg, Vörös major (Hungary) – kiln of a villa (Cat. 47.)

T. Buocz uncovered a rectangular tile kiln in Csepreg but she has not published her findings. The kiln was in very poor condition, nothing of its walls or oven floor survived.¹¹¹

Balogunyom (Hungary) – kiln of a villa (Cat. 48.)

A Roman villa and a possible tile kiln were observed during field walking by Ferenc Derdák, Gábor Kiss and E. Tóth near Balogunyom. The site has not been excavated yet.¹¹²

Nemesrempehollós (Hungary) – kiln of a villa (Cat. 49.)

South of Nemesrempehollós, at Csárdahel/Gövecsébánya dűlő traces of a Roman villa and tile kiln were identified by F. Derdák.¹¹³

Hévíz-Egereg (Hungary) – kiln of a villa (Cat. 50.)

A Roman tile kiln was found in 1936 in the yard at 27. Egeregi Street. The rescue excavation was carried out by Aladár Radnóti in 1940.¹¹⁴

Szentgyörgyvár (Hungary) – kiln of a villa (Cat. 51.)

A Roman pottery or tile kiln was discovered during a road construction in 1925 near Szentgyörgyvár. Roman bricks, tiles and pottery shards were collected at the site.¹¹⁵

Balatonfüred, 1 Szőlősi Street (Hungary) – kiln of a villa (Cat. 52.)

A rectangular tile kiln with rounded corners was found in 1973 in Balatonfüred (Fig. 8). It was small, its firing chamber measured appr. 2.52×2.04 m. The combustion chamber had one main flue and four vaulted cross walls. The construction method of the oven floor is worth mentioning: $240 \times 340 \times 40$ mm large bricks stood in zigzag so that triangular holes were created. These holes were partly filled in with clay in order to make the holes circular.

The kiln was dated to the 3rd century AD by Sylvia Palágyi, who led the excavation.¹¹⁶

Balatonfüred, Fürdő Street (Hungary) – kiln of a villa (Cat. 53.)

Five years later, in 1975, another rectangular kiln with rounded corners was found in Balatonfüred, just a few hundred meters from the other (Fig. 8). The excavation unearthed a kiln with a 3.14×2.92 m large firing chamber. Its 3.3 m long *praefurnium* opened to the east. The combustion chamber had one main flue and six vaulted cross-walls. The oven floor was built of bricks with their corners cut off and lined with clay so that the holes became circular.

There were broken *tegulae* and *imbrices* in the *praefurnium*. No datable find material came to light inside or around the kiln.¹¹⁷

There are at least two Roman villas in Balatonfüred within 500 m from the above-mentioned tile kilns.¹¹⁸ The kilns might be related to the villas.

Balatonfüred, Baricska-dűlő (Hungary) – possible tile kiln of a villa (Cat. 54.)

B. Kuzsinszky supposed a Roman tile kiln in Balatonfüred, Baricska-dűlő. According to his description a vaulted structure was found with three flues underneath, bricks with holes at their corners and *tegulae*.¹¹⁹

Csopak, Sportpálya (Hungary) – tile kiln of a villa (Cat. 55.)

A rectangular tile kiln in Csopak was unearthed in 1975 (Fig. 8). The sides of the firing chamber of the trapezoid kiln measured $2.96 \times 3.36 \times 2.50 \times 2.78$ m. The 1.01 m long *praefurnium* opened to the south. *Tegulae* and *lateres* were found around the kiln, none of which bore tile stamps.¹²⁰

¹⁰⁹MLADONICZKI 2012, 152–164.

¹¹⁰MLADONICZKI 2012, 164–165. T. Buocz published only a short report: RégFüz 13 (1960) 55.

¹¹¹MLADONICZKI 2012, 164.

¹¹²MLADONICZKI 2012, 152–164; F. Derdák, G. Kiss and E. Tóth published their findings in short reports: RégFüz 38 (1985) 34. and ArchÉrt 112 (1985) 275.

¹¹³MLADONICZKI 2012, 165.

¹¹⁴LŐRINCZ 1981a, 77.

¹¹⁵LŐRINCZ 1981a, 77; MÜLLER *et al.* 2002, 14.

¹¹⁶PALÁGYI 1993–1994, 215–218.

¹¹⁷PALÁGYI 1993–1994, 218–220.

¹¹⁸GABLER 1993–1994, 151; PALÁGYI 1993–1994, 226.

¹¹⁹PALÁGYI 1993–1994, 222; KUZSINSZKY 1920, 170.

¹²⁰PALÁGYI 1993–1994, 220–222.

Gyulaírádtót, Pogánytelek (Hungary) – tile kiln of a villa (Cat. 56–57.)

The villa complex at Gyulaírádtót-Pogánytelek had a pottery workshop with four kilns. The two smaller, round kilns were used for firing pottery (nos 1–2.), while the two bigger, rectangular kilns (nos 3–4.) were used for firing bricks and tiles.¹²¹ Both of the rectangular kilns had one main flue and four cross walls. Their exact size was not mentioned in the original publication of Gyula Rhé in 1906. Beside the kilns a pit was found filled with *tegulae* prepared for firing.¹²²

Alsóörs, Kemencs-rét (Hungary) – possible tile kiln (Cat. 58.)

In 1908 a small, “hypocausted” room was found, the function of which is debated. Based on the small size of the feature (one side was 3.0 m long, the other at least 2.0 m), the lack of rocks in the walls and the abundance of Roman bricks near the site B. Kuzsinszky defined the feature as a pottery or tile kiln. Dezső Laczkó thought it to be a hypocausted building, while Edit Thomas described it as a bath.¹²³

Alsóörs, Orgona Street (Hungary) – tile kilns (Cat. 59.)

During a gas line installation in front of 21 Orgona Street a Roman tile kiln was found under the road. Most of it was destroyed before the archaeologist S. Palágyi could investigate. The internal size of the rectangular kiln was about 3.0×2.7 m, and it had one main flue and several cross flues. The oven floor was punctured by circular vent holes 9 cm in diameter.

Based on photos taken during the gas line installation two more kilns are to be counted with.¹²⁴

Berhida, Nagygizder (Hungary) – possible tile kiln (Cat. 60.)

In 1938 a kiln-like structure was found with bricks and tiles. All finds were lost, thus the one-time existence of a Roman tile kiln at this site is questionable but not impossible.¹²⁵

Wolfsbrünnl bei Sommerein (Austria) – tile kiln (Cat. 61.)

A rectangular tile kiln was unearthed in 1980 near Wolfsbrünnl bei Sommerein. The size of the kiln was about 3.0×3.5 m and could be dated to the 4th century AD. A large number of unstamped *tegulae* and *imbrices* were found around the kiln.¹²⁶

Eisenstadt-Gölbesäckern (Austria) – kiln of a villa (Cat. 62.)

The villa complex in Eisenstadt Gölbesäckern also had tile and pottery kilns.¹²⁷

E. Thomas referred to tile kilns in the villa complex of Tokod-Erzsébetakna beside the pottery workshop and glass workshop in the same area.¹²⁸ The workshops operated in the 4th century AD, after the villa building was abandoned. However, M. Kelemen and B. Lőrincz did not mention tile kilns in the monograph of Tokod, although they did describe the pottery workshop and the tile stamp found on site in detail.¹²⁹

CONCLUSIONS

Based on earlier publications 62 tile kilns were collected in 30 settlements. Fourteen belonged to 7 different military workshops, 27 to civilian workshops in towns and 19 to villas (Table 2). All of them were rectangular in shape, and their size ranged roughly from 2×2 m to 6×6 m. They operated from the turn of the 1st and 2nd centuries AD to the end of the 4th century AD. In some cases, for instance in Brigetio, the kilns seem to have been used for centuries, while in the numerous workshops of Poetovio kilns were generally short-lived. All tile kilns listed were rectangular, but their exact type could only be decided in 34 cases: 24 had one main flue, 9 had two main flues and 1 had three main flues in their combustion chamber. The ceramic building material fired in them included *tegulae*, *imbrices*, *lateres*, *antefixa*, *tegulae mammatae*, *tubuli*, floor tiles and drain pipes. Stamped tiles were found in all military workshops, in fact, the stamps of several different units or officers were found in most military workshops. In Vindobona, a few civilian stamps (6 out of 2,000) were also found in the legionary workshop. In the civilian workshops in towns stamped tiles or stamp dies around the kiln were found in only four settlements: Aquincum-civil town, Neviodunum, Poetovio and Siscia. Not one stamped tile came to light from kilns around villas.

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- ¹²²PALÁGYI 1993–1994, 222; RHÉ 1906, 21–23; KUZSINSZKY 1920, 195.
- ¹²³PALÁGYI 1993–1994, 222; LACZKÓ 1912, 7; KUZSINSZKY 1920, 180–181; THOMAS 1964, 19.
- ¹²⁴PALÁGYI 2004, 50.
- ¹²⁵PALÁGYI 1993–1994, 223.
- ¹²⁶PLOYER 2015, 217.
- ¹²⁷THOMAS 1964, 139, 151.
- ¹²⁸THOMAS 1964, 268.
- ¹²⁹KELEMEN 1981, 13–19; LŐRINCZ 1981b.

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Table 2. Roman tile kilns in Pannonia

Nr.	Location		Shape	Size	Type	Date	Ceramic Building Material	Stamps	Date of Excavation	Publication
1.	Vienna-Hernals, 13 Stenergasse	Vindobona legionary tilery	rectangular			turn of the 1 st and 2 nd c. AD – middle of the 3 rd c.	<i>tegulae, imbrices, lateres, antefixa, floor tiles</i>	<i>legio X Gemina, legio XIII Gemina, legio XVIII Gemina, legio XV Apollinaris, legio XXX Ulpia Victrix, cohors I Aelia mill. sag. eq., FEARORI ANIS, ADRI [- -], Atilia Firma, C V (S) G F () P () P L () S E ()</i>	1953	NEUMANN 1968, LŐRINCZ 1981, MOSSER 2013
2.	Vienna (Hernals), 15 Stenergasse		rectangular		C. di C. II/c, BL I				1975	HARL 1976, LŐRINCZ 1981a
3.	Vienna-Hernals, 16 Stenergasse / 47 Geblergasse, Ofen 1		rectangular	2.60 × 2.20 m (inside)	C. di C. II/b, BL II				2013–2013	MOSSER 2013, MOSSER 2014, MOSSER 2018
4.	Vienna-Hernals, 16 Stenergasse / 47 Geblergasse, Ofen 2		rectangular	2.75 × 2.5 m (inside)	C. di C. II/b, BL II					
5.	Komárom-Szőny, Kurucdomb, Kiln I	Brigetio legionary pottery and tile workshop	rectangular	2.90 × 2.80 m (inside) c. 5.0 × 4.0 m (outside)		turn of the 1 st and 2 nd c. AD – end of the 4 th c. AD		<i>Legio XI Claudia, Legio XXX Ulpia, Victrix</i>	1934	PAULOVICS 1934, 1938, LŐRINCZ 1981a
6.	Komárom-Szőny, Kurucdomb, Kiln II		rectangular	c. 6.80 × 6.0 m				<i>Legio I Adiutrix, vexillationes of the legio XIII Gemina and the legio XVIII Gemina, Lupicinus tribunus</i>	1934	PAULOVICS 1934, 1938, LŐRINCZ 1981
7.	Budapest-Óbuda, 124 Bécsi Street, Kiln 1967/3	Aquincum legionary pottery and tile workshop	rectangular	3.20 × 2.80 m	C. di C. II/c, BL I	around the 2 nd –3 rd c. AD	<i>tegulae, imbrices, lateres, tegulae mammatae, antefixa, floor tiles</i>	<i>Legio II Adiutrix, legio X Gemina, legio III Flavia, Frigeridus dux, Iovinus tribunus, Valentinus centurio, APIVINI</i>	1967	PARRAGI 1971, PARRAGI 1976, PARRAGI 1981, LŐRINCZ 1981a
8.	Budapest-Óbuda, 124 Bécsi Street, Kiln 1970/1		rectangular		C. di C. II/c, BL I				1970	
9.	Budapest-Óbuda, 128 Bécsi Street, Kiln 1970/2		rectangular	4.0 × 4.0 m					1970	
10.	Dömös, Kiln I	legionary tilery	rectangular	6.20 × 5.44 m	C. di C. II/c, BL I	second half of the 2 nd c. AD	<i>Tegulae, imbrices, lateres, tubuli</i>	<i>Legio I Adiutrix</i>	1987	KELEMEN 1994–1995

(continued)

Table 2. Continued

Nr.	Location		Shape	Size	Type	Date	Ceramic Building Material	Stamps	Date of Excavation	Publication
11.	Dömös, Kiln II	legionary tiler	rectangular	5.45 × 5.10 m	C. di C. II/c, BL I	second half of the 2 nd c. AD	Tegulae, imbrices, lateres, tubuli	Legio I Adiatrix	1988	KELEMEN 1994-1995
12.	Solva, Esztergom- Szentgyörgymező	military tiler	rectangular	3.80 × 4.10 m	C. di C. II/c, BL I	4 th c. AD	tegulae, imbrices, lateres	Quadriburgium, Terentianus tribunus	2005	KELEMEN 2011
13.	Lugio, Dunaszekcső- Halena	military tiler	rectangular			2 nd - 3 rd c. AD		cohors VII Breucorum	2012	FARKAS 2013, GÁBOR 2019
14.	Progar	military tiler	rectangular			2 nd - 3 rd c. AD ?		Classis Flavia Pannonica		DIMITRIJEVIĆ 1967, VIKIĆ-BELANČIĆ 1970, PETRU 1976, STOJANOVIĆ 2013
15.	Budapest-Óbuda, Gázgyár pottery workshops, Kiln I	Aquincum civil town civilian pottery and tile workshop	rectangular	7.90 × 7.35 m (outside) 4.80 × 4.80 m (inside)	C. di C. II/b, BL II	beginning of the 2 nd c. AD – end of the 2 nd c. AD		D [quarta] officina] Vindo/nis Ak[vincensis] stamp die	1910– 1911	KUZSINSZKY 1932, LŐRINCZ 1981a
16.	Budapest-Óbuda, Gázgyár pottery workshops, Kiln I		rectangular	6.65–6.85 × 6.75 m (outside) 4.35 × 4.35 m (inside)	C. di C. II/b, BL II					KUZSINSZKY 1932, LŐRINCZ 1981a
17.	Budapest-Óbuda, Gázgyár pottery workshops, Kiln III		rectangular	5.30 × 5.20 m (outside) 4.05 × 3.70 m (inside)	C. di C. II/b, BL II					KUZSINSZKY 1932, LŐRINCZ 1981a
18.	Budapest-Óbuda, Gázgyár pottery workshops, Kiln VIII		rectangular	5.60 × 5.00 m (outside) 4.05 × 3.40 m (inside)	C. di C. II/b, BL II					KUZSINSZKY 1932, LŐRINCZ 1981a
19.	Budapest-Óbuda, Gázgyár pottery workshops, Kiln XII		rectangular	4.25 × 4.20 m	C. di C. II/b, BL II					KUZSINSZKY 1932, LŐRINCZ 1981a

(continued)





Table 2. Continued

Nr.	Location		Shape	Size	Type	Date	Ceramic Building Material	Stamps	Date of Excavation	Publication
20.	Budapest-Óbuda, 12 Bécsi Road Kiln 1	Aquincum <i>canabae</i> civilian pottery and tile workshop	rectangular			late 3 rd c. AD – early 4 th c. AD			1996	FACSÁDY 1997
21.	Budapest-Óbuda, 12 Bécsi Road Kiln 1		rectangular	3.20 × 2.40 m (oven internal)						
22.	Sopron-Kányaszurdok, Kiln 1	Scarbantia civilian tilery	rectangular	2.64 × 2.3 m (comb. chamber)	C. di C. II/b, BL II				1981	GÖMÖRI 1984
23.	Sopron-Kányaszurdok, Kiln 2		rectangular	2.60 × 3.0 m (comb. chamber)	C. di C. II/b, BL II					
24.	Szombathely, Bolyai Street	Savaria, civilian pottery and tile workshop	rectangular	3.2 × 3.1 m					1968	SZENTLÉLEKY 1968a, SZENTLÉLEKY 1968b, MLADONICZKY 2012
25.	Drnovo, Velika vas	Neviodunum, civilian tilery	rectangular	c. 2.0 × 2.0 m	C. di C. II/b, BL II		<i>tegulae,</i> <i>imbrices,</i> pipes	SIS	1960s	PETRU <i>et al.</i> 1966, VIKIĆ-BELANČIĆ 1970, PETRU 1976
26.	Ptuj, 2 Ciril-Metodov Avenue, Kiln A	Poetovio, civilian pottery and tile workshop	rectangular	3.7 × 3.9 m	C. di C. II/b, BL II	late 2 nd – early 3 rd c. AD		CCC <i>Marcus Iunius Firmus</i>	1967	ŠUBIĆ 1968, VIKIĆ-BELANČIĆ 1970, HORVAT 2010
27.	Ptuj, 2 Ciril-Metodov Avenue, Kiln B		rectangular	3.7 × 4.2 m (outside) 3.1 × 3.0 m (inside oven)	C. di C. II/b, BL II					
28.	Ptuj, 2 Ciril-Metodov Avenue, Kiln C		rectangular							
29.	Ptuj, Križišče Kraigherjeve Street		rectangular			2 nd – 3 rd c. AD	<i>tegulae,</i> <i>imbrices</i>		1974	VIKIĆ-BELANČIĆ 1970, HORVAT 2010
30.	Ptuj, 7–10 Rimska ploščad, two kilns		rectangular						1975–1976	HORVAT 2010

(continued)

Table 2. Continued

Nr.	Location		Shape	Size	Type	Date	Ceramic Building Material	Stamps	Date of Excavation	Publication
31.	Ptuj, Porodnišnica three kilns	Poetovio, civilian pottery and tile workshop	rectangular			2 nd – 3 rd c. AD		QSP	1989–1991	HORVAT 2010
32.	Sremska Mitrovica, Ciglana, Kiln 1.	Sirmium, civilian pottery and tile workshop	rectangular	4.10 × 3.95 m	C. di C. II/c, BL I	3 rd – 4 th c. AD	<i>tegulae, imbrices, tegula mammatae, floor tiles</i>		1985	JEREMIĆ 2000
33.	Sremska Mitrovica, Ciglana, Kiln 2.		rectangular	3.20 × 2.20 m	C. di C. II/d, BL I variant				1997	JEREMIĆ 2000
34.	Sremska Mitrovica, Ciglana, Kiln 3.		rectangular	1.90 × 1.90 m	C. di C. II/b, BL II				1969	JEREMIĆ 2000
35.	Sremska Mitrovica, Ciglana, Kiln 4.		rectangular	2.95 × 2.65 m	C. di C. II/b, BL II				1985	JEREMIĆ 2000
36.	Sremska Mitrovica, Ciglana, Kiln 5.		rectangular	1.90 × 2.80 m	C. di C. II/b, BL II				1985	JEREMIĆ 2000
37.	Sremska Mitrovica, Ciglana, Kiln 6.		rectangular	c. 1.80 × c. 3.00 m	C. di C. II/b, BL II				1985	JEREMIĆ 2000
38.	Sremska Mitrovica, Ciglana, Kiln 7.		rectangular	c. 1.80 × 3.95 m	C. di C. II/ b, BL II				1985	JEREMIĆ 2000
39.	Sisak, 3 Vinogradska Street	Siscia, civilian tilery	rectangular	length: 3.15 m			<i>tegula mammatae</i>	SISC	1948	LŐRINCZ 1981a , PETRU 1976 , VIKIĆ-BELANČIĆ 1970
40.	Vinkovci, several tile kilns	Cibalae, civilian and pottery workshops	rectangular							ISKRA-JANOŠIĆ 2004

(continued)





Table 2. Continued

Nr.	Location		Shape	Size	Type	Date	Ceramic Building Material	Stamps	Date of Excavation	Publication
41.	Osijek, several tile kilns	Mursa, imperial, military, civilian pottery and tile workshops								FILIPOVIĆ 2004
42.	Fertőrákos-Golgota	villa	rectangular	5.50 × 4.20 m (outside)	C. di C. II/b, BL II	end of the 1 st – middle of the 3 rd c. AD			1964–1965	GABLER 1973, LŐRINCZ 1981a
43.	Fertőrákos- Alsóültetvény dűlő	villa	rectangular	2.80 × 2.40 m	BL III	second half of the 4 th c. AD			1979	GÖMÖRI 1981, LŐRINCZ 1981a
44.	Kőszegfalvi rétek, Kiln 1.	villa	rectangular (oblong)	3.50 × 1.72 m	C. di C. II/b variant, BL II variant	2 nd – 3 rd c. AD	<i>tegulae, imbrices, lateres, floor tiles</i>		2012	MLADONICZKY 2012
45.	Kőszegfalvi rétek Kiln 2.		rectangular	1.94 × 1.80 m	C. di C. II/b, BL II					
46.	Uraiújfalu	villa							1959	BUOZ 1960, MLADONICZKY 2012
47.	Csepreg	villa								MLADONICZKY 2012, BUOZ 1960
48.	Balogunyom	villa								MLADONICZKY 2012, DERDÁK <i>et al.</i> 1985a, DERDÁK <i>et al.</i> 1985b
49.	Nemesrempehollós	villa								MLADONICZKY 2012
50.	Hévíz-Egregy	villa							1936	MRT 1, LŐRINCZ 1981a
51.	Szentgyörgyvár	villa							1925	MRT 1, LŐRINCZ 1981a
52.	Balatonfüred, 1 Szőlői Street	villa	rectangular	c. 2.62 × c. 2.04 m	C. di C. II/b, BL II				1973	PALÁGYI 1993–1994

(continued)

Table 2. Continued

Nr.	Location		Shape	Size	Type	Date	Ceramic Building Material	Stamps	Date of Excavation	Publication
53.	Balatonfüred, Fürdő Street	villa	rectangular	3.14 × 2.92 m	C. di C. II/b, BL II		<i>tegulae, imbrices</i>		1978	PALÁGYI 1993–1994
54.	Balatonfüred, Baricska-dűlő	villa					<i>tegulae</i>			PALÁGYI 1993– 1994, KUZSINSZKY 1920
55.	Csopak, Sportpálya		rectangular	2.96 × 2.50 m	C. di C. II/c, BL I		<i>tegulae, lateres</i>		1975	PALÁGYI 1993–1994
56.	Gyulafirátót- Pogánytelek, Kiln 3.	villa	rectangular		C. di C. II/b, BL II		<i>tegulae</i>		before 1906	PALÁGYI 1993– 1994, THOMAS 1964, RHÉ 1906
57.	Gyulafirátót- Pogánytelek, Kiln 4.		rectangular		C. di C. II/b, BL II					
58.	Alsóörs, Kemencs-rét	villa	rectangular	length: 3.0 m					1908	PALÁGYI 1993–1994
59.	Alsóörs, Orgona Street	villa	rectangular	c. 3.0 × 2.7 m					1998	PALÁGYI 2004
60.	Berhida, Nagygyzsdor	villa							1938	PALÁGYI 1993–1994
61.	Wolfsbrünnl bei Sommerein	villa	rectangular	3.5 × 3.0 m		4 th c. AD	<i>tegulae, imbrices</i>		1980	PLOYER 2015
62.	Eisenstadt Gölbesäckern	villa								THOMAS 1964

