

## EARLY MEDIEVAL HILLFORTS

### Comments on the Construction and Lifespan of Fortifications Based on Modern Reconstructions in Modrá near Velehrad<sup>1</sup>

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For a long time, the issue of early medieval hillforts attracts the great attention of both researchers and the lay public. The paper discusses questions related to the determination of the lifespan and functionality of wood-soil fortifications of early medieval hillforts. The paper builds on our experiences gained during nearly twenty years of observations at the archaeological open-air museum in Modrá near Velehrad in Moravia, Czech Republic. We compare our findings with other archaeological open-air museums and research concerning fortifications. The paper presents older as well as the most recent reconstructions of fortifications built in Modrá between the years 2020 and 2021. Those constructions are then compared with similar fortifications recently reconstructed on the Bojná-Valy hillfort near Topolčany in Western Slovakia. Finally, we briefly discuss several questions concerning hillforts and their fortifications in the Great Moravian times (9<sup>th</sup> c.).

Keywords: Great Moravia, ringwall, fortification, rampart, reconstruction.

For a long time, early medieval strongholds in Central attract the great attention. Very early – for example, at St. Kliment near Osvětimany in Moravia already in the 17<sup>th</sup> c. – the fortification ramparts were considered a ‘treasure’. Unfortunately, this kind of ‘treasure hunt’ is still popular today. Only the methods have changed. We can only hope that it is motivated by an honest interest in the strongholds, fortifications and by the fact that many of the sites still hide some of their secrets. In the cadastre of the village of Bojná, the phenomenon is certified by the presence of several hillforts where research and discovery are permanently and unmistakably linked with Karol Pieta. Only in recent decades, hillforts and their fortifications were discussed in so many monographs, scientific papers and chapters in books that it would take too much time and space to mention them all here (e.g. *Dresler 2011; Galuška 2017, 85–92, 133–155; Henning/Ruttikay 1998; Hulínek 2008; Jenčík/Struhár 2015; Kouřil/Procházka et al. 2018; Lutovský 2006; Mazuch 2014; Procházka 2009; Šalkovský 2015*). Among other things, the publications show how our cognitions – for example concerning the hillforts chronology – have evolved compared to what we knew in the 1980 s (*Poulik 1988; Šolle 1984; cf. Henning et al. 2017; Lutovský 2009; etc.*). In

the paper, we will try to answer several questions concerning the construction and lifespan of fortifications in the 9<sup>th</sup> c. as well as the feasibility and durability of modern hypothetical reconstructions of fortifications. The present considerations are based primarily on our experiences with 1) the construction and almost twenty years of use of reconstructed wooden fortifications in the archaeological open-air museum in Modrá near Velehrad and the comparison between the fortifications on other sites in Moravia and Slovakia and 2) the reconstruction of fortifications from Uherské Hradiště-Rybárny and Staré Město recently performed in Modrá and their comparison with contexts and reconstructions on the Bojná I hillfort.

#### HYPOTHETIC RECONSTRUCTIONS OF FORTIFICATIONS AT THE ARCHAEOLOGICAL OPEN-AIR MUSEUM IN MODRÁ NEAR VELEHRAD BETWEEN 2003 AND 2011

The beginnings of the archaeological open-air museum in Modrá near Velehrad (Fig. 1), close to Uherské Hradiště, reach back to 2003 and 2004

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Fig. 1. Modrá. View of the archaeological open-air museum. In the background, on the left the Velehrad monastery and the Chřiby mountain range.

(Galuška 2005). The village of Modrá built the museum near a historic monument – the foundations of the early medieval St. John's church, a site known as 'Díly u Božího syna' and its hypothetical reconstruction from 2000 – on a southern slope oriented towards a route leading to Staré Město-Velehrad. Before the reconstruction, the site has been investigated by archaeologists who discovered settlement features and graves from the Great Moravian times. Some of the features, for example, underground storage pits, were reconstructed and made available to the visitors. Consequently, it is not true that the open-air museum in Modrá has been established 'in the middle of nowhere' (Makýš 2014, 166). Most of the constructions, however, are hypothetical interpretations of well-preserved archaeological finds from Staré Město, Uherské Hradiště and Ostrožská Nová Ves, 'imported' to Modrá. Based on the knowledge about the urban structure of the Great Moravian Staré Město, the reconstructions were purposefully group in thematic quarters representing, among others, manufacturing, settlement and farming, and sacral or power-related facilities. The archaeological open-air museum presents a 'Great Moravian fortified settlement' – i.e. a stronghold. The first significant development of the museum took place in 2011 and included the construction of a stone-mortar baptistery, watchtower and a long wooden palace-like building. Most recently, ten years after the first development, we added forti-

fications with a front stone wall and an adjoining tower and gate (see below).

In the beginning, in 2003, the archaeological open-air museum included three fortifications. All of them were built of undried debarked oak poles. The construction process included both traditional and modern methods and, thus, is not an example of experimental archaeology (e.g. Malina 1980; Popelka 2000). No chemical or physical measures were used to protect the wood (Makýš 2003, 208; 2014, 36–44). The first fortification built was a wooden wall made of poles – a palisade. It is an old-time fortification type. Together with a moat, it was used, for example, as an element of defensive structures around a settlement dating back to the first half of the 9<sup>th</sup> c. in Staré Město 'Na Valách' (Galuška 1997). The second fortification was a shell structure built of wood and clay reconstructed based on a description of the first type of external fortifications around Staré Město – the so-called Christin's rampart from about mid-9<sup>th</sup> c. (Galuška 1998, 345; 2017, 137–139; Hrubý 1965, 217–219, fig. 68). The third and the most complex fortification was a wooden double gate with two towers at the sides (Fig. 2). It was modelled on findings of archaeological research of the second type of external fortifications in a place where the Salaška stream flowed into the premises of Staré Město.

Technologically, the wooden palisade wall was the simplest construction. It was built of round poles (diam. of 15–20 cm, height of 250 cm) – sharpened





Fig. 2. Modrá. The wooden double gate with two towers.

in the upper part and flat at the bottom. The bottom part was gently charred up to 50–60 cm and then placed in a ditch filled with fresh concrete. Afterwards, the poles were fixed with smaller stones. The

entire construction resembled ‘concrete shoes’. Tips of the poles were all 220 cm above the surrounding terrain covered with flat stones mixed with mortar. The palisade was about 17 m long and ended at the northern tower of the gate.

Wood-soil shell fortifications consist of two combined, parallel palisade walls spaced about 100 cm apart. The outer – or front – wall was higher and consisted of a single row of round poles (palisade) – 270 cm high and 20–25 cm wide. Poles were embedded using the same method as in the case of the simple wooden palisade wall. The only difference was that on the inside of the wall, there were larger stones that served as additional support of the poles. All poles were 220 cm high. The inner, rear retaining wall was shorter and consisted of poles of 10–15 cm in diameter and 150 cm in height. The upper ends of the poles that remained above ground – 100 cm high – were cut flat. Lower ends were sharpened and dug into the ground up to 50 cm. On the back, the rear wall was supported with additional transverse poles. The space between the walls was filled with soil. The soil surface was covered with finer stones. The shell fortifications were about 20 m long and ended at the southern tower of the gate.

Until 2021, the wooden double gate with two towers (Fig. 2) was technologically the most complex construction in the archaeological open-air museum in Modrá. Square towers – with 300 cm long sides – are supported by four oak poles and four further poles placed in-between that are 600 cm high and



Fig. 3. Modrá. Oak poles of the entry tower embedded in concrete twenty years after construction with legible traces of rain water effects.



Fig. 4. Modrá. Oak poles of the palisade embedded in crushed stones.



Fig. 5. Modrá. Oak poles of the palisade: on the left well charred, on the right improperly charred.

about 40–45 cm wide. Uncharred lower parts of the poles were fixed in concrete beds up to 70 cm. Up to 250 cm above the surrounding terrain – just below the first level – the towers are covered with vertical 20–30 cm wide half logs. In the upper part, up to 100 cm above the floor level (i.e. about the level of an adult person's belly), the shell is formed of tightly fixed spheres. On the front and from the sides, the shell is additionally strengthened by vertical planks with openings for archers. The towers are covered with four-sided roofs made of chipped shingles. Both towers are combined with a thatch-covered corridor stretching over the gate. The original purpose of the construction was to strengthen a weak point in the fortifications – there was a stream flowing between the towers, i.e. through the gate. In Modrá, the gate serves as an entrance for visitors and provides a view of the countryside.

It is well known that wooden elements such as those used in the above-mentioned constructions are gradually damaged by weather conditions, therefore it is not possible to preserve them indefinitely. Some of the damages are caused by climatic changes throughout the year other by biological factors. Those adverse effects became visible in Modrá after four–six years. After two further years,

the scope of the damage was so extensive that the fortifications could not function properly any more. Consequently, in the first quarter of 2011, we were forced to dismantle the constructions. Apparently, the greatest error we have made was to embed the oak poles in soft concrete (Fig. 3) or a ditch filled subsequently with concrete or fixing the poles with stones (Fig. 4). When the stones were hard rocks, the wood was better preserved than when the stones were soft and absorbed more humidity. In general, we can conclude that wood fixed in impermeable concrete absorbed more water. Consequently, external layers (sapwood) of the oak poles – 20–25 cm – started to decay already during the first 4–6 years after the construction. The same process could be also observed just above the soil level. This, in turn, caused that decayed and narrower poles became shaky, less stable and pose a considerable threat to the visitors. We are aware that our findings are inconsistent with experiences gained in Slovakia. For example, according to O. Makýš, the lifespan of poles fixed with concrete was doubled when compared to poles embedded only in soil – about 20–30 years compared to only 10–15 years, respectively (Makýš 2014, 27). Furthermore, researchers from the University of Žilina found that





Fig. 6. Modrá. Charring lower parts of oak beams.

after 12–13 years, poles fixed in concrete on the peak of Havránok above Liptovská Mara still contained at least 70–80% of healthy matter (*Makýš 2018*, 128). It seems that the inconsistencies could be caused by different natural conditions and the type of wood used. While in Modrá we have used deciduous oaks, on Havránok the researchers used larch (*Larix decidua*) or, more generally, conifer trees (Fig. 5).

Another interesting finding from Modrá is that undried, debarked oak poles with fully charred sapwood – 20–25 cm diam. – that were embedded between large stones can be used for 15 years or even longer. When similar undried and uncharred or only slightly charred poles with sapwood were embedded between (or fixed with) stones, their lifespan shortened to only eight–ten years. Dried poles with similar characteristics were considerably damaged after only six years and required replacement in the next two years. We should also add that in many cases, the poles were subjected to adverse weather conditions. Generally, our data are consistent with other experimentally obtained data (*Makýš 2014*, 201; also, *Dresler 2011*, tab. 7). However, our view concerning the efficiency of charring as a wood preservation technique is inconsistent with previous findings. In the past, the technique has

been used so that ‘the charred layer together with the layer of resin on the surface protected the wood from decomposing’ – with the reservation that the technique is not very efficient (*Makýš 2014*, 34). In Modrá, we found that if the wood was charred only on the surface, the technique, indeed, was not very efficient in preserving it. Sapwood is often infected by wood-destroying insects or fungi. Therefore, we decided to experiment with charring the poles more intensely and remove also sapwood or burning it deep to heartwood (Fig. 6; 7). First, we light a fire on a flat surface of about 200 × 70 cm. The fire was maintained until we obtained a layer of red-hot charcoals. Subsequently, we placed tips of poles in layers (up to 3) on the charcoals and added fuel to maintain sufficient and constant heat around the poles (neither too high nor too low). The poles were charred 8–12 minutes on one side and then max. 10 minutes on the other side. Generally, the process did not exceed 20 minutes (see *Dragoun/Protiva/Zelenka 2014*, 25)<sup>2</sup>. It is worth mentioning here also another of our experience with charring. It concerns the question of water that drips down the poles and significantly reduces the poles lifespan. It is believed that wooden gutters can be a solution although they do not extend the wood lifespan (*Makýš*

<sup>2</sup> In the open-air museum in Villa Nova Uhřínov, however, the procedure was different: four planks were placed vertically in a ditch for 8 minutes with the fire burning in the centre.



Fig. 7. Modrá. Well charred lower parts of an oak pole.

2014, fig. 2: 1: 5). Preparing wood in Modrá, we used experiences of the old masters. During frosts, we took larch that rested one month on a slope, trunk up and branches down the slope. Then bark and branches were removed and grooves carved using chisels and axes (Fig. 8). At this point, however, we decided to modify the traditional process and use a gas burner. Burning a three-meter long groove took about one hour (100 cm/20 minutes). Using hooks and branches we have placed the gutter below the roof (Fig. 9), where it is functioning very well already for 5 years without any repairs. Based on all these, we can conclude that in Modrá, deep charring proved to be an efficient technique of preserving poles.

In 2011, all palisade walls, as well as the wooden-soil shell construction (Fig. 10; 11), were replaced. All concrete elements were removed because they proved to be useless. Instead, we dug ditches (60 cm deep) filled with a 10 cm thick layer of stones. Subsequently, we put deeply charred poles (250 cm high/20–25 cm diam.) on the stones and covered them with the next layer of stones. The construction of the front wall of the new shell fortification was similar. The only difference was that it consisted of a double row of poles. The solution allowed strengthening the wall in terms of statics and defensive characteristics. The poles used were 20–30 cm in diam. all. Half of the poles were 270 cm

high. The other half was higher – 350 cm. Consequently, in the upper part, the wall is ‘corrugated’: about 70 cm wide higher sections alternate similarly wide shorter sections, consisted of 7–9 poles each. All poles are pointed at the top. However, although sharpened shorter poles are not fully consistent with the contemporary military tactic (Unger 2008, 178), sharpening extends the poles lifespan. During the reconstruction, we have also repaired the rear wall of the shell fortification. Now, it consists of 5–10 cm thick poles placed horizontally one on top of another. On the outer side, the poles are supported by vertical, 100 cm high poles spaced about 60–80 cm apart. Along the inner sides of the walls, there is a layer of fine stones that facilitate water drainage. Additionally, the stones separate the wood from soil that fills the space between the front and rear wall of the fortification. The surface of the embankment remained untreated and is now overgrown with grass. The embankment is a natural feature that significantly prevents water erosion caused primarily by rains (Makýš 2018, 128). In 2012, this construction was used during the filming of battle scenes for the television movie ‘Cyril a Metoděj – apoštolové Slovanů’ (directed by P. Nikolaev). In 2016, it became a stage for a three-part docu-drama ‘Slyšte, Slované’ (directed by M. Petřík). It remains a part of the archaeological open-air museum even though numerous vertical poles of the rear wall and





Fig. 8. Modrá. Details of a charred wooden gutter.



Fig. 9. Modrá. A wooden gutter and its attachment to the lower part of the roof.





Fig. 10. Modrá. A palisade wall surrounding the archaeological open-air museum with well charred oak poles embedded in crushed stones.



Fig. 11. Modrá. The palisade back sides of the shell fortifications, reconstruction of the so-called Christin's wall.





Fig. 12. Modrá. The watchtower with stone foundations and wooden constructions made of red spruce.

some poles of the front wall show traces of activities of wood-damaging factors. Interestingly, the same type of shell construction – built in line with the original reconstruction design from Staré Město – is planned to be erected as part of the reconstruction of the Great Moravian manor in Ducvé-Kostolec near Piešťany in Western Slovakia (*Grznár/Gregorová 2018, 144–146*).

So far, the towers, as well as the entrance gate to the archaeological open-air museum in Modrá, have not required any repairs. The entire construction is still sufficiently stable. Rainwater, however, harms its lower parts. After dripping from the roof onto the surrounding mortar-stone floor, the rainwater sprays poles and the shell that soaks up to 60 cm over the ground. At the floor level, thus, sapwood had already decayed – only the heartwood remained. Finally, due to various chemical processes, the wood changed colour into grey and, thus, looks old (*Žák/Reinprecht 1998*). Nevertheless, after nearly twenty years, the towers are still stable and solid.

In 2011, another construction was built in Modrá: a 1,300 cm high, square, three-storey watchtower (Fig. 12). The tower rests on four massive corner poles (50 cm diam. in the lower part) and four further poles placed in-between. Generally, the tower

is supported by eight 1,100 cm high timber stakes made of larch. All poles are combined with iron belts. Additionally, the tower walls are strengthened with mortared stones between the poles on the ground floor. The construction is covered with a four-sided (hipped) roof made of spruce shingles. The cladding consists of four vertical half logs with openings for archers. The top floor lacks cladding and thus offers a nice view of the surrounding countryside. Such high and heavy constructions pose a great stability challenge to prevent the building from collapsing or sliding. At present, the tower is stabilised by massive iron pins fastened in the centre of each supporting pole and fixed in a concrete bed. Foundations of the poles are not put directly in the soil; thus, the negative effects of wood-damaging factors are limited. However, the disadvantage of this solution is that the spot requires ‘a cover’, for example, lined with stones. The tower stands on the highest spot in the archaeological open-air museum and serves primarily as a viewpoint.

#### HYPOTHETICAL RECONSTRUCTIONS OF FORTIFICATIONS AT THE ARCHAEOLOGICAL OPEN-AIR MUSEUM IN MODRÁ NEAR VELEHRAD IN 2020 AND 2021

The most distinctive fortification construction in Modrá is the rampart with stone front wall, wooden-soil construction and rear retaining wall. The fortification was built in 2020 and the first half of 2021 (Fig. 13; 14). It is a hypothetical reconstruction of fortifications discovered during research in Uherské Hradiště-Rybárny (*Galuška 2006; cf. Procházka 2009, 219–221*). The original construction was part of the outer fortification system of the Staré Město – Uherské Hradiště agglomeration (Veligrad) and was built at the end of the 9<sup>th</sup> c. in the final phase of the existence of the Great Moravian state (*Galuška 1998; 2017, 135–139*). The front dry-stone wall was 200 cm wide at the wall foot. The rampart – marked with a palisade stretching along the inner wall and the retaining wall at the rear of the fortification – was 630 cm wide with 700 cm retaining poles. The total width of the construction was, thus, 900 cm. In the space between those two walls, there were found remains of transverse beams aimed transversely towards the fortification. There were also traces of beams laid parallel to the fortification. Therefore, it seems likely that either 1) the fortification core consisted of wooden chambers filled with soil or 2) there were only transverse tie beams that linked the rear wall made of poles with the front wall or



Fig. 13. Modrá. The archaeological open-air museum and its new landmark – fortifications with a stone wall (photo by M. Kovářík).



Fig. 14. Modrá. The gate, defensive tower and fortifications with front stone wall, front view.



with the front stone wall or 3) the construction combined both of those solutions – i.e. chambers and transverse tie beams (*Procházka 1990, 293, 296*). The pits discovered on site had flat bottoms. The poles were put inside the pits and fixed with stones. In some cases, the stones were arranged in a form of a wreath around a beam. It has been also mentioned that inside the fortification – in one of the filled chambers – there were traces of a dwelling identified as a hidden guardhouse (*Marešová 1980, 241; Snášil 1981, 491*). However, the excavation documentation we reviewed contained no such information. Finally, let us add that the entire fortification was 370 m long and protected the entrance to the settlement agglomeration of Staré Město – Uherské Hradiště.

The fortification with the front stone wall and wooden-soil rampart built in Modrá near Velehrad is a hypothetical reconstruction. Its primary aim is to provide lay visitors – mainly children – with an impression of Great Moravian fortifications (professionals may be satisfied with digital visualisations: *Makýš 2018, 137, 138*). So, it is not an example of experimental archaeology. The fortification core, therefore, does not consist of wooden chambers or tie beams and the rear retaining wall is not 200 cm wide. On the contrary, the wall is only 70 cm wide and rests on a concrete base – due to current safety precautions the construction would not be approved otherwise. However, the construction was built without heavy machines – only by the hands of craftsmen, mainly stonemasons, masons and carpenters. The fortification dimensions are consistent with values measured during field research or extrapolated from the data – e.g. this applies to the construction height. Sandstone from the Bzova quarry in the White Carpathians proved to be a suitable stone material. A cubic meter of the material weighs about 2,651 kg. In total, we have used 16 m<sup>3</sup> of crushed sandstone, i.e. 33.5 tons. Stones were dry-laid, wedged and fitted only on the outer side (see e.g. *Dresler 2011, 107, fig. 132–140*). Larger, massive stones were used mainly in lower parts of the construction. In the upper parts, there are rather smaller, flat, slate-like stones arranged in irregular rows. As already mentioned, the inner wall rests on concrete. At the top, the wall is 30–40 cm wide. The maximum height – at the point where the wall connects to the tower (see below) – is 400 cm. Down the slope, where the wall links with the oak palisade, it lowers to 270 cm. The raw material used for the construction was undried, debarked oak. Oak poles and split logs were used in three structures of the construction. First, the material was used for the construction of a palisade wall that stretches towards the rear



Fig. 15. Modrá. A red spruce pole from the well, embedded in gravel pebbles.

side of the front stone wall. The wall consists of eighty poles (250–270 cm high) and about an equal number of smaller poles (150 cm high) – all about 10–25 cm in diam. Lower parts of the poles were deeply charred and dug – up to 50–60 cm – into stone grit (Fig. 15). Higher poles reach 190–200 cm over the walking level – i.e. above the gallery – and have pointed tips. Poles, tightly grouped by four or five, form 70–90 cm long wall sections. Those higher sections are linked with about 50–70 cm long lower sections consisted of poles reaching the height of 90 cm, i.e. just above the top of the front stone wall. Tips of lower poles are cut flat and slightly inclined to the inside (see *Makýš 2014, 23, 24*). Higher pole sections provide sufficient cover for at least one warrior in case the fortification is attacked by archers or javelin throwers. Gaps in the wall where lower poles are grouped provide sufficient space for defence, e.g. direct repelling attacks with hand weapons and archery (e.g. *Unger 2007, 180; Vignatiiová 1971*). According to J. Unger, however, higher poles should be grouped in 120 cm long sections that would provide cover for two warriors, while the lower sections for defenders should be 60 cm wide and reach 90 cm above the gallery (*Makýš 2014, 22–24; Šalkovský 2006, 251;*



Fig. 16. Modrá. The stepped body of the wooden-soil construction of the fortifications and the defensive tower, back view.

Unger 2007, fig. 10). Our construction of the front wooden wall of the fortifications is very similar to the proposal by J. Unger. The only difference is the length of sections consisted of higher poles. Second, wooden elements were used for the construction of the rear wall of the rampart chambers. The wall stretches parallel to the front palisade wall about 330–350 cm apart. The wall is 80–120 cm high and consists of vertical poles tightly arranged in a line. After about 300 cm, the wall turns into a set of pole tips placed one above another oriented towards the fortification interior. The combination of vertical poles and pole tips is repeated four times along the fortification line. Consequently, the fortification looks as if consisted of chambers. Third, the 60–100 cm high rear wooden wall of the fortification is also built of those elements. Again, the wall consists of a tight row of poles with sharpened tips. The lower ends of the poles are deeply charred and fixed in stone grit. Along the upper edge, there is a horizontal line of half logs fixed with transverse poles, spaced about 90–120 cm apart. The description indicates that the fortification core has two levels. The first level consists of an about 350 cm wide gallery (footpath). The gallery is just behind the front stone wall and the palisade and is paved with larger, flat stones. The large paved area allows the potential defenders to run smoothly and safely during a battle. Similar

paved footpaths on early medieval hillforts are only rarely preserved. When the fortifications were destroyed, most construction elements slipped to front moats or the ramparts back. Such stones can be found only if no one had removed and reused them in other constructions. However, in Bojná the situation was different – in the western part, ‘the rampart was densely paved with large stones, nearly certainly remains of a gallery’ (Pieta 2017, 20, fig. 7). This finding unambiguously documented that galleries – or footpaths – of fortifications were paved (see Bialeková 1978, 166; Dostál 1979, 75; Procházka 2009, 263; Unger 2008, 180, 181). In Modrá, the paving on the gallery is slightly sloped and thus improves water drainage protecting the soil embankment from eroding. The second level of the fortification is separated by the rear wall of wooden chambers and is placed about 80–120 cm lower. One can easily imagine that warriors waiting to replace their fallen fellows – partially covered by the wall of the chamber – were kneeling here while waiting. Only a few steps up a short ladder and they were on the gallery. Moreover, visitors of the open-air museum, including those with motor impairment – can reach the gallery from its northern, lowest end.

The defensive tower (Fig. 16) – to the right of the gate – links with the southern end of the fortifications. The tower is not a reconstruction of any





Fig. 17. Modrá. Details of the lower part of a red spruce pole from the gate construction on a lead pad.

known archaeological feature but provides access to the open-air museum for heavy equipment such as fire engines (similarly as large internal dimensions of the gate itself, the author's comment). The tower rests on square foundations – each side 300 cm long – marked with eight, 700 cm high larch poles (30–35 cm in diam.). On the side and front, the space between the poles – up to 450 cm – is filled with an identical wall as in the case of the fortifications. On the back, there is an entrance to the tower ground floor. The tower gallery is on the same level as the fortifications footpath (gallery). Both galleries are connected and allow access from one structure to another. The upper part of the tower is covered with half logs with openings for archers. The hipped roof of the tower rests on the upper tips of the poles and is made of spruce shingles. The total height of the construction is 850 cm. By the outer corner pole, there is another massive pole supporting the right wing of the gate. On the other side of the gate, there are three further massive larch poles bonded with iron belts into one block. The block supports the left wing of the gate. In the future, the block will serve for the construction of another fortification connecting the gate with the entrance of heavy equipment

through the northern tower of the main museum entrance. The main supporting poles of the tower and the gate are fixed with iron pins to the concrete foundations – similarly as in the case of the watchtower. However, we have introduced some improvements. Between wood and concrete, iron pins are coated with a lead insert – about 2 cm thick and 8–12 cm in diam. (Fig. 17). It turns out that lead (as well as copper and zinc) is very efficient in preserving wood against fungi and wood damaging insects. Twenty-one years ago, the method was used to preserve the foundations of a wooden cross at a hypothetical reconstruction of the early medieval St. John's church in Modrá. To this day, the cross stands on the spot unaffected by weather or wood damaging factors. It is worth mentioning that the total length of the fortifications and the tower is 17 m. Together with the gate, the construction is 20 m long. So far, no similar reconstruction endeavour with fortifications including a front stone wall has ever been undertaken in any other archaeological open-air museum.

To some extent, the constructions from Modrá near Velehrad can be compared with recent reconstructions on site of the upland Bojná-Valy hillfort (Fig. 18) in Western Slovakia (*Pieta* 2007; 2012; 2017; *Pieta/Ruttikay* 2018, 15–21). The reconstruction, in the true sense of the word, answers to the issue of protection and presentation of those fortifications that were negatively affected by human activities in the past and are now a subject of archaeological research. This applies mainly to the entrances-gates which, for decades, served as passages for heavy equipment of lumberjacks and places where the ramparts have been intersected to investigate their internal structure. The main assumption of the reconstructions on site of the trenches is to apply the knowledge gained during research to restore wooden and stone construction elements in a position consistent with that in the core of the original fortifications. Consequently, the reconstructions cannot be considered hypothetical (*Pieta* 2017, 20–27). The current condition of wooden elements protruding from the front and rear parts of those reconstructions indicates traces of activities of wood damaging factors and weathering. The situation seems better where wood directly touches stones, whether the stones are hardcore or stone walls. Interestingly, the reconstruction uses also wattle fences on vertical poles or woven walls supported by pillars. When it comes to strength and statics, however, such elements are not considered very durable (*Procházka* 2009, 255). The Bojná I hillfort is visually dominated by the eastern gate reconstruction built in 2018 on-site of the original entrance. Its appearance is based



Fig. 18. Bojná. The reconstructed eastern gate, back view.

on the results of archaeological research and an architectural project by a team of professionals (Makýš 2018). The construction was carried by the village of Bojná and supported by the Ministry of Culture SR with the supervision of professional committees. It is a large rectangular construction with a two-storey tower over the gate. The facade is covered with half log siding with openings for archers. The hipped roof is covered with boards. The tower rests on two square log constructions made of horizontal poles and strengthened with additional poles in the upper part. Between those two constructions, there is an entrance to the hillfort. At both sides of the log construction, there are partially reconstructed fortifications with front foundations made of stones and a palisade wall on the top. The footpath on both sides allows access to the tower. Generally, the reconstruction is impressive, perhaps somehow oversized, particularly when it comes to the tower dimensions. Certainly, it will be reasonable to observe how the known negative factors will affect the reconstruction in the future since already after two years from its construction (2020), the woven wall on the right side of the gate broke. This, however, does not challenge the fact that the Bojná I hillfort – not only due to remarkable finds but also its three-dimensional reconstructions – deservedly attracts both professional as well as lay interest.

## CONCLUDING REMARKS

One of the main factors that cause wood degradation is aggressive and extremely resistant fungi *Serpula lacrymans* (Slovak *drevokaz slzivý*; Czech *dřevomorka domácí*). In early medieval graves deeper than 90 cm, the fungi are believed to change wooden structures – including coffins and cladding of burial pits – into brown-grey or even black dust (e.g. Mazuch et al. 2017, 27–31; Staššíková-Štukovská 1993). Other authors, however, speculate that *Serpula lacrymans* is not local and was only imported to our region in the 19<sup>th</sup> c. According to this hypothesis, the fungi comes from Southeast Asia and was brought to Europe on wooden vessels about 130 years ago. Once in Europe, the fungi invaded primarily ‘dead’ wood of already processed coniferous trees (Makýš 2014, 28, 30). The question, thus, is: could the fungi be responsible for the so-called red decay of wooden fortifications and graves already in the Middle Ages? An answer could affect our views on the lifespan of the fortifications protecting Great Moravian strongholds.

Currently, due to wood damaging factors and weathering, the lifespan of poles in palisades and single walls of light shell fortifications does not exceed 10–12 years (Fig. 19). This, however, is inconsistent with conclusions of B. Dostál, who estimated





Fig. 19. Modrá. The archaeological open-air museum, view from the south.

the lifespan of palisades of the Great Moravian manor in Pohansko near Břeclav at 'a quarter, no more than half a century' (Dostál 1975, 36) – i.e. more than two to four times longer. Almost certainly, however, that was not the case.

The impregnation of lower parts of poles with charring is believed to be the only method of extending the lifespan of wooden fortifications available in the early Middle Ages. However, it is commonly believed that the archaeological material provides little arguments for corroborating the hypothesis that the method was used (Dresler 2011, 133). It is certainly true in the case of poles placed in palisades which mostly completely decayed or preserved only in a form of dusty residues. In the case of constructions found deep inside ramparts, though, wooden elements can be found occasionally. Such elements look as 'faded, hardly legible smudges', 'charred' or 'burnt wood', the condition is usually associated with a fire that destroyed the fortification or at least its fragments (Dresler 2011, 102–106). Could, thus, the 'charred or burnt wood' be evidence of the wood being preserved with deep charring rather than of the fortifications being burnt? Especially, when the charred or even burnt sapwood only cracked and formed a tight net around the hardwood core. After all, according to some studies, the lifespan of raw wooden constructions buried in the fortifica-

tion core was very short – only 8–15 years. After 3–5–8 years, wooden chambers inside fortifications would rotten and ceased to be functional. It seems, thus, that their only function would be to secure freshly heaped soil from sliding (Makýš 2014, 20; cf. Procházka 2009, 274, 275). Charring, however, would extend their lifespan.

If the Great Moravian fortified manors, strongholds and hillforts existed for at least 50 years, as it is believed in many cases, the palisades and front walls made of poles had to be repeatedly repaired and even replaced. If only some poles were damaged, they could be replaced whenever it was needed (pole by pole) and thus current archaeological research would be unable to detect the changes. If, however, a larger section of the fortifications was damaged, extensive repairs could leave noticeable or identifiable traces in the soil. This could be confirmed by the palisade gutter on the NE side of the manor in Pohansko near Břeclav. A 15 m long section of the palisade foundations widened up to 90 cm, particularly in places where 'lobular protrusions' were found (Dostál 1975, 30). The protrusions were nearly certainly traces of newly embedded or replaced poles. Those findings seem to corroborate the hypothesis that the manor existed for over fifty years, had two constructional phases and was repeatedly repaired.

There is a controversy concerning 4 m high wooden retaining walls – known from fortifications with a front stone wall – consisted of horizontal poles placed one on top of another held in certain intervals by vertical poles and, sometimes, strengthened by transverse beams. We can see such a wall in the reconstruction of unpreserved aboveground fragments of some fortifications, for example in Mikulčice and Pohansko near Břeclav (Unger 2007). The wood of such walls must have suffered severe damages due to weather conditions, mainly during rainfalls. Water could not drip off the horizontal poles and reduced the wood lifespan while remaining on them. Additionally, soil filling the fortifications was exerting pressure on the poles and wood damaging factors operated where the wood touched soil (modern reconstructions use dimple boards inserted between wood and soil to prevent this, e.g. in Bojná and Modrá near Velehrad). The destructive impacts were even stronger in the case of vertical retaining poles. If a wall was 400 cm high, the poles had to be dug up to at least 100 cm into soil, so the poles were at least 500 cm long. We assume that it was very difficult to replace such long poles when they were heavily damaged, particularly in lower parts. At the same time, damages to the rear wall could have fatal consequences for the entire construction. Is, thus, the idea that the entire fortification had a uniform height correct? Of course, archaeological contexts associated with the foundations of the fortification seem to confirm this assumption. But is the ‘as below, so above’ hypothesis the only possible one? Numerous reconstructions of wider fortifications indicate that the core height could change in two or three steps (e.g. Staré Město, Uherské Hradiště-Rybárny, Levý Hradec, Fyrkat: see Procházka 2009). Some researchers consider this hypothesis as disputable because the different height would make it more difficult for the defenders to move along the fortifications (Unger 2007, 179). In our view, if a fortification gallery was sufficiently wide – 200 and 330 cm as in Uherské Hradiště-Rybárny and Staré Město – moving around would be smooth enough. On the other hand, a stepped profile divided the pressure on the rear side of the fortifications into two or three lower wooden walls. Consequently, the pressure

would be lower than on one high wall. Also, as we have already indicated, walls protecting each step could provide additional protection for ‘substitutes’ against arrows fired from the aggressors’ bows. The main argument, however, in favour of this solution is that shorter poles of such walls would be replaced easier and faster than massive poles of single-level walls. This finding should not be overlooked in any considerations concerning the lifespan and durability of fortifications protecting early medieval hillforts.

Recently, more researchers conclude that fortifications of the Great Moravian or early medieval hillforts that contained stone front walls and foundations started to appear after the mid-9<sup>th</sup> c. or even in the last two decades of the 9<sup>th</sup> c. (Dresler *et al.* 2010, 123, 124, 136; Galuška 2017, 135–147; Henning *et al.* 2017; Lutovský 2009, 7, 8; Mazuch 2013; Poláček 2016, 8, 70). This late dating raises numerous questions often related to the interpretation of well-known written sources concerning fortified sites. For example, how should we interpret the information about ‘massive fortifications’ behind which the Moravian prince Rostislav covered in 855 that inclined Louis II, king of the East Franks to ‘leave him temporarily in peace’? How did the ‘unspeakable and unlike any old fortifications’ Rostislav’s fortress – which the Franks and the Alemanni did not manage to conquer in 869 but at least ‘destroyed all fortifications in the area by fire’ – actually look like (MMFH 1966, 93, 103)? Currently, it seems unlikely that some of the Moravian power centres such as Mikulčice, Staré Město – Uherské Hradiště or Nitra had solid fortifications with stone walls already at that time. Archaeological research relatively well confirms only the presence of wooden and soil constructions (Galuška 2017, 143, 144). Such fortifications, however, should not pose an insurmountable obstacle for the best warriors of that time even if protected by elite Rostislav’s troops. Did the authors of the *Annales Fuldenses* overestimate the fortifications deliberately to justify the defeat in Moravia or were at least some of the Moravian hillforts protected by stone fortifications already in 869? Both alternatives seem likely. Hopefully, the controversy will be solved by future analyses and archaeological research.



## BIBLIOGRAPHY

- Bialeková 1978 – D. Bialeková: Výskum a rekonštrukcia fortifikácie na slovanskom hradisku v Pobedime. *Slovenská archeológia* 26, 1978, 149–172.
- Dostál 1975 – B. Dostál: *Břeclav-Pohansko IV. Velkomoravský velmožský dvorec*. Spisy University J. E. Purkyně v Brně. Filosofická fakulta 208. Brno 1975.
- Dostál 1979 – B. Dostál: K opevnění Břeclavi-Pohanska. *Sborník prací Filozofické fakulty brněnské univerzity. Řada archeologicko-klasická* E24, 1979, 73–93.
- Dragoun/Protiva/Zelenka 2014 – B. Dragoun/O. Protiva/T. Zelenka: Oprava domu z Mariánské louky v Archeologickém muzeu v přírodě Villa Nova Uhřínov. In: T. Zelenka (sest.): *Rekonstrukce a prezentace archeologických objektů 3*. Uhřínov 2014, 22–26.
- Dresler 2011 – P. Dresler: *Opevnění Pohanska u Břeclavi*. *Dissertationes archaeologicae Brunenses* 11. Brno 2011.
- Dresler et al. 2010 – P. Dresler/B. Humlová/J. Macháček/M. Rybníček/J. Škojec/J. Vrbová-Dvorská: Dendrochronologické datování raně středověké aglomerace na Pohansku u Břeclavi. In: Š. Ungermaň/R. Přichystalová (uspoř.): *Zaměřeno na středověk. Zdeňkovi Měřínskému k 60. narozeninám*. Brno 2010, 112–138.
- Galuška 1997 – L. Galuška: K problematice předvelkomoravského opevnění Starého Města. In: P. Michna/R. Nekuda/J. Unger (uspoř.): *Z pravěku do středověku. Sborník k 70. narozeninám doc. PhDr. Vladimíra Nekudy, DrSc.* Brno 1997, 73–83.
- Galuška 1998 – L. Galuška: Die großmährische Siedlungsagglomeration Staré Město – Uherské Hradiště und ihre Befestigungen. In: *Henning/Ruttkay* 1998, 341–348.
- Galuška 2005 – L. Galuška: Archeologický skanzen v Modré u Velehradu – velkomoravské opevněné sídliště středního Pomoraví. *Archaeologia historica* 30, 2005, 9–22.
- Galuška 2006 – L. Galuška: Velkomoravská hradba v Uherském Hradišti-Rybárnách. *Archeologické rozhledy* 58, 2006, 486–510.
- Galuška 2017 – L. Galuška: *Slované – stopy předků. O Moravě v 6.–10. století*. Brno 2017.
- Grznár/Gregorová 2018 – P. Grznár/J. Gregorová: Návrh prezentácie veľmožského dvorca Kostolec-Ducové. (Prezentácia včasnostredovekej fortifikácie.) *Monumentorum tutela. Ochrana pamiatok* 29, 2018, 139–150.
- Henning/Ruttkay 1998 – J. Henning/A. T. Ruttkay (Hrsg.): *Frühmittelalterlicher Burgenbau in Mittel- und Osteuropa. Tagung, Nitra vom 7. bis 10. Oktober 1996*. Bonn 1998.
- Henning et al. 2017 – J. Henning/M. Ruttkay/K. Pieta/K.-U. Heussner: Bojná a datovanie hradísk Nitrianskeho kniežatstva. Prínos prírodovedných metód k archeologickému výskumu. In: K. Pieta/Z. Robak (eds.): *Bojná 2. Nové výsledky výskumov včasnostredovekých hradísk*. *Archaeologica Slovaca Monographiae. Fontes* 22. Nitra 2017, 335–345.
- Hrubý 1965 – V. Hrubý: *Staré Město. Velkomoravský Velehrad*. Praha 1965.
- Hulínek 2008 – D. Hulínek: Funkčné členenie veľkomoravských opevněných sídlisk na základe ich spoločenského významu a kontinuita ich pretrvávania v 10. storočí (Morava a západné a stredné Slovensko). In: T. Štefanovičová/D. Hulínek (zost.): *Bitka pri Bratislave v roku 907 a jej význam pre vývoj stredného Podunajska*. Bratislava 2008, 195–252.
- Jenčík/Struhár 2015 – P. Jenčík/V. Struhár (zost.): *Hradiská – svedkovia dávnych čias. Zborník odborných príspevkov o hradiskách a ich obyvateľoch*. Dolná Mariková 2015.
- Kouřil/Procházka et al. 2018 – P. Kouřil/R. Procházka et al.: *Moravian and Silesian Strongholds of the Tenth and Eleventh Centuries in the Context of Central Europe*. Spisy Archeologického ústavu AV ČR Brno 57. Brno 2018.
- Lutovský 2006 – M. Lutovský: Od palisády ke zdi: Raně středověká hradiště v Čechách ve světle archeologického bádání posledních dvou desetiletí. *Archaeologia historica* 31, 2006, 21–44.
- Lutovský 2009 – M. Lutovský: Doba hradištní bez hradišť? Úvaha nad strukturou, chronologií a terminologií raně středověkých fortifikací v Čechách. In: P. Dresler/Z. Měřínský (eds.): *Archeologie doby hradištní v České a Slovenské republice. Sborník příspěvků přednesených na pracovním setkání Archeologie doby hradištní ve dnech 24.–26. 4. 2006*. *Archaeologia mediaevalis Moravia et Silesiana. Supplementum* 2. Brno 2009, 5–9.
- Makýš 2003 – O. Makýš: Realizácia experimentálnych rekonštrukcií stavieb – poznámky. *Živá archeologie. (Re)konstrukce a experiment v archeologii* 4, 2003, 201–210.
- Makýš 2014 – O. Makýš: *Včasnohistorické a rannostredoveké drevené a drevozemné pamiatky. Hypotetické rekonštrukcie a konzervácia*. Bratislava 2014.
- Makýš 2018 – O. Makýš: Návrh makety brány a opevnenia rannostredovekého slovanského hradiska Bojná. *Monumentorum tutela. Ochrana pamiatok* 29, 2018, 127–138.
- Malina 1980 – J. Malina: *Metody experimentu v archeologii*. Studie Archeologického ústavu ČSAV v Brně 8. Praha 1980.
- Marešová 1980 – K. Marešová: Archeologický výzkum velkomoravského Starého Města v r. 1979. *Časopis Moravského muzea. Vědy společenské* 45, 1980, 240–242.
- Mazuch 2013 – M. Mazuch: Předběžné výsledky záchraného výzkumu SZ úseku opevnění akropole raně středověkého mocenského centra Mikulčice-Valy. *Přehled výzkumů* 54/2, 2013, 25–44.
- Mazuch 2014 – M. Mazuch: Findings about the early medieval fortification of the Mikulčice-Valy acropolis. *Slavia Antiqua* 55, 2014, 7–66.
- Mazuch et al. 2017 – M. Mazuch/M. Hladík/R. Skopal: *Úpravy hrobových jam a dřevěné konstrukce v hrobech na pohřebištích Velké Moravy (sociální, duchovní a chronologický fenomén)*. Spisy Archeologického ústavu AV ČR Brno 56. Brno 2017.
- MMFH 1966 – *Magnae Moraviae Fontes Historici. Annales et Chronicae*. Brno 1966.
- Pieta 2007 – K. Pieta: *Bojná. Nové nálezy k počiatkom slovenských dejín*. Bojná 2007.
- Pieta 2012 – K. Pieta: Tri hradiská. Bojná. In: D. Kollár (zost.): *Veľkomoravské hradiská. Kultúrne krásy Slovenska*. Bratislava 2012, 16–21.
- Pieta 2017 – K. Pieta: Včasnostredoveké mocenské centrum Bojná – výskumy v rokoch 2007–2013. In: K. Pieta/Z. Robak (eds.): *Bojná 2. Nové výsledky výskumov včasnostredovekých hradísk*. *Archaeologica Slovaca Monographiae. Fontes* 22. Nitra 2017, 11–45.
- Pieta/Ruttkay 2018 – K. Pieta/M. Ruttkay: *Centrá Veľkej Moravy a ich prezentácia*. Nitra a Bojná. *Monumentorum tutela. Ochrana pamiatok* 29, 2018, 15–34.

- Poláček 2016 – L. Poláček: *Hradiště Mikulčice-Valy a Velká Morava. Mikulčice-průvodce. Svazek II*. Brno 2016.
- Popelka 2000 – M. Popelka: Několik poznámek k experimentální archeologii. *Živá archeologie. (Re)konstrukce a experiment v archeologii* 1, 2000, 207–211.
- Poulik 1988 – J. Poulik: K otázce vzniku předvelkomoravských hradišť. *Slovenská archeológia* 36, 1988, 189–216.
- Procházka 1990 – R. Procházka: Charakteristika opevňovacích konstrukcí předvelkomoravských a velkomoravských hradišť na Moravě. In: V. Nekuda/J. Unger/M. Čižmář (uspoř.): *Pravěké a slovanské osídlení Moravy. Sborník příspěvků k osmdesátým narozeninám akademika Josefa Poulika*. Brno 1990, 288–306.
- Procházka 2009 – R. Procházka: *Vývoj opevňovací techniky na Moravě a v českém Slezsku v raném středověku*. Spisy Archeologického ústavu AV ČR Brno 38. Brno 2009.
- Šalkovský 2006 – P. Šalkovský: Výskum a rekonštrukcia fortifikácie západného areálu včasnostredovekého hradiska v Spišských Tomašovciach. *Slovenská archeológia* 54, 2006, 239–257.
- Šalkovský 2015 – P. Šalkovský: *Hrady dávných Slovanov*. Archaeologica Slovaca Monographiae. Fontes 19. Nitra 2015.
- Snášil 1981 – R. Snášil: Nové archeologické výzkumy. In: M. Zemek/A. Verbík a kolektiv: *Uherské Hradiště. Dějiny města*. Brno 1981, 488–498.
- Staššíková-Štukovská 1993 – D. Staššíková-Štukovská: Neue Erkenntnisse zur Dekomposition menschlicher Skelette am Beispiel des frühmittelalterlichen Gräberfeldes von Borovce, Slowakei. *Praehistorische Zeitschrift* 68, 1993, 242–263.
- Unger 2008 – J. Unger: Problematika hájitelnosti předvelkomoravských a velkomoravských hradeb. In: T. Štefanovičová/D. Hulínek (zost.): *Bitka pri Bratislave v roku 907 a jej význam pre vývoj stredného Podunajska*. Bratislava 2008, 177–182.
- Vignatiová 1971 – J. Vignatiová: K otázkám obrany a údržby velkomoravských valů. *Sborník prací Filozofické fakulty brněnské univerzity. Řada archeologicko-klasická* E16, 1971, 199–204.
- Žák/Reinprecht 1998 – J. Žák/L. Reinprecht: *Ochrana dřeva ve stavbě*. Praha 1998.

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