



Radosław Biel*

The functional analysis of the 15th century fortification of the Grodno Castle

Introduction

Relics of a previously unknown stone structure discovered on the zwinger of the Grodno Castle, located in Zagórze Śląskie (Wałbrzych district), were discovered for the first time in 2017. The archaeological research conducted in 2017 was aimed at establishing the chronology and structure of the earthen embankment located on the castle's zwinger¹. The article aims to describe discovered relics and their potential function, as well as to present the results of the functional analysis of the application of such a solution in the Grodno Castle.

The discovered relics of the stone structure were subjected to photographic and drawing documentation and the photogrammetric Structure-from-Motion method were used to create 3D model. In this way, a documentation for the purposes of further analyses was obtained. The research reports are in the Archives of the Regional Office for Monuments Protection in Wałbrzych [1]–[3]. Further analysis aimed at interpreting the discovery was carried out on the basis of the methods traditionally used in humanistic descriptive studies of architectural theory according to the classification proposed by Elżbieta Niezabitowska [4]. Studies of written and iconographic sources were undertaken, the literature of the subject was familiarized and comparative analyses were carried out. The assumptions and results of analogous experiments published as part of works on the theory of military and defence were

used² to create a simplified model of the hypothetical effectiveness of the supposed parkan (outer defensive wall with wooden construction) from the Grodno Castle.

Characteristics of the discovery

The relics of the structure were found in the north-eastern part of trench No. 6 (Fig. 1). Its coping was located at a depth of about 2 m from the first offset of the upper castle's walls captured in the same research trench [2]. Later in the work, this fragment of the wall is referred to as the northern section. It crossed the trench transversely along the south-west and north-east axis, running parallel to the wall of the upper *castle*, approximately 6.5 m from it. At that time, due to the discovery of the *papal bull of Avignon obedience* Pope Benedict XIII (made in the course of the same research), initially little attention was paid to the discovered *stone construction*. Only as a result of architectural consultations conducted by Małgorzata Chorowska, more attention was paid to the exposed *structure relics*.

In order to capture the further layout of the object, discovered in 2017 at a length of only 2 m, another survey trench was established to the south of it in 2018 [3]. It was marked out at a slight angle in the relation to the previous one, so that its northern border was approximately 2 to 0.69 m away. The initial, too ambitious research area in trench No. 7 was quickly reduced during the works, as a result of which the southern section of the structure was finally fully exposed at a length of 1.2 m. At this point, it turned at an angle of about 25° to the south, thus no longer

* ORCID: 0000-0002-1505-1279. Institute of Environmental Biology, Wrocław University of Environmental and Life Sciences, e-mail: radoslaw.biel@upwr.edu.pl

¹ Due to the content of other articles contained in this issue of "Architectus", the historical outline of the Grodno Castle and a detailed description of the course of these studies and analyses of the artefacts will be omitted.

² The author of this text, an archaeologist and architectural historian by profession, some details of the technical aspects of the functioning of firearms consulted with Łukasz Andrasiak, a second lieutenant in the Polish Army.



Fig. 1. Research trenches, along with the planar orthomosaic of the discovered relics of structure in trenches No. 6 and 7 and its hypothetical course in the section between them (elaborated by R. Biel)

II. 1. Lokalizacja sondażu badawczych wraz z ortofotomapą reliktyw konstrukcji odkrytych w sondażach 6 i 7 i jej hipotetycznym przebiegiem na odcinku pomiędzy nimi (oprac. R. Biel)



Fig. 2. Horizontal plan of the trench No. 7 with the orthomosaic of the southern section of the so called parkan (elaborated by R. Biel)

II. 2. Plan poziomy sondażu 7 z ortofotomapą południowego odcinka parkanu (oprac. R. Biel)

running parallel to the wall of the upper ward, but rather slightly heading towards it (Fig. 1).

Both the northern and the southern sections of the structure were made of medium-sized flat stones, 0.2 to 0.4 m wide. Only one larger-size erratic boulder, which was part of the northern section, was observed. The stones were placed in a careless manner and connected with mostly etched clay mortar of dark orange colour. The southern section consisted of approximately 4 rows of stones and its average width was approximately 1 m, and the northern section – 3 rows, ranging from 0.6 to 0.9 m wide. Additionally, on the eastern side of the southern section, i.e., inside the fortifications, additional numerous stones were discovered, the arrangement of which seemed chaotic. They were in no way bound to the actual wall and were interpreted as destroyed (Fig. 2).

In the northern section, the number of stones at the foot of the structure was much smaller. It is possible, however, that this is the result of mistakes made during the exploration and removal of some of them³. In the stratigraphic

system, no object contacts that could be associated with a possible foundation trench were observed. The stones were placed directly on the natural rock wear layer without being buried (JS 7008 and 6008) (Fig. 3). In the case of the tested sections, no remains, or even negatives, of any wooden elements were found.

The entire structure was covered with a layer of black clay humus with numerous burns, brick fragments, slopes, charcoal and a large amount of artefacts (Fig. 3)⁴. As in most archaeological sites, the stratigraphic units (JS 7005 and JS 6004) were interpreted as remnants of war damage [3]. Based on the dating of finds within these layers, the moment of destruction was widely established for the 15th century. The connection of the hypothetical moment of the structure destruction with the Hussite siege seems obvious, especially taking into account the discovered military equipment. In this particular case, they could be related to the Hussite raid in 1429 described in the work of Robert Weber [5], but unfortunately, he does not provide the source of this information.

³ Before the nature of the structure was recognized, its material had been partially displaced during the excavation work.

⁴ A detailed analysis of the archaeological finds is presented in this issue of "Architectus" in the article describing the results of archaeological research conducted in years 2017–2019.

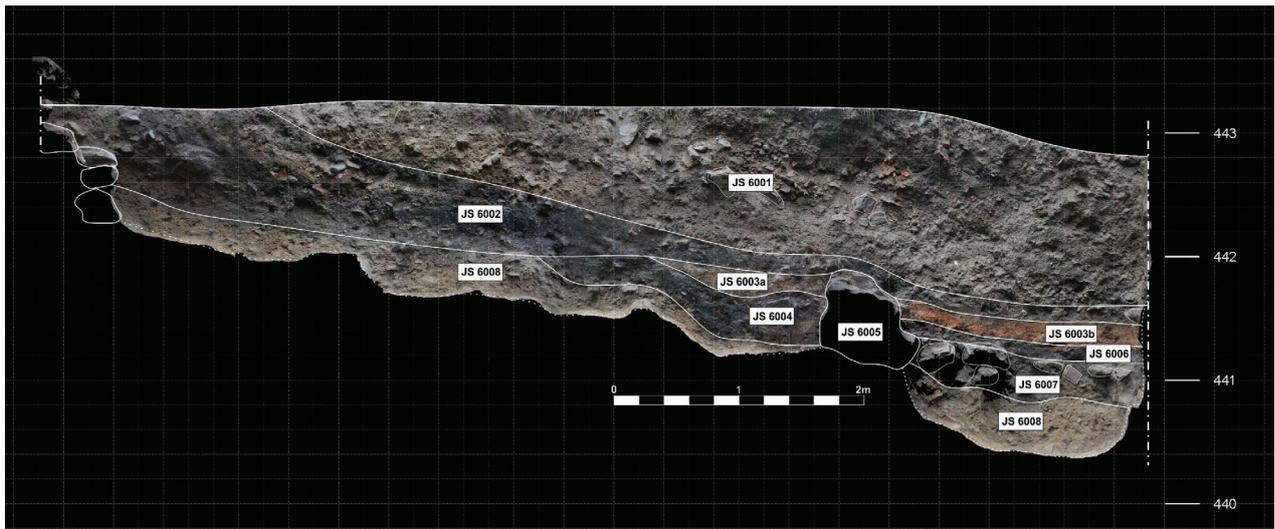


Fig. 3. Stratigraphy with the orthomosaic of the southwestern section of the trench No. 6 (elaborated by R. Biel)

Il. 3. Stratygrafia wraz z ortofotomapą południowo-wschodniego profilu sondażu 6 (oprac. R. Biel)

Assuming that the exposed wall was only the foundation for a larger stone and wooden structure, and taking into account its location and the proposed dating, it is possible that, as a result of the carried out excavations, the remains of the oldest, so far unknown to the science line of the fortifications of a specific form, were discovered, which in the literature are referred to as so called parkans [6]–[8]. Their genesis is closely related to the transition period between medieval and modern siege techniques.

Parkans in castellology

The dynamics of development and changes caused by the introduction of firearms resulted in hastily implemented modernizations, which did not always lead to the formation of completed forms [8]. In Silesia and Bohemia, this development is visible primarily during the Hussite Wars, during which traditional medieval fortifications were not able to withstand attacks with small arms and cannons. To prevent direct access and the possibility of easy firing shots towards the main walls of the castle, the construction of clay embankments, sometimes with stone facing, or stone foundations with wooden structures erected onto them [7], [9]–[11]. In this way, the zwinger space (between outer and inner castle's defensive walls) was obtained, limited, on the one hand, by internal walls, and on the other, by a bulwark. This solution not only made it difficult to break through the perimeter of the fortifications, but also allowed for the placement of two rows of shooters. What is more, it ensured smooth movement for the defenders [7]. The structures created in this way, in the literature referred to as parkans, constitute a specific evolution of the previously used fences or palisades. Various forms of wood were used for their construction – poles, logs or planks, and placing them on foundations prolonged their durability. The fact that the stone foundations were not bonded with mortar made them tougher in absorbing the power of shots fired in their direction [12].

At the same time, fences should be distinguished from wooden, earth and stone fortifications registered on older transitional type castles, known both from Polish territories (e.g. Pieszyce-Rościszów, Bukówka, Rościszów, Wałbrzych – Stary Książ) [10], [13], [14] and Czechia (Angerbach u Kožlan, Hlavačov u Rakovníka, Tachov, Týnec nad Sázavou) [15]. One important issue, which is the problematic nature of the used term “parkan”, should be mentioned here. In Polish and Czech scientific literature, the use of this word can be understood in two ways. Some researchers, when using it, mean zwinger [6], [7], [16], [17], and others mean palisades, fences or walls [8], [13], [14], [18]–[20]. As the purpose of the article is not to solve the problem of terminological correctness, it was concluded that the “parkan” was the fortifications forming the outer line of defence.

If, as a result of later transformations, the first examples of modernization of medieval fortification systems had been destroyed, researchers very rarely had the opportunity to register them in the field [11], [21]. Most of the archaeologically researched remains of this type, related to the Hussite wars, are known from the territory of Czechia (Most, Starý Žeberk, Nový Žeberk, Albrechtice, Oheb, Lipnice, Orlik near Humpolec, Křivoklát, Švihov, Košťálov [9], [12], [13], [18], [19])⁵. The main difficulty in reconstructing the potential appearance of fences erected with different materials was the fact that stone was mainly used to build foundations. Therefore, their wooden superstructures remain mostly a mystery to researchers (Fig. 4). However, the later iconographic representations (Fig. 5), such as those included in the manuscript *Codex Palatinus germanicus* [22], provide some clue. They show both simple palisade structures and wooden superstructures with numerous arrow slits, with

⁵ Some of the mentioned objects are described in this issue of “Architectus” by Milan Sýkora.

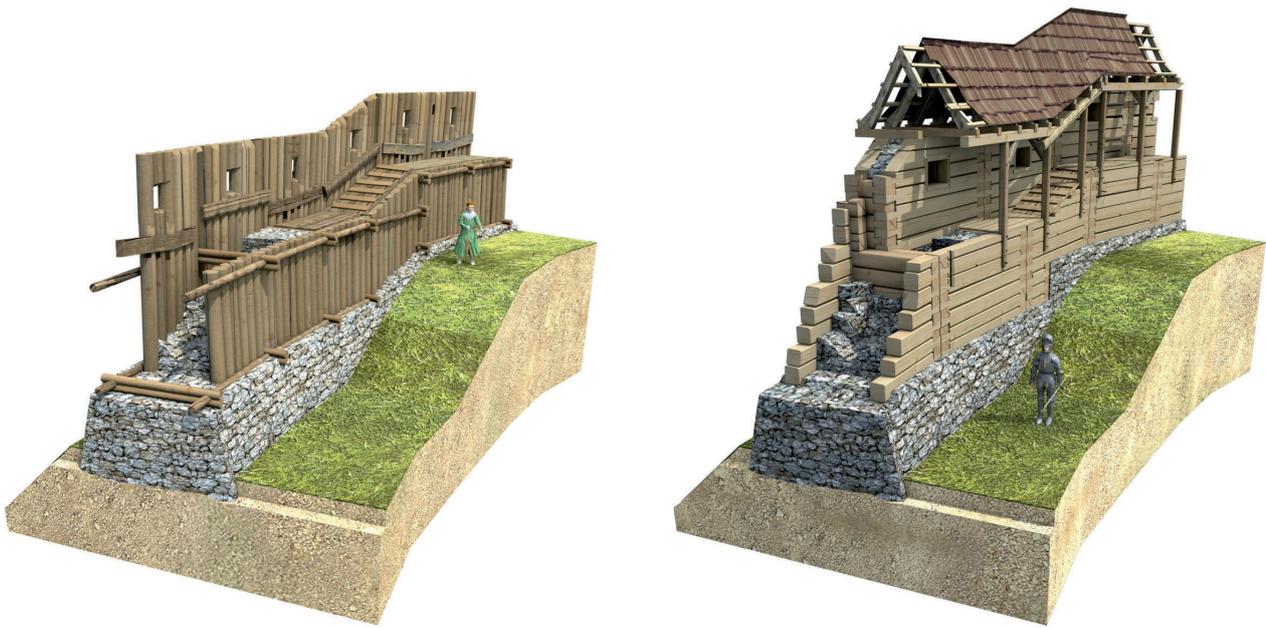


Fig. 4. Variants of reconstruction of so called parkans discovered at sites in Czechia (elaborated by I. Lehký, source: [18])

Il. 4. Propozycje rekonstrukcji parkanów odkrywanych na stanowiskach na terenie Czech (oprac. I. Lehký, źródło: [18])



Fig. 5. Hussite army besieging the Hohengeroldseck Castle in 1486. Illustration from *Codex Palatinus germanicus* (source: [22])

Il. 5. Oblężenie przez wojska husyckie zamku Hohengeroldseck w 1486 r.

Ilustracja z *Codex Palatinus germanicus* (źródło: [22])

sidewalks or even covered with roofs. Based on them, as well as on the results of archaeological research, in reconstructions and visualizations, parkans are most often presented in the form of simple palisades erected on embankments or stone foundations (Most, Volfštejn, Nový Žeberk or Šoštýn) [7], [19], [23]. More technologically advanced structures serving as positions and shelters for defenders (e.g., Kalich, Panna, Rýzmburk near Oseka) are suggested much less frequently [7], [12], [18]. For example, the researchers of the Kalich castle proposed not only a parkan surrounding the entire castle, but also additional one creating a corridor leading to the forward defence point [12].

All the construction method, location and the proposed dating of the relics discovered at Grodno Castle seem to correspond to similar objects. However, how effective could an additional line of fortifications be in a form of just a palisade built on a stone foundation?

Theoretical effectiveness of the Grodno Castle's parkan

In order to carry out a functional analysis of the hypothetical fence, a simplified model was created, in which the basic factors influencing the possibility of firing under ideal conditions were taken into account, such as: terrain, building method, possible location of attack points, appropriate location of all these elements in relation to each other and the technical possibilities of armaments from that time [24]. However, the incorporation of specialized data into the model, such as the ballistic values of individual types of weapons and missiles, was impossible due to the insufficient number of experiments carried out for weapons from that period. Although it can be assumed that, even in spite of generalizations and simplifications,

the presented model allows to obtain answers regarding the potential benefits resulting from the application of additional fortifications.

The technique of assaulting permanent resistance points by the Hussite troops differed not only depending on the besieged object but also the type of carried out operations [25]. Significant differences can be noticed in the approach of the siege of castles and towns in Bohemia and Moravia, and objects lying on the way of the Hussite raids. In the case of the former, the time did not play a significant role [26]. In addition to the most frequently used fire of varying intensity, aimed at destroying and creating a breach in the walls, trenches were also made under the walls. In extreme cases the besieging troops built fortification systems with towers and stockyards surrounding the attacked object with a tight blockade [17], [25]. One of the best-studied places in terms of identifying this type of siege is Lichnice Castle. Archaeological research conducted in its vicinity provided evidence of such activities, and the reconstructed line of siege forces ran in the distance between 300 and 400 m from the castle [27]. However, in the case of the raids conducted in the years 1428–1433, the main strength was the element of surprise resulting from the exceptional mobility of the Hussite troops. These assaults were carried out only when defences could be taken in stride, given the speed which the troops were moving with, and too well-protected points of resistance were then ignored. It can only be assumed that each attempt was associated with the calculation of the success chances, and for this purpose all available means and weapons were used [25].

Equipment of the 15th century troops

Much information about the existing firearms at that point can be obtained not only from written and iconographic sources but also from archaeological finds [25]. While the development of firearms in individual armies was irregular and it is impossible to present it in detail in a short article, in the light of the available data on the Grodno Castle and the political situation that prevailed in the 15th century, this analysis can be without any doubts narrowed down to Hussite troops. It is true that the defenders of the castle themselves were most likely not Hussites, but there are no grounds for assuming glaring technological disproportions in the armaments between the various sides of the conflict.

The main part of the Hussite troops during larger plundering expeditions was the infantry [26]. As a rule, there were ten footmen for one horseman. Although today it is impossible to determine exactly what the division of weapons between individual units looked like, it is known what types of weapons were used. And so, among melee weapons, flails and spears with hooks were in the lead, with the use of swords, cords, glaives, maces, axes, pickaxes, as well as stabbing weapons known from archaeological research – rondel daggers and daggers. When addressing the issue of firearms, which is the key to considerations regarding the functioning of the parkan, it should be noted that the most common written sources mention pistols and



Fig. 6. The Armory of the Museum of West Bohemia in Pilsno with numerous examples of early modern firearms (photo by R. Biel, 2017)

Il. 6. Zbrojownia Muzeum Zachodnich Czech w Pilźnie z licznymi egzemplarzami wczesnonowożytnej broni palnej (fot. R. Biel, 2017)

hook guns, which are usually referred in sources under one term such as “puszka” [25]. As these were not the times of mass production, the then firearms were not standardized, so the examples referred to by the same name had different sizes, structures and widths of the barrels (Fig. 6). It is visible in the discovered artefacts gathered in the museum collections⁶. Apart from them, the most frequently used ranged weapons should be mentioned, i.e. crossbows, and the constantly used barobalistic weapon – trebuchets. Also in the case of artillery weapons, their diversity is relatively large. The basic type were bombards, divided into smaller field guns and larger siege guns, called howitzers. Except for them, there were also tarasnicas intended for direct fire, which with time, together with hook guns, were used to defend walls [25].

The practical significance of the above-mentioned types of ranged and artillery weapons is a subject of constant discussion by theoreticians and practitioners of military art. The range of distances given not only in sources but also in scientific studies is extremely divergent [24], [28]–[30]. Certainly, an important factor was the individual characteristics of each specimen which influenced

⁶ The largest collection of small arms from this period is available to visitors to the Museum of Western Bohemia in Pilsen.

their capabilities. Additional information on this subject is provided by reconstructive experiments [31], [32]. For the purposes of the presented model, underestimated, averaged and hypothetical values were adopted, as a result of which the range of individual types of weapons could correspond to the ranges presented in the Table 1. Trebuchets were excluded from this list because they were using plunging fire and any strengthening would not protect against them under any conditions [33].

Table 1. Hypothetical, averaged values of the effective range and the maximum range of different ranged weapons and artillery used at the turn of the Middle Ages and Early Modern Period (elaborated by R. Biel)

Tabela 1. Hipotetyczne, uśrednione wartości donośności skutecznej oraz maksymalnego zasięgu różnych rodzajów broni dystansowej oraz artylerii wykorzystywanych na przełomie średniowiecza i nowożytności (oprac. R. Biel)

Type of the weapon	Effective killing range [m]	Maximum range [m]
Crossbow	30	500
Pistol	20	150
Hook gun	30	300
Tarasnica	100	300
Howitzer	150	350
Bombard (heavy)	500	1700

As a part of the confirmation of similar weapon types use in other armies during this period, the so-called signature registers of the Kingdom of Poland can be briefly mentioned⁷ [35]. Thanks to these documents containing a list of soldiers and their equipment at the time of joining the service, we obtained the most information on the development of this type of armament for the lands of the Kingdom of Poland. These documents were the basis for determining the amount of the payout or possible compensation. The registers mention three types of firearms known from the Hussite troops, that is: hook guns, pistols and hand cannons [35].

Parkan's characteristics

For the wall of the upper castle, the assumed height was 15 m and the thickness was 3 m (Fig. 7b). Probably, as presented in Chorowska's article, it was lower in this particular place, but even raising it and making it equal to the other, better-preserved fragments do not significantly affect the results of the analyses. The biggest unknown is the structure of the parkan itself. The analyses only confirmed the initial assumptions that the height of the

palisade was proportional to its defensive values. For the purposes of the publication, an arbitrary height of 4 m was assumed, which, taking into account the construction possibilities at the time and the results of comparative analyses, seemed to be an appropriate obstacle at the same time, but also did not require too much work during construction.

The method of calculations

The terrain model and its profile have been developed⁸ assuming that it has not changed significantly over the last 500 years. From the downloaded files in the .LAS format, measurements classified as terrain were extracted, and then a numerical model of the terrain and a vertical AB cross-section with a length of a little over 500 m were created. Point A was marked in the place of the outer face of the upper castle wall, and point B in the area of today's center of Zagórze Śląskie (Fig. 7a). At the same time, the height of the terrain at that time was taken into account, which the researchers managed to document in the trench No. 6, introducing an amendment to the obtained AB cross-section on the studied section. The attackers were positioned at 3 hypothetical points C, D and E, which were determined based on the terrain in combination with the values presented in Table 1. Thus, the absolute shot distance at point C was approximately 30 m, for point D it was approximately 50 m, and for point E – 500 m (Fig. 7a), which would suit people using the hook gun, tarasnica and bombard.

The ballistic values of each type of weapon have been simplified to a minimum. For points C and D, due to the relatively small distance, the shooters' field of view is shown, not the possible flight paths of the missiles. In the case of point E, theoretical ballistic curves were calculated using the following formula derived from the equations for motion and velocity:

$$y = \frac{h + x \cdot \tan(\alpha) - g \cdot x^2}{2 \cdot V_0^2 \cdot \cos^2(\alpha)}$$

where:

- g – gravitational acceleration (9.81 m/s²),
- α – angle at which the projectile was fired,
- V_0 – projectile muzzle velocity,
- h – initial height of the projectile,
- x – distance (on the Earth's surface) travelled by the projectile at a given moment,
- y – height of the projectile at the moment.

And so, based on the research carried out for the Mons Meg bombard, the muzzle velocity was initially assumed at 315 m/s, the initial height as 0 m, the analysed distance was 500 m, and the target heights ranged from 72.65 to 88.43 m, which corresponded to the outer face of the castle wall.

⁷ Kazimierz Górski introduced the registers to a wider audience at the end of the 19th century and to this day they remain the most comprehensive and easily accessible publication on this subject [34].

⁸ The spatial data needed for this purpose was obtained from the resources made available free of charge by the Head Office of Geodesy and Cartography.

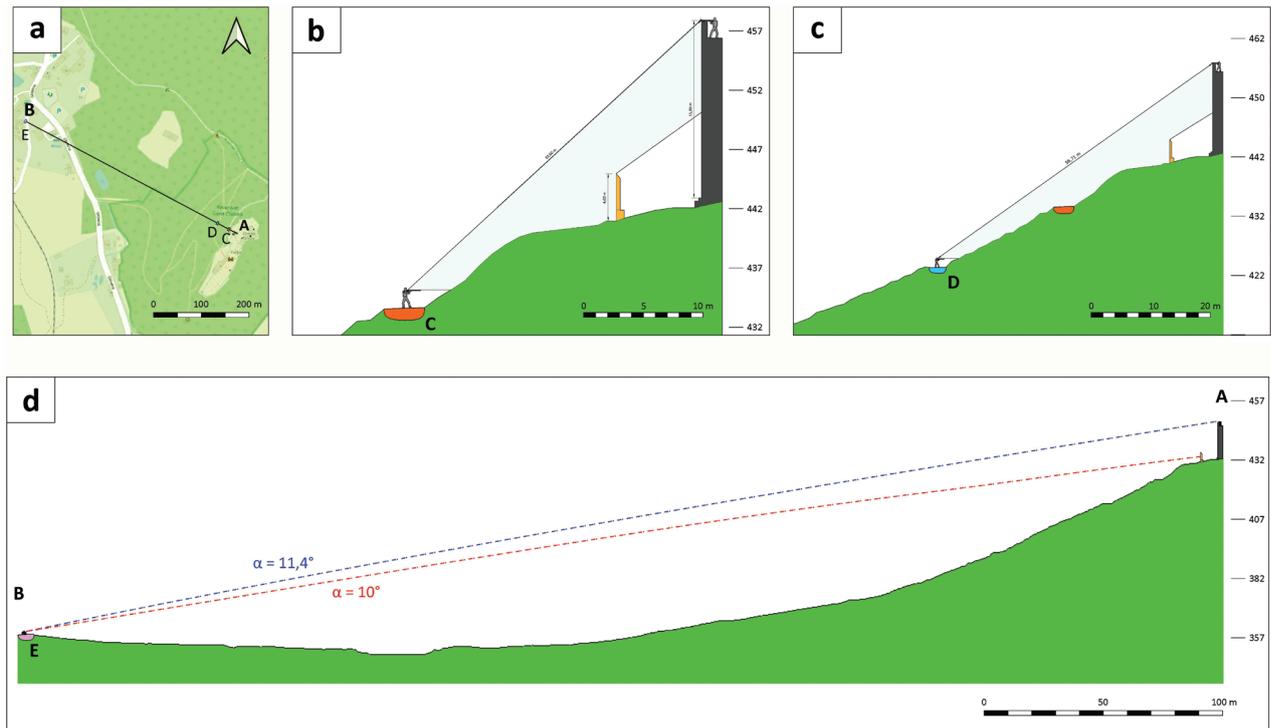


Fig. 7. A hypothetical model of three scenarios of attack on of the Grodno Castle along the line of the parkan:
 a) the course of the designated AB cross-section of the terrain along with individual attack points marked on the topographic map,
 b) point C located on the closest road running approx. 30 m from the wall of the upper castle,
 c) point D located on the lower path, approx. 50 m from the wall of the upper castle,
 d) point E, located approx. 500 m from the castle in the center of today's Zagórze Śląskie (elaborated by R. Biel)

Il. 7. Hipotetyczny model trzech scenariuszy ataku i ostrzału zamku Grodno na linii parkanu:

- a) przebieg wyznaczonego przekroju terenu AB wraz z zaznaczonymi na mapie topograficznej poszczególnymi punktami ataku,
 b) punkt C znajdujący się na najbliższej położonej drodze przebiegającej ok. 30 m od muru zamku górnego,
 c) punkt D zlokalizowany na niżej położonej ścieżce odległej ok. 50 m od muru zamku górnego,
 d) punkt E usytuowany ok. 500 m od zamku na terenie centrum dzisiejszego Zagórze Śląskiego (oprac. R. Biel)

Results and discussion

In the case of the attackers from both points C and D, it seems that the additional fortifications did not constitute any obstacle in firing shots at the defenders located on the castle walls (Figs. 7b and 6c). At least hypothetically at one point, the defenders were able to fire their shots unaffected by the attackers' response for a short moment, but after crossing it, the attackers entered the blind zone – both they and the defenders were unable to fire (Fig. 7b). In the case of a greater height of the fortifications, the potential of preventing direct shots at the same time reduced the defence capabilities. On the other hand, with lowering the height, the width of the dead zone would decrease proportionally, while the total height of 2 m, with the appropriate skills of the defenders, would allow at least theoretical making it null. At the same time, attackers with such a height of fortifications should not be able to raise their weapons high enough, and certainly not to fire a precise shot. In the analysed model, the parkan completely prevents direct fire on the lower part of the walls from points C (Fig. 7b) and D (Fig. 7c), so in their case its effectiveness seems indisputable.

It seems that the fence fortifications would be the biggest obstacle in the direct attack on the wall. Regardless

of its height, overcoming an additional obstacle was tantamount to direct exposure to fire from the defenders, with the simultaneous lack of the response possibility. This made it impossible to approach the wall and make the excavations mentioned in the written records, although in the case of Grodno Castle it was also ensured by the solid rock itself on which the castle was built.

The last considered aspect is the bombardment from point E (Fig. 7d). Although it might seem that the issue of firing from point E will require deeper considerations, as a result of carrying out a series of calculations with variables in various configurations, it turned out that also here the additional reinforcements completely fulfil their role. With a distance of 500 m and a muzzle velocity of 315 m/s, hitting the castle wall, even without this obstacle, seems to be a real feat. It would have been possible only if the angle of the shot had been within a narrow range between 8.5° and 11.4°. At the analysed distance, only a significant reduction in speed and a directly proportional change in the angle of inclination would have affected the projectile's flight path. The feat of firing a shot to bypass the fence with the proverbial lob which would have resulted in a direct shot at the lower parts of the walls was not only almost impossible, but also completely pointless. Even if medieval artillerymen would have managed,

against all logic, to fire a cannonball exactly at an angle of 45° with an exact speed of 75.8 m/s, it would have been tantamount to donating these bullets as a gift and replenishing the ammunition of the castle crew. In this way, an additional obstacle in the form of a simple wooden palisade, if it had not stopped the enemy missiles completely, it would have certainly reduced their speed, and thus the damage caused. But was even a projectile fired at a 10° angle at 315 m/s, after flying 500 m and still keeping it at 312.64 m/s, a threat to 3 m thick stone walls?

Despite the fact that written records usually agree on the damage caused by fired cannonballs⁹, material sources contradict them. The marks on walls, and sometimes even cannonballs discovered in the castle walls like the ones in castle Rýzmburk near Osek, suggest that the bombardment was not as devastating as the chronicles suggest. For obvious reasons, the number of practical experiments that would allow this myth to be confirmed or debunked is very small. The few experiments, in which the power of historic artillery have been tested, rely on the use of replicas of guns from later centuries. The most information on the possibilities of 15th century bombards is provided in the publication from 2016 [32], in which theoretical considerations were subjected to computer simulation. And although the case of one of the largest bombards of the period known to us was analyzed – Mons Meg, and the calculations themselves were simplified for the needs of the computing power, finally even the possibility of punching a brick wall with a thickness of 1 m was questionable. Based on this experiment, a possibility of piercing a 3 m thick stone wall bonded with lime mortar can be rejected.

Therefore, not believing the historical records, it should be assumed that, although not so destructive, still effective firing from medieval bombardments focused on the gradual straining of the stability of the castle walls. Only the development of artillery caused an arms race and the pro-

gress of fortification thought, which in the case of defence points was associated with the modernization or abandonment of such a function. In this situation, the existence of an additional obstacle, which would be constituted by even the simplest parkan structure, seems to be entirely justified by practical reasons. At least in the presented model, it prevented direct fire on the lower parts of the wall¹⁰, and even penetration of cannonballs through the wooden superstructure probably resulted in a significant decrease in their kinetic energy.

Conclusions

In the light of the presented data, the stone structure discovered during the archaeological research of the zwinger at the Grodno Castle may be a foundations of the previously unknown stage of the castle fortifications modernization. The connection of the fact of their destruction with the date of the Hussite raid in 1429 is confirmed by the chronology of covering it layers and discovered archaeological finds. Analogous parkans known predominantly from castles in the former Kingdom of Bohemia provide some suggestions as to the likely appearance, but at this stage of research it is impossible to present its full reconstruction. The functional analysis showed that even in the case of the simplest form of a palisade, it could fulfil its basic tasks. Most likely, they were the impediment to direct access to the proper castle walls and the impediment to direct artillery fire. Determining the layout of the newly discovered line of fortifications and possible clarification of the method of its construction at this moment seems possible only in the case of subsequent excavation research. This discovery is a novelty in the history of the construction development of the Grodno Castle, and at the same time fits into the development of the fortification thought known from the surrounding lands.

Translated by
Kinga Janowska

⁹ Usually they were supposed to pierce the castle walls and destroy everything completely, injuring people at the same time. An example story about the siege of the Scottish castle Threave mentions the punching through the castle wall by a bullet fired from the bombard Mons Meg, and then tearing off Margaret Douglas's hand, who was to eat inside the object [32].

¹⁰ The structural violation of the wall at its base would lead to the fastest possible breach.

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Abstract

The functional analysis of the 15th century fortification of the Grodno castle

The aim of the article is to discuss the potential purpose, and then a functional analysis of the structure, the stone relics of which were discovered during the archaeological research conducted in 2018 and 2019, on the zwinger of the Grodno Castle, located in Zagórze Śląskie. The chronology of the structure, based on the analysis of the accompanying artefacts, was established in the first half of the 15th century, linking its destruction with the Hussite wars that were going on at that time. The analysis of the iconographic material and the results of research carried out on similar sites in Silesia, the Czech Republic and Moravia allowed for a hypothesis that the structure in question was a relic of a so called parkan – the oldest, previously unknown line of additional fortifications. Such wooden or stone-and-wooden objects would be the first response to the firearms spreading at that time. The theoretical model of the effectiveness of this type of fortification is considered, taking into account a number of basic factors, such as the terrain, the possibilities of armaments at that time, and the location of attackers and defenders. Various scenarios are discussed, taking into consideration the results of practical and theoretical experiments related to the use of early modern firearms and artillery published in the literature on the subject. The results of the conducted analyses seem to confirm both the proposed function of the structure and a number of benefits of its construction.

Key words: Middle Ages, castellology, Hussite Wars, Silesia, Grodno Castle

Streszczenie

Analiza funkcjonalna XV-wiecznego parkanu na zamku Grodno

Celem artykułu jest omówienie potencjalnego przeznaczenia, a następnie analiza funkcjonalna konstrukcji, której kamienne relikty odkryto w trakcie badań archeologicznych prowadzonych w 2018 i 2019 r. na międzymurzu zamku Grodno, położonym w Zagórze Śląskim. Chronologię konstrukcji, w oparciu o analizę towarzyszącego mu zabytkowego materiału ruchomego, ustalono na I. połowę XV w., wiążąc jej zniszczenie z trwającymi wówczas wojnami husyckimi. Analiza materiału ikonograficznego i wyników badań prowadzonych na analogicznych obiektach na Śląsku, w Czechach i na Morawach pozwoliła na wysunięcie hipotezy, wedle której omawiana konstrukcja stanowiła relikw parkanu – najstarszej, nieznaną dotąd linii dodatkowych umocnień. Tego typu drewniane lub kamiennie-drewniane obiekty miałyby stanowić pierwszą odpowiedź na rozpowszechniającą się wówczas broń palną. Rozpatrywany jest teoretyczny model skuteczności tego typu umocnień, biorący pod uwagę wiele podstawowych czynników, takich jak ukształtowanie terenu, możliwości ówczesnego uzbrojenia oraz lokalizacja stanowisk atakujących i obrońców. W dyskusji omawiane są różne scenariusze, uwzględniające publikowane w literaturze przedmiotu wyniki eksperymentów praktycznych i teoretycznych związanych z wykorzystaniem wczesnonowożytnej broni palnej i artylerii. Wyniki przeprowadzonych analiz wydają się potwierdzać zarówno proponowaną funkcję konstrukcji, jak i szereg korzyści płynących z jej budowy.

Słowa kluczowe: średniowiecze, kastellologia, wojny husyckie, Śląsk, zamek Grodno



Zagórze Śląskie, Grodno Castle.
The eastern wing of the upper castle
from the 2nd half of the 16th century,
from the side of the courtyard
(photo by A. Gryglewska, 2021)

Zagórze Śląskie, zamek Grodno.
Wschodnie skrzydło górnego zamku
z 2. połowy XVI w. od strony dziedzińca
(fot. A. Gryglewska, 2021)