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Marek Bogdała*, Anna Chodkowska**

Roundel bastion fortifications of Grodno Castle in Zagórze Śląskie

Introduction

The article aims at presenting fortifications of the homesteads at the foot of Grodno Castle – middle and lower, zwinger and objects outside the present line of walls. To a large extent, it will be a description of roundel bastion fortifications which were adapted to the use of firearms as well as the connections between the structure, form, and matter of the preserved relics with the earlier and later defensive layouts of this mountainous stronghold.

The castle, which is located on the border of the Waldenburg and Sowie (Owl) Mountains, rises on the longitudinal ridge of Mount Choina, at an altitude of 450 m above sea level and about 100 m above Bystrzyckie Lake. The topographical relief forced an elongated plan of the structure. The highest part of the rock was occupied by the oldest part – the upper castle. The gradual extension of the building and the transformation of the top of the hill resulted in the construction of subsequent perimeters of walls, i.e., the middle castle, zwinger and the lower castle.

The creation of a complete roundel bastion circuit around Grodno Castle (Fig. 1) should be attributed to the von Logau family and the building works they carried out [3]. The construction of early modern fortifications was divided into three stages. The first one was connected with the takeover of the castle by Mathias von Logau in 1547. At that time, the older fence with two cylindrical towers was made higher (No. 1 and 2). The low stone defensive wall stretched between them was raised and modernized in accordance with early modern standards. The second stage of extension began under Georg von Logau in 1568. Then, another section of the medieval wall, which ran from tower No. 2 to the east, was adapted. Two new roundel bastions and walls closing the outer bailey on the eastern side were built. In the third and last stage of the castle extension, the outer bailey was enlarged by the lower part, also enclosed in a roundel bastion wall equipped with five shells. The collapse of Georg von Logau's property in 1595 brought an end to the works on the castle. The subsequent constant changes of owners did not contribute to the good condition of the building which gradually began to fall into ruin.

After the 16th-century extensions, there was a period of stagnation. It was interrupted in the 19th century by Johann Gustav Büsching who purchased the castle on September 18, 1823, and then began its renovation and remodeling in the spirit of the 19th-century Romanticism [4]. From 1840 his work was continued by Friedrich von Burghaus [3]. Among other things, roundel bastions of the lower castle were remodeled and "enriched". He established new gardens and terraces along with walking paths around the castle, which also changed the topographical relief around the stronghold.

The research into the history of the castle has been conducted since the 19th century. It was initiated by August Zemplin [5] and then continued by Heinrich Schubert [3], Robert Weber [6], and Viktor Schaetzke [7]. They described the history of the castle's rulers and, to a small extent, transformations which were connected with the construction of the roundel bastion circuit. After World War II, architectural research was carried out by Jerzy Rozpędowski [1]. He described the entire castle along with reconstruction drawings of the whole perimeter of walls. The latest discoveries outside the area of the upper castle resulted from archaeological research which was conducted by Paweł Konczewski and Radosław Biel in 2017. They discovered relics of a previously unmarked wall within the zwinger [2]. The last architectural research was carried out by Małgorzata Chorowska, Agnieszka Gryglewska, Anna Chodkowska and Marek Bogdała in the years 2018–2021.

* ORCID: 0000-0002-9596-9695. Faculty of Architecture, Wrocław University of Science and Technology, e-mail: marek.bogdala@pwr.edu.pl

** ORCID: 0000-0003-1479-4887. Castellum Sp. z o.o. Przedsiębiorstwo budowlano-konserwatorskie, Wrocław.

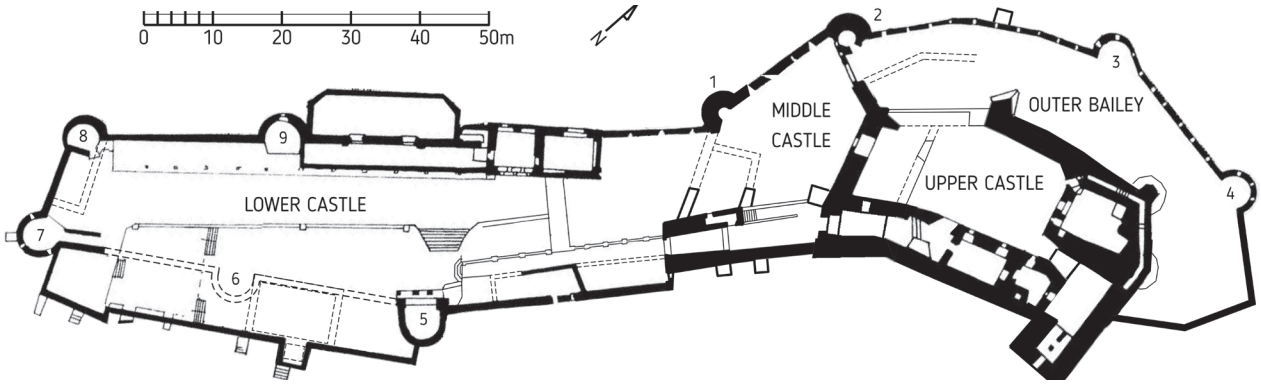

Fig. 1. Plan of Grodno Castle – present condition. Roundel bastions were marked with numbers from 1 to 9 (elaborated by M. Bogdała, A. Gryglewska on the basis of J. Rozpędowski [1], R. Biel [2])

Il. 1. Plan zamku Grodno – stan obecny. Bastiony okrągłe oznaczono numerami od 1 do 9 (oprac. M. Bogdała, A. Gryglewska na podstawie J. Rozpędowski [1], R. Biel [2])

Middle outer bailey and the 1st phase of the 16th-century transformations in the times of Matthias von Logau in the years 1547–1567

The area adjacent to the gate of the upper castle, due to the topographical relief and transportation system, was a natural place for the extension of the stronghold. It was also the place where the fortified outer bailey along with a stable were located and is now called the castle or the middle outer bailey. According to Rozpędowski, its perimeter consisted of a long foregate which was ended with a protruding tower, similar to the solutions found in Bolków and Chojnik castles, as well as the necks of city gates and the perimeter wall with two semi-cylindrical shell roundel bastions (No. 1 and 2). A stable adjoined the south-western section of the wall [1]. The foregate underwent later transformations and now at that place there is a brick, high stone ramp and a later, neo-Gothic castle chapel. In the earlier days, the first external gatehouse was situated here. These buildings as well as the wall connecting the foregate with tower No. 1 have not survived. At present, its course can be reconstructed on the basis of the direction of the buttress of the entrance ramp and the shape of tower No. 1. The north-western section of the wall with two shells (No. 1 and 2) has survived until today.

In order to verify the dating of the existing section of the defensive wall in the fall of 2020, its detailed inventory and architectural reconnaissance in terms of workshop and building material were carried out[1]. The outer section of the wall between towers Nos. 1 and No. 2 as well as the fragment of wall accessible from the inside were measured. The method of ground and aerial photogrammetry was applied with the use of an unmanned quadrocopter, the small dimensions of which made it possible to conduct research in the wooded space surrounding the wall. From the inside, measurements were made under the roof of a modern shelter. On the basis of the prepared two-dimensional images, a digital model of three-dimensional surfaces was developed in a computer environment, which was then scaled and oriented on the basis of metric field measurements. Using the achieved data of the grids, ortho-photographic views of the researched planes were obtained. Data processed in this way was synthesized and presented graphically (Fig. 2).

Applying the above measurements, it was determined that the researched fragment of fortifications, including both towers, is about 26 m long, of which the curtain of the wall is about 16 m. The height of the preserved relics, from the outside, ranges from 6 to 8.5 m, but tower No. 2 is about 1.5 m higher than remaining part. The area inside the perimeter is approximately 1 m above the level of the outer side. This disproportion increases to the north along with the change in the slope of the ground. The measured thickness of the walls of towers ranges from 1.7 to 2.3 m and the section between the towers is 1.5 m to 1.2 m thick. This is connected with the fact that the walls of all buildings have offsets from the outside side, i.e. two for tower No. 1 and the wall curtain, and three in the case of tower No. 2. The crown of the fortifications is not preserved and the vegetation overgrowing it leads to the degradation of the historic tissue.

Initial analyses of the external face of the wall showed its homogeneous structure made of broken stone. In the higher parts of the northern tower, the rock material was smaller. In the case of the curtain, there were some fragments filled with brick crumb and clearly visible brickwork around arrowslits made of bright and slightly burnt brick. Moreover, especially in the opening located on the upper storey, there were single, lower and more oblong bricks with a dark cherry color. Moreover, especially in the opening located on the upper storey, there were single, lower, and more longitudinal bricks with a dark cherry color[2]. From the inside, the wall structure is not uniform.

[1] Carried out by M. Chorowska, A. Gryglewska, A. Chodkowska, M. Bogdała.

[2] It was the 19th-century brick, used by Büsching to repair the upper castle, as discussed in this volume in the article by M. Chorowska and later in this article.

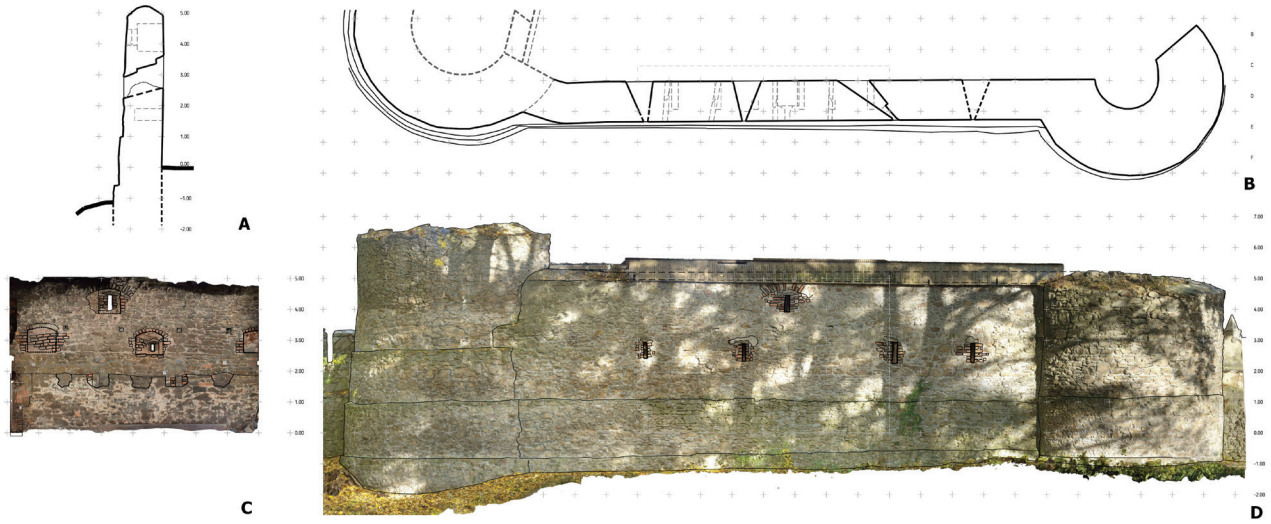

Fig. 2. Section of the wall between towers Nos. 1 and 2: A – cross-section, B – projection, C – view from the inside, D – view from the outside of walls (elaborated by M. Bogdała)

Il. 2. Przekrój muru między wieżami nr 1 i 2: A – przekrój, B – rzut, C – widok od wewnątrz, D – widok z zewnątrz murów (oprac. M. Bogdała)

Differentiation of the mortar in terms of color and grammage was observed. Areas of variable sizes of stones as well as brick fillings were found. Apart from vaults of the arrowslits, light brick appears in the form of fragments bound with a layer of scratch coat in the lower parts of the wall. The traces of the scratch coat are arranged in alternating fields at a height of about 1.60–1.80 m above the ground level. In these places, there is a visible change in the way the wall is filled, including smaller fractions of stone and brick fillings. These are fillings with dimensions of about 20 × 35 cm on the degraded nests for the platform beams, which used to be serve defenders to support lower arrowslits. These nests were formed in the older wall and when they were no longer needed, they were bricked up. Above the zone of the lower row of windows, there are openings with dimensions of 12 × 12 to 14 × 14 cm. They almost occupy the whole thickness of wall, only from the outside are they secured with brickwork. They can be connected both with the platform for the higher embrasure and with the roof necessary to protect firearms from getting damp, or they are simply putlog holes.

In the wall there are embrasures which are faced with light brick, now partially destroyed, and splayed from the inside to the dimensions of 80–90 cm wide and 70–80 cm high, measured in the key of the vaults. The openings narrow to vertical slots and in the external face they are about 10–15 cm wide and from 51 to 68 cm high. The embrasures were situated on two levels. The lower one, with four openings, is located at a height of 2.60 m above the ground level, i.e., about 0.7 m above the previously described traces of the platform nests. The upper level contains one window at a height of 3.85 m. We cannot fail to mention the characteristic shape of the arrowslits. They are directionally profiled in the vertical and horizontal planes. The beveling was formed in successive windows alternately in the northern or southern direction, and the upper embrasure is perpendicular. The angle between the face of the wall and the axis of the openings ranges from 81° to 43°. Such a sharp angle is justified by the protection of a fragment of the foreground with the road leading to the castle. Similarly, the inclination of windowsills – it is visible only in the lower strip of openings and is around 20°. One more hole deserves attention. It is situated in the wall of the northern tower. Once open and directed towards the inside of the tower with its field of fire, it is now walled up with large bright brick similar to the one from which it was built.

Computer-developed models of the wall surface made it possible to analyze the object without texture, but with the use of methods of variable and virtual illumination of the model. This made it easier to highlight irregularities which are invisible to the naked eye. These observations were of particular significance in relation to the outer face of the wall and the determination of deviations in the higher and inaccessible part of it. In this area, a clear leveling layer, corresponding to the level of traces left by the nests of the internal platform was distinguished (Fig. 3).

The mortar on the inner surface of the wall was subjected to observation on a macroscopic scale. In the lower parts, up to a height of about 1–1.5 m above the ground level, there was a lime mortar with a dark, brownish color, quite loose due to a high content of sand, containing the so-called lumps of poorly absorbed lime, characteristic of medieval mortars. Above, a much stronger and better calcified beige mortar was observed. On the outside, most of the wall joints were covered with cement mortar, probably as a result of modern repairs.

Summarizing the above observation data, as well as taking into account M. Chorowska's research within the upper castle[3], two main stages of the growth of defensive walls of the middle castle and zwinger can be distinguished.

[3] Cf. M. Chorowska, *Chronology of transformations in Grodno Castle from the 13th to the mid-16th century*, in this issue of "Architectus".

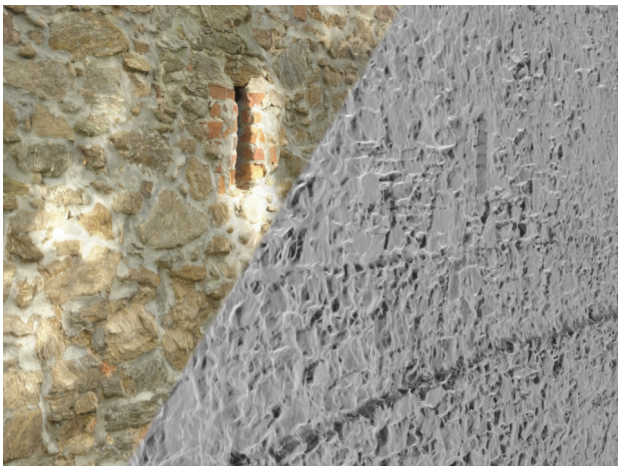

Fig. 3. Leveling layer and offset visible on the surface of 3D model (elaborated by M. Bogdała)

Il. 3. Warstwa wyrównawcza i odsadzka widoczne na powierzchni modelu 3D (oprac. M. Bogdała)

The first of them was connected with the activities of the 16th-century construction workshop, and the works were also carried out in the upper castle. It should be identified with the third phase of construction transformations of Grodno Castle, dating back to around 1500, i.e. the times of the reign of the Czettritz family. In the second stage, this wall was made higher as part of the renaissance remodeling of Grodno Castle by Mathias von Logau. The older genesis of the defensive wall and two round towers under the upper castle was also guessed by Weber who dated them to the time of reconstruction of the stronghold after the Hussite attack in 1429 and connected these works with the period of the fortress being held by the Czettritz family (1465–1535) [3], [6].

It is worth considering what this early-modern fortified perimeter from around 1500 looked like. Apart from the towers of a standard height for the Middle Ages, its stone relics are now preserved to the level slightly above the second offset rising above the escarpment on the outside of the walls. The higher parts of this wall, if they were present at all, must have been dismantled to the level of the leveling layer, which is clearly visible on both of its faces. However, the solution in which the stone part of the wall constituted only the foundation for higher structures made of wood, similar to the fences known from the iconography of Bohemian castles during the Hussite Wars, seems more probable[4].

The second stage consisted of adding a brick and stone wall with the arrowslits described above to the stone foundation. These openings were accessible from the platform which was supported by wooden cantilever beams. The nests for the beams were made in the late-medieval foundation, just below the aforementioned leveling layer, whereas the Renaissance wall with embrasures constituted additional weight to the beams (Fig. 4). Dating the latter structure to just after the mid-16th century results from the use of strong well-calcified mortar and bricks of a still medieval format[5], i.e., 8.0–8.9 cm high, 13.6–14.5 cm wide and 25.6–26.8 cm long. As mentioned above, modernization of the outer bailey's perimeter should be attributed to the actions of Matthias von Logau, who, by making the fence higher by a wall with a series of openings adapted to the use of firearms, deserved to be commemorated with the Logau family's coat of arms with the initials M v L and

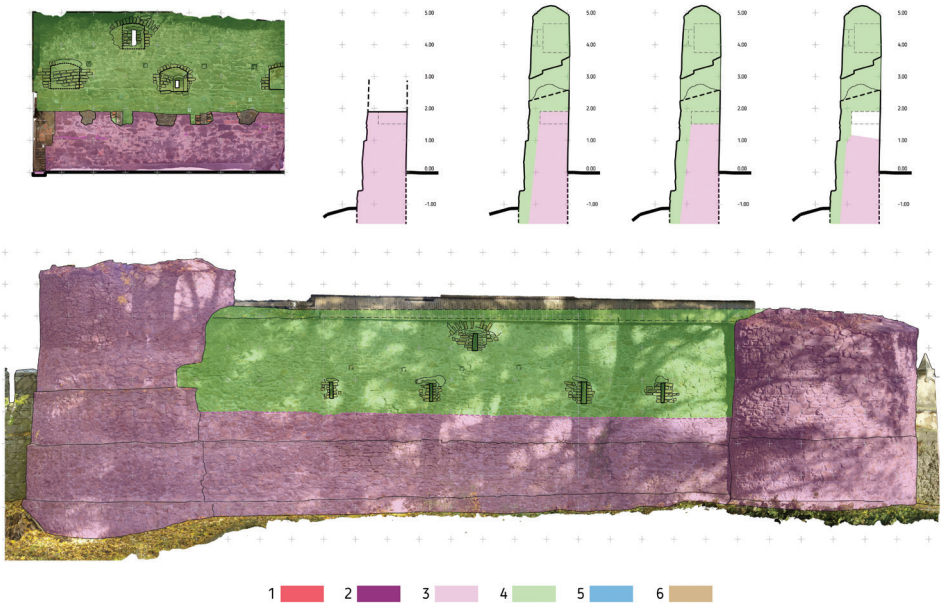

Fig. 4. Chronological stratification of the walls between towers No. 1 and 2 in relation to the stratification of the upper castle. Phases: 3 – around 1500, 4 – 1550–1600. Other phases do not occur in this section (elaborated by M. Chorowska, A. Chodkowska, M. Bogdała)

Il. 4. Rozwarstwienie chronologiczne murów między basztami nr 1 i 2 w odniesieniu do rozwarstwienia zamku górnego. Fazy: 3 – ok. 1500 r., 4 – 1550–1600. Pozostałe fazy nie występują na tym odcinku (oprac. M. Chorowska, A. Chodkowska, M. Bogdała)

[4] Cf. article by R. Biel, *The functional analysis of the 15th century fortification of the Grodno Castle*, in this volume.

[5] It was a poorly burnt brick, quite bright in color and strongly eroded under the influence of unfavorable weather conditions. It appeared in the fourth construction phase of the upper castle.

Fig. 5. The interior of roundel bastion No. 3 (photo by A. Chodkowska)

Il. 5. Wnętrze bastei nr 3 (fot. A. Chodkowska)

the date of 1551 [6], [7]. In the 19th century, this cartouche was found on the western side of the front of the roundel bastion perimeter of the lower castle.

Second stage of the extension in 1568 – zwinger, Georg von Logau

After Matthias von Logau's death in 1567, the castle was taken over by his eldest son Kaspar who became the bishop of Wroclaw in 1562 [3]. In 1568, the new owner renounced the inheritance and divided it among his brothers [3]. The castle together with its adjoining estates were handed over to Georg von Logau along with the lien for 10 years after Kaspar's death. It was then that the second stage of the renaissance extension of the castle including the roundel bastion fortifications began. In the case of the zwinger, it meant the construction of two shell roundel bastions (Nos. 3 and 4), the superstructure of an early-modern fence stretching from tower No. 2 almost to roundel bastion No. 3 and the curtain of the wall closing the zwinger from the north-eastern side.

The remaining part of the fence is unknown. To make it higher, mainly stone was used with small elements of crushed brick in some places. Numerous narrow arrowslits, which were splayed towards the interior of the zwinger and currently accessible from the ground level, were made. The glyphs of openings were finished with brick. In the corners of the arrowslits, 6.5–7 cm high obtuse fittings were used, which distinguished them from the bricks of the medieval format, i.e., 8–10 cm high. The presence of these fittings gave the basis for dating the perimeter of the zwinger to the time after 1560, i.e., to the times of Georg von Logau. In 2/3 of its length, the wall was supported by a wide stone buttress. Its middle section probably collapsed in 1789 [3]. In later years, it was repaired and rebuilt many times, which blurred its original character.

Roundel bastion No. 3 was directed asymmetrically in relation to the adjacent walls. Its eastern arm was slightly longer and smoothly changed into the further part of the defensive perimeter. On the western side, it was perpendicularly connected with the wall. This arrangement provided defenders with an increased field of observation of the access road to the castle and the space in front of the gate. The shell probably had two utility levels. The first one was accessible from the contemporary ground level and was equipped with three brick key embrasures (Fig. 5). We can assume that there was the lower level due to the second line of embrasures, now bricked up and visible in its external face 2.5 m below the key embrasures. Their longitudinal shape and brick finish, as in the case of other embrasure openings, suggest that the roundel bastion was originally casemated. Its lower level was equipped with arrowslits. The course of vertical transportation between the levels is unknown. Only excavations works could explain it.

The negatives of wooden beams are visible above the embrasures of the upper level. Their location just below the preserved remnant of the Renaissance attic allows us to suppose that they had elements of the roofing structure which protected defenders against unfavorable weather conditions and against gunpowder getting damp[6]. The left internal corner of the roundel bastion was finished with sandstone dimension stones fitted into the stone wall.

From the eastern side, the roundel bastion gently changes into a stone and brick defensive wall. The wall, together with a series of six slit embrasures accessible from the contemporary ground level, rises gently upward in line with the topographical relief. The embrasures, similarly to the ones described above, were finished with brick and splayed to the interior of the zwinger. Above the embrasures, a wall fragment can be distinguished, in the lower part of which, just above the offset, there are openings across the entire width of the wall, which are relics of wooden beam nests which could have supported a wooden porch above the wall or the roofing of shooting positions. The second option seems probable if we take into account the presence of the remnants of the attic on roundel bastion No. 3. This attic was probably continued on the crown of the walls from that period and its presence

[6] Similar solutions occurred, inter alia, in Chojnik Castle.

rules out the possibility of constructing an additional defensive porch.

Roundel bastion No. 4 was constructed very similarly to roundel bastion No. 3. It was also probably equipped with two levels of embrasures finished by means of brick. The upper storey is accessible from the contemporary ground level, whereas the lower storey remains buried. Internal corners of the roundel bastion were finished with sandstone dimensions stones. What distinguishes it from roundel bastion No. 3 is its symmetrical location in relation to the walls with which it is connected.

The further eastern part of the fortifications from the second phase of extension is the wall equipped with arrowslits located near roundel bastion No. 4. The remaining part of the wall rises steeply in line with the topographical relief, then joining the wall of the medieval castle. A small walled-up opening reminiscent of a tiny door leading to the outside fortifications in the eastern section of the walls is still a mystery[7].

Third stage of the extension until 1587 – lower outer bailey, Georg von Logau

The time of construction of the lower outer bailey and the original methods of defending this part of the castle hill are unknown. The sgraffito decoration of the second gatehouse bears the date "1570" which probably refers to its origins and at the same time the beginnings the local roundel bastion fortifications. Around the new courtyard, a bakery, a bathhouse and other farm buildings were situated [1]. Defensive walls were equipped with five shell roundel bastions, three of which have been preserved to our times. Construction works were completed by 1587, when the castle and its surroundings were valued by commissioners appointed for this purpose [3]. The estimate of the value of the works carried out was made due to the end of the ten-year pledge (it started in 1584 [3]) and a considerable debt which Georg von Logau had fallen into.

The southern section of the wall, rising above the steep slope above the river, along with two roundel bastions, i.e., No. 5 and 6, has not been preserved to modern times. In the 19th century, terraces were arranged in their place and the area of the courtyard of the lower castle was enlarged to the south. The building, where ticket offices are now located, was built on the site of roundel bastion No. 5.

Roundel bastion No. 7 was built as a stone shell, probably two-storey. As the only one of the preserved ones it has a buttress which was added to its middle part. Two extreme arrowslits in the form of slots situated in a recess splaying into the interior of the building have been preserved to the present day. The part of the wall between the right and left embrasures collapsed. It was reconstructed during renovation works in the 19th century. In the reconstructed wall, the central arrowslit was symbolically reconstructed by making a blind window from the inside of the roundel bastion. Arrowslits are now accessible from the ground level. On the basis of the inspection of the wall from its external side, it can be assumed that the roundel bastion was not casemated because there were no openings in the wall on the lower level. Remnants of wooden beam nests, probably a battle porch, are visible above the shooting positions. A characteristic feature of roundel bastions surrounding the lower castle is the second-storey wall. In the case of roundel bastion No. 7, a small part of it has been preserved. The first and second storeys have a common and continuous facing of the roundel bastion edge in the form of an aesthetic and even brick finish, which was also used to finish arrowslits along with recesses. The wall of the second storey is set back towards the interior of the building, at the same time creating the offset from the external side (Fig. 6). The finishing of the edge of the second-storey wall allows us to assume that it was not connected with the wall running between roundel bastions.

The wall between roundel bastions Nos. 7 and 8 is currently mostly obscured – from the side of the courtyard it is illegible due to the addition of a new face to it, and from the outside its legibility is obscured by farm buildings. In a small fragment, which is visible from the outside, we can see an arrowslit finished, like the others, with brick. Perhaps this wall, similar to the walls of the zwinger, was also equipped with a number of arrowslits guarding the foreground of the castle.

Due to the reconstruction, which was carried out in the 19th century, roundel bastion No. 8 stands out the most among the other preserved ones. It was closed from the courtyard side, then plastered and roofed. Two neo-gothic openings lead to its interior, i.e., the one from the courtyard level and the other accessible from the stairs leading to the first floor. The present floor covering level in its interior is below the level of the courtyard. Internal recesses, which may have been shooting positions, are visible. The external part of fortifications is not plastered. It was built in a very similar way to roundel bastion No. 7, i.e., it was equipped with three arrowslits finished with brick and a second-storey wall with an offset from the external side. The arrowslits were bricked up. Traces of the 19th-century remodeling are also visible from the outside – under the central embrasure and above the level of the outer ground, there is a plastered blind window which is 187 cm high and 77 cm wide. Moreover, from the western side, there is a visible bricked up opening in the wall, below which there are broken stone cantilevers. One of these openings, which was made in 1873, probably constituted an exit to the forest [3].

The wall, which is situated between roundel bastions Nos. 8 and 9, is hardly legible from the side of the courtyard due to the modern facing of its surface. From the outside, it can be seen that the original wall was made like the others, i.e., made of stone and brick. In the vicinity of the western roundel bastion, there are two arrowslits finished with brick. Half a meter above the arrowslits, a row of nests with a spacing of 60–70 cm has been preserved. These nests are located about 2 m below the current level of the wall crown. Apart from the two arrowslits, no other embrasure openings or their remains were observed.

[7] The small opening seems to be a creation made in the 19th century due to the use of brick present in the walls and wall supplements at that time.

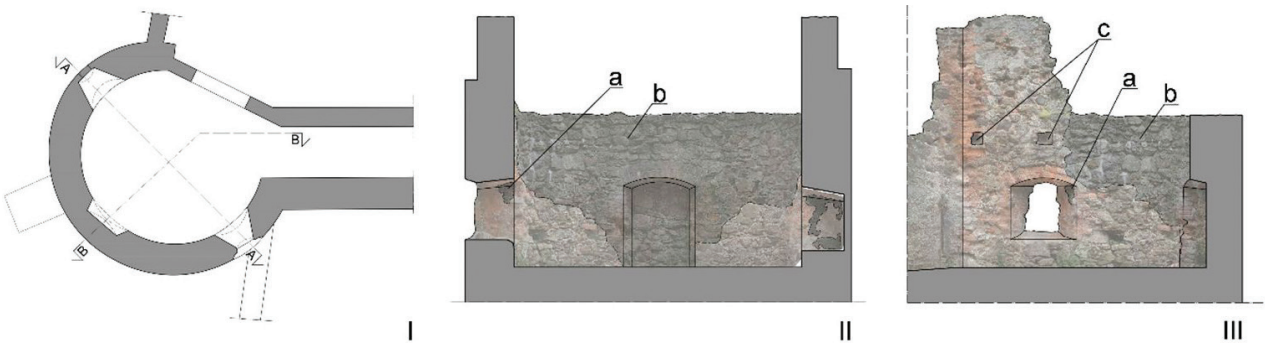

Fig. 6. Roundel bastion No. 7: I – projection, II – cross section A-A, III – cross section B-B, a – plaster residues, b – reconstructed fragment of the wall, c – nests of the beams (elaborated by A. Chodkowska)

Il. 6. Basteja nr 7: I – rzut, II – przekrój A-A, III – przekrój B-B, a – pozostałości tynku, b – zrekonstruowany fragment muru, c – gniazda po belkach (oprac. A. Chodkowska)

Fig. 7. Types of shooting holes in Grodno Castle: a) slit embrasure in the zwinger, b) keyhole embrasure of roundel bastion No. 3 (photo by A. Chodkowska, M. Bogdała)

Il. 7. Rodzaje otworów strzelniczych na zamku Grodno: a) strzelnica szczelinowa międzymurza, b) strzelnica kluczowa bastei nr 3 (fot. A. Chodkowska, M. Bogdała)

The last of the described roundel bastions – roundel bastion No. 9 – has been preserved to modern times in the form of a stone and brick roofed shell which is plastered in its inside. With its structure and layout, this roundel bastion resembles other roundel bastions from that period – a shell with an external offset on the level of the second storey with probably three arrowslits. Nowadays, only one bricked-up embrasure opening can be observed from the external side – on the western side of the object. The middle one was re-pierced in the 19th century in the form of an ogival window – then a garden room was arranged inside it [4]. The eastern arrowslit, if there was any, was covered by a restaurant which was added to the roundel bastion and the external wall.

The wall leading from the roundel bastion to the gatehouse is inside the bar. Its facing was contemporarily changed, which makes its original shape and embrasure openings hardly legible. To the east of the gatehouse, the wall is relatively thin, not high, equipped with four arrowslits which are 60–63 cm high and 22–24 cm wide and accessible from the ground level.

Complete perimeter of fortifications

In the 1580s the castle had a complete perimeter of early modern roundel bastion fortifications which consisted of the lower castle, middle castle and zwinger. The analysis of the defensive structures allows us to conclude that the strongest line of defense started at roundel bastion No. 7 and it spread through the northern part of the walls up to roundel bastion No. 4[8].

Two types of shooting holes can be distinguished in the object, i.e., arrowslits and keyholes (Fig. 7). The first ones were narrow vertical slits splaying towards the interior of the building. These embrasure were very simple in their form – there are no remains of technological facilities which would make it possible to use conveniently, for

[8] Building a roundel bastion at a distance of an effective shot between them made it possible to eliminate a blind spot formed at the foot of the object. In the case of Grodno Castle, the distance between the roundel bastions was 20–30 m.

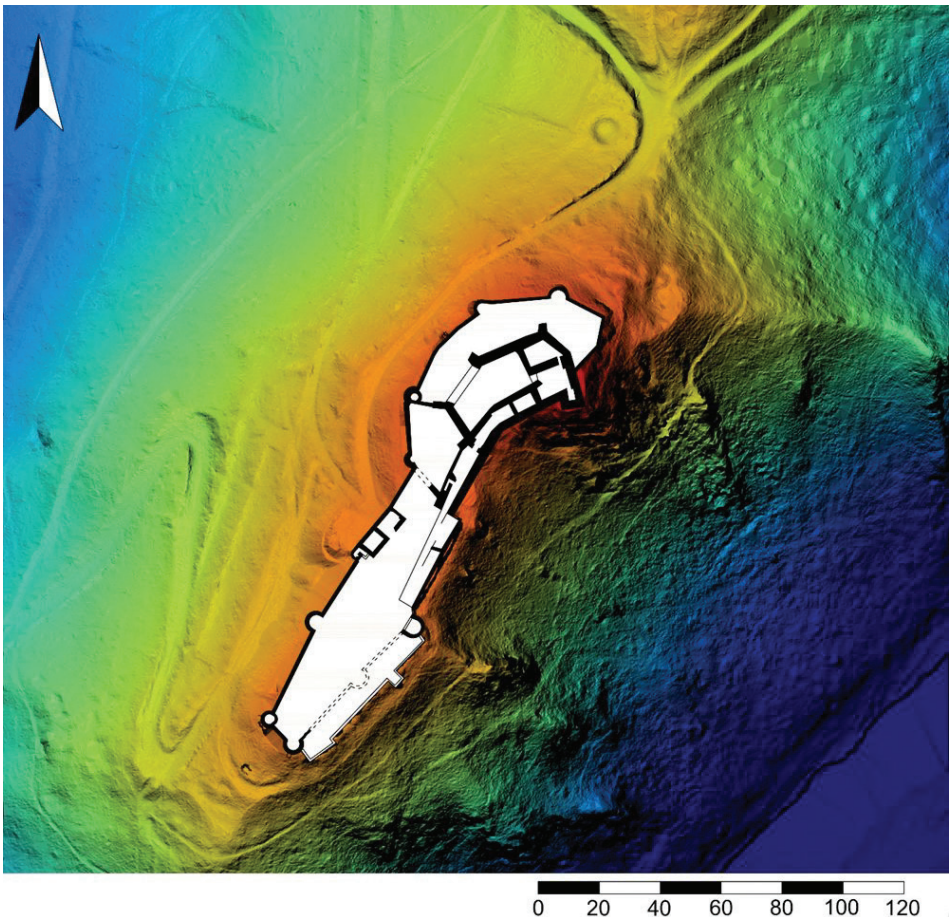

Fig. 8. Numerical terrain model showing the immediate surroundings of Grodno Castle (elaborated by A. Chodkowska)

Il. 8. Numeryczny model terenu przedstawiający najbliższe otoczenie zamku Grodno (oprac. A. Chodkowska)

example, arquebuses. Muskets, which were much smaller and more convenient to use than arquebuses, should be considered the most likely weapon which was used to defend the walls. The small width of shooting holes excluded the use of artillery. The second type of embrasures – keyholes – occurred within the zwinger area. Their presence was certainly connected with the use of more powerful firearms, probably artillery cannons[9]. The keyhole embrasures which are situated at the height of the modern ground level protected the northern part of the wall, i.e., to the east of the middle castle. Apart from embrasures, the opening with dimensions of 20 × 40 cm which is situated above the ground level in the central part of roundel bastion No. 8, is also noteworthy. Its even design from the inside and a slight slope suggest that it could have been an opening for dropping grenades.

The southern side of the castle did not require a strong defense system due to the steep slope going downwards to the river, however, it was equipped with two roundel bastions with a wall connecting them, which no longer exist. Perhaps their task was to guard the road which ran at the foot of the mountain.

In the numerical model of the terrain (Fig. 8), which shows the surroundings of the castle, we can see oval shapes at the north-eastern perimeter of the zwinger walls, from the external side. This area has not been researched so far, so it is difficult to assign a specific function to it, in particular, taking into account the lack of references to this place in literature. During field observations, the presence of remnants of walls along oval earth formations was noticed. They seem to resemble the remains of earthen and brick roundel bastions, but this requires verification in further studies.

The topographical relief, which forms the natural defense of the castle from the south-east, whereas from the north it enforces a strengthened defense line, is also fairly legible.

19th-century Romantic transformations

Over the next centuries, owners of the castle changed many times. Between small renovations, neglected, it fell into greater and greater ruin. At the turn of the 1830s, the castle was auctioned off and became the property of peasants who purchased it to obtain building materials. In 1823 Wrocław professor Johann Gustav Gottlieb Büsching bought the castle, saving it from further devastation and demolition [5, p. 83]. The 19th-century renovations and remodeling of the castle can be divided into three stages. The first of them was conducted in the 1830s by the aforementioned Wrocław professor. This remodeling protected the castle from further damage, but it also resulted in the diversification of buildings in the Romantic spirit. The castle was made available to tourists. In the years 1840–1855,

[9] In the 16th century, cannons with a diameter of 50–100 mm were probably used in Chojnik Castle. This can be confirmed by the cannons with the coat of arms of owners of Chojnik – the Schaffgotsch family, which at present are situated in the castle in Bolków.

Friedrich von Burghaus [3, p. 64] was responsible for the second stage of the renovation. The third stage of remodeling the building took the 2nd half of the 19th century.

Romantic renovations and reinforcements of the castle affected the middle castle and zwinger to the slightest extent – in the zwinger area, an animal preserve, which was closed with a stone and brick gate, was established. Parts of roundel bastions of the lower castle were pulled down and the others were adapted to new functions by rebuilding them to a greater or lesser extent. Roundel bastion No. 8 underwent the greatest changes – it was closed from the inside, it gained a new roof, as well as window and door openings from the inside of the courtyard. A door opening, which led to the outside of the building, i.e. to the forest with walking paths, was also made in it. The area around the castle was transformed as well – new alleys, which have been partially preserved until today, were created around the building. Their layout is clearly visible in Figure 8.

Summary

The presented study of the lower defensive perimeters of Grodno Castle provided more details and supplemented the current state of research as regards their origins. Closer observations of individual fragments of the fortifications, apart from documenting the condition, made it possible to precise the time of their formation and the reconstruction of their past appearance. This allows us to better imagine the fortress in its heyday, when the von Logau family completed the works connected with its extension and described it in 1588 as the place […] *fit for a prince to live in* [3, p. 34].

Within the outer bailey (of the middle castle) and partially the zwinger, an earlier, hitherto undefined phase was found, which dates back to around 1500. It is connected with the construction of a low wall – a fence and cylindrical towers as well as the first gatehouse. In the second stage, these elements became the foundation for further defensive improvements to the stronghold. In the 16th century, as a result of three stages of extension, the object received a complete roundel bastion perimeter which was adapted to the firearms and topographical relief. Despite common features, such as the presence of a shell roundel bastion with slit hole embrasures, individual solutions appeared at each stage, e.g., keyhole embrasures, multi-level shooting positions or the second storey of roundel bastions with an external offset.

The present studies did not give answers to the questions about the presence of a moat separating the castle from the north-western and northern parts of the hill – this could only be settled by archaeological survey research. The article also showed the need to conduct such research in the area of roundel bastions No. 3 and 4 as well as of the north-eastern section of the zwinger walls. They would allow us to verify the issue of the presence of lower storeys in these defensive works and to determine the method of vertical transportation between these storeys. The presence and primary function of the semi-circular earthen or earthen-wall formations located on the outer north-eastern side of the stronghold also require separate explanations.

Translated by
Bogusław Setkowicz

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Abstract

Roundel bastion fortifications of Grodno Castle in Zagórze Śląskie

The article presents the roundel bastion fortifications of Grodno Castle in Zagórze Śląskie in detail. It also describes subsequent stages of their extensions, including the previously unknown phase of fortifications of the outer bailey (the so-called middle castle), dated to around 1500, when a fence with two cylindrical towers, the first gatehouse, and a stable building were built. The largest transformations were connected with the construction activity of the von Logau family, which in 1547 came into possession of the castle and made its renaissance reconstruction as well as its extension by the lower part of the outer bailey. Other significant changes took place in the 19th century when the castle was saved from complete demolition and adapted for visiting by tourists. These actions influenced, inter alia, the appearance of its fortifications and surroundings.

The text presents the stages of the roundel bastion perimeter construction. There are also references to the traces of its non-existent elements. Building material such as brick formats and the type of mortar were observed. In the course of analyses, technologies of terrestrial and aerial photogrammetry were used, which made it possible to develop virtual models of the researched objects. On the basis of the data obtained from laser aerial

scanning, a visualization of the terrain model around the castle was developed. Thanks to digital models, information, which was hardly legible during architectural research using traditional methods, was obtained. The authors express the need for further studies, in particular archaeological ones, which would allow discovering these relics of the castle which are still hidden.

Key words: roundel bastion, fence, defensive wall, embrasure, Grodno

Streszczenie

Fortyfikacje bastejowe zamku Grodno w Zagórzu Śląskim

W artykule szczegółowo przedstawiono fortyfikacje bastejowe zamku Grodno w Zagórzu Śląskim. Opisano kolejne etapy ich rozbudowy, w tym nieznaną wcześniej fazę obwarowań podzamcza (tzw. zamku średniego), datowaną na około 1500 r., kiedy to powstał parkan z dwiema cylindrycznymi basztami i pierwszym domem bramnym oraz budynkiem stajni. Największe przekształcenia powiązano z działalnością budowlaną rodziny von Logau, która w 1547 r. weszła w posiadanie zamku i dokonała jego renesansowej przebudowy i rozbudowy o dolny człon podzamcza. Kolejne istotne zmiany miały miejsce w XIX w., kiedy to zamek został uratowany przed całkowitą rozbiórką i przystosowany do zwiedzania przez turystów. Działania te wpłynęły m.in. na wygląd jego obwarowań i otoczenia.

W tekście przedstawiono etapy powstania obwodu bastejowego. Odniesiono się również do śladów po nieistniejących jego elementach. Poddano obserwacji materiał budowlany, jak formaty cegieł i rodzaj zaprawy. W toku analiz wykorzystano technologie fotogrametrii naziemnej i lotniczej pozwalających na opracowanie wirtualnych modeli badanych obiektów. Na podstawie danych pozyskanych z lotniczego skanowania laserowego opracowano wizualizację modelu terenu wokół zamku. Dzięki cyfrowym modelom uzyskano informacje, które nie były czytelne w trakcie prowadzenia badań architektonicznych tradycyjnymi metodami. Autorzy wyrażają potrzebę przeprowadzenia dalszych badań, w szczególności archeologicznych, które pozwoliłyby na rozpoznanie niewidocznych reliktów zamku.

Słowa kluczowe: basteja, parkan, mur obronny, strzelnica, Grodno