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**MAIN TRENDS IN DEVELOPMENT OF FORTIFICATION TECHNOLOGIES
OF CASTLE CONSTRUCTION IN WESTERN UKRAINE
(second half of the 14th-16th centuries)**

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**ОСНОВНІ ТЕНДЕНЦІЇ В РОЗВИТКУ ФОРТИФІКАЦІЙНИХ
ТЕХНОЛОГІЙ ЗАМКОВОГО БУДІВНИЦТВА НА ТЕРЕНАХ ЗАХІДНОЇ УКРАЇНИ
(друга половина XIV – XVI ст.)**

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The article traces the development of fortification construction of defence complexes of Western Ukraine according to innovations in military affairs and technology. The main factors that contributed to the development of fortification construction during the 14th-16th centuries were determined, the author traced the main tendencies that were typical of the development of defence systems of Western Ukraine.

Key words: artillery, loopholes, construction, towers, war, wood, castle, Western Ukraine, stone, defence, strategy, tactics, fortification.

Introduction. Until the middle of the 15th century, artillery finally surpassed catapults, which were gradually disappearing from the military history arena. During next centuries, the main weapon of attackers was artillery, the strength of which was constantly increasing. Wooden siege structures – towers and rams – became completely ineffective, taking into account rapid destruction of besieged fortifications by artillery. As a result of such changes, during siege of fortifications the main role was played by artillery, which contributed to further development of fortifications construction technologies.

Problem statement. Given the geopolitical location of Western Ukraine, which was on the border of the east and the west, it is considered relevant to conduct a more detailed research of the stages of fortification technologies development that took place during construction of defence complexes located within the designated region.

Recent research analysis. Research of ancient Rus fortified settlements, as well as peculiarities of wooden and stone fortifications is given in works of M. Bevz; A. Bunin and T. Savaretska; N. Voronin; V. Dovzhenko; V. Kostochkin; N. Kradin; A. Kuz; M. Kuchera; O. Matsiuk; O. Okonchenko; O. Plamenetska; C. Planysko; L. Prybiega; P. Rappoport; P. Siredzhuk.

Regional features of ancient Rus towns, fortresses and their fortifications were considered in works of P. Drenko; I. Kachor; O. Matsiuk; R. Mohitich; O. Okonchenko; B. Omelchuk; Ya. Pasternak; R. Pidstavka; L. Prybiega; V. Pshik; P. Rappoport and V. Kostochkin; Z. Fedunkiv.

Aim. To trace the transformation of fortification and castle construction technologies in the 15th-17th centuries in the context of development of military affairs and technology, to trace the main trends of fortification construction in the region.

Materials and research results. During the given period, the method of gradual attack was spread on the Ukrainian lands. During the 16th-17th centuries throughout all the Ukrainian territories the most widespread was capture of a fortress by direct storming with usage of artillery. Defence of fortresses in Western Ukraine was more developed than the siege technologies. Successful defence of fortresses in the “century of gunpowder” was possible only with active actions of defenders. The besieged troops usually used the following methods:

- construction of retrenchments behind an area that is subjected to artillery attack the most; those were supportive (usually wood and earth) fortifications inside the fortress to strengthen internal defence after the enemy captures external fortifications;
- frequent raids aiming to destroy artillery, mine galleries and enemy live forces;
- counter mining to neutralize miners and blow up mines of the attackers. In order to detect mine galleries, there were erected trenches faced with stone that led behind the fortress walls.

During that period, both wood and earth, as well as stone defence structures actively coexisted. Wooden log walls were usually connected either with the internal rampart structures located below them, the continuation of which they were, or put on piles, hammered into ram-

parts. An example is the old wooden wall in Kolomyia, which laid on piles, located in a quadrilateral in the earth ramparts [11, p. 108].

The logs of wooden fortresses were usually connected "in oblo" ("in a bowl"), i.e., the ends of the logs extended beyond the outer side of the wall. In that case, the upper log was placed in a semicircular cut-out of the lower log. In earlier buildings, a reverse scheme was used, i.e., the upper log with a semicircular cut was placed on the lower log, but then logs quickly rotted. The connection of the logs ends in the corners of both rectangular and multi-angle towers was carried out not only "in oblo", but also "in lapa", i.e., without extending the logs ends beyond the outer side of the wall [6, p. 13].

Walls and towers were usually covered with a roof. They were usually "in two planks", i.e., thin boards of softwood that were overlapped so that the top layer closed the gaps of the lower one. The roof "in one plank" was less commonly used. In that case lath was put under or battens were nailed on the top. Sometimes the ends of the planks were decorated in the form of dentils or feathers (spears). Wooden walls were covered with a coating, usually made of clay. Such coating protected the walls from burning. In addition, it looked like whitewashing and provided wooden defence constructions the appearance of stone buildings.

The masonry of stone walls was mostly stone-faced rubble. As a result, the structure was triple, consisting of two outer layers of facing masonry and internal rubble fill. The outer layers, especially the first one, were usually made of the hardest stone, softer stone like crushed or uncut stone was used for rubble fill, which together with mortar filled all the holes and depressions. Unlike monolithic masonry that was used in those lands much less often, such a construction of walls took much less time to build and it was possible to use wastes of brick and monumental construction [4, p. 104-107].

Clay was usually used as a mortar for foundations and lower parts of stone walls. The upper parts of walls consisted of lime mortar with addition of sand or crushed local stone. Stone walls were never erected without mortar [9, p. 234].

Walls and towers of some castles had a layered structure, i.e., consisted of horizontal rows of different stones. It should be noted that the boulder played a major role in fortification architecture. Cannonballs of the first artillery either splat or ricocheted when got at a boulder. That was why the bulk of boulders was concentrated on the outer sides of walls. But by the end of the 15th century, the power of artillery greatly increased. When a strong ball hit the wall, boulders shattered and pulled out. Therefore, the builders returned to stone-faced rubble masonry, placing boulders between layers of treated flagstone [2, p. 68]. Then, with destruction of the outer layer of flagstone, a stronger mass of the boulder rubble fill was opened, where each boulder was set much stronger and not easily fell out.

From the end of the 15th century, bricks became widespread as building material, which firstly had been

used only in military architecture. Sometimes brick and stone were used together - the bottom part of the wall was made of stone, and the upper part - of brick; or rubber fill was made, and the outer and inner sides of the wall were faced with brick. To increase strength of stone walls, logs for connecting the wall elements were used. The logs were longitudinal or transverse, and sometimes they were horizontal frames, connected with joints at the ends. Such frames were made of long parallel logs, connected in several places by transverse short logs. Frames were usually located in two or three layers along the walls. In tower walls, frames were sometimes like a "ring" of logs connected at an angle [6, p. 8-10]. In the 16th-17th centuries, iron elements became greatly widespread for connecting walls.

In northern regions of Volyn, where the area was a boggy lowland, fortresses were built among impenetrable bogies, which minimized the possibility of using stone mortars and artillery. Fortified settlements in those regions were mostly of cusp type and protected by defensive structures of various capacities. On the side where there were natural obstacles, fortifications were significantly less strengthened, due to impossibility of location of stone mortars in those areas. However, the side facing the enemy was always protected by several lines of ramparts and moats [15, p. 45-47]. The purpose of such fortifications was to force the attackers to push the stone mortars as far as possible from the fortification walls and overcome each line of defence in turns, under constant fire of the defenders.

For Western Ukraine, a system of three-line fortifications was the most common. On the first rampart there were walls of a fortress and a wall walk, the width of which was about 20-32 m. Such dimensions were explained by its use for equestrian movement. In front of this rampart there was a moat equal to 7-8 m in width, and between it and the second line of defence called a "stronghold", there was a moat with the width of 6-14 m. The stronghold was made of wood and was quite low, the width of the wall walk was 2-9 m. Between the stronghold and the third line of defence there was another moat with the width of 14-15 m. The third line of defence was 2-3 times higher than the barrier of the first two lines, since it fired all the surrounding area [3, p. 21-24]. In Galychyna, defence of the outer town consisted of three parallel lines of ramparts and moats. The ramparts were slightly spaced and the total width of the defence belt was 84 m from the outer rampart to the ridge of the third rampart. It was important that in order to achieve the greatest fire effectiveness to destroy the fortress walls, stone mortars should have been at a distance of no more than 50-60 m from the first rampart. However, at the same time, the military operating stone mortars turned out to be in a disadvantage - the defenders of the outer rampart could fire at them at a very short distance [5, p. 240]. Thus, the storming attackers were forced to fight for each line of defence in turns, and be under fire from all the defence lines of the fortress.

Like in Volyn, cusp type fortresses of the second half of the 14th-first half of the 15th century had a "one-

way” character, i.e., one side –facing the enemy, was protected by powerful artificial fortifications, and the others– with weaker defensive structures. On the side facing the enemy, there were wooden towers, which provided flanking fireas the most effective against the forces storming the wall. On the side facing the enemy, it was possible to carry both frontal and flanking fire, and on the other side – only frontal [12, p. 7-9]. Such a defence system was in towns of Starytsia, Romanov, Vyshhorod on Protva, Pleso, Galych-Merskyi. The smaller the length of the side facing the enemy was, the lower cost the fortress erection required, and the better it was protected. Fortifications of the 14th - the first half of the 15th century had the same principles of planning.

The 14th-15th centuries were the period of permanent construction of fortifications in Galychyna, Volyn, Novhorod and Pskov. In contrast, at that time, in north-eastern Rus, they did not only erected new defensive structures of outertowns, but even did not reconstruct the old fortifications built in the 12th-13th centuries.

At the turn of the 14th-15th centuries, in the region wooden fortresses were also built, which continued to coexist with the stone ones. Sometimes one fortress had stone and wooden walls at the same time. In the western lands such examples include fortifications of Galych and Kholm, where stone walls were usually used to protect the most vulnerable side facing the enemy.

In the 15th century ramparts generally did not have an internal wooden frame and consisted of just earth and stones. In those cases, where the internal rampart structure was still present, it was simpler than that used in ramparts of fortresses of previous centuries. Such a construction was mostly anoak log wall with short transverse cuttings, which extended beyond the outer side. It is worth noting that in some of the fortresses of that period there were found inclined wooden frames located in the outer side of the rampart. The wall of the internal rampart structure extended over the surface of the rampart ridge. The front slope of the rampartwas always steeper and at least 30° to the horizon, and the otherone – flatter. Compared to ramparts of the 11th-12thcenturies, the horizontal platform on the top of the rampartbecame wider due to complication of the walls construction and its width could be 8-9 m.

Moats in fortresses of the 14th-15th centuries were deep and wide. The moatwidth was of particular importance for protection of settlements from the fire of stone martyrs, and then artillery. Moats were located so that they could move the enemy troops to the maximum distance from the fortification walls. Moats had mostly a symmetrical profile with a slope of walls at an angle about 30° to the horizon.

From the middle of the 13th century in the majority of Rus regions, an active construction of stone defensive structures began. Stone walls of fortresses in the 13th - the first half of the 15th century were of different thickness. From the side facing the enemy – the most vulnerable one, their thickness could be up to 3-4 m, and on other side it was 1.5-2 m. The thickness of stone walls, as well as towers, usually slightly decreased upwards.

They ended with a parapet with stone dentils, which in their turn ended with the roof. The thickness of walls at the top was determined by the parapet width, which was not less than 55 cm, and the width of the wall walk, which was supposed to be wide enough so that two armed soldiers could pass each other, i.e., about 1.5-2 m [8, p. 42; 14, p. 123]. Taking this into account, the optimum wall thickness should have been at least 2 m.

From the second half of the 14th century, there was a general tendency to increase the walls height, and in the first third of the 15th century– to make them thicker. Similar processes were observed at that time in Western Europe. From the middle of the 15th century loopholes were made in the walls for wall base fight [12, p. 109-111].

In the first half of the 13th century, fortresses practically did not have towers. Generally, besides the gate tower, typical of the earlier period, fortresses of that period were equipped with one or two towers that were located on the side facing the enemy. Those constructions were called towers, pillars and barbicans. The pillar was the tower, which was not connected with the fortress walls and stood apart. Towers and barbicans were both separate towers, and towers connected with the fortress wall.

During the 14th-15th centuries, fortresses were equipped with a large number of towers. During that period, their aim was changed as towers began to play an active part in defence. Towers of the 14th-15th centuries extended beyond the wall and were built mainly where walls changed the direction, i.e., on the corners of fortresses [6, p. 14]. Thus, they were built for flanking fire on bordering walls. The appearance of a large number of towers in a separate fortress was also associated with spread of artillery. That phenom on wasexplained by the fact that at the beginning of the era of artillery, the defenders of fortresses placed artillery in towers. In that period, defence of fortresses became more passive: it was active only on the side facing the enemy, and passive on the other side defended by natural obstacles.

Wooden towers were rectangular or multi-angle – hexagonal or octagonal – which were often called “round”in written sources [13, p. 71]. Stone towers had a rectangular, round or semi-circular shape. Some researchers believe that round stone towers were next stage of development compared to rectangular [14, p. 108]. This is explained by the fact that round towers largely avoided the fire of cannonballs, while the angles of rectangular towers were easily shot down. This hypothesis is proved by the fact that in some fortresses of Galychyna and Volyn, quadrangular towers were rebuilt into round and semicircular with appearance of artillery [14, p. 204]. It should be noted that the last two types of towers were better adapted to conduct “fan-shaped” fire than rectangular.

Thus, it is clear that round and rectangular towers coexisted actively both during the period of martyrs, and during the period of artillery. It should be noted that with appearance of fire artillery, the number of round and semicircular towers increased compared with the

previous period, but rectangular towers did not disappear completely.

From the 14th century towers were extended beyond a line of fortress walls, which allowed flanking fire. They were divided into tiers by wooden bridges – plank covering, grooves of beams of those bridges can still be seen in many of them. The number of tiers usually reached 3-4, and sometimes 5. The connection among tiers was made by wooden stairs through special hatches in coverings. Sometimes stairs were attached, and in case of danger they were pulled up.

From the end of the 14th century, towers were smooth, without vertical or horizontal splits, and slightly narrowed upwards. The surfaces of walls were not smooth, but slightly curved. It is worth noting that towers were never completely identical. Stone towers were equipped with two types of loopholes with and without chambers. Some researchers of medieval fortifications believe that loopholes with chambers were designed for placing artillery and appeared only after its spread [15, p. 140-142]. Loopholes in towers were located in a semicircle, which allowed firing in any direction – forward or along the walls. Loopholes of one separate tier did not give an opportunity for this, and there remained unshelled area in front of the tower. Such an area was under the sight of loopholes of other tiers. However, in Galychyna, Volyn, Pskov and other regions there were towers, loopholes of which were equipped with chambers. Construction of those structures referred to the first half of the 14th century – in the period when artillery was not very known. It should be noted that by the beginning of the 15th century loopholes with chambers were not wide-spread, but with spread of artillery, they became typical of fortress towers.

In the 14th-15th centuries in gate towers of Western Ukraine fortresses, there were drop gates, which were mostly made of metal, and rarely of wood covered by iron. In front of the gate, a narrow bridge on pillars was thrown across the moat. Until the middle of the 15th century bridges were made of wood, later, along with wooden, there were stone bridges. In the territory of modern Western Ukraine, as in Rus, particularly, lift-bridges were not built until the end of the 15th century.

Conclusions. Taken into account the above-mentioned, it becomes clear that at the beginning of the 15th century fortification technologies of all the previous eras were actively used in Western Ukraine. The main driving forces in the development of fortification technologies in the second half of the 15th-early 16th century were:

- permanent military clashes, which resulted from the military-political and socio-economic situation in the region in the 14th-15th centuries and stimulated qualitative changes in development of defensive structures, siege technologies, methods of battle conduct;

- wide-spread of artillery, which in its turn gave rise to a number of innovations in the fortification construction of the specified period.

It should be noted that these factors caused the development of fortification technologies in the region in previous eras as well.

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Аносова В. С. Основные тенденции в развитии фортификационных технологий замкового строительства на теренах Западной Украины (другая половина XIV-XVI ст.)

В статті, простежено розвиток фортифікаційного будівництва оборонних комплексів Західної України відповідно до новацій у військовій справі та техніці. Визначені основні чинники, що сприяли розвитку фортифікаційного будівництва протягом XIV-XVI століть, автором простежені основні тенденції, що були характерні в розбудові оборонних комплексів західноукраїнського регіону.

Ключові слова: артилерія, бійниці, будівництво, вежі, війна, дерево, замок, Західна Україна, камінь, оборона, стратегія, тактика, укріплення, фортифікація.

Аносова В. С. Основные тенденции в развитии фортификационных технологий замкового строительства на территории Западной Украины (вторая половина XIV-XVI вв.)

В статье, прослежено развитие фортификационного строительства оборонительных комплексов Западной Украины в соответствии с новациями в военном деле и технике. Определены основные факторы, способствовавшие развитию фортификационного строительства в течение XIV-XVI веков, автором прослежены основные тенденции, которые были характерны в развитии оборонных комплексов западноукраинского региона.

Ключевые слова: артиллерия, бойницы, строительство, башни, война, дерево, замок, Западная Украина, камень, оборона, стратегия, тактика, укрепления, фортификация.

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