

# **Elements of Polygonal Fortification on the Example of Lviv Citadel (Елементи полігональних фортифікацій на прикладі Цитаделі у Львові)**

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The aim of this article is to show the importance of interpretation of fortification complexes and their components as the elements of the more general defensive system on large territories on the whole.

In particular it concerns the whole frontier defensive lines, which include cities-fortresses, fortresses and other smaller fortification elements.

They were set the task of complete defense of certain territories. In case of change their political orders or administrative-territorial division and reorganization as well as the quick development of artillery and military tactics directly influenced the way of arranging fortifications. It could concern the arrangement of powerful fortifications on strategic crossings, communications, mountain passes, ports, cities and fortresses. All these fortifications operated systematically according to infrastructures and plans elaborated for them as well as the sources of supplying with food, building materials, accoutrements and all other things necessary for the existence of military fortification order, which showed the effectiveness of such system during the defense or hostilities.

During the arrangement of every new fortification there took place the modernization of obsolete fortifications which because of change in conducting war could not defend some points.

With the introduction of the new system of fortifications – polygonal, after the Napoleonic wars on the territory of Central and Eastern Europe, the old Vauban system sank into the background as nonserviceable for the arrangement of fortifications any more.

Underlying the polygonal tracing of the main walls there was mutual flanking of all protrusions and tenails. Every facet of this salient should have been covered with fire from the other and the caponiers were made for shooting through the ditch and approaching them. Behind the main wall there were multistoried casemate reduits which had to dissuade the enemy from the beginning of the siege with their frequentative fire.

Huge armies with mobile artillery demanded now larger areas for retreat which a typical Vauban fortress could not provide any more. Even the very fortress became an easy target for the enemy.

The task was set to achieve two main factors: cantonment on the large area of a fortified camp for a considerable quantity of troops and the defense of the city-nucleus with the main wall from hostile bombarding. On this purpose French military engineers M. R. Marquis de Montalembert and Napoleon's general J. Rogniat worked out a smart system of detached forts in their treatises. They formed the fire circle being settled from each other in the sufficient distance for mutual flanking. The radius of this circle was long enough for the enemy's cannon shot not to reach the central nucleus: city-fortress, fortress or a large fort.

New fortified encirclements, citadels, forts were formed according to the same principle of mutual flanking. Lviv Citadel built in 1850 – 1856 will be observed as the best example of illustration of such a retrenched camp and the way of fire covering individual objects of fortification.

Before beginning the survey of the citadel fortification complex components we should become acquainted with the terminology of military structures and fortifications which was mostly written in Italian and French and later it was translated into other languages, German, for example, (the term *Sternschanze* – the star-shaped fort, *Wallgang* – entrance in the defensive wall) and thus entered the terminology of military structures. Reaching the immediate sources as well as finding the translations of these works is important in the research of fortifications. A certain defensive element was given an appropriate name in accordance with the functions immediately upon its appearance (*Barbet* – literally from French, the headdress of nuns, actually, the position of cannons, citadel – head of the city, from Italian, – in the fortification terminology – citadel).

It is important to know the succession of the arrangement and purpose of the fortification elements, polygonal in particular, while analyzing them.

Also we should start with the basic term of *fortification* – reinforcement, beginning our analysis with defining the object.

For this reason we shall take the textbook on fortification war for the officers with different armaments published in Stuttgart in 1836 under the authorship of Carl von Zontag, a military engineer. The term *fortification* and its purpose are described briefly and clearly in it.

- **Fortification** - the environment of the area-surface, protected with entrenchments or works, to oppose the superior attack of the enemy with own means.

The fortification can be divided into the permanent and semi permanent or temporary.

- **Permanent fortification:**

- **Regular** – is the permanent fortification, in which all fronts and angles are equal and similar to each other.
- **Irregular** – the works are adapted to the terrain, and so the mentioned fronts and angles are no longer equally dropping out.
- Surrounded with the permanent fortification area –surface, depending on its size, location and composition is divided into Fortress, Fort and Citadel.
- The fortresses have both offensive and defensive purpose. In the first case, when several are in a line, as operation base, and individually as supportive or following points of the attacking army.
- In the second case they defend coasts, overlook harbors, narrow passes, or big depot of weapons, ammunitions, provisions and trade items against the enemy seizures, protect the borders of countries, hinder the intrusion of the enemy and serve as the place of refuge for the beaten army.
- The fortresses are divided into three classes: the first rank Fortress or big fortress, when its perimeter is formed with the polygon of 12 or more sides, the fortress of the second rang or middle fortresses when their polygon consists of 8 to 11 sides, and the fortress of the third rank or little fortress with the polygon only of 6 to 7 sides.
- The small fortified place from 3 to 5 sides encloses and is independently situated, then it's called – fort, and citadel, when it is built into the fortress.

- The citadel had an aim to keep under control part of the rebelled inhabitants of the place, and part of the insurgent place in case when the main walls of the fortress fall down and the enemy breaks into the city.
- Between the citadel and the houses of the city there is a big free space, called esplanade, through which in case the enemy breaks into the city or fortress, it will not be able to use the houses as protection from coming closer to citadel and will be exposed and destroyed.

Having figured out the planning and situational position of the citadel, as well as its function, we shall add the explanation of citadel from the textbook on architecture for students by the British Royal Major Hector Straight:

- **A citadel** should, if possible, form part of the general outline of the fortress, so as to be able to communicate with, and receive supplies from, the country during the siege; and yet ought to be in a position so formidable, that the enemy would be forced to attack any other side in preference to the citadel.

Here we get another important instruction in accordance with which we should dislocate the citadel. So the most dominating place over the city is not sufficient. It should be situated not only in a quite suitable place in view of the defense but also considering the control it should be near the arterial road which could guarantee the most direct and the safest communication with the depth of the state territory and its capital.

Having got acquainted with the main principles of positioning and functioning of the citadel we shall resort to a short historical excursus of its origin.

Vauban in his system began to introduce the basics of arrangement of the strongest point in the defensive system of fortresses – the citadel. According to it the encirclement of the fortresses anticipated polygonal tracing, actually an arrow-like curtain, in which the inner fortifications or the main walls were formed by the bastions with numerous auxiliary external fortifications (the fortifications between the main walls and the glacis, ravelins, tenailles, counterguards). The tangent fortifications of independent defense (reduits, forts, field fortifications) were situated before them. In the opinion of the fortificators of that time: the more bastions the fortified encirclement had, the more efficient it was.

Between the city and the citadel there was a buffer zone – an esplanade with the ban on building on it.

Apart from this every fortress and citadel had their own regime zones within which regular building was conducted. These zones had a general determination – rayon (the area around the fortress with partial or absolute ban on building civil structures). Their number and expansibility were determined in different ways in each state.

The new form of citadel planning in accordance with Vauban's principles was elaborated at that period. It was a regular polygon or a star in the planning. This principle was so successful that its founder Vauban was invited to numerous European cities in order to renovate or build anew their defensive system. However, it had its own shortcomings. Accurate geometry of the citadel did not permit its location in the mountainous area because most of Vauban's citadels were situated on the plain surface. The defensive systems of the cities Oléron, Neuf-Brisach, Lille and others appertain to the best examples of the author. The most famous among them all was the citadel in Lille, called by Vauban "the Queen of the Citadels" (*Reine des citadelles*). It consisted of five bastions. It was accessible through the balance-bridge. The buildings and the pentagonal bridgehead were situated in the middle of the citadel.

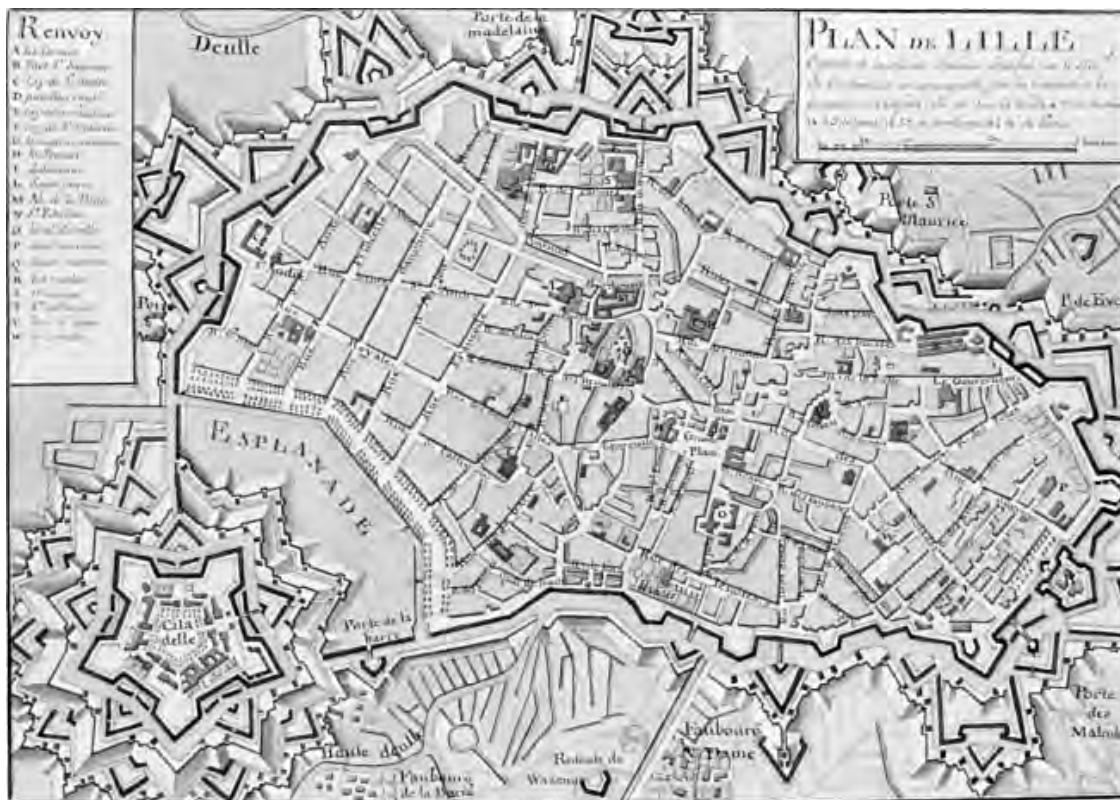


Fig. 1. Plan of the Lille's citadel

Yet every bastion and the curtain between them demanded those auxiliary external fortifications which in their turn were not effective during the independent defense. Communication among them and the main wall was complicated and absent somewhere. The need in providing those objects with additional artillery or food was complicated. Obtaining these fortifications stipulated for the main wall in case of collapse.

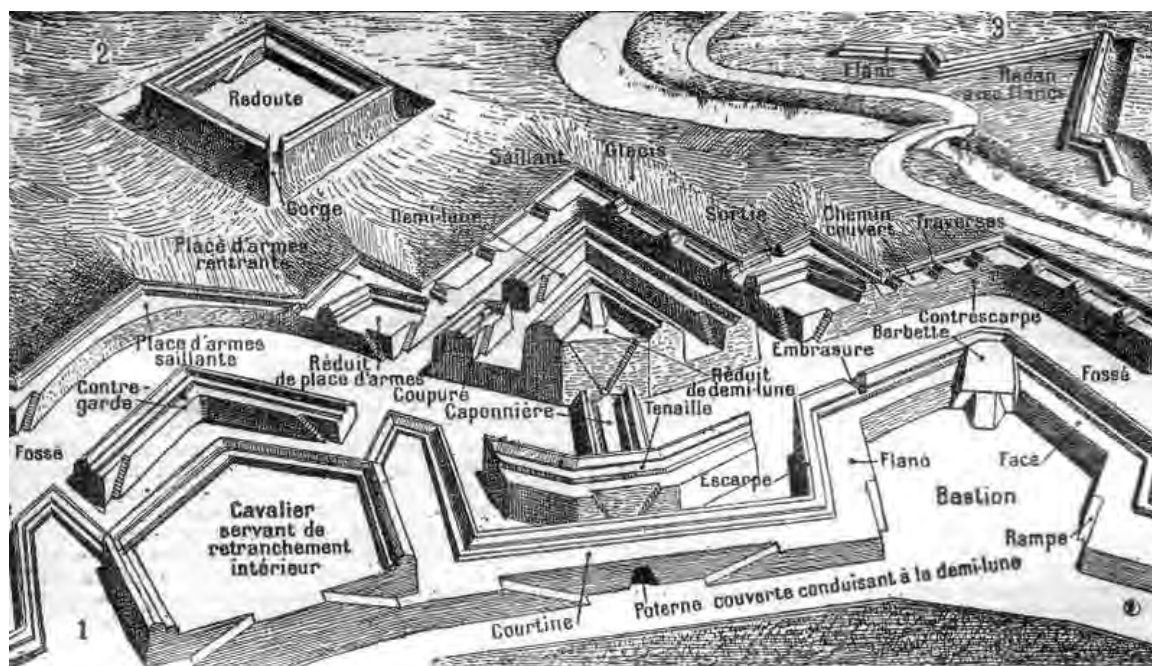


Fig. 2. The bastion system and it's elements

They tried to prevent the shortcoming of the bastion system by means of accumulation of bastion's bulk and number. Also the analysis of the stages of Vauban's bastion system proves that the fortificators were trying to eliminate these drawbacks by means of accumulating external fortifications as well as distancing them from inner fortifications.



Fig. 3. *The Vauban's three bastion system*

A striking example of this problem can be illustrated on three stages of Vauban's bastion system where he gradually accumulates their bulk and number. However, gradual distancing of the external fortifications from the inner encirclement is also observed.



Fig. 4. *Three tracings of defensive systems: bastion, tenail and polygonal*

To understand the operation, disposition and designation of the defensive elements it is important to consider the fragment of the model of arrangement of the bastion system in the second half of the 16-th century.

Observing the bastion system let us compare it with the following two types which form a polygonal system: tenail and caponier.

The arrangement of jaw salient of the same size along the perimeter of the fortress underlay the tenail system. The facets of salient should have been covered with fire from the adjacent salient creating flanking fire not to allow the enemy to approach the curtain.

The polygonal system is developed according to the rule of mutual flanking. Flanking of the main ditch turns into a prolonged caponier from the curtain. In its turn it is flanked with the indentations in the curtain.

In the future this caponier was substituted by prolonged reduits with several levels for the artillery.

In 1776–1778 the work in four volumes „La Fortification perpendiculaire, ou essai sur plusieurs manières de fortifier la ligne droite, le triangle, le quarré et tous les polygones, de quelque'étendue qu'en soient les côtés, en donnant à leur défense une direction perpendiculaire” by the French military engineer Mark Rene Marquis de Montalembert was published in Paris.

Engineers of the states, members of the “German Federation” of new-Prussian polygonal school later used the examples of arrangement of new tracing of the fortified encirclement represented in it as a basis of elaboration – a variety of polygonal system.

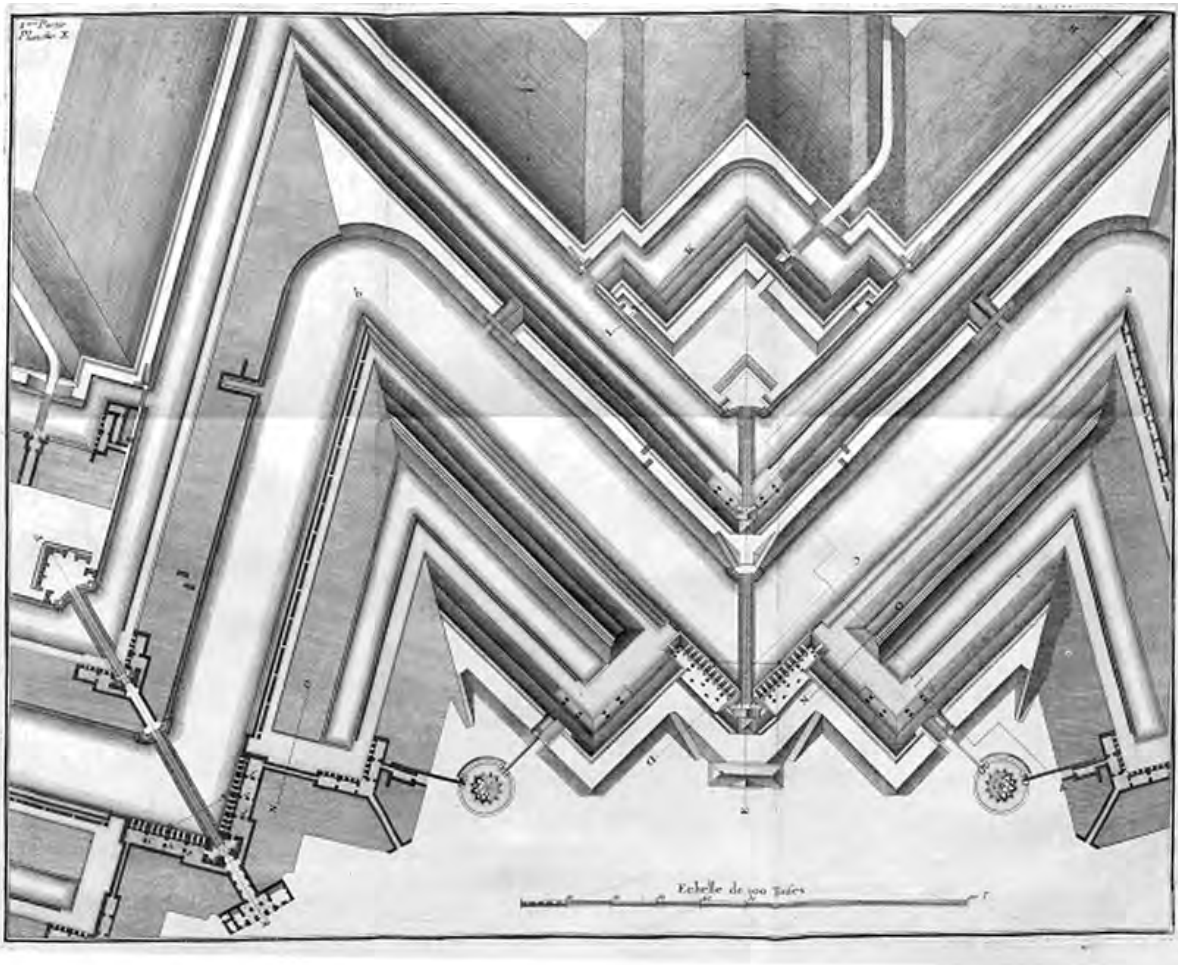


Fig. 5. The example of the tenaille system after M. Montalembert

In accordance with Montalembert, it was suggested that the place which needed reinforcement should be surrounded with four defensive lines.

The first one consisted of a glacis, a hidden path and place of arms on the reentering angle, where the casemate battery for the mortar and the counterscarp wall were situated. Behind them there was a dry or damp ditch with lunettes and scarp walls. The third line of defense formed by a big reduit-caponier and the curtain with the casemate gallery for the infantry riflemen was hidden behind the lunettes. Beyond it there rose the third line of the main earthy wall on which there were the positions of artillery. The cavaliers organizing mutual flanking were arranged in the curtain in sections between the reduit-caponiers. (Fig. 6)

Thus, as Montalembert anticipated in his theory – all facets of the salients were flanked mutually, the number of positions for the artillery prevailed over the quantity which the enemy could dispose of and was defended in the casemate structures at the same time.

As well the area around the nucleus which could be occupied by the enemy for arranging the batteries of fire, was transformed into the territory for a fortified camp. The circle of tangent forts situated according to the principle of their mutual flanking guarded its boundaries.



Fig. 6. The example of the caponier or polygonal system after M. Montalembert

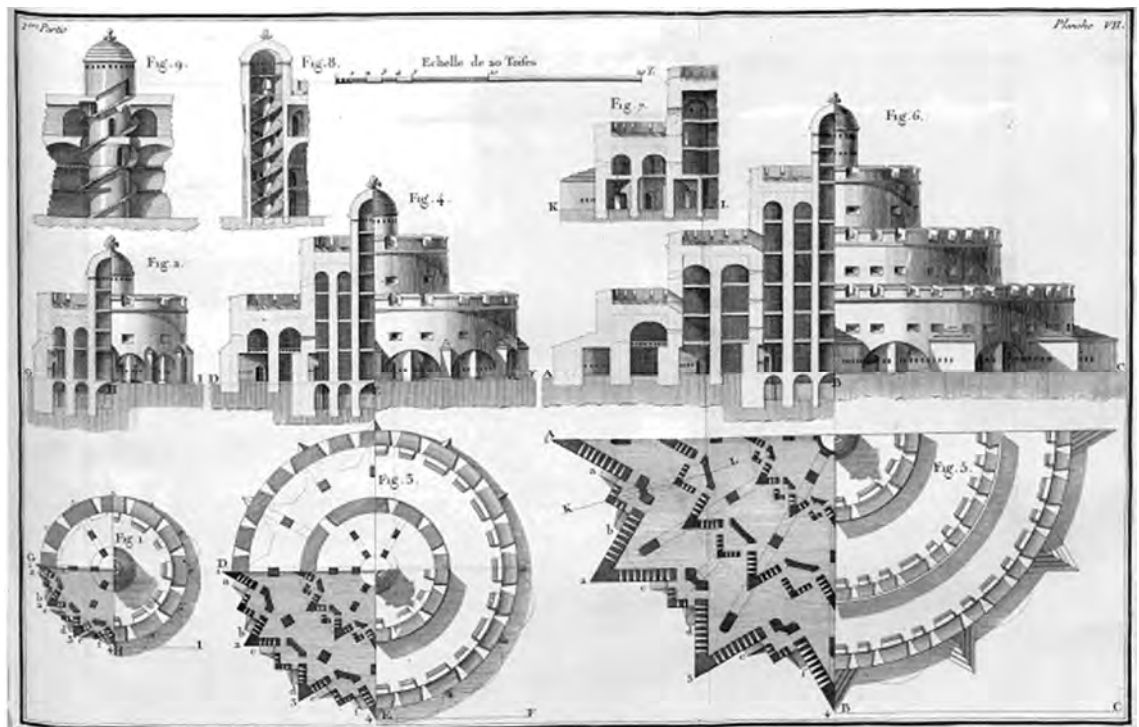


Fig. 7. Three types of the casemated artillery towers after M. Montalembert

As a basis for those tangent forts Montalembert elaborated and modeled a casemate artillery tower that could easily be reinforced on the mountain peaks hard for fortification.

This tower could be used as a fort reduit being surrounded by the curtain of wall. In case of need to give the fortification more considerable meaning the tower was enlarged in the dimensions twice or three times or was hoisted in a vertical position.

On receiving the model of polygonal fortification the basis of which formed a circle of the tangent tower-forts and the nucleus-reduit, we can read the scheme of Lviv citadel planning and disposition.

1. It was situated on the route which connected the city – the capital of the Habsburgs Halychyna with Vienna and the other part of the empire.
2. It was set on the position dominating over the city – on the hill, which since ancient times the enemy had used for firing (the siege of the Turks and Cossacks in 1648, 1655, 1672).
3. The presence of existing citadel with the new fortified encirclement of the city suburbs had been anticipated in the unfulfilled plan of the reinforcement of Lviv since 1853.
4. In peaceful times there were up to 814 military men on the citadel and up to 1240 men during mobilization. The space for the officials and their families was provided as well.
5. Three forts of Franz von Scholls fieldworks scheme were built on the southern slopes along the main communication – the Stryisk high road in 1.5 km from the citadel. Thus the hills dominating over the citadel were defended and a retrenched camp with the citadel as its nucleus was built.

To have a complete picture of polygonal system after getting familiar with the basic elements of polygonal fortresses arrangement in the first half of the 19<sup>th</sup> century let us now consider the defensive elements of the citadel.



Fig. 8. Unrealised project of the Lviv's new fortification system with the citadel. Year 1855





Fig. 9. Plan of the Lviv's citadel Rayon with matching of its regulatory area for development. Year 1853

The fortified encirclement of the citadel consists of the earthen wall curtain which forms an irregular quadrangle. Four forts – casemate artillery towers – are situated on its angles.

The main wall curtain between them is broken off to the middle and outside so that the forts are mutually flanked and their sides are covered with fire from the *reduit-nucleus* – the middle of the citadel.

To the south and to the north from the nucleus between the perimeter of the main wall and the forts there were two places of arms: *Waffenplatz A* and *B*.

Redan with a parapet, barbet and two apparels was arranged in the southern curtain of the main wall where quite a wide place of arms – *Waffenplatz - A* was situated to flank southern forts III and IV.

The postern with loopholes along the front side was situated in this redan closer to fort III. There was a hidden path from it to the fortified camp on the Stryisk hills. This way joined the Stryisk highway which led to the capital of empire. The earthen ravelin was built before it to shelter the postern.

Forts-towers were the peculiarity of the arrangement of the fortified encirclement. Considering the function of citadel as a gendarme building the towers from the city side (p. I and II) are seventeenhedral with the inner courtyard and refer to the type of embankment forts off Pula and Venice. The forts-towers closer to the south (III and IV) are smaller. They are ninehedral with the staircase in the middle and refer to the towers of Verona type.

Up till now no analogous arrangement of the fortified encirclement of the citadel or fort with casemate artillery towers as independent components of a single complex had been found on the territory of the former Habsburgs Empire.

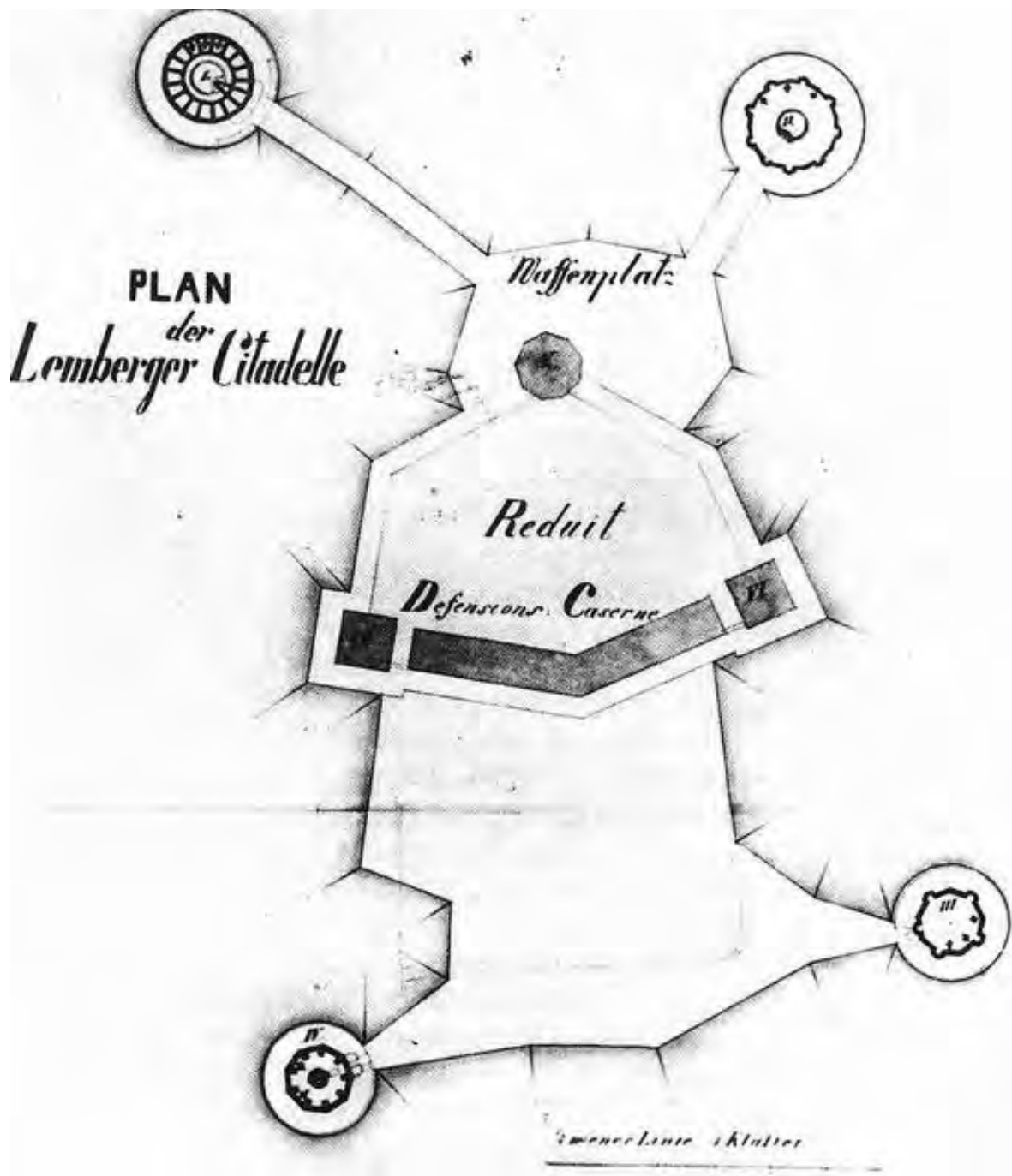


Fig. 10. Plan of the Lviv's citadel. Year 1855

The trapezium-shaped reduit was in the middle of the citadel. The defensive barracks of indented shape formed its front side. A multistoried tower-caponier flanked their gorge side. On the flanks of the reduit facet there were two quadratic artillery towers p. V and VI with the duple artillery layers. Unlike independent polygonal fort-towers (I, II, III and IV) they had one more storey. It was connected with Montalembert's theory who suggested four tenail defensive lines around the fortification, and behind the last one situated the reduit with two or even three artillery tiers.

In their turn they advanced the front line of barracks by one third providing for their flanking. The gorge side of these towers was even with the back line of defensive barracks. The whole back axis was flanked with a semicircular tower.

In addition the quadratic towers were connected with the facet of defensive barracks by a two-tier wall of Carnot's scheme.

A single-tier crenelled wall closing the area of the reduit lay along the flanks of the reduit from the quadratic towers and alongside of the gorge. There was the roundel along the capital of this fortification for flanking the gorge. The arrangement of all salients of the curtain of not only small embrasures for the infantry but also for the artillery is typical of the polygonal system. So flanking of the curtain among the polygonal bastions and salients was carried out not only by the embrasures for the infantry which formed the Carnot wall but also by the cannon fire from the especially integrated artillery embrasures. It is also pointed out in the description of the new-Prussian polygonal school in the abovementioned textbook by major Hector Straight.



Fig. 11. The satellite photo of the reduit with the present location of no longer existing roundel

Similar flanking was arranged on the flanks of polygonal bastions in Verona.



Fig. 12. Verona: 1. – view on the artillery embrasure of the polygonal bastion;  
2. – view on the artillery embrasures from internal side. Photo's 2011

Only the corner and a part of the gorge encirclement in the western side of the reduit is preserved now. The road runs on site of the bastion.

Having reviewed the planning solution to the reduit complex, we see how ideally there was elaborated the system of own flanking accomplished due to the curtain of barracks break-off, protrusions of artillery towers, the arrangement of the tower-caponier and a semicircular bastion in the middle of the gorge.

The use of two different types of rounded artillery towers confirms the author's deep knowledge of the fortification methods of that time.

As it has been already mentioned, the type of big towers p. I and II was used during the fortification of sea ports in Pula and Venice as independent reduits. However, there are two examples where they were used in the mountainous locality of Podguzhe to the south of Krakow (fort nr. 32 Kshemionky – non-existent, nr. 31 Benedict is preserved) and fort Wolgemuth in the town of Rivoli – Northern Italy.

Next type of two tower-forts Nr. III and IV is small ones with the winding staircase in the middle. Their closest analogues are four towers on the northern slopes of Verona. They are situated in a zigzag line along the road thus flanking its crossing.

These forts are also independently situated both in Krakow and Rivoli and can be perfectly used for the reinforcement of mountain peaks

The functional allocation and arrangement of towers was typical of the so-called Maximilian towers. The first tier was used for warehouses and was mainly either on the level of a dry ditch or in the basement. It was followed by the residential tier covered with the level of a wall and a counterscarp wall permitting to make the windows larger and wider. The artillery level was after it. On it there were cannons situated along the perimeter in the suite of chambers. Their haulage took place either through the aperture and a lift near the entrance or from outside through the system of hoisting through a wide door (the example from Rivoli).



Fig. 13. Rivoli: 1. – fort Wolgemuth and the tower;  
2. – internal view of the towers courtyard. Photo's 2011

Above it there was a flat terrace on which cannons could be arranged. For example, the grooves in the breastwork fastening the gun carriage are preserved in the small towers of Verona.



Fig. 14. Verona: 1 – the small maximilian tower nr. III;  
2 – view from the roof terrace of the small maximilian tower nr. I. Photo's 2011

All in all 108 people should have stayed in the big towers of Lviv citadel and 208 people during war. In its turn 10 people should have stayed in the small towers and 36 during war. It is not surprising that these fortifications would become out of date in 10 years. New rifled weapon would appear. It would pull down the visible multilayered reduits from the horizon. There was a paradoxical case when similar towers in the Dutch defensive system of “New Water Line” in the forts Gonsviyk and Weesp had the extra storeys simply blown off because of danger now.

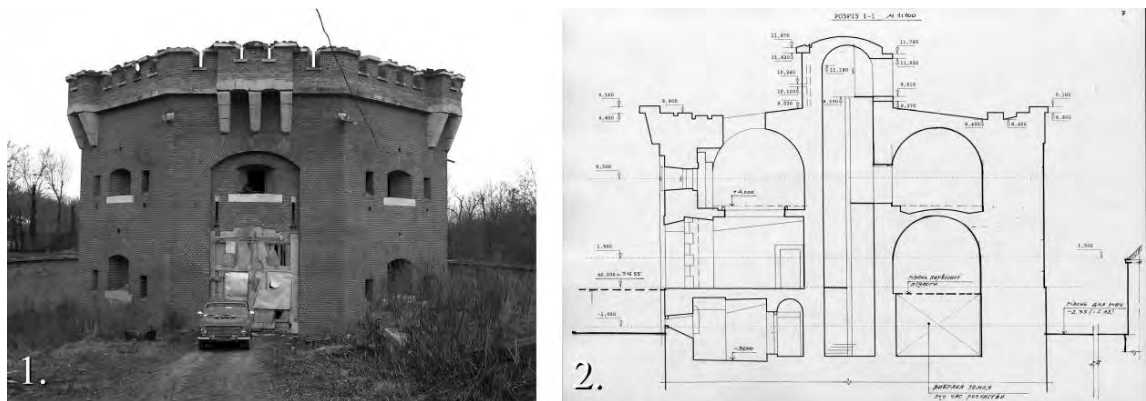


Fig. 15. Lviv: 1 – small maximilian tower nr. IV on the citadels western curtain;  
2 – section of the tower. Photo's 2004

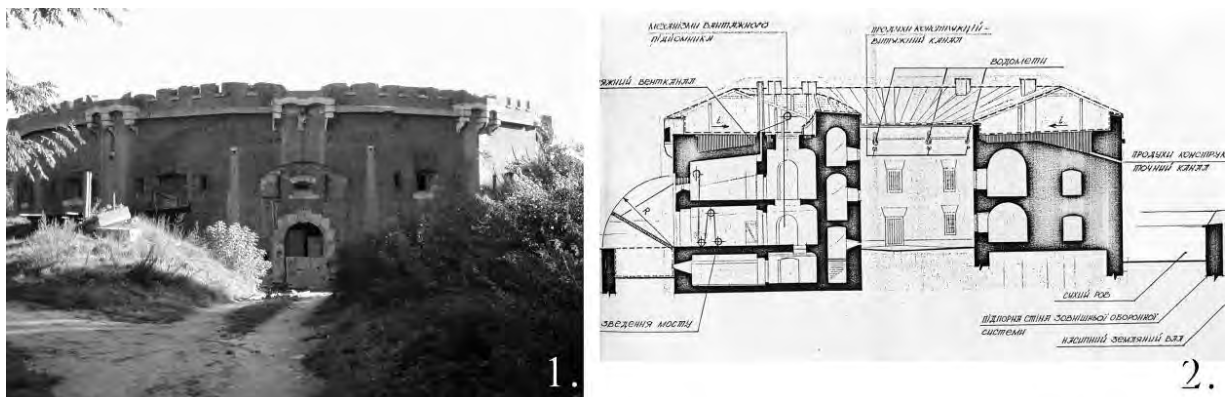


Fig. 16. Lviv: 1 – big maximilian tower nr. II on the citadels eastern curtain;  
2 – section of the tower. Photo's 2003

Very soon the fortification structure became useless. During hard times it was never used in military operations. It was involved only in the struggle for the independence of Ukrainian Republic in November 1918. Shortly after this it became a usual place of troops stationing. It is paradoxical but up to 1.000 000 guldens was spent on building this fortification pearl. It was built in 1850-1854. This is testified by the dates on the lock stones of towers. Let us point out that the city budget did not make even 350 thousand in 1851. (Kurzgefasste Zusammenstellung statischer Daten über die königliche Hauptstadt Lemberg im Kronlande Galizien. Peter Piller Verlag: Lemberg 1851. S. 30).

Looking at the modern condition of Lviv Citadel management, silent observation of the western community aware of the problem and its reluctance to interfere with the policy of ungifted management of the fortress are astonishing. It does not only refer to the very citadel but also to the old part of the city enlisted in the monuments of UNESCO. What two world wars could not ruin is ruined by a post-soviet society.

It is strange that giving numbers and huge building expenditures, the consummate quality of fortification works which have no analogues on the territory of the Habsburgs Empire is not enough for the competent processing of management project concerning its keeping. It is the most important step before elaborating any project documentation. The research can be continuous and there is a question of what to do with the results of investigation when the monument can be lost literally in a short time. As we see from the results of the conducted conference: the problem of keeping large polygonal and scattered fortresses is urgent for all European countries and demands complete preservation and representation of the fortifications that escaped destruction as the monuments of architecture with special purpose and of high quality and according to their erecting they should remain in their original shape and preserve their defensive zone so that their structure and aim might be easy to understand without adding other or supplementary elements.

Conservation of Lviv Citadel which is not only a local monument lies in introducing it into a wider complex of fortification system built for the defense of the north-eastern border of the Austrian Empire including the main fortress in Krakow, the fortress in Peremyshl, the fortifications in Lviv, the double bridgehead over the Dnister, in Mykolayiv and Maryniv, and a retranched camp in Zalishchyky.

Nonetheless we see that this question is of transboundary character and embraces the monuments of the nonexistent state in modern European Union. Facing the problem of the gradual loss of these monuments mostly because of the urban sprawl and having no national meaning for the state on the territory of which they are there arises the need to elaborate a single law with concrete instructions to their use and conservation, including them in a general register and catalogue as a joint intergovernmental acquisition. This is probably the only right way out of this uneasy situation. The member-states will benefit from it and their regions included in a single register will make use of equal privileges and the advantages gained from this.

The project "New Dutch Water Line" organized in the Netherlands which as a huge defensive complex was included in the UNESCO heritage may serve as one of the successful projects of such system coordination of a large defensive line.

The defensive system on the territory of the former Austrian Empire is much more valuable as it represents different periods of fortifications introducing the origin of polygonal system and finishing with the front lines of World War I. Unlike others, the constantly modernized fortifications on the north-eastern border proved to be powerful engineering and architectural structures which like any fortification could not develop so quickly as artillery and mostly depended on the operation of a regular army.

Once more I express my sincere gratitude to all the participants who responded and took part in this year's conference. A wonderful collection of articles is the result of a positive feedback about a well conducted event.