Architectural morphology of Fortified Palace in Pidhirtsi, Ukraine

Olha Tikhonova
Faculty of Architecture, University of Lisbon
Lisbon, Portugal

***Abstract*— This study is concentrated on a single castle morphology that remains as one of the best examples of Fortified Palaces in Europe. Different scholars studied the history of Pidhirtsi castle and its value as a part of composition design in the village landscape. However, the geometrical analysis of the Palace has not been done yet. This research aims to study the geometry of the country Palace ground plan and Elevation to find out which rules were used for its design. The author supposes that the Pidhirtsi castle was designed according to Sebastiano Serlio's rules described in the Book III of his treaties.**

Keywords- Pidhirtsi; fortified palace; geometrical analysis; proportions

I. INTRODUCTION

Pidhirtsi castle (Fig.1) is one of the best examples of fortified palaces in Europe. Also, it is one of the best-preserved palaces of this type on the Ukrainian territory. This study is a part of current research about Fortified palace phenomena in Europe, especially in the historical region Galicia (Ukraine, Poland). It is very important in the process of typological classification to have a detailed analysis of the Geometry of building plans of studied cases. This castle is especially important as it remains in good conditions until nowadays and we can study it precisely using the field observations, scaled drawings, along with computer program that will help to calculate the proportions. This research will contribute to the knowledge of Fortified palace type characteristics, and the results can be used for comparison with other European examples of this type.

Figure 1. Castle in Pidhirtsi (Author's photo, February 2016)

Unfortunately, there is no accurate evidence of the construction of the first residence in Pidhirtsi village. However, from some facts from archival documents it is possible to suppose that in XV, the beginning of XVI century, the Pidhoretski family was the owner of Pidhirtsi and had their palace in this place[1, p. 8]. Researcher Krzyczynski affirms that there is a mention about the castle in Pidhirtsi in 1637, namely that Grand Crown Hetman Stanislaw Koniecpolski built a beautiful castle in Pidhirtsi for recreation purpose [1, p. 9]. Also, he assumes that Konecpolski did not build the castle from scratch but made a reconstruction of the old residence in the Renaissance style, decorated with marble and golden sculptures and enhanced with bastion system of fortifications. Researcher Adolf Szyszko-Bohusz after studying the walls of Pidhirtsi residence went to the conclusion that the Renaissance palace was based on the remains of previously built fortified residence of XVI century [2, p. 155]. Namely the walls and vaults of the ground floor and basement belong to the previous residence. However, the first floor is totally new and doesn't have any traces of previous period. Also, there is no evidence about stairs that could lead from the ground to the first floor. So, probably the first residence was typical for that period 1-storey building.

The construction of the new stronghold in "Renaissance style" with Italian influence was finished in 1640 [1, p. 10]. According to Roman Aftanazy, it was built as analogous to Italian type "villa Castello"[3, p. 431]. We can find a great description of the beauty of the palace in Adolf Szyszko-Bohush research (Free author translation from Polish):

"Although that Castle in Pidhirtsi is a little delicate, it is the best building in Poland, and even in other countries, it would be one of the best examples. It is built in good taste. It consists of the main residential palace with two corner pavilions and small, slender tower with a dome in the middle of the building, which creates a good impression of the total height of the monument…The only imperfection is its small size and slimness[2, pp. 150–151]".

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II. Literature review

Boguslaw Dybas in his studies [4] raised a question about the military value of noble residences in XVII century in Poland. He studied different aspects of fortified Palace in a way to find an answer to the questions:

- Which of the fortified palaces have bigger military value than residential,
- Which of them have stronger military features than others?
- Which of them are more like forts than residences?

Also, he tried to answer which of castles were built just for a residential purpose and which were built (if such was) for the country benefit (country defence). He underlines that this period was a transition period for a new military design. The strongholds were increasing in size according to new rules in fortification geometry. Those rules appeared in reflection to the intervention of firearms. The author claims that we can find different types of Fortified residences in XVII century with a different defence system. However, the new fortifications of XVII century were built with bastions. However, it is hard to say that all of them were strong enough to resist new weapon technology. Even the noble residence with well-developed bastion fortifications according to all military rules could reflect not only high-quality military technology but also be an example of aesthetic beauty and prestige. In some cases, the military value went to the background and became minor than the comfort of the owner [4, p. 71]. The best example of such objects is Fortified Palace in Pidhirtsi, according to researcher Dybas:

"Although it was surrounded by light fortifications, which could even serve as a military pretext against a weak counterpart (for example, a small Tatar raiders), however first of all, it was a palace in which the fortifications did not serve the previously stated military objectives, but rather emphasized the status of the landlord[1] [4, pp. 71–72]".

The studies of a single building history as an example of Fortified Palace was made by Anna Agnieszka Zywicka [5] on the palace of Krzyztopor at Ujezdz in Poland. In her work, she explains the meaning of term Fortified palace as the building that is at the in-between structure of the military object and noble residence. The author determines it as a complex that represents two main functions: defensive and representative. Zywicka asserts that it was a specific type of palace with bastion fortifications that had raised in Italy in Renaissance period. Thanks to defensive walls which surrounded the territory complex, the palace does not need to have thick walls and could be more open to the landscape. However, she does not give the detailed spatial evaluation of the castle. She provides the reader with a short history of Krzyztopor complex and describes its main elements. Additionally, she drew an analogy of the Krzyztopor castle shape to Fortified Palace of Farnese family in the town of Caprarola in the province of Viterbo, Italy.

1 [1] Free author translation from Polish

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Specific research on the periodization of Pidhirtsi castle was done by researcher Kossak [6]. Source affirms that Pidhirtsi castle "was built earlier than it was said noted in scientific sources" [6, p. 144]. Author has got to this point using notable proves that was found during field observations and analysis of other examples of noble residence from different periods. Interesting for our research facts are connected to the main corpus. According to Kossak, initially the palace had two levels, and after the restoration in 1680 the third level was added [6, p. 147]. Also, an outdoor staircase that connects inner courtyard with the second level of the palace and terrace was added during the restoration. Author explain it using the fact that constructive solution of staircase completely independent from the palace: windows are walled up and hidden by stairs on both sides. Also, the author asserts that the main staircase was constructed in a late Gothic style and was embedded in the bearing walls, not symmetrical to the axis a house that is not permissible for the Renaissance time. From what has been said it follows that the palace was initially built as a one-story building on square or rectangular plan with square towers on the corners.

Oresta Remeshylo-Rybchynska in her article [7] studied the development and main components of architectural design of noble ensembles in XVII-XVIII century and the main components based on the example of Pidhirtsi village with a monumental complex that includes fortified palace. Source emphasis that the main shape of noble residence design in the second half of XVII century characterized by a hip roof on a rectangular plan with four faces and could be diversified by towers or corner risalits. Also, the author affirms that in that time in noble residence construction was dominating a design-driven from Italian structures of palaces of XVI century, namely the Poggio Reale Villa (Fig.2) that became a popular example of design between Italian architects. It was a very rational plan under the point of view of the classical composition. Also, it was described in Book III of Sebastiano Serlio's architectural treatise [8, p. 240]:

This palace has a most beautiful shape for a modern building…the courtyard of this palace is surrounded by loggias, one upon another. In the central part, marked E, many steps were descending to a beautiful paved floor…At the corners of these, inside the thickness of the wall, there are spiral staircases for climbing to the upper parts, and the upper floor is the same as the lower.

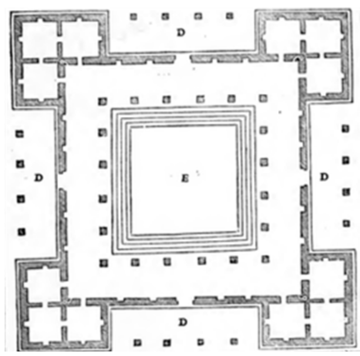


Figure 2. Plan of villa Poggio Reale [8, p. 241].

As we can see from the picture (Fig. 2), Poggio Reale was a palace based on the square plan with courtyard and had four towers-pavilions on the corners. The studied example, a castle in Pidhirtsi, has a hip roof on a rectangular plan too. However, it has just two tower pavilions on corners from the north-eastern and northwest sides of the main corpus. Nevertheless, to prove Remeshylo-Rybchynska supposition that Pidhirtsi as other palaces of XVII century in Ukraine was design based on the rules of Italian architects we can study the proportions of Pidhirtsi ground plan.

III. Research Aims and Questions

Aim 1: Study the composition of ground plan and main Façade of Pidhirtsi castle.

Aim 2: Provide a hypothetical reconstruction of the design process of Pidhirtsi Castle.

Questions: Was Pidhirtsi castle designed according to Renaissance rules?

Hypothesis: Pidhirtsi castle was designed according to Serlio’s rules, and it is possible to recreate its hypothetical design process.

IV. Methodology

The starting point for this study was based on the approach used by Rui de Klerk [9] for analysis of the geometry of Quinta das Torres (Palace, in Setubal, Portugal from XVI century). He provides a geometric analysis of the ground floor of the palace to understand the composition of the palace and find out the rules (proportions) according which the palace was designed. He took seven mains proportion values that were described in the First book of Sebastiano Serlio [8, p. 30], namely:

- perfect square (1:1);
- “sesquiquarta”, that is, square and a quarter (5:4);
- “sesquittertia”, that is, square and a third (4:3);
- “diagonal proportion” (√2:1);
- “sesquialtera”, that is square and a half (3:2);
- “superbipartiens tertias”, that is a perfect square divided up into three equal parts and two of those parts added to it (5:3);
- “double proportion”, that is two squares (2:1).

Also, the author considered another proportion such as golden ratio, and 2: √3; √3: √2; √3:1; (2+ √3): √3;(1+ √2):1; (2x √2):1. Rui de Klerk divided a ground plan of Quinta das Torres into several main parts, such as a courtyard, whole plan, towers, principal rooms and their combination and checked their proportions with mentioned above. He used an error calculated as e (%)= |1-(R1/R2) |*100, where R1 was proportions mentioned above and R2 real measurements from the plan, to evaluate his results. If the error was more than 3%, it meant that that proportion was not used in the design of palace. As a result, he got that the main proportions that were used for the design of Quinta das Torres were “diagonal proportion” (√2:1) and “sesquittertia” (4:3).

Author of this research decided to go deeper into using this approach and use it in two dimensions for Pidhirtsi castle. Using the proportional rules and calculating the possible error in 3%, as it was done by Klerk in the Quinta das Torres, author of this paper analysed the Ground Plan and the Façade of Pidhirtsi country house. The process was applied just to the main building not considering fortifications. Although that Serlio wrote about several fortified mansions in his treaties, he did not specify the Geometrical rules for fortification elements, just for buildings and decoration elements. That is why the author applied this approach just for the main corpus. Olha Tikhonova used a top-down approach to analyse the Pidhirtsi castle ground plan to find the rules that were used for the design of the plan. Remeshylo-Rybchynska provided the ground plan. She has drawn a detailed plan of Pidhirtsi castle based on the field measurements, that she made with her students (Fig.3).

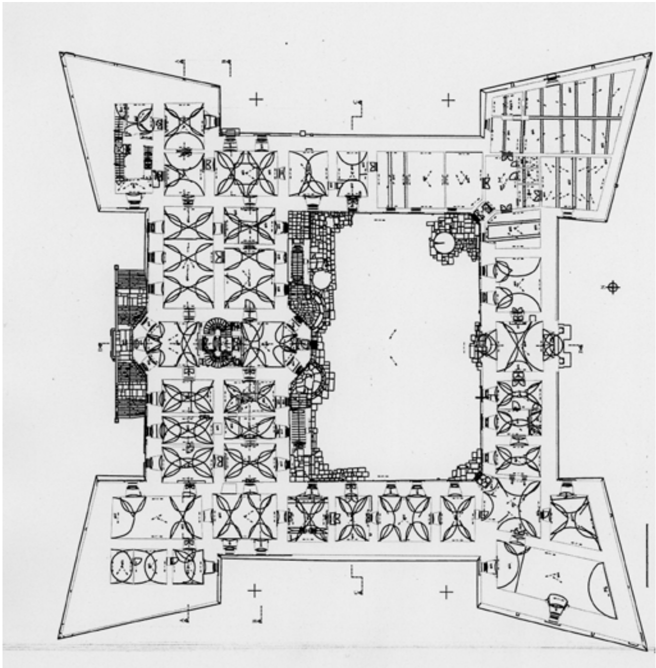


Figure 3. Dimensional drawings of the castle's buildings in Pidhirtsi made by Remeshylo-Rybchynska.

The first step was to simplify the ground plan into lines, using centerlines of the walls. Next step was to define the exterior boundary. This step was done manually starting from the biggest possible rectangle and after that trying smaller overall rectangle shapes using the main spaces (Fig.4).

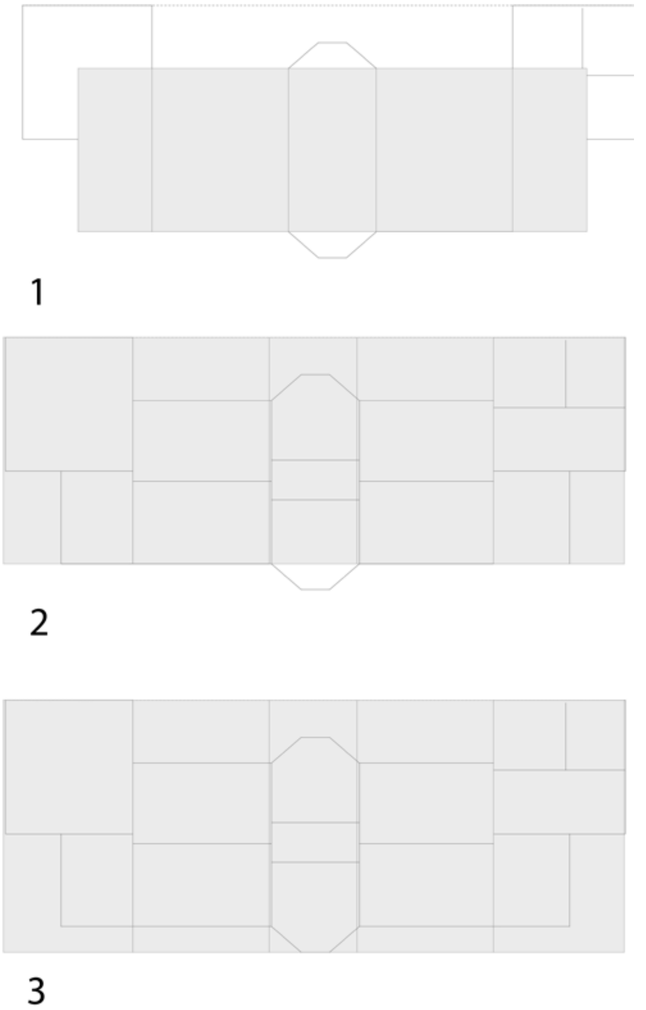


Figure 4. 1st stage: Definition of exterior boundary.

The second stage was compartmentation of the big rectangles, starting from triple vertical split (Fig. 5), and continuing division until the room dimensions.

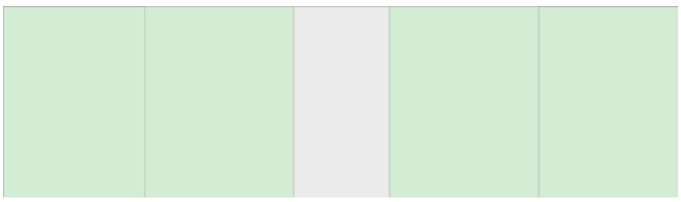


Figure 5. Triple vertical split

Then the author of the paper determined the ratio of each rectangle and took the previously described rules to compare with obtained measurements. Taking into consideration the error maximum 3% as the dimensions were rounded to meters, was found that there were six unique (some of them have duplications in the plan structure) rectangles with 0% error (Fig.6A). Looking to those smaller rectangles were determined the best fitted bigger rectangles (bottom-up method), (Fig.6B).

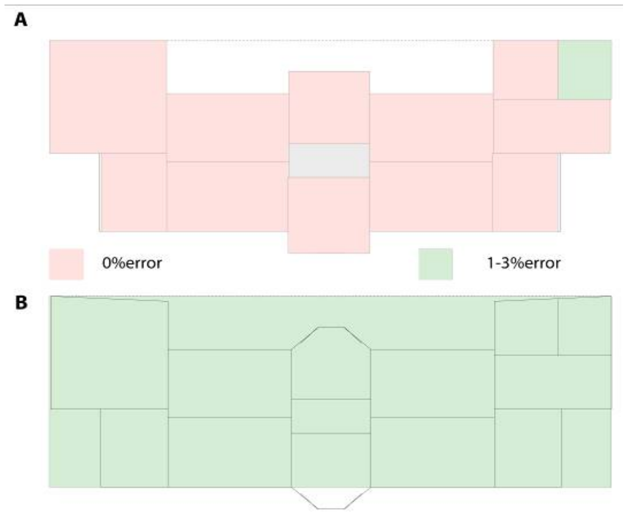


Figure 6. A- Rooms concatenation with the colour representation that shows the error value. B - The best fit exterior boundary.

A similar approach was applied to the main façade. The proportion of exterior boundary of plan perfectly fit the main façade(Fig.7).

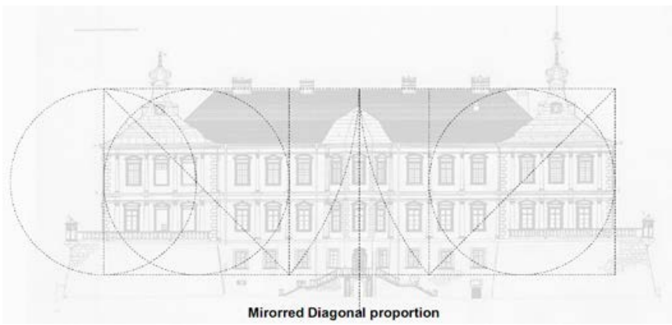


Figure 7. The mirrored diagonal proportion on the main façade of Pidhirtsi castle based on the elevation plan provided by Remeshylo-Rybchynska.

The next step was to transfer the lines that represent the main forms to the façade and find out other smaller proportions. After that the author divided the façade into several parts:

- roof
- entablature
- floors
- corner risalits
- avant-corp

The author started from the corner risalit roof. The second step was to find the proportion of the overall façade of the risalit. After that, floor body proportions were checked on each part of the façade. Likewise, the avant-corp geometry and windows proportions were done too (Fig.8).

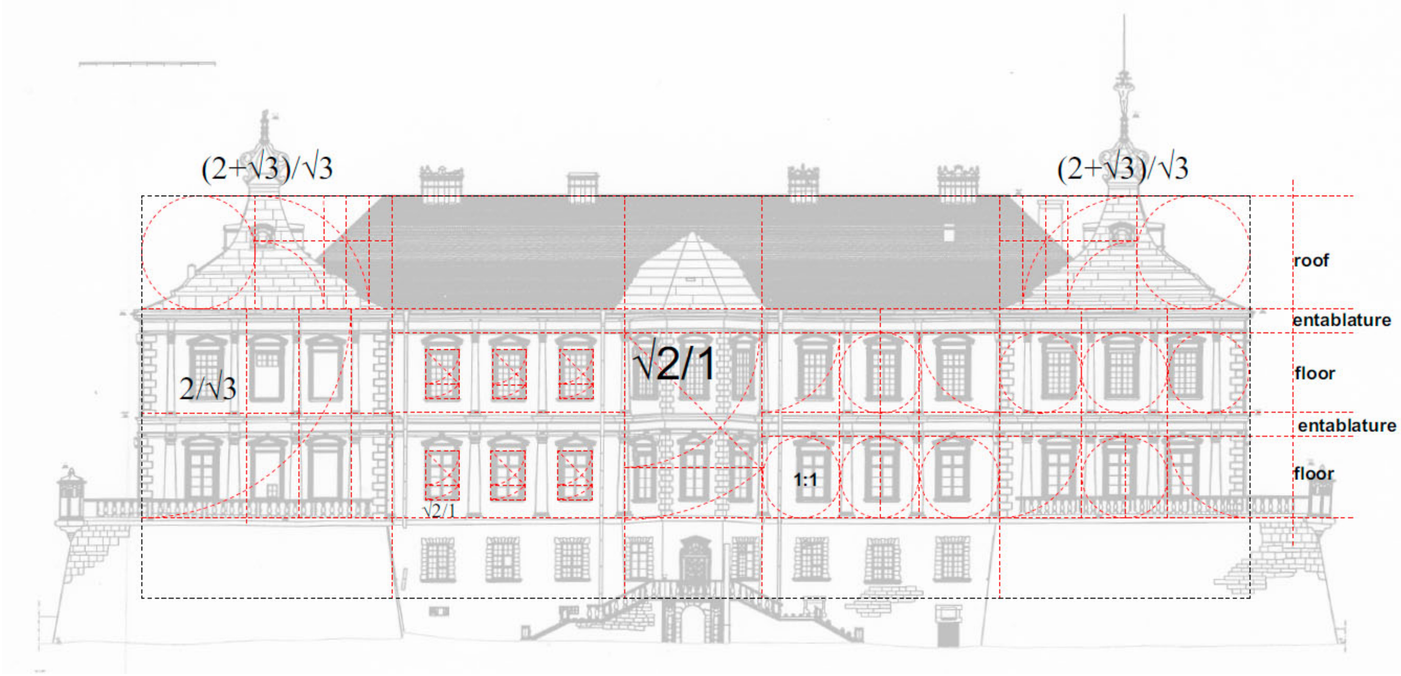


Figure 8. The proportions of the main façade in Pidhirtsi.

V. RESULTS

The results of defined ground plan proportions were following: 3 rectangles with the perfect square; 1 with "sesquiquarta" (5:4); 1 with "superbipartiens tertias" (5:3); 1 double (2:1) with 0% error. The main overall rectangle has mirrored diagonal proportion with 2.85% error. Last small piece had proportion 2: √3 with 1.02% error.

The theoretical reconstruction of the design process of the ground plan of Pidhirtsi castle is shown in the Table 1 step by step.

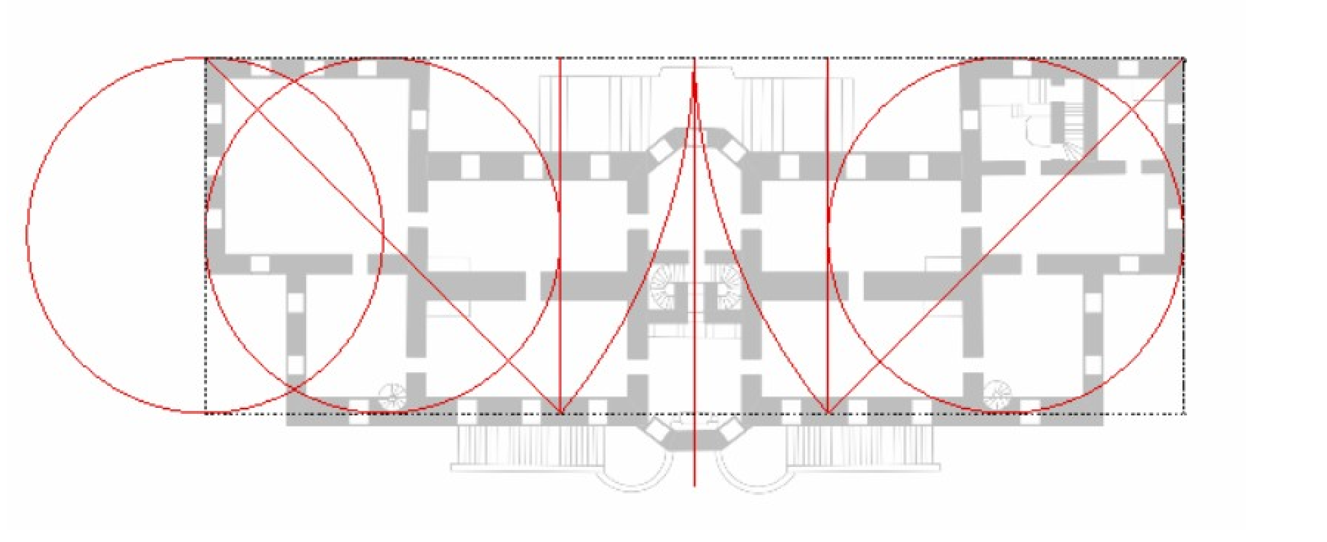
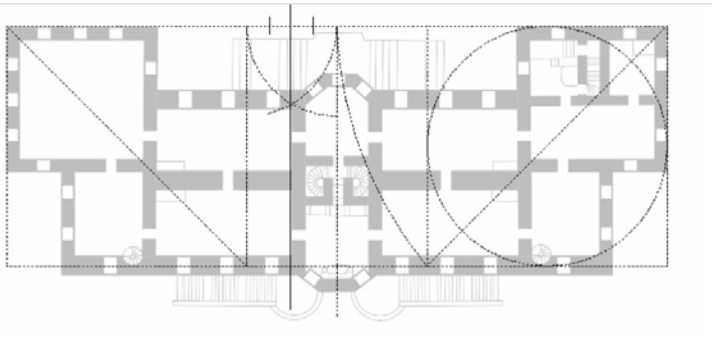
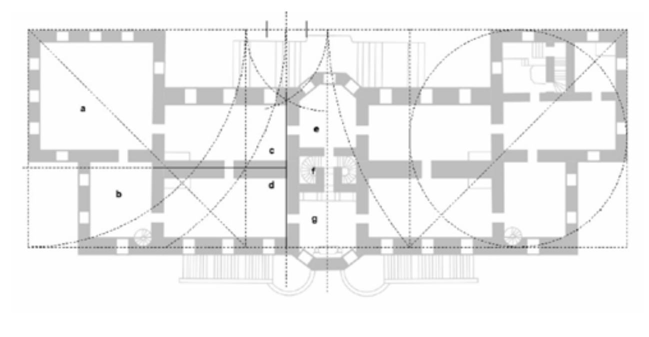
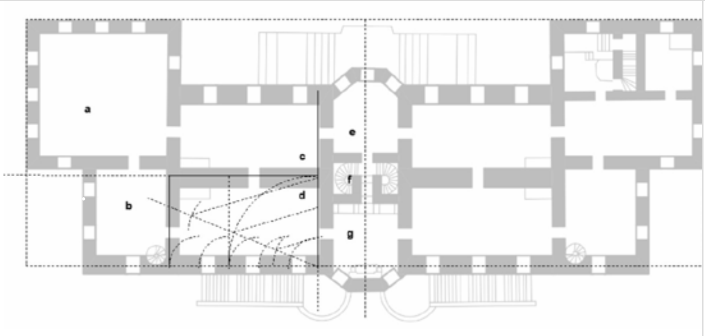
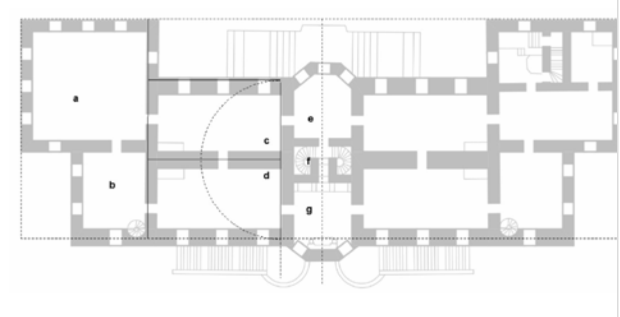
The façade proportions were following:

- The external rectangle of the ground floor perfectly fit the boundaries of the façade
- The corner risalit roof had proportion (2+ √3): √3 with an error of 2.22%
- The corner risalit body had proportion 2: √3 with an error 1.92%
- The avant-corps body had proportion √2:1 with an error of 2.85%
- Floor elevation consists of 3 perfect squares in a row on the first and the second floor with an error of 2.26%.
- Windows had proportion √2:1 with an error of 2.03%

I. DISCUSSION

Using this methodology, we can find out which parts of the design of the building that was made in Renaissance period were added in the later period (if the shape does not fit Renaissance rules). Otherwise, we can claim that building was constructed before that period and just some parts were added in the renaissance period depends on the question of the research. Also, it is very useful to study the design of the palace in 2-dimensions, using not only plans but the façades too. It is especially important in the studies about fortified palaces, where we have a big range of differentiation of the main corpus. It could be a castle that was redesign into the palace, or a villa that was enhanced according to owner's needs, or the entire new palace made from the scratch. Also, some examples were reconstructed in different periods of time to enlarge the building adding some new parts, because the initial space was too small for the new social requirements. In other cases, just, facades decoration was changed. Using this methodology, we can reconstruct the periods of formation of the Palace and pick up the changes that were done since its construction. The further step in this research can be the analysis of the geometry of defensive system of Pidhirtsi castle and its comparison with forts design. As we mentioned above the researcher Dybas claimed in his work [4] that although that Pidhirtsi castle had modern bastion fortifications, it does not have a strong military defence, it was more a palace than a stronghold. We have already checked and proved that Pidhirtsi design of the main corpus was done according to the rules that were used in palaces of that time. So, it would be interesting to know to what extent it has similarities with forts, which were designed to protect a country in that period.

TABLE I. THEORETICAL RECONSTRUCTION OF DESIGN PROCESS OF PIDHIRTSI CASTLE GROUND PLAN

<table>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">1st step: Application of the mirrored diagonal proportion for external boundary of the ground plan.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>2nd step: subdivision into equal parts the part that left next to ideal square</td><td>3rd step: Applying the proportion 2:$\sqrt{\mathbf{3}}$ we can define the line between space c and d</td></tr>
<tr><td></td><td></td></tr>
<tr><td>4th step: Applying the proportion “superbipartiens tertias” (5:3) we can define the boundaries of space d</td><td>5th step: Using mirroring we have got a boundaries of space c</td></tr>
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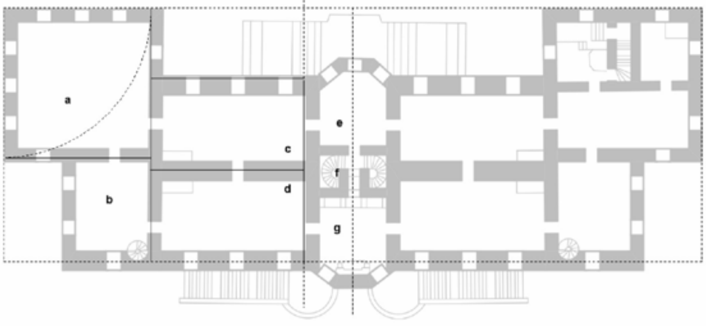
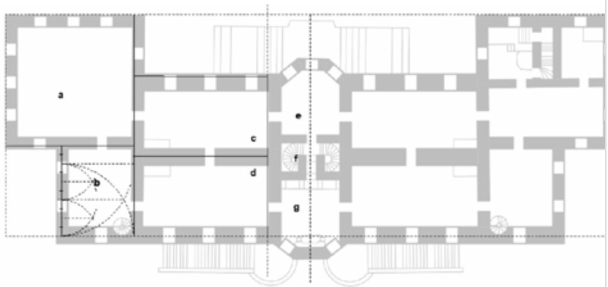
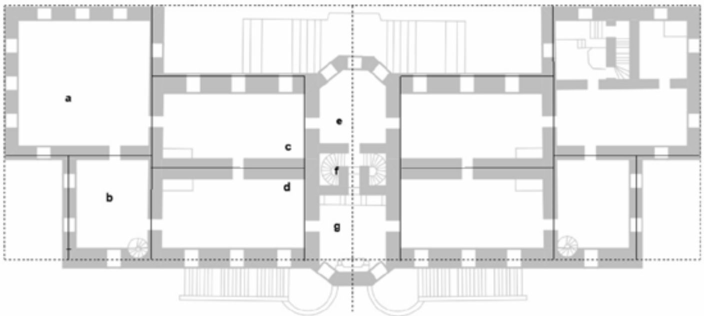
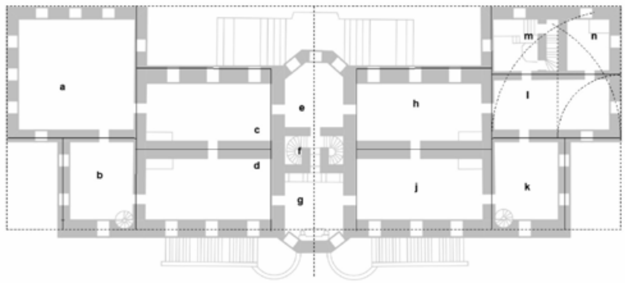
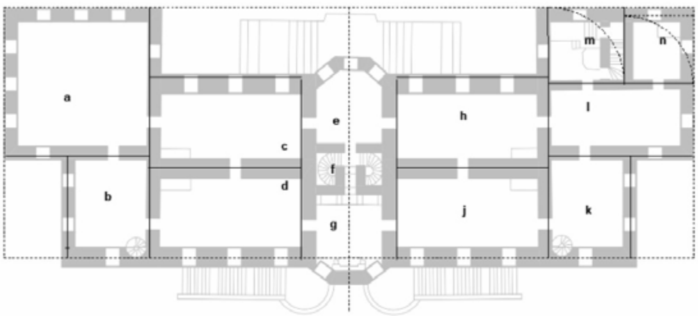
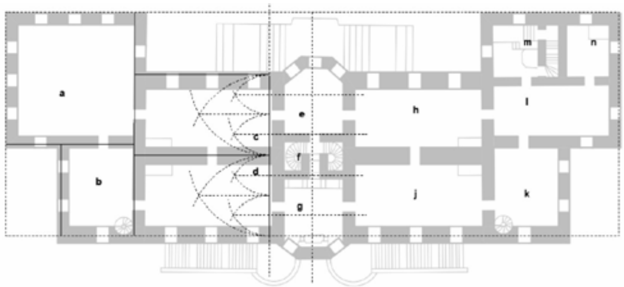
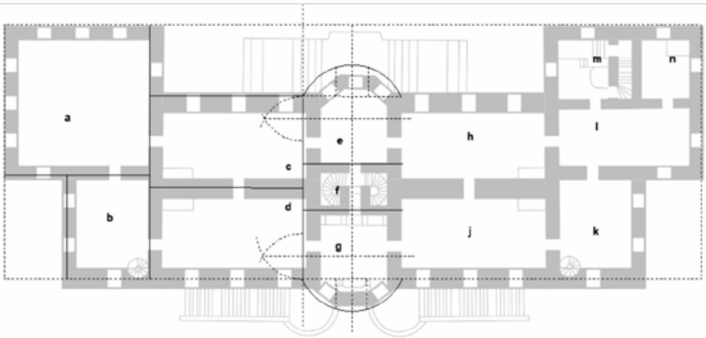
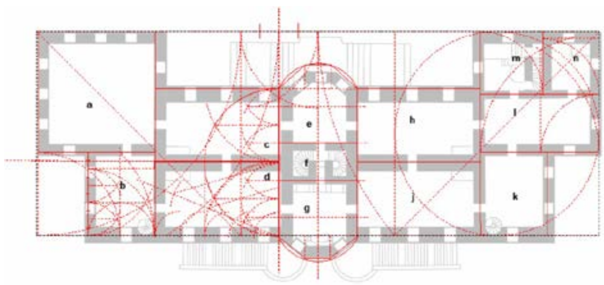
	
6th step: Applying perfect square using the width of left rectangule we have got a space **a**	7th step: Applying the proportion “sesquiquarta” (5:4) we have got the dimensions of space **b**
	
8th step: After mirroring we have got the main spaces of another part of the palace	9th step: Using double proportion (2:1) we have got the boundaries of space **l**
	
10th step: Space m is a perfect square and n has a proportion $2:\sqrt{3}$	11th step: The subdivision into two equal parts give us a centre of semi-hexagon
	
12th step: Construction of a regular semi-hexagon using compass and straightedge	All proportions in one scheme

CONCLUSION

To sum up, we can claim that in that case the design of the fortified palace was made according to the rules that were used when designing the best samples in the palace building. Most of the proportions that were found in the design of Pidhirtsi castle matches with Serlio's rules, as the author claimed in the hypothesis. It says that even if there was a previous palace on this territory as researcher Kossak affirms, it was rebuilt from scratch according to Renaissance rules that spread among Ukrainian building design in XVII century.

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