

Analysis of Gothic Revival churches designed by Stanislaw Majerski located in Podkarpacie District

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Abstract. The main purpose of this article was to perform an analysis of the geometric characteristics for Gothic Revival churches located in the Podkarpacie District. The authors explored five churches designed by Stanisław Majerski – an architect from Przemyśl who created at the beginning of the 20th century. In order to create point clouds of the studied buildings, the authors used the TLS method to provide the credibility of the study. The obtained data were subjected to statistical analysis. Geometry of the facades, spatial systems and trajectory of vault arch were examined. As a result, we obtained estimated values of studied parameters that characterized the geometric oscillate of Stanisław Majerski's churches.

1. Introduction

Polish historical architecture was created mostly under the impact of foreign trends. However, there are several styles that are solely characteristic of Polish architecture. Among them there is e.g. Zakopane architectural style. The qualification of certain objects to the specific style was based on factors obtained mostly in sensational than experimental manner. The development of modern computational tools allows scientists to deal with large amounts of data, obtained during geometrical analysis. There are not well-known architectural monuments of international significance located in the area of Podkarpacie. The basic issue of this research is to determine the value of features that demonstrate a common architectural style based on selected objects. According to our best knowledge, there is no previous research in this field concerning analysis of the Gothic Revival churches located in the Podkarpacie District despite the large number of architecture monuments designed in that era. One of the most well-known architects who designed in Gothic Revival style and worked in south-eastern Poland was Stanisław Majerski. Most of buildings designed by him have survived to this day being a reliable area of research. Places where he designed include among others Bircza, Pantalowice, Kołaczyce, Przemyśl and Korczyn [1]. At first glance, each of the churches located in the places mentioned above has its own unique style, but with widespread analysis of several objects, it is possible to obtain average values that will be used for the study of Gothic Revival style in the Podkarpacie District. Presented effects should be treated as preliminary results of extensive study concerning the Gothic Revival style in Podkarpacie District (Fig. 1), which we are going to perform.

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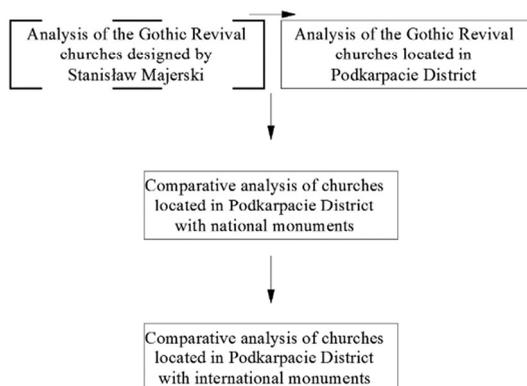


Fig. 1. Diagram representing the scope of research of Gothic Revival architecture of Podkarpace District.

2. Stanisław Majerski

Stanisław Majerski (Fig. 2) was born on November 13, 1872 in Przemyśl [1]. He studied architecture from 1891 until 1897 in Lviv. He also continued his education abroad, among others in Italy, Budapest and Prague [1]. Numerous trips allowed him to become acquainted with Gothic architecture. Reference to Gothic architecture can be found mostly in his later works. His first architectural project which was realized concerned a tenement house in Lviv, created in the years 1898–1899 [1]. Since 1902 he designed as an independent architect working in his own design studio in Przemyśl [1]. Stanisław Majerski unexpectedly died in 1926. He became famous as a designer of temples, churches and synagogues, but he also took part in architectural competitions, for instance sketches an idea of the national house in Cieszyn in 1899 [1]. At the end of his professional career he expanded his horizons to include interior designs and church decorations, e.g. a pulpit and two altars in a cathedral in Przemyśl or the Station of the Cross for the parish of the Franciscans in Przemyśl [1].

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Fig. 2. Signature of Stanisław Majerski on design of the church façade in Pantalowice
Source: Archive of the parish in Pantalowice.

3. Studied objects

The key issue was the proper selection of the examined objects. In order to ensure success of the planned analysis, surveyed objects could not be reconstructed in style transformed manner. The studied objects were selected to present a common Gothic Revival style, but presented different spatial solutions. The church in Kołaczyce is a single-nave church similar to the Greek-cross-plan, the church in Przemyśl is a single-nave church with a Latin-cross plan, the church in Pantalowice is an object with three naves without a separated transept, the church in Bircza is a building with three naves with an emphasized transept and the church in Korczyn is an object with three naves with an extended Latin-cross plan with an emphasized transept enclosed with an apse. The diversity of spatial solutions allows us to identify common features in a clear and reliable manner typical to the entire population of churches designed by Stanisław Majerski.

3.1 Church of Immaculate Conception of the Blessed Virgin Mary in Pantalowice

The oldest of the analyzed objects was created in the years 1901–1902 [1]. The church was designed as an answer for immediate need caused by fire. The previous church was burnt in 1899. After this incident, a specially formed committee decided to build a bricked temple. The authorship of both the project and the cost estimation is attributed to Stanisław Majerski [2]. The church was designed as oriented on a rectangular plan with the end of the plan in the form of a triangular presbytery (Fig. 3). The interior was divided into a nave and two aisles. The object does not have a transept, so the nave passes directly into the presbytery.

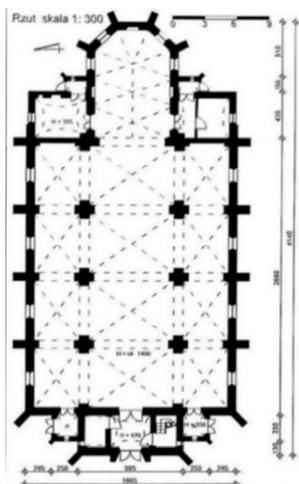


Fig. 3. Plan of church in Pantalowice Source: Provincial Heritage Monuments Protection Office in Przemyśl.

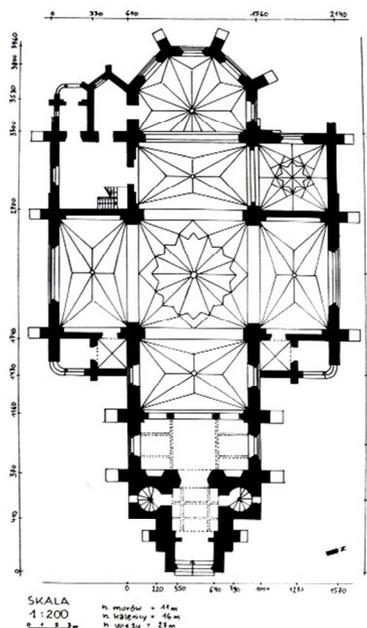


Fig. 4. Plan of church in Kołaczyce Source: Provincial Heritage Monuments Protection Office in Przemyśl delegacy in Krosno.

3.2 Church of Saint Ann in Kołaczyce

The church was built in the years 1903–1906 [1] in the town of Kołaczyce in the place of a previously demolished church [3]. The history of the tempels in Kołaczyce dates back to the 14th century, but a direct predecessor was created in the 19th century. The building is located in the city center at Kościelna St. The church square has an oval form with the main entrance located from the market square side. The plan of the Saint Anna church refers to Greek cross. The nave is divided into three bays, and enclosed by a triangular apse. The transept and nave are crossing in the center of object, which makes an impression of a symmetrical plan (Fig. 4).

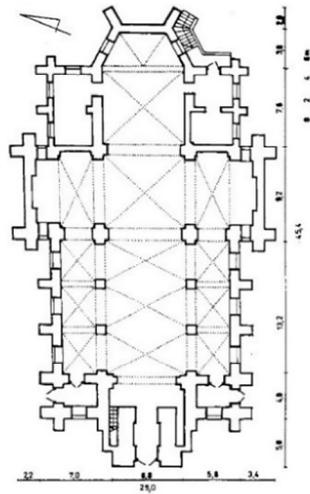


Fig. 7. Plan of church in Bircza Source: Provincial Heritage Monuments Protection Office in Przemyśl.

4. Research methodology

The building's geometry, and in particular the supporting systems, have not changed over the years. Specific elements, such as the finishing layer of the walls, had often been exchanged due to the degree of destruction of the original solution, aesthetics and economic reasons. Such interference in a historic building often obliterates the original idea of the designer preventing a modern point of view based on a scientific standpoint. The geometry of the church, i.e. the characteristics of load-bearing systems, dimensions and cubature of the object were not subjected to transformations. Changing the original church geometry was associated not only with technological difficulties, but also with significant costs, often exceeding the financial capacity of a particular parish. The research of the churches of Stanisław Majerski will be carried out in the field of building geometry. As a reference point for measurements in the study we assumed the level of the main entrance to objects.

4.1 The research models

In order to reduce measurement bias, research models were prepared based on point clouds generated using the TLS method¹. Each of the examined objects has been subjected to a laser scan both in the external and internal range. During the research, 95 laser scans were created, which were transformed into 5 models containing both internal and external geometry of the selected objects (Fig. 8). The accuracy of the generated objects allowed us to perform a statistical analysis in order to conclude using tested samples common points concerning the entire population of the churches designed by Stanisław Majerski.



Fig. 8. Computational models generated using the TLS method with the local coordinate system. From the left: Pantalowice, Przemyśl, Bircza, Kołaczyce and Korczyzna.

¹ Terrestrial Laser Scanning

Due to the specificity of the analyzed issues, i.e. architectural solutions, dimensionless parameters occurring in the entire population were examined (e.g. the ratio of height to width of the nave). Statistical analysis of such parameters focused on the determination of median along with the determination of the quartile range at the significance level of 0.05.

4.2 The geometry of the façade

The entrance wall is an important element in the appearance of a building mostly noticed by users. An important feature affecting the perception of the dimension of the building is the ratio of the width to height of the main nave. Such indicators describe the slenderness of the building from the perspective of the entrance façade (or cross-section). The ratio between the width to height of the aisle or transept has also been determined. The analysis also included the geometry of the entrance itself. The measurements of the height and width of the entrance portal in relation to the dimensions of the façade and the whole building were compared. The analyzed parameters of the geometry of the façade (Fig. 9) were summarized in Table 1.

Table 1. Analyzed parameters of the geometry of the façade.

No.	Parameter	Description
1.	$\frac{H}{B}$	The ratio of the height to width of nave
2.	$\frac{h}{b}$	The ratio of height to width of aisle or transept
3.	$\frac{a_{nave}}{a_{aisle}}$	Determination of the relation between area of the nave related to area of the aisle or transept
4.	$\frac{h_{portal}}{b_{portal}}$	The ratio of the height to width of entrance portal
5.	$\frac{a_{nave}}{a_{portal}}$	Determination of the relations between area of entrance portal related to area of the nave
6.	$\frac{H_c}{H}$	The ratio of the overall height to height of the nave
7.	$\frac{H_c}{h}$	The ratio of the overall height to the aisle or transept
8.	$\frac{H_c}{h_{portal}}$	The ratio of the overall height to the height of the entrance portal

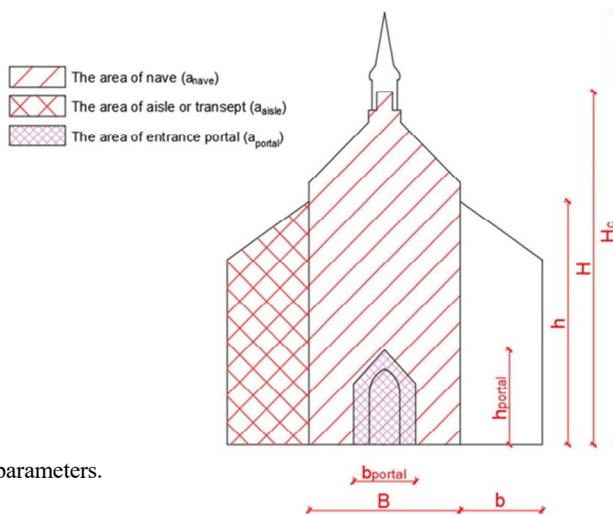


Fig. 9. The façade parameters.

4.3 Spatial systems analysis

Gothic Revival spatial solutions refer to assumptions developed in medieval Gothic churches, among others buttresses, sharp arch, cross-rib vaults, etc. The research area was focused on the geometry of the nave. The parameters influencing the cubic volume of objects have been analyzed, e.g. the ratio of the span of the nave and its length. The values that are parallel to the Z axis of the local coordinate system have a big influence on the perception of the interior in the object. The influence of the height of both vault and pillars on the perception of the interior in the object. The influence of the height of the vault and pillars of the main structural system was examined, e.g. the height of the vault related to the span of the nave. Details of analyzed parameters (Fig. 10) are presented in the Table 2.

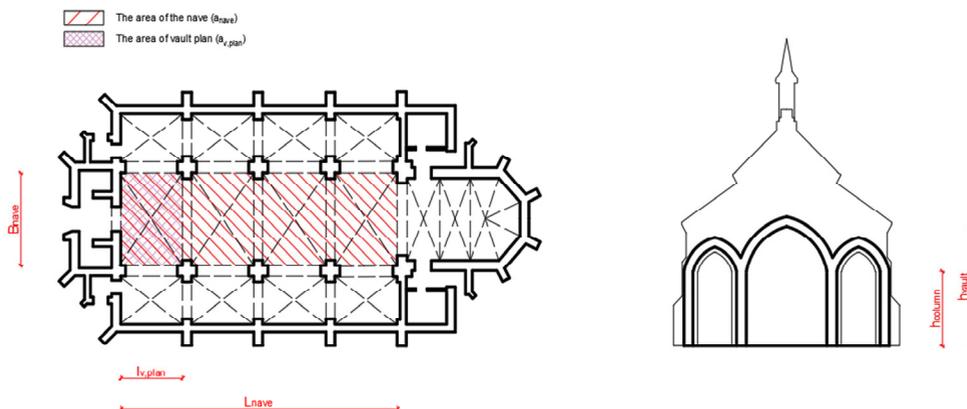


Fig. 10. The spatial system parameters.

Table 2. Analyzed parameters of the spatial system.

No.	Parameter	Description
9.	$\frac{L_{nave}}{B_{nave}}$	The ratio of the span to length of the nave
10.	$\frac{h_{vault}}{h_{column}}$	The ratio of the height of the vault to the height of the structural column
11.	$\frac{B_{nave}}{l_{v.plan}}$	The ratio of the span of the nave to length of the vault plan
12.	$\frac{h_{vault}}{l_{v.plan}}$	The ratio of the height of the vault (measured from the “0” point) to the length of the vault plan
13.	$\frac{h_{vault}}{B_{nave}}$	The ratio of the height of the vault (measured from the “0” point) to the span of the nave
14.	$\frac{h_{column}}{l_{v.plan}}$	The ratio of the structural column height (measured from the “0” point) to the length of the vault plan
15.	$\frac{h_{column}}{B_{nave}}$	The ratio of the structural column height (measured from the “0” point) to the span of the nave
16.	$\frac{a_{nave}}{a_{v.plan}}$	Determination of the relations between area of the vault plan related to the area of the nave

As a results of the statistical analysis carried out using the median obtained in selected churches, both minimum and maximum values same as interquartile range were estimated. Results were summarized in Table 3. The Graph was created to clearly present indicate outliers (Fig. 11).

Table 3. Estimated values of the examined features.

No.	Median value	Minimum value	Maximum value	Interquartile range
1.	2.4972	2.2305	5.6606	0.5099
2.	3.2927	2.3816	4.8694	0.5122
3.	2.6838	2.0507	3.6501	0.4330
4.	1.4338	1.4123	2.0337	0.4695
5.	10.4670	5.0999	28.9370	3.3808
6.	1.5125	1.0000	1.8618	0.5284
7.	2.2591	1.8077	3.0807	0.5641
8.	5.2938	1.1273	8.2995	0.6168
9.	3.3790	2.3923	8.0647	0.4813
10.	1.7265	1.5022	1.9882	0.2564
11.	1.4953	0.4047	1.6500	0.2085
12.	2.6080	2.1111	3.3915	0.5991
13.	2.0554	1.4119	7.7575	0.9025
14.	1.5106	1.3125	2.0201	0.1736
15.	1.1519	0.8635	3.9018	0.2844
16.	4.0934	3.1882	6.0097	0.6851

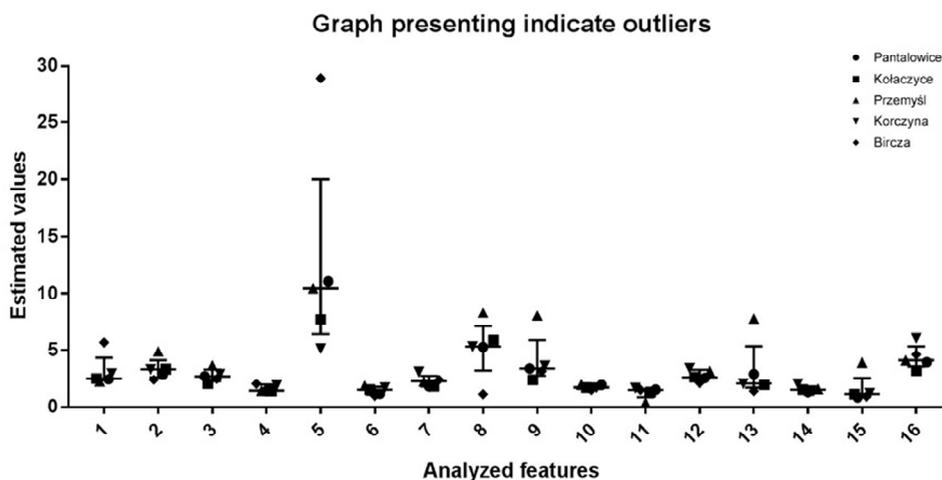


Fig. 11. Graph presenting indicate outliers.

4.4 The profile of the vault

The Gothic architecture style and further the Gothic Revival architecture style developed a specific type of vault different from the solutions presented in previous ages. In analyzed churches there is cross-rib vault system. Such a vault system with the sharp arc is problematic for design, preservation and survey. Due to the complexity of the Gothic

Revival vaults, a different measurement method was adopted. From the generated point clouds, the sharp arch was extracted, which was meshed. This approach allowed us to determine the trajectory of the arch of the vault. Referring the generated points to the XZ coordinate system (Fig. 12) allowed us to examine the curvature of the arc using the least squares method. For the examined objects, a function has been developed that is responsible for the curvature of the arches. The vault profiles have been described in a way which could be used for comparative analysis with other Gothic Revival objects. The result of the analysis of the profile of the vaults is equation (1) to the power of five which described the trajectory of the arch.

In Table 4 constants for each examined churches were described.

$$y = p_1 * x^5 + p_2 * x^4 + p_3 * x^3 + p_4 * x^2 + p_5 * x + p_6 \tag{1}$$

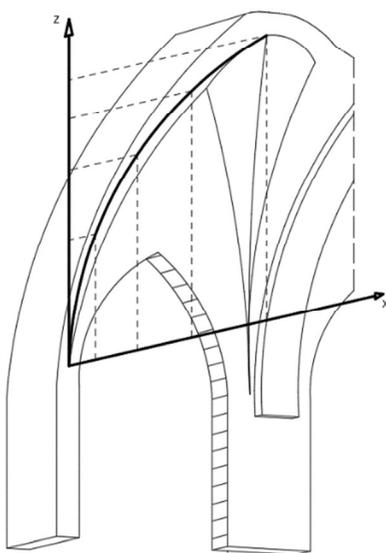


Fig. 12. The analyzed trajectory of arch in vault.

Table 4. Constans for examined objects.

No.	Pantalowice	Kolaczyce	Przemysł	Korczyzna	Bircza
p ₁	-297.4	199.79	43.701	356.31	-137.15
p ₂	723.9	-158.38	-97.945	-635.16	416.59
p ₃	-690.27	-487.98	34.564	-133.04	-576.43
p ₄	123.7	77.544	-24.431	41.028	122.24
p ₅	535.63	1770.1	230.6	1878	515.7
p ₆	0.12145	-0.016068	-0.026495	-0.1901	0.16661

5. Summary

In the Podkarpacie District there are numerous unexamined buildings belonging to the Gothic Revival architecture which remain as monuments of the past era. The complexity of the spatial solutions does not allow us a precise architectural analysis using conventional methods. The TLS method in the creation of computational models allowed us to accurately reproduce the design solutions and simultaneously avoid measuring errors. As a result of statistical analysis, the features characterizing the population of Gothic Revival churches designed by Stanisław Majerski was estimated. The obtained results will be used for research on the population of Gothic Revival churches in the Podkarpacie District and for comparison with objects located in Poland and abroad. The surveys carried out in this way will allow one to determine the degree of innovation of monuments located in the Podkarpacie District in comparison with national and foreign monuments.

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