

RESEARCH AND CONSERVATION ISSUES REGARDING THE SOUTHERN FACADE OF WROCLAW TOWN HALL. A CASE STUDY

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Abstract

The article presents an exemplary process of revitalisation of a historic building, using the example of the conservation of the southern elevation of Wrocław Town Hall. The introduction presents the building - one of the most beautiful Gothic town halls in Europe. Then the current state of research was discussed. The results of interdisciplinary research are presented in the form of historical, iconographic, architectural and conservation (laboratory) research. The results of the research work were the starting material for the conservation and revalorisation project for the southern façade. Two possible options for the façade's revaluation are presented. In conclusion, the selected variant is presented, along with supporting arguments.

Keywords: Architecture; Conservation science; Gothic; Town Hall; Silesia; Wrocław;
Multidisciplinary research.

Introduction

The town hall in Wrocław is one of the most recognizable monuments of bourgeois architecture in Poland and Europe. It is located in the south-eastern part of the market square. Its present look results from the intention of its first builders, historical transformations and extensions, and conservation and restoration work that were carried out in the 19th, 20th and 21st centuries. The first seat of the Wrocław City Council, which was mentioned in 1299 [1], was gradually enlarged in the first half of the 14th century [2, 3].

However, it was only the extension carried out from the late 1570s that gave the town hall the form (with a representative southern facade) that can be seen to this day. Conservation works on the southern facade, conducted in the years 2004-2007, gave an opportunity for interdisciplinary research, which brought new findings within the context of changes in its architecture (similar research and conservation issues on other sites are presented in, among others [4-7]). Based on architectural and conservation research, a new arrangement of the facade was proposed, which significantly differs from the existing aesthetics, and refers to its look from the Middle Ages (Fig.1) [8].

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Fig. 1. Wrocław Town Hall, southern façade after restoration

Description of the southern façade

The two-storey building with a basement has a rectangular plan with a three-section layout. The three high gable roofs that cover it have their ridges located in the east-west direction. The main body of the town hall from the north-western side is adjoined by a high tower, which is square at the bottom and octagonal at the top (66 meters high). The southern facade, which is the subject of the study, is the most impressive. It is 50 meters long, quite regular, has ten axes (double windows in the third axis from the east) and has three decorative avant-corpses that are topped with pyramidal cupolas (Fig. 2a and b). The highest avant-corps, the middle one, has an entrance to the basement that used to house the Piwnica Świdnicka Inn. On both sides of the avant-corps there are flights of stairs with stone panel balustrades. The widest avant-corps, the eastern one, is directed partly to the south.

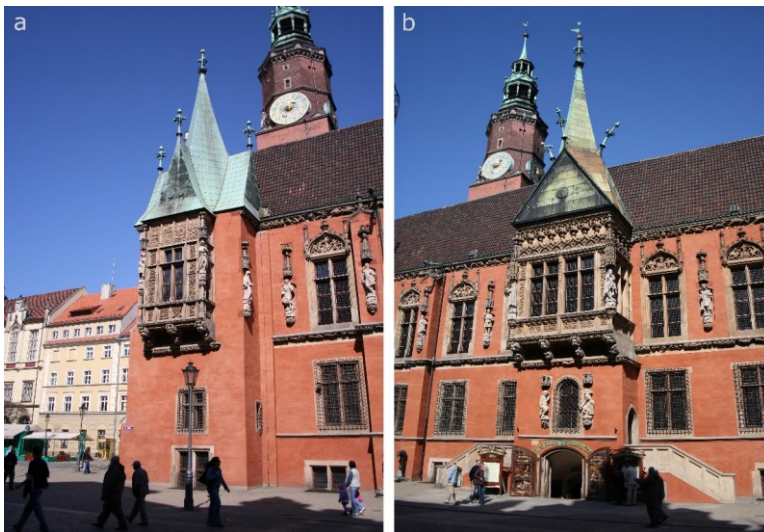


Fig. 2. Wrocław Town Hall, southern façade after restoration, (a) western risalit, (b) central risalit

The wall of the southern facade is strengthened by three buttresses: two located between the avant-corpses and one by the south-western corner. The facade is plastered, painted in a rusty red color and has stone details. The first floor, the grandest one, is distinguished by high windows, rich ornamentation and decorative bay windows located on three avant-corpses (Fig. 3a-f).



Fig. 3. Wrocław Town Hall, southern façade,
on eastern part: a. before restoration; b. after restoration;
on western part: c. before restoration; d. after restoration;
first floor of western part: e. before restoration; f. after restoration

Sources and the state and purpose of the research

The oldest preserved mention of Wrocław town hall can be found in the Wrocław accounting book, which is dated to 1299. It provides information about the income related to the oldest part of the building - the consistorium [1]. Over the next two hundred years, the town hall was expanded. The building obtained its final shape in the years 1470-1486 [9]. At that time, the southern facade was erected in its present form [2, 3]. The topic of the development of the architecture of Wrocław town hall was previously discussed by, among others, Carl Lüdecke [10], Rudolf Stein [11], Marcin Bukowski and Mieczysław Zlat [2] and Olgierd Czerner [12]. In 2002, Rafał Czerner [2] summarized the research concerning the transformations of the shape of Wrocław town hall from the end of the 13th century to the beginning of the 16th century. He presented it within the context of Silesian medieval central market square developments [3]. He

also dealt with the issue of the evolution of the layout of the southern aisle and the avant-corpses associated with it [3].

In turn, Carl Lüdecke's inventory drawings (Fig. 4a and b) are important with regards to considerations about the design of the southern façade. They were made during the renovation of the town hall, which was carried out under his supervision in the years 1884-1891 (Fig. 4c).

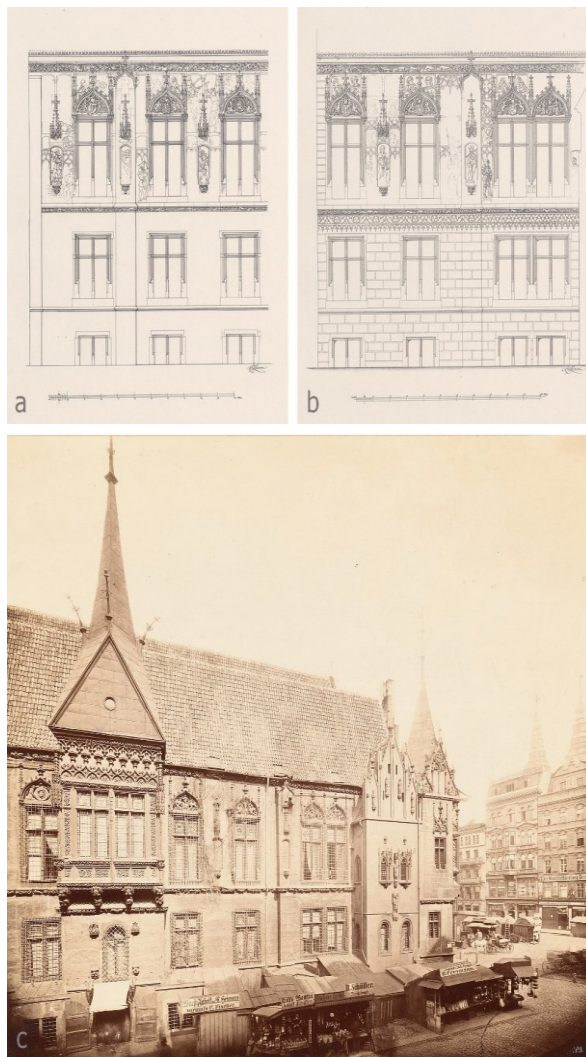


Fig. 4. Wrocław, Town Hall: a. part of the southern façade (western part) and inventory of the painting decorations from 1510, which was drawn up by Carl Lüdecke [10]; b. part of the southern façade (eastern part) and inventory of painting decorations from 1510, which was drawn up by Carl Lüdecke [10]; c. the eastern section of the southern façade in 1858 photo by Eduard Willem van Delden (Architekturmuseum TU Berlin)

The last works on the southern facade were carried out in the first decade of the 21st century. The research carried out during these works aimed to unambiguously determine the phases of the southern facade's transformation and also to identify its historical color scheme. The obtained results were the starting material for the project of the conservation and renovation of the southern facade [8].

The aim of this paper is to present a broad aspect of the research and conservation issues in the context of the revalorization of the southern facade of the seat of the municipal authorities of Wrocław, which was the second largest city in the Kingdom of Bohemia. Based on the results of interdisciplinary research, changes in the decor and colors of the grandest facade of the town hall were presented. In addition, based on the obtained research material, the scope of the revalorization and conservation works was proposed, with the history of transformations and the preserved details of the late-Gothic facade of the seat of the municipal authorities of the most important city in Silesia being respected.

Results of architectural research

Phase I (around 1330)

The oldest fragments of the walls found within the current southern facade (discovered on its edges), which was rebuilt in the years 1471-1486, were made in two phases. The first building was constructed in the vicinity of the eastern edge of the facade. It was a single-nave, two-bay building arranged on the east-west axis. It was added to the eastern facade of the town hall, which was extended in around 1330 [3, 13]. This building had a rectangular plan, and its southern facade was decorated with a slanted avant-corps located in the south-eastern corner of the present town hall. The preserved remains of the avant-corps include fragments of a demolished wall measuring approx. 1.70 x 2.80m, which are located near the most outer eastern window of the basement (Fig. 5).

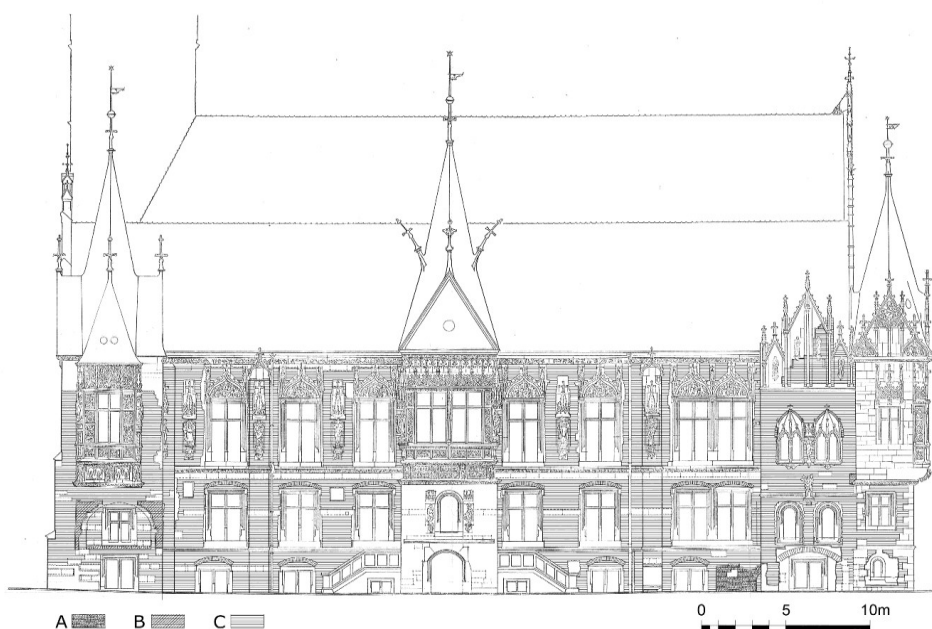


Fig. 5. Wrocław, Town Hall, southern façade with chronological stratification of its walls:

- A. eastern part of the southern part of the Town Hall with the eastern avant-corps (first phase of constructing the façade from around 1330)—dismantled wall;
- B. western part of the southern part of the Town Hall with the western avant-corps (second phase of constructing the façade from the period after 1330);
- C. phase of constructing the façade from 1471–1486), created by the authors—adapted a drawing from [2]

The bottom part of this building is located below the level of the current surface of the market square and its exact arrangement was determined during archaeological and architectural

research conducted in 1997. Studies of the lower parts of the outer western, southern and eastern walls were carried out by [13] in cooperation with a team led by Cezary Buśko. At the turn of 1999 and 2000 Rafał Czerner and Czesław Lasota [14], both teams conducted research in the interiors of Piwnica Świdnicka. Rafał Czerner [2] and Rafał Czerner and Czesław Lasota [13, 14], described the aforementioned layout of the eastern avant-corps. At the western wall of the present eastern avant-corps and on the adjacent edge of the facade of the southern aisle, two fragments of the imposts of the brick semi-circular barrel vault, with a thickness of 1 brick, were found (Fig. 5).

Phase II (after 1330)

Shortly after the completion of the eastern building, another was erected on the western edge of the facade. It was constructed along the southern and western parts of the oldest town hall building that was erected at the end of the 13th century.

The composition of its southern facade is partly known due to the later transformations of the town hall. On the ground floor of the present western avant-corps, there were probably ogival windows. On the southern facade, an opening of about 3.60 meters wide and about 2.50 meters high was placed. The base for the probable stone framing was a ceramic windowsill made of bricks arranged vertically in the so-called row lock. It is still preserved in the form of hammered bricks. There was a narrower opening on the eastern facade. Its windowsill was at the same level as the southern window and the height of both windows was also similar. The south-western corner of the building was reinforced with a corner buttress - currently visible on the ground floor of the western facade of the western avant-corps (Fig. 5).

However, it was definitely narrower and was about 90cm wide. The perimeter walls of this wing were buttressed along the entire length, which is confirmed by the traces of buttresses found under the floor of the market square during research in 1997 [13]. The south-western corner was reinforced with a corner buttress - currently visible on the ground floor of the western facade of the western avant-corps. The texture of the wall in this part of the seat of the municipal authorities was made of bricks arranged in a regular stretcher pattern with carefully formed triangular joints. The arches of the western avant-corps window openings were made of bricks and were one brick thick (Fig. 5).

Phase III of the shaping of the façade and phase I of the color scheme (1470-1486)

The construction of the current southern aisle of the town hall and the central and western avant-corps was probably carried out in the years 1470-83 [2, 3]. The facade had seven axes: three axes in the western part and four in the eastern part, with this division being accentuated by a central bay window (Fig. 5).

The current southern facade was erected between the avant-corps in the western and eastern corners of the town hall after demolishing its former southern section to the basement level. The wall was built at the same time as the central avant-corps (in one construction action), which is confirmed by the interconnections between the walls. The erection of the brick walls began with the construction of pillars between the windows. The stone profile frames of the rectangular windows were placed in the openings prepared in this way. The window openings on the ground floor and first floor were divided by a stone muntin and a transom in the form of a Latin cross. In some places, brick toothings were clearly cut during the setting of the sandstone frames. Over the window openings on the basement and ground floor level, arches (one brick thick) were built. The areas above the tympanums of the first-floor windows were filled with bricks after the stonework was implemented (Fig. 5).

The western avant-corps were also rebuilt. Its walls were demolished to a height of about 5.70 meters. The framing of the ogival opening on the southern wall was removed and the opening itself was blocked with a brick wall with integrated stone blocks. The same was done with a small ogival opening on the eastern facade of the avant-corps. Parts of the ground floor were also rebuilt by expanding the avant-corps to the west by 1.2 meters. The form of the eastern avant-corps was also changed. Its diagonal south-western wall was demolished to the level of the market square

floor. On the rest of the walls, the plasters were removed to a height of about 1.70 meters and new plasters were then made. The same was done with the vault, the opening of which was bricked up. The perimeter walls were raised to their present height. The southern facade of the avant-corps on the first floor was shaped as a two-axis composition with two ogival window openings that were probably decorated with stone traceries. It was crowned with a triangular gable that had lesenes decorated with pinnacles. In turn, from the east, a richly decorated bay window was placed on prominent corbels. A similar form was given to the bay window crowning the central avant-corps and a slightly more modest form to the western avant-corps (Fig. 5).

The brick pillars between the windows, as well as the buttresses on the level of the first floor, were enriched by introducing recesses with segmental arches, the frames of which were made of ceramic fittings (with a concave). The recesses were decorated with stone consoles and canopies. They were probably intended to embed sculptures, which are not preserved today. In the middle of the width of both sections of the facade, between the avant-corps, two narrow buttresses topped with stone caps in the form of an ogee arch were added. In the upper part of the western buttress, a stone gargoyle with a simple form was implemented in order to drain water from the gutter on the roof (Fig. 5).

The stone detail of the facade consisted of, apart from window frames, ogee-shaped tympanums that were placed above the windows of the first floor. They were filled with richly carved shields supported by angels, wild men, or lions and also had heraldic elements from the coat of arms of Wrocław: the Czech Lion, the Silesian Eagle, the Jagiellonian Eagle, the image of St. John the Evangelist, the letter W (symbolizing the name Vratislavia) and the head of St. John the Baptist. The arches of the tympanums were supported on consoles and decorated with crockets, finials and a pair of pinnacles at the base. The cornice between the ground floor and the first floor was decorated with an openwork braid that had plant motifs, depictions of animals, and scenes from the life of people (a duel, a scene of playing cards and a scene with playing on instruments). The second crowning cornice was placed above the decoration of the tympanums. Its openwork carved decoration was made of motifs of plant tendrils and leaves, as well as genre scenes (hunting, a knights' tournament, a man carrying a woman in a wheelbarrow, wanderers etc.). The authorship of the stonework decoration is attributed to the workshop of Briccius Gauske [9, 15].

On the walls of the southern facade, two zones were distinguished, which differed in the way the bricks were bonded. On the ground floor, up to a height of about 5.20 meters above the ground level (i.e. up to the height of the window transoms), a stretcher bond pattern with stone blocks was used. Sandstone quoins were inserted to reinforce the corners of the lower part of the south-western bay window. Some stone elements were machined with a bush hammer. The walls of the upper part of the ground floor and the entire first floor were erected in a homogeneous stretcher bond pattern. The joint on the facade between the bricks was flat with a crack, with excess mortar being applied on the wall surface (Fig. 6a).

Relics of the color scheme recorded on the surface and stone detail give an idea of the colorful design of the facade. Traces of red that were found in many places on the bricks, mortar surfaces in joints, stone elements aligned with the wall and stone blocks indicate that the facade plane was painted red with the use of iron red as a pigment and that probably casein was used as a binder (Fig. 6b). Next to the crockets on the pinnacles flanking the tympanums and in the bends of the profiled frames, traces of red lead pigment were found directly on the stone (Fig. 6c).

In addition, at least three colors were found on the surface of the stone within the tympanums and the heraldic representations composed in them (Figs. 7a-d). Iron red was also captured in the backgrounds of the tympanums, the folds of the sashes and on the shield with the representation of the Lion with a split tail (the coat of arms of the Kingdom of Bohemia) (Figs. 7a and b). Black was registered on the folds between the feathers of the Eagle with a crescent on its chest (the coat of arms of Silesia). In turn, traces of a white layer of paint were found between the feathers of the Eagle on the shield, on the two feathers supporting it (the Jagiellonian coat of

arms) (Fig. 7c), in the folds of the robes of the angels supporting the tray with the head of St. John the Evangelist and in the folds next to the outer edges of the sashes.



Fig. 6. Wrocław, Town Hall, southern façade, remains of colors: a. red monochrome on the joint and a brick surface; b. red monochrome on the stone block; c. red lead on the pinnacle



Fig. 7. Wrocław, Town Hall, southern façade, color remains: a. white and red paint layer on the tail of the griffin supporting the Silesian coat of arms; b. white monochrome on the lion in the coat of arms of the Kingdom of Bohemia and on the two lions supporting it; c. white monochrome on the surface of one of the griffin's labrums supporting the Jagiellonian coat of arms; d. red monochrome on the surface of the griffin's labrum supporting the Jagiellonian coat of arms

The preserved relics of color layers indicate that the facade, completed in 1483, was painted entirely in red monochrome and that the architectural detail was probably distinguished by the use of the red lead pigment, traces of which were found in the hollows of the stone. Elements of the coat of arms of Wrocław placed in the tympanums of the windows on the first floor were probably colored according to heraldry [8, 16].

Phase IV (Phase II of the color scheme) (ca. 1510)

The facade presented in Carl Lüdecke's inventory drawings has a completely different composition than the one we know today [10]. The surface of the ground floor and the first floor was covered with painted bossage and crowned with a painted wide tracery frieze, which together

with the stone frieze, created a clear horizontal accent. The part of the facade of the ground floor with the bossage was a high plinth for the first floor, which had rich iconographic painted decorations that complemented the composition of the stonework. The theme of the illustrations in the eastern part was made up of multicolored views that symbolized the city in times of peace. It had representations of various urban states (burghers drinking wine or playing with a falcon and a dog, a street musician and a guard leaning on a halberd) and also a bear playing bagpipes. In turn, in the western part, the city was shown during the war, with images of the walls being conquered (a soldier climbing a ladder or shooting a bow and arrow and people aiming a crossbow and throwing stones). The content of the painting representations is only known from the 19th century inventory, because after removing the layers of cement plasters made in the 20th century, only a few fragments of the plaster coatings from this phase were found. Two areas of about 40 x 40cm were discovered in recesses between the windows of the first floor. In one of them, a fragment of a red stripe circling the area of a black painted recess, which was originally the background for the figural decoration, was exposed (Fig. 8c). Small strips of plaster have also been preserved above the roof of the eastern avant-corps, at the edge of the roof flashing (Fig. 8a and b).

A fragment of the lower edge of the motif, painted in white on a red background, was found here. The plasters of this phase were sand-lime in a pink-sand color and with visible small lumps of unslaked lime. The thickness of the plasters ranged from about 5 to 7mm. The plasters obtained a smooth texture by being smoothed with a soft trowel but had a slightly uneven (wavy) surface [8, 16]. It is worth noting that both elements – the stone detail and polychrome - formed a coherent composition that shaped both the tectonics of the facade and the narrative layer with a clear ideological message.

Changes in the articulation system of the facade were only found within the range of the southern facade of the eastern bay window. In place of the two ogival windows, two stone bay windows were introduced. Under their windowsills, depictions of monkeys and fanciful animals were placed and St. John the Baptist was assembled on the post between the openings (Fig. 5).

Phase V - Restoration work in the 19th and 20th centuries

Conservation works on the facade of the town hall, which were conducted in the 19th and 20th centuries, were carried out as part of three major renovations directed by Carl Lüdecke [10] in the years 1884-1891, Rudolf Stein [11] between 1934 and 1936, and Marcin Bukowski and Mieczysław Zlat [2] during the post-war reconstruction in the period between 1949 and 1953.

The first works that took into account the conservation doctrine (based on the study of the object) was carried out in the years 1884-1891 [10]. From the decision to renovate the object in 1877 and to entrust the project to Carl Lüdecke, discussions on the proposed solutions and numerous consultations lasted for seven years [2]. In terms of the decoration of the southern facade, the inventory drawings of the polychrome that was preserved on it are extremely important [10]. Carl Lüdecke commissioned the execution of these drawings in order for them to serve as the basis for the description of paintings in the future.

The completed works were minor and did not cause any changes in the facade's composition. During the inventory, the weakened and loosened fragments of plaster were removed and necessary repairs were made to the brick surface under the crowning cornice and around the stonework of the window openings [10]. The newly laid parts of the plaster seemed too bright and stood out from the old plaster that was covered with polychrome relics and were therefore artificially darkened. Carl Lüdecke was counting on a natural patina effect, street dust and atmospheric factors. However, this did not happen. On the facade, plaster additions were made with the use of hydraulic lime. The plasters and sculptures were painted uniformly using asphalt-graphite paint. It was a simplified evening of contrasts [2].



Fig. 8. Wrocław, Town Hall, southern façade:
 a. and b. remnants of plaster with traces of painted decoration
 above the roof of the eastern risalit (red, black and white);
 c. background of a niche in a buttress in the eastern part
 of the façade with traces of painted decoration (black)

The damaged elements of the stonework were supplemented or replaced - mainly the finials of the canopies and the areas under the eaves in the western avant-corps. It was probably also then that the bars on the windows of the first floor were removed. These bars are visible in the photos taken before Carl Lüdecke carried out his works (Fig. 3). In the photos taken after his renovation, they are no longer there and the additions of stone frames in the place where the bars were assembled are visible. The losses in the plaster were supplemented with a lime hydraulic mortar, which was popular at the time and known as Roman cement. During the renovation, on empty consoles under the canopies, 3D sculptures were placed. They depicted figures in historical guild costumes, the faces of which were the famous Wrocław residents from the second half of the 19th century, including building counselor Richard Plüddemann and Carl Lüdecke. The authors of the sculptures were Christian Behrens and Otto Rassau [2]. The sculptures were made of limestone. The decision made at that time to unify the colors of the new historical details and plasters had serious consequences for the state of preservation of the stonework. Asphalt-graphite

paint was used for this purpose, which eventually was applied, among others, on the entire surface of the southern facade. In this way, an artificial patina effect was obtained [2].

Further significant work was carried out after 1935 under the direction of Rudolf Stein. This work covered the main building and the interior of the town hall, which were significantly transformed. On the southern facade, stairs were added by the central avant-corps and plasters were replaced with a mortar that had a high content of cement. The old plaster with the remnants of polychrome was removed. Construction work was also carried out during these works. Two rectangular anchor sockets were found on the facade under the inter-storey cornice. The entire facade, as was the case during the reconstruction of the 19th century, was repainted with insulating paint. The sculptures were covered with the same paint [2]. During the post-war reconstruction of the town hall, which was carried out in the years 1949 - 1953 under the direction of Marcin Bukowski and Mieczysław Zlat, the missing elements of the stonework (e.g. cornices) were reconstructed on the southern facade, and its most destructed fragments were replaced using the same sandstone.

It was decided to remove all the plasters due to their detrimental effect on both the bricks and the stone elements. The facade was plastered with lime mortar that contained gray sand and ground black marble in the top layer [2]. It is important that it was decided at that time to expose the stone strips and blocks of stone inserted into the brick surface, e.g. on the facade of the eastern avant-corps. Based on their alignment with the brick wall, it was concluded that the builders intended to expose the stone and to not cover it with plaster. It should be emphasized that Marcin Bukowski and Mieczysław Zlat drew attention to the very poor condition of the preserved stonework and emphasized the need to undertake further work.

Comprehensive conservation works of the stonework on the southern facade were carried out in 1985-1986 by a team led by Wiesław Domaśłowski from the Nicolaus Copernicus University in Toruń. At that time, preventive works were carried out, including the removal of corrosion layers and secondary protective and strengthening layers of the stone, as well as the improvement of the capillary properties, the structural strengthening, and the filling in of defects (within the preventive scope of works).

During these operations, research was also carried out, the purpose of which was to identify the technique of preparing the remains of the painting decoration preserved on the surface of the stone details (They were performed by a team of employees from the Nicolaus Copernicus University (hereinafter NCU) in Toruń under the supervision of Wiesław Domaśłowski. The work covered only the stone elements of the facade decoration, which underwent preventive maintenance). The work was carried out by Maria Poksińska from the Department of Painting Technologies and Techniques of the Nicolaus Copernicus University in Toruń. The paint residues were then examined and their pigments and binder was identified.

The subsequent conservation and restoration work on the southern facade were carried out in the years 2005-2006, with the main reason for them being the poor condition of the plasters covering the surface of the facade. Due to the access to stone details after erecting the scaffoldings on the facade, the scope of work also included the removal of the remains of old materials and the maintenance of the stonework, i.e. the cleaning of the layers formed during the 20 years that had passed since the previous works. Moreover, it was decided to carry out a wide range of restoration works on the sculptures. Their goal was not only to fill in the gaps in the medieval sandstone details, but also those in the sculptures from the 19th century.

Prior to the commencement of the works, the scope of intervention with regards to the plasters was not clearly defined. It was only the direct visual inspection of the plasters that revealed that, apart from previously visible damage, there was also discoloration, stains and cavities, extensive detachments, disintegration and the falling off of the top layer. The presence of a cement binder in the under layers was unfavourable. Due to the poor state of preservation, a committee decision was made to remove all the plasters. At this point, it is worth paying attention to the aesthetics of the southern facade of the town hall before the work was started. The post-

war plasters had a warm grey colour, which was obtained by using grey sand and by adding ground black marble to the mortar [2]. It can be assumed that this was a deliberate procedure in order to obtain a darker coating, which better harmonizes with the damaged dark stone (Similarly, on the western facade, the mortar for the joints in the brick surface was colored in an intensely dark gray color using black aggregate.). The stone elements - due to dirt - did not differ significantly from the surface of the plastered facade (Fig. 2a, b and e). It was mainly the sculpted details that were legible thanks to their spatial form and chiaroscuro texture. In addition, the sandstone blocks and strips, according to Bukowski's concept, were left without plaster, and thus recessed in relation to the plane of the plaster. It seems that the reason adopted by Marcin Bukowski and Mieczysław Zlat in favor of such a solution, i.e. that the alignment of the stone elements with the brick wall is an indication that the stone was not plastered, is incorrect. This is also supported by the fact that the window frames and the accompanying details protruded in front of the surface of the wall by about 1 cm, i.e. to the assumed thickness of the plaster.

The removal of the plaster from the southern facade and the conducted conservation research opened a discussion regarding its arrangement.

The removal of the secondary plasters was carried out very carefully while searching for the remains of the medieval plasters. Marcin Bukowski and Mieczysław Zlat also mentioned their search during post-war works. Small fragments have been preserved next to the flashings of the roof of the bay window in the east avant-corps.

The brick wall under the plaster was in poor condition on almost the entire surface. This was mentioned by Marcin Bukowski and Mieczysław Zlat, who stated that due to extensive damage, which he associated primarily with the plastering of the facade with cement plaster during Stein's renovation, numerous brick replacements covering over 20% of the wall surface were necessary. Demolition bricks from the ruins of Wrocław were used for the repairs, which is why the places of repair were hardly legible. They could mainly be recognized by the color and the texture of the mortar in the joints. The state of preservation of the bricks on the surface of the wall, despite the repairs made after the war, was bad in many places. The surface of the bricks was damaged, with many cavities, chips, indentations and damage. Despite this damage, there was medieval mortar in the joints on about 15% of the surface. The mortar was distinguished by having a very smooth surface texture. It was not formed by undercutting but rubbed onto the surface of the wall. The line of the joint was marked by underlining or a slight undercut. It was extremely important for further conservation decisions to find a red paint layer on the surface of these medieval mortars, which was preserved as a thin, almost glazed coating.

Identification of the mortars and color layers

Samples of the following were taken to identify the materials:

- mortar from joints, which have a preserved surface and the remains of color (3rd construction phase/1st color phase);
- color layers preserved on the surface of the stone details,
- painting layers from the 4th construction phase/2nd color phase.

In order to identify the mortars and color layers, the following was conducted: cross-sectional cuts of samples; macroscopic descriptions of the cuts; microchemical analyzes of pigments; the identification of paint binders, and the phase composition of the mortars (determined using thermal differential analysis) and XRF spectrographic examinations of the paint layers (using a PW4025 X-ray spectrometer). The pigments were tested by Adam Cupa at the Department of Painting Technologies and Techniques of the Nicolaus Copernicus University. The mortar tests were carried out by Anna Nowak from the Department of Conservation of Architectural Elements and Details of the Nicolaus Copernicus University (Currently, the Department of Conservation and Restoration of Architecture and Sculpture of the Nicolaus Copernicus University) and by Katarzyna Polak.

Table 1. Location, dating and scope of tests of the plaster samples and color layers.

Sample No.	Location	Sample description	Dating	Purpose of research
Sample No. 1	The surface of the wall by the edge of the roof over the eastern avant-corps	Dark ocher mortar with a visible layer of black on the surface	Probably phase III	Identification of the mortar Identification of the pigments and binders of the color layer
Sample No. 2	The wall at the height of the window tympanums in the eastern part of the facade	A light ocher mortar from a joint with a preserved surface and with a visible color layer on the surface		Identification of the mortar Identification of the pigments and binders of the color layer
Sample No. 3	The bottom part of the left recess on the eastern part of the facade	Ocher mortar with a layer of black on the surface		Identification of the mortar Identification of the pigments and binders of the color layer
Sample No. 4	The wall on the central avant-corps	A light ocher mortar from a joint with a preserved surface and with a visible color layer on the surface		Identification of the mortar Identification of the pigments and binders of the color layer
Sample No. 5	A crocket on the window tympanum on the eastern part of the facade	A layer of red lying directly on the stone		Identification of the pigments and binders of the color layer
Sample No. 6	The framing of the window tympanum on the eastern part of the facade	A layer of red placed directly on the stone		Identification of the pigments and binders of the color layer

Table 2. Mortar and plaster samples

Sample No. 1 - mortar from phase III.					
Thickness	Structure	Color	Filler	Binder	Comments
5 mm	fine-grained; homogeneous, compact and non-directional mortar; compact mortar, does not crumble and does not delaminate; smooth surface with visible color layers	dark ocher to brown;	light quartz sand; grain diameter: 0.1 - 1 mm with a predominance of finer grains; rounded; not many grains with a diameter of up to 2 mm; a few lime particles	contact binder, evenly filling the space between the grains of the sample	no solid organic additives

Chemical and instrumental analyzes of the mortars

Binder	Proportions (by weight) after decomposition of calcium carbonate in 5% HCl	Additives
Calcium carbonate (CaCO ₃)	1 part binder 2 parts filler	After roasting, the mortar sample did not change color, which proves that it does not contain organic components.

Mortar surface: visible layers of color on the surface: red and black

Microchemical tests and spectrograph analysis

Thickness	Color	Binder
0.8 mm	in the red layer - iron red, in the black layer - vegetable black	in the red layer - protein binder; in the black layer - no organic binder was identified

Sample No. 2 - mortar from a joint in a brick wall (Fig. 6a)					
Thickness	Structure	Color	Filler	Binder	Comments
1 cm	fine-grained; homogeneous, compact and non-directional texture; compact mortar; does not crumble and does not delaminate; smooth surface with a visible layer of red	light creamy color; in some places light other discoloration on the surface	light quartz sand; grain diameter: 0.1 - 1 mm with a predominance of finer grains; rounded; not many grains with a diameter of up to 2 mm, a few lime particles	contact binder, evenly filling the sample space	no solid organic additives; in some places larger lime particles and larger filler crumbs

Chemical and instrumental analyzes of the mortars

Binder	Proportions (by weight) after decomposition of calcium carbonate in 5% HCl	Additives
Calcium carbonate (CaCO ₃)	1 part binder 2.2 parts filler	After roasting, the mortar sample did not change color, which proves that it does not contain organic components. During the dissolution, a thin layer of insoluble substance - probably organic - was observed on the surface of the sample, forming a translucent film. This was probably the binder of the color layer.
Mortar surface: on the surface - a visible layer of color, which is very well bound to the surface of the mortar.		

Microchemical tests and spectrograph analysis

Thickness	Color	Binder
0.05 -0.5 mm	iron red	protein

Sample No. 3 - mortar from phase III

Thickness	Structure	Color	Filler	Binder	Comments
1 cm	compact, homogeneous structure; compact mortar, does not crumble and does not delaminate; a thick (about 0.8 mm) layer of red is visible on the rough surface	creamy	quartz sand; grain diameter: up to 1 mm; well rounded;	contact binder, evenly filling the sample space	———

Chemical and instrumental analyzes of the mortars

Binder	Proportions (by weight) after decomposition of calcium carbonate in 5% HCl	Additives
Calcium carbonate (CaCO ₃)	1 part binder 2.2 parts filler	After roasting, the mortar sample did not change color, which proves that it does not contain organic components
Mortar surface: On the surface - a visible layer of color, which is very well bound to the surface of the mortar.		

Microchemical tests and spectrograph analysis

Thickness	Color	Binder
ok. 0.8 mm	black (plant black and carbon black)	As a result of microchemical reactions, no organic binder was identified.

Sample No. 4 - mortar from a joint - phase III					
Sample description					
Thickness	Structure	Color	Filler	Binder	Comments
1 cm	fine-grained; homogeneous, compact and non-directional texture; compact mortar; does not crumble and does not delaminate; smooth surface with a visible layer of red	creamy	light quartz sand; grain diameter: 0.1 - 1 mm with a predominance of finer grains; rounded; not many grains with a diameter of up to 2 mm, a few lime particles	contact binder, evenly filling the sample space	no solid organic additives; in some places: larger lime particles and larger filler crumbs
Chemical and instrumental analyzes of the mortars					
Binder	Proportions (by weight) after decomposition of calcium carbonate in 5% HCl			Additives	
Calcium carbonate (CaCO ₃)		1 part binder 2.2 parts filler		After roasting, the mortar sample did not change color, which proves that it does not contain organic components	
Mortar surface: on the surface - a visible layer of color, which is very well bound to the surface of the mortar.					
Microchemical tests and spectrograph analysis					
Thickness	Color			Binder	
0.1 -0.3 mm	iron red			protein	

Table 3. Samples of color layers (sample No. 5 and No. 6) (Fig. 6c, 6b)

Sample No. 5 - red color from the surface of the detail (Fig. 6c)				
Slight remnants of red preserved mainly in the hollows of the sculptural detail and in the pores of the stone				
Color	Layer	Thickness	Chemical and instrumental analyses	
			Filler	Binder
orange-red	hard, compact; directly on the stone	0.3-0.8 mm	Red lead pigment (Pb304), ceruse	iron red, protein
Sample No. 6 - red color from the surface of the detail (Fig. 6b)				
Slight remnants of red that is mainly present in the pores of the stone, on the surfaces of the stone blocks aligned with the wall, and on some parts of the detail.				
Color	Layer	Thickness	Chemical and instrumental analyses	
			Filler	Binder
red	hard, compact; does not form a continuous coating; in the form of spots; residues mainly in the near-surface pores of the stone	0.1-0.5 mm	iron red	protein

Results and discussion

As a result of the conducted observations and tests, it was found that the mortar in the joints, which had a layer of red color on its surface, undoubtedly comes from the period when the walls of the town hall were built. It is a lime mortar with fine-grained sand and a few fragments

of carbonated lime. The proportions of the mortar were defined as: 1 part of binder (by weight): 2 parts of aggregate (by weight). The mortar on the surface of the wall is the same as inside the wall. The walls were built with the so-called full joint, i.e. an excess amount of mortar was applied to the brick and after placing the next brick, it was squeezed out and removed with a tool, in turn giving the joint a specific shape. The excess mortar was also spread on the surface of the bricks. In this way, the surface of the wall was leveled and numerous cracks and defects in the bricks were filled. It should be emphasized that the brick used for the masonry is very heterogeneous, with numerous chips and defects on the edges (maybe it is a demolition brick). The use of the masonry technique discussed above enabled an even surface to be obtained. Edmund Małachowicz confirms that at the end of the Middle Ages, in Silesia, the brick pattern in walls became less precise (perhaps due to the production of inferior brick) and also that plasters were more often used for the final treatment of the surface of a brick wall [17]. In the 15th century, the brick pattern was rarely used in interior decoration and in the 16th century it also disappeared from facades, where multicolored compositions painted on plaster or whitewash appeared [18]. In the case of the facade in question, demolition bricks from the transformed older fragments of the walls of the town hall rooms were likely to have been used.

The original surface of the mortar, which was exposed from under the secondary mortar layers, is very smooth. The joints are shaped in a variety of ways: flat, incised and undercut (to varying degrees and in various forms). Numerous remnants of the red colored layer are visible on the preserved original mortar surfaces. Its thickness varies - from a fraction of a millimeter (in the form of a slightly red glaze) to about 0.5mm (in the form of a covering porous layer). Such variation is probably due to the different state of preservation and the detachment of parts of the colored layer. The red layer is intense - it consists entirely of iron red pigment with a small content of fine sand. The basic component of iron reds of natural origin is iron oxide (Fe_2O_3), with an admixture of aluminosilicates, quartz, calcium carbonate, and sometimes dolomites [19]. Natural iron reds have been known since antiquity. They are obtained from natural red clays by roasting natural yellows or are produced artificially (modern pigments). Iron reds vary in shades, and are characterized by very good resistance to light, weather conditions and acidic, and alkaline environments. They can be mixed with all pigments and can be used in all techniques, including those involving lime. In most cases, iron reds have very good coverage. In the colored layers, protein was identified. It is a component of the pigment binder.

Taking into account the state of preservation, exposure conditions and decorative techniques used in wall painting, as well as the physical properties of the colored layer, it is assumed that casein is the binder of the pigment. W. Ślesinski [20] states that the casein technique consists in painting with dyes made with casein binder. The casein technique is simple and cheap, and glazed or opaque paints can be used. Casein paints combine well with almost all canvases. The surface of paintings made with casein paints is matte and at the same time lively and bright. The casein technique is one of the most suitable for painting on a dry wall, both outside and inside, however, in the case of heavy moisture, this binder can quickly decompose. In turn, durability depends on the type of used casein, with calcareous casein being considered the most durable. Painting on fresh mortar increases its durability. The surface of the wall was probably painted right after the masonry work was completed. No secondary layer (e.g. dirt) between the mortar and red paint was noticed on the executed cuts. Remnants of red color layers are also visible on the stone details. Two different reds were found: iron red and red lead pigment. Iron red is present on the surface of the stone blocks aligned with the wall and on some fragments of the detail, e.g. on the soffits of the arches within the tympanums. It occurs as a discontinuous layer, which is mainly preserved in the near-surface pores and in a very thin layer on the surface of the stone (Fig. 6b). On the surface of the details, e.g. crockets, pinnacles and finials, there are remnants of paint that is based on red lead pigment (Figs. 6c and 7d). Red lead pigment is a compound of divalent lead oxide and tetravalent lead oxide. It is a pigment obtained artificially and is known since antiquity in Greece and Rome. In the Middle Ages, it was used in wall

techniques i.e. glue and tempera techniques and sometimes with the addition of iron reds. Red lead pigment has good coverage properties [20]. The preserved traces of two reds suggest that there was a color variation on the stone detail. The surfaces were probably painted in the color of the walls - iron red and the details in orange lead pigment. However, in the light of previous observations, the colors of the entire stonework cannot be unequivocally reconstructed.

Summing up, it was found that probably just after the completion of construction works on the southern facade (around 1483), the brick surface was painted with uniform red paint [16]. It could have only been a temporary solution, which allowed for the aesthetic closure of the construction phase. It should be noted that painting the facade in red was a very common solution in the Middle Ages in Silesia. The facades of the town halls in Namysłów [21] and in Zielona Góra [22] were painted with red monochrome, as was the case with the tower of the Krakow Gate in Namysłów [23] or the churches in Grodków [24] and Dzierżoniów [25].

Due to the lack of resources, it can only be assumed that the budget for the costly construction and stonework was used, and therefore the plastering and painting of the facade was postponed until the next construction stage. As already known, this happened after less than 30 years. The only material evidence of these works are Carl Lüdecke's inventory drawings and the small fragments of plaster found during the discussed conservation works. They testify to the content, color and richness of the painted facade decoration [16]. How colorful the southern facade could have been is indirectly evidenced by the preserved Gothic decorations from other town halls in Silesia, including Środa Śląska [26]. The decoration of Wrocław town hall probably did not differ from other European solutions of this type - such as the facades of the town hall in Ulm with frescoes from around 1540 by Martin Schaffner [27], or the tower of the town hall in Toruń with engraved and painted traceries [28].

Conclusions

Based on the research carried out and discussed above, it was possible to formulate conservation conclusions for the renovation project of the southern facade of the town hall in Wrocław. The preserved archival materials and the results of the conducted research enabled proposals for the color arrangement of the facade (referring to historical solutions) to be proposed. This arrangement took into account the conclusions obtained during architectural and conservation research, iconography analyzes and conservation doctrines.

The first variant assumed an arrangement referring to the first color phase of the facade, and the restoring of the historical late-Gothic decor with colors from around 1483 [16]. However, due to the condition of the brick surface and numerous masonries works from later phases, it was impossible to carry out exactly the same work as in the Middle Ages, i.e. to paint the brick walls with red paint. It was therefore proposed to cover the entire brick facade with fine-grained plaster (2-3mm thick) that would be applied in a way that its texture would reflect the original pattern and then to paint it (a similar problem of exposing the late-romanesque portal in the baroque porch, changed by later transformations, in the Premonstratensian monastery in Kraków was discussed in [29]). Considering the intensity of Gothic paints mixed with natural ingredients, it was suggested to first paint the plaster surface in a color similar to the natural lime-sand mortar, and then to apply a layer of red using a glaze technique. The iron red discovered and recorded on the surface of the wall during the tests was adopted as the reference color. Obtaining a color-accurate and at the same time aesthetic luminous coating required many tests with different compositions of pigments and also their different concentrations in the binder. Silicate binder glazes, system pigments and dry iron pigments were used.

In order to fully emphasize the aesthetic values of the facade and to expose the sculptural detail, it was proposed to match the colors of the wall surface with the plastered background of the surface of the stone blocks, which constitute the background for the sculptures and architectural details. This solution was supported by traces of red paint preserved on the surface

of the stone, which suggests that these fragments were color-integrated with the surface of the brick wall.

The second proposal assumed a far-reaching restoration of the facade, with its painting decoration referring to those made in around 1510 [16]. As the basis for the reconstruction, an inventory made by Carl Lüdecke and fragments of plaster found in recesses and above the roof of the eastern avant-corps, should be used. Unfortunately, while they provide the basis for reconstructing the thickness and texture of the plaster, the preserved traces of paint layers do not provide sufficient information about the color scheme. Conducting the reconstruction based on Carl Lüdecke's inventory would be burdened with the stigma of individual creation, and also a high degree of hypothetical assumptions. This, in turn, would be inconsistent with conservation doctrines.

When attempting to reconstruct the decoration, it would be necessary to carry out comparative studies of late-Gothic facade polychromes. Several examples of such solutions have been uncovered during conservation works on the facades of town halls and tenement houses in Silesia in recent years. Similar decorations were found e.g. on the facades of town halls in Środa Śląska [27], Namysłów [21] and Zielona Góra [22]. Based on a comparative analysis, the reconstruction of repetitive elements, such as tracery or cornice friezes, seems to be largely reliable. However, in the case of individual forms, mainly figures or human busts, when the preserved documentation does not allow for their faithful reconstruction, it would be possible to leave the areas empty (without decorations). Background colors discovered and recorded during the tests should be made using the glaze technique. This applies to the iron red as the background of the facade and the black found on the plasters in the recesses between the windows.

Plastering of the brick surface and searching for a neutral color that would be the best background for the unevenly colored stonework (discolored as a result of many years of exposure to pollution) was also considered. The rejection of this solution was determined by conservation considerations and the conviction that an unfavorable ahistorical effect will be obtained. Based on the above findings, the first color version was proposed for implementation.

An important conservation aspect within the context of the color scheme of the facade was the issue of heraldic elements: the coats of arms of Poland and the Bohemia Kingdom and the coat of arms of Wrocław, which were located in the tympanums above the windows of the first floor. The investigations carried out during the research indicate that they were probably painted in colors consistent with heraldry. Traces of polychrome were found directly on the surface of the stone, which suggests that they were made straight after the southern facade was erected [16]. The restoration of colors for the heraldic elements was also based on a comparative analysis of the city's coat of arms and historical sources. Despite the above arguments, restoring the colors of the coats of arms was abandoned due to the scarcity of data and the lack of unequivocal relics of the color scheme on the figures supporting the elements of the shields of the coats of arms. The return to such a solution, although correct for compositional and aesthetic reasons, raised some concerns due to the fragmentary iconographic resources and the not many preserved traces.

The revalorization of the late-Gothic decoration of the southern facade of the town hall allowed for the colors of the whole building to be integrated and also for the most beautiful Gothic facade in Silesia to be enriched. The proposed technology for the works on the surface of the wall, i.e. a thin layer of lime plaster in a sand color covered with glaze in a color that closely reflects the reds preserved on the joints, enabled a valuable and attractive appearance of the facade, which refers to the historical solution, to be obtained (Fig. 1).

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