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The Restoration of the 12th Century Engraved Estrich Gypsum Floor from the Church in Wiślica

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Abstract The so called “floor” from Wiślica has an outstanding place among other medieval artefacts in Poland. Its latest history began at the break between 1959 – 1960 when the floor was discovered during archaeological excavations. The issues of its restoration remained complex and exceptional despite the fact that the work was preceded by all possible examinations and treatments. The greatest achievement of this project was matching the applied technology and technique of restoration with the historic fabric. The employed procedures might be suitable and applied either directly or by analogy in similar cases.

1 Introduction

One of the popular materials used throughout centuries is gypsum; its qualities and usage in art have been well recognized. However, how to cope with the gypsum floor regarding limitations related to its location in situ, what material should be used to stabilize crumbled elements, and what procedures and technique should be applied were all unanswered questions when the works in Wiślica began. Also, when the work was completed, one might have expected that the gathered experience that allowed him to answer all related dilemmas would help one to know what to do with similar objects, but it was not the case! Or rather, it only partially was; every artefact has its individual conditions and needs to be treated individually, which requires a modification of the methods worked out for other cases. (We could testify this notion when together with professor Zalewski we began to restore the tomb plate dated to ca 1000, which was also made of estrich gypsum, in the cathedral basilica in Gniezno. The experiences gathered in Wiślica were very useful regarding restoration techniques, but numerous new
issues occurred, including these related to the artefact’s appearance and display – much different than these which we faced in the case of Wiślica [1].)  

When we encounter problems related to historic fabric that we have not faced before, we search for technical solutions based on our personal experiences. When we cannot find them we shall count on the support and creativity of scientists. Also, of course, when a situation calls for immediate action, one applies some sort of effective material that will protect an artefact from damage, even if it is not optimal.

![Fig. 1 Estrich gypsum floor in the crypt of first Romanesque church.](image)

The 12th century engraved floor in the church in Wiślica survived under a four meter thick covering of soil and rubble beneath the floor of the Gothic church. The discovery came at the time of commemoration of the Polish State Millennium, which is associated with the introduction of Christianity to Poland (966). The Romanesque floor, with the representations of historic figures, had obvious indigenous features. The discovery had a great impact on scientific circles, both in the country and abroad. However – similar to the other discoveries made by the Zespół Badań nad Polskim Średniowieczem [2] (the Team of Researchers of the
Polish Middle Ages) – it could not be introduced into the commemorative events by communists for the obvious ideological reasons.

2 Relics and their exposition

The most precious artefact discovered in Wiślica was the floor of the Romanesque church of St. Mary, dated to ca 1175 – 1177 (according to L. Kalinowski) [3]. A vaulted crypt was once located beneath the presbytery of this first Romanesque church. It was originally supported by six columns and termed with a semicircular apse. An altar was located at its eastern end (at present it is vestigially preserved). The paving was made with an estrich gypsum floor, with an engraved central part and decorative strips running between the columns. The grooves were filled with a dark-coloured substance. The areas between the columns and the outer walls were not decorated. What we can see at present are two scenes framed with a decorative strip running between the columns; the composition entirely fills the small crypt from its eastern to western ends. The scenes depict historic figures, one of whom is presumably a founder. These depictions are supplemented with a Latin inscription that states the will of the dead, who wished to be trampled in order to reach stars (Inscription says: HI CONCULCARI QUERUNT UT IN ASTRA LEVARI: POSSINT ET PARITER VE

In the scientific world, the discovery was immediately recognized, not only because of the age of the artefact but also because of its ideological complexity, history, and form; its religious and spiritual values; and finally its technique and employed materials. These factors make the floor one of the most precious Polish Romanesque pieces of artwork, along with the tomb plate and gate from Gniezno and the columns from Strzelno.

Numbers of prestigious scientists of various disciplines, including art restorers, went on a pilgrimage to Wiślica. Professor Władysław Zalewski (Academy of Fine Arts in Kraków) witnessed this discovery and was later engaged with revealing, documenting, examining, and finally restoring the floor [4]. I had honour to take part in this work as one of the co-leaders of the restorers’ team.

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1 In my personal experiences of living under communist rules I simply cannot avoid mentioning the implications of Marxism ideology which had striking impact on science and social life. Marxism rebutted values of Latin civilization along with great rules of entity – the great holarchy of development (K. Wilber) along with truth, morality, religion, replacing them by simply “rationalism” – which in fact offered nothing instead. It was striking during commemorative events organized by the communist government. For instance: celebration of the Millennium of Baptism in Poland was nothing in respect to yet another anniversary of the Communist Manifesto. I am happy that this conference takes place in Prague, for I will be well understood in this country, a former part of the so called “Eastern Bloc”, where, similarly as in Poland, all the values such as humanism, culture, religion, commemoration were also not respected.
Professor Andrzej Tomaszewski – at present, renowned architect and restorer – examined the stratigraphy of the place and carried out investigations of the original layout of both the Romanesque and Gothic churches. At that time he worked with the above mentioned Team of Researchers of the Polish Middle Ages at the University of Warsaw and the Technical University of Warsaw, guided by an archaeologist, associate professor Zofia Wartolowska, PhD [5].

Many decisions had to be made and many works had to be completed in order to provide public access to such an outstanding discovery. Following the concept of display, many conservators’ boards had gathered, but the decision of restoration had not been made, mainly because the restoration issues had not been recognized. The other complicated concerns included unstable temperature and humidity, threat of microbiological attack, and ongoing protective and technical work in the close surroundings of the floor. For these reasons, the floor was simply unveiled, initially cleaned, and subjected to basic protective measures. However, it was not wasted time; all possible archive materials were researched, the finding’s environment was under constant control, and the state of the floor was documented and studied in respect of its construction, technology, structure, and history.

At that point discussions were restricted only to the restoration guidelines of solely the floor. In these times, the concept of the overall restoration – that would in fact comprise the whole interior – was not standard, and the spectacular case of the gypsum floor was the main focus. It was seen as an entirely independent piece of artwork, which had been not related to its surroundings. In this approach was the threat that the original floor would be distorted into some spruced preparation – ready just to be presented – while its spatial context would be totally neglected. Finally, the decision was made to expose the artefacts and stratigraphic sequence in situ. This was a step forward, for it became obvious that the space between the floor of the Gothic church and the Romanesque estrich floor must be cleared. It was also declared that before the restoration of the floor, restoration guidelines and procedures must be established.

The beginning of the work was the turning point; soil and rubble were removed, walls of the crypt were cleaned, and the space was covered with a new vault. The technical works aimed at providing access to the church basements, including the building of a platform and barriers, were finally completed at the beginning of the 1980s - almost thirty years after this sensational discovery!

The programme of restoration, worked out in 1974 by professor Zalewski, was the basis for further decisions, examinations, and the subsequent restorative treatments [6]. The guidelines directed the stages and arrangement of the procedures. At the first stage, Zalewski suggested complex conservation and structural stabilization of the whole basement area (i.e. relics of archaeological strata, walls of the foundations of the Gothic church, and relics of both the first and second Romanesque churches). There was also some basic cleaning work to do. As the environment was stabilized, the sources of dust and dirt removed, the next stage – restoration of the floor – could begin.
3 Restoration

As the system of natural ventilation had been introduced in 1982, the environmental conditions (mainly decrease of humidity) within the crypt were improved so that we could start restoration works. They were completed in 1986 [7]; the works carried in the year 2000 were aimed at providing public access to the crypt.

We could not follow up on any former restoration procedures carried out on estrich floors dated to a similar period. There were only examples of basic conservation treatments, such as protection and relocation of broken parts, shielding a floor with glass plate, or transferring it from its original location to a store room. The only – unsuccessful – attempts that had been carried earlier on the Wiślica floor were tests of cleaning with sulphuric acid, which resulted in the deterioration of gypsum.

At the beginning of the work, the floor was extremely dirty. However it was shielded, particles of dirt, dust, and rubble gathered on the floor surface, while moisture present in some areas bonded the dirt particles with gypsum. In general, humidity in the basement, resulting from groundwater and precipitation water, was very high. This thick coat of dirt was also an effect of the conscious decision to abandon any cleaning treatments of the floor, for even the lightest touch could have resulted in mechanical damages.

4 Restoration issues

Materials that might be used in joining broken estrich floor elements had been the topic of consideration since the fabric of the floor was recognized. Estrich gypsum in the first Romanesque church was employed as mortar for plastering the inner walls of the crypt and for the whole floor (i.e. decorated and undecorated parts). The mortar, which once bonded the blocks and stones of the masonry, was subjected to mechanical damage; it was partially lost or crushed, mainly within the protruding elements. If the broken elements had not shifted their position it would have been possible to reassemble them.

Gypsum of poorer quality was used in the undecorated (not engraved) areas of the floor. These areas were cracked and crumbled, but the broken elements remained on their spots. Even small chips were not shifted as they were embedded in clay ground, in some areas in a few layers, one on top of another.

The decorated floor was made of the best quality sifted gypsum. The main damage was mechanical; the gypsum slab was crumbled with some parts broken mainly at the border areas, generally along the edges of the consecutive coats of poured fluid mass of gypsum (eastern part). Yet, another type of damage – located mainly in the eastern part of the floor – was distinguished as “clusters” of crumbled gypsum matter with clearly confined areas. This type of damage resulted
from the separation of the bottom layers of the floor, which caused a loss of stability in the upper coats and caused them to fall into pieces.

The main concern of the restoration project was related to the protection, stabilization, and rejoining of the broken parts, but not exclusively. Cleaning the gypsum surface was a separate dilemma, especially the small, crumbled chips. It was the main difficulty in the process of cleaning the area of the undecorated floor (mainly northern and southern parts). Any attempt to wash mud away from the interstices and crackles caused the small chips to shift their position. However, it was necessary to remove the soil, as it was the source of dust and further deterioration. The simplest solution – adopted in similar cases – is consolidation, but in this case, given the very unstable and humid environment (resulting also from groundwater), introduction of any new substance would not be an acceptable solution. One should keep in mind that such a substance would be irreversible and would penetrate the whole body of the floor. Yet another problem was cleaning the surface of the decorated floor (especially its eastern part) where the crumbled bits (a few millimetres in size) were grouped together in “clusters,” for even touching them with a paint brush would have resulted in displacement of the minute bits.

5 Gypsum and its application

In the territory of the historic Polish Kingdom, gypsum was relatively quickly replaced by lime. Although estrich gypsum and limestone need similar calcination temperature, lime is generally easier in application; lime mortar may be easily prepared and used later, while gypsum mixed with water sets quickly and must be used soon after the mortar is prepared. The setting time of gypsum mortar is yet another issue: it differs depending on the calcination temperature, and the process is irreversible, which in some cases it is a benefit – especially in moulding. Gypsum as a material has many advantages, and for this reason, it is produced and used nowadays.

Estrich gypsum is obtained by calcinations of raw gypsum (crystal sedimentary rock) at the temperature of ca 600 – 1200°C. The material sets very slowly over a few days until the chemical process is completed. The prolonged setting time allows for shaping and manipulating the mass. Once estrich gypsum crystallizes and dries it obtains mechanical resistance. The most common forms of gypsum (hemihydrate gypsum and di-hydrate gypsum) are calcinated at lower temperatures (ca 110 – 200°C); gypsum used in building sets in about two hours, while Plaster of Paris sets in 10 minutes.

The application of estrich gypsum in the oldest architectural structures of Wiślica seems obvious, as the river Nida Valley (i.e. Wiślica region) is within the three richest in gypsum rock areas in Poland. The technology used in the floor's creation is superior; the produced material is of the highest quality, which allowed
it to be engraved. Other places where similar technology was used are quite distant and located in regions rich with gypsum deposits (e.g. in Saxony).

In Wiślica, estrich gypsum was not used only in the 12th century Romanesque church. The grave slab found at the extension of Romanesque church of St. Nicolaus (11th century) was also produced from this material. A few fragments of the estrich floor, a dozen centimetres thick, also were found during archaeological excavations on the site called “castle.” In the nearby Romanesque church in Kije, other fragments of estrich floor were found; the liquid gypsum mass was poured onto stone chippings.

Other regions of Poland where gypsum stones were calcinated and employed in architecture structures are the regions of Wielkopolska, Kujawy (Romanesque church in Gniezno, grave slab ca 1000), Ostrów Lednicki (“baptism pools” and fragments of the floor in the castle chapel), and Lębno (rotunda of St. Peter discovered in 1983), the city of Kraków and its region (St. Benedict church, fragment of gypsum floor found in the square Romanesque structure located beneath the Main Court of the Wawel Castle), and Tyniec (relics of floor in the presbytery of the church).

In Europe, gypsum was used in the early Middle Ages as a mortar for plastering walls and in flooring. There are ten examples of artefacts found in the Western countries dated to the times when the Wiślica floor was executed: Quelenburg, the former collegiate church 2nd part of the 12th century; Ilsenburg, the former Benedictine church, 12-13th century; Drübeck, the former Benedictine church, end of the 12th century; Erfurt, cathedral, chapel in the northern tower, ca 1160; Nienburg, the former Benedictine church, crypt, after 1163; Hildesheim, cathedral eastern apse, ca 1153-1162; Helmstedt, the former Benedictine church, crypt, ca 1150; Benediktbeurern, the Benedictine church, send half of the 12th century; Basel, cathedral ca 1170. None of these have been displayed in situ, and none of them are as well-preserved as the one in Wiślica. The mortar of the Wiślica floor has a pink tint, especially apparent when the surface is wet, which is the effect of clay components contained in gypsum rock. When calcinated in high temperature it becomes red in colour (as in calcination of biscuit clay). In fact, depending on calcination temperature, minerals can become various colours.

There were a number of professionals involved in the part of the research carried out within the two Romanesque churches and their surroundings. Examinations were aimed at the recognition of archaeological strata, reading iconography of depiction, and the technique and technology of the floor. In-depth studies revealed complex issues [8].

The most extensive examinations of the gypsum material were made by a petrographer, Tadeusz Kawiak, PhD, from the Cracow University of Technology [reference number and list his published work at the end of the document] [9]. The samples were studied by X-ray diffraction, differential thermal and gravimetric analysis, and electron and optical microscopy; physical properties were measured by the mercury displacement method. Obtained results allowed for the identification of the mineral components of the mortar and revealed the employed
technology. The basic component of the mortar used in the floor is gypsum (91 – 96%), and the average temperature of calcinations was 500 – 1000°C.

The knowledge of the material’s technology and its inner structure does not automatically provide tools and methods for conservation – these had to be created. The basic concept was to use gypsum to reassemble the broken elements, taking into account the artefact’s state and environmental conditions. Therefore, the parameters of gluing and setting gypsum had to be defined with respect to the conditions on-site. The necessary tests were carried out by Kawiak, both on-site and in the laboratory; as he was a member of the team, he could recognize the specific situation of the restored artefact. The priority of conservation was to work out technological consensus of historic fabric with techniques of modern restoration.

6 The technique of bonding with estrich gypsum

Kawiak produced estrich gypsum (anhydrite CaSO₄) in the laboratory and continued experiments on modifying its setting time by admixtures of hemihydrate (2CaSO₄·H₂O) gypsum and calcium oxide. This was followed by tests of gluing with this medium, which provided data on conditions in which bonding is effective and resistant. This specially produced material was used for restoration of estrich floor, but depending on size of the broken pieces, the technique of gluing had to be modified. Large elements had to be treated differently than smaller ones and the smallest bits, yet another technique of bonding had to be used for the loosened areas of the mentioned “clusters” of tiny chips, for these had to be kept in their positions. The basic principle was to provide proper setting time by keeping the glued fragments wet with gypsum water [10].

The gluing procedure began by joining the larger pieces of mortar. They had been initially wet with gypsum water, as were the locations where they were to be affixed. Next, the joints were covered with fresh estrich gypsum mass. Once the elements had been matched, the joint was covered with a poultice of cellulose wadding, also wet with gypsum water, and wrapped with foil. On the following day the excess of putty was removed, and joints were worked out. For the following three to four days the joints had to be kept wet, thus wetting with gypsum water was necessary. Finally the protective shield was removed and the reassembled elements left to dry. The abundant saturation with gypsum water caused evaporation which lasted up to a few weeks.

As noted above, cleaning the small chips was problematic. In order to prevent their replacement or loss, the cleaning procedure was combined with the procedure of fixing these chips to their original location. One after another, the chips were cleaned and immediately set in their places.
The areas of “clusters” with tiny cracked bits – which resulted from the inner, horizontal cracks in the body of the floor – called for yet another approach. These areas consisted of tiny soiled fragments (of 1 to 3 millimetres), some of which were dislocated; they could not be moved and put back (as with the above described elements). They could not be cleaned prior to placement, as this might have washed them out and dislocated them. Thus, they had to be stabilized. To this end, the area first was saturated with methanol. This decreased the surface tension and, as it penetrated into the fabric, also introduced dirt particles, consequently increasing the spaces between them. Next, the suspension of finely ground gypsum in methanol was injected with a medical syringe; alcohol was used as a chemically neutral carrier. The composition of gypsum filler was modified according to the degree of damage of the area – whether a stronger or weaker binding medium was needed. The mortar was composed of estrich gypsum and calcium oxide. An addition of semi-hydrate gypsum shortened the setting time. As the fluent putty was introduced, the “cluster” was wet with methanol dropped from another syringe. During the process, the gypsum particles gradually set and filled empty spaces between the broken chips. As all elements were embedded, the area was left alone to allow the alcohol to evaporate. Once the evaporation had been completed, the area was saturated with gypsum water and the setting was initiated. Poultices were kept for another two or three days. Only after the setting process was complete was cleaning carried out. At this stage the crumbled bits were all secured and affixed to their original locations.

The limitation of this method is that the procedure may be carried out only on a small, restricted area. Gypsum putty must be prepared in small portions and the
composition must be properly adjusted. Finally, once the procedure has been started, it must be completed with no timing delays.

7 The stabilization of the floor

Yet another problem had resulted from the natural weathering that weakened the surface of the estrich gypsum floor. A microscopic examination carried out by Kawiak on the site identified the structural damage which had decreased the mechanical resistance of the surface when compared to the inner body of the floor. The following questions appeared: how to bring the re-stabilize the surface and what materials should be used in the conditions of unstable humidity. The issue was connected with cleaning process, as for instance, distilled water – which is considered to be neutral – was too aggressive in this case and might have caused the washing out of the deteriorated surface.

One of the methods of non-invasive surface consolidation, used in the restoration of fresco, is sprinkling the wall with lime water; and it seems to be an ideal component in terms of similar materials. Because distilled water caused destruction of the weakened surface, the tests were conducted with gypsum water (one litre of gypsum water contains two grams of gypsum), which the tests carried out by Kawiak determined was effective. So all estrich gypsum surfaces were cleaned with gypsum water only. In fact, it was used from the very beginning of the works as the only acceptable cleaning agent.

The petrographer pointed out that at a decreased temperature of 4°C, eight grams of gypsum might be dissolved in one litre of water (instead of two grams, which is the case for higher temperatures), and this specific property was adopted to stabilize the floor. As the tests of consolidation brought positive effects, the consolidation was carried out on the whole floor at the final stage of the work, with all preceding procedures carefully prepared. So first, the water was cooled down to 2°C, then the gypsum was added, and as all large particles fell to the bottom, water was filtered through blotting paper. Clear water, highly saturated with gypsum, was dispersed onto the floor, and the surface was secured with hostaphan foil. The procedure was carried out a dozen times or so, and the tests confirmed that it was effective. In order to provide optimal environmental conditions the procedure was carried out at the break between winter and spring, when the temperature in the crypt was about 4 – 6°C. Temperature was further decreased by a cooling device.

The Regional Museum in Wiślica was created as soon as archaeological, architectural, and restoration works were completed and access to the basement provided [11]. The Museum requires monitoring and general care of the floor and excavation area, as well as an interpretation of the site. The institution is not alone in the protection of the ancient artefacts, however; professors Tomaszewski and Zalewski regularly visit Wiślica and help to care for and keep historic monuments
in proper condition. During their last visit in March this year, they confirmed that both floor and its surroundings needed cleaning.

8 References

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