

CONDITION SURVEY OF THE LAST JUDGEMENT MOSAIC ST. VITUS CATHEDRAL, PRAGUE

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Abstract:

Over the centuries, the vividly colored images and figures of the Last Judgment mosaic, on the southern facade of St. Vitus Cathedral, in Prague, Czech Republic, have been obscured by a gray crust. Before conservators could begin to restore the mosaic, they needed to study the types and locations of damage, previous treatments, and other problems. Graphic documentation enables conservators to record their studies and note conditions. Technology should assist, not interfere, with this process. How can conservators record these conditions using simple techniques yet still harness the power of technology?

1. CONDITION SURVEY WITH SIMPLE TECHNIQUES

1.1 St. Vitus Cathedral, Prague Introduction

Jesus Christ, the central figure in the Last Judgment mosaic, is depicted passing judgment on the world, surrounded by triumphant angels above the patron saints of Bohemia. To his right, the dead are resurrected from their graves. To his left, blue devils welcome the damned. These dramatic scenes have become visible only recently. For hundreds of years, they were obscured by a chalky gray crust caused by the corrosion of the small glass cubes, or tesserae, that make up the mosaic. The corrosion was the result of rainwater interacting with the impurities of potassium and calcium within the medieval glass. When exposed to water, these minerals are leached out, creating alkaline salts that react with carbon dioxide and sulfur dioxide and crystallize on the surface.

It is likely that Charles IV, king of Bohemia and the Holy Roman Emperor, noticed the “dimming” of his mosaic. He commissioned the work in 1371 for the southern entrance of the cathedral to symbolize the magnificence of his kingdom. Called the Golden Gate, as much of it was gilded, the mosaic is made of more than a million red, blue, and other brilliantly colored tesserae. It is composed of three panels 4 meters wide by 8 meters high, and is considered to be the most important mosaic north of the Alps. Cleaning and repairs had been attempted several times over the centuries but always with short-term results, and the mosaic soon became obscured again.

In 1992, the Office of the President of the Czech Republic, the Prague Castle Administration, and the Getty Conservation Institute (GCI) began a project to conserve the mosaic and make it permanently visible. An expert conservation team was formed with leading conservators, historians, and scientists from across Europe and the United States. They were presented with three significant challenges: to determine what caused the crust, to safely clean the glass without damaging it, and to protect the work from the elements once cleaned¹.



Figure 1: Detail of an angel, shown after cleaning, in the Last Judgment mosaic, above the entrance to St. Vitus Cathedral, Prague.

1.2 Project

The ten-year project was divided into four phases. First, conservators studied and researched the mosaic's history, past treatments, and physical composition to identify and describe the mechanisms of deterioration. Second, they examined and assessed its current condition, documenting in detail the levels of corrosion, cracks, missing tesserae, original traces of gilding, previous interventions, and other significant attributes. This was followed by the third phase, extensive testing of treatments for both cleaning and protection. Conservation was implemented in the final phase once the team was absolutely sure of a safe and effective treatment. After conservation was finished, the mosaic was periodically monitored to ensure that it remained visible. Constraints on the project were few, as this is a significant work of art and a national treasure. However, there was one significant constraint concerning documentation during the second phase. Project managers wanted to use advanced computer imagery and graphics to record and analyze the information collected on the mosaic, yet expert conservators on the team had never used this technology. The managers insisted that conservators should not have to alter their methods or compromise their condition assessment. An approach had to be developed so that the conservators could collect data on site, yet still use computer technology for analysis, investigation, and publication.

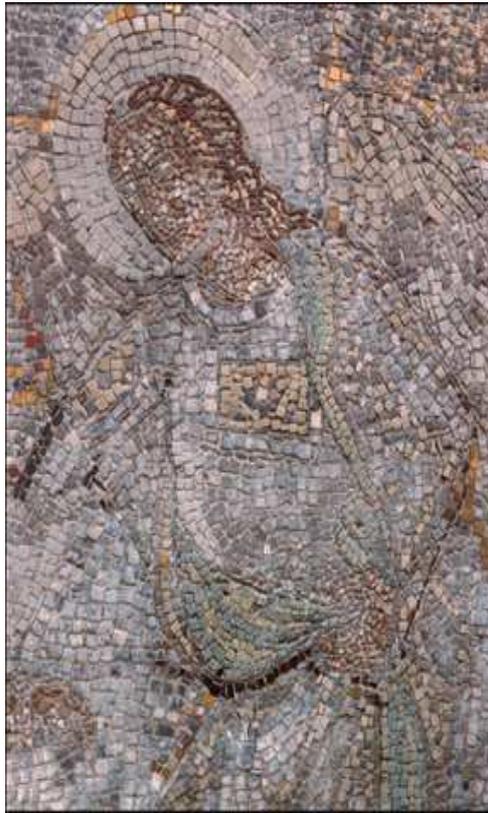


Figure 2: Detail of the mosaic before cleaning

1.3 Base Map

A simple but systematic method was devised using multiple A4-size transparent plastic sheets over printed images of the mosaic. By using this method, conservators were not distracted by technology and did not have to substantially change the way they worked. Several important steps were required, however².

The first step was to begin with a good image of the mosaic to use as a base map. The image had to be of sufficient resolution for the conservators to see each small, 30 × 30-millimeter-square tessera. This step required specific expertise, so the conservation team hired a Czech company to photograph, accurately measure, and process the images to be used for the base map. Each panel of the mosaic was photographed in its entirety with a medium format (13 × 18 centimeter) Carl Zeiss Jena UMK 10/1318 camera with a Lamegon 8/100 lens using Kodak Ektachrome E100s color film, speed 100ASA. The film was then developed and scanned with a photogrammetric Zeiss/Intergraph TD scanner.

High resolution is only one aspect of creating a good base map; the images also have to be distortion free. Distortion is caused by the curvature of the lens, the film, and the position of the camera in relationship to the subject. With accurate measurements of the mosaic and knowledge of the camera and lens geometry, any distortion can be removed through computer processing.

In the second step, the sharp corners of ten individual tesserae on each panel were selected as control points. Then, their three-dimensional coordinates were measured with a Wild T2000/ Distomat DI1600 total station. Using the target measurements and the computer program.



Figure 3: Conservators at St. Vitus Cathedral inspecting the mosaic, recording conditions on transparencies overlaid on rectified photographs of the facade. Photo: Dusan Stulik.

PhoTopoL, the digital images were then rectified, or transformed, and correlated to fit actual dimensions of the mosaic. The removal of distortion and the placement of the images to exact scale were crucial, as each of the three panels was photographed separately during different phases of the work. This allowed images taken before, during, and after conservation of each panel to align exactly.

In the third step, the distortion-free images and measurements were imported into AutoCAD, a computer drafting program, and sent to the conservators. Using this program, a grid was then drawn every 20 centimeters over each image, both vertically and horizontally. This, along with a naming standard, created a coordinate system that allowed the team to reference specific sections of the mosaic. For example, Christ passing judgment is located at LJCBC B4. This refers to the Last Judgment (LJ), center panel (C), before conservation (BC), column B, row 4. Four rows by four columns were then printed at a scale of 1:4 on A4 heavyweight paper. A4 transparencies were also printed with a corresponding grid in order to align properly with the image of the mosaic. This proved to be a good size, as it was manageable on a clipboard yet still provided an acceptable level of detail. By using the base map image and transparency overlay, conservators could work on the scaffolding to manually record important features.

1.4 Condition Survey

Information collected by conservators on the transparencies was scanned and imported back into the computer model. Prior to collecting information on the transparencies, it was found that certain colors—green, yellow, and other light colors—were not optimal for scanning. Therefore red, dark blue, black, brown, magenta, and orange were chosen for use. It was also important that only new markers were used. A condition legend was created that corresponded to each color. Red referred to cracks, magenta to traces of original gold, and blue to missing tesserae. In addition, extra transparencies were made available if the conservator made a mistake; no corrections were possible given that the transparency was

scanned. All of these issues were carefully explained to the conservators, who were required to change their usual methods.

After the transparencies were scanned as bitmaps, they were converted into a form that could be included in a computer drawing program. Bitmaps (or raster graphics) are how computers and programs such as Adobe Photoshop record and display graphic images. The computer image created from the scan of the transparency is composed of millions of individual points (or pixels) of color. The number of points determines the resolution of an image. In this form, the information is not easy to calculate, combine, or separate into distinct divisions or layers; it is also of limited use at a large size. The individual points in a bitmap image can be seen if printed too large, resulting in uneven lines. The scanned data had to be converted into a different form—a vector graphic image. Vector graphics represent an image through numbers or mathematical models, and in this form it could be combined and manipulated more easily. Cracks could be measured and areas calculated because the graphics are based on numbers, not just on individual points. Vector graphics could also be printed at any size without a loss in resolution. A computer program, Adobe Streamline, was used to perform this conversion. Once complete, the data from each separate transparency were digitally reassembled on top of the image of the mosaic.



Figure 4: Scanned transparency of the mosaic, with graphic recording of corrosion levels.
Drawing: Rand Eppich. Corrosion forming a crust Heavy corrosion Medium corrosion Light corrosion



Figure 5: Rectified images of the facade, showing its state before conservation (left), after treatment (center), and after gilding (right). Jaroslav Zastoupil.

This simple method allowed a team of five conservators to manually record the condition of each panel in approximately two weeks. It only slightly altered the way they traditionally work, requiring very little training in the use of computer graphics³. One junior member of the team was trained in scanning the transparency images, converting them from bitmap to a vector form and then assembling them back into the AutoCAD file. This same member was also responsible for all data management on site and additional work that was accomplished several weeks later. Once the documentation was finished, corrections and additions were made and the data printed at various sizes for further use in the project. The observations of the conservators aided in forming the subsequent treatment plans and also served as a benchmark for future work on the mosaic. At the end of the project, the data were archived in both print and digital form in Prague and Los Angeles.

Alternative tools, such as the direct use of laptop computers, were considered, but this required too much training and may have been a distraction while working on the scaffolding. Computers that allow the operator to draw directly on screen were also considered, but at the time of this project the technology had not progressed sufficiently. This methodology is still viable for projects without sufficient funds to purchase computers. Minimal training was required for the expert conservators but some training in scanning and AutoCAD was needed for the junior member⁴.

2. CONCLUSION

Conservators recorded the condition of the mosaic in order to understand and note issues that led to a conservation strategy. The techniques used in this example allowed them to conduct their evaluation without significantly changing their methodology.

The information collected, once converted to digital form, allowed conservators to view various conditions in new and different ways. Cracks and areas of loss were easily measured, as were patterns of corrosion relating to the different types of tesserae. The mosaic and the condition record were studied in detail away from the site, in multiple locations, which facilitated communication among the experts. Prints were made at various scales for use on the scaffolding and in presentations to both the public and professionals. Historic photographs were also scanned and included with the condition record. This method provided a tool that was more flexible and useful than if the documentation had not been digital. It also provided a complete visual description of the mosaic and serves as a record of recent interventions.

After the record was complete, the final phases of the project were carried out. A suitable method for removing the crust was tested and used. The mosaic was cleaned using compressed air and microscopic glass particles that were harder than the crust but softer than the tesserae. After cleaning, the surface was prepared with a solvent to remove any remaining residue. Each tessera was then treated with a complex protective coating that consisted of several layers. The outer layer is sacrificial and needs to be replaced every five years, whereas the inner layer is more durable and expected to last at least twenty-five years. This coating will shield the mosaic from the elements while allowing it to remain visible. The mosaic is inspected annually and photographed systematically in detail to determine if the coating is still functioning. Plans are in place to photograph and measure the entire mosaic every five years.

3. REFERENCES

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