

STONE DURABILITY UNDER CLIMATIC INFLUENCES: A CASE STUDY OF THE YUGOSLAV MONUMENT AT THE MAUTHAUSEN MEMORIAL

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The Yugoslav monument within the Mauthausen Memorial was erected in 1958 to honor the Yugoslav victims. The design specified the use of home materials—marble and granite—for the monument. It featured 8-meter-high two obelisks, and a “sarcophagus” constructed from eleven marble panels, all made from white marble sourced from Venčac. All materials were prepared and produced in Yugoslavia. In response to a report submitted by the diplomatic mission of the Republic of Serbia in Austria regarding the deteriorating condition of the marble columns, the Institute for the Protection of Cultural Monuments of Serbia initiated an investigation in 2024. This research included collecting data from archival documents dating back to the original memorial's construction in 1957 and detailed comparison with the monument's current state. This study presents a comparative analysis of the properties of the material at the time of construction and its current condition, after 68 years of exposure to climatic factors and static stability. The Institute for Materials in Belgrade conducted examinations of the stone samples in 1957 and again in 2024.



Based on the accepted suggestion of the jury reviewing the competition entries for the sculptural part of the monument—that the three-column architectural elements impaired the complete perception and visibility of the sculptural features and that the mass of the main block alone was sufficient to stand as a monument—certain conceptual changes were made. The changes also aimed at simplifying production and transport of the monument's elements.

Archival documentation shows that the main block was divided into 11 elements for easier transport and then clad with blocks 0.3 m thick. The visible surfaces of the block were roughly processed but completely even. The core and foundation were executed on site, with a foundation depth of 1.4 m. The number of columns was reduced to two, with altered dimensions of 0.55 m in diameter and 8.5 m in height. The columns were embedded in a 1.0 m-high foundation, roughly treated up to that height.

The plateau paving in front of the monument was executed using Jablanica granite slabs ($1.2 \times 0.6 \times 0.04$ m), laid on a macadan and concrete base. The access steps were made of tamped concrete clad with Jablanica granite. The plateau paving between the steps was initially intended to be constructed with granite slabs of various dimensions, also laid on a prepared base.



Reports and contracts confirm that all three columns were fabricated, but one was not transported or installed. The columns were of circular cross-section, 0.55 m in diameter and 8.55 m in length.

The sculpture, measuring 1.9×6.7 m, was cast in bronze, chiseled, and patinated in the Artistic Workshop of the Association of Fine Artists of Serbia, *Plastika*, Belgrade. The inscription consisted of 57 bronze letters (10 cm high), 8 numerals, and one dash.

The ceremonial unveiling of the monument was originally scheduled for May 1, 1958, but took place on May 11, 1958, at 13:15. The monument was unveiled by Yugoslavia's ambassador to Austria, Jože Zemljak, who also gave a short speech together with Drago Milenković. The Yugoslav delegation attending the unveiling of the monument to the Yugoslav victims who perished in the Mauthausen concentration camp in Austria consisted of Veljko Gilgorić (head of delegation), Veljko Marić, Miloš Bajčić, Miša Rajšić, Nandor Glid (author of the relief), and Kopal Cvetko. The ceremony followed the established protocol of strictly codified public commemorations for monument unveilings in Mauthausen, organized by the Austrian Association of Concentration Camp Survivors (*KZ Verband*).

RESEARCH AND PROJECT IN 2024

In 2024, based on research concerning the existing condition of the monument, the Institute for the Protection of Cultural Monuments of Serbia prepared a **Project for Conservation and Restoration Works with a Proposal for Structural Rehabilitation of the Yugoslav Monument at the Mauthausen Memorial in the Republic of Austria**.

On-site work included detailed documentation of the existing state with mapping of damage, as well as comparison of the executed monument with archival project documentation.

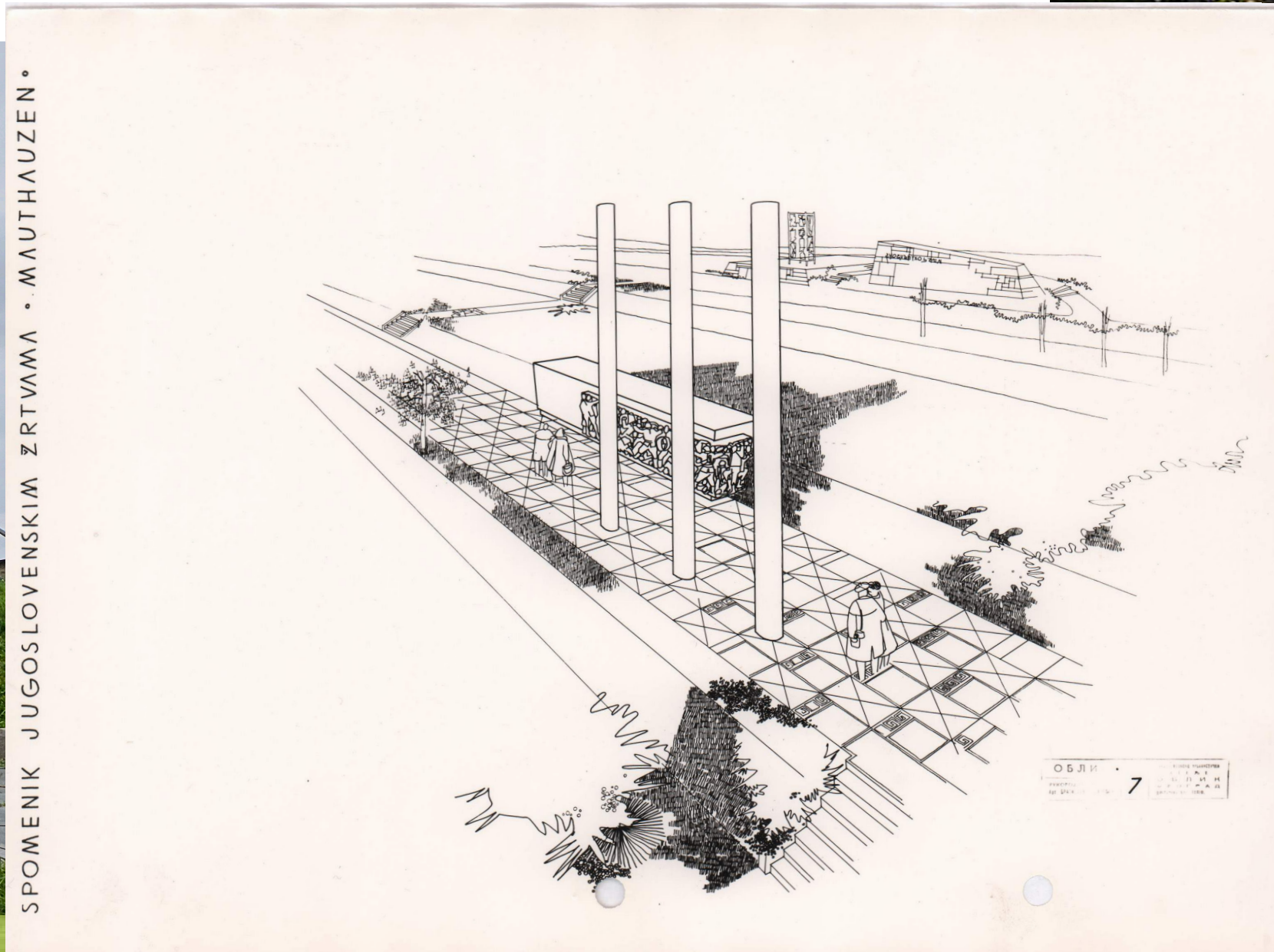
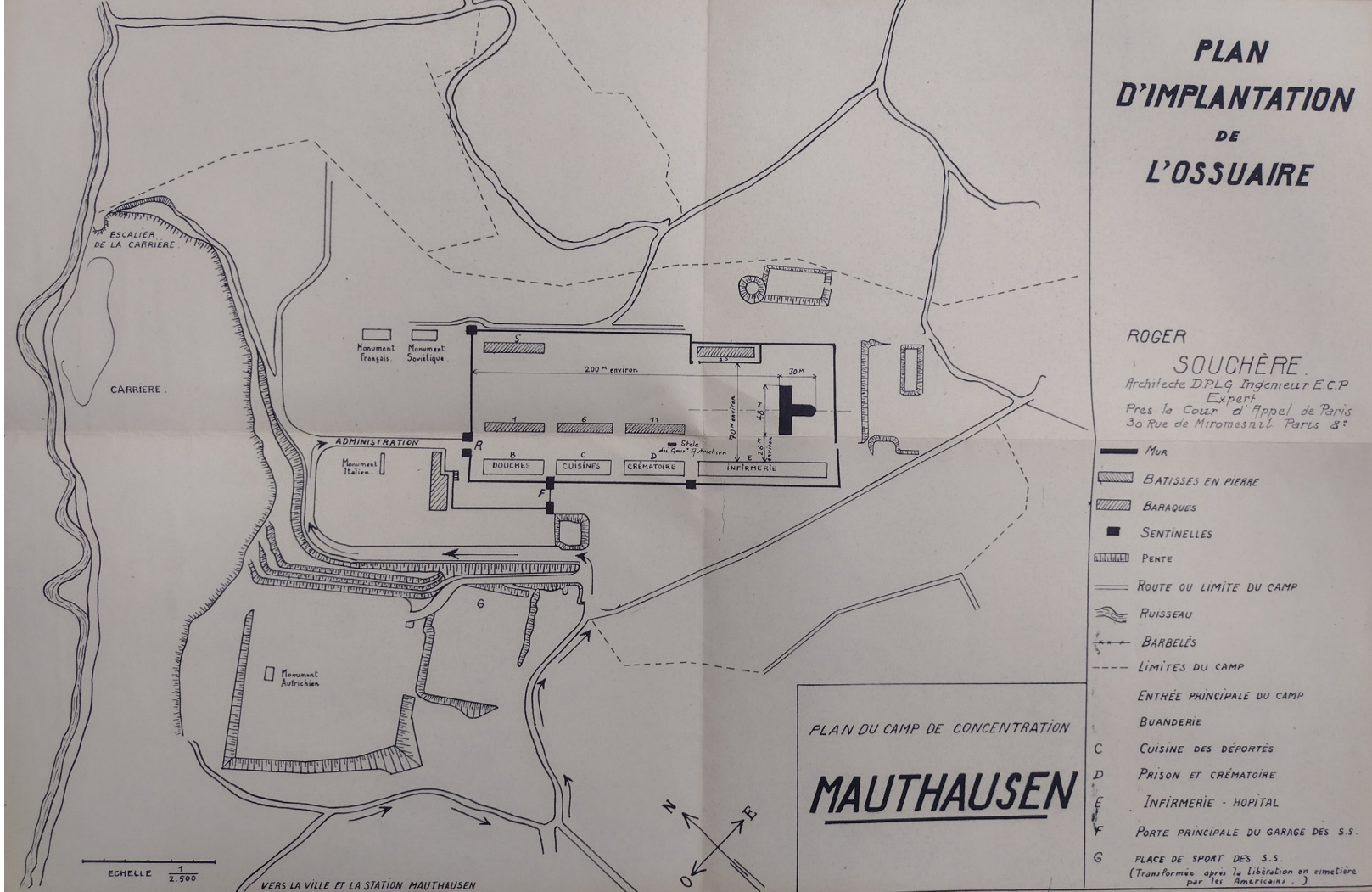
The monument is situated on terraced ground, formerly the site of camp barracks. Access steps lead to a plateau paved with Jablanica granite slabs measuring $10 \times 60 \times 4$ cm and $120 \times 60 \times 4$ cm. The investigative works involved the removal and dismantling of granite floor slabs around the columns, with verification of substrate layers, the connection of columns with their foundations, and the dimensions of the foundation footings. The total granite-paved area amounts to 142 m². The slabs were found to be placed on a layer of soil and aggregate; several are damaged and require replacement. Their smooth finish is also unsuitable for use in winter conditions.

The plateau unites the monument's elements: two Venčac marble columns, the marble block (“sarcophagus”), and the bronze relief set in front of it. The relief composition measures $6.73 \times 2.14 \times 0.17$ m,

positioned 40 cm in front of the marble block, anchored into the ground. The marble block (“sarcophagus”) measures $9.92 \times 2.13 \times 2.38$ m and consists of 11 Venčac marble blocks with roughly hewn surfaces. Bronze letters and numbers form the inscription on its surface.

According to archival documentation, the planned height of the columns was 750 cm above the granite-paved plateau, with an additional 100 cm embedded into the foundation, making the total length 850 cm. Field measurements established that the actual visible height is 795 cm. The depth of the foundations was not investigated so as not to jeopardize monument stability. The columns deviate from vertical, with variations in circular cross-section along their height, and are not aligned with the axis of the footing. Visible cracks were recorded, though their depth and degree of impact on the structural stability of the columns could not be precisely determined. Moisture and dirt infiltration into the marble material have intensified the damage.

Material samples were taken and analyzed at the Institute for Materials Testing. The report confirmed the presence of microflora, parasitic vegetation, and surface deposits. The marble showed clear signs of deterioration in the form of biological patina—colonies of microorganisms containing mechanical impurities, soot, and dust. Biological analysis confirmed the presence of lichens (lichenized fungi with foliose thalli), microcolonial fungi adapted to stone substrates, melanized fragmented hyphae with chlamydospores penetrating into deeper layers of stone, as well as yeasts and bacteria. Samples from the bronze sculpture revealed filamentous fungi and bacteria.



The project envisaged conservation and restoration works on all elements of the Yugoslav Monument, aiming to prevent further deterioration and destruction of its integral parts, and to improve its visual presentation currently compromised by surface deposits and mechanical damage to the sculpture and stone elements.

MATERIAL DEGRADATION ASSESSMENT

The Yugoslav Monument at the Mauthausen Memorial in Austria commemorates a site of suffering within a natural landscape, harmoniously integrated into its surroundings. The monument was carefully planned from both architectural and sculptural perspectives. Architect Stojanović chose to use stone materials sourced in Yugoslavia, despite Austrian architect Bauer's recommendation to opt for a harder material, pointing out the severe climatic fluctuations in the Mauthausen area and the risk of frost damage.

Our conservation-research work at Mauthausen in 2024 was initiated based on reports from the Mauthausen Memorial concerning the endangered condition of the two marble columns. Monumental changes are rarely caused by a single factor but rather by a complex interaction of environmental processes over extended periods.

Visual inspection and detailed documentation confirmed that the marble columns are tilted. However, no archival geodetic survey exists to identify the cause of this deformation. On-site tests of material strength showed that the right column has a compressive strength of 44–48 MPa, while the left measures 46–48 (52) MPa. Cracks were recorded in the lower zones of both columns.



Venčac marble consists of pure calcite grains, typically white with bluish tones. Earlier testing (1963) had established that the material is water-resistant and frost-resistant. Nevertheless, deterioration may arise from external, surface-level, or internal factors. If unaddressed, these combined causes may ultimately lead to the monument's complete devastation.

CONCLUSION

Proper and timely intervention contributes to the sustainability of the monument. The project for conservation and restoration of the Yugoslav Monument is directed towards preventing further deterioration and safeguarding all integral parts of the memorial.

As a public monument exposed to natural elements, it is vulnerable to various agents of gradual material degradation. Effective preservation requires thorough consideration of environmental risks, material vulnerabilities, and protective measures at the design stage.

Based on our experience in researching, designing, and executing conservation works at the Yugoslav Monument at Mauthausen, we conclude that stone materials for public monuments must be carefully selected—high-strength, compact, resistant to abrasion, frost, and environmental aggressors—while taking into account local climatic and natural conditions.

Furthermore, in striving for sustainable architecture, it is essential to use indigenous materials from the immediate environment when constructing outdoor public monuments, thereby ensuring their durability and long-term preservation.

