

WEATHERING OF THE GABBRO STONES OF THE UNKNOWN SOLDIER MONUMENT (MT. AVALA, SERBIA)

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The Unknown Soldier monument on Mt. Avala was built of Jablanica gabbro in 1934–1938 (Fig. 1). It is the work of the world famous sculptor Ivan Meštrović and represents a part of outstanding value of our cultural heritage.

The Jablanica Gabbro has high compressive strength and wear resistance. It is frost resistant with low porosity and water absorption but decay types appeared indicating the ability of the gabbro to absorb water and moisture hygroscopically and capillarily.

The results of the first mapping have shown a great variety of weathering forms (loss of stone material, discoloration/deposits, detachment of stone material and fissures/deformation), and a wide range of intensity. Damage such as break-out, discoloration, crust deposits, granular disintegration, contour scaling, flaking and biological colonization, are observed both on the exposed and sheltered stone surfaces of the monument (Fig. 2).



Fig. 1: The Unknown Soldier Monument.

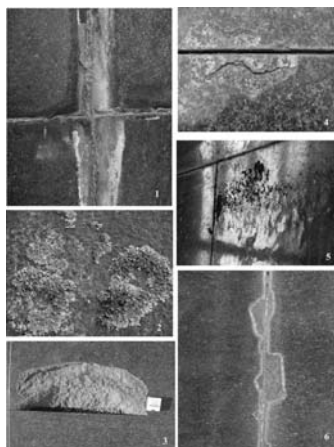


Fig. 2: Weathering forms: 1. Incrustation; 2. Lichen; 3. Contour scaling & granular disintegration; 4. Flaking; 5 Blistering and roughening; 6. Contour scaling and light-coloured crust.

Considerable amounts of severe or even very severe damage were noted on the lower and middle parts of the monument.

Most of the damage observed on the monument is superficial and caused by synchronous physical and chemical processes. They are controlled by the migration of solutions through half-filled joints and the porous stone network. These solutions originated from rainwater and condensation water, dissolved cement mortar and lead elements, they migrate through the stone under the influence of capillary tensions. They evaporate during dry periods and leach out the dissolved components in the forms of white and dark incrustations. This in turn leads to mechanical disruption (fracturing, contour scaling, granular disintegration, flaking) and to chemical transformations of the polished stone surfaces (loss in lustre and changes in colour). Exposed stone surfaces are bleached or covered by hard crusts leaked from the joints. Some of the mechanical damage is caused by freezing and thawing water. In winter, when temperatures oscillate around freezing point, at the rise of water/ice volume in the joints or stone pores, pressure on the walls increases and the stone is subjected to internal mechanical stresses. Simultaneously, captive stresses between the grains of the minerals arise from differences in their temperature coefficient of linear extension. When the ice melts, the water volume decreases and a new quantity of water is absorbed into the capillaries. During freezing, a new cycle of the same process begins and in consequence, the mechanical disruption of the stone grows repeatedly (WINKLER, 1994). The same mechanism appears in the fissures and microcracks during the freezing and melting of water and moisture.

Salt deposits (thermonatrite, trona, apthitalite, calcite, halite, anglesite, hydrocerussite, plumbonacrite) occur on facades and in sheltered areas, especially inside of the monument. They cause very considerable very frequent damage. Where liquid water transfer is fast and porosity allows a flow that compensates for the evaporation, salts crystallize on the surface as efflorescence. In contrast, when the capillary supply does not compensate for the evaporation, the salts precipitate inside the stone, under the surface in form of subefflorescence and gabbro surfaces became rough and are affected by blistering, granular disintegration, and flaking.

Generally, the Jablanica gabbro has low vulnerability to decay mechanisms. The stone surfaces on the monument display evident signs of degradation clearly associated with local environmental conditions and factors encountered during construction. It must be stressed that the Unknown Soldier monument represents a unique structure for that period. Masons did not find a similar model in the entire world for that kind of building and had to solve many technical problems which arose during the construction. From our standpoints, it is clear for us that they made some mistakes in the final phases of work (the mode of joint filling, the binding between the foundation and the mausoleum, the mode of polishing and installation of glass doors at the entrance and exit of the mausoleum) which caused different kinds of damages.