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On the "non- destructiveness" of Schmidt hammer test: a microscopic approach

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Schmidt hammer is used as a non-destructive surface strength tester of construction materials including natural stones for many decades. Dimensionless rebound value is a measure of tested material's recoil when being impacted by a plunger. The acceptable correlation between Schmidt hammer rebound value and rock strength has been proved experimentally for many lithotypes.
Assumed non-destructive nature of the Schmidt hammer testing favoured its implementation in the evaluation of surface strength and degree of damage of natural stones used in monuments and sculptures. The nature of Schmidt hammer test raises a question, whether the response of material to which plunger impacted is purely elastic or if some brittle damage is involved.
In our experimental study, several types of building and sculptural sandstones have been tested in dry and/or wet conditions. Due to the fact, that our recent study was focused on the search for possible brittle damage to the tested material, the sites of impact have been impregnated with the mixture of low viscosity epoxy resin and fluorescent dye in order to preserve all phenomena (by hardening of epoxy resin) and to allow observation of brittle damage pattern (e.g. microcracks, crushed grain) in optical microscope equipped with a source of fluorescent light. After the hardening of the resin, the thin sections have been prepared by cutting the impacted site in the middle, perpendicularly to the surface. For all studied sandstones and all test conditions, pronounced brittle damage zone was found in the material just below the impact. The observed phenomena correspond to the similar patterns caused by static or dynamic indentation test and consist of microcrater formation with grain crushing at the bottom and microcrack pattern radiating outside the microcrater. This observation confirms our assumption that Schmidt hammer test cannot be considered as innocent non-destructive test. Its use for the testing of surface strength of carved/sculpted works of art is thus highly questionable because any additional damage to the most valuable part of sculptures (i.e. modelled surface touched by sculptor's tools) is not acceptable.