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Stone and render of Medieval Church of Tök (Hungary); diagnosis and non-destructive testing

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The preserved Medieval architectural heritage structures are sparse in Central Europe. These buildings represent unique cultural and historic values although most of them are in ruins. The present study focuses on one of these buildings, the Medieval ruins of a Church located 2 km NE to Tök village (Central Hungary). The history of the construction is not well dated but the building was most probably constructed in the 13th century. The outline of the standing walls is 14m x 8m. The small sanctuary is 2.3m x 3m x 3m, while the nave is 9.5m x 6.1 m in dimensions. To facilitate diagnostic studies a 3D model was prepared based on photographic documentation. Autodesk Recap Pro 3D software was used to create the model of the wall remnants. The eastern part of the ruin is better preserved the remaining stone walls are of 4 to 5 m high, while at the western part only few tens of centimetres of the stone wall is preserved. Stone and render material were studied on site by using non-destructive test methods. Surface strength was measured by Schmidt hammer, while moisture content was documented using portable device (GANN Hydromette UNI 1) along vertical profiles both in the internal and the external side of the walls. The lithological mapping revealed that three different stone types and various lithotypes were used in the walls. The prevailing lithology is Miocene porous limestone. Six different lithotypes of this limestone were identified: i) yellowish white cemented ‘travertine-like’ limestone with few gastropods; ii) fine to medium grained porous limestone with quartz sand; iii) medium grained bioclastic limestone; iv) lumachelle-like limestone with small quartz pebbles; v) medium grained ooidal limestone and vi) cross-bedded calcarentic limestone. The second most common lithology in the walls is the sandstone. A few irregular blocks of 20-30 cm of grey to brownish medium-grained to fine-grained sandstone were found. White, micritic limestone is even sparser in the walls. This belongs to Triassic Dachstein Limestone formation. The Schmidt hammer tests have proved that Dachstein limestone and the yellowish white cemented ‘travertine-like’ Miocene porous limestone have the highest surface strength with mean rebound values of 55 to 43, respectively. The lowest Schmidt hammer rebound (mean value of 22) was measured on medium grained ooidal limestone, which has been used as replacing stone during the restoration of the year 2000. The moisture content measurements clearly demonstrate that the walls are moist, since only 1% of the readings were in the range of dry values while 89% of the records are representing high moisture content. The most common weathering phenomena are weathering crust formation, multiple scaling, dissolution and micro-cracking. The presence of biological crusts such as lichens is also documented. Four different renders were also identified ranging from the Medieval lime-based to the portland cement containing 21st century repair mortar. The study reveals that 3D documentation and lithological mapping with the mapping of decay forms can contribute to our understanding of the Medieval stone heritage and allows a better reconstruction of construction periods.