

Archaeometric study of a typical medieval fortified granary (Amtoudi Agadir, Anti-Atlas Chain, southern Morocco): A key case for the maintenance and restoration of historical monuments

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An interdisciplinary archaeometric study concerning the Amtoudi Agadir, declared World Cultural Heritage (northern border of the Sahara Desert, southern Morocco), was performed consisting in lithostratigraphic reconstruction of the bedrock, diagnosis of constitutive materials (stones, mortars, and wooden elements), and analyses of constructive techniques and architectonic elements (load-bearing and supported structural elements). The medieval agadir (fortified granary) was built directly on a rocky piton with rocks of the substratum with traditional materials and ancestral techniques. The stones have been identified and classified into four petrofacies. Degradation such as biological attacks, chromatic alteration, erosion, exfoliation, and fissuration on the stones have been characterized. Recommendations for conservation and maintenance of the rocks have been proposed in compatibility with the environment. Load-bearing (masonry walls) and supported structural elements (ceiling structures) have also been studied in order to define their stability. Worst cases of 1- and 2-height walls, together with worst cases of the wooden or stone ceiling structures have been analyzed. Materials, techniques, and dimensions have been characterized for possible failures to shearing, bending, and flexural buckling as guide for maintenance of the agadir. The main

problems of the walls derive from excessively thin construction with a lack of interlocking of the rocks and a diminished proportion or quality of mortar joining the rocks due to washing. It has been recommended to avoid thicknesses lower than 0.4 m for 2-height walls and lower than 0.3 m for 1-height walls. A nominal load has been estimated in the worst case (with wooden elements) for the ceiling structures of about 7.0 KN/m². The calculations have indicated that a 25% increase over the nominal load would imply a risk of failure, the use of stone elements being preferable over wooden ones. With these propositions for the Amtoudi Agadir, new management and prospects for cultural tourism are feasible. © Società Geologica Italiana, Roma 2016.

Amtoudi Agadir

Conservation measures

Constructive techniques

Deterioration processes

Morocco

Sustainable maintenance