Laboratory Evaluation of the Compatibility of Portland Cement-based Mortar Used in Restoration Processes in the North Theatre, Jerash

By

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Abstract


This research aims to provide a scientific evaluation of the suitability of Portland cement-based mortars to be used in restoration and reconstruction of archaeological and historical stone buildings. The north theatre in the archaeological city of Jerash was selected as a case study.

Samples from four types of limestone and three types of restoration mortars have been collected from the theatre for this study. These samples were studied by X-ray powder diffraction and thin section analysis to determine the mineralogical composition of the samples and the raw materials which were used in the restoration mortars. The results of the X-ray powder diffraction analysis indicated that only one of the three types of restoration mortar is Portland cement-based mortar. The cement/aggregates ratio of this restoration mortar was determined by using the point counting process. Identical mortar was prepared in the laboratory to evaluate its compatibility by determining the following physical and mechanical properties: porosity, density, water uptake under atmospheric pressure and under vacuum, capillary water uptake, water vapor diffusion resistance, thermal dilatation and compressive strength.

The obtained results indicate that the studied mortar did not partially fulfill all requirements of restoration mortar. Although it is less dense, more porous and weaker than the stone, but it has some serious drawbacks; it does not match the original mortar in color, it absorbs water more than the original limestone, and it does not have the same
thermal dilatation of the stone. Also, in the water vapor permeability test, the results
show that, in the wet conditions, the mortar is less permeable than SC and SD types of
limestone, and in the dry conditions; its permeability is lower than SB type of stone.
Because of these serious drawbacks, this type of mortar is not recommended to be used
in restoration and reconstruction application.

Keywords: Mortar, Portland Cement, Jerash, North Theatre, Mineralogical
Composition, Petrographical Analysis, Density, Porosity, Water Absorption, Water
Vapor Diffusion, Thermal Dilatation, Compressive Strength.