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The Role of Application Techniques for High Performance Traditional Renders

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Abstract

Traditional renders based on lime had an aesthetic as well as a protective role for the historic masonry. They were applied in layers in order to ensure good adhesion and cohesion with the substrate but also in order to be functional. The technology of each layer was different in relation to the maximum grain size of the aggregates and the binder/aggregate ratio. Main requirements were the high water vapor permeability, the low water retention in order to avoid salt formation and the capacity of water absorption by capillarity of each layer should increase outwards. As moisture has a detrimental role in the thermal behavior of materials, an effort has been made to record the effect of layering in energy properties. Lime-based renders were tested in relation to their hybrid properties when different application techniques were followed. Two-layer renders with different technological characteristics in each layer were produced. Their behavior, in various deterioration mechanisms such as capillarity, external water uptake (measured by karsten tubes) and water vapor permeability was monitored. It seems that low porosity and adequate permeability is achieved in two-layer renders while the thermal conductivity was effective.
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Keywords: lime-based renders; layers; strength; capillarity; λ value; permeability

1. Introduction

Ancient masons were using a combination of basic bio-climatic principles such as the selection criteria for building materials, the thickness of the walls, the forms and the orientation of the structures, in order to assure the durability and sustainability of their structures. Protecting the materials from environmental deteriorating

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agents was of primer importance and both the quality criteria of the materials as well as the techniques applied were on the direction of preserving the longevity of the buildings [1].

Traditional coatings based either on clay or on lime are frequent in the architectural heritage and their role is well-recognized. One of the main functional uses of the coatings was the removal of humidity by allowing the masonry to “breath”. Their smooth external texture could reduce the water penetration while in order to restrict their hydrophilic nature the masons invested in compaction. By this way, they could also control the porosity of the coatings which is a key factor of their function [2]. The equilibrium between reduced water penetration and high evaporation rate due to the high vapor permeability is due to the nature of the traditional binders combined ideally with the selected aggregates. Historic and pre-historic coatings were usually applied in successive layers (2-4) characterized by good compaction and coherence the width of each one being decreased to the outer surface. The thickness of the coatings was usually depending on the type of masonry as rubble masonry was covered with thicker coatings in relation to ashlar masonry [3]. External layers presented fine aggregates and rich content in binder and in cases where resistance to humidity was required a combination of binders forming a hydraulic type was used [4].

In order to perform durable, resistant to moisture, repair coatings one factor was to control the effects of dampness. Parameters such as the layering of the mortars as well as the binder/aggregate ratio and the size of the aggregates were taken into account in order to design, produce and test a series of mortars. Mechanical and physical properties in combination with their hydroscopic properties were tested. Additionally, the thermal conductivity was measured and correlations were made with the porosity. The aim of the present paper was to record the effect of layering of mortars used as coatings, in the mechanical, physical, hydroscopic and thermal properties.

2. Materials and Methods

As binders in the produced mortars lime, natural pozzolan and brick dust were used. Their properties are gathered in Table1.River sand of 0-4mm and of 0-2mm was used as aggregates. The proportions of the components of the mortars are shown in Table2. A reference mortar (P) was produced in 40x40x160mm specimens and two modifications were made in order to apply a second layer on top of it. While the mortars are at the fresh state, a part of the P mortar was substituted by a second layer of 1cm thickness. Two different mortars were produced as second layers coded P’ and K’ respectively (Table2). The P’ and K’ mortars were made with finer sand of the same origin as the sand used for the P mortars and the B/A ratio was 1:2. The P’ and K’ mortars were also produced in 40x40x160mm specimens in order to individually test their properties. The workability of the mortars was measured according to EN 1015- 3:1999.

Table 1. Physical properties of binders

	Diameter of grains (μm)			**Specific gravity (g · ml−1)**
	(0.1)	(0.5)	(0.9)	
Lime	1.20	3.09	10.80	1.961
Pozzolan	1.51	5.11	34.49	2.403
Brickdust	12.50	110.80	454.00	2.683

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