

Grouting mortars for consolidation of historical renders showing loss of adhesion

Martha Lins Tavares¹, M^a Rosário Veiga², Ana Fragata³

¹Restorer, Laboratório Nacional de Engenharia Civil, Lisbon, Portugal, marthal@lnec.pt

²Civil Engineer, Laboratório Nacional de Engenharia Civil, Lisbon, Portugal, rveiga@lnec.pt

³Civil Engineer, Laboratório Nacional de Engenharia Civil, Lisbon, Portugal, afragata@lnec.pt

Abstract - Loss of adhesion is one of the main forms of degradation of old renders, in the form of separation of different render layers or between render and substrate, producing anomalies, such as debonding, detachment, cracks and lacuna on the render. In the present paper a study developed at LNEC – National Laboratory of Civil Engineering of Portugal – is presented, concerning restoration techniques for historical renders by consolidation using grouts for adhesion restitution. Lime grouts for consolidation should be mechanically, physically and chemically compatible with the original render, as this is a practically irreversible treatment. The aim of the study was the discussion of characteristics of grouts, considering both compatibility and efficacy. Several grouting mortars are selected, the methodology of the study and the laboratory tests carried out are described, as well as the critical analysis of the results, and the conclusions are summarized. Some proposals for future research are also presented.

1 CONCLUSIONS

The results obtained showed that mortars A and B have general favourable characteristics. They fulfil the basic requirements for grout mortars, thus they can be used in old renders conservation for adherence restitution, as long as these are strong and well carbonated renders. Grout mortar C was found to be weaker and more deformable than the other tested grout mortars. With the low characteristics obtained, grout mortar C could be used to consolidate weak renders; however, it was observed that it didn't harden during the 90 days of curing time, probably due to difficulty of carbonation inside the voids.

The grout mortar choice depends on the pre-existent renders mechanical behaviour and decay (lacunae/detachment deepness, humidity rate in the wall, etc.). Hence, considering the tested grout mortars, mortar B should be chosen for more resistant existing renders (compressive strength > 6,1 N/mm², according to the requirements defined in table 1, which is a rather high value for old lime renders).

Concerning water absorption, all the tested grout mortars should be used only on old renders with capillary water absorption coefficients, calculated at 5 minutes, lower than about 5 kg/m².min^{1/2}.

Mortar B has an hydraulic binder, mortar C has a pozzolanic additive to get hydraulic characteristics and it is possible that mortar B has also pozzolans as additives. However, in the case of mortar C, apparently the pozzolanic additive didn't react, because a powdery texture was observed.

The development of grouts with hydraulic characteristics is important; indeed it allows their hardening in spite of low carbonation rate inside the wall, not exposed to the air [8]. As a result, mortar B presented lower water absorption, higher mechanical strength, higher shrinkage and lower deformability. However, the addition of hydraulic binders should not be excessive in order to prevent a high increase of mechanical strength which contributes to the development of anomalies in the old renders, as detachments or cracks.

This research must go on by developing new grout renders formulated in this investigation framework, with optimized behaviour. The formulations should be improved, by altering the proportion of hydraulic

binder or pozzolanic additions, by choosing aggregates with better grain size distribution and adequate admixtures, in order to optimize several characteristics such as: fluidity, solidification, penetration and carbonation.

The continuation of this study will allow us to go deeper in this area and diffuse the knowledge through the international and national technical environment in order to contribute to the improvement of the conservation interventions in historical renders using traditional materials.

2 ACKNOWLEDGEMENTS

This study is developed in the scope of the Project PTDC/ECM/100234/2008 – LIMECONTECH – Conservation and durability of historical renders: compatible techniques and materials, co-financed by FCT (the Portuguese Foundation for Science and Technology) (<http://conservarcal.lnec.pt/>). The authors acknowledge the contribution of the LNEC's technicians Bento Sabala and Ana Maria Duarte to carry out the laboratory tests.

3 Bibliographic references

1. Ferragni, D. Forti, L. Mora; P. et al – Injection Grouting of mural paintings and mosaics, in: Congress, Adhesives and Consolidants, Paris, IIC, September 1984.
2. Zajadacz, Karina - Grouting of architectural surfaces – the challenge of testing, in: International Seminar Theory and Practice in Conservation – a tribute to Cesare Brandi, Lisboa, LNEC, May 2006.p.509 – 516.
3. Tavares. Martha - A conservação e o restauro de revestimentos exteriores de edifícios antigos - uma metodologia de estudo e reparação. (Conservation and restoration of old buildings' renders) Ph.D Thesis, Faculdade de Arquitectura, Universidade Técnica de Lisboa, Lisboa, November 2009.
4. Mora, Paolo, Mora, Laura – La Conservazione delle pitture murali; Bologna, Compositrice, 2001, p.256.
5. Veiga, Rosário – Regras para a concessão de documentos de aplicação a revestimentos pré-doseados de ligante mineral com base em cimento para paredes, Relatório LNEC 427/05 – NRI, Lisboa, 2005.
6. Martins C, Paiva, H., Ferreira, V.M, Tavares M., Veiga, R., Velosa A - Preliminary studies on a lime grout for built heritage conservation, in: Historical Mortars Conference, HMC 08, Lisboa, LNEC, September 2008.
7. Magalhães, Ana; Veiga - R. Physical and mechanical characterisation of historic mortars. Application to the evaluation of the state of conservation, in: Materiales de Construcción Vol. 59, 295, Madrid, Jul—September, 2009.
8. Griffin, Isabel - Pozzolanas as Additives for Grouts – An investigation of their working properties and performance characteristics, in: Studies Conservation, 49, London, IIC, 2004, p.23-34.