TC.07

Performance and Repair Requirements for Renders and Plasters

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Abstract This summary deals with repair or replacement of renders and plasters. Introducing design issues such as functional, technical, and performance requirements, and authenticity and compatibility, it eventually focuses on the aspects related to the choice of repair renders and plasters on salt laden substrates.

1 Introduction

Renders (exterior) and plasters (interior) constitute the protective and/or decorative skin of structures composed of stone, brick masonry or even adobe. They have been used continuously from prehistoric times to the present.

Renders and plasters show a wide variation in properties not only due to the method of application but also geographically and over time. The thickness of historical renders range from coats of considerable thickness to coats less than a centimetre in thickness [1]. The different layers generally show very good adhesion with the masonry substrate. Up to the 19th century most mortars were based on lime. The composition usually is comparable with modern non-hydraulic pure lime mortars but were sometimes sub-hydraulic to weakly hydraulic. An exception was mud mortars used in covering adobe. However, hydraulic
components such as pozzolans, brick dust, or other additions (gypsum, marble dust) were widely used for enhancing the protective role (impermeability) or for decorative purposes. After the 19th century cement gradually became one of the main constituents of renders and plasters; their use is covered in modern standards (e.g. EN, ASTM etc.). However, these standards do not cover the needs of repairing older historic structures.

2 Design issues

2.1 Functional requirements

Functional requirements derive from (i) the role or function of the mortar on the masonry element, and (ii) the role of the masonry element in the building. The requirements will differ depending on whether the mortar is applied on exterior surfaces (renders) or interior surfaces (plaster). Resistance to frost and rainwater penetration are clearly related to outdoor renders. Resistance to salts and mechanical actions may apply to both outdoor and indoor applications. If plaster is used as a base for artwork, further requirements may apply. The composition of mortar for the repair of renders/plasters should, through defined performance characteristics, be related to functional requirements.

2.2 Technical requirements based on performance

Introduction

Renders are used in exterior applications and plasters in interior applications, therefore their performance requirements may significantly differ. For renders (driving) rain, frost, and aerosols may be important threats to a long service life. At first sight for plasters a good surface hardness may be more important than frost resistance or its hygric characteristics. However, this may not be true if salts are present in combination with rising damp in an inner wall which may cause serious damage to a plaster.

For renders as well as plasters the boundary transition surface between masonry and mortar plays an important role on the bonding properties. Furthermore, the technique used for mortar application is a practical parameter that influences the bonding and depends on the technician’s expertise.

Many practical aspects should also be considered, such as the proper consistency of the mortars that should be checked as well as premature setting; subsequently, measures should be taken in case of high temperature and low relative humidity; and finally the curing period and regime should be predetermined.
Performance requirements

General technical requirements for renders and plasters are:

- not to damage the existing substrate
- not be of higher strength than the existing old mortars
- be flexible enough for spreading and filling lacunae
- develop adhesion with the masonry
- low tendency to shrinkage
- resist as much as possible the local environmental conditions

Specific technical requirements for repair renders and plasters are:

(R): especially relevant to renders
(P): especially relevant to plasters

- moderate capillary water absorption (R)
- high drying (R)
- some degree of surface hardness
- low amounts of released salts
- good resistance to soluble salts
- good resistance to freeze-thaw cycles (R)
- colour and texture compatible with the objectives defined for the intervention

2.3 Historic authenticity & compatibility

Regular replacement of plaster and render has always been a normal maintenance activity. Deteriorated plasters are not only repaired for aesthetic reasons but more importantly for the protection and preservation of the underlying masonry wall. Render (and plaster) play a very important role in the protection of our cultural heritage.

Given the relevance of the medium and long-term performance of historic masonry in our built heritage, protection and preservation should be the first objective to be taken into account in the physical preservation of the existing materials and structures. This means that the repair mortar should contribute to this objective during its service life; moreover, it should be able to be removed without damage to the masonry once this functionality is lost. However, at the same time the repair mortar should also be as durable as possible, to avoid unnecessary maintenance.

Practice shows that protection requirements related to the masonry substrate may sometimes be contrary to those required for a durable repair material: avoidance of degradation of the substrate versus degradation of the repair material. An example in this respect is bond strength: a repair material with high durability often develops a strong bond with the existing materials. But high bond strength may cause substantial damage to the masonry substrate if the repair render has to be removed in future conservation work. From this it can be concluded that for the
selection a repair render-mortar different viewpoints must be considered, and consequently compromises are often unavoidable.

3 Repair render/plaster considering salt damage risks

3.1 Traditional mortars

This paper briefly considers the choice of mortars for salt laden substrates. Traditional renders and plasters were usually transporting systems: salts easily travel through the plaster to the surface. In simple constructions they were transported quickly through several layers of air lime mortars and lime paint. In important constructions (such as military and religious constructions) and where severe exposure to salts was foreseen, the mortars were prepared with binders, such as pozzolans or hydraulic lime, which conferred them some hydraulicity. In these cases they functioned as slow transporting systems [2].

In both cases they were multilayer systems with higher porosity and smaller pores in the external coats, thus salt crystallization occurred normally on the outer surface or at least in the outer layer. In these conditions frequent simple maintenance operations (in the outer layer) permitted good durability of the render system.

Plasters were not usually directly attacked by salts, as crystallisation took place at the outside face of the render. They were also multilayer systems, but the last layer was sometimes quite impermeable, for example ceramic glazed tiles or decorated plasters with water repellent additives.

The use of repair mortars that reproduce this functioning is a possible solution for repair, as it should work in the same way as the old ones provided there are no important changes concerning environmental conditions such as high pollution, climatic variations or internal conditioning [3].

3.2 Prefab mortars

Traditionally, renders and plasters have been made using locally available materials such as sand and binders (hydrated lime, hydraulic lime, pozzolanic binders, and more recently cement).

However, the application of traditional repair renders on salt containing substrates may lead to problems (bond, durability).

For some decades now, pre-fabricated renders/plasters have been developed to improve performance where salts are present. These industrially designed restoration plasters are often composed of various types of aggregates. Besides sand, lightweight aggregates such as pumice, perlite and vermiculite are used. The
binding agent is usually cement. Often additives are added to influence the salt-moisture flow in the mortar. For the choice of an adequate prefab repair mortar see [4]. In [4] the choice of prefab repair mortars is related to the degree of risk, determined as a function of:

- the moisture load in the substrate; especially the number of wet-dry cycles or the number relative humidity cycles around an equilibrium RH of a salt (combination) present
- the porosity (mainly coarse pores) in the substrate
- the salt content in the substrate

4 References