Hippisley-Cox, Charles

Rediscovering Clay Mortars

Original Citation

Hippisley-Cox, Charles (2008) Rediscovering Clay Mortars. Building Engineer, 83 (1). pp. 28-29. ISSN 0969-8213

REDISCOVERING CLAY MORTARS

By Charles Hippisley-Cox BSc BA MBEng

It is really only during the last two centuries that mortars have been approached scientifically. Previously the knowledge and traditions were passed from generation to generation by word of mouth shrouded in mystery within craft guilds and traditional apprenticeships. The skills associated with making mortar were regarded almost as a form of alchemy with mortar-men able to command higher daily wages than stonemasons during the high Middle Ages.

At a more local and vernacular level skills of stonemasons, mortar-men and bricklayers were more closely intertwined and geographically remote areas had traditions, practices and mixes determined by the availability and, more pertinently, by the non-availability of materials.

The function of mortar within masonry has always been two-fold: firstly, to give stability to the wall by physically holding the wall together and, secondly, to give the builder the opportunity to maintain level courses whilst using relatively irregular pieces of stone. As a consequence of these main functions mortar also enables buildings to support larger loads whilst providing protection from the weather. Although, outside this particular discussion, mortar also has an important historical role for weatherproofing when applied as a render to the external elevations or as a plaster to the interior.For a mortar to have the desired properties it needs to have a coherence provided by a binding agent. Most modern mortars are bound by cement-based products whereas historically most mortars for brick-laying and masonry were bound by lime (usually in the form of a putty) until the mid 20th century.

In traditional buildings especially in remote areas where lime was either in short supply (or limestone was absent from the local geology) other materials had to be considered. The most common substitute for lime, especially in upland granite areas such as Dartmoor and Exmoor, was local clay.

Clay is often found in pockets or as a major constituent of the subsoil over large areas of granite landscapes. When crushed and ‘puddled’ with water, sand is added and the mortar begins to take shape. For bedding mortar a little lime was sometimes added (if available) or animal slurry or manure was used to improve workability and the required texture. For renders hair (either animal or human) would be added along with short pieces of hay or grass straw to reduce problems associated with shrinkage and premature drying.

Clay mortars could, therefore, demonstrate the physical properties required for the task expected. However, the wall would need protecting from the weather either by a large eaves overhang or with pointing using a lime mortar. In some areas tallow was added to the mix or applied to the completed exterior.

Over the last fifteen years there has been a revival of interest in traditional mortars driven primarily by the repair of historic buildings. However, a new interest is anticipated as the construction industry looks for ways of addressing the principles of sustainability. It is well known that cement production and the transportation of bulk materials gives modern mortars a very high ‘embodied energy’ and locally sourced aggregates (especially when combined with alternative binding agents) could go some of the way towards addressing the sustainability agenda.

The performance of mortars both in terms of their ease of application and their physical characteristics are notoriously difficult to assess in non-laboratory conditions. However, during the spring and summer of 2006 a field experiment was set up to test three clay-based mortars during the repair of a two-metre high granite retaining wall in the Normandie-Maine National Park, France.

A stretch of wall was dismantled and re-built three times using the three mixes and each time subjected to tests. The wall was deliberately built without ‘weep holes’ preventing rapid seepage of water during the tests.

The three mixes comprised as follows:

Mix 1
3 parts clay subsoil
2 parts local building sand
Mix 2
3 parts clay subsoil
2 parts local building sand
1 part ordinary Portland cement
Mix 3
4 parts clay subsoil
2 parts local building sand
1 part lime putty.

The tests were pretty basic, with the first involving pouring 100 litres of water immediately behind the retaining wall and seeing how long it took for the outer face to become wet.
The second test was to see how the repaired wall resisted a high pressure water hose.
Regarding the first test, the mixture that showed the greatest porosity was mix 1 that became damp throughout the whole height of the wall within ten minutes of the 100 litres being poured behind the top. The least porous was the cement mix which showed isolated damp patches after 15 minutes. The third mix (with the lime putty) became damp after about 12 minutes and the dampness was more even and less isolated than the cement-based mix.
When the trial repairs were tested to destruction using a power hose, the clay/sand mixture (Mix 1) was the first to collapse. The cement wall resisted the hose, but eventually collapsed due to the weight of the water trapped behind the retaining wall.
The lime-mix eventually collapsed due to the high-pressure water wearing away the mortar. It is possible that the wall would have offered more resistance if more carbonation of the lime had taken place. There was a logistical problem with the experiment which was originally designed to test for all three mixes simultaneously. Unfortunately permission was only attained for the stretch of wall to be worked on and the experiments had to be undertaken consecutively. This meant that the experiment was spread over a six-month period with each 'repair' tested to destruction after only a six-week 'curing' time.
The main conclusion from the experiments was that traditional clay mortars are more likely to allow for gradual water movement within masonry. In certain circumstances the movement of water within a wall might be desirable, for example, the gradual movement of rising damp to the outer face rather than to the interior finishes. The cement-based mortars displayed characteristics that might be undesirable within a traditional vernacular construction preventing the free movement of moisture. The lime mortar produced results somewhere between the other two mixes.
It is likely that interest in traditional mortars will grow especially if clay can be used as a binding agent. Such mortars would have a significantly lower carbon rating than either a lime or cement-based mortar. However, there is likely to be some scepticism as traditional materials are often more difficult to source and contractors are inclined to be a little wary of 'non-industry' products.

● Charles Hippisley-Cox graduated with a degree in Geology before studying Architecture as a mature student. He is currently Senior Lecturer at Huddersfield University where he runs the degree programmes in Architectural Technology.