The ability to breath is vital to the survival of almost all historic buildings and the application of impermeable modern renders must be avoided at all costs. Bob Bennett, one of the UK's leading lime specialists, explains the importance and use of traditional lime renders.

The use of an external render probably dates back to mans earliest attempts to construct a simple mud hut shelter. Earth structures were particularly vulnerable to water erosion damage and the provision of good roof protection in the form of generous eave and gable overhang, a good underpin course and a render, helped to prolong the life of the walls. The simplest renders take the form of a '*slurry*', produced by removing the larger particles from the material used to build the walls and adding sufficient water to produce a serviceable paste. But they are quite weak and require regular maintenance. There is evidence to suggest that the earliest use of non-hydraulic lime as a binder was about 2500 BC, although recent excavations in the Euphrates Valley may predate this. In any event, lime gradually became used as the principal binder in mortars, plasters, renders and washes right up until the comparatively recent invention of *Portland Cement*, attributed in this country to Aspdin Senior in 1824.

EARTH RENDERS

Earth structures survive by retaining sufficient moisture to maintain the integrity of the *binder*. It is therefore vital that they are allowed to 'breathe' and any render must be vapour permeable and marginally weaker than the structure. A common cause of failure can be attributed directly to the inappropriate application of hard cement render and impervious paint. By denying the absorption of moisture from the atmosphere, an earth structure will slowly dry out to the point of sudden collapse – very much like a sandcastle on the beach, which survives while damp but collapses without warning as the sun dries it out.

Early structures were built from a wide variety of materials that were close to hand including clay, suitable earth, chalk and even dung mixed with sand. Straw or similar fibre was added as a reinforcing agent. But all suffered from the common problem of being vulnerable to water erosion.

NON HYDRAULIC LIME RENDERS

Once lime began to be adopted as the principal binder in mortars, plasters, renders and washes, the integrity of the structure improved because as *non-hydraulic lime* (calcium hydroxide) cures, it absorbs carbon dioxide from the air and slowly reverts back to calcium carbonate, which is more resistant to water erosion. The application of a lime wash, often modified by the inclusion of water-resisting agents such as tallow, raw linseed oil, animal glues, casein and even common salt, has proved very successful in further extending the life of lime render. All of the limewash variants are. to a greater or lesser degree, sacrificial. Further maintenance applications are required at regular intervals, depending on the number of initial coatings; the vulnerability of the site, and the quality of both the original material and the workmanship.

The durability of non-hydraulic lime render depends on three factors. First, the quality of the lime putty which needs to have matured for at least three months after thorough slaking. Second, the aggregate should comprise of a wide range of particle sizes, equally represented throughout the range. Finally, the degree of carbonation that takes place. This will depend on temperature and moisture as well as the ability of the pore structure of the aggregate and the presence of carbon dioxide. Rapid drying out in hot weather can produce an early set with little carbonation, resulting in a weak render, which will be vulnerable to rain erosion.

APPLICATION

Lime rendering has been applied in one, two and even three coats, although normally a dubbing out or scratch coat is followed by a finishing coat. The first application, as the name 'dubbing' suggests, is intended to overcome some of the inaccuracies that occur in old masonry walls. This is particularly noticeable in earth structures where quite deep pockets may need to be filled in order to achieve a relatively flat surface. The first coat is usually prepared from one part matured slaked lime putty mixed with three parts of a well-graded aggregate. Rather misleadingly, this is sometimes referred to as ''sharp'' sand. When filling deep pockets and applying a relatively thick coat, the aggregate should contain particles of up to one-fifth of the thickness of any individual coat and should also contain equal quantities of all the sievings through to the fines. Experiments carried out at the Lime Centre demonstrate that a render repaired in this way will dub out well without slump and with very little crazing. On the other hand, a render prepared from badly graded material is more susceptible to slump, and shrinkage crazing will occur during the cure. To reduce the initial suction of a dry wall, the substrate will need to be made wet before the application of each coat.

Unlike modern cement renders, a lime-based material should be applied, ruled off and left for about 24 hours before any attempt is made to float the surface. Working a lime render immediately after application will tend to draw fines to the surface, which will increase the risk of slump and probably cause crazing during the cure.

Carbonation is a slow process and several days often pass before the surface of the first coat is firm enough to take a finishing coat. Full carbonation often takes weeks, or even a year. The floating or finishing coat is usually prepared from one part lime putty to one to three parts well-graded aggregate, but with a smaller maximum particle size. Research shows that renders prepared from finer sands tend to craze during the initial drying-out period and are often reinforced with animal hair. A good technique is to leave the material for about 24 hours, after which it is quite likely that a certain amount of crazing will have taken place. Using either a wooden or a plastic float, the surface should be gently rubbed-up to generate a certain amount of fat before pressing firmly to achieve a finish.

MODIFIED LIME RENDERS

Apart from the addition of animal hair to assist in reinforcing the render, other modifications include the use of *pozzolanic additives* such as crushed brick, tile or other clay fired products to form '*hydraulic*' *mortars*. With this addition, the render tends to take on an earlier set and sometimes produces a more weather-resistant finish.

Casein, egg, linseed oil, fresh blood, bees wax, tallow, beer and urine have all been used as additives to improve the renders performance at one time or another. Animal fats and oils improve the water-repellent properties of the render, while beer and urine act as air entrainers. Little use is made of the majority of these products today. Modern air entraining agents create air bubbles, which are distributed more uniformly throughout the mortar to assist in frost protection.

CEMENT MORTARS

The invention of *Portland Cement* has enabled architects and engineers to design structures that would be difficult, and sometimes impossible, to build with lime mortars. Cement renders and waterproof masonry paints are often used to achieve an impervious external membrane. Used in conjunction with new technology and modern construction methods, they are likely to work very well. However, the structural advantages of Portland Cement are of no benefit when considering the repair and maintenance of historic buildings. Lime mortar and cement mortar expand and contract at different rates due to the change in the weather and, consequently, do not work well together. Almost all historic buildings rely on the ability to breathe in order to survive and any interference by way of an impervious membrane could, at best, be harmful and, at worst, disastrous!