PRACTICAL ACTION
Technology challenging poverty

MUD PLASTERS AND RENDERS

The traditional use of mud plasters and renders to coat and protect walls dates back a very long time and is found in almost all regions of the world. Finishing a house with mud plaster when the house itself has been built with earth is a natural, complementary technique, but mud plasters can also be used for buildings of stone and fired brick provided they incorporate an earth-based mortar for the joints.

Earth-based plasters often use earth in combination with other natural materials such as wheat straw or cow dung, or with mineral additives such as bitumen, to improve the basic qualities of the earth by acting as stabilisers, hardeners, and waterproofers. Even without additives, however, mud plasters and renders can give excellent results provided that they are made and applied with skill and care, and maintained regularly. Today, with low-cost mass housing a priority and with the increasing interest in the preservation of architectural heritage, the need for plastering materials which are efficient and economical has awakened a new interest in earth. Earth-based plasters are completely compatible with traditional materials and building techniques and the almost universal availability of suitable earth for building gives them a distinct advantage over some modern synthetic plasters.

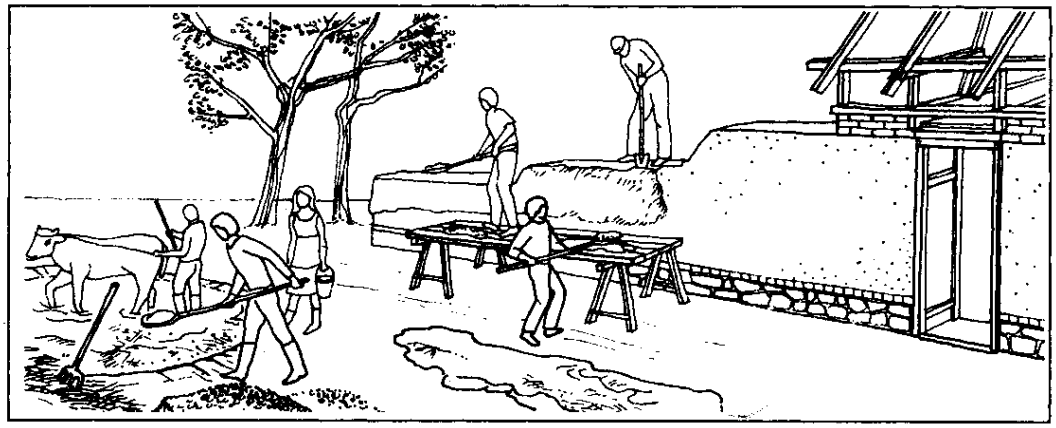

Figure 1: Walls built using traditional methods, such as cob, are very suitable for mud renderings.

Fundamental properties

The need for a plaster and the type of plaster that should be used depends particularly on the method of construction and quality of construction. The provision of adequate footings, basements, eaves, and overhangs to a roof can in certain circumstances eliminate the need for a plaster coating altogether. As plastering can amount to 15 to 20 per cent of the total cost of a house, its benefits need to be considered relative to alternative options.

In general, except in the case of highly exposed walls in areas of heavy rain, a plaster should protect against wind, rain, knocks and abrasion, and should improve the thermal insulation and appearance of a wall. At the same time it has to be easy to apply without requiring expensive and elaborate tools, and must be affordable. All types of mud plasters, but especially those on external surfaces, need to offer erosion resistance, impermeability to moisture, and impact resistance, and be well bonded to the wall.

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Erosion resistance

The main cause of erosion is heavy rain, and high winds driving the rain hard onto walls at an angle will increase erosion further still. Heavy rain, even for a short time, is much more damaging than prolonged light rain. A knowledge of local weather patterns and an analysis of meteorological data can give an indication of erosion risk and hence appropriate plastering materials and methods. It is advisable to study local traditional buildings and practices, as their evolution will have been influenced by the local climate.

Impact resistance

The durability of mud plasters depends on their ability to withstand the impact of humans and animals by bumping, scratching, or scraping. Impact resistance is closely linked with the quality of the plaster, which is determined by its density, methods of application, number of coats used, and maintenance practices. The texture of the plaster is also important.

Good bonding

The bonding of earth plasters to walls is very important. When plastering a stone or earth wall the composition of the mix as well as its application are both crucial in producing a good bond (the join between the two materials). The plaster and the wall itself should ideally be compatible so that shear forces are transmitted between them and not terminated at the bond. Good bonding reduces the incidence of cracking caused by changes in ambient temperature and humidity. The plaster must be applied in coats of recommended thickness to prevent excessive strain at the bond.

Testing the performance

A simple soil test which will show whether the soil is suitable is to plaster an area of wall and to observe the development of cracks on drying. A number of different compositions can be tried to find the one which produces the least cracks and satisfies the need for hardness and water resistance in that particular situation.

Simulation tests in the laboratory, such as the spray erosion test, can only be indicative because factors such as changes in scale, influence of true climatic conditions, building usage and maintenance practices are not easily replicated. One of the most realistic simulation methods is to expose small test-walls to natural weather conditions; this has been done in Australia, the United States, Senegal, and France, for example. This test is a good indicator of the durability of different plasters and allows a realistic comparison between plasters with different compositions and methods of application. The main drawback with this test is the length of time needed to obtain meaningful results, and building projects cannot always afford to wait that long.

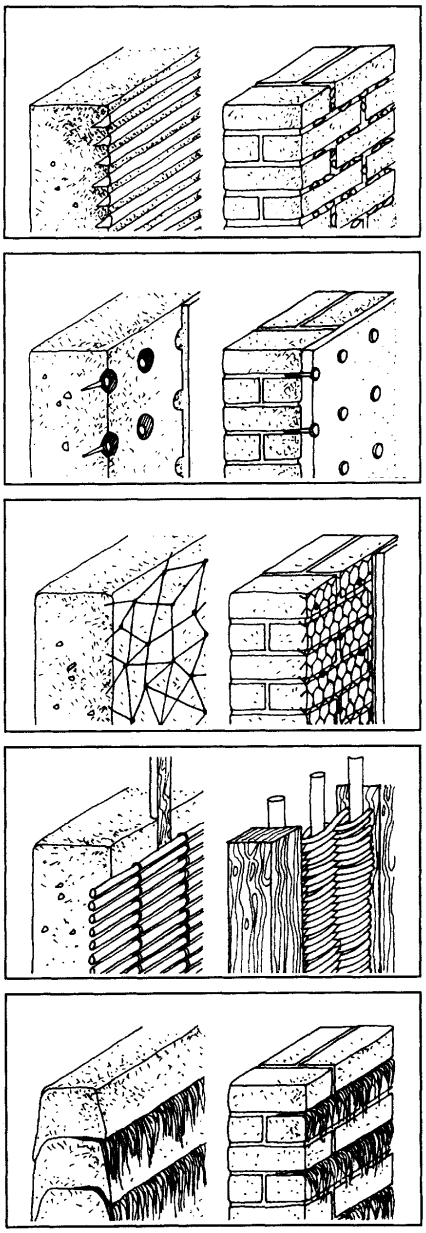

Figure 2: There are many ways to prepare wall's surface to help the render to form a good bond.

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Clay content

The composition of traditional mud plasters varies from place to place and is an important factor in determining durability. The clay content is particularly significant, because if it is too low the plaster will lack strength and cohesion, and if it is too high there will be a risk of cracking due to shrinkage, which will weaken the bond to the wall. A suitable clay content is usually around 10 to 15 per cent, but values outside this range could also be suitable depending on the type of clay. Soils with unstable or swelling clays must be used with great care. The sand-to-silt ratio is also very important in determining the quality of a plaster. Traditionally, clay plasters were often applied in one coat both internally and externally. If applied in two coats, the first can contain more clay, even if cracks develop, while the second, containing more sand, is applied in a thinner layer. The second coat will help to close the micro-cracks in the first, provided the surface has been lightly dampened before plastering. Finally, lime distemper or whitewash can be applied to give some additional weatherproofing. This will need to be re-applied periodically.

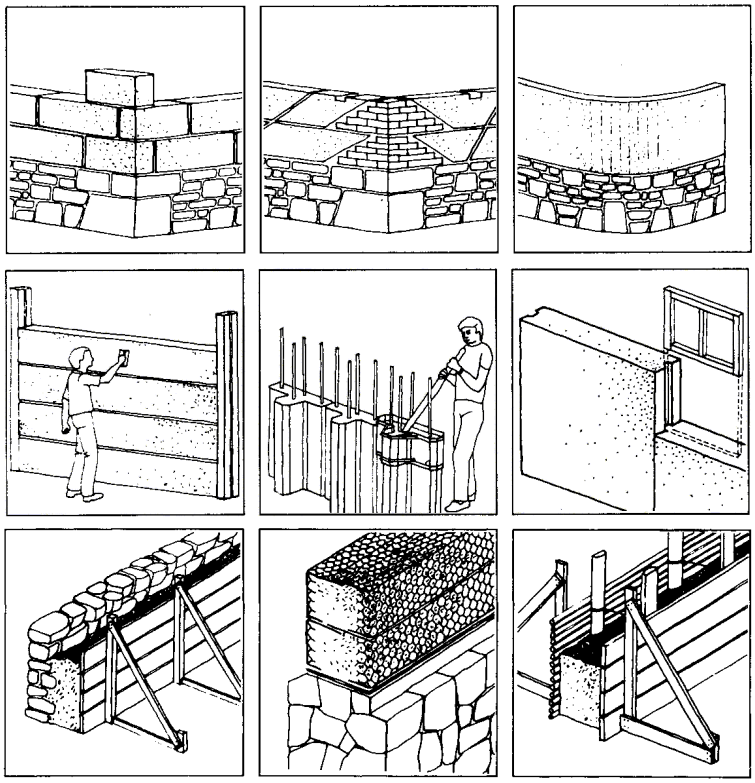

Figure 3: Rammed earth walls can be built in many ways; all can be protected with mud render or plaster.

Clay renders are commonly improved by adding natural fibres such as cereal straw, animal hair, pine needles, bark, and wood shavings. Long straw or hair is chopped into short lengths (2 to 5cm) for easier mixing: the function of the fibres is to resist cracks and facilitate the drying process. They also make the plaster less dense and improve its insulation properties. The amount of fibres required will vary depending on soil characteristics and can be from 35 to 70kg per cubic metre for straw; 50kg per cubic metre is a typical figure. In India, paddy straw (blusa) is added at a rate of 6 per cent by weight, or 60 to 65kg per cubic metre. The straw is soaked for several days in water to facilitate a rotting process, and the complete mixing process can take 10 to 15 days.

Another traditional practice is the addition of cow dung, which improves the cohesion and plasticity of soils of low clay content. Sometimes the dung is applied to mud plaster which is partially dry to help stop the development of cracks. A traditional waterproofing in India, known as Gohber leaping, consists of one part cow dung and five parts earth by weight, made into a fine paste with water and applied to fill up surface cracks. Another practice is the addition of horse urine, which acts as a hardener and improves impermeability and impact resistance.

Improving the composition

It is possible to improve the quality of mud plasters by:

- controlling the quantity of the sand fraction in the soil; to no less than three parts sand to one of clay, for example. This helps reduce cracks without compromising cohesion. A

shrinkage of more than a quarter of an inch (0.64cm) over the 2-foot (0.6m) length of the box in the shrink box test indicates a soil liable to significant cracking.

- stabilising the plaster by adding cement, lime, bitumen, or some other binder in small quantities. Possible limitations include the cost of the stabiliser and lack of skill in its proper use.

Bitumen cutback plaster is prepared by mixing hot bitumen with kerosene in a 5:1 ratio, and then combining one part of that mixture with 20 parts of previously fermented soil and wheat straw. Water is added and the whole mixed together thoroughly. This type of plaster is applied in two layers, and the second is applied only after the first has dried.

Lime-soil plaster can be made with one part hydrated lime mixed with two parts of clayey soil and 3 to 6 parts sand, the optimum amount of sand depending on the clay content of the soil. The quality of the plaster depends a lot on the quality of the lime available and the type of soil.

Another proprietary plaster is 'dagga-cement', a mix of two parts sand to one part clayey soil to 0.2 parts cement by volume. This produces a good weather-resistant plastering mix.To plaster the surfaces of stabilised soil blocks, and for these surfaces only, a coating of a stabilised mud slurry may be painted on. This slurry is prepared by mixing one volume of cement with two of mud. The final mix should have the consistency of paint, allowing it to be applied in a very thin coat. For decorative appearance, the colour of the clay stands out better if white cement is used rather than Ordinary Portland Cement. Red cement has sometimes also been used for this reason.

In all cases it is preferable to experiment with different mixes to find which one gives the best results with a given soil, rather than accept a general plastering recipe.

Application: Good practice

There are general rules to follow when applying all plasters. Firstly, the wall surface has to be prepared well. This can be done by scrubbing off all the surface dust and loose material with a metallic brush. Then the wall surface must be moistened to stop water being drawn out of the plaster layer into the wall. If the plaster is applied in two coats, the first layer must be applied with force and be no more than 20mm thick. Before hardening of the first layer is complete, its surface must be

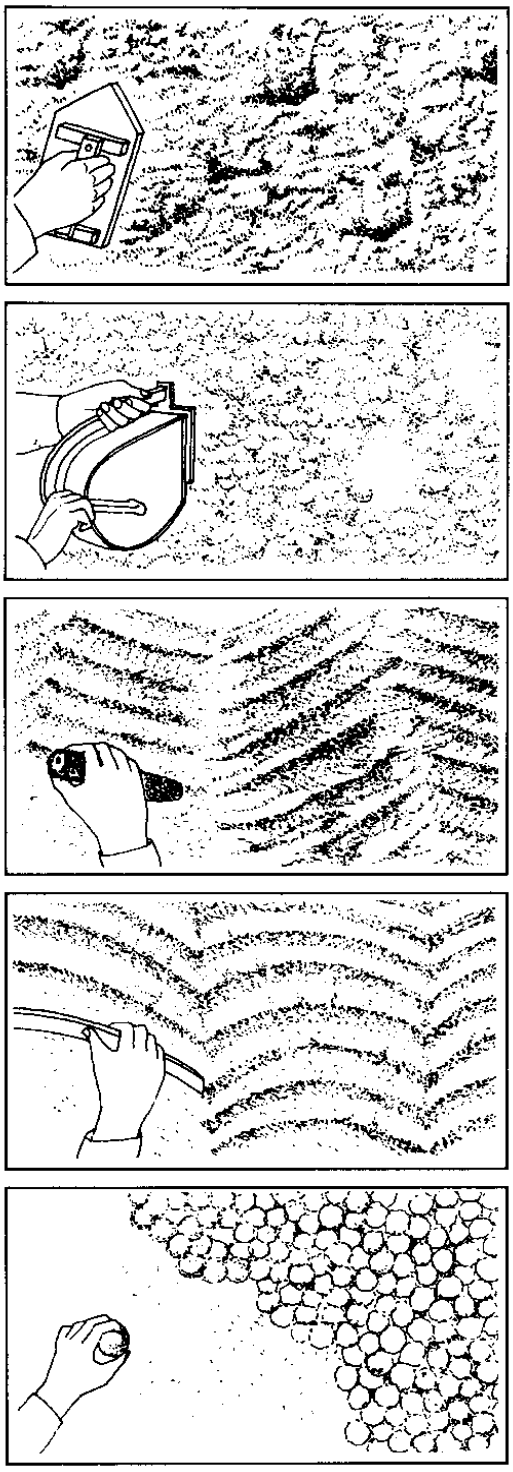

Figure 4: The final coat of render or plaster can be applied to produce a decorative finish.

roughened by light grooving, scratching or pitting, to provide good bonding for the second coat. The second coat is only applied when the first is dry.

If the plaster contains a cement or lime stabiliser, it is important to spray the plaster coat twice or three times a day with water during the first days of drying, especially during hot weather, to reduce the development of cracks. In general, plaster work should be shaded from the sun, and it is better to avoid plastering on very hot or windy days.

All pictures are extracted from Earth Construction: A comprehensive guide (see below).

Further reading

- *Alternatives to Portland Cement* Practical Action Technical Brief
- *Additives to Clay: Organic additives derived from Natural Sources*, Practical Action Technical Brief
- *Additives to Clay: Minerals and synthetic additives,* Practical Action Technical Brief
- *Mud as Mortar* Practical Action Technical Brief,
- *Clay as a binder* Practical Action Technical Brief,
- *How to Make Stabilised Soil Blocks*, Technical Brief by Practical Action Southern Africa
- *Earth construction, A comprehensive guide,* CRATerre, Practical Action Publishing, 1994.
- *Building with Earth,* CRATerre, Mud Village Society, Delhi, India, 1990
- *Building with Earth, A handbook*, 2nd Ed., J. Norton, Practical Action Publishing, 1997
- *Appropriate Building Materials, A Catalogue of Potential Solutions,* R. Stulz, K. Mukerji, Practical Action Publishing/SKAT, 1993
- *Soil Preparation Equipment* (product information), by Kiran Mukerji et al, GTZ, Eschborn, Germany, 1991
- *Earth Building Materials and Techniques*, Select bibliography, CRATerre, GTZ, Eschborn, Germany, 1991.
- *The basics of compressed earth blocks*, CRATerre,GTZ, Eschborn, Germany, 1991
- *Stabilisers and Mortars (for stabilised soil blocks)* product information, by Kiran Mukerji, CRATerre, GTZ, 1994
- *Compressed Earth Blocks: Vol. 1,Manual of Production*, Vince Rigassi, CRATerre-EAG, GTZ, 1995
- *Earthen Architecture*, Hands On Brief, Practical Action / TVE, Series 1,
- *Rammed Earth Structures* Keable & Keable Practical Action Publishing 2011

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CRATerre is the international centre for earth construction at the school of Architecture in Grenoble. CRATerre is a member of **basin**.

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