

Interim Guidance on the use in construction of

## UNFIRED CLAY BRICKS, MORTAR AND PLASTERS

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In recent years there has been growing interest in the use of unfired clay materials in construction. Among the most common of these are clay bricks, mortar and plaster. While these are essentially simple materials, with good environmental and working characteristics, the UK building industry is unfamiliar with them and there is little guidance for potential users on their appropriate use in contemporary construction.

This document aims to give basic guidance so that clients, designers, builders and those who occupy buildings can use these materials correctly and with confidence. It is intended as general guidance and is based on the assessed performance of a range of specific products. It should not be used to endorse any individual use or product and those intending to use unfired clay materials should always obtain detailed guidance from the material suppliers on their appropriateness in any particular situation.

### Current Research.

This guidance is issued as interim results on a two-year research project to monitor and evaluate the use of unfired clay bricks, mortar and plasters in recent construction projects. A new house built in Perthshire in 2002 forms the principal focus of the research, which is funded by the Department of Trade and Industry *Partnership In Innovation* scheme and Communities Scotland.

The final results and guidance will be available in the 2005, following a yearlong post construction monitoring of the buildings performance. This, and other, buildings evaluated as part of this project used unfired clay bricks and mortar supplied by the Errol Brick Company and Claytec plasters supplied by Natural Building Technologies Ltd. The materials were used as the inner leaf of external walls and for internal partitions. They were built in monolithic form and as infill within timber frames. The house in Perthshire can be visited by arrangement, through Arc. Further information is available on the project at [www.arc-architects.co.uk](http://www.arc-architects.co.uk).

### Feedback.

We welcome feedback on this interim advice, which will help in the preparation of the final guidance, which will be available in 2005. Please send comments to [tom@arc-architects.co.uk](mailto:tom@arc-architects.co.uk)

## Guidance for Designers

**Structural Properties.** These materials generally have the properties of weak masonry and are commonly used in a non-structural capacity, both as monolithic walling and as infill within timber frames. Thin mortar beds may be used to speed drying, though thickness can depend on fixings to be laid in the beds. A wide range of wall ties and other accessories are usually appropriate for use with these materials, though there may be some differences, for example tie centres may be closer than standard to give adequate restraint.

**Performance in Fire.** These materials are generally non-combustible and perform well in fire, for insulation, resistance and surface spread of flame. When subjected to intense heat they become ceramic, with some distortion and cracking. Exposure to water during fire fighting, especially under high pressure, can cause deterioration and potentially complete loss of the material.

**Durability.** The materials are generally robust and durable when used internally. In external applications, they will degrade with prolonged exposure to water and in freeze thaw cycles. Clay plaster finishes are suitable for most internal situations if correctly detailed and applied. Some materials may be appropriate for external applications, on advice from suppliers.

**Detailed Design.** Sections of wall that are slender, exposed or poorly restrained should be avoided and corners that are vulnerable to impact should be rounded or chamfered. The use of timber beads at exposed plaster corners is more effective than standard metal reinforcement beads. Metal mesh and fibreglass can also be effective. A base course of fired bricks can protect the materials from flooding during the works and later occupancy. Good detailing in bathrooms, kitchens and cold window reveals is important to avoid vulnerability to moisture damage.

**Fixings.** The materials are generally capable of taking fixings for standard domestic uses, such as shelves. Small fixings are often best with self-tapping screws without pilot holes or rawlplugs. Larger fixings may require timber grounds and/or filling of any voids with mortar or resin.

**Finishes.** Unfired clay brickwork can be left exposed or finished with a variety of vapour porous materials, including clay and lime plasters, some paints and limewashes. The surface application of oils will reduce vapour permeability, as will many paints. Only highly vapour permeable paints should be used. Silicate paint is not recommended, as it is too brittle.

**Shrinkage.** A small amount of shrinkage in clay mortars is generally achieved a short time after laying. Full strength is achieved, through drying, in a number of days. Both depend on mortar type, thickness, moisture content and site conditions. An additional undercoat and reinforcement may be required when plastering over differential substrates, such as timber frames or lintols within brick walling. Reinforcement should be hessian or fibreglass, rather than metal.

**Testing & Certification.** The materials listed have extensive test data available from the manufacturers. The Errol 'Eco-bricks' and mortar are due to receive BBA certification in 2004.

## Guidance for Contractors

**Delivery, Handling & Storage.** As the materials may be damaged by prolonged exposure to water, delivery, handling and storage are best carried out under dry conditions. Tarpaulins may give temporary external storage, but the materials should be raised off the ground and ventilated to avoid condensation from ground moisture. Mechanical handling should be carefully considered. Equipment such as a hyab may damage brick materials by crushing where a lifting device such as a forklift will not. Movement of brick materials should be minimised.

**Mortar Making & Bricklaying.** Mortars not containing fibre can be mixed in a standard belle mixer, with the minimum amount of water added to make a workable mix. Mortars containing fibre are more successfully mixed with a plaster drill or in a roller pan mixer. The mortar sets by drying, which often takes longer than with cement mortars and depends on site conditions.

Bricklaying should be carried out in accordance with normal best practice. The bricks can be cut with a saw or brick hammer. Rates of work are generally the same as for fired brickwork, though guidance on appropriate heights of day lifts should be sought from the manufacturers. The works should be protected from rain and frost at all times. Special training is not usually necessary, though there may be a short period of adjustment to the different handling qualities.

**Plastering.** Clay plastering should follow traditional good practice. Materials should be mixed with the minimum amount of water to make a workable mix. Clay plaster is heavier than gypsum plaster, with working qualities more akin to lime plaster. The plasters often work better with a slightly textured, rather than a polished finish. Over-working of the plaster should be avoided as it can separate the clay binder from the sand, leaving a dusty film of clay on the surface and unbound sand, which rubs off. Over-wetting should be avoided and a minimum amount of water used in the finishing process.

Clay plasters set by drying rather than chemical action and this should be allowed for in programming the work. Drying rates are affected by the wall background, size of room, ventilation, air moisture and heating. In poorly ventilated spaces, drying can take weeks and some temporary surface mould may be produced. To facilitate drying, air movement and humidity reduction can be achieved by use of fans and the gentle, low-level action of de-humidifiers and heaters.

Test panels are useful in agreeing finish and establishing likely drying rates. Guidance and training may be available from the materials suppliers or the Scottish Lime Centre.

**Fixings, Chases, etc.** These materials generally will take standard fixings for secondary works, such as electrics, plumbing and joinery. 25mm self-tapping screws used without pilot holes or rawlplugs are usually appropriate for light loads. Larger fixings may require filling of voids with mortar or resin. Holes for services and chases for fixtures such as electrical boxes are best formed with mechanical wood-working tools, such as routers and drills.

**Aftercare.** The materials should not be exposed to water or high levels of relative humidity during completion of the works. Care should be taken to avoid impact damage. If self-finished plasters have been applied, other trades should be made aware of this and care taken to protect the finish.

**Health & Safety.** The materials generally have benign health and safety characteristics. There is a small risk of dust inhalation when handling materials in their dry state.

**Waste.** Very little waste is created by the proper use of these materials. Accurate estimation of quantities required should be made before ordering. Plaster and mortar that drops and dries during application can usually be re-mixed into the next batch. Excess materials at the end of a job can often be benignly disposed of into site soil, rather than being removed from site as waste.

## Guidance for Clients and Occupants

**Drying out.** If a building with clay plasters is occupied soon after completion, there may be an initial period of drying out when increased ventilation is needed to avoid condensation.

**Robustness.** The materials are generally robust, if correctly used, and should have a long life without need for maintenance. Any impact damage to plasters can be simply repaired, to match, with the original material.

**Care.** It is important that clay materials are not given prolonged exposure to water. Areas that may be sprayed with water, e.g. behind sinks, should be given some protection, e.g. tiles.

**Re-decoration.** When decorating the surface of unfired clay materials it is important that the applied finishes are vapour permeable, to prevent the build up of moisture in the walls and deterioration of the clay materials. A range of appropriate paints is widely available.

## Unfired Clay Materials

Unfired clay materials generally have excellent sustainability characteristics: low carbon emissions, very low waste, high re-cyclability and no detrimental health impacts. In the fabric of a building they can inhibit condensation, give thermal mass and acoustic insulation. By regulating the relative humidity of internal air, they can significantly reduce the risk of respiratory diseases and asthma triggers.

The materials covered by this guidance are relatively dense mixtures of clay, sand and plant fibres. They generally have the structural properties of weak masonry and achieve strength through drying rather than by chemical action. They will degrade with prolonged exposure to water.

**Relevant Proprietary Materials** currently available in the U.K. include:

<b>Unfired Clay Bricks</b>	
Eco-Bricks	The Errol Brick Company, Inchcoonans Road, Errol, Tayside. Tel: 01821 642 653. <a href="http://www.errolbrick.co.uk">www.errolbrick.co.uk</a>
Claytec compressed unfired clay bricks	Construction Resources, 16 Guildford Street, London SE1 0HS. Tel: 020 7450 2211 <a href="http://www.constructionresources.com">www.constructionresources.com</a>
Karphosit blocks	Construction Resources

<b>Clay Mortars</b>	
Eco-Mortar	The Errol Brick Company
Light Clay Mortar	Construction Resources
Claytec Undercoat	Construction Resources Natural Building Technologies Ltd., The Hangar, Worminghall Road, Oakley, Bucks, HP18 9UL. Tel: 01844 338338. <a href="http://www.natural-building.co.uk">www.natural-building.co.uk</a> .

<b>Clay Plasters</b>	
Bayosan VL14 E Top coat plaster without fibre	Natural Building Technologies Ltd.,
Bayosan VL14EC Self-coloured plaster	Natural Building Technologies Ltd.
Bayosan VL14F One coat clay plaster	Natural Building Technologies Ltd.
Bayosan VL14G Undercoat clay plaster	Natural Building Technologies Ltd.
Claytec Clay & Straw Undercoat Plaster	Construction Resources, Natural Building Technologies Ltd.
Claytec Clay & Straw Coarse One Coat Plaster	Construction Resources, Natural Building Technologies Ltd.
Claytec Clay & Flax Fibre Top Coat Plaster	Construction Resources, Natural Building Technologies Ltd.
Claytec Japan Plasters Self-coloured Clay Plasters	Natural Building Technologies Ltd.
Tierrafino Self Coloured Top Coat Clay Plaster	Construction Resources

### **Non-Proprietary Products & Other Clay Materials.**

Non-proprietary, unfired clay bricks, mortars and plasters can be used successfully in construction, though a level of expertise is required to select appropriate materials and achieve a good quality of work. Unfired bricks obtained from a brickworks will tend to be clay rich and liable to increased shrinkage and associated defects. Natural clays mixed with sand to form mortars and plasters can have widely varying properties. Such materials should only be used with expert guidance and appropriate testing and their use is outside the scope of this guidance.