

# INFORM

INFORMATION FOR HISTORIC BUILDING OWNERS

## Clay Mortars for Masonry Buildings



HISTORIC SCOTLAND  
ALBA AOSMHOR

## Introduction

This INFORM explains how clay and clay-rich earth have traditionally been used in Scotland to make mortars for masonry wall construction and surface finishing. It explores how and why clay mortars were used and how to identify these mortars in traditional buildings and other structures. It also briefly covers maintenance and repair and some factors to consider if you own or care for a building that has clay or earth mortar. This publication complements the Historic Scotland INFORM Guide Earth and Clay Construction, which describes the use of earth and clay as the primary building material for vernacular buildings.

Most traditional masonry construction relies on a mortar for bedding stones and spreading the structural load of the wall. Clay is one of the oldest building materials in the world, with a history of use going back thousands of years. It has been used on its own, and in conjunction with other materials such as lime, timber, straw and stone to build structures which are well adapted to many different locations and durable in a wide range of climates.



*Fig. 1 This 19th century mansion was constructed using clay in the wall core and pointed with lime externally.*

## Clay mortar in Scotland

Lime is generally considered to be the most common mortar material for traditional structures, yet in many parts of Scotland, especially areas where clay-rich soils are common, clay was commonly used as a mortar in masonry building. Sometimes seen as an archaic and purely vernacular tradition, clay mortars were in fact used up until the end of the 19th century and possibly later in some locations. A suitable mortar should contain heavy clay from a silicate-rich soil that can bind the matrix of the mortar together and support the compression loads of the masonry. Such material, normally found below the topsoil layer, was dug out of the ground and sometimes used directly for bedding the masonry and filling the wall core, or mixed with aggregates and straw to form a mortar. Sometimes lime was added to clay mortars to produce a more robust material. Generally clay mortars were used for rubble built structures such as houses, farm steadings and cottages, but there is evidence of clay mortars being used in the wall core of larger houses (Fig. 1), until lime became more readily available from the mid-19th century onwards.



*Fig. 2 A clay-bonded wall in Stromness retaining the original lime harl that protects the underlying clay mortar. Masonry walls built using clay often do not differ in external appearance from lime-bonded walls.*

Clay mortars are sometimes considered to be inferior materials, as they can be weak in tension and vulnerable to damage from exposure to water. However, a primary role of bedding mortars is to support the structural elements of a masonry wall, and earth mortars typically have sufficient compressive strength to perform this function. Cement and some lime mortars can be very hard and inflexible with high compressive strength, yet such qualities are unnecessary for traditional building and can be incompatible with some types of masonry. As clay mortar is susceptible to damage from water, most clay-bonded walls were externally pointed or harled with lime mortar to provide additional protection from the weather, and concealing the underlying composition of the walls. Consequently many clay-bonded masonry structures look much like lime-bonded and lime-finished traditional buildings and are not easily identifiable by external inspection (Fig. 2).



*Fig. 3 Mervinslaw Tower in the Scottish Borders dating from c.1600. Many ruins can appear to be drystone built, however in this case much of the clay mortar has simply been washed out.*



*Fig. 4 The remains of clay mortar visible in the wall core at Mervinslaw.*

A clay mortar is not necessarily inferior to a lime mortar for a wall core, although due to the reduced processing and local availability of the material it was undoubtedly cheaper and quicker than lime to obtain in the past.

When correctly maintained, clay mortars are resilient and durable. They can also be flexible, allowing thermal expansion to be accommodated, and are able to handle occasional wetting. Tests have also shown that clay mortars have good insulating properties.

Many medieval and later buildings which survive as ruins are sometimes interpreted as having been dry stone built, meaning masonry constructed without mortar. This is often not the case, as in fact many were often built with an earth mortar wall core.

Mervinslaw Tower, a 16th century bastle house in the Scottish Borders (Fig. 3) is a good example. At first sight it appears to be dry built, but closer inspection shows it to have been constructed using clay-bedded rubble, pointed and rendered with lime. Its abandonment, probably in the 18th century, has led to the progressive washing out of the clay over the years, resulting in the settlement and distortion of the masonry. Some clay mortar still remains within the wall core (Fig. 4).

The resulting unevenness of the surviving walls is probably not a result of vernacular construction, but a symptom of the loss of the mortar from within the wall core. When first built the walls would probably have been regularly coursed masonry.

Clay mortars continued to be used until the mid-19th century for buildings of all types. As transport improved and building limes became more readily available, clay mortars progressively fell out of use. Recent work has shown that clay-bonded structures in Scotland are much more common than previously realised.

Buildings with clay mortars should not be confused with those built from mass or shuttered clay; such structures are quite different in their detailing, require a higher quality of clay and are much less common in Scotland. Such buildings tend to be limited to certain areas, for example the Carse of Gowrie, near Dundee where suitable clay was readily available. Clay wall construction is a reviving craft however, and shuttered clay, often reinforced with straw, is a popular material for the construction of 'eco houses' where the low embodied energy and high thermal mass of the material is an important consideration in the project design.

## Identifying a clay bonded structure

Identifying a clay mortar or clay bonded masonry is not difficult but will normally involve some intervention to the building fabric. This may require a small opening to be made through the face of the external or internal wall and into the wall core to remove a sample of mortar. This can be done by removing a small facing stone and scooping out the backing material. Clay mortar is commonly discovered accidentally during building works, and can sometimes cause unnecessary alarm.

Fig. 5 shows an opening made in a wall for electrical work that has revealed the clay core. Old clay mortar often appears as a soft material that can be crushed in the hand giving a fine powder (Fig. 6). The colour, texture and appearance of clay-rich mortars are generally quite different to a lime-based mortar (Fig. 7).

Laboratory testing for the presence of fine silicates can confirm the clay content of a mortar, but generally the soft texture and absence of small hard particles (aggregates), as well as the colour, will be enough for identification. A clay mortar will generally be composed entirely of very fine material, commonly with a reddish or yellow colour. Lime mortar by contrast is generally cream, off white or pale grey in colour containing aggregates of various sizes in the mix. The soft and friable (crumbly) nature of a clay mortar does not necessarily indicate a problem with the structure of the wall, providing it is kept dry and undisturbed. Another indication of clay in walls is where, on exposed elevations, brown or reddish staining on the external masonry shows where clay is being washed out.



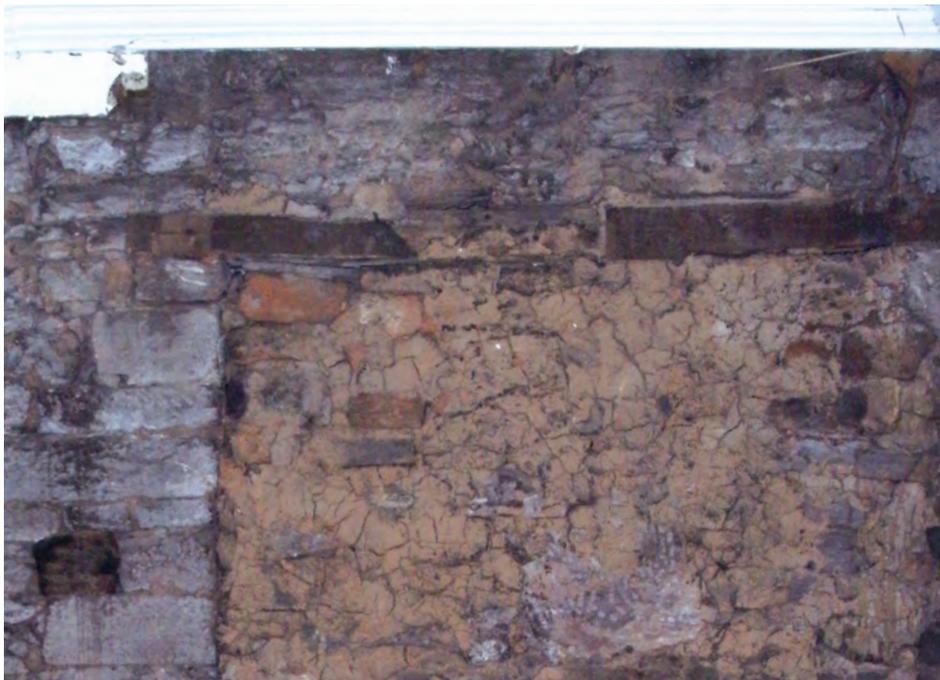
*Fig. 5 This opening in a wall has revealed the clay-bonded wall core.*



*Fig. 6 Old clay mortar is often soft and can be easily broken down.*



*Fig. 7 A lime mortar wall core from the early 19th century, very different in appearance and texture to a clay mortar.*



*Fig. 8 Interior masonry flush pointed with clay at a 17th century house in Brechin.*

## **Maintenance**

While there are many benefits of building with clay mortars, they, like many traditional materials, are vulnerable to damage from water saturation and persistent dampness. High levels of moisture progressively break down the clay matrix, leading to increasingly friable mortar, a loss of structural integrity and ultimately the deformation of masonry elevations. This can be seen on elevations exposed to prevailing weather where one side distorts due to loss of the mortar within the wall core.

Keeping walls dry and adjacent areas well drained is a priority for any building, old or new. Common defects such as blocked gutters, raised surrounding ground levels or unsuitable renders all contribute to damp walls. Such matters should be addressed before any work to the masonry itself is considered. Higher level defects associated with chimneys and skew copes may also contribute to dampness in a wall. Where areas of clay bonded masonry have suffered localised damage they should be repaired with a compatible clay mortar where possible.

While such work is not complex it is generally a specialist trade, and the specification of appropriate repair materials can differ significantly from the original material in response to the technical requirements of individual structures. Therefore, specialist advice should be sought for most works. For small areas of repair it might be possible to use a weak lime mortar, typically made with a putty lime.

Once an appropriate specification has been established, sourcing new materials can be challenging. Commercially available materials can be cost-effective and appropriate for many projects, but locally sourced, job-specific materials will usually be more compatible with the original fabric and can achieve a higher quality of conservation repair. Time should be allowed in the programme for sourcing of such materials well in advance of the actual repairs.

For internal areas a finish coat of clay or lime-based plaster may be appropriate to complete the repair. Historically, where lath and plaster was used to line the building and the internal finish of the masonry was not important, the inner face of the wall was sometimes flush pointed with clay (Fig. 8). Clay was also used as a material for internal plastering. Such plasters were normally finished with a limewash or distemper. For all walls it is important to maintain the vapour open nature of clay-bonded buildings through the use of breathable materials on the inside and outside faces.

Traditional materials, especially clay mortars, can be quick to show signs of distress if poorly maintained. This should not be seen as a weakness but rather an early indication that the building is in need of attention. Historic Scotland Short Guide 9 Maintaining Your Home covers essential elements of routine inspection and repair for traditional and historic buildings.



*Fig. 9 Dampness necessitated the removal of the cement render from this clay-bonded wall.*

## **Treatment of external walls**

Many clay bonded buildings have been externally rendered in cement in recent years, as a replacement for weathered lime harling. Where such render is in good condition, and adjacent detailing and chimneys are handling water well, the render may be left in place, and the health of the wall maintained internally with vapour open linings and finishes. However, where the render is cracked or defective, or water ingress from other areas has resulted in damage to the walls, it may be necessary to remove the cement render and replace with a more compatible lime or clay based render or harl (Fig. 9).

In many parts of Scotland external lime pointing was applied to clay-bonded walls, flush with the rubble, producing a smooth but gently undulating surface. Limewash was then applied to protect the masonry and the pointing. As exposed masonry elevations became popular from the mid-19th century this flush pointed and limewashed finish largely died out although traces can often be seen on sheltered elevations (Fig. 10). Owners should be cautious over the use of water repellents, masonry paints and other 'one coat cures' for walls of any construction as they are short term solutions which may reduce the ability of the masonry to manage moisture in the longer term.



*Fig. 10 Remains of a flush point and protective layers of limewash on a wall in the Scottish Borders probably dating from the early 19th century.*

## **Conclusion**

Clay has been used in construction for thousands of years and until relatively recently it was used in Scotland both for building and, more commonly, in mortars for masonry walls. A significant number of historic and traditionally built structures with clay mortars still survive; indeed such construction is more widespread than often realised. Clay mortars have proved effective and durable for masonry construction and are a significant feature of our traditional built heritage. If correctly identified and appropriately maintained with the right materials and skills, buildings with clay mortar can be as resilient and durable as lime-bonded masonry walling.

## Contacts and Further Reading

### Historic Scotland Conservation (technical advice)

T: 0131 668 8668

E: [hs.conservaiongroup@scotland.gsi.gov.uk](mailto:hs.conservaiongroup@scotland.gsi.gov.uk)

W: [www.historic-scotland.gov.uk/conservation](http://www.historic-scotland.gov.uk/conservation)

### Earth Building UK (EBUK) (information, advice and contacts)

W: [www.ebuk.uk.com](http://www.ebuk.uk.com)

Houben H. and Guillard H., 'Earth Construction: A Comprehensive Guide', Intermediate Technology (1994)

Morton T., 'Earth Masonry Design and Construction' BRE (2008)

Norton J., 'Building with Earth: A Handbook', Intermediate Technology (1986)

Practical Building Conservation Series: Earth, Brick and Terracotta, English Heritage (2014)

Walker B. and McGregor C., 'Earth Structures and Construction in Scotland', Historic Scotland (1996)

Walker B., 'Scottish Turf Construction', Historic Scotland (2006)

Historic Scotland's INFORM Guide and Short Guide series contain further information on the conservation and maintenance of traditional buildings. These publications are free and available from our technical conservation website, address above.

Alternatively, you can contact us on **[hs.cgpublications@scotland.gsi.gov.uk](mailto:hs.cgpublications@scotland.gsi.gov.uk)** for these or any other publication enquiries.



**Principal author: Roger Curtis**

**Published by Historic Scotland June 2015**

**Historic Scotland, Longmore House, Salisbury Place, Edinburgh EH9 1SH**

**Tel: 0131 668 8600 Fax: 0131 668 8669**

**W: [www.historic-scotland.gov.uk](http://www.historic-scotland.gov.uk) E: [hs.conservaiongroup@scotland.gsi.gov.uk](mailto:hs.conservaiongroup@scotland.gsi.gov.uk)**

While every care has been taken in the preparation of this guide, Historic Scotland specifically excludes any liability for errors, omissions or otherwise arising from its contents.