



EARTH MORTARS RESEARCH PROJECT

Stage 1: Knowledge Review & Research Strategy

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ÀRAINNEACHD
EACHDRAIDHEIL
ALBA



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Previous page: Fig. 1: Earth mortared wall with lime harl at Rait.

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1 SUMMARY

This report presents the results of the first stage of a research project into traditional earth mortars, funded by Historic Environment Scotland, and comprised a desk-based assessment of the extent, character and significance of historic earth mortars in Scotland, and an assessment of the condition of conservation practice relating to them.

Earth mortars are here defined within a wider family of traditional earthen materials and other kinds of mortar, though the edges that define the tradition are imprecise and there is a question over how relevant achieving clear definitions is to practice in the field.

Earth mortar has been used since the first masonry buildings were built in Scotland and up until the 19th century. This is a tradition encompassing some 5,500 years that transcends cultural eras, building typologies and extends beyond the end of vernacular procurement. There is currently a poor level of documentation to understand these uses and transitions.

The main cultural significance of earth mortar is as a long-standing and geographically extensive vernacular tradition. The diversity of soils, climate and stone across Scotland resulted in a rich diversity of earth mortared masonry, reflected in regionally varied materials, construction technique, building form, and construction skills. This tradition thereby documents a key characteristic of Scottish vernacular built culture, the close local relationship of people to place, which gradually decayed between 1740 and 1900.

The understanding, documentation and conservation of earth mortared heritage is impeded by poor identification, inaccurate recording, lack of training and guidance, and a pervasive cultural bias against earthen materials, which originates in elitist attitudes from the 18th and 19th centuries.

The Scottish tradition of earth mortars is part of a vast global cultural heritage, but there is not currently a strong international network specifically on earthen mortars. There is also a context of the use of earth mortars in contemporary eco-construction, reflecting its low carbon, and circular economy characteristics. This has strong potential to support the increased use of earth mortars in a heritage context in pursuit of a national transition to zero carbon construction in Scotland by 2045.

The report maps 396 individual earth mortared structures in Scotland, approximately 2% of perhaps 200,000 which are guesstimated to exist. The poor level of recording impedes understanding. These sites have been included on an online GIS map.

The report lists 119 relevant publications of which 14 are identified as key documents.

58 people volunteered to form a cross-sector international network to guide this research project. The first meeting of the Network will review this report and guide the next stage of research.

The report makes 29 general recommendations of actions to develop this field and 12 specific actions of the next stage of this project. These include further desk and field research to better understand the heritage, cross-sector training and guidance to improve skills, knowledge and competence, exemplar projects and fostering of the network.

2 INTRODUCTION

This section outlines the aims and process of the research project.

2.1 Background

Over the last 20 years there has been growing awareness of the important role that earthen materials hold in the built vernacular cultural heritage of Scotland. Within the family of earthen materials, earth mortars are known to have been used extensively across Scotland, but they have not been well documented, technically understood or supported by technique and skills in practice.

In 2018, the Tay Landscape Partnership identified a significant number of earth-mortared structures in the Carse of Gowrie and developed a range of desk-based and field processes for identification. Over the last 10 years, repairs at individual sites in Scotland and Northumberland have helped develop materials understanding and conservation technique.

At the same time, the development of materials, knowledge and skills in the use of earth mortars for contemporary construction has been increasing, especially in mainland Europe, as part of the transition to construction processes with lower environmental impact, of which Conservation is part.

Historic earth mortars are found across the world and there is ongoing potential for Scotland to work within the context of a European and global knowledge and skills community.

2.2 Aims of the Research Project

The general aims of this research project are:

1. To better understand Scotland's earth mortar heritage.
2. To better document Scotland's earth mortar heritage.
3. To better understand the materials science of earth mortars.
4. To improve processes of identification and recording.
5. To improve repair techniques.
6. To develop a network to support knowledge and practice.

This report summarises the first phase of research, which was commissioned by Historic Environment Scotland to:

1. Assess the baseline of current knowledge.
2. Assess the extent, character and significance of Scotland's earth mortar heritage.
3. Assess current conservation practice.
4. Develop a stakeholder network.
5. Recommend priorities for further research.

2.3 Research Activities

This was a desk-based research stage, based on currently available information.

2.3.1 Survey of Sites

Searches were made of online archives and other public internet sources to identify specific sites within Scotland with confirmed earth mortar. Information was also

provided by the project network. This identified 396 individual earth-mortared structures.

These sites include standing buildings, ruins and archaeological sites where there are no standing remains above ground. This broad inclusion is in order to best interpret the historic patterns through available evidence, and the different classifications are available as subsets of data.

The team recognise that this is only a very small proportion of Scotland's earth buildings, and this led to a focus on mapping and interpretation of these results, rather than documenting them in individual audit form, as was done for the Tay Landscape Partnership and the Thatched Building Survey, where a smaller number of specific buildings were catalogued.

The database of 396 sites is summarised in this report as Appendix 1 and intended to act as a live record, increasing as sites are notified.

The sites were added to an online GIS digital mapping system, as a tool for analysis and communication. This can be accessed at <http://www.mapping.earthtecture.co.uk>

2.3.2 Knowledge Baseline

Searches were made of print and online publications to identify specific knowledge resources relating to earth mortars generally, and specifically to those in Scotland in order to understand the current national knowledge base and how this relates to the global knowledge context. The network also provided resources.

A total of 119 publications were read by the team, of which 14 related specifically to Scotland. It was felt that 11 were documents imparting highly relevant information. and these are identified in the bibliography contained in this report as Appendix 2.

Electronic copies were obtained, where possible, as the basis for a publicly-accessible online resource.

2.3.3 Network

A total of 510 individuals and organisations were contacted, 74 within Scotland. 58 responded asking to be part of the Network and around 20 gave substantive information based on their experience. A virtual meeting of the network was held on 26.04.2022 to review the draft report and recommendations for further research, with comments incorporated into this version.

It is intended that the responders shall form the basis of an open sector Network to guide and disseminate work in this field. The current network of 58 includes 12 archaeologists, 12 architects, 13 contractors, 4 engineers, 5 scientists and 4 surveyors.

The Network list is included as Appendix 3.

3 HERITAGE ASSESSMENT

What do we know about the historic use of earth mortars in Scotland?

This section presents the results of research to understand when, where, how and why earth was used as mortar in Scotland. While we recognise that the evidential record is patchy and that technical information is rarely available, the authors feel that sufficient information has been gathered to make an overview assessment of the patterns of this material heritage, to consider its significance, and to identify areas that merit further investigation.

3.1 What are Scottish Earth Mortars?

Before we can begin this assessment, we need to define our research parameters, whereupon immediately a level of imprecision becomes inevitable. The general principles adopted to guide the project are outlined in the following sections.

3.1.1 What is Mortar?

Mortar *n* a mixture of cement, clay or lime, sand and water which eventually sets hard and is used by masons and bricklayers for making joints between stonework and brickwork; *orig* used to describe clay soil which was used for similar building purposes; the strong clay was carefully tempered with sharp sand and gravel or could be beaten with a mixture of hot lime.

Pride, G.L. 1996, Dictionary of Scottish Building. The Rutland Press.

We take *mortar* to be a malleable material used in the spaces between masonry elements (stone predominantly, but also brick and other materials). We note that earth mortars were not necessarily tempered or mixed with hot lime, and that the dictionary definition above therefore does not accurately describe the entire tradition.

Such mortar can be found in walls, vaults, bridges and any other masonry structures. Our research to date has predominantly documented building and enclosure walls.

The term *mortar* has been used historically in Scots construction terminology to denote a material that has a wider range of applications, including daubs, renders, plasters, tile bedding, etc. and indeed some deposits of clay-rich soil have historically been described as '*mortar*' while in the ground. These are not what we mean by *mortar* in this research, though we have used the knowledge contained in these contexts, where relevant.

3.1.2 Where is Scotland?

Sites are only recorded where they are geographically located in contemporary Scotland, though we have considered relevant information on sites located elsewhere, especially in Northumbria, Cumbria and Ireland, where vernacular material heritage can be very similar to parts of Scotland. For clarity, we have not included sites built by Scots outside Scotland, although these may represent the application of Scottish techniques and knowledge.

We have used as wide an international knowledge base as possible, in order to inform our understanding of the context of Scottish heritage and practice, and in doing so have tried to identify any relevant parallels and distinctions.

3.1.3 What is Earth?

By *earth* we mean naturally occurring soils. These are predominantly subsoils from below the surface layer of living and decomposed plant and animal organic matter.

Scotland has a very diverse variety of natural subsoils, most of which have been put to use as mortar at some point.

Earth used as mortar can be naturally occurring, or it can be blended to change its performance, typically to vary the amount of clay which acts as the binder, or to vary the proportion of mineral particles to affect its workability, strength and durability.

Other non-earth materials that were sometimes traditionally added to earth mortars include animal dung, straw and hair. These still count as earth mortars as they enhance, rather than fundamentally change, the materials nature and performance.

Lime does fundamentally change the nature and performance of earth mortars and this can happen in a number of circumstances within the Scottish tradition, as outlined below.

Some soils, occurring where limestone is the parent rock, have a natural calcareous content and mortars made with these soils can have a natural chemical interaction between the lime and clay. These are earth mortars, though they are a small part of the Scottish tradition.

There is a significant tradition of small amounts of quicklime being added to earth mortars to improve their bond, plasticity, durability and to enable masons to increase the amount built in a day by having a faster initial stiffness. Adding lime fundamentally changes the chemistry of the mortar. Most importantly, it reduces the earth mortar's natural plasticity relationship to water, which is what enables them to be fully recycled without adding more binder, and it significantly increases the materials embodied carbon. The kind of composite mortars are widespread in the Scottish tradition and a better understanding of their development and chemistry would help to understand the heritage of earth mortars. Therefore, we have included investigating them within our the scope of research, and we have classed these as *earth-lime mortar*.

There are also weak lime mortars made with unwashed sands or sandy soils that contain clay. This would have been a low-cost process using local materials and achieves a similar chemical condition as earth-lime mortars. In field surveys, it can be impossible to distinguish these from earth-lime mortars without laboratory testing, but for the purposes of this research we class these as *weak lime mortars* and exclude them from the research. Undoubtedly interesting and extensive, they are the scope for a different research project.

3.1.4 Things We Don't Say

In the course of this research, we found a range of terms in frequent use that are either inaccurate or misleading and so we do not use them in our research unless quoting other sources. These terms include:

' <i>clay mortar</i> '	clay is a key mineral constituent and binding element in earth mortars defined by chemistry and/or particle size, but occurs along with other particles, thereby becoming 'earth.'
' <i>clay bonded</i> '	this is a term frequency encountered in descriptions by archaeologists, but is insufficiently precise for the reasons given above.
' <i>improved mortar</i> '	this term is often used when lime is added to earth mortar, but makes assumptions about their relative qualities that are not helpful and imply a hierarchical view of materials. We generally use the neutral term 'altered' when materials are changed.

'lime-stabilised' this term implies that mortars without lime are unstable.

3.2 Where are Scotland's Earth Mortars?

Fig. 2 shows the geographical distribution of the 396 recorded sites. What does this tell us?

First, it is important to recognise that it does not show the intensity of distribution. The project's collection of site data is very uneven across the country, as it mainly originates from individuals who were minded to record earth mortar and who often operated in a particular geographical area. This creates specific clusters of sites, the main one being the Tay Landscape Partnership area, which conducted a specific search for earth materials and individually recorded earth mortar as a material. This one relatively small area contains 146, or 37%, of the recorded sites.

What it does tell us is that earth mortars occur across the whole country but that recording is uneven. Where surveys in a local geographical area have specifically looked for earth mortar and systematically recorded them, then a large number are identified.

We can therefore, to some extent, extrapolate those intense local results where a focused search has been undertaken, to the whole country, where there is a widescale presence recorded at low intensity given a non-systematic identification process.

However, caution is required as the TLP area was the focus of a detailed survey because it was known to be a place where vernacular buildings had been built using earth materials, so it is reasonable to extrapolate that intensity nationally? Perhaps, because when we look elsewhere, we see all kinds of clay-rich or clay-poor mortars made from all kinds of subsoils.

The TLP Survey was instigated primarily to record mudwall buildings and recorded other earth materials in parallel. The survey results for earth mortar were different, the Report stating:

'This map [Fig. 4] shows the 141 surviving and 22 lost buildings recorded with clay masonry, making clay mortar the most common earth material, and found throughout the area. These include 72 surviving and 1 lost where earth mortar was the main construction and the 69 surviving and 21 lost mudwall buildings where clay mortar formed the masonry plinth, protecting the mudwall from damp, requiring only a small amount of stone to be sourced.

The sites include the 2 high status medieval buildings that survive to show the use of clay mortar alongside lime in that period. Elsewhere, most of the buildings date from the 18th and 19th centuries, when many improved houses were built using mostly clay mortar, sometimes with added lime, and usually with lime pointing. Blank locations tend to reflect the difficulty in obtaining survey data, rather than a local absence of examples.

This distribution shows that the benefits of clay materials were sufficiently widely recognised by professional builders to merit sourcing and transport materials some distance, and that their material properties were well enough understood to combine with other materials in designed, commercial construction projects. However, where clay soil was abundant and stone scarce, mudwall was preferred and masonry used sparingly.'

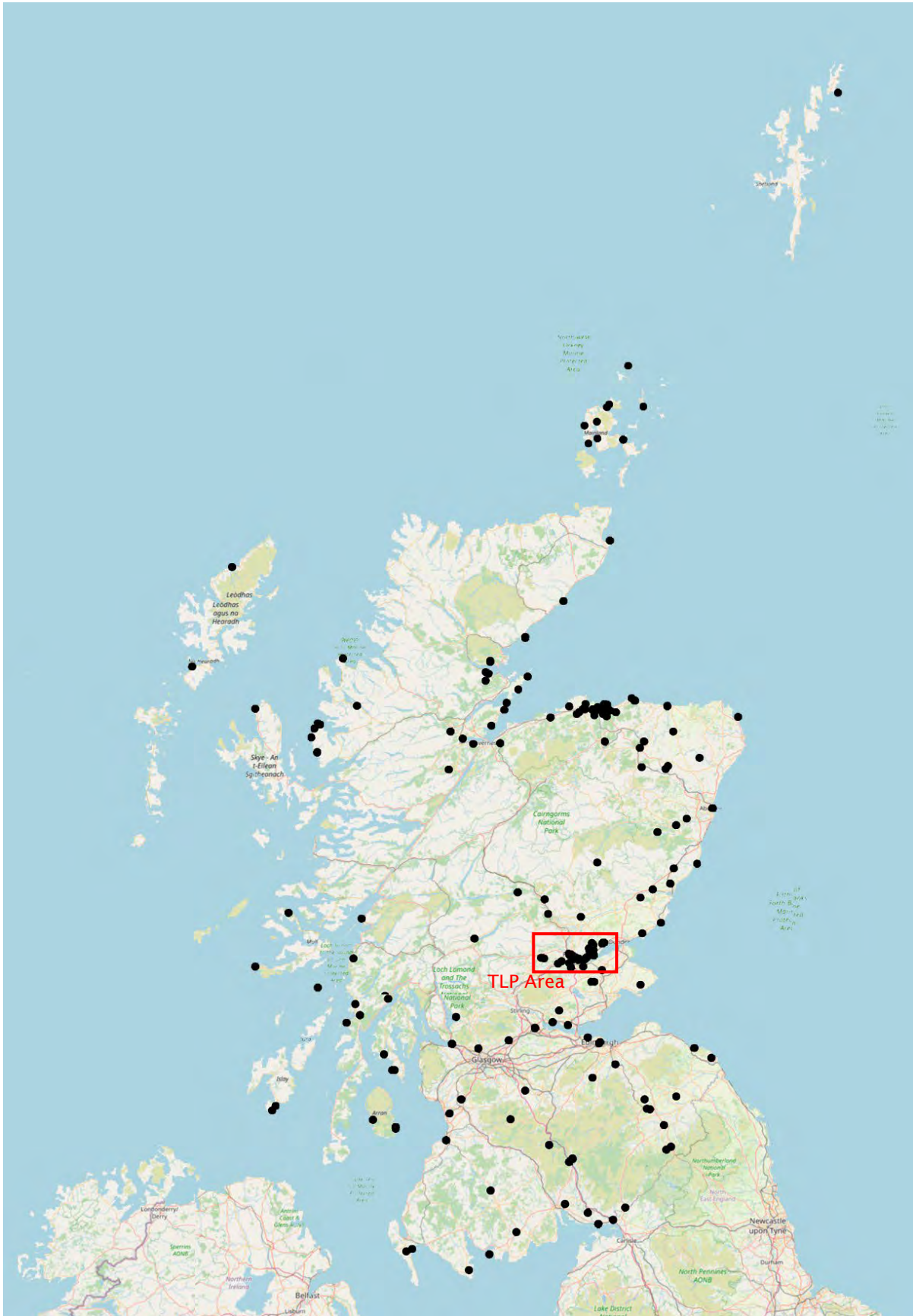


Fig. 2: Earth Mortar Site Map, extracted 22.04.2022

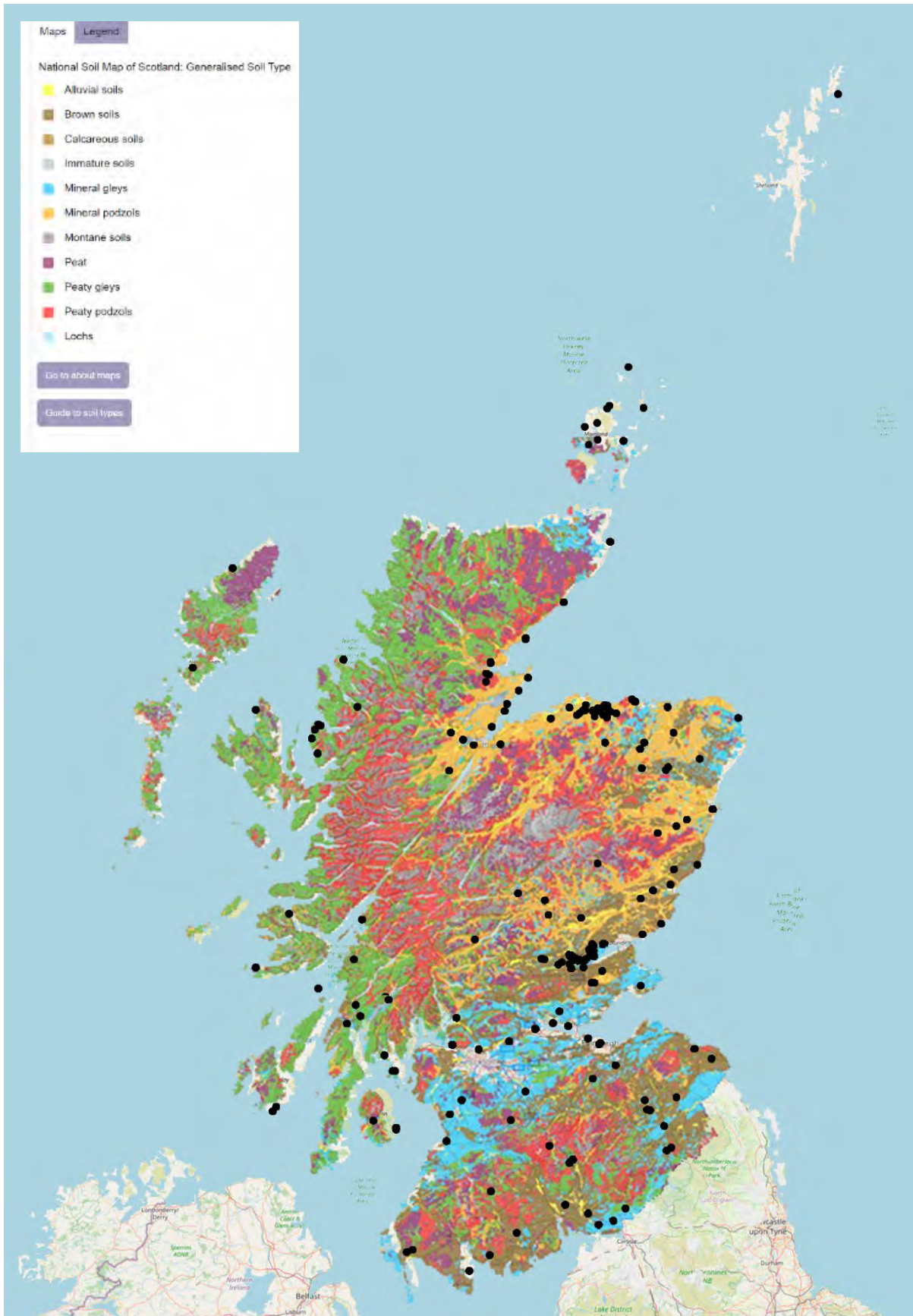


Fig. 3: Scotland's soils map, with earth mortar sites.

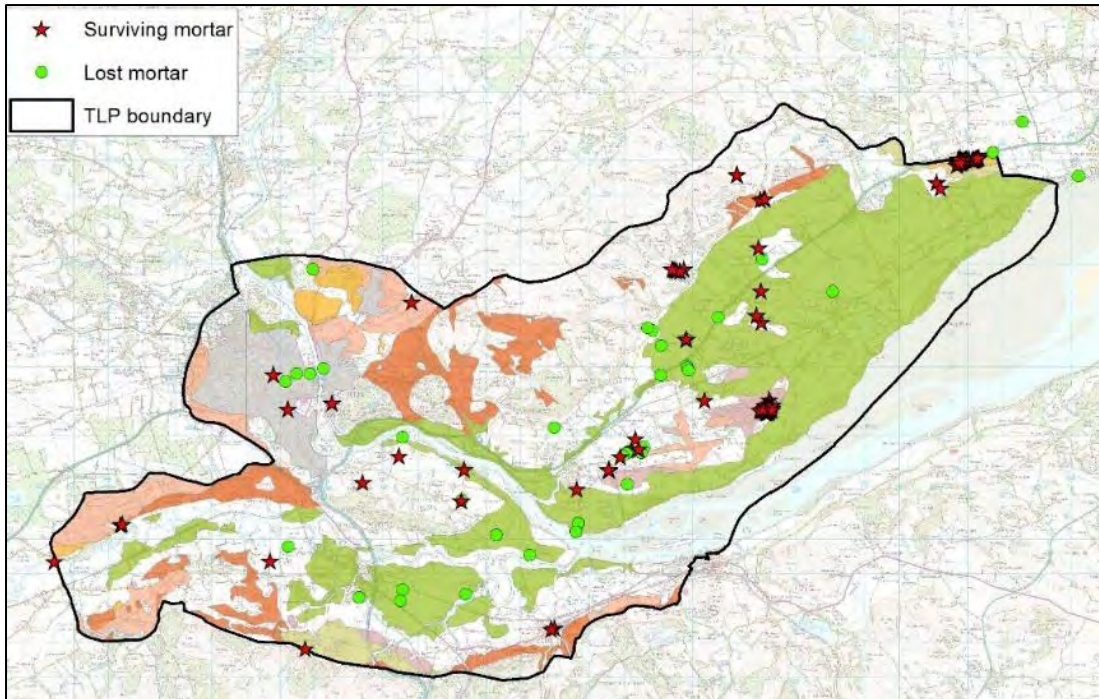


Fig. 4: Map of earth mortared structures in the Tay Landscape Partnership area.

This conclusion suggests that the presence of mudwall buildings reduced the amount of earth mortar, rather than increased it, though the quality of clay earth available also meant that earth mortar was transported to where stone was abundant. This is demonstrated in Fig. 4, which correlates earth mortared buildings with clay soils, showing earth mortars were used where there were buildings, rather than where there were clay soils. It is also noted that soils that are optimal for mudwall tend to be too clay-rich for optimal earth mortar.

Fig. 3 shows the national map of sites correlated against general soil types, and shows that earth mortared buildings are found across the country, and across all soil types. This reinforces the conclusion that earth mortar is found wherever there are traditional buildings, rather than wherever there are clay-rich soils. This is the principal finding of our mapping research.

Having said that, well-graded clay soils would have been used where these were available according to local knowledge and this is often in quite localised deposits not indicated in this scale of map. The relationship of the diversity of soils to mortar performance is discussed in section 3.3.

There are some other comments worth making about the geographical distribution shown in Fig. 2.

The map would appear to suggest a correlation to coasts and river locations where fluvial and estuarine clays can be deposited, but we feel this is probably misleading and is likely to simply represent a correlation to traditional settlements, which tend to be located in these locations in relation to early transport routes. There may then be an indirect relationship between good earth mortar soils and agricultural soils.

The map would appear to suggest a lack of earth mortar in the Central Highlands and North Scotland, Shetland and the Outer Hebrides. We feel this represents a lack of available recorded data rather than an absence of earth mortar. It is our

recommendation that further information should be sought on sites in these areas to clarify this.

The map does not indicate a correlation between the location of earth mortar and rainfall or other climatic factors.

The map suggests a lack of earth mortars in cities. The recorded sites were generally either standing Listed buildings or buildings in decay and archaeological sites where core mortar was visible. Decayed buildings and archaeological sites tend to be located outside cities, and inside cities the majority of masonry structures date from the 19th century, when masonry structures may have often been built solely in lime mortar. However, given the lack of data, it is a recommendation that a suitable sample area be investigated in a city.

The map, and comments received from the Scottish Lime Centre, demonstrates that proximity to limestone did not preclude use of earth mortars. This illustrated the key finding that earth mortars were not generally used because of lack of building lime, but in preference because it was a good building material.

3.3 What Are Scotland's Earth Mortars Like?

We found that earth mortars used historically in Scotland can be considered as three broad types:

3.3.1 Natural Soils, Used Essentially as Dug

The simplest and cheapest way to make a mortar is to use the soil dug up for foundations and dampen it. Undoubtedly this did happen, but many traditional buildings had very shallow excavations for foundations, which would have produced an insufficient quantity and that mainly topsoil.

From our experience of putting mortar back into walls where it has eroded away, 30-50% of the volume of a rubble wall can be voids filled with mortar and pinnings. This requires a substantial volume of mortar.

Therefore, masons would have sourced earth dug specifically to use as mortar, and in most traditional situations this would have been selectively sourced, as close to site as possible, based on local knowledge.

Scotland has a very diverse array of natural soils, the result of parent rock diversity, glaciation, fluvial, estuarine and marine activity, and the effects of plants and weather.

In some places this means that local soils suited to make earth mortars are abundant and easily obtained. The characteristics of such a naturally optimal soil appear to be:

- Clay content 8-20%, providing good cohesion and working plasticity.
- Clay mineral type has low expansiveness in water.
- Well graded particle size, creating good cohesion and low shrinkage.
- Few stones, requiring to be removed before use.

Perhaps around 5% of Scotland's land mass has such soils, including substantial parts of Angus, Perthshire, Stirlingshire, and Ayrshire, and elsewhere in more localised deposits. In most places, subsoils are less than perfect, and the choice was to bring in a better earth from somewhere else, to use an imperfect local earth, or to alter a local earth's properties by adding things to it.



Fig. 5: Example of earth mortar, used as dug, from very close to site, Main St. Longforgan, early 19th C. Shrinkage cracks as a result of high clay content in chimney wall.



Fig. 6: Stirling series soil, in rear garden of house, note external lime pointing.

In many places, the evidence suggests that people often used imperfect local soils without altering them, for all but high-status buildings. This seems to have generally been the case up to the widespread changes that began after 1745 and peaked 1820-1860. After 1745, the use of unaltered soils appears to have retreated towards more geographically remote locations and for lower cost/status buildings. In these places, local knowledge of earth materials that could be freely obtained and used in traditional ways, seems to have persisted for longer.

In some places, the use of local soils meant that some very weak mortars were used. The weakest earth mortar we are aware of is at Moirlanich Longhouse, a rubble masonry structure near Killin, where the mortar is silty/peaty and has negligible strength. Such structures rely on good masonry technique, with stone-to-stone contact and through stones binding the inner and outer leaves to resist movement. The mortar provides cushioning and air-tightness. Such mortars rely on protective weathering coatings to the outside, usually lime pointing or renders.



Fig. 7: Moirlanich Longhouse, weak earth mortared rubble with lime pointing & wash. The leaning section to the right of the porch is shown in repair below.



Fig. 8: Back face of inner leaf exposed during repairs at Moirlanich, with cruck leg having benefitted from the preserving effect of earth mortar drawing away moisture.

More common are sub-optimal mortars where the mortar has low clay content or poor grading, where the mortar provides some cohesive strength, but is vulnerable to weathering. The evidence suggests that the majority of historic Scottish earth mortars fall into this category, reflecting the economy, local knowledge and construction skills that are essential characteristics of vernacular construction.

3.3.2 Natural Soils, Altered Without Fundamental Change

Soils could traditionally be altered in several ways to enhance their performance:

- Removing stones to create a more workable mortar, by hand or sieve.
- Adding sand to clay-rich soil to create a more workable and better graded mortar.
- Adding clay to sandy soils to increase bonding and cohesion.
- Adding dung to increase bonding, cohesion and plasticity.
- Adding straw or hair to increase tensile strength.

We found little historic recorded evidence of any of these processes, and there is not a sufficient record of mortar analysis from sites to form an evidential scientific basis for assessing how mortars were sourced and prepared.

This lack of historical documentary evidence is unsurprising and typical for vernacular materials and processes. Perhaps it is reasonable to say that the method of sourcing and making mortars was based on local knowledge and was 'normal' to an area's tradition and thus not noteworthy.

It is important to recognise that mortars cannot be considered in isolation as part of a masonry tradition and that they worked along with the locally available stone in a composite construction. Thus, earth mortars could be specifically tailored to work with the particular characteristics of the local stones, which would vary with the location and status of the structure.

The *clay and bool* tradition of Northeast Scotland is a good example of this, which has a rare historical description of the sourcing, mixing, construction and design processes. Elizabeth Beaton¹ provides a good explanatory introduction:

A variant where the clay mix has added round stones from the river or shore, known as 'bools', was called Auchenthalrig work from the name of a hamlet in Bellie parish. The following description, written in 1812, on the use and preparation of Auchenthalrig work, is worth quoting at length:- 'This work is built of small stones and mud, or clay, mixed with straw.

The proportions of these materials required to make a rood of thirty-six square yards, are nearly as follows, viz. about thirty cart loads of stones, ten cart loads of clay or mud, and twenty-four stones weight of good fresh straw. When the clay is strong and tough it will require fully three cart loads of sharp water sand. The mode of preparation is thus – if the mud or clay is lumpy, it must be reduced with a mallet, mixed with the sand, and made pretty thick with water: the straw is then equally strewed over it, trampled with the feet and wrought from one side to the other; until the whole is of proper consistency for admixture with the stones.

In building any kind of stones will answer; even stones from the channel of a river, which are generally round, are preferred by some workmen to any other. They ought not to be larger than a workman can with ease put upon the wall; and though much smaller, they are perfectly sufficient; indeed, large stones are improper, as they prevent the mud from consolidating, and, by consequence, diminish the strength and durability of the walls, which are of much the same breadth as those built with stone and lime: twenty-two inches are sufficient for a wall of seven feet high: if higher, they should be two feet thick, carried up perpendicularly the same as other walls, and care should be taken never to build more than two or three feet of height in any one part in the same day: if raised more, the wall is apt to swell, for which there is no remedy but to pull it down, and rebuild. To prevent accidents of this nature the work is so proportioned to the number of hands employed, as to admit of three or four days for each division to dry, before more is put upon it. In order, therefore, to keep two men constantly at work, one building and another pre-paring the mud, a wall to the extent of about forty feet going on at one time is requisite. Where there is any joisting for grain lofts, etc. there should always be a wall plate of wood one and a half inches thick laid below the joists, and their ends brought within six inches of the outside of the wall: a similar plate is also necessary below the feet of the couples.

These walls are equal to the weight of any roof commonly put on mason work, either slate, heath, mud and straw, or stab thatch. If done with mud or stab thatch there should be a good heath brush laid on the wall head to bear up the straw, and to carry the rain over the walls, as nothing is so injurious as rain falling into the face, or getting into the middle of the wall.

In the course of two or three years after being built, the frost has generally such an effect upon the mud on the outside of the walls, that it falls off, leaving the stones (which are covered with it when newly built) quite bare. Whenever the walls begin to appear in this state, they should be harled over with lime properly mixed with pure river or sea sand pretty rough; and that the inside walls of barns and grain lofts may be sufficiently close and smooth, it is strongly recommended to do them over with a thin coat of plaster lime, which adheres

¹ Beaton E., 1993, The Pattern of Moray Building

firmly to the mud. Thus finished, the Auchenthalrig houses are, out and inside, as ornamental as those built entirely of stone and lime mortar'.

As at Cowfurach, Rathven, the 'bools' are laid in neat rows (Fig.9) in a shed on Longhill Mill, Urquhart, they are in a herring-bone pattern. Most of the cottages at Kingston-on-Spey, built initially at the end of the 18th century to house workers in the ship building and timber industries there and at Garmouth, are of clay and bool. The material was used for simple linear steadings at Bogmuir and considered in 1820 for a 'Square of offices' to be built at Edom, Pluscarden. Here the farmer, Mr. Bain, when advertising for tenders for the work, stated that he would provide the materials but 'as it is not yet decided whether the offices will be of Mason or Achainhalrig (sic) Work, Contractors are requested to estimate for these different works separately'.



Fig. 9: Clay and Bool wall, Cowfurach, Moray. © HES. Similar arrangements of round river stones laid in herring-bone rows can be found in other countries.

3.3.3 Natural Soils, With Quicklime Creating Fundamental Change

In principle, adding quicklime to earth mortars does several things:

- It provides additional binder and plasticity.
- The quicklime draws moisture out of the earth that had been added to make it plastic and break down the clay, enabling a faster drying strength to be achieved within the wall.
- A weak ion-exchange, similar to pozzolanic (Minke), reaction occurs between the clay and lime minerals, improving its durability, especially in wet conditions.

Quicklime seems to appear as an additive in earth mortars increasingly through the 19th century examples, with white flecks of imperfectly burnt lime appearing in the material.

Analysis suggests that quicklime was typically added at about 5% volume, creating 10% if fully slaked. However, the combination of lime and clay minerals varies in effect and both written sources and field experience suggest that often the mortar becomes more plastic and more durable, but sometimes it can become weaker and the earth mortar is stronger without the addition of lime.

The key characteristic of earth-lime mortars is that they undergo chemical change, which fundamentally alters the material properties. These mortars can no longer change their state by rewetting, as earth mortars can, enabling them to be re-cycled or returned to ground as soil. Compared to earth mortars, earth-lime mortars are less simple to repair, have higher embodied carbon, cannot be re-cycled without adding new binder, and are hazardous to make. It is for all these reasons that earth mortars are generally preferable, unless there is a specific need to add lime.

An early and impressive example of an earth-lime mortar is Castle Huntly Doocot, near Dundee, built in the late 17th century and a complex arrangement of masonry with projecting turrets and internal nest boxes that has been roofless for over a hundred years. The structure is built of basalt, a dense and low porosity stone creating very challenging conditions for an earth mortar.

While there remains only the faintest traces of the original lime harl, there has been practically no decay of the earth-lime mortar, showing that it has significantly outperformed a richer lime material for durability, probably because it has hydraulic reaction.



Fig. 10: Castle Huntly Doocot.



Fig. 11: Detail of earth-lime mortar.

3.4 Who Built What When with Earth Mortars?

The evidence currently available is insufficient to form a definitive assessment of the chronological, typological and socio-economic patterns of use of earth mortars in Scotland, but enough has emerged to propose the following broad picture, to draw tentative conclusions and prioritise further areas for investigation.

3.4.1 'Pre-history'

Stone masonry buildings began to be built in Scotland around 3,500 BCE, first subterranean masonry tombs and then masonry houses for the living above ground. Orkney holds a particularly rich collection of substantial remains from this period, having benefitted from a local sandstone that naturally breaks into even beds.

In multiple locations on Orkney, excavations of Neolithic stone masonry buildings have recorded several different types of clay used for different purposes, including clay floors, clay plasters, below wall foundations and as waterproof coatings, (Richards & Jones, 2016) clear evidence that clay was being sourced and used for specific construction purposes in an unfired state, aside from its use fired for pottery.

While the typical twin-faced masonry walls have core fill, this is not recorded as mortar. Often walls are described as 'drystone' construction or filled with 'midden'. We think this is likely to be a misrepresentation of the construction process and that these walls can often properly be classed as Scotland earliest examples of earth mortared masonry.

We were unable to find any specific research into the Neolithic use of unfired clay earth in construction in Scotland (though we do have European examples) and it is a recommendation that specific research is undertaken on a focused group of Orcadian sites to analyse earthen materials, to identify their geological and geographic sources and to understand how they were sourced, processed and used.



Fig. 12: Part of the emerging Knap of Brodgar complex, with clay floor and mortared masonry walls. © Hugo Anderson-Whymark.

3.4.2 Roman

The period of partial Roman occupation of Scotland (~70 to 210 C.E.) saw use of a range of construction technologies for military complexes which included earth-mortared masonry.

Parts of Hadrian's Wall are earth-mortared masonry and significant remains survive at Cramond and other sites in Scotland. At Cramond, several courses of dressed stone are laid in a strong clay earth, though the source was not identified or the degree of

any alteration from the dug material. There was no evidence of lime mortar pointing (Little). The Roman complex at Bearsden has similar earth-mortared masonry with no record of lime².



Fig. 13: Roman masonry at Crammond.



Fig. 14: Earth mortar, note no lime.

The Roman use of earth mortar, as with its use of daub and turf, does not seem to have been significantly different from indigenous practice, apart from potentially the introduction of using lime as protective finishes. In any event, the use of lime did not continue in Scotland after the Romans left.

While the Roman Empire utilised a range of earth building technologies across its diverse geography, the Scottish examples of earth mortar could be interpreted as the Romans using a native construction technology to construct a different building typology, as much as the importation a technique utilised by an international building organisation. In reality, these Romano-Scottish examples highlight the fact that earth-mortared masonry traditions were common across Europe for much of the historic and pre-historic period.

3.4.3 Iron Age

In the Iron Age most buildings were constructed from wood, wattle, daub, and turf. Surviving masonry structures include souterrains, wheel-houses, hill-forts and brochs, which are famously recorded as drystone construction.

We were unable to find sufficient well-documented sites to allow us to assess the use of earth mortar in these masonry structures and the historical patterns of transition in masonry construction technique through this period. This is a recommended area for further research.

3.4.4 Medieval

A significant number of masonry structures survive from the medieval period. These are primarily higher status buildings, as domestic buildings were largely constructed of wattle and daub and turf.

Though the quality of recording is rarely satisfactory, there are many examples from this period, including:

8 -11th C. Ardwall Isle, Kirkcudbright, remains of early chapel walls are set in yellowish clay.

² Breeze, Building 4, p29, The Excavations

- 9th C. St. Ninians Chapel, Bute – earth mortar, not surviving lime.
- 9th C. Kilmichel Chapel, Bute – earth mortar, not surviving lime.
- 1140 Abernethy Round Tower, earth mortar found in base masonry, lime above.
- 12th C. Whithorn Priory - earth mortar and *evidence of clay as a bonding mortar.*'
- 12th C. Eynhallow Monastery, Orkney - earth mortar and lime mortar.
- 12th C. St Ninian's Chapel, Whithorn – foundations of*undressed bounders set in clay...*later described as "*unmortared*" and an enclosure wall "*roughly dressed stones set in clay.....poor mortar...*'
- 1262-1559 Carmelite Friary of Tillium, Perth - earth mortared masonry base walls remain as archaeology.
- 13th C. Auchenass Castle, Moffat - "*the space between the facings was filled with earth and boulders.*"
- 14th C. Perth City Walls.
- 1450 Threave Castle, Galloway – '*local graywacke with a core of smaller stones, the whole bonded with pale-yellow silt.*'
- 14 -16th C. Dundonald Castle, Ayrshire – Smiddy with "*two earth bonded walls to south and east*" and a free standing building and courtyard structures "*of clay or soil-bonded stonework.*'
- c. 1560 Elcho Castle, Perthshire - barmkin tower walls earth mortar seen internally.
- Polmaddy, New Galloway - clay bonding recorded but assigned as "dry stone" and noted presence of leached out earth mortar.
- Melrose Abbey – clay core reported.

The above list demonstrates the widespread use of earth mortars in high status buildings throughout the medieval era. The lack of lower status examples reflects the fact that most buildings during this time had wattle and daub or turf walls, and that there is poor survival of low status masonry buildings.

There is some evidence supporting a view that some foundations were earth mortared to provided damp-proofing to lime mortared masonry above. This seems to especially occur in the later sites, but there is insufficient evidence to determine whether this was a systematic approach specifically using an expansive clay. This would merit further research.



Fig. 15: Carmelite Friary, Perth, earth mortared wall bases, may have had lime mortared masonry above.

3.4.5 Post Medieval

Masonry buildings became more common as towns and cities grew, though few survive before 1750. During the following 150 years there was extensive change in the Scottish building stock associated with population movement and emigration, industrialisation, agricultural ‘improvements’, land ownership changes, industrial scale manufacture of construction materials, railway transport of materials and the development of the private commercial construction sector.

Several things happened during this time that affected the use of mortars.

Firstly, a lot of new masonry buildings were constructed, often on a developer scale in villages, towns and cities, but also large new farm complexes, and large military, commercial and industrial buildings of new typologies, as well as civil engineering structures such as bridges. These largely replaced the medieval building stock often made of wattle, timber, turf and earth.

The growing commercial approach of estate owners towards tenants had a significant affect in many areas, with landowners replacing older buildings with new ones, and requiring a change in construction materials as part of this process, though this was sometimes not achieved due to cost. It involved the construction of new villages, such as at Tomintoul in Moray, the rebuilding of villages in a new location, as at Lonbain in Rossshire, and the replacement of buildings on a village scale, as at Longforgan in Perthshire. In Lonbain and Longforgan, earth mortar was used in the new buildings.



Fig. 15: The village of Longforgan was ‘built with turf and stone or clay for mortar, and not a vestige of lime’ before 1777 (OSA). Soon after, all were replaced by the landowner with smarter buildings, built of earth mortared masonry pointed in lime. See Figs 5 & 6.

At the same time, landlords stipulated in leases that tenants should use lime and stone in their buildings, though this was not always followed, and restricted traditional rights to harvest natural building resources, such as clay, turf and wood, as these resources became a commercial commodity rather than common resources. Indeed the ‘*enclosure of previously common lands largely deprived communities of ready access to the necessary sub-soils and lime-sand mortars came to dominate throughout the 19th century*’.³

³ N. Copsey, 2020

In cities and for new commercial and military typographies, a different process is perhaps evident. In such situations, professionalisation of design and specification, and the commercial supply of mass-produced standardised materials became dominant as part of building procurement. Previously, craftspeople would have had more autonomy over the selection and sourcing of materials, based on small scale construction and local procurement from a traditional skills and knowledge base that was vested in locally-sourced, natural materials (Copsey, 2020). This correlates with the use of other vernacular materials in Scotland, such as wood.

This transition to Architect & Engineer specified rather than artisan designed, brought a focus for mortars on strength and standardisation, rather than performance, workability, economy, efficiency and local sourcing. As a direct consequence, the use of naturally variable and locally sourced earth mortars declined and the use of lime-sand mortars increased. Rural depopulation and mobility of labour reinforced this process by reducing the local skills and materials knowledge base.

We know this because the processes were fairly well documented by estates and businesses commercially procuring buildings. Traditional use of earth mortars carried on, especially in rural areas, though far less well-documented. The example of clay and bool quoted previously is a good example of this.

The use of earth-lime mortars can be seen as a half-way house, where landowners aspired to the modernity of lime but, especially for boundary walls and low-value buildings, the cost-effectiveness of earth materials spoke to their pockets.

It is worth noting that while Scotland experienced a fairly brutal process of industrialisation, emigration, land privatisation and agricultural reorganisation over a few generations, the same process was far less abrupt in other European countries, and as a result the craft traditions of earth mortars, as with other earth materials, survived to a much greater extent into the 20th century.

It is therefore poignant that the most earth-mortared masonry buildings that survive in Scotland date from this period. There was so much masonry building going on that, even if earth mortar was used in a minority of structures, it still amounts to a very significant number of buildings.



Fig 16: 19th C. building, Brechin



Fig. 17: Earth mortar core, lime pointing

It is very difficult to estimate how many earth mortared buildings there are in Scotland. If we had to guess, we might say that, before 1800, 75% of masonry buildings had earth mortar, and after 1850 it was 25% and by 1900 it was almost none.

9% of inhabited dwellings in Scotland are pre-1919 detached, semi-detached or terraced homes, amounting to some 230,000 buildings⁴. Perhaps half of these are earth-mortared. We could not find useful statistics for buildings that are not dwellings, or for boundary walls, bridges or other masonry structures. Scotland has 8,164 monuments and 47,288 listed buildings.

A guestimate might therefore suggest that Scotland has something around 200,000 earth mortared structures, and among them are some of our most outstanding and our most commonplace heritage.

3.5 What is the Significance of Scottish Earth Mortars?

We have identified 4 key points of significance in Scotland's earth mortar heritage:

1. Material Culture

Scotland's surviving earth mortared masonry structures, which may number around 200,000, represent a key element of Scotland's masonry tradition, physically documenting the character of its development over 5,500 years from the earliest Neolithic masonry structures until the end of vernacular techniques in the late 19th century. This is a chain of continuity into the deep past of Scotland's built heritage.

Earth mortar is one of the family of three principal traditional stone masonry techniques, alongside drystone and lime mortared, each holding distinctive characteristics. Drystone is a classic technique requiring a specific skill set, which is defined by limited structural and typological applications. Lime mortars are an advanced technique representing the transition to industrially produced and professionally procured structures. In this context, earth mortars represent a vernacular tradition vested in local, natural materials which was the dominant masonry tradition across the whole country, in all typologies, up until the modern era. These characterisations are of course simplistic, and as a family they are all similar and related in skills type and level. Most earth or weak earth/lime relies on good stone to stone contact, like drystone. Probably lots of drystone buildings had gaps filled with moss to stop draughts, of which there is some record and example.

The Family of Traditional Scottish Masonry Mortar Techniques					
drystone	drystone caulked with moss	earth mortared	earth-lime mortared	weak lime mortared	lime mortared

2. Vernacular Character

The earth mortar tradition is defined by its vernacular character. Local knowledge of an area's natural resources and how to use them to create durable and comfortable buildings developed over many generations, with knowledge passed down within communities. The characteristics of local earth materials was reflected in how they were processed and used in masonry work, and this was also influenced by the character of local stone. The design of structures regionally reflected how these local materials responded to the local climate.

⁴ 2018 Scottish House Condition Survey

The diversity of Scotland's natural resources and climate is reflected in the richness of its vernacular built heritage. In this context, earth mortars were used everywhere but are highly varied, and this forms an important strand in the narrative of how vernacular built heritage is a repository of the historic cultural connection between people and place in Scotland.

3. The Intangible Heritage of Skills

There is a distinct traditional skill set associated with the material culture of earth mortars, which includes:

- an understanding of the material science of clay earth
- an understanding of natural soil character and distribution patterns
- sourcing soils
- testing soils
- blending and additives
- mixing, storage and application
- compatibility with other materials
- finishes
- durability & maintenance.

This traditional skills base barely survives, with very few masons trained to any extent in earth mortars, and a handful with a high level of skill.

4. The Material Science of a Low-Carbon, Low-Waste Technology

The tradition of earth mortars carries with it the time-proven, practical material science of a low environmental impact construction technology, which holds relevance to the contemporary transition to Scotland's 2045 net zero carbon targets.

Earth materials are inherently low energy and low carbon, as they do not require heat or chemical change through energy inputs, but instead are manipulated through variation in moisture content. This makes them highly relevant alternatives to cement and lime mortars in a range of applications.

Earth mortars also have highly favourable circular economy characteristics. Inherent to manipulation of moisture content, earthen materials can be infinitely recycled without loss of performance or significant energy inputs.

Traditional earth mortars were also low waste in sourcing, using natural subsoils with minimal processing. This is in contrast to most modern mortars which rely on processed aggregates, including washed sands, which now are a globally threatened natural resource. By using a wide range of natural subsoils, in an unwashed condition, earth mortars are a model for sustainable extraction and use of natural mineral resources.

Earth mortars are therefore a highly significant part of Scotland's tangible and intangible cultural heritage, one which carries relevance from our traditions to the delivery of a sustainable future. It is, however, a heritage that is poorly understood and supported. This endangers its survival and limits its ability to contribute to a sustainable transition to net zero Scotland.

4 ASSESSMENT OF CURRENT PRACTICE

This section assesses the capability and capacity of the conservation sector to sustain and support Scotland's earth mortar heritage.

4.1 Identification

There is consistent evidence of poor levels of identification of earth mortars at historic sites. Common poor practice includes:

- Earth mortars are not recorded, with masonry mis-identified as 'drystone' or 'un-mortared.'
- Earth mortars are mis-identified as soil that has 'migrated' into walls from the surrounding landscape, or lime mortar that has leached its lime binder.
- Earth/lime mortar is hard to differentiate from weak lime/unwashed sand mortars. A sieved sandy subsoil is similar to unwashed sand and lime is not always obvious to the eye.
- Earth mortars for bedding are not sampled if lime mortar pointing is present – that becomes the focus of repair specification.

These issues were commonly found in our documentary research and also noted by several of our respondees.

In a reappraisal of 107 British earth mortared sites, of which 36 were Scottish, Markey (2018) noted that earth mortar is generally overlooked, mistaken, misclassified and neglected with '*pervasivehesitancy on behalf of recorders to define earth as mortar used in stone construction*'.

The poor general level of identification is put into perspective by the few individual survey professionals who consistently identify earth mortars and this is reflected in the clustering of some of the mapped sites in Fig. 2. This indicates that the poor general level of identification is a consequence of a poor level of training in identification, as well as cultural bias.

There were several contractor repsondees who reported that most of the traditional buildings in their area were earth-mortared, but these lacked individual records or identification. This included regions Caithness and The Borders. Earth mortars are generally not recorded in regional or local traditional material and character appraisals.

4.2 Recording

Echoing the poor level of identification, a very poor level of recording of earth mortars was found, both in formal and informal records.

Poor recording goes right back to historic records of original construction. As construction records became more prevalent during the 18th and 19th centuries, they focused on commercial construction for estates and urban areas where the use of earth mortars was in decline and purchased lime increasingly prevalent.

Even where the construction of earth mortared buildings was recorded, Copsey (2019) noted that the earth mortar was often not identified in construction records as a material, as it was often won from excavations of foundations, and therefore it was

represented in labourer cost, not in materials purchased. Thus, as Scotland moved to procurement of commercially produced material products, vernacular earth materials were literally written out of the records.

This was reinforced by the culture of the 'Improvement' period, from which a wealth of geographical area descriptions and estate audits have survived. These area descriptions were generally written by people whose cultural experience and economic interests were vested in the transition away from vernacular culture. Thus, derogatory terms were often used to describe natural materials associated with low status buildings and communities, often as justifying context for their removal and replacement.

An audit of terms used to describe earth buildings from the 18th and 19th centuries in the Carse of Gowrie (Arc, 2016) found that the terms used in general descriptions of vernacular earth buildings were negative, including;

Humble, lowly, mean, naughtie, paulty, ugly, inferior, poor as can be, wretched, rudely constructed, damp, peculiar

This contrasted with the rare descriptions recorded by people who lived in such buildings:

Warm, Durable

A cultural association was thus generated between earth materials and inferiority, and this cultural bias became embedded in the construction sector.

Thus, the people who subsequently inspected and recorded historic sites during the 20th century, often Architects and Surveyors, were themselves not experienced in specifying and procuring earth materials, and thereby unskilled in understanding and identifying them. They, along with Archaeologists, were inheritors of a culture that had a hierarchical view of heritage, where some materials were 'noble' and others 'primitive', and a narrative of built heritage as one of cultural progress towards enlightenment. This cultural norm directly affected how historic sites were recorded in the past and still does today.

Markey (2018) assesses Scottish examples: *'Scottish research analysis revealed similar derogatory terms were utilised in describing the use of stone and earth mortared masonry construction dating from pre-history to the post medieval period. "Unmortared, poor mortar" as well as "no mortar traces" described buildings dating to the period. "Weak mortar, very poor construction" and "poor quality construction" were perceived in structures dating between the twelfth and late sixteenth century. "No mortar" was prescribed to buildings in many cases spanning the entire period despite the recorded presence of earth mortar. The identification and recording of earth mortar was referred to as "a primitive method of construction" and "a primitive form of house construction" in stone buildings dating from the thirteenth to sixteenth centuries. It was equally referred to as "a peasant mode of building suitable only to semi-skilled labour" in Scotland.*

The legacy has been that statutory records of historic sites are often misleading in respect of the presence of earth mortars and this was highlighted by several respondees. It is a recommendation that a process for review and updating historic building records to correct poor historic recording be initiated.

These comments primarily relate to ruined sites, where the walls are climatically exposed and have therefore been the subject of decay, which has removed and degraded the earth mortar as a result of exposure to moisture.

It is very important to recognise that most Scottish earth-mortared structures do not fall into this category as they are standing structures in good condition where earth mortar is concealed behind lime pointing, harl or other finishes. Here, identification and recording are very scant, and there is a presumption of lime mortar. Earth mortar is only identified where there is an alteration or failure in the masonry that reveals the underlying core earth material.

This assumption that earth mortars are not present can lead to inappropriate decisions about repairs and maintenance. Earth mortars can cause alarm when found, leading to panic and removal of earth. This has been reported many times in online lime and mortar forums, based on unfamiliarity and a common presumption that earth is second rate and has to be replaced.

There is a small number of Archaeologists, Architects, Engineers and Surveyors who have a good understanding of earth mortars, as well as a body of international experience, which can inform training and guidance to improve skills on identification and recording.

4.3 Understanding Decay Mechanisms

The poor level of identification and recording feeds into what is generally a poor understanding of the processes of decay that affect earth-mortared structures.



Fig. 18: Earth mortar, severe external decay.



Fig. 19: Earth mortar concealed behind lime finishes.



Fig. 20: Earth mortar concealed behind internal linings.

While these decay mechanisms are essentially similar to those that affect lime mortars, the relationship to water is fundamentally different and the diversity of clay type, percentage and particle size distribution are key factors that vary hugely across traditional buildings, leading to a wide range of performance.



Fig. 21: Earth-mortared wall with lime pointing, the face having fallen away due to water ingress at the wallhead and lack of restraining through stones tying the outer to the inner face.

In addition, the relatively low tensile strength of earth mortars compared to lime mortars, can lead to a mis-reading of how a masonry element will perform when exposed to decay mechanisms. Earth mortared structures rely on good masonry technique. The absence of through stones connecting faces is a key vulnerability not always apparent.

There is a small number of contractors and professionals who have a good understanding of how earth mortars decay, as well as a body of international experience, which can inform training and guidance to improve knowledge.

4.4 Materials Analysis

There is a very small body of materials analysis data available on earth mortars. This is primarily a consequence of the low level of identification and recording, but even where it is identified, there is a lack of understanding of appropriate materials analysis methods, capacity to deliver and experience to interpret the results.

There is perhaps also a residual cultural bias that earth materials do not merit analysis as they are somehow not 'proper' materials and thus do not merit a proper conservation methodology as is standard for other materials, such as lime mortar.

In 2015, Historic Environment Scotland (HES) funded a collaborative project with SLCT, managed by the HES Conservation Science team, to develop their understanding of Scottish mortars using this extensive and previously undisclosed resource. This work included the digitalisation of the archive, previously held as individual analysis reports, in a purpose-built database ('SLCT Mortars Database') and subsequent interrogation of the data, to provide an evidence-based and quantitative understanding of historic mortars in Scotland. The information held within the SLCT Mortars Database relates to a range of different materials including lime, cement, earth and clay, although given the focus of the Centre's work, there is an understandable bias towards lime mortars.⁵

This summary of mortar analysis undertaken on pre-1850 mortars listed 20 earth and earth-lime mortars out of a total of 3,407 samples. This reflects the data bias noted in the Introduction above, in a report that was intended to guide conservation repair practice. This is a typical example of data bias relating to earth mortars across the heritage sector. If the data is not there, how can it be included?

Good practice suggests that a range of simple field tests can be used to determine the essential performance characteristics of earth mortars, with laboratory analysis useful for particle size grading and plasticity. More expensive lab tests are rarely necessary if there is an experienced practitioner involved.

There is a sound basis of knowledge and experience among a very small number of practitioners and laboratories. It is a recommendation that this materials knowledge capacity be increased.

4.5 Conservation Technique

Conservation of earth mortar requires a distinct range of techniques founded in the characteristics of the material's performance in relationship to moisture and reflecting the wide diversity of traditional earth mortar materials. Conservation of earth/lime is vested in the hot lime skills and knowledge base.

⁵ HES Technical Paper 32, A data driven approach to understanding historic mortars in Scotland, 2020, Introduction

Repair techniques for standing structures are relatively straightforward masonry practice, as long as there is a sound understanding of the materials and how they affect the behaviour of the masonry. In this, it is important to recognise that the mortar and stone have to be considered together as two halves of the masonry whole.

Conservation techniques for ruined masonry elements are more complex, as the exposure to moisture is more significant and this can have an effect on the stability of the structure and durability of the repairs, which requires some experience to interpret on an individual site.

The specification of repair mortars is also a specialist skill, especially for ruins, reflecting the variety of original materials, variety of monument conditions, and availability of earth for repair materials. There is a small specialist skills base that has developed a high level of capability through projects, including with Historic England, who have a research report on the conservation of the Horneystead Bastle in Northumbria, which is relevant to practice on Scottish ruins.

This is an adequate knowledge basis for developing technical guidance relevant to practice in Scotland, especially if better links made to earth/lime experience and network.

There is also some scope to develop applications of earth mortars to enhance the conservation of non-earth heritage, especially where timber, fabrics, paper and other materials are vulnerable to high humidity environments.

4.6 Repair Materials

Traditional practice suggests that a wide range of natural Scottish subsoils can be used to make earth mortars of varied performance.

Where like-for-like repairs are specified, field work is required to identify suitable source earth material, given that the traditional local knowledge base no longer survives in Scotland. This has been successfully achieved on many projects, but can be time-consuming. A range of aids include local cross-sector contacts, soil pans, historic maps and other records.

Often traditional mortars are sub-optimal and in repairing masonry, specifiers can seek to enhance performance, typically by varying grading and clay mineralogy while maintaining compatibility. Where mortars form the concealed core behind lime finishes in a complete building, as at Moirlanich Longhouse, this is a fairly straightforward process as visual matching is not required.

Where the mortar is visible on an exposed masonry ruin, the process is more complex. At Horneystead Bastle, a Scheduled Monument in Northumberland, seven factors were considered in specifying a repairs mortar: stability, authenticity, durability, appearance, reversibility, cost and practicality, and three different mortars were specified to stabilise the monument, based on a very local clay-rich soil and non-local sand.

Such bespoke specification for conservation projects is possible with expert knowledge, but is time-consuming and unnecessary for most projects, where a more standardised approach is usually possible. While restrictions over access to land and the loss of local knowledge mean it can be challenging to access suitable local soils, there is a range of commercially available clay-rich earths that are marketed for other uses, but which can be sourced for earth mortar repair materials.

In any event, due to its current rarity, the process of specification and sourcing earth mortar materials is rarely simple and straightforward and it is best considered with

suitable expert advice, well in advance of works on site. With a growing demand for earth building materials generally, there is potential to improve the supply for heritage mortars, with sector support.

4.7 Contractor Skills

There is a low level of skills, knowledge and competence among masons in the use of traditional earth mortars, as it is not included in standard vocational training courses and there are few contractor companies who have the ability or opportunity for on-site skills transfer.

There are some contractors with specialist skills, obtained either from traditional firms with long experience of working in a particular geographic area where earth mortars are frequently encountered, or from smaller and younger companies who specialise in earth materials. This shares the skills base between companies who have a greater knowledge of masonry and those who have a greater knowledge of earthen materials.

In both cases the capacity is small, with training unstructured and technical support almost non-existent. The sector body, Earth Building UK & Ireland (EBUKI), is a forum for specialists but provides limited practical support to individual contractors in the field.

In recent years, Historic England has funded short regional skills training courses based on funded local conservation projects, and this has proved a successful model for developing local skills capacity among contractors and consultants. We would recommend this model as one to be used in Scotland to increase skills capacity on a regional basis, reflecting regional heritage and materials.

There is some scope for skills transfer between the heritage mortar sector and new eco-build sector, based on the related materials having applications in low carbon construction for new buildings and retro-fit. However, there is currently no funded mechanism for delivering this systematically in Scotland. There is an SVQ qualification available under the Heritage Skills Suite, with qualified Assessors and ECVET Learning Units, but no SQA Awarding Body in a position to offer vocational qualifications. Progress to date has been the result of collaboration between EBUKI and HES over several years and this is ongoing, but slow.



Fig. 22: Earth mortar in contemporary eco-house, Perthshire.

4.8 Consultant Skills

There is a low level of skills, knowledge and competence among professional Conservation Architects, Engineers, Surveyors and Archaeologists, with a small number of individuals.

A good example is the Archaeologist on the Discover Bute Landscape Heritage Project, who led the repair of 2 ruined early Christian chapels, which had previously been wrongly recorded as unmortared, but were very clearly earth-mortared. This led to the appropriate repair of the sites using local earth mortar.

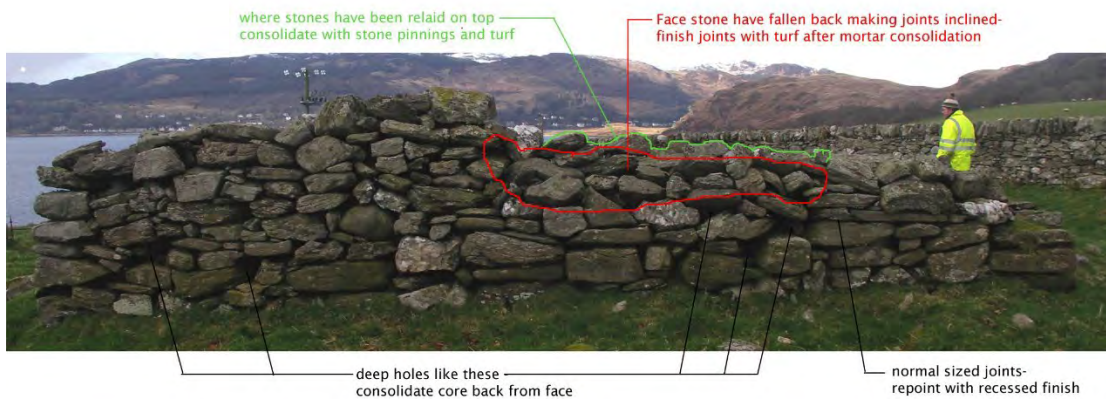


Fig. 21: 9th C. Kilmichel Chapel, Bute, prior to repairs.

The only regular professional skills training available in Scotland is the Conservation MSC delivered by HES, which includes an earth mortar unit. Otherwise, there is no specific training in earth mortars included in professional training in Scotland, which relates to the historic pattern of low recognition and cultural value ascribed to vernacular materials in general and earth mortars in particular.

This is seen as a greater challenge than developing contractor skills, as it requires change in culture and practice as well as dissemination of technical knowledge. However, there are potentially easier routes to deliver this training among professionals, which have formal accreditation processes and mandatory CPD requirements to maintain current knowledge and skills.



Fig. 22: Blended earth mortar training event for architects and contractors, Northumberland.

It is felt that this audience benefits from the mixture of desk-based and practical learning delivered through the regional case study approach piloted by Historic England at Horneystead, supplemented by better and more tailored technical guidance and specialist support networks.

4.9 Statutory Controls

There is a low level of awareness among Planning, Conservation and Building Control Officers, due to the general low level of recognition, apart from isolated individuals with experience in particular local areas where earth mortar is frequently encountered. This can lead to inappropriate technical guidance and a lack of appropriate control through Listed Building Consents and other statutory processes.

The level of skills and knowledge exercised by HES and other national bodies over listed buildings, scheduled monuments and archaeological sites is quite variable, with some excellent quality of understanding and technical approaches in individual officials, but very poor quality exhibited by others. This includes the management of Property in Care.

The HES Soft Cappings In Scotland Research Report (2015) included the 12th century scheduled monument of Eynhallow Monastery as a case study, highlighting how the structure was clearly earth mortared but was being repaired and maintained using drystone techniques, resulting in a fundamental change in the appearance of the monument and a reduction of its structural stability and material integrity.



Fig. 23: Eynhallow Monastery, Orkney, movement of masonry followed erosion of earth mortar.

4.10 Cultural Attitudes

A common theme identified in this assessment of conservation practice is a low capacity of high ability flourishing amid a general low level of knowledge and skill. This is in part the result of a historic pattern of dominance of lime and cement mortars following the replacement of vernacular practices with ‘modern’ procurement processes, but it is also sustained by a residual cultural bias which mitigates against earth materials in general as perceived as having low cultural value.

This attitude is reflected in wider cultural perceptions of Scotland traditions, and therefore among building owners and other stakeholders in the built heritage community. It would therefore be beneficial to address these underlying cultural attitudes in any strategy to create a more receptive environment for sustaining and valuing Scotland’s traditional earth mortar heritage.

It was frequently reported by the stakeholder network that contractors, consultants and building owners who discover their walls have earth mortar often 'panic' and rush to remove it and replace with a cement or lime material. In that context, the fact that earth mortars are often hidden behind other materials is probably why so many have survived. In improving recognition, it will be important to dispel these common cultural attitudes and encourage the public and sector to understand and value its vernacular materials heritage.

5 RECOMMENDATIONS

A key purpose of this desk-based research stage has been to guide further action in support of earth mortar heritage.

5.1 Prioritisation & Integration

As outlined in this report, there are range of aspects of earth mortar heritage which suffer similar challenges and, if addressed, would better preserve and share this aspect of Scotland's cultural heritage. But in a time of limited resource, what should be prioritised?

Experience to date suggests that all of these challenges are inter-related and the most cost-effective interventions tackle multiple aspects in order to improve situations and increase capacities. While programmes and organisations tend to focus on a single aspect, it is better to try and use funding-limited initiatives in an integrated way to tackle multiple aspects.

The professional and contractor skills training delivered for Historic England in Northumberland is a good example where other outcomes included the conservation of a Monument, enhanced owner guardianship, improved historic materials records, improved local heritage regulatory skills, and enhanced local earth materials availability.

Similarly, the Tay Landscape Partnership delivered improved site identification and recording, repairs of historic sites, improved understanding of local materials, local community engagement, contractor and professional skills training, and enhanced building owner guardianship.

However, it is also important to integrate earth mortars into well-established processes supporting lime and other materials, so that earth mortars are 'normalised' into an integrated approach to heritage mortars.

It is also important to identify opportunities for partnerships outside Scotland and cross-sector outside of the heritage sector. The context of decarbonisation of construction is especially important, where there is an opportunity for earth mortars to play a significant role within and beyond heritage.

5.2 General Recommendations

The following are 30 general recommendations to improve earth mortar heritage by increasing understanding, demand, capacity and quality.

Identification

1. Work with the archaeological sector to develop better knowledge, skills and guidance.
2. Work with the Conservation Architect and Engineer sector to develop better knowledge, skills and guidance.
3. Work with Local Authority Conservation and Building Standards officers to develop better knowledge, skills and guidance.
4. Work with building owners to develop better knowledge and guidance.

Recording

5. Work with the Archaeologists, Surveyors and Inspectors to improve recording practice.
6. Review Canmore, listing and other records to improve existing database.
7. Develop the GIS map record of sites as an online resource for public input, providing a template record.
8. Encourage local/regional surveys in potentially earth-mortar dense locations.

Analysis

9. Develop consultant and contractor skills for simple on-site earth mortar analysis.
10. Develop technical capacity and interpretive skills for lab analysis in Scotland.
11. Embed earth mortar analysis as a standard conservation practice, through requiring in regulated and funded projects.
12. Provide guidance on analysis good practice.
13. Create a database of earth mortar analyses for comparative research.

Conservation Technique

14. Publish more detailed technical guidance.
15. Publish case study exemplars.
16. Collaborate internationally and cross-sector to develop conservation techniques, fostering an active network to support delivery of sector development.

Materials

17. Provide good practice guidance on sourcing and making materials.
18. Create database of available clay sources and characteristics, working with sector stakeholders, including the James Hutton Institute.
19. Identify opportunities to increase potential earth materials sources.

Skills

20. Deliver consultant and contractor skills training through a series of short, regional, project-based training courses.
21. Promote skills training & knowledge resources through professional networks & established training programmes.
22. Make earth mortars a mandatory part of heritage masonry skills training.
23. Deliver Scottish Vocational Qualification in earth heritage skills.

Statutory Controls

24. Improve control of appropriate mortar specification through Listed Building Consent and grant-funded programmes.
25. Improve Building Standards knowledge of earth mortars in relevant local areas.

Zero Carbon Transition

26. Develop embodied carbon protocol for mortar specification.
27. Develop capacity to specify and use unwashed sands.
28. Develop protocols for the recycling of earth mortars and lime mortars.
29. Disseminate best practice case studies for low carbon, circular economy approaches to mortar repairs.
30. Identify opportunities to collaborate with the eco-build sector.

5.3 Specific Recommendations for Further Research

The following are 13 recommendations for the next stage of this research project:

1. Investigate Neolithic Orkney – a targeted site investigation and stakeholder consultation on targeted sites, including materials analysis and mapping.
2. Investigate Iron Age Structures – a targeted site investigation and stakeholder consultation on targeted sites, including materials analysis and mapping.
3. Investigate Central Highland and Northern Sites – a targeted stakeholder consultation to try and identify more specific sites and include in map database.
4. Investigate City Sites – a targeted site investigation and stakeholder consultation to try and assess extent of earth mortars in 18th and 19th C. urban locations.
5. Develop GIS Map Resource – develop the online map site as a hosted publicly accessible resource, open to contributions.
6. Undertake a targeted suite of earth mortar tests and analysis to develop a better technical understanding and characterisation to inform technical guidance.
7. Develop practical technical conservation guidance.
8. Hold a sector event specifically for Archaeologists and Inspectors.
9. Develop a programme of regional training events over several years, based on small local conservation projects.
10. Identify opportunities for earth mortar case study projects.
11. Develop an exemplar low carbon project using earth mortars.
12. Undertake further sector research into the availability, character and use of unwashed sands.
13. Develop the earth mortar network, including international and cross sector.

APPENDIX 1: SCHEDULE OF SITES

The following table presents the basic location and age information gathered on sites as of 26.05.2022, and excludes data on:

- Grid references
- Northings & eastings
- Ownership
- Materials
- Defects
- Form
- Condition
- Contact Log
- Record Notes
- Mortar characterisation

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H.R.WINSHIP)																		
SITE NAME	ADDRESS	ERA										BUILDING TYPE						NOTES		
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL	DEFENSIVE	DOMESTIC		RECREATION	SECULAR
		7	2	4	55	19	109	138	1	3		31	60	2	17	15	254	1	16	TOTAL 396 SITES
BANFF TOWN HOUSE	Town House, 34 Low Street, Banff, Aberdeenshire						1				1796		1					1		Recording when floor boards removed in 1796 Town House. An earlier wall was revealed below existing building. Wall clay-bonded 750-780mm wide. Possibly part of town house of Lord Banff destroyed 1642. Source: Murray, 2004.
CLAY COTTAGE IN LAWRENCEKIRK	Lawrencekirk, Kincardineshire.																	1		SVBWG Newsletter 1-3 1975-77, (Stell, G. (ed)) p6.
CLAY COTTAGE LUTHERMUIR	Luthermuir, Kincardineshire.																	1		SVBWG Newsletter 1-3 1975-77, (Stell, G. (ed)) p6.
CLAY COTTAGE RUIN	Culforbie, Aberdeenshire.																	1		SVBWG Newsletter 1-3 1975-77, (Stell, G. (ed)) p6.
CRATHES CASTLE (Excavation in lawn)	Crathes Castle, North Deeside Road, Crathes, Aberdeenshire, AB31 5QE					1	1						1					1		Thick hard yellow clay bonding in stone wall of garden/ entrance pavillion/lodge. 17-18thC. Source: MAS 2014-08.
DRUM CASTLE	Drum Castle, Aberdeenshire.			1									1					1		East wall of excavated building abutting tower and brewhouse was clay-bonded. Possible brewing room of brewhouse which was built 15thC. Demolished by 1850s. Source: MAS 2014-7.
HADDO HOUSE	Haddo House, Scots Mile, Aberdeenshire, AB41 7EQ			1		1							1					1		Trench 2. Possible wall of Kelly Castle. Foundations Clay bonded, higher was lime mortar. 16thC? Source: MAS 2011-19,20.
KINEFF, KINCARDINESHIRE	Knieff, Kincardine, Aberdeenshire.																			Walker, 1996, TAN6 p59.
LEITH HALL (Excavation)	Leith Hall, Aberdeenshire. (Excavation in Lawn)						1						1					1		Garden pavillion/lodge. Interior cross wall clay bonded. ?Mid 18thC. Source: MAS 2007-27.
MASTRICK FARM	Mastrick Farm, Old Rayne, Aberdeenshire.							1			pe 1867		1					1		L plan steading. One gable broken out and clay bonding in core of wall clear, had been externally lime. First half of 19thC. Source: MAS 2015-30, 9 & illus 13.
MERCAT CROSS CAFÉ	Mercat Cross Café, Low Street, Banff, Aberdeenshire (adjoins Town House above).					1	1						1							West Wall, earlier foundations core bonded with thick grey clay, mortar only at inner face. 17-18thC? Source: Murray 2005 (grey lit),7-8
OLD RAYNE (Excavation)	Old Rayne, Aberdeenshire.			1									1					1		Medieval Bishop's Palace/manor. Building 16 clay-bonded stone. Building 10 (?Kitchen) clay bonded stone. L13th/E14thC. Source: Excavation Murray & Murray 2012. SAIR, 52. www.sair.org.uk
RATTRAY (deserted medieval settlement at)	Rattray, Aberdeenshire.			1									1							*Archaeological evidence revealed 14thC. clay and clay and rubble walled buildings (Murray & Murray, 1993) Source: The Past Ubiquity and Environment of the Lost Earth Buildings of Scotland. Parkin, S. & Adderley, W.P. In Hum Ecol (2017) 45:569-583.
TEMPLAR'S HOUSE (DESTROYED)	Templar's House, Turriff, Aberdeenshire												1							DESTROYED. Site of alleged Templar's House, said to have stood until c1840, and described as being nearly ruinous in 1842. The vaults of this building were supposedly finally removed during the second half of the 19th century. It was named as Castle Rainy, having belonged at one time to a family named Rainie. The Town Hall was later built on the site. An excavation was carried out prior to the addition of an extension at 10 Castle Street. Two trenches were dug and cleaned by hand. Trench 1 revealed two walls, at right angles to each other, of stone construction with yellow lime/clay mortar. It was thought that these walls dated to the 1920s-1930s, when the building was used as a cinema. The fill of the trench was fine black topsoil and broken crockery, none of which dated earlier than the late 19th or early 20th century. Trench 2 revealed a wall running at right angles to the upstanding boundary wall. It was constructed of the same materials as the boundary wall, red sandstone and dry lime and clay mortar, and abutts the standing wall but does not tie into the structure. Source: https://online.aberdeenshire.gov.uk/smpub/master/detail.aspx?refno=NJ74NW0010
WEST OUTBUILDING AT CORSE CROFT	West Outbuilding at Corse Croft, Kinnoir, Huntly, Aberdeen			1							pre1782							1		The west outbuilding is laid out in two sections. The southern part, which has a door and a window to the main (east) elevation, was formerly a cottage. The northern part, which has a higher ridge height, was the byre. It is built of random rubble field stones with clay mortar and larger stones at the base. Source: Listed Building description. The farmhouse is a single-storey rubble cottage with clay mortar. It has a turf gable to the south, which was formerly ivy clad and has a stone base course to the cill level of the window. Deep turf blocks have been taken from naturally consolidated loam and laid grass side down, some grey, some orange. There is a four-pane glazing pattern in the roof, which is shallow pitch with thatch insulation on timber slabs and A-frame trusses with corrugated iron over. The south gablehead has a brick stack. The interior has clay-plaster-rendered walls and a boarded, coombed ceiling with cover straps. A chimneypiece at the south gable has brick supports to a corbelled stone lum with an iron lintel and segmental arched opening. Dry stone rubble boundary walls adjoin. Source: https://online.aberdeenshire.gov.uk/smpub/master/detail.aspx?refno=NJ54SE0089

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H.R.WINSHIP)																			
SITE NAME	ADDRESS	ERA									BUILDING TYPE					NOTES					
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR	
HUNTLY CASTLE	Huntly Castle, Marquis Drive, Huntly, Aberdeenshire, AB54 4SF												1								A rectangular area measuring 6 x 1m was investigated by Kirkdale Archaeology to the N of the castle sales point. A wall was built against the SW tower and although it may be possible that the upper part of the wall was a rebuild on an earlier line, the upper part at least post-dated the main 16thC. works. An earlier clay-bonded wall was also recorded, although whether this dates to the motte period is not clear. G. Ewart, A. Radley 1997. Source: http://archaeol.wmms6.a2hosted.com/wp-content/uploads/2017/02/1997.pdf
CASTLE FRASER (Coutyard Drain Excavation)	Castle Fraser, Cluny, Aberdeenshire.												1								"Observation of two test pits dug to remedy a blocked drain in the courtyard at Castle Fraser revealed one face of a clay bonded stone wall, possibly the foundations of a structure shown on the first OS map of 1864." Murray, H. K. (2010) Castle Fraser Courtyard drain, Aberdeenshire. Aberdeenshire: Murray Archaeological Services Ltd (MAS) Source: https://doi.org/10.5284/1018240
UPPER HAUGH (RECORDED DEMOLISHED 2003)	Upper Haugh, Alford, Aberdeenshire.																	1			"The claywall structure at Upper Haugh (demolished 2003). Source: The Past Ubiquity and Environment of the Lost Earth Buildings of Scotland. Parkin, S. & Adderley, W.P. In Hum Ecol (2017) 45:569-583.
2-4 CHURCH STREET BRECHIN	2-4 Church St, Brechin, Angus.				1								1						1		Sandstone wall with clay bonding. Possibly part of 15thC. toolbooth or pre-1798 rebuild of townhouse. Source: MAS 2009-5.
A 17th C House in Brechin (45 HIGH STREET?)	45 High Street, Brechin, Angus.				1														1		18th century, Rubble with ashlar margins. Broad 3-storey and attic twin-gabled frontage, 4 windows wide. Shops and close. In HES Inform Guide Clay Mortars for Masonry Buildings, p8 Fig 8.
BARRY MILL (UNCONFIRMED)	Barry Mill, Mill Road Barry Village, Carmoustie Angus, DD7 7RJ								1				rebuilt 1814	1							"I visited the last year and there are masonry walls of earlier structures (I think) within the mill that are constructed of earth mortar." Bryan Dickson pers.comm. Email 07.02.2022.
BLAIR HOUSE	Blair House, Glen Doll, Clova, Kirriemuir, Angus, DD8 4RD									1									1		A new ecological house in Cairngorms National Park (2021) with earth mortared unfired earth brick and clay plastered walls. Designed by Arc Architects.
CRAIGTON, MONIKE	Craigton, Monike, Angus																				Source: Walker, B. 1996, TAN6 p59.
FLEMINGTON TOWER	Aberlemno, Angus				1																Reported by Geoffrey Stell who did survey in 1970s. Scheduled Monument description does not mention clay.
LOGIE SCHOOLHOUSE	Logie Schoolhouse, Craigo Angus							1											1		Clay mortared foundations to mudwall building. Arc renovated in 2009.
MEARNS ACADEMY (Excavation)	Mearns Academy, Laurencekirk, Angus				1								1	1							Medieval farmstead. Probable solid clay walls. 13-14thC. Excavation MAS 2012.9.
77-79 HIGH STREET ARBROATH (ex YMCA site)	77-79 High Street, Arbroath, Angus.												1								A midden deposit dating to the late 12th and 13th centuries, which underlay cobbled surfaces of a formerly wider High Street. These street surfaces abutted a clay-bonded stone wall, set some 2m back from the present street frontage. Source: http://archaeol.wmms6.a2hosted.com/wp-content/uploads/2017/02/1997.pdf p14.
ACHINDRAIN.K, THE WOOL & BULL HOUSE	Auchendrain Township, Auchindrain, Inveraray, Argyll, PA32, 8WD								1											1	"We have documented clay from 100m away on our land being used in the bottom four courses of the south gable of the random rubble dry-stone building known as ACHINDRAIN.K, the Wool & Bull House". Bob Clarke pers.comm. Email 08.03.2022
BALISCATE CHAPEL	655m WSW of Kilninian, Kilninian, Argyll & Bute			1																1	The stone chapel has rubble-built walls with a clay core. Other features in the vicinity are also undated and include a cairn 25m east of the chapel and part of a building with rubble and clay walls 50m east of the chapel. Source: Listed Building Description.
CARNASSARIE CASTLE	Carnassarie Castle, Kilmartin, Argyll.				1															1	Walker, B., 1996 (TAN6).
CASTLE SHUNA	Castle Shuna, Lismore and Appin, Argyll And Bute				1														1	1	About 10m SE of the castle are the turf-covered footings of a building measuring 20m NE-SW by 7.3m NW-SE over walls 1.2m in thickness, and lying approximately parallel to the axis of the castle. The masonry is set in clay mortar. Source: Listed Building description.
CILL CHOMHAN	Chapel and burial ground 480m NE of Stremnishmore, Islay, Kildalton, Argyll & Bute				1															1	The turf and heather-covered walls of the chapel and enclosure survive in good condition. Areas of the masonry wall-faces remain visible, particularly on the enclosure wall, but there are no traces of mortar suggesting drystone or clay-bonded construction. Source: Listed Building description.
EILEACH AN NAOIMH	Jura, Argyll & Bute				1															1	Chapel. HES Statement of Significance 2006: A small chapel, dated to approximately 12th or 13th century, approximately 6.6m by 3.6m, stands within the central enclosure. Its clay-bonded walls, composed of thin slabs of sandy flagstone, stand to a maximum height of 2.6m and vary from 0.85m to 1.0m in thickness. Source: https://pub-prod-sdk.azurewebsites.net/api/file/b18dabb8-f774-4e2e-abfe-aaff00faaf4d
KILBRIDE CHURCH	Nr Kilbride Farm, South of Oban, Argyll & Bute																				Recently consolidated with Lime. I have visited this on several occasions and I am fairly certain it has an earth core (though has been surface pointed with alternate material over the years). There is an image that shows the core material within the report. See below. I'm also trying to find images that show the core from my own visits (there is another phase of work later in the spring on the structure that we may be able to get some core material for analysis). G. Briggs pers.comm. Email 02.2022.

SCOTTISH EARTH MORTAR SITES SCHEDULE														(Compiled and updated 26.05.2022_H.R.WINSHIP)													
SITE NAME	ADDRESS	ERA										BUILDING TYPE										NOTES					
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL	DEFENSIVE	DOMESTIC	RECREATION	SECULAR								
KILMICHEL CHAPEL aka St Michael's Chapel, Kilmichael	St Michael's Chapel, Kilmichael, Isle of Bute, Argyll & Bute			1																1	Earth mortar ruined 7thC. chapel repaired by Arc Architects and funded by HES.						
KILMORY CASTLE, MEIKLE KILMORY	Kilmory Castle, Meikle Kilmory, Isle of Bute, Argyll & Bute				1															1	This monument is of national importance as the remains of a medieval castle. Its position on the top of a steep slope suggests that defence was always an important consideration, even before the addition of the corner tower. It is of particular interest in that the walls of the main block are clay bonded. Source: Listed Building Description.						
LOCH LOMOND VISITOR CENTRE	Loch Lomond Visitor Centre Facility, Rowardenan, Argyll & Bute														1						New visitor centre building has external mudwalls, finished internally with earth plaster and externally with lime and earth renders. Pre-fabricated earth blocks bedded in earth mortar were used in the gables. Source: Morton, T. & Little, R. Earth Building in Scotland, Past, Present, Future. A paper for the first international conference on Ecological Building Structures (2001).						
LURABUS, township and farmsteads, Mull of Oa, Islay	LURABUS, Mull of Oa, Islay, Kildalton, Argyll and Bute																			1	Twelve buildings are associated with enclosures of various sizes. There is clear evidence of cultivation to the S of the settlement and aerial photographs show traces of ploughing on the ground to the N. The buildings, which sometimes survive to their original heights, are rubble-built, gable-ended and mainly square-angled, many appear to have been bonded with clay rather than with lime mortar. Vestiges of earlier building foundations occur within the settlement. Source: Listed Building description.						
ST NINIANS' CHAPEL	Isle of Bute, Argyll & Bute				1															1	Low clay mortared masonry above ground remains. Arc Architects oversaw repairs to the structure by Little & Davie. Raleigh Radford described the 12thc foundations as "undressed bounders set in clay...later described as 'unmortared' and an enclosure wall 'roughly dressed stones set in clay...poor mortar...later became dry stone and turf'."						
KILMORY OIB, KNAPDALE	Kilmory Oib, North Knapdale, Argyll & Bute	1																			Dalriada Project - Kilmory Oib Walkover survey Roddy Regan - Kilmartin House Museum. Structure 3, while built with solid footings, appears to have been an outbuilding, store or workhouse, possibly a peat store. Structure 3 appears to have replaced an earlier building (Structure 17). This earlier building was a post-built structure with evidence of stone and clay footings along one side. The building had a beaten earth floor with evidence of hearth placements. The age of this earlier structure proved elusive as no diagnostic artefacts associated with its use were recovered. Source: https://archaeologydataservice.ac.uk/archiveDS/archiveDownload?t=arch-753-1/dissemination/pdf/2000/2008.pdf p47						
TORBHLAREN	Torbhlairen, Argyll & Bute			1							c680AD										"Excavations in 2004 and 2006 produced evidence for a stone and clay built platform encircling the eastern edge of the rock art site." Source: "Dating and analysis of prehistoric rock art A. Jones - University of Southampton https://archaeologydataservice.ac.uk/archiveDS/archiveDownload?t=arch-753-1/dissemination/pdf/2000/2008.pdf p46.						
MOY CASTLE, MULL	Moy Castle, Torosay, Mull, Argyll & Bute PA62 6AA				1																"Parts of the original flooring of square sandstone slabs for the chamber were exposed and some of the internal mortar bonded stonework of the castle E wall was recorded when the pipe trench was excavated." Chachart, R. (2012). Moy Castle, Mull. Scheduled Ancient Monument Archaeological Works for Waterproofing Upper Floor Level MY01. Perth: Alder Archaeology Ltd. https://doi.org/10.5284/1019725						
42 ST PAUL ST, ABERDEEN	42 St Paul Street, Aberdeen City					1															Building JC possible clay bonded stone wall. Source: Murray, Soc Ant Monogr 2, 75,226.						
6-8 CASTLE STREET, ABERDEEN	6-8 Castle St, Aberdeen City					1															Clay Bonded cellar wall, possibly smithy 17thC. Source: Murray, Soc Ant Monogr 2, 101,227.						
ABERDEEN, 84 WEST NORTH STREET, VICTORIA HOUSE	Victoria House, 84 West North Street, Aberdeen City.																				Hall, D. (2010a) 'Victoria House, 84 West North Street, Aberdeen (Aberdeen parish), watching brief, Discovery Excav Scot. New, vol. 11, 2010. Cathedral Communications Limited, Wiltshire, England Page(s): 12.						
BON ACCORD CENTRE GEORGE ST, ABERDEEN	Bon Accord, George Street, Aberdeen City.				1																"The fourth phase was tentatively dated to the 14th-15thC, and saw an increase in structural remains, with evidence for clay-bonded stone walls representing the remains of boundanades and perhaps buildings." Source: https://archaeologydataservice.ac.uk/archiveDS/archiveDownload?t=arch-753-1/dissemination/pdf/2000/2008.pdf p13.						
43 JEFFREY STREET, EDINBURGH (Excavation)	43 Jeffrey Street, Edinburgh																				"A building of probable 17thC. date was located to the south of a modern terracing cut (564) that crossed Area 8 from east to west. A substantial rubble-built clay-bonded wall footing one metre wide (544 & 545) apparently representing the west and south walls of a large building was associated with a drain (Context 613) and a narrow cobbled surface (Context 547), probably the surface of one of the closes shown on Edgar's 1742 map (illus 2) running along its west side (p21). Sandstone rubble wall length 5.7m, with 0.35m and height 0.25m with two courses bonded with clay. West side of culvert running beneath Paisley Close. Kiln/oven base, 1.2m L x 1.5m W x 0.40m D, constructed from well sorted rubble, 0.15 x 0.25 x 0.1m in size, no visible coursing, bonded with clay and lime mortar with grit and coal inclusions. Source: https://archaeologydataservice.ac.uk/archsearch/record?titleid=2589849						

SCOTTISH EARTH MORTAR SITES SCHEDULE		(Compiled and updated 26.05.2022_H.R.WINSHIP)																		
SITE NAME	ADDRESS	ERA										BUILDING TYPE				NOTES				
		PIRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR
CRAMMOND ROMAN FORT	Cramond, Edinburgh, EH4 6NS		1													1				Archaeological. Low clay mortared masonry wall with mortar surviving in good condition. "Sound clay mortared remains were repaired with lime mortar which was not part of the original construction, because of a perception that this was required to ensure durability. This intervention will promote sacrificial climatic decay of the clay mortar." Source: Morton, T. & Little, R. 2012. Conserving earth mortared monuments in a damp climate.
EDINBURGH GRASSMARKET	41, Grassmarket, Old Town, City of Edinburgh, Scotland, EH1 2HJ				1								1							"In West Bow at the NE end of the Grassmarket a number of roughly coursed walls, bonded together with a clean mid brown clay, were exposed. These are most likely to represent medieval and early post medieval street frontages." Source: Capital Streets Project, Grassmarket, Edinburgh Watching brief James McMeekin - Headland Archaeology Ltd. https://archaeologydataservice.ac.uk/archiveDS/archiveDownload?t=arch-753-1/dissemination/pdf/2000/2008.pdf P72.
OLD COLLEGE QUADRANGLE, University of Edinburgh: Archaeological Excavations	Old College, South Bridge, Old Town, City of Edinburgh, Scotland, EH8 9YL				1								1							Early fragments of clay bonded walls in the SE of the site may represent outbuildings associated with the Kirk O' Fields Church. Source: Cameron, R. and Addyman, T. (2011). Old College Quadrangle, University of Edinburgh: Archaeological Excavations: June - October 2010. Addyman Archaeology. https://doi.org/10.5284/1043795 .
40 BARTON AVENUE, EDINBURGH	40 Barton Avenue, Edinburgh.												1							"Two structural phases were identified, the later structure comprising two lime mortar bonded sandstone walls with a brick and sandstone slab floor and associated culvert. Underlying one of the mortar bonded walls was an earlier clay bonded sandstone wall on a differing alignment." Source: Humble, J. (2013). 40 Barton Avenue, Edinburgh: Archaeological watching brief Data Structure Report. AOC Archaeology Ltd. https://doi.org/10.5284/1028548 .
EDINBURGH PRINTMAKERS	Edinburgh Printmakers, Castle Mills, 1 Dundee Street, Edinburgh, EH3 9FP														1					"Parts of this building have earth lime mortar." Steve Wood, David Narro Associates, (pers. comm. Email 28.04.2022).
4 AND 6 NEWHAVEN MAIN STREET, FORMER VICTORIA PRIMARY SCHOOL	4-6 Newhaven Street, Edinburgh									1					1					"Parts of this building have earth lime mortar." Steve Wood, David Narro Associates, (pers. comm. Email 28.04.2022).
ACADEMY ROAD HOPETOUN HOUSE	Hopetoun House, Academy Road, Moffat, Dumfries & Galloway									1										The Hopetoun House title deeds note that the house was built for John Black of Heatherhaugh and his wife Jannat Johnstone around 1723 (information courtesy of member of the public, 2019). Hopetoun House and the nearby Archibald Moffat House are believed to be the oldest houses in Moffat. They are built using clay mortar which predates 1762 when the Earl of Hopetoun outlawed the use of 'failed clay'. Source: Listed Building Description.
ARCHIBALD MOFFAT HOUSE	Archibald Moffat House, Academy Road, Moffat, Dumfries																			"The house is a rare survival in the town, being of local whinstone, with sandstone dressings laid in clay mortar. Belonging to the minister, it escaped demolition by the Laird for them to be rebuilt using lime-sand mortars. The clay for the mortars was sourced from the adjacent common land and ox-hair was used to mitigate shrinkage. The exterior was originally pointed with hot mix lime mortars and harled." Source: Copsey, N. (2021) Hot Mixed Lime and Traditional Mortars. P43
ARDWALL ISLE, CHAPEL	Ardwall Isle, Kirkcudbright, Dumfries & Galloway				1															Remains of an early chapel (8th to 11th century) - walls are set in yellowish clay - good example as archaeologist recognises many uses of clay in the building, skills of masons, and way it has been leached out. Source: (Markey, S. 2018) Charles Thomas investigation at Ardwall Isle, Kirkcudbright. https://doi.org/10.1080/00766097.1967.11735294
AUCHEN CASTLE (Excavation)	Auchen Castle, Beattock, Near Moffat, Dumfries & Galloway DC10 9SH				1								1		1	1				"The space between the facings was filled with earth and boulders, a primitive method of construction." Source: (Markey, S. 2018) Reid's (Reid, R. C. (1927b) 'The excavation of Auchencas', Trans Dumfriesshire Galloway Natur Hist Antiq Soc, 3rd, vol. 13, 1925-6. Page(s) 104-24) archaeological explorations at Auchen Castle, Garpol Burn, south-west of Moffat, early 13thC. And https://canmore.org.uk/site/48391/auchen-castle "in the late 15th or early to mid-16th century, the castle was converted for use as an artillery fortification. The present uniform level of the curtain-walls suggests that they were lowered all round while earth-packing was added to the N and S curtain-walls (and possibly also on the W and E)."
BARHOBBLE (Excavation of chapel)	Barhobble, Airylick, Dumfries & Galloway												1							At Barhobble, an enclosed early timber chapel was replaced by a clay bonded one in the twelfth century (Cormack 1995). Source: Morton, T. 2009. Conserving the earth mortared ruins of St Michaels and St Ninians Chapels Isle of Bute. From Canmore: "Phase II covers the life of a clay bonded church, built in the 12th century over the Phase I burials, three of the bays separated probably by two timber crucks. The two western bays formed a nave with clay floor, the eastern bay a chancel with slightly raised stone-paved floor. At the NE corner between the altar and the N wall was a rectangular sunken area filled with rubble from which was recovered the leg of a pewter ewer or other vessel: this sunken area may have originally contained a sacristy chest. After a brief life, during which several burials, of which 3 were in partly stone-lined graves, were inserted in the church floor, this phase ended in burning."

SCOTTISH EARTH MORTAR SITES		SCHEDULE														(Compiled and updated 26.05.2022_H.R.WINSHIP)					
SITE NAME	ADDRESS	ERA									BUILDING TYPE					NOTES					
		PRE HISTORY	ROMAN	PICTISH	MEDIAEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR	
BLACKSMITHS COTTAGE	Blacksmith's Cottage, Greta Green, Dumfries & Galloway, DG16 5EA						1														"The famous blacksmiths cottage at Greta Green is still partly clay" Source: Jennings, N., 2003, Clay Dabbins Vernacular Buildings of the Solway Plain. p 88.
CALDONSHILL FARM STEADING	Caldonshill Farm, Stoneykirk, Dumfries & Galloway												1								The RCAHMS has surveyed this where a claywall steading faced in later brickwork still stands". Source: The Past Ubiquity and Environment of the Lost Earth Buildings of Scotland. Parkin, S. & Adderley, W.P. In Hum Ecol (2017) 45:569-583.
CANONBIE PRIORSLYNN BARN	Prior Linn, Canonbie, Dumfries, Dumfries & Galloway						1						1								Clay walled cruck frame and internal clay partition. Source: Stell, G. (1972) Two Cruck-framed buildings in Dumfrieshire. Transactions of the Dumfrieshire and Galloway Natural History and Antiquarian Society. Vol 49. Source: Listed Building description. Outer walls: rubble footings, narrow coursed clay/pebble mix bound with intermediate layers of straw
DURNOCK COTTAGE (now demolished)	Dumfries, Dumfries & Galloway																				Source: Stell, G. (1972) Two Cruck-framed buildings in Dumfrieshire. Transactions of the Dumfrieshire and Galloway Natural History and Antiquarian Society. Vol 49.
MOFFAT OLD CHURCHYARD (15thC.Gable)	Moffat Old Churchyard Moffat Dumfries and Galloway DG10 9EB				1																Earth mortar present in 15th C gable of old churchyard. Source: William Reid pers.comm. Email 01.03.2022.
POLMADDY	Kells, New Galloway Dumfries & Galloway				1								1								Remains of a fermtoin. SVBWC Newsletter 1-3 1975-77. (Stell, G. (ed)) P22. Excavations at Polmad Kirkudbrightshire 1975 - the two outer faces of boulders filled in between with rubble and poor local clay. (Markey, S. 2018) Yates excavations in Polmaddy, New Galloway (Yates, M.J. (1978) 'The excavations at Polmaddy, New Galloway', Trans Dumfrieshire Galloway Natur Hist Antiq Soc. 3rd, vol. 53, 1977-8. Page(s): 133-46) ...clay bonding recorded but assigned as 'dry stone' and noted presence of leached out earth mortar. ...'no trace of mortar but a silt clay found amongst the core material suggested some attempt at weather proofing.' (Markey, S. 2018)
THATCHED COTTAGE AT TORTHOWALD, LOCHAR MOSS	Torthowald, Lochar Moss, Dumfries & Galloway							1					1								"The external walls are constructed of limewashed rubble masonry bonded in mud mortar and pointed with lime." Source: Stell, G. (1972) Two Cruck-framed buildings in Dumfrieshire. Transactions of the Dumfrieshire and Galloway Natural History and Antiquarian Society. Vol 49. Cruck framed cottage
THREAVE CASTLE	Threave Castle Balmaghie, Dumfries & Galloway				1								1			1					Threave Castle, Galloway 1974-1978 excavation - "local graywacke with a core of smaller stones, the whole bonded with pale-yellow silt"...1450 AD.
TORTHORWALD (CRUCK FRAMED) COTTAGE (aka Lochar Moss)	Torthorwald, Dumfries & Galloway				1								1				1				Batholomew's investigations of early 16th century cottage at Torthorwald "rubble pointed with sand, clay and lime...a primitive form of construction... a peasant mode of building." The external walls are of lime-washed rubble bonded in mud mortar and pointed with lime. Source: G. Stell 1972 in (Markey, S. 2018).
WHITHORN PRIORY (Excavation)	Whithorn Parish Church, Bruce Street, Whithorn, Dumfries and Galloway.			1	1								1							1	1975 excavation of Whithorn Priory - 12th century earth mortar and 'evidence of clay as a bonding mortar. (Markey, S. 2018). The burial chapel (Building 2) to the east of the church had an equally long structural history apparently spanning the same period. The stone-founded walls had been renewed on at least three occasions. The walls of the last two phases were built of clay. P Hill and A Nicholson 1990.
GIPSY POINT (Kirkcudbright parish) Brandy Hole	Dundrennan Camp, Kirkcudbright Training Area, Dumfries & Galloway												1								NX 70 44 (approx.) A brandy hole, possibly 200 years old, was found in 1995 c. 2km E of Gipsy Point at Dundrennan Camp. A rectangular manhole, c. 2m deep and c. 35 x 55cm in size, gives access to a straight passage-like trench c. 2m long, c. 55cm wide and c. 1.5m in height. The bottom end of the manhole is a vertical rock face, but elsewhere construction is of well-preserved quarried drystone bonded with clay, the passage roofed with stone slabs. Source: J.G. Scott in http://archaeol.wmnl6.a2hosted.com/wp-content/uploads/2017/02/1997.pdf p10.
HALLGUARDS QUARRY HODDOM (The Pre-Enclosure Stone Building)	Hallguards Quarry, Hoddom, Dumfries & Galloway												1								"A large amount of clay was used in the construction of the building. The walls were founded on a clay skim, overlying the floor slabs." Source: http://archaeol.wmnl6.a2hosted.com/wp-content/uploads/2017/02/1992.pdf p22.
WEST FREUCH (RECORDED DEMOLISHED 2005)	Stoneykirk, Wigtownshire, Dumfries & Galloway																				"In Scotland, the recorded demolition of a mudwall farmhouse at West Freuch (demolished 2003). Source: The Past Ubiquity and Environment of the Lost Earth Buildings of Scotland. Parkin, S. & Adderley, W.P. In Hum Ecol (2017) 45:569-583. (Oxford Archaeology North 2005).
10 & 12 LONGTHWAITE ROAD, WIGTON	10 & 12 Longthwaite Road, Wigton, Dumfries & Galloway.				1																"In view of the fact that clay not lime mortar was used, we can only surmise that this was indeed a late seventeenth century house, probably though not certainly stone built from the start, which has subsequently undergone changes." Source: Jennings, N. 2003, Clay Dabbins Vernacular Buildings of the Solway Plain. p178.
BURNS COTTAGE, AYRSHIRE	16 Alloway, Ayr KA7 4PY						1														There was red/brown clay mortar, I think had straw in it so might be mudwall. (Becky Little pers.comm. Email 09.02.2022).
CAIRNIBOTTOM, EAST AYRSHIRE	Cairnibottom Farm, Muirkirk Parish, East Ayrshire // Old Coal Pit, A70, East Ayrshire, KA18 3SD.																				Internal comfort levels were achieved initially from the application of a thin coat of a weak lime plaster over a rudimentary clay and straw binding mortar. The internal surfaces of the flues at both gables are parged with a mortar of clay and straw, bound with hessian to reduce the fire risk. Source: https://www.svbwg.org.uk/journals/SVBWC.V8.34.2011.pdf .

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H.R.WINSHIP)																	
SITE NAME	ADDRESS	ERA									BUILDING TYPE					NOTES			
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION
BEARSDEN BATHHOUSE ROMAN FORT ON ANTONINE WALL	Bearnsden, New Kilpatrick, East Dunbartonshire		1										1			1	1		Reported by David Breeze. Source https://doi.org/10.9750/9781908332189
74 BLACK BULL CLOSE (Old rigg wall to rear of High Street) DUNBAR	Dunbar, East Lothian						1												Clay mortar found on old rigg walls to the rear of Dunbar High Street at a site known as Black Bull Close. This is an interesting site with some early 17th C artisans dwellings being restored by local social enterprise The Ridge who are training young people to be stone masons who can work on old buildings.
VICTORIA PARK, HADDINGTON, Archaeological Watching Brief	Victoria Park, Haddington, East Lothian				1								1						The watching brief revealed the truncated footings of the Medieval town wall. These were overlain by the foundation deposits of the present wall. The medieval wall was constructed of rough clay bonded sandstones and was approximately 1.0m in width. An elevation of 0.40 m was recorded. Source: Engl. R. P. (2014). Victoria Park, Haddington, Archaeological Watching Brief. AOC Archaeology Ltd. https://doi.org/10.5284/1045859 .
NEW CARON ROAD, STENHOUSEMUIR	New Caron Road, Stenhousemuir, Falkirk												1						The pottery production centre of Stenhouse, the remains of a clay bonded structure which was sealed by an extensive dump of redware pottery. Source: Derek Hall Excavation https://archaeologydataservice.ac.uk/archiveDS/archiveDownload? t=arch-753-1/dissemination/pdf/2000/2007_low.pdf p92.
ASH COTTAGE	Ash Cottage, Monimail, Cupar, Fife, KY15 7RJ							1									1		A 19thC? Possibly earlier Cottage resurrected by Arc Architect Tom Morton and Rebecca Little of Reearth, incorporating mudwall, earth mortar, clay floor, earth plaster and wattle.
BENNETT/SANDHAVEN HOUSE, CULROSS	Culross, Fife								1									1	When Bennet House was being converted by National Trust for Scotland in Culross as part of Little Houses Scheme 2015-17, the builders identified a clay mortar there, but I don't think samples were taken during works. At least worth noting possibility of further clay mortars in Culross should National Trust for Scotland be undertaking future work on any of the Little Houses. Source: Bryan Wilkinson pers. comm. Email 09.02.2022. (https://canmore.org.uk/site/222229/culross-sandhaven-house?)
BROOMHALL POLICIES	Dunfermline, Fife								1		1860								Clay Pits - see listing.
KELLIE CASTLE GARDEN WALLS	Kellie Castle, Carnbee, Fife.																		Confirmed earth mortar bedding and core. Source: Becky Little pers.comm. Email 23.02.2022.
LECKERSTON FARMHOUSE	Leckerston Farmhouse, Saline, Dunfermline, Fife, KY12 9TU													1					Earth mortar in new heather thatched extension to farmhouse. (Arc Architects Project 2006).
MONCREIFF HOUSE, MAIN ST, FALKLAND	Moncreiff House, Main Street, Falkland, Fife, KY15 7BZ				1													1	In East Gable, Alison Davie worked on it. (Becky Little pers.comm. Email 09.02.2022).
WESTFIELD FARM STEADING	Westfield Farm, Falkland, Fife, KY15 7AE							1				1							Clay mortar and possible rammed earth. (Becky Little pers.comm. Email 09.02.2022).
BRUCEHAVEN (aka CLAY SIKES FARM)	Brucehaven Farm, Dunfermline, Fife					1				U		1							18thC. 2-storey, 3 bay, L-plan farmhouse with single storey range to E. Harled. Recorded for possibility of clay. Requires confirmation.
31-32 GORDON'S LANE	31-32 Gordons Lane, Cromarty, Ross-shire, Highland.																	1	Clay rubble infill. Source: SVBCWG Newsletter 16 1992, p 32.
APPLECROSS MAINS	Applecross, Highland							1			19thC	1							Not mentioned on listed building record. TM found clay mortar on 03.02.2022.
APPLECROSS MAINS TOP BARN	Applecross, Highland					1					Late 18thC	1							Not mentioned on listed building record. TM found clay mortar on 03.02.2022.
AULTREA near Mellon Udrigle (Clay mortar in wall at)	Aultbea, Mellon Udrigle, Cairloch, Highlands																	1	There is no HES record but 1 listing for an 18thC. cottage at Mellon Udrigle (no clay mentioned). Source https://blog.engineshed.scot/2018/08/24/traditional-mortars-going full-circle/
AVOCH VILLAGE, 34 DOCK, MAJI COTTAGE	34 Dock, Maji Cottage, Avoch Village, Highland								1									1	Traditional, early-mid 19th century thatch-roofed cottage, early thatch survives beneath corrugated-iron roof. Battered clay boole(?) walls, painted render and harl. modern glazing, gabled large bedroom wing (extension) central on front of house also built of traditional materials; main roof runs continuously over timber walled garage at west. Small, modern outshot on E gable. Interior: coombed ceilings, in loft exposed early roof timbers, with collars, turf and thatch all visible. Source: Listed Building description.
BEATONS COTTAGE (Skye, Bornesketaig, No. 40, Beaton's Cottage)	Beatons Cottage, Kilmuir, Skye, Highland IV51 9WS							1			1880							1	Dating from the 19thC. Bornesketaig is a traditional thatched Skye cottage comprising a single storey divided into two rooms. Thick walls and rounded corners reduce the impact of cold weather and strong winds. Restored and owned by the National Trust for Scotland, it is let as holiday accommodation. Contractor, Craig Frew pers. comm. email 16.03.2022. I sampled the mortar and did a crude sedimentation test - it was approx. 80% sand, 15% silt & 5% clay, but was a rather small sample (25g). I think it was originally just limewashed over but has since been heavily repointed in cement with numerous coats of modern masonry paint.
CLAISHAHISICH	Knockclor, Migdale Moor, Creich, Sutherland, Highland									U		1						1	A farmstead. Comprises the main building oriented approximately east/west, with addition to west. Stone built with clay mortar bonding; cement mortar repairs visible in places.
CNOC A' CHINN - HOUSE	Cnoc A' Chinn, Kirkhill, Inverness, Highland									U		1						1	A single cottage of stone and clay-mortar construction. RCAHMS 1979, visited 1979. Source: https://her.highland.gov.uk/Monument/MHC3349 .

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H.R.WINSHIP)														NOTES				
SITE NAME	ADDRESS	ERA									BUILDING TYPE									
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR
COTTAGE AT ARBRIACHAN	Arbrnahan, Lower Balmore (South of Inverness) Highland																1			Up on top of the hill from Lower Balmore there is a single storey building (former dwelling?) with a red tin roof which covers old heather thatch. Inside there are hazel straw and mud partitions and cruck timbers. There was no partition between the animal quarters and the living quarters. The exterior is comprised of rough field stone and it has small windows.
CUAIG BUILDING C	Applecross Estate, Applecross, Ross & Cromarty, Highland							1						1						Ruinous cottage. Used to be heather thatched. It is well constructed of clay mortared coursed rubble masonry. Turf cope. RCAHMS. Survey GS 1975.
EILEAN GHRUIDIDH, CASTLE.	Loch Maree, Gairloch, Highland				1								1					1		The enclosure wall is of rubble construction, well-coursed from roughly-squared stones apparently set in a clay mortar. Source: Listed Building description.
FAIRBURN TOWER COTTAGE	Fairburn Tower Cottage, Fairburn Estate, Muir of Ord, Highland							1					1						1	Clay bonded mortar present in ruined cottage adjacent to A listed Tower (LB14030). Source: Addyman Archaeology Preliminary Analytical Assessment for The Landmark Trust April 2017 p 15.
FEARNBEG BUILDING J	Applecross Estate, Applecross, Ross & Cromarty, Highland							1										1		A small thatched byre, roof collapsed, clay mortared rubble walls. RCAHMS. Survey GS 1976.
FEARNBEG BUILDING D.	Fearnbeag Road, Fearnbeag, Highland, Scotland, IV54 8XU							1										1		Rubble masonry drystone which appears to be dry jointed but formerly were probably bonded in clay mortar. RCAHMS. Survey GS 1976.
FEARNBEG BUILDING E	Fearnbeag Road, Fearnbeag, Highland, Scotland, IV54 8XU							1										1		Walls of drystone masonry perhaps formerly bonded in clay mortar. Survey GS 1976.
FEARNBEG BUILDING F	Fearnbeag Road, Fearnbeag, Highland, Scotland, IV54 8XU							1										1		The joints of the masonry internally appear to have been pointed with clay mortar. Survey GS 1976.
FEARNBEG BUILDING G	Fearnbeag Road, Fearnbeag, Highland, Scotland, IV54 8XU							1										1		Rubble masonry drystone but formerly bonded in clay mortar. RCAHMS. Survey GS 1976.
FEARNBEG BUILDING P	Fearnbeag Road, Fearnbeag, Highland, Scotland, IV54 8XU							1										1		Portion of earlier gabled house the walls are clay mortared rubble masonry. RCAHMS. Survey GS 1976.
FEARNMORE BUILDING E	Applecross Estate, Applecross, Ross & Cromarty, Highland							1										1		A well clay mortared cottage which preserves some remains of heather thatch. RCAHMS. Survey GS & IF 1975 & 1976.
FISHERTOWN 34 GORDON'S LANE, Cromarty, Highland	34 Gordon's Lane, Fishertown, Cromarty, Highland							1										1		Late 18th/early 19th century, single storey cottage, 4 bay Thick rubble walls, plastered and lime washed. Broad south gable chimney, windows small and irregularly shaped, 2 later barge-boarded dormers, slate roof. "vernacular fishertown dwelling, precise dating difficult. Probably clay mortar." Source: Listed Building description.
GIRNIGOE & SINCLAIR CASTLE	Girrigoe & Sinclair Castles, Wick, Highland				1	1												1		"We used lime-clay mortar for repairs in the 1990s". Lachie Stewart, pers. comm. Email 18.02.2022. Not mentioned on listing.
HANNAH'S CROFT 17 MELLON UDRIGLE	Hannah's Croft, 17 Mellon Udrigle, Ross, Highland									1590-1900								1		"The proposed restoration of Hannah's Croft. Photographs taken circa. 1995 prior to initial clearance and application for Planning. It is understood that the croft was last occupied circa 1903 by Hannah McLennon. Construction of stone wall, gable with clay soil and shell lime mortar. Roof of turf over wooden beams."
HOUSE AT SKERRAY	Skerray, Sutherland, Highland																	1		Red Clay mortar. Abandoned house because of infectious disease. Source: Nick Aitken pers. comm. Email 18.02.2022.
HUGH MILLARS COTTAGE (WALL BEHIND)	Hugh Miller's Birthplace Cottage & Museum Church Street, Cromarty Highland, IV11 8XA																	1		Becky Little did repairs to the wall with Glyn Young. Clay collected from Rose Farm near Cromarty
INVER, 10, SHORE STREET	INVER, 10, SHORE STREET, TAIN, Highland							1		early mid 19thc								1		Earlier-mid 19thC: single storey, 4-bay cottage, all white washed clay and rubble, painted margins, clay stack serving clay and wattle "hanging lum". Source: Listed Building description.
KINLOCHMOIDART HOUSE	Kinlochmoidart House, Glenmoidart Road, Kinlochmoidart, Highland, Scotland, PH38							1		18thC								1		"Such buildings have a stone faced outward appearance with internal walls of traditional mudwall or mud mortar and boulders (Walker, 2009) Source: The Past Ubiquity and Environment of the Lost Earth Buildings of Scotland. Parkin, S. & Adderley, W.P. In Hum Ecol (2017) 45:569-583. Confirmed by Bryan Dickson as earth mortared masonry faced with cement.
KNOCKCLOR, MIGDALE MOOR	Knockclor, Migdale Moor, Creich, Sutherland, Highland									U			1					1		Shown on first edition OS as 4 buildings, W of rectangular enclosure. Open patches of land in rough woodland. At least two, possibly three chambered stone buildings bonded with clay mortar were recorded at this location during walkover survey (AM6). Other features related to the farmstead were recorded, including an enclosure (AM7) and field boundaries (AM8 - AM10) comprising the Knocklor farmstead shown on the first edition OS 6" map. Much collapsed. A number of boundary dykes were also recorded (AM11 and AM12). Source: https://her.highland.gov.uk/Monument/MHC31636 .
LEACHONICH	Edderton, Ross & Cromarty, Highland																	1		At NH6768 8527 is a cottage of clay-mortar construction measuring 12m by 4m and standing 3m high, to the E at NH 6771 8526 there are the footings of a long, narrow building of similar construction, measuring 22m by 5m. RCAHMS 1979, visited September 1978. Source: https://her.highland.gov.uk/Monument/MHC8081

SCOTTISH EARTH MORTAR SITES SCHEDULE		(Compiled and updated 26.05.2022_H.R.WINSHIP)																		
SITE NAME	ADDRESS	ERA										BUILDING TYPE						NOTES		
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL	DEFENSIVE	DOMESTIC		RECREATION	SECULAR
LONBAIN COTTAGE	Lonbain, Applecross, Highland						1										1			Not mentioned on listed building record. TM found clay mortar during condition inspection for National Trust for Scotland on 03.02.2022
LOWER EATHIE FERMTOUN	Eathie, Black Isle, Ross & Cromarty, Highland Region																	1		The turf covered footings of at least 4 deserted cottages lie to the S and W of a cottage of stone and clay-mortar construction with lime-mortar pointing. RCAHMS 1979, visited 1979.
LOWER ETHIE FARM	Fortrose, Highland, IV11 8XY																	4		Ethie 1 NH 774 635 NH765E. The turf-covered footings of at least four deserted cottages lie to the S and W of a cottage of stone and clay-mortar construction with lime-mortar pointing. RCAHMS 1979, visited May 1979. Source: https://her.highland.gov.uk/monument/MHG14725
LUACHARNHOR COTTAGE 1	Aultnamain, Highland, IV19 1LH																	1		Two deserted cottages of clay-mortar construction situated at NH 6743 8036 and NH 6745 8038, immediately E of a stream; one of them has been re-pointed with lime mortar. RCAHMS 1979, visited September 1978. Source: https://her.highland.gov.uk/Monument/MHG8047
LUACHARNHOR COTTAGE 2	Aultnamain, Highland, IV19 1LH																	1		Two deserted cottages of clay-mortar construction situated at NH 6743 8036 and NH 6745 8038, immediately E of a stream; one of them has been re-pointed with lime mortar. RCAHMS 1979, visited September 1978. Source: https://her.highland.gov.uk/Monument/MHG8047
MEIKLE DALLAS	Meikle Dallas, Edderton, Ross & Cromarty, Highland																			This two-roomed cottage measures 20m from WSW to ENE by 5m transversely and is of crude, clay-mortar construction. RCAHMS 1979, visited September 1978. Source: https://her.highland.gov.uk/Monument/MHG8050 .
NEW STREET No.2	2 New Street, Shandwick, Ross-shire, Highland																			"The walls are of dark red sandstone rubble, bound with clay mortar." Source: SVBCWC Newsletter 4, 1978, p9 Bruce Walker- Report on 2 New Street, Shandwick Ross-shire.
POLLAGHARRIE COTTAGE 1	Edderton, Highland																	1		The remains of two cottages of clay-mortar construction are visible at NH 6798 8472 and NH 6804 8471, 100m E of Pollagharrie. Both have been partially re-pointed with lime mortar. RCAHMS 1979, visited September 1978. Source: https://her.highland.gov.uk/Monument/MHG8046
POLLAGHARRIE COTTAGE 2	Edderton, Highland																	1		The remains of two cottages of clay mortar construction are visible at NH 6798 8472 and NH 6804 8471, 100m E of Pollagharrie. Both have been partially re-pointed with lime mortar. RCAHMS 1979, visited September 1978. Source: https://her.highland.gov.uk/Monument/MHG8046 and Canmore https://canmore.org.uk/site/13910
ROCKFIELD CASTLE (formerly Little Tarrel Castle)	Tarbat, Ross & Cromarty, Highland			1														1		Fortified Lairds house - dangerous building due for demolition in 1978 - stabilised and renovated c.1986. The walls are constructed of clay mortared random rubble of local extraction. Internally there are two surviving secondary partitions of clay and wattle construction. Source: RCAHMS Survey GS 1978 and
SHORE COTTAGES, BERRIEDALE	The Shore Cottages (No. 1 & 2), Berrisdale near Wick, Caithness, Highland KW7 6HR																	1		Clay bedding mortars pointed in lime (Becky Little pers. comm. Email 09.02.2022). Cottages: earlier 19th century terrace of 4 single storey cottages, each 3 bays with centre door. Rubble, rubble dressings Symmetrical front; small windows with 12 pane glazing; end and ridge stacks; slate roof. Roughly coped front retaining wall.
THE FAIRY GLEN	Rosemarkie, Highland																			In 1910, Drummarkie was described as a 'stone, clay and thatch house with 3 apartments and a woodshed, with a wooden summer house. Stable and burn' (SRO). The townspeople also had the right to collect clay for their houses from the Glen.
TOMICH (LETTOCH) MHC14126 - Settlement or Farmstead	Tomich, Highland																			NH535 482 The remains of two cottages. At least one is of stone and clay-mortar construction, January 1978 <1>-Source: https://her.highland.gov.uk/Monument/MHC14126 There are several listed 18 19thC cottages in Tomich but clay mortar is not mentioned.
OLD LEANACH COTTAGE	Old Leannach Cottage, Culloden Battlefield, B9006 Westhill, Inverness																			"A standing building survey, analytical account and comparative study were undertaken January- March 2009 to inform future conservation. The small, originally T-shaped cottage was probably constructed in the early 18thC., as part of improvements on the Culloden Estate. The T-plan layout and clay-bonded coarse rubble-stone construction, with turf gables and a thatched roof, closely parallels that of King's Stable Cottage, also on the Culloden Estate, and probably part of the same improvement scheme." Source: https://archaeologydataservice.ac.uk/archiveDS/archiveDownload?t=arch-753-1/dissemination/pdf/2000/2009_high.pdf p97.
BACK BEACH BORA CLYNE	Back Beach, Brora, Clyne, Highland																			"The excavation of the salt pans along the Back Beach continued The 2008 trench exposed a substantial building, neatly constructed from hard white quartzite boulders. Much of the masonry was covered in barnacles, confirming documentary evidence that many of the stones had been taken directly from the beach. Both the internal and external walls appear to have been clay mortared and then harled." Excavation Janet Hooper - Clyne Heritage Society.

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022, H.R. WINSHIP)																		
SITE NAME	ADDRESS	ERA									BUILDING TYPE					NOTES				
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR
GOREBRIDGE, CLAY HOUSES	Corebridge, Borthwick, Midlothian							1			U	1								Former smiddy. Existing in 1921. Source: Canmore.
MUIR OF MAVERSTON	Muir of Maverston, Garmouth, Moray											1								The remains of a house and enclosure stand in a slight clearing of woodland. It is depicted on the first edition OS map, with an enclosure to the south. By the second edition the enclosure has been attached to the west face of the house. An archaeological survey was undertaken in June 2007 by Murray Archaeological Services Ltd. This revealed a 3-compartmented building, 11 m x 5.3 m, 7 m x 5.1 m, circa 4.5 m x 3.6 m, orientated northwest-southeast. The walls were built of a mixture of rounded pebbles and angular field stones bonded with a yellow, clay based mix. There was also straw tempering visible throughout. A building survey was carried out in 2007 prior to development. The buildings were all identifiable on the OS first edition OS map, and some had remained in use until the mid 20th century. All were in ruinous condition. The original construction method was clay and boulder walling and some interesting structural details were recorded. Source: https://canmore.org.uk/site/192501
SPYNE PALACE	Spynie, Moray				1															Much of the west curtain wall survived only as rubble foundations or, in places, merely as a spread of mortar and clay. The kiln bowl measured 1.8 m in diameter with clay bonded, rubble walls 0.6 m wide. Further south, the drystone east-west perimeter wall built in 1820 was dismantled to reveal an underlying clay-bonded and mortar-pointed, rubble wall that survived to a length of 5.4 m. This lower wall is believed to have formed the boundary between the palace and its gardens and orchards. Source: https://online.aberdeenshire.gov.uk/smrpub/master/detail.aspx?refno=NJ26NW0004
103 SEATOWN	103 Seatown, Cullen, Moray																			Early 19th C., single storey, narrow 3-bay cottage with slightly advanced additional bay at W. Harled (probably over clay and boulder walling), rendered margins. Source: https://online.aberdeenshire.gov.uk/smrpub/master/detail.aspx?refno=NJ56NW0257 .
105 SEATOWN	105 Seatown, Cullen, Moray																			Early 19th century, single storey, narrow 3-bay cottage. Harled (possibly over clay and boulder), rendered margins. Off centre door. End stacks and concrete tiled roof with single loft roof light. Source: https://online.aberdeenshire.gov.uk/smrpub/master/detail.aspx?refno=NJ56NW0260
107-147 HIGH STREET, ELGIN (Excavation)	107-147 High Street, Elgin, Moray				1								1							This structure had been overlaid in the 14th century by a building consisting of a clay-bonded stone wall. This building had gone out of use and was succeeded in the 17th century by a stone building. Source: https://online.aberdeenshire.gov.uk/smrpub/master/detail.aspx?refno=NJ26SW0060
114 SEATOWN, CULLEN	114 Seatown, Cullen, Moray, AB56 4SN																			Late 18th/early 19th century, single storey, 3-bay cottage with additional bay at W. Dry dashed frontage, rendered flanks (probably over clay and boulder walling), contrasting painted margins. Centre entrance with double-leaf plank door. Clay and boulder end stacks and asbestos tile roof (replacing former thatch) with 2 loft roof lights. Source: Listed Building Description.
13 PARK STREET	13 Park Street, Portknockie, Moray AB56 4LT																			Source: Listed Building description.
130 HIGH STREET, ELGIN (Excavation)	130 High Street, Elgin, Moray				1								1							Cross-slab, found during machine excavation of a cellar area within the building (NJ26SW0521) in 1996. Cleaning section of trench revealed part of a clay-built wall on the line of the medieval close. Cross-slab had been used as paving within this structure.
171 SEATOWN, CULLEN	171 SEATOWN, CULLEN, Moray																			Early 19th century with later attic. Small single storey and attic, 3-bay cottage. Rendered, painted and lined as ashlar (probably over clay and boulder walling), contrasting painted dressings with long and short detailing. Centre entrance, small flanking windows; later panted domers with bipartites; 2-pane glazing. End stacks, slate roof. Source: Listed Building description.
185 SEATOWN, CULLEN	185 Seatown, Cullen, Moray, AB56 4SN																			Early 19th century. Single storey, 3-bay cottage. Rendered frontage, harled flanks (probably over clay and boulder). Source: Listed Building description.
193 SEATOWN, CULLEN	193 Seatown, Cullen, Moray, AB56 4SN																			Early 19th century. Single storey, narrow 3-bay cottage with slightly advanced additional bay at W. Harled (probably over clay and boulder walling), rendered margins. Source: Listed Building description.
195 SEATOWN, CULLEN	195 Seatown, Cullen, Moray, AB56 4SN																			Early 19th century. Single storey and attic, 3-bay cottage. Dry dashed frontage (probably over clay and boulder), contrasting painted margins. Centre entrance, 2-pane glazing. Brick stacks, slate roof with loft roof lights. Source: Listed Building Description.
196 SEATOWN, CULLEN	196 Seatown, Cullen, Moray																			Early 19th century. Single storey, 3-bay cottage. Rendered with contrasting painted long and short detailing (probably over clay and boulder). Source: Listed Building description.

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H.R.WINSHIP)																		
SITE NAME	ADDRESS	ERA								BUILDING TYPE					NOTES					
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE		COMMERCIAL	DEFENSIVE	DOMESTIC	RECREATION	SECULAR
202 SEATOWN, CULLEN	202 Seatown, Cullen, Moray							1									1			Early-mid 19th century. Single storey, 3-bay cottage with later extension at S gable. Dry dashed (probably over clay and boulder), contrasting painted margins. Off-centre door in E elevation; 2 windows in N gable (seaward) 2-pane glazing. End stacks; slate roof, with modern loft roof lights. Source: Listed Building description.
206 SEATOWN, CULLEN	206 Seatown, Cullen, Moray							1									1			Earlier 19th century. Single storey, narrow 3-bay cottage. Dry dashed (probably over clay and boulder). Source: Listed Building description.
209, 210 SEATOWN, CULLEN	209-210 Seatown, Cullen, Moray							1									1			Early-mid 19th century, single storey, 3-bay cottage (formerly 2 small dwellings). Rendered and lined as ashlar (probably over clay and boulder construction), with contrasting painted margins. Source: Listed Building description.
216 SEATOWN, CULLEN	216 Seatown, Cullen, Moray							1									1			Early 19th century, single storey, wide 3-bay cottage. Drydashed (probably over clay and boulder), contrasting painted margins. Central entrance, with irregular rear enlarged fenestration and projecting addition at SW. End stacks and purple Welsh slate roof with loft roof lights. Source: Listed Building description.
223 SEATOWN, CULLEN	223 Seatown, Cullen, Moray							1									1			Early 19th century. Single storey, 3-bay cottage. Rendered and lined as ashlar (probably over clay and boulder walling). Source: Listed Building description.
228 SEATOWN, CULLEN	228 Seatown, Cullen, Moray							1									1			Early 19th century. Single storey, small 3-bay cottage. Rendered (probably over clay and boulder walling), contrasting painted margins. Centre entrance, 2-pane glazing. End stacks; slate roof with modern loft roof lights. Source: Listed Building description.
60 SEATOWN, Cullen	60 Seatown, Cullen, Moray							1									1			Early 19thC. Small single storey, 3-bay cottage. Colour washed harl (probably over clay and boulder), contrasting painted margins. Centre entrance with plank door, small flanking windows with 4-pane glazing. End stacks; asbestos tiled roof. Source: Listed Building description.
AUCHENHALRIC	Auchenhalrig, Cowfurach, Moray																			Clay & bool. Source: The Past Ubiquity and Environment of the Lost Earth Buildings of Scotland. Parkin, S. & Adderley, W.P. in Hum Ecol (2017) 45:569-583
BALBEG	Urquhart, Moray																			Immediately to the S of this there is a building measuring 11.7m by 3.7m internally; the WSW half has been robbed, but elsewhere the clay-bonded rubble walls stand up to 1m high (URQ97 157; NH 4508 3123). Source: NMRS Report: (02/12/2004) https://her.highland.gov.uk/Monument/MHG47298 .
BOGMUIR, 19	19 Bogmuir, Belle, Moray							1									1			Early-mid 19thC. Single storey, 3-bay E facing cottage. Whitewashed, clay and boulder walling. Centre door, single window in S gable, mainly 4-pane glazing. End stacks, corrugated-iron roof. Low coped wall encloses garden fronting house. Good example of 19th century clay and boulder (bool) cottage, the walling material traditional to the immediate area. The corrugated iron roof replaces former thatch. Source: Listed Building description.
BOGMUIR, 20 CLAY & bool cottage (Rose Cottage)	20 Bogmuir, Belle, Moray																			Source: SVBWG Newsletter 1-3 1975-77, (Stell, G. (ed)) p6.
CLAY BYRE	Stewarts Place, Garmouth, Moray																			Source: SVBWG Newsletter 1-3 1975-77, (Stell, G. (ed)) p6.
COSY CORNER, MOSSTODLOCH	Cosy Corner, Mosstodloch, Speymouth, Moray							1									1			Early 19th century, single storey, N facing 3-bay cottage. Whitewashed rubble (probably concealing clay and boulder). Central door and 4-pane glazing. End stacks and corrugated-iron roof. Source: Listed Building description.
EDDER INNES, CADGERS ROAD, KINGSTON	Edder Innes, Cadgers Road, Kingston, Moray							1									1			Early 19th century, single storey, 3-bay cottage. Clay and bool walling with lime washed extenor. Central door masked by small later porch with 12-pane glazing. End stacks and corrugated-iron roof. Source: Listed Building description.
FALCON HOUSE, CHURCH STREET, GARMOUTH	Falcon House, Church Street, Garmouth, Moray						1			1781							1			Dated 1781. 2-storey house with 4-bay street elevation and 5 windows to garden front. Refronted (street elevation) in later 19th century with tooled rubble and tooled ashlar dressings over clay walling, harled garden front with ashlar margins. Wallhead gable with apex stack to garden elevation, 2-pane glazing. Coped end stacks; slate roof. Low coped wall encloses Church Street frontage. Source: Listed Building description.
GARMOUTH HIGH STREET, THE MOORINGS AND REAR CICHOUSE	The Moorings, Garmouth High Street, Urquhart, Moray							1									1			Gighthouse and stable at rear; single storey; clay and bool walling. Slate roof (some local slates). Source: Listed Building description.
GARMOUTH, 1 AND 2 SPEY STREET	1 & 2 Spey Street, Garmouth, Urquhart, Moray						1			late 18th							1			Pair 2-storey, 3-bay cottages. Harled solid clay walls. Listed for traditional clay walling construction. Source: https://online.aberdeenshire.gov.uk/smrpub/master/detail.aspx?refno=NJ365W0110
GARMOUTH, HIGH STREET, LABURNUM AND WASH HOUSE	Laburnum, High St, Garmouth, Urquhart, Moray							1									1			Early-mid 19th Century single storey and dormerless attic, 3-bay cottage with centre door. Probably clay and bool construction beneath harling. Source: Listed Building description.
GARMOUTH, HIGH STREET, THE SHOP (DWELLING HOUSE ONLY)	The Shop, High St, Garmouth, Urquhart, Moray							1		early 19							1			Early 19th-century. Single storey 3-bay cottage. Clay and bool harled with painted margins. Varied glazing. Ridge stack next High Street set slightly in from north gable formerly serving a 'hinging lum' or timber canopy. Corrugated iron roof. Source: Listed Building description.
GARMOUTH, SOUTH ROAD, STEWART HOUSE, STABLE AND GARDEN WALLS	Stewart House, Garmouth Road, Urquhart, Moray							1									1			Low coped garden wall fronts house linked to former stable gighthouse with gable loft door and slate roof. Clay and bool walls enclose remainder of garden. Source: Listed Building description.
GARMOUTH, SPEY STREET, STAINSON HOUSE	Stainson House, Spey Street, Garmouth, Urquhart, Moray							1		Mid 18th							1			Mid 18th century with later additions. 2-storey, wide 3-bay house with single storey, single bay addition set back at E gable and further single storey, 2-bay addition projects at right angles from SW angle forming L-plan. Harled over clay and bool. Source: Listed Building description.

SCOTTISH EARTH MORTAR SITES		SCHEDULE														NOTES				
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202 SEATOWN, CULLEN	202 Seatown, Cullen, Moray							1									1			Early-mid 19th century. Single storey, 3-bay cottage with later extension at S gable. Dry dashed (probably over clay and boulder), contrasting painted margins. Off-centre door in E elevation, 2 windows in N gable (seaward) 2-pane glazing. End stacks, slate roof with modern loft roof lights. Source: Listed Building description.
206 SEATOWN, CULLEN	206 Seatown, Cullen, Moray							1									1			Earlier 19th century. Single storey, narrow 3-bay cottage. Dry dashed (probably over clay and boulder). Source: Listed Building description.
209, 210 SEATOWN, CULLEN	209-210 Seatown, Cullen, Moray							1									1			Early-mid 19th century, single storey, 3-bay cottage (formerly 2 small dwellings). Rendered and lined as ashlar (probably over clay and boulder construction), with contrasting painted margins. Source: Listed Building description.
216 SEATOWN, CULLEN	216 Seatown, Cullen, Moray							1									1			Early 19th century, single storey, wide 3-bay cottage. Drydashed (probably over clay and boulder), contrasting painted margins. Central entrance, with irregular rear enlarged fenestration and projecting addition at SW. End stacks and purple Welsh slate roof with loft roof lights. Source: Listed Building description.
223 SEATOWN, CULLEN	223 Seatown, Cullen, Moray							1									1			Early 19th century. Single storey, 3-bay cottage. Rendered and lined as ashlar (probably over clay and boulder walling). Source: Listed Building description.
228 SEATOWN, CULLEN	228 Seatown, Cullen, Moray							1									1			Early 19th century. Single storey, small 3-bay cottage. Rendered (probably over clay and boulder walling), contrasting painted margins. Centre entrance, 2-pane glazing. End stacks; slate roof with modern loft roof lights. Source: Listed Building description.
60 SEATOWN, Cullen	60 Seatown, Cullen, Moray							1									1			Early 19thC. Small single storey, 3-bay cottage. Colour washed harl (probably over clay and boulder), contrasting painted margins, centre entrance with plank door; small flanking windows with 4-pane glazing. End stacks, asbestos tiled roof. Source: Listed Building description.
AUCHENHALRIG	Auchenhalrig, Cowfurch, Moray																			Clay & bool. Source: The Past Ubiquity and Environment of the Lost Earth Buildings of Scotland. Parkin, S. & Adderley, W.P. In Hum Ecol (2017) 45:569-583.
BALBEG	Urquhart, Moray																			Immediately to the S of this there is a building measuring 11.7m by 3.7m internally, the WSW half has been robbed, but elsewhere the clay-bonded rubble walls stand up to 1m high (URQ97 157; NH 4508 3123). Source: NMRS Report (02/12/2004) https://her.highland.gov.uk/Monument/MHG47298 .
BOGMUIR, 19	19 Bogmuir, Bellie, Moray							1									1			Early-mid 19thC. Single storey, 3-bay E facing cottage. Whitewashed, clay and boulder walling. Centre door, single window in S gable, mainly 4-pane glazing. End stacks; corrugated-iron roof. Low coped wall encloses garden fronting house. Good example of 19th century clay and boulder (bool) cottage, the walling material traditional to the immediate area. The corrugated iron roof replaces former thatch. Source: Listed Building description.
BOGMUIR, 20 CLAY & bool cottage, (Rose Cottage)	20 Bogmuir, Bellie, Moray																			Source: SVRWG Newsletter 1-3 1975-77, (Stell, G. (ed)) p6.
CLAY BYRE	Stewarts Place, Garmouth, Moray																			Source: SVRWG Newsletter 1-3 1975-77, (Stell, G. (ed)) p6.
COSY CORNER, MOSSTODLOCH	Cosy Corner, Mosstodloch, Speymouth, Moray							1									1			Early 19th century, single storey, N facing 3-bay cottage. Whitewashed rubble (probably concealing clay and boulder). Central door and 4-pane glazing. End stacks and corrugated-iron roof. Source: Listed Building description.
EDDER INNES, CADGERS ROAD, KINGSTON	Edder Innes, Cadgers Road, Kingston, Moray							1									1			Early 19th century, single storey, 3-bay cottage. Clay and bool walling with lime washed exterior. Central door masked by small later porch with 12-pane glazing. End stacks and corrugated-iron roof. Source: Listed Building description.
FALCON HOUSE, CHURCH STREET, GARMOUTH	Falcon House, Church Street, Garmouth, Moray						1				1781						1			Dated 1781. 2-storey house with 4-bay street elevation and 5 windows to garden front. Refronted (street elevation) in later 19th century with tooled rubble and tooled ashlar dressings over clay walling; harled garden front with ashlar margins. Wallhead gable with apex stack to garden elevation; 2-pane glazing. Coped end stacks; slate roof. Low coped wall encloses Church Street frontage. Source: Listed Building description.
GARMOUTH HIGH STREET, THE MOORINGS AND REAR GIGHOUSE	The Moorings, Garmouth High Street, Urquhart, Moray							1									1			Gighthouse and stable at rear, single storey, clay and bool walling. Slate roof (some local slates). Source: Listed Building description.
GARMOUTH, 1 AND 2 SPEY STREET	1 & 2 Spey Street, Garmouth, Urquhart, Moray						1				late 18th						1			Pair 2-storey, 3-bay cottages. Harled solid clay walls. Listed for traditional clay walling construction. Source: https://online.aberdeenshire.gov.uk/smpub/master/detail.aspx?refn0=NJ36SW0110
GARMOUTH, HIGH STREET, LABURNUM AND WASH HOUSE	Laburnum, High St, Garmouth, Urquhart, Moray							1									1			Early-mid 19th Century single storey and dormerless attic, 3-bay cottage with centre door. Probably clay and bool construction beneath harling. Source: Listed Building description.
GARMOUTH, HIGH STREET, THE SHOP (DWELLING HOUSE ONLY)	The Shop, High St, Garmouth, Urquhart, Moray							1			early 19						1			Early 19th-century. Single storey 3-bay cottage. Clay and bool harled with painted margins. Varied glazing. Ridge stack next High Street set slightly in from north gable formerly serving a 'hinging lum' or timber canopy. Corrugated iron roof. Source: Listed Building description.
GARMOUTH, SOUTH ROAD, STEWART HOUSE, STABLE AND GARDEN WALLS	Stewart House, Garmouth Road, Urquhart, Moray							1									1			Low coped garden wall fronts house linked to former stable gighthouse with gable loft door and slate roof. Clay and bool walls enclose remainder of garden. Source: Listed Building description.
GARMOUTH, SPEY STREET, STAINSON HOUSE	Stainson House, Spey Street, Garmouth, Urquhart, Moray						1				Mid 18th						1			Mid 18th century with later additions. 2-storey, wide 3-bay house with single storey, single bay addition set back at E gable and further single storey, 2-bay addition projects at right angles from SW angle forming L-plan. Harled over clay and bool. Source: Listed Building description.

SCOTTISH EARTH MORTAR SITES SCHEDULE		(Compiled and updated 26.05.2022_H.R.WINSHIP)																		
SITE NAME	ADDRESS	ERA									BUILDING TYPE						NOTES			
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL	DEFENSIVE		DOMESTIC	RECREATION	SECULAR
MUIR OF MAVERSTON (2)	Carmouth, Moray.																			Two houses and enclosures are visible on the first and second edition OS maps. The area is now afforested and overgrown. The ruins of the two houses are depicted on the current edition (2006). An archaeological survey in 2007 recorded one building, 4.1m x 10m, orientated north-northwest to south-southeast to the southeast of the track and another 10.9m x 5.5m, orientated east-west to the northwest of the forest track. Both were built with a mixture of rounded pebbles and angular field stones with yellow, clay-based bonding. Source: https://online.aberdeenshire.gov.uk/smrpub/master/detail.aspx?refno=NJ36SW0041
PEBBLE COTTAGE (aka WEST END COTTAGE)	Pebble Cottage, Lein Road, Kingston, Moray.							1									1			Not mentioned on listed building description. Early to mid-19th century, single storey, 3-bay cottage. It has a harled exterior, with a centre door, 9-pane glazing, end stacks and a slated roof. There is a rear extension. There are clay bonded walls, which were exposed when the North-West corner collapsed. It was modernised in circa 1987. Previously known as West End Cottage. Source: https://online.aberdeenshire.gov.uk/smrpub/master/detail.aspx?refno=NJ36NW0005
PITTENDREICH DOVECOT	Elgin, Moray.				1					16thC	1									Probably 16th century, almost square dovecot, harled over rubble and clay mortar. Source: Listed Building Description.
ROSE COTTAGE	Urquhart, Moray.									U							1			Clay & boof cottage. Source: SVBWG Newsletter 1-3 1975-77, (Stell, G. (ed)) p6.
STAINSON HOUSE, SPEY STREET, CARMOUTH	Stainson House, Spey Street, Carmouth, Moray.					1											1			Mid 18th century with later additions. 2-storey, wide 3-bay house with single storey, single bay addition set back at E gable and further single storey, 2-bay addition projects at right angles from SW angle forming L-plan. Harled over clay and boof. Tooled ashlar margins to centre door now masked by modern sun porch. Slightly enlarged ground and outer first floor windows. Source: Listed Building Description and https://online.aberdeenshire.gov.uk/smrpub/master/detail.aspx?refno=NJ36SW0113 .
STARWOOD KILN	North Alves, Alves, Moray. IV30 8UZ						1				1									Kiln. Contained burnt oats and wood, paved at bottom with large stones and lined with rough boulders with a backing of clay. The mouth of flue near bottom, part of structure slipped downslope. Possibly 18thC.
STEWART HOUSE, SOUTH ROAD, CARMOUTH	Stewart House, South Road, Carmouth, Moray.					1											1			Mid 19th century with earlier core (probably later 18th century). Single storey and attic, 5-bay house with 2-storey, 2-bay rear wing. Harled frontage, rubble flanks, tooled ashlar dressings. Centre entrance with flanking projecting canted windows; 3-plied dormers break wallhead; modern 2-pane glazing. Tall end and ridge stacks; slate roof; stone ridge. Low coped garden wall fronts house linked to former stable gighouse with gable loft door and slate roof. Clay and boof walls enclose remainder of garden. Source: Listed Building Description.
THE COTTAGE, BURDSHAUGH, FORRES	The Cottage, Burdshaugh, Forres, Moray.							1									1			Early/mid 19thC. Single storey cottage, 3-bay with centre door with timber porch. Harled (probably over clay and boulder). Extension to S gable. End stacks; corrugated iron roof. Source: Listed Building Description.
THE OLD POST OFFICE, CLOCHAN	The Old Post Office, Clochan, Rathven, Moray.							1						1			1			Former Post office and house, built c.1820 still in use, depicted on the first edition OS map (but not marked as a post office until the second edition OS map). There was a well for the house to the west (now shown as a spring), and a number of outbuildings to the south, only one of which (facing on to the street) appears to survive. The house was originally a single storey clay and stone building with roof lights in a slate roof. The shop (PO) was 2-storey with basement, the first floor with tripartite dormer windows, the shop on the ground floor and a store and garage/stabling to the basement at rear. Source: https://online.aberdeenshire.gov.uk/smrpub/master/detail.aspx?refno=NJ46SW0132
TONGUE	Dufftown, Moray, AB55 4JT																			Remains of farmstead, comprising the remains of three buildings, a mill pond with lade and two enclosures. One of the buildings was a mill. The building which lies on the south has clay-bonded walls. Depicted on the first and second edition OS maps. Visited by RCAHMS in 1990. Source: Canmore.
TUGNET, WILLOW COTTAGE	Willow Cottage, Tugnet, Moray.							1									1			Early-mid 19thC. Single storey S facing 3-bay cottage. Whitewashed rubble (probably mixed with clay). Centre door. Good example of traditional 'clay and boof' cottage; shingle roof replaces former thatch. Source: Listed Building Description.
URQUHART MANSE, DOVECOT	Urquhart, Moray.							1			1									Clay and dab, harled. 32 nesting boxes in upper half of cote (intermediate ceiling demolished) modelled from clay mix with wood or stone slab horizontals. Only clay and dab doocot in north-east of Scotland. Source: Listed Building Description.
URQUHART VILLAGE, OAKLANDS	Urquhart Village, Oaklands, Moray.						1			early 19thC							1			Early 19thC. Long single storey, irregular 8-bay cottage. Harled over clay and boulder walling. Source: Listed Building Description.
URQUHART VILLAGE, THE MAINS	The Mains, Urquhart, Moray.						1			early 19thC							1			Harled clay and boulder walling and boulder case course. Source: Listed Building Description.
SPYNIE PALACE (WALL)	Spynie Palace, A941, Paddockdale, Seatown, Lossiemouth, Moray, IV31 6RZ											1								Excavation by J. Lewis, 2017. "Further S, the drystone, E/W perimeter wall built in 1820 was dismantled to reveal an underlying, clay-bonded and mortarpointed, rubble wall that survived to a length of 54m. This lower wall is believed to have formed the boundary between the palace and its gardens and orchards." Source: http://archaeol.wmms6.a2hosted.com/wp-content/uploads/2017/02/1992.pdf p38.
CLAY COTTAGE ARNOG	Amog, Banffshire, Moray																			Source: SVBWG Newsletter 1-3 1975-77, (Stell, G. (ed)) p6.

SCOTTISH EARTH MORTAR SITES		SCHEDULE														(Compiled and updated 26.05.2022_H.R.WINSHIP)				
SITE NAME	ADDRESS	ERA										BUILDING TYPE				NOTES				
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR
MAES HOWE	Maes Howe Burial chamber, Ireland Road, Stenness, Orkney Islands. KW16 3LB	1																		The mound itself, 25m in diameter and 7m high, consists largely of clay and stones. Source: Canmore.
WHITEHOUSE LANE, WHITE HOUSE, OUTBUILDINGS TO REAR	White House Lane, Stromness, Orkney Islands.						1										1			Possibly circa 1680. Single storey and attic 3-bay rectangular-plan asymmetrical crowstepped gabled outbuilding with forestairs to N, with further rectangular-plan shed/store set close to W, to rear (W) of re-built Whitehouse. Harl-pointed rubble. The Whitehouse, the replacement to which stands directly to the E of these buildings, was built in 1680 and was so called because it was the first house in Stromness to be constructed with lime mortar instead of clay. Captain Bligh dined in the house with the Stewarts of Masseter when Captain Cook's ships called into Stromness in 1780. Source: Listed Building description
KNAP OF HOWAR	Knap of Howar, Papa Westray, Orkney Islands.	1																		"Prehistoric monuments such as Knap of Howar...all utilize earth as a lubricant mortar to slide larger stones into position and clay puddle as a waterproof layer, underfoot and round the outside of the stone structure before the earth is piled round. Source: Walker, B. in Terra Britannica (2000) A celebration of Earthen structures in Great Britain and Ireland. ICOMOS Chapter 5: p 21.
SKARA BRAE	Skara Brae, Sandwick, Orkney Islands.	1																		"Prehistoric monuments such as Skara Brae...all utilize earth as a lubricant mortar to slide larger stones into position and clay puddle as a waterproof layer, underfoot and round the outside of the stone structure before the earth is piled round. Source: Walker, B. in Terra Britannica (2000) A Celebration of Earthen Structures in Great Britain and Ireland. ICOMOS Chapter 5: p 21.
MIDHOWE	Midhowe, Rousay, Orkney Islands	1																		"Prehistoric monuments such as Midhowe...all utilize earth as a lubricant mortar to slide larger stones into position and clay puddle as a waterproof layer, underfoot and round the outside of the stone structure before the earth is piled round. Source: Walker, B. in Terra Britannica (2000) A celebration of Earthen structures in Great Britain and Ireland. ICOMOS Chapter 5: p 21.
STACKLEBRAE, EDAY	Stackel Brae, Southside Road, Backaland, Orkney Islands. KW17 2AA											1								"The excavation revealed a series of walls forming a room or building, the S end of which has been lost to the sea. The structure was oriented cN-S, with an entranceway in the SE portion of the trench and measured 3.5m E-W by 5m N-S. The walls were clay-banded with some traces of lime render on the exterior wall face * Excavation by Amanda Brend - ORCA. Source: https://archaeologydataservice.ac.uk/archiveDS/archiveDownload?t=arch-753-1/dissemination/pdf/2000/2009_high.pdf p 131
1 CHURCH PLACE	North Bank Dykes, Errol, Perth and Kinross. PH2 7QH							1									1			This is thought to be typical example of 19thC. two storey mudwall semi-detached house. In 2015 a patch fell off the gable to the abutting building and revealed mudwall beneath. TM. Apart from cement render the building seems in good condition.
1 KIERS VILLA	1 Keirs Villa, High Street, Errol, Perth and Kinross. PH2 7QQ						1										1			This is a typical mudwall house with notable batter to the wall. Earth mortared foundations.
1 POND GREEN	1 Pond Green, off Church Lane, Errol, Perth and Kinross. PH2 7PX							1									1			This is a typical mudwall house with modern extension. The main walls front and back are solid mudwall. It appeared on the OS Map of 1854.
105 MAIN STREET (POST OFFICE)	105 Main Street (Post Office) Longforgan, Perth and Kinross. DD2 5EW							1						1			1			TM & LD confirmed earth mortar, cement pointed on 25.08.2017. The building is on the first edition OS map. This former farmhouse is particularly noteworthy since it joins the south range of Longforgan Farm steading. Together with the steading and the present Longforgan Farmhouse, this building forms a significant group within the village.
156 ATHOLL ROAD, SUNNYBRAE COTTAGE	156 Atholl Road, Sunnybrae Cottage, Pitlochry, Perth and Kinross							1									1			NN 936 583 A detailed survey of this cruck-framed building (DES 2000, 73) has enabled the phasing of the structure, although the exact date of its original construction remains elusive. It is, however, thought to be at least 200 years old, but could be considerably older. The original walls were probably of turf, supported on a low rubble wall, with an earthen core. Over the years, the turf was replaced with mortared stone masonry but the cruck frame has been retained in situ. The survey has enabled the preparation of detailed reconstruction drawings that will form the focus of a small display centre on the site. T. Holden, 2002. Source: Canmore https://canmore.org.uk/site/227111/pitlochry-156-atholl-road-sunnybrae-cottage
2 CHURCH PLACE	North Bank Dykes, Errol, Perth and Kinross. PH2 7QH							1									1			This is thought to be typical example of 19thC. two storey mudwall semi-detached house. In 2015 a patch fell off the gable and revealed mudwall beneath. (TM). Apart from cement render the building seems in good condition.
2 KIERS VILLA	2 Keirs Villa, High Street, Errol, Perth and Kinross. PH2 7QQ							1									1			This is a typical mudwall house. It is cement rendered but otherwise in fair condition. Walls are 3ft thick with horsehair & straw right through it. Damp and crumbling on gable wall.
41 MAIN STREET	41 Main St, Longforgan, Perth and Kinross. DD2 5ET							1									1			TM & LD confirmed earth mortar with some lime inclusion 25.08.2017. Cement pointed.
ABERNETHY MAUSEOLEUM	Abemethy Mausoleum, Churchyard, Abemethy, Perth and Kinross							1										1		This rectilinear structure has earth mortar, possibly with lime inclusion. The original lime pointing has been replaced with cement, which is falling. At low level there is decay with stones falling out. Site visited by TM on 01.11.2017. Many of the graveyard walls are similarly maintained but have not been included in the survey record.

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H.R.WINSHIP)																		
SITE NAME	ADDRESS	ERA										BUILDING TYPE				NOTES				
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR
ABERNETHY ROUND TOWER	Abenethy Round Tower, School Wynd, Abernethy, Perth and Kinross.				1														1	The ancient tower is a rare example in Scotland of a round tower more typically found in Ireland. Earth mortar found 01.11.2017 in an open joint near the base of the tower and recent mortar analysis higher up found a mix of clay and lime with sand.
AN CALA	An Cala, 117 Main St, Longforgan, Perth and Kinross. DD2 5HB									1							1			This building is on first edition OS map and likely to be earth mortar based on date and form, cement pointed.
AR BOTHAN	Ar Bothan, Gas Brae, Errol, Perth and Kinross. PH2 7QR									1							1			This is thought to be a mudwall house with signs of historic alterations. It is cement rendered, but otherwise appears in fair condition.
ARDENLEA	Ardenlea, Cowbank, Southgate, Errol, Perth and Kinross. PH2 7QS									1							1			This is thought to be a mudwall house with signs of historic alterations. It is cement rendered, but otherwise appears in fair condition.
ARTHURLEA	Arthurlea, Cowbank, Southbank, Errol, Perth and Kinross. PH2 7QS									1							1			This is thought to be a mudwall house with signs of historic alterations. It is cement rendered, but otherwise appears in fair condition.
ASHBANK EAST	Ashbank East, Cowgate, Southbank, Errol, Perth and Kinross. PH2 7QS									1							1			This semi-detached house has cement rendered mudwall to the gable and rear external walls, with the front elevation faced in stone, presumably mudwall behind. Mudwall was confirmed on the rear wall where the cement render is cracked and boss (TM).
ASHBANK WEST	Ashbank West, Cowgate, Southbank, Errol, Perth and Kinross. PH2 7QS									1							1			This semi-detached house has cement rendered mudwall to the gable and rear external walls, with the front elevation faced in stone, presumably mudwall behind. Mudwall was seen in an internal cupboard TM.
ATELIER (77 MAIN STREET)	77 Main St, Longforgan, Perth and Kinross. DD2 5EU									1										TM & LD confirmed earth mortar, 25.08.2017. Cement pointed.
BALLINCRAIG	Ballincraig, High Street, Errol, Perth and Kinross. PH2 7QP									1							1			The owner confirmed mudwall which was visible at the rear of the property. It has modern cement render and window alterations.
BEE COTTAGE	Leetown, Glencarse, Perth and Kinross. PH2 7NN									1							1			The owner confirmed the cottage was clay built and it appears on the first edition OS. It may reflect an estate use of materials, but no specific records are known in the Errol Estate.
BEECHWOOD	Beechwood, High St, Errol, Perth and Kinross. PH2 7QJ									1							1			Adjacent to Errol Fish & Chip shop. The owner confirmed this cottage was clay built. It appears a typical mudwall house, with window alterations and cement render.
BONHARD DOOCOT	Murrayshall Road, Scone, Perth and Kinross.									1										The dovecot at Bonhard House is a large lectern type with harled walls of sandstone 0.8m thick in two compartments. The two skewputs on the crowstepped gables bear the date 1709. The slated roof was originally thatched. Earth mortar was reported by Steve Newsom in 2012. Fenced off to prevent access due to the collapse of the east section. Despite repairs that took place in 1990 this looks in worse state than the similar doocots. clay/lime mortar confirmed by TM & LD, 2017.
BOWERVIEW	Bowerview, High St, Errol, Perth and Kinross. PH2 7QQ									1							1			The owner confirmed it was clay built and a former stable. Built by the same man who built 1 James Terrace. Cement rendered otherwise good.
BRAE COTTAGE	1 Castle Road, Longforgan, Perth and Kinross. DD2 5HA									1							1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
BRAEHOUSE	Braehouse, Church Lane, Errol, Perth and Kinross. PH2 7PX									1							1			The owner confirmed that all walls are mudwall 1.5-2ft thick. There was a serious house fire 10 years ago which melted a water pipe causing flooding of the entire building, but the clay walls absorbed most of it, and dehumidifiers dried it out. Formerly thatched. Old family home and former weavers cottage. Old title deeds on velum (now lost). Other than cement render the house appears in good condition.
BRAEKNOWE	Braeknowe, Gas Brae, Errol, Perth and Kinross. PH2 7QR									1							1			The owners confirmed that this house has all walls of mudwall and was built before 1745. The original staircase was on the outside, put was inside in 1962 with a small extension. Slate roof, no damp.
BURNSIDE COTTAGE AND SMITHY	East bank of the Wylie Burn 250m SSE of Pitkeathley Mains, Steading Bridge of Eam, Perth and Kinross. PH2 9HL									1							1			Remains of 2 cottages - clay bonded random rubble walls. Shown on 1866 OS maps, they were gone by 1920 map. Reference to thatch. The site is located not far from a map reference for Clayfolds. There was a planning application 2012 for redevelopment. May be lost. Surveyed and confirmed by LD, SW and TM, 2017.
CALVINE	Calvine, 37 Main St, Longforgan, Perth and Kinross. DD2 5EU									1							1			This building is on the first edition OS map. Highly likely to be earth mortar based on date and form.
CARMELLITE FRIARY, PERTH	Whitefriars Street, Carmelite Friary, Perth, Perth and Kinross.				1														1	This substantial complex of medieval masonry building lay just outside Perth city walls. Recent excavations (2017) have revealed clay mortared masonry wall bases, which are thought to have supported lime mortared upper walls.
CARR'S CROFT (Demolished)	Carrs Croft, Priory Place, Perth, Perth and Kinross.									1							1			This is the last sad remnant of a terrace of thatched cottages recorded in an early photograph. Roofless and derelict, the interior showed earth mortared masonry and mudwall, possibly just the upper gable. It is significant to find mudwall within the city of Perth and it is likely the clay was close. Present as 14 cottages on Perth Town Plan 1837-8 CG Sidey. The building was demolished in 2021.

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H.R.WINSHIP)														NOTES					
SITE NAME	ADDRESS	ERA							BUILDING TYPE												
		PRE-HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR	
CARSE CHEMIST	Carse Chemist, High Street, Errol, Perth and Kinross. PH2 7QQ						1								1						This looks like a typical mudwall house, with modern cement render. It is reported that Dr Easton discovered it was mudwall when he put in a side door and it clearly has had alterations over the years.
CARSE CHEMIST (TOP FLAT)	Top Flat, Carse Chemist, High Street, Errol, Perth and Kinross. PH2 7QQ						1										1				Mudwall upper flat over shop listed previously.
CARSELEA	Carselea, High St, Errol, Perth and Kinross. PH2 7QP						1										1				The neighbour reported this building as being clay mortar though it would be reasonable to assume mudwall over a mortared, masonry plinth. All well concealed behind painted cement render. The neighbouring building is Traquair and confirmed mudwall.
CASTLE HUNTLY DOOCOT	Huntly Castle Doocot, Longforgan, Perth and Kinross					1					17thC	1									TM & LD found earth mortar with hot lime inclusions on 25.08.2017. The earth mortar has a lovely red/brown colour and appears strong compared to the lime mortar. There is evidence for lime mortar in some places but it is almost all gone but the earth mortar is in excellent condition, despite the absence of the roof and corbelled corner turrets. Traces of a lime harl remain. This derelict doo'cot masonry was in significantly better condition than the others examined and this attributed to the quality of the mortar.
CASTLE HUNTLY ICEHOUSE	Huntly Castle Icehouse, Longforgan, Perth and Kinross.					1					1692	1									A very early intact example of an estate icehouse, situated to the northeast of the castle. There is a semi-circular forecourt set into the sloping ground, with rubble retaining walls and a flight of steps leading down to the entrance. This is surrounded by later metal railings. The interior is brick with a passage leading to the bottle-shape ice chamber. TM & LD identified clay mortar behind lime mortar on the entrance wall, 2017. How much clay mortar is used in the main construction could not be determined.
CHAMBERBANE COTTAGE	Chamberbane Cottage, Blair Atholl, Perth & Kinross						1				17-18						1				At Chamberbane the four cruck couples are not carried on the walls but are supported on the projecting stone base. As they are independent of the walls, this means that the original walls were likely to have been built of a non-load-bearing and perishable material such as turf, which was constructed over the projecting stone base. The walls were then later built up using locally available rubble stone, clay mortar and lime. Some footings and walls of these previous buildings do remain evident, as do the earth and rubble stone platforms on which they were sited. Source: Listed Building description.
CHEPSTOW	Chepstow, High St, Errol, Perth and Kinross. PH2 7QQ							1			1880						1				The owner confirmed that this building is mudwall 17.01.2017 and it appears a typical town house dating from the latter period. Cement render in decent condition.
CHERRY COTTAGE	Cherry Cottage, 44 Main St, Longforgan, Perth and Kinross. DD2 5EU							1			Early 19thC						1				TM & LD confirmed earth mortar, 25.08.2017 behind cement pointing.
COBBLER BRAE GROUND FLAT	Ground Flat, Cobbler Brae, Errol, Perth and Kinross. PH2 7QR							1			1880						1				A late example of a mudwall town house with later window alterations. Cement render appears in reasonable condition.
COBBLER BRAE TOP FLAT	Top Flat, Cobbler Brae, Errol, Perth and Kinross. PH2 7QR							1			1880						1				A late example of a mudwall town house with later window alterations. Cement render appears in reasonable condition.
COTTOWN NORTH RUIN 1	Cottown, St Madoes, Perth and Kinross.						1										1				This ruined cottage comprises substantial walls and internal features, but it is overgrown with vegetation. The walls are mainly clay mortared masonry, but mudwall was also thought to be used. Photographs from 1973 show a thatched building, similar of the pictures of Cottown West Ruin.
COTTOWN NORTH RUIN 2	Cottown, St. Madoes, Perth and Kinross.						1														This ruined cottage comprises substantial walls and internal features, but it is overgrown with vegetation. The walls are mainly clay mortared masonry, but mudwall was also thought to be used. Photographs from 1973 show a thatched building, similar of the pictures of Cottown West Ruin.
COTTOWN SCHOOLHOUSE	Cottown, St Madoes, Perth and Kinross.						1								1						This well-documented building is by far the best surviving example of a traditional mudwall building, with mud and stud internal partitions, wattle and daub lums and authentic thatched roof. The building has lost its original floor and has been damaged by flooding and neglect. It is not generally open to the public.
COTTOWN WEST RUIN	Cottown, St Madoes, Perth and Kinross.						1										1				The west ruin was known to contain 18th C. clay and straw walls attached to a larger clay-mortared rubble house. Alterations during the late 19thC including the blocking of the rear door, the creation of a window, and the construction of a brick partition wall which
CRAIG COTTAGE EAST	Craig Cottage East, Southbank, Errol, Perth and Kinross. PH2 7QS							1			1872						1				The owner reported that originally there was a clay wall at the front. The house burnt down in 1920 and after it was rebuilt, the only remaining mudwall is in the downstairs kitchen. The next door house was rebuilt completely.
CRAIG GOWAN	11 Castle Road, Longforgan, Perth and Kinross. DD2 5HA							1			Early 19thC?						1				This building is on first edition OS map. Highly likely to be earth mortar based on date and form.

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H R WINSHIP)																		
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		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR
EAST INCHMICHAEL OUTBUILDINGS	Cairn O'Mohr Winery, East Inchmichael, Errol, Perth and Kinross. PH2 7SP						1										1			Clay mortared masonry was found on the east gable of barn and in the wall of the outbuilding holding the tank. Clay/lime mortar was found in the wall and remnants of the building next to the shed. The owner reports that 2 types of clay found close by the main clay is greyer than the boulder clay from Ninetree Brae.
ELCHO CASTLE BAMKIN TOWER	Elcho Castle, Rhynd, Perth and Kinross.			1									1							The base of this tower is a vaulted oven of clay mortared masonry and with a clay floor. External pointing is lime and it is unclear whether other clay mortars in the castle are clay, or why clay could have been specially selected for an oven. This area is not normally accessible to the public, being adjacent to a domestic cottage.
ELIZLEA	Elizlea, High Street, Errol, Perth and Kinross. PH2 7QQ						1										1			The owner said it had been rebuilt in 1870, thought to be older. Extended. No visible damp. No foundations. Two walls internally are clay.
ERROL PARK SHELTER	Public Park beside Church, Errol, Perth and Kinross. PH2 7SQ																	1		The park shelter was designed by Arc Architects and constructed 2017 by Tay Landscape Partnership volunteers and trainees under guidance of Becky Little of Rebeath. It is the first mudwall structure to be built in the Carse of Gowrie for over 100 years. It features a clay mortared base on gravel foundations, mudwall with local clay plaster and a cor-ten steel roof.
FERN COTTAGE	89 Main St, Longforgan, Perth and Kinross. DD2 5EU								1								1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
FERNBANK	Fernbank, High Street, Errol, Perth and Kinross. PH2 7QQ						1										1			This building has been much altered and is now divided into the 4 flats. Clay was identified by TM in a hole in the cement render on the north side.
FERNBANK	Westend, Rait, Perth and Kinross. PH2 7RT						1										1			Single storey thatched cottage, highly likely to be clay mortared masonry, given age, location and precedent. Dark stains indicate clay mortar. Walker states that surviving features, such as the rounded corners, the projecting footings and the presence of some slightly concave walls, indicate that Fernbank has origins in the 17th or early 18th century (1981, p.206). It is likely that the original walls would have been built of turf, wattle, mud or clay, over the rubblestone footings and corners which comprised of rounded field boulders (Walker, B. 1981, p.203). The walls were then later built up using locally available rubblestone, clay mortar and lime.
FERNBANK	50 Main St, Longforgan, Perth and Kinross. DD2 5EU								1								1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
FLATFIELD BYRE	Flatfield, Errol, Perth and Kinross. PH2 7RW						1						1							This building appears on first edition OS map and shows alterations including increasing the wall height which suggests it may have originally been a cottage. Extensive repairs undertaken as part of the Tay Landscape Partnership in 2015. Remnants of turf roof, internal clay plaster and external lime were found. The repairs included a new external earth render.
FLATFIELD BARN (EAST RANGE)	Flatfield, Errol, Perth and Kinross. PH2 7RW						1						1							This outbuilding contains mudwall in a number of external and internal walls alongside later masonry alterations. Repairs to the mudwall were undertaken in 2016 as part of the Tay Landscape Partnership. There are timber lintols and cement render in poor condition.
FLATFIELD CATTERY (former cart shed)	Flatfield, Errol, Perth and Kinross. PH2 7RW						1										1			This is named as former cart shed on the Listed Building description and incorporates a pigeon loft with entry on the south gable. The silt-rich mudwall is visible and in better condition on the north gable than on the south where there is significant moss growth that does not appear to be causing significant damage. Evidence of significant alterations in brick. No internal inspection. (TM)
FLATFIELD NORTH RANGE	Flatfield, Errol, Perth and Kinross. PH2 7RW								1				1							This is one of the few surviving examples of clay floor which were found during the TLP survey. It is a working farm floor, regularly trafficked and the owner reports it works well. The building is thought to have clay mortared masonry as well, but not mudwall.
FORTEVIOT BRIDGE	Forteviot, Perth and Kinross.						1							1						The 18thC bridge is single carriageway over 3 arches. TM & LD found earth mortar in the parapet, behind modern cement pointing in poor condition. (2016).
FROCHOOP	Froghoop, Southbank, Errol, Perth and Kinross. PH2 7QS						1										1			The owner describes all walls are clay about 600mm thick. The building had been subject of a fire in the past and 'Old tree trunks' are reported to have been found during renovation. Mudwall can be seen in airing and electricity cupboard.
GLENVIEW	4 Westend, Rait, Perth and Kinross. PH2 7RT						1										1			18th C. row of dwellings slightly curved in plan, now united into one dwelling. Recorded as 3-6 Westend in Canmore. The cottages have a continuous thatched roof, thatched in reed. Single storey whitewashed rubble walls with clay mortar. Brick chimneys. Canmore has a photo apparently showing a turf wall in the attic, but this could not be confirmed on site (2016).
GOWRIE COTTAGE	Gowrie Cottage, 79 Main Street, Longforgan, Perth and Kinross. DD2 5EW								1								1			TM & LD confirmed clay mortar behind cement pointing 25.08.2017.

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GRAY HOUSE	Cray House, School Wynd, Errol, Perth and Kinross. PH2 7QN							1									1			Cray House is a mudwall house, with numerous alterations, mainly with clay mortared masonry and brick. It underwent extensive repairs in 2017 as part of the TLP, and this is recorded in HES Good Repair Guide. Remnants of broom thatch in the roof space were found although, like all Errol buildings, it is now slated. The south gable was faced with concrete block after demolition of the neighbouring building, which was semi-detached, leaving this one alone.
GREENBANK	Greenbank, Gas Brae, Errol, Perth and Kinross. PH2 7QR						1										1			This was identified as mudwall in 2012, but no details have been verified. There are cracks in the cement render.
HARCOT	78 Main St, Longforgan, Perth and Kinross. DD2 5EW						1			Late 18thC							1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
HAWTHORN COTTAGE	Hawthorne Cottage, 59 Main Street, Longforgan, Perth and Kinross. DD2 5EW						1			Late 18thC							1			Thatch survey 150. The cottage is still thatched (2017). TM & LD found red clay mortar behind cement pointing with some lime harl remnants
HILLCROFT	22 Castle Road, Longforgan, Perth and Kinross. DD2 5HA						1			Late 18thC							1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
HILLVIEW	82 Main St, Longforgan, Perth and Kinross.						1			Early 19thC?							1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
HILLVIEW	Hillview, Southbank, Errol, Perth and Kinross. PH2 7QS				1												1			This is one of the oldest houses in the village though remodelled in 1931. The owner confirmed mudwall and it has cruck roof timbers, low ceilings, a clay floor under timber and was previously thatched. Deeds give right to dig clay at Auld Scots Bridge.
HOLLYDENE	Village Road, Rait, Perth and Kinross. PH2 7RT						1			18thC - 19thC							1			Single storey slated cottage, highly likely to be clay mortar given is age, location and precedent.
HOUSE AT DALGUISE	Kirk Park, Dalguise, Dunkeld, Perth and Kinross. PH8 0JU													1						Arc Architects new build (2003) eco home using unfired earth bricks internally and clay mortar.
HUNTLY COTTAGE	Huntly Cottage 4 Castle Road, Longforgan, Perth and Kinross. DD2 5HA							1		Early 19thC?							1			LD & TM confirmed earth mortar 25.08.2017. This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
INGLENEUK	Ingleneuk, Southbank, Errol, Perth and Kinross. PH2 7QS							1		1820							1			The owner described how this was six clay built cottages. Each house was 20ft x 15ft with two outside stairs, curved on front, and a straight stair on the back. It has been extensively renovated to form one dwelling. Only two internal clay walls remain and a concrete floor was laid over the clay floor.
KIMBERLEY	Kimberley, Church Lane, Errol, Perth and Kinross. PH2 7PX						1			18thC-19thC							1			This house shows typical characteristics of mudwall house with a battered base, but all concealed behind cement render, which shows some cracks. Neighbour to Morar.
KIRKSTYLE	Kirkstyle, Church Lane, Errol, Perth and Kinross. PH2 7PX							1		19thC?							1			The building is shown on first edition OS map of 1854 and appears to be mudwall, much altered and cement rendered. An adjacent building showed clay through a crack.
LANGDALE	Langdale, 48 Main St, Longforgan, Perth and Kinross.							1		Early 19thC?							1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
LEETOWN VICTORY SOCIAL CLUB	Leetown, Errol, Perth & Kinross.							1		pre 1898							1			There were substantial brick-faced mudwall remains of this building in the 1990s but little now remains. It was thought the building was built after WW1, but there is some uncertainty if this is the correct name for the building. In 1996, you could see half brick thick facing and mudwall about 500mm thick behind, apparently an original composite construction. There are some record photos at Historic Environment Scotland.
LILAC COTTAGE	Lilac Cottage 39 Main Street, Longforgan, Perth and Kinross. DD2 5ET						1			Early 19thC							1			TM & LD identified clay mortar 25.08.2017. The building was vacant and the chimney was in the garden.
LIME GREEN COTTAGE	Lime Green Cottage, Gas Brae, Errol, Perth and Kinross. PH2 7QR							1		1870							1			This is a typical mudwall, semi-detached where mudwall was visible during repairs to the rear wall of the neighbouring building, Riverview. The render is cement.
LONGCROFT	29 Main Street, Longforgan, Perth and Kinross.						1			Early 19thC							1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
LORNE COTTAGE	Lorne Cottage, 115 Main St, Longforgan, Perth and Kinross.							1		Early 19thC							1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form. Substantial and imposing modern alterations.
LORRAIN	Lorrain, Cowgate, Southbank, Errol, Perth and Kinross. PH2 7QS							1?									1			Front wall clay mortar, confirmed by owner.
MADDERTY PARISH CHURCH BOUNDARY WALL	Madderty, Strathearn, Perth & Kinross.									from 1200 -								1		Suggested by Daniel Postma pers.comm. Email 04.02.2022.
MAGPIE COTTAGE	Magpie Cottage, Cowgate, Southbank, Errol, Perth and Kinross. PH2 7QS						1			18thC.							1			Confirmed mudwall by Viv Whyte 2012. TM visited in 2016 and gave advice on maintenance. The render is cement and the rear is altered and extended.

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H.R.WINSHIP)																		
SITE NAME	ADDRESS	ERA									DATE	BUILDING TYPE						NOTES		
		PRE HISTORY	ROMAN	PICTISH	MEDIAEVAL	17th C.	18th C.	19th C.	20th C.	21st C.		AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL	DEFENSIVE	DOMESTIC		RECREATION	SECULAR
MAINS OF PITCASTLE	Logierait, Perth & Kinross.					1										1				The Old Laird's House, a cruck-framed building, stands behind the farmhouse of Pitcastle. It is now uninhabited, roofless and derelict, but its chief interest lies in the fact that it was evidently erected, probably in the 17th century, as a residence of a small laird, and therefore stands apart from other cruck-framed buildings in Scotland - mostly cottages or small farms. The building, 55' long, is built of rubble masonry set in mud mortar, with originally, thatched roof and unglazed windows. There were three ground floor rooms and two above. J Dunbar 1960 Suggested by Daniel Postma pers comm Email 04.02.2022.
MANDALAY	Mandalay, Church Lane, Errol, Perth and Kinross. PH2 7PX							1			1854					1				The owner confirmed mudwall construction (2016) and it appears a typical mudwall building in good condition apart from cement render.
MO DHACHAIDH	76 Main Street, Longforgan, Perth and Kinross.					1					Late 18thC.					1				This building is on first edition OS map. Highly likely to be earth mortar based on date and form. Neighbouring to Rannoch Cottage where clay mortar and earth floor were confirmed.
MORAR	Morar, Church Lane, Errol, Perth and Kinross. PH2 7PX.							1			1854 poss earlier					1				The main body of the house is mudwall, which has been confirmed by the owner. It has a stone foundation course. First noted on valuation rolls in 1854.
MUIREDGE FARM COTTAGE	Muiredge Farm Cottage, Errol, Perth and Kinross. PH2 7RD							1			1892					1				This cottage has had significant modern alterations, but mudwall wallheads were seen in attic space. There are minor cracks in the cement render and TM gave the owner maintenance advice.
NORTH VIEW	North View, High Street, Errol, Perth and Kinross. PH2 7QQ							1			1880					1				This was formerly two properties, merged when it was renovated in 2007. The walls are 2ft thick with a stone front facade, cement pointed and cement rendered side and rear. The owner found mudwall in attic. A bit of damp is reported near windows. The uninsulated plasterboard linings are reported to be 1ft away from the mudwall which is "crumbly".
OAKBANK	Oakbank, 7 High Street, Errol, Perth and Kinross. PH2 7QQ							1			1870					1				The owner confirmed the walls are 2ft thick mudwall which is visible in the attic. Harled with cement, with a modern extension to rear. There is damp around the fireplace but not elsewhere. Outside is harled with slate roof. Modern extension to rear.
OLD BURNSIDE COTTAGES	Old Burnside Cottages, Rait, Perth and Kinross.					1										1				Evidence uncovered during the survey and restoration works of the 1970s showed that the house is of an early construction date, predating the 19th century (Walker, B. 1981, p.205). The building would have once had a narrower footprint and the walls would have originally been constructed of turf, wattle, mud or clay, over the rubble stone footings and corners, which comprised rounded field boulders. Remnants of these footings and corners survive at Old Burnside Cottages and they are a common feature of pre-19th century vernacular buildings. The walls were then later built up using locally available river-washed boulders set into clay, which in this case, would have required the use of shuttering. Walker states that the method used at Old Burnside Cottages was very unusual, as the larger boulders were carefully placed against the outer face but the smaller stones were simply dropped into the tempered clay in the centre of the wall and were not bound (1981, p.205). Source: Listed Building Description.
ORMLIE	Ormlie, Cowgate, Southbank, Errol, Perth and Kinross. PH2 7QS							1			18thC. 19thC.					1				This building bears the hallmarks of an older mudwall building with a significant batter on single storey cement rendered walls.
PERTH HIGH STREET (Excavation)	High Street, Perth, Perth & Kinross				1											1				850 clay bonded at foundations, mortared above 824, 852 clay bonded low stone walls to carry sill beams. (Also clay on wattle 834 Possibly solid clay - so common use and ready availability of clay). 14thC. Source: Murray in PHSE vol 1, 133-135, 186, 190-191, 196.
PITFOUR FARM	Pitfour, Carmie Farm, St Madoes, Perth and Kinross.							1					1							Canmore records that the east part is clay walled and was once thatched. Notes: Carmie Mill Steading nearby formerly also thatched, now re-roofed (From Canmore). Illustrated in Whyte, V., 2010 p63.
PITMIDDLE BUILDING 1	Kinnaird, Carse of Gowrie, Perth and Kinross.										Earl 19thC.					1				Building 1 is the most substantial ruin, with most walls surviving to a fair height, including windows and internal press openings. There is one cast iron fireplace, half buried in the rubble. This is understood to have been the last house abandoned and to have housed a mason, which may explain why this is the only building to have clay/lime rather than pure clay earth mortared masonry. Some lime pointing remains on the north exterior. TM & LD found earth mortar 06.09.2017
PITMIDDLE BUILDING 2	Kinnaird, Carse of Gowrie, Perth and Kinross.										Earl 19thC.					1				TM & LD found clay mortar 06.09.2017 in all observed remains. Building 2 comprises one substantial gable and low remains of rectilinear earth mortared masonry.
PITMIDDLE BUILDING 3	Kinnaird, Carse of Gowrie, Perth and Kinross.										Earl 19thC.					1				TM & LD found clay mortar 06.09.2017 in all observed remains. Building 3 comprises only low remains of rectilinear earth mortared masonry walls.
PITMIDDLE BUILDING 4	Kinnaird, Carse of Gowrie, Perth and Kinross.										Earl 19thC.					1				TM & LD found clay mortar 06.09.2017 in all observed remains. Building 4 comprises only low remains of rectilinear earth mortared masonry walls.
PITMIDDLE BUILDING 5	Kinnaird, Carse of Gowrie, Perth and Kinross.										Earl 19thC.					1				TM & LD found clay mortar 06.09.2017 in all observed remains. Building 5 comprises only low remains of rectilinear earth mortared masonry walls.
PITMIDDLE BUILDING 6	Kinnaird, Carse of Gowrie, Perth and Kinross.										Earl 19thC.					1				TM & LD found clay mortar 06.09.2017 in all observed remains. Building 6 comprises only low remains of rectilinear earth mortared masonry walls, with one window opening.
PITMIDDLE BUILDING 7	Kinnaird, Carse of Gowrie, Perth and Kinross.										Earl 19thC.					1				TM & LD found clay mortar 06.09.2017 in all observed remains. Building 7 comprises only low remains of rectilinear earth mortared masonry walls.

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H.R.WINSHIP)																		
SITE NAME	ADDRESS	ERA									BUILDING TYPE					NOTES				
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR
PITMIDDLE BUILDING 8	Kinnaird, Carse of Cowrie, Perth and Kinross.							1									1			TM & LD found clay mortar 06.09.2017 in all observed remains. Building 8 comprises only low remains of rectilinear earth mortared masonry walls.
PITMIDDLE BUILDING 9	Kinnaird, Carse of Cowrie, Perth and Kinross.							1									1			TM & LD found clay mortar 06.09.2017 in all observed remains. Building 9 comprises reasonably well defined remains of rectilinear earth mortared masonry walls.
POST OFFICE	Post Office, High Street, Errol, Perth and Kinross. PH2 7QQ						1										1			The building is mudwall with cement render, which is cracked in places. The east and ground floor is the post office, believed to have housed a cobbler's and/or a saddlers. The original structure is mudwall construction built of a boulder base, later raised in brick. Source: Whyte, V. 2010, A study of the earth structures in the Carse of Gowrie, p 118-124).
POST OFFICE HOUSE	Post Office, High Street, Errol, Perth and Kinross. PH2 7QQ						1										1			The building appears to have originally been two separate properties, now united. The west end (left) is residential accommodation and is linked to the east at first floor. Originally 1 3/4 storey, raised to 2 in brick, likely some time before the mid 19thC. The original structure is mudwall construction built of a boulder base, later raised in brick. (Source: Whyte, V. 2010, A study of the earth structures in the Carse of Gowrie, p 118-124).
RAIT OLD PARISH CHURCH	Westend, Rait, Perth and Kinross. PH2 7RT				1													1		The remains of the pre-Reformation parish church, which was abandoned in the early 17th century. It is 20m by 6.4m with walls 0.8m thick of random coursed rubble with freestone quoins and dressings. The east gable survives to its full height and other walls to varying height. Original sections of wall are earth mortared, with remnants of internal lime plaster, and later alterations in lime. The ruin was repaired by the TLP project and comprehensively re-pointed in lime, with new interpretation panels.
RANNOCH	Rannoch, 80 Main St, Longforgan, Perth and Kinross. DD2 5HB						1											1		TM & LD confirmed clay mortar 25.08.2017. Red clay mortar found in all internal walls. Clay subsoil in garden looked similar. The owner is renovating including pointing walls with lime. Concrete floor has been lifted finding flagstones under and presently looks like a earth floor beneath. This row is a curved row of 4 cottages in a row 76-82, assumed originally identical.
RATTRAY "CLAY" HOUSE	Back Brae, Blairgowrie, Perth & Kinross.																	1		Mudwall on clay bonded founds.
RIVERVIEW	Riverview, Gas Brae, Errol, Perth and Kinross. PH2 7QR							1										1		The rear wall was seen to be mudwall with cement render when under repair in 2016.
RIVERVIEW	Riverview 10 Castle Road, Longforgan, Perth and Kinross. DD2 5HA						1											1		TM & LD confirmed clay mortar 25.08.2017.
ROSE VILLA	Rose Villa, High St, Errol, Perth and Kinross. PH2 7QP							1										1		This was recorded as mudwall in 2012 in a conversation with Warren Mailer of Glen Construction who had previously worked on the building. It appears to have a modern stone face in cement mortar.
ROSEBANK COTTAGE	121 Main Street, Longforgan, Perth and Kinross.						1											1		This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
RUSTIC HOUSE	Rustic House, Church Lane, Errol, Perth and Kinross. PH2 7QS							1										1		The house is present on the first edition OS map 1860. All walls are mudwall, excluding recent extension, with a brick built chimney stack. Lime render was removed in 1970, and replaced with wire lath and sky marble chip cement roughcast. Title deeds to the property grant a feu duty with rights to cut reeds from the Tay and dig clay, so it must originally have been thatched.
SEAFIELD COTTAGE	Seafield Cottage, 53 Main Street, Longforgan, Perth and Kinross. DD2 5EW						1											1		This building is on first edition OS map. Highly likely to be earth mortar based on date and form. TM & LD identified earth mortar 25.08.2017. Wide boulder base course.
SHED BEHIND 66-68 DUNDEE RD, KINNOULL	66-68 Dundee Road, Kinnoull, Perth, Perth and Kinross. PH2 7BA							1										1		Clay mortar identified by LD during fieldwork 2017, in a rubble built shed behind property, may have been part of a larger building or wall and indicate the presence of clay mortar in some of the more substantial 19thC buildings which could not be examined closely.
SOUTHBANK	Cowgate, Errol, Perth and Kinross. PH2 7QS							1										1		The owner confirmed mudwall, brick-faced. It is unclear on these brick based buildings whether the inner base for the mudwall is also in brick and lime mortar.
SPARROWMUIR COTTAGE	Sparrowmuir Cottage, St Madoes, Perth and Kinross. PH2 7NP						1											1		Traditional 18thC. Mudwall cottage. Single storey, 5 bay altered from 6, this was originally a pair of cottages united into one. On first edition OS map. The cement render is badly cracked in places and there is signs of damp problems on the north west wall. TM & BL visited in Dec 2016, and gave the owners maintenance advice. Sparrowmuir was originally built as part of a pair of symmetrical single storey 3 bay cottages, two windows and a central lined storm door. (Source: Whyte, V., 2010, Earth Buildings in the Carse of Gowrie, 108-110).
STEEPLE COTTAGE	93 Main Street, Longforgan, Perth and Kinross.						1											1		This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
TARSAPPIE BUILDING 2 (Moncreiffe Hill Cottage)	Moncreiffe Hill near Perth, Perth and Kinross.							1										1		The remains of two cottages, each with an outbuilding to the S, are situated in pasture on the NE flank of Moncreiffe Hill. All these structures are depicted as roofed on the first edition of the OS 6-inch map (Perthshire, 1866, sheet xcviij), but had been abandoned by the date of the second edition (1902, sheet xcviij, SW), and have now been reduced to low clay-mortared masonry walls. LD confirmed clay mortar 2017.

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H_R WINSHIP)																		
SITE NAME	ADDRESS	ERA								BUILDING TYPE						NOTES				
		PRE-HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR
THE BIELD (38 HIGH ST)	The Bield, 48 High St, Errol, Perth and Kinross. PH2 7QJ						1										1			This is a mudwall building with a clay floor under concrete. The external cracked cement render was being removed and expected to be lime harled.
THE COTTAGE	36 Main St, Longforgan, Perth and Kinross.						1										1			This cottage is still thatched with reed rather than straw. TM & LD confirmed red clay mortar 25.08.2017 behind cement pointing, with some lime harl remains.
THE CROFT	The Croft, East Brae, Errol, Perth and Kinross. PH2 7QR						1										1			The owner confirmed this building is mudwall. The front is stone faced, the gable and rear cement rendered.
THE FISH BAR	The Fish Bar, High Street, Errol, Perth and Kinross. PH2 7QJ							1						1						The chip shop is an unusual mudwall building with a corner doorway and corbel over. The cement render is cracked.
THE FISH BAR - TOP FLAT	Top Flat, The Fish Bar, High Street, Errol, Perth and Kinross. PH2 7QJ							1									1			The owner confirmed this building is mudwall. It is cement rendered with an unusual corbel corner door.
THE HORN FARMHOUSE	The Horn Farm, Errol, Perth and Kinross. PH2 7SR						1										1			The Horn Farmhouse is an unusual mudwall building, with a low ground storey and generous first floor. Most of the walls are cement rendered, but the west wall is stone faced. It is recorded as being designed or altered by a Dundee Architect in the 19th Century. A Latin inscription above the door is translated as "A mud house is my defence". The building has been disused for several decades and is poorly maintained. Leaking rhones led to the collapse of a section of mudwall, which was repaired in 2017 though the Tay Landscape Project. It remains unused and at risk from further decay.
THE QUOINS	The Quoins, 91 Main Street, Longforgan, Perth and Kinross. DD2 5EW						1										1			TM & LD found clay mortar 25.08.2017. Red clay mortar found, still thatched.
THE RETREAT 18 CASTLE RD	18 Castle Road, Longforgan, Perth and Kinross. DD2 5HA						1										1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
THE SHIELING	The Shieling, Church Lane, Errol, Perth and Kinross. PH2 7PX						1										1			Neighbour to Morar and Kimberley. The property was being renovated and extended (2016). The walls show the batter typical of mudwall.
THE SHIELING	The Shieling, Rait, Perth and Kinross. PH2 7RT						1										1			Good example of earth mortared masonry in decay with large cracks. Previously thatched, single storey harled and slated. The work revealed that Shieling Cottage has clay bonded rubble walls and was constructed over two phases, a small structure to the W being later extended to the E. The building was altered several times during the 19th C. and the original thatched roof replaced in slate. A number of elements in this building hinted at a possible original late 18th century date. Barton, T. (2012). HISTORIC BUILDING RECORDING SHEILING COTTAGE, THE SMITHY AND SMITHY HOUSE, RAIT Perth Alder Archaeology Ltd. https://doi.org/10.5284/1019722 . ON BARR register. LD & TM 06.09.2017 confirmed earth mortar.
TRAQUAIR	Traquair, High St, Errol, Perth and Kinross. PH2 7QP						1										1			The owner confirmed this building is mudwall, formerly thatched and built by a sea captain. When the ceiling came down internally it revealed it had been constructed from ship timbers. There are several periods of construction, the owner thinks it is much older than 1899 as there was a window which is now facing another building. Adjacent house is Carselea (recorded as clay mortar).
VICTORIA COTTAGE	Victoria Cottage, 3 Castle Road, Longforgan, Perth and Kinross. DD2 5HA						1										1			TM & LD confirmed earth mortar 25.08.2017. Lime harl remains.
VIEWBANK	Viewbank, High St, Errol, Perth and Kinross. PH2 7QE						1										1			A mass clay stove was built in this house by Swedish and German experts during Clayfest in 2015 using earth mortared brickwork and clay plaster.
WALLACE COTTAGE	35 Main Street, Longforgan, Perth and Kinross.						1										1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form. Reportedly the fleeing resting place of William Wallace.
WEAVERS COTTAGE	Weavers Cottage, Westend, Rait, Perth and Kinross. PH2 7RT						1										1			18thC. pair of cottages, united into one. The cottages have a continuous thatched roof, thatched in reed. Single storey whitewashed rubble. Wallhead slopes with ground. Brck chimneys. TM found clay mortar (2016).
WEST CRAIG	West Craig, Southbank, Errol, Perth and Kinross. PH2 7QS							1									1			The building appears to be mudwall, much altered.
WESTEND COTTAGE	119 Main Street, Longforgan, Perth and Kinross.						1										1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form.

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H.R.WINSHIP)																		
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		PRE-HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR
WESTOWN CHAPEL	Westown, Inchture, Perth and Kinross. PH2 7SX				1						16thC.								1	The remains of a medieval church which has clay/lime mortar. HES cleaned and stabilised the walls in 2012.
WHITE BARNS	12 Castle Road, Longforgan, Perth and Kinross. DD2 5HA						1				Late 18thC						1			This building is on first edition OS map. Highly likely to be earth mortar based on date and form.
WIRIBEG	Wiribeg, East Inchmichael, Errol, Perth and Kinross. PH2 7SP									1	before 1843						1			The current owner is unsure if it is mudwall, and was once told the cottage was built on the spoils of the gully making. It is present on first edition OS map of 1843. Parts look to be stone foundations, but the owner believed there was a rebuild on the old foundations. A 1940's plan of the cottage shows it was once two dwellings. The 1940's work included concrete add ons, which had flat roofs & metal windows.
WOODSIDE COTTAGE	Leetown, Glencarse, Perth and Kinross. PH2 7NN									1							1			This cottage is assumed to be mudwall as the adjacent Bee Cottage is confirmed mudwall. On first edition OS map. Known as Coldcot in OS name book 1859-62.
ANCRUM VILLAGE, THE GREEN, SMITHY COTTAGE, ALSO KNOWN AS SUNNYSIDE COTTAGE	Smithy Cottage, Ankrum, Scottish Borders						1				early 18th						1			Single storey dwelling and byre dating possibly to early 18thC, with alterations at various dates. S-N orientated, with front (S) gable facing The Green. Thick walled in random rubble with clay mortar. Source: Listed Building description.
CLAY HOUSE (SMITHY)	Coldingham, Scottish Borders.											1								The first edition Ordnance Survey map shows a pair of buildings, marked as "smithy" within a small enclosure beside the road from Coldingham to Ayton. Beside the smithy is what appears to have been a cottage, possibly for the smith. By the time of the second Edition Ordnance Survey map of Berwickshire (1899) the buildings are no longer marked as a smithy and by the third Edition (1908) the buildings have been gone. It is not known if any remains connected with the smithy and adjoining cottage survive.
EASTER WEENS	Easter Weens, Bonchester Bridge, Hawick, Scottish Borders. TD9 8JQ																1			Clay mortar present. (R. Curtis pers.comm. Email 07.03.2022).
FISHER'S TOWER	Melrose, Scottish Borders				1	1											1			Recently completed (2019) consolidation of this 16th century (?) small tower house which was substantially altered and enlarged in the 18th century. The work comprised consolidating the masonry structure using clay/earth sourced from a building site 200m away and Scottish larch lintols, repointing and plaster edge consolidation with mortar containing Scottish lime burnt in a small kiln on site and aggregate extracted (with permission) from a River Tweed sand bank, and localised repairs to the naturally occurring soft capping with local turf, seed mix and sedums. Over 50 people attended two open days held on site to see the work in progress, which were part funded by Historic Environment Scotland, carried out by Alison Davie Construction and managed by Adams Napier Partnership, with input from Steve Woods of David Narro Associates and a fantastic client. The work carried out on this category B listed structure, which sits in the garden of Damick Tower, will allow it to be taken off the Buildings at Risk Register, which is nice. https://www.instagram.com/p/B1OZxqDfe/ Listed Building description (Clay not mentioned)
HUME (Buildings at)	Buildings at Hume, Scottish Borders.				1						from 14thC. Rebuilt 18thC		1							Excavations at a couple of post medieval buildings at Hume in the Scottish Borders, where the footings of one of the structures (structures likely had some form of earth based mortar (or matrix for its stone foundations), but may have had a clay or earth superstructure as opposed to masonry walls. Ian Hill, Harper Archaeology, pers. comm. Email 22.02.2022. Canmore says. The village houses that were located did not stand to any great height and the walls were mostly reduced to footings or robber trenches, suggesting that the superstructure of the walls may have been of perishable material, such as clay, on a stone base. Dr Piers Dixon (2017).
LANGSHAW TOWER and associated structures	Langshaw Tower, Melrose, Scottish Borders				1								1				1	1	1	The building is constructed in uncoursed whin rubble bedded in clay mortar and built without quoins. Source: Listed Building description.
MELROSE ABBEY	Abbey Street, Melrose, Scottish Borders. TD6 9LG				1													1		Clay core Masonry (B. Little pers.comm. Email 09.02.2022).
MERVINSLAW TOWER	Mervinlaw Tower, Southdean, Scottish Borders.				1												1			The bastle is intact apart from the loss of its roof. Its masonry is roughly coursed rubble with distinctive pinnings, set in clay, and the numerous quarry-pits that are to be seen close to the building suggest that the material was obtained locally. Sources: HES Inform guide Clay Mortars for Masonry Buildings, p4, Fig. 3 7 4, and https://ancientmonuments.uk/125326-mervinlaw-tower-jedburgh-and-district-ward#YeFsR_7P2Uk and https://fortified-britain.com/blog/mervinlaw-pele-house-mervinlaw-tower-mervinlaw-zeanwingslawe-zernwingslaw/

SCOTTISH EARTH MORTAR SITES		SCHEDULE (Compiled and updated 26.05.2022_H.R.WINSHIP)																			
SITE NAME	ADDRESS	ERA								BUILDING TYPE						NOTES					
		PRE HISTORY	ROMAN	PICTISH	MEDIEVAL	17th C.	18th C.	19th C.	20th C.	21st C.	DATE	AGRICULTURAL	ARCHAEOLOGICAL	BRIDGE	COMMERCIAL		DEFENSIVE	DOMESTIC	RECREATION	SECULAR	
THE HEBRIDEAN BLACKHOUSE AT 42 ARNOL	42 Arnol, Barvas, Lewis, Western Isles.																				The walls are drystone faced mudwall, waterproofers at exposed wallhead with blue clay protected by a layer of living turf. Blue clay also used in floors, mortar and plasters and to construct the hearth. Roof is thatched oat straw over a layer of heather turf. Source: Morton, T. & Little, R. 2001, Earth Building in Scotland, Past, Present, Future. A paper for the first international conference on Ecological Building Structures. Statement of Significance: https://pub-prod-sdk.azurewebsites.net/api/file/ea98b467-4aeb-4ac7-a4ab-a86500e6688d - It consists of two parallel units which were a byre dwelling and barn, built with very thick walls (two faces of random rubble masonry infilled with clay and earth) The roof timbers were built with driftwood and thatched with straw, covered with rope made from heather or marram grass.
39 ARNOL BLACKHOUSE	39 Arnol, Barvas, Lewis, Western Isles.																				The unroofed remains of the blackhouse at no 39 have been analysed and excavated in 1995. It consists of three parallel units built with random rubble walls packed with earth and clay. Source: arnol-blackhouses-39-42-sos.pdf and https://canmore.org.uk/site/140881
ST RONAN'S CHURCH IONA	St Ronan's Church, Iona, Western Isles.																				Excavation of the 12th/13th century medieval parish church of St Ronan's was undertaken by AOC (Scotland) Ltd on behalf of the Iona Cathedral Trust to facilitate refurbishment of the building as a museum. Excavation recorded several distinct stratigraphic phases on the site. These span a range of activities potentially dating from the Early Christian period to the present day. The earliest phase consisted of a cemetery of E-W extended inhumations. This was succeeded by a small rectangular building with clay-bonded walls and lime-mortar wall-rendering. This building was replaced by St Ronan's church itself. Upon construction of the church, the walls of the early clay-bonded building were systematically levelled to low butts, and these were then exploited as foundations for the E and S walls of the church. Source: http://archaeol.wmlls6.a2hosted.com/wp-content/uploads/2017/02/1992.pdf p57 and https://canmore.org.uk/site/21630/iona-st-ronans-church
HORGABOST, ISLE OF HARRIS	A859, Horgabost, Western Isles. HS3 3AE																				All three structures are likely to belong to the later Iron Age and had become infilled with aeolian sand. Features included walling complexes showing a variety of constructional types, the remains of a stone-sided tank with grey clay luting and shell middens. Source: Geophysical survey and excavation by Kevin Colls and John Hunter - University of Birmingham. Source: https://archaeologydataservice.ac.uk/archiveDS/archiveDownload?t=arch-753-1/dissemination/pdf/2000/2009_high.pdf p184.

APPENDIX 2: BIBLIOGRAPHY

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Rice husk-earth based composites: a novel bio-based panel for buildings refurbishment.	Antunes, A., Faria, P., Bras A., & Silva, V.	Construction and Building Materials 221, 99-108 (October 2019).	2019		Y	
Clay Biggins of the Tay Landscape. (2 volumes)	Arc Architects	Clay Biggins of the Tay Landscape. 2 Volumes. Perth: Perth and Kinross Heritage Trust (PKHT).	2016	Scotland	Y	1
Interim Report for Communities Scotland on the development and use of unfired clay bricks and mortar. (CONFIDENTIAL)	Arc Architects	Unpublished confidential report. Arc Architects	2003	Scotland	Y	
Characterization of Earth Used in Earth Construction Materials.	Aubert, J.E., Faria, P., Maillard, P., Ouedraogo, K.A.J., Ouellet-Plamondon, C., Prud'Homme E	In: Fabbri A., Morel J.C., Aubert J.E., Bui Q.B., Gallipoli D., Reddy B.V. (eds) Testing and Characterisation of Earth-based Building Materials and Elements. RILEM State-of-the-Art Reports, vol 35 (November 2021), 17-81. Springer, Cham.	2022		N	
Mud	Baker, L.				Y	
Mortar Analysis: A View from the Lab	Barnham, M.	BCD Special Report on Historic Churches 26th Annual Edition, Cathedral Communications			Y	
The Pattern of Moray Building	Beaton, E.		1993			1
Traces of Earth - How the History of Earth Building in Austria can Inform Modern Sustainable Construction Methods	Blaschek, J.A.	Lehm 2016: 7th International Conference on Building with Earth	2016		Y	
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Conservation Approaches to Earthen Architecture in Archaeological Contexts	Cooke, L.	BAR International Series 2147	2010		N-book	
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Hot Mixed Lime and Traditional Mortars A practical guide in their use in conservation and repair	Copsey, N.		2021	UK	BOOK	1
Like-for-Like and Compatible Mortars for the Repair of Traditional Buildings	Copsey, N.	The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLIV-M-1-2020, 2020 HERITAGE2020 (3DPast RISK-Terra) International Conference, 9-12 September 2020, Valencia, Spain	2020	UK	Y	1
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Mud Mortars in Masonry Construction - Malton, North Yorkshire	Copsey, N., Gourley, B. & Allen, R.			England	Y	
A Critical Review of Historic Literature Concerning Traditional Lime and Earth-Lime Mortars (& Earth Mortars and Earth Building as Referenced in Old Texts and Assorted Building Accounts	Copsey, N.D.	MA Thesis University of York, Department of Archaeology, Conservation Studies	2019	UK	Y	1
Earth-Lime Mortars (Presentation)	Copsey, N.D.	Traditional Mortars Symposium York 2019	2019	UK	Y	
Clay Mortars for Masonry Buildings	Curtis, R.	Historic Scotland Inform Guide	2015	UK	Y	1
Learn with Clay Part II	ECVET	ECVET Earth Building Handbook Learn with Clay Part II	2009		Y	
Compressed Earth Block and Mortars with Metakaolin and Lime Additions	Eires, R. & Jalali, S.	Lehm 2008: 5th International Conference on Building with Earth	2008	Portugal	Y	
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Hygrothermal and Acoustic Assessment of Earthen Materials.	Fabbri, A., Aubert, J.E., Bras, A.A., Faria, P., Gallipoli, D., Goffart, J., McGregor, F., Perlot-Bascoles, C., Soudani, L.	In: Fabbri A., Morel J.C., Aubert J.E., Bui Q.B., Gallipoli D., Reddy B.V. (eds) Testing and Characterisation of Earth-based Building Materials and Elements. RILEM State-of-the-Art Reports, vol 35 (November 2021), 83-126. Springer, Cham.	2022			
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Earth-based mortars for repair and protection of rammed earth walls. Stabilization with mineral binders and fibers.	Gomes, M.I., Faria, P., & Gonçalves, T.D.	Journal of Cleaner Production 172, 2401-2414 (January 2018).	2018			

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Mortars for Unfired Clay Masonry Walls	Lawrence, M., Heath, A. & Walker, B.	Lehm 2008: 5th International Conference on Building with Earth	2008	UK	Y	
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Evaluating the physical and mechanical properties of earth plasters with cow dung - a vernacular solution for earth building in Brazil	Pachamama, R.V., Penido de Rezende, M.A. & Faria, P.	Lehm 2020 8th International Conference on Building with Earth	2020	Brazil	Y	
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Vernacular earthen buildings from Leiria, Portugal - Architectural survey towards their conservation and retrofitting.	Parracha J.L., Lima, J., Freire, M.T., Ferreira, M. & Faria, P.	Journal of Building Engineering 35 (March 2021), 102115. https://doi.org/10.1016/j.jobe.2020.102115	2021	Portugal		
Vernacular Earthen Buildings from Leiria, Portugal: Material characterization.	Parracha J.L., Lima, J., Freire, M.T., Ferreira, M. & Faria, P.	International Journal of Architectural Heritage (online September 2019) 15 (9), 1285-1300.	2021	Portugal		
Efficacy of iron-based bioproducts as surface biotreatment for earth-based plastering mortars.	Parracha J.L., Pereira, A.S., Velez da Silva, Almeida, N. & Faria, P.	Journal of Cleaner Production 237, 117803 (November 2019).	2019			
Effect of innovative bioproducts on the performance of bioformulated earthen plasters.	Parracha J.L., Pereira, A.S., Velez da Silva, R., Silva, V. & Faria, P.	Construction and Building Materials 277 (March 2021), 122261.	2021			
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Mud Plasters and Renders	Practical Action Technical Brief The Schmacher Centre for Technology & Development	Appropriate Technology magazine Volume 26/Number 1 June 1999 ATBrief No 28,	1999		Y	
Clay as A Binder	Practical Action Technical Brief. The Schmacher Centre for Technology & Development	Practical Action. The Schmacher Centre for Technology and Development			Y	
Mud as a Mortar	Practical Action Technical Brief. The Schmacher Centre for Technology & Development	Practical Action Technical Brief. The Schmacher Centre for Technology & Development			Y	
Additives to Clay Minerals and Synthetic Additives	Practical Action Technical Brief. The Schmacher Centre for Technology & Development	Practical Action Technical Brief. The Schmacher Centre for Technology & Development	?		Y	
Additives to Clay: Organic Additives Derived From Natural Sources	Practical Action Technical Brief. The Schmacher Centre for Technology & Development	Practical Action Technical Brief. The Schmacher Centre for Technology & Development	1985		Y	
Stabilized Mud Mortar	Rashmi, S., Jagadish, K.S. & Nethravathi, S.	IJRET: International Journal of Research in Engineering and Technology Volume: 03 Special Issue: 06 May-2014 RRDC - 2014.	2014	India		
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Modern Clay Plasters as Prefabricated Dry Mortar	Schade, G.	Lehm 2004: 4th International Conference on Building with Earth	2004	Germany	Y	
Testing the Adhesive Strength of Clay Plasters	Schroeder, H. & Ziegert, C.	Terra 2008: The 10th International Conference on the Study and Conservation of Earthen Buildings	2008		Y	
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Repair of earth masonry by means of grouting: importance of clay in the rheology of a mud grout.	Silva, R., Schueremans, L., & Oliveira, D.	8th International Masonry Conference 2010 in Dresden.	2010		Y	
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Technical Paper 32: A Data Driven Approach to Understanding Historic Mortars in Scotland	Torney, C., Schmidt, A. & Graham, A.	HES	2020	Scotland	Y	
An Experimental Study of the Use of Soil-Based Grouts for the Repair of Historic Earthen Walls and a Case Study of an Early Period Buddhist Monastery	Vargas, J., Dandona, B., Blondet, M., Cancino, C., Iwaki, C., & Morales, K.	Terra 2008: The 10th International Conference on the Study and Conservation of Earthen Buildings	2008		NOT FOUND	
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Mortars and Plasters Produced with Earth-Based Sustainable Mixes: A Methodology Proposal for Recovery of Vernacular Architecture in Roero Piedmont (Italy)	Vignola, M., Bosia, M., Pennacchio R. & Zerbinatti, M.	The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLIV-M-1-2020, 2020 HERITAGE2020 (3DPast RISK-Terra) International Conference, 9-12 September 2020, Valencia, Spain	2020	Italy	Y	
Scottish Turf Construction	Walker, B.	Historic Scotland	2006	Scotland	BOOK	
Clay Buildings In North East Scotland	Walker, B.	Scottish Vernacular Buildings Working Group	1977	Scotland		
Earth Structures and Construction in Scotland	Walker, B., McGregor, C. & Little, R.	Historic Scotland Technical Advice Note 6.	1996	Scotland	Y	
Physical, Mineralogical & Chemical Properties of Mud-Brick of "Chogha Zanbil" ziqqurat, Iran	Watanabe, K., Vatandaust, A. & Okada, Y.	Terra 2003: 9th International Conference on the Study and Conservation of Earthen Architecture	2003	Iran	BOOK	

APPENDIX 3: NETWORK RESPONDANTS

NAME	ORGANISATION	COUNTRY	Archaeologist	Architect	Contractor	Engineer	Materials	Scientist	Surveyor
		TOTAL 58	12	14	13	4	1	6	5
Aitken, Nick		Scotland			1				
Allsopp, Lauren	Arizona State University	USA						1	
Artis, Roz	Scottish Lime Centre	Scotland						1	
Barham, Paul	Barham Glen Architects	Scotland		1					
Berry, Emma Rose	LDN Architects	Scotland		1					
Braidwood, Niall	Ogilvy Chalmers	Scotland		1					
Breeze, David		UK	1						
Briggs, Graham	Historic Environment Scotland	Scotland		1					
Brown, Maria	ESTEPPA	Spain		1					
Butler, Feile	Mud & Wood	Ireland			1				
Cafrae, Jim	Plymouth University	England						1	
Clark, Bob	Auchendrain Museum	Scotland							
Cooke, Lu	York University	England	1						
Copsey, Nigel		England			1				
Corrigan, Wendy	Wylie Shanks Architects	Scotland		1					
Curtis, Roger	Historic Environment Scotland	Scotland		1					
Davie, Alison	Alison Davie Construction Ltd	Scotland			1				
Dickson, Bryan	National Trust for Scotland	Scotland							1
Dixon, Piers		Scotland	1						
Dunwell, Linda		Scotland			1				
English, Liz	Highland Folk Museum	Scotland							
Faria, Paulina	NOVA University of Lisbon	Portugal				1			
Farrell, Stuart	Archaeologist	Scotland	1						
Forster, Alan	Herriot-Watt University	Scotland						1	
Frew, Craig	Frew Conservation	Scotland			1				1
Goddard, Oliver	Austin Smith Lord	Scotland		1					
Goodhew, Steve	Plymouth University	England						1	
Heath, Bob		Scotland	1						
Henry, Alison	Historic England	England		1					
Hill, Ian		Scotland	1						
Holmes, Stafford	Rodney Melville & Partners	England				1			
Hunnisett, Jessica	Historic Environment Scotland	Scotland							1
Knierim, Erik		USA			1				
Laidlaw, Kinlay	Laidlaw Associates Building Surveying Ltd.	Scotland							1
Little, Rebecca	Rebeearth	Scotland			1				
Lloyd, Abigail	(via SPAB)	UK							
Maskell, Dan	Bath University	England					1		
Morton, Tom	Arc Architects Ltd	Scotland		1					
Mullane, Fidelma		Ireland							
Murray, Hilary	Murray Archaeological Services Ltd	Scotland	1						
Narro, David	David Narro Associates	Scotland				1			
Pollard, Tom		Ireland			1				
Postma, Daniel	Archaeobuild	Scotland	1						
Reid, William	Historic Environment Scotland	Scotland			1				
Revie, Bill	CMC Ltd.	Scotland						1	
Riesterer, Johannes	Tillitsverket	Sweden			1				
Roberts, Sarah	Roberts Molloy	England		1					
Romankiewicz, Tanja	Edinburgh University	Scotland	1						
Rowan, Bee	Strawbuild	UK			1				
Small, Thomas		Scotland	1						
Stell, Geoffrey	Edinburgh University	Scotland		1					
Stewart, Lachie		Scotland		1					
Stockdale, Andrew	Stockdale & Lyall	Scotland			1				
Strachan, David	Perth & Kinross Heritage Trust	Scotland	1						
Stuart, Christina		Scotland		1					
Wilkinson, Brian	Historic Environment Scotland	Scotland	1						
Wood, Steve	David Narro Associates	Scotland				1			
Young, Glyn	Glyn Young Associates	Scotland							1