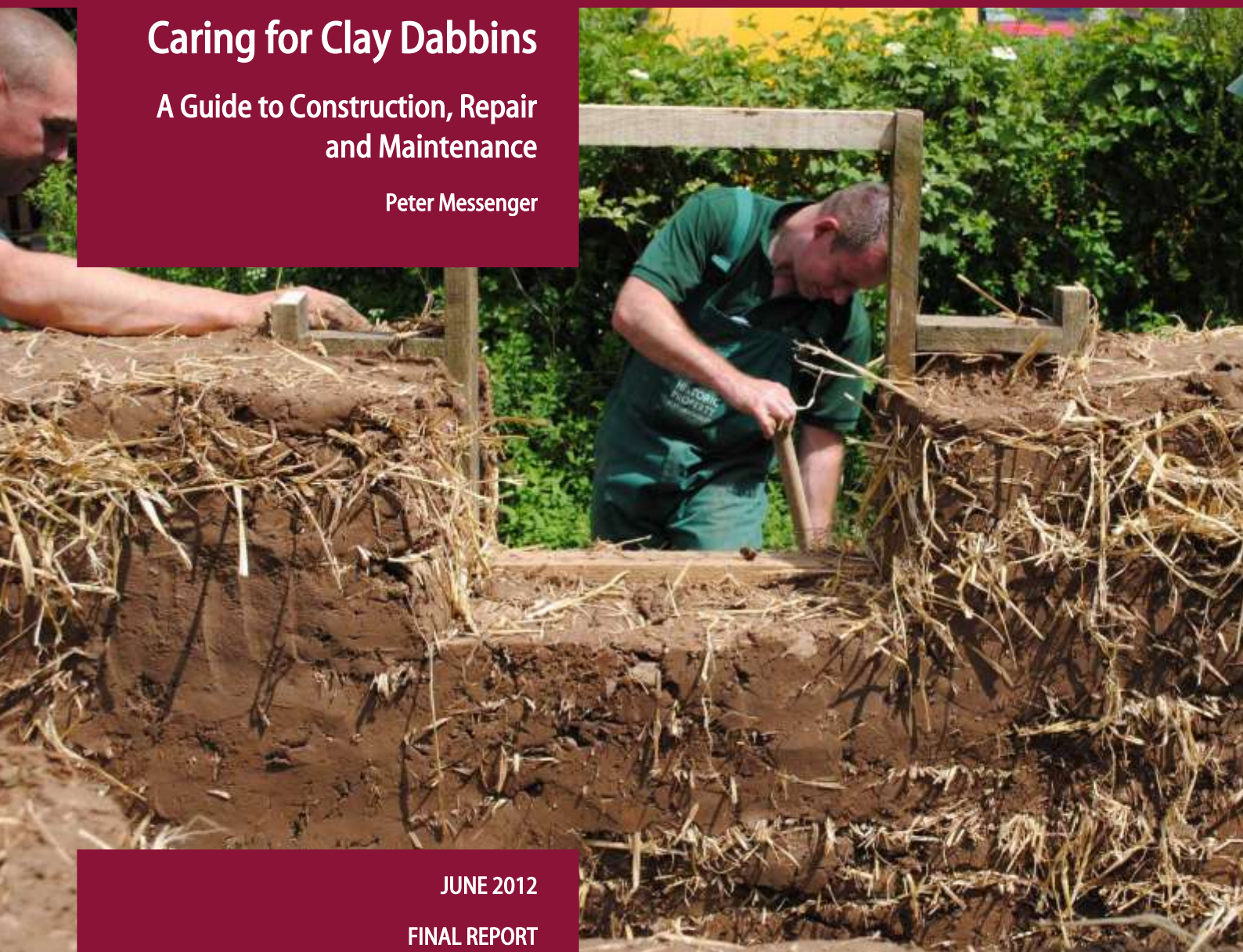




Caring for Clay Dabbins

A Guide to Construction, Repair and Maintenance

Peter Messenger



JUNE 2012

FINAL REPORT

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Introduction

- 1.1 This guide is part of a three year project to promote public awareness of the Cumbrian Clay Dabbin, a part of Cumbria's vernacular architecture that has been diminishing for more than a century. The project, developed and funded by English Heritage, had four elements:
 - ◆ To raise public awareness of the importance of this part of our built heritage
 - ◆ To train local builders in the methods of clay dabbin construction and repair
 - ◆ To identify all (or as many as practically possible) of the surviving clay dabbins on the Solway Plain
 - ◆ To gain a better understanding of the development and age of surviving clay dabbins, in particular through tree-ring dating of timbers found in clay dabbins.
- 1.2 The intention of this booklet is to guide those who own, or have in their care, clay dabbins and to help them with the maintenance and repair of these buildings. Some elements of this work are fairly basic, albeit arduous, and can be tackled by anyone who is reasonably fit. The booklet explains how some of the common problems should be approached. However, not all of these tasks are DIY jobs and, in these instances, the advice of surveyors and builders who have had experience in clay dabbin work should be sought.
- 1.3 The information given here covers how to deal with clay dabbin construction. It does not cover other components of the construction process such as masonry or roofing. Where the work involved goes beyond simple repair it may require Building Control approval and the local authority should be consulted for advice on this. The traditional manner of clay dabbin construction is described and guidance offered on how this can be reproduced today. Also indicated are the proper methods and materials for maintaining clay dabbin, and where problems occur, ways are suggested in which repairs can be made.
- 1.4 Although the methods described here, for the most part, are fairly straightforward, the first requirement is to be clear about the origin of any problem before deciding on how it can be rectified.
- 1.5 Finally, in aiming to provide an overview of the construction, maintenance and repair of clay buildings, a bibliography is provided which gives additional sources of help and guidance. These publications expand on the contents of this work.

a metre deep. The weight of this amount of material (which has been mixed with water) is such that construction has to cease in order to allow the wall to dry out before the next layer can be applied on top. This can take up to a week and because of this the method has been called the “slow process”.

- 2.5 Observing the unrendered walls of a Clay Dabbin it will immediately be apparent that the construction process in Cumbria is very different. Very thin layers (from 5cm to 20cm) are visible of an earth and straw mix separated by an even thinner layer of straw (usually about 5mm). These thin layers allow those building the wall to put down a layer of the earth/straw mix followed by a thin layer of straw on top and then to continue with the next layer and so on. Carried out with a lean enough (just enough water) mix there is no need to wait for the wall to dry out before putting down additional layers. This method has therefore been called the “quick process” because construction can continue until the wall is complete.
- 2.6 The method of constructing the clay walls was remarkably consistent on both sides of the border. In Dornock, Dumfriesshire at the end of the eighteenth century, farmhouses and cottages built of clay, when plastered and properly finished, were considered “*exceedingly warm and comfortable*” (Sinclair 1792, 22). Despite this appreciation, the Scots gentry were able to remove nearly all of these clay buildings over the next century.
- 2.7 The communal method practised in Dornock involved digging out a foundation in which could be laid: “a row or two of stones; then they procure... as much clay or brick earth as is sufficient to form the walls, and, having provided a quantity of straw or other litter to mix with the clay... Some fall to the working of the clay or mud by mixing it with straw; others carry the materials; and four or five of the most experienced hands build, and take care of the walls. In this manner, the walls of the house are finished in a few hours...” (Sinclair op cit, 22-3).



Treading the clay dabbins

2.8 The method described by Housman for Orton in Cumberland is almost identical. Here it was also a communal effort with neighbours being called to appear on a particular day and then some would, “*lay on clay, some tread it, while others are preparing straw to mix with it. By this means, building comes low and expeditious, and indeed it must be owned that they have brought the art of clay building to some perfection. They generally ground with stone about a yard high; and a house thus built will stand (it is said) 150 or 200 years*” (Hutchinson 1794, 515).

2.9 The majority of clay dabbins that survive are in the north-west of the County between Brampton, Longtown and Allonby. Prior to the 19th century the distribution was much greater. Thomas Denton in 1688 was either appalled or intrigued by the fact that “*most of the houses*” in Wigton were “*walled, with clay*” (Winchester 2003, 205) and “*the houses in all the country roundabout Carlisle are made of clay*” (op cit, 272).

- 2.10 Brunskill (1962) used documentary sources from the 18th century onwards to show that nearly all of the northern parishes of Cumberland had clay buildings. Sources such as Housman’s parish notes in Hutchinson’s *History of Cumberland* (1794) enabled him to map the 18th and 19th century distribution. The 1910 Inland Revenue Survey, part of which become known as Lloyd George’s Domesday Survey, has provided a valuable source for identifying the distribution of clay buildings at that time. Over 1300 structures have been identified in the Field Books which has broadened the distribution over north Cumbria.

The majority of these have not survived; indeed many are described as being derelict or disused at the time they were surveyed.

- 2.11 About 300 clay dabbins are believed to still exist. Many have been altered or extended and during the process have lost parts of their clay walling. For over a century few people, if any, were available to care for and repair clay walls in an appropriate manner and as a result much of the work that has been carried out on them has actually caused further decay. One of the most significant causes of decay to clay buildings, particularly since 1900, has been the widespread use of cement renders. If those who live in clay buildings are troubled by damp walls then the cause is likely to be cement render which prevents the wall from "breathing" or drying out.
- 2.12 This Guide is intended to give general advice on how such problems can be avoided. There is also advice on how to deal with other problems that can be found in many old buildings but which, if they are built of earth and straw, need special care and should not be treated as if they were built of brick, stone or blockwork.



Removal of render will often reveal evidence of earlier alterations to the building. Cross Farm, Burgh by Sands



Still standing in the 1950's but later demolished, a clay dabbin in North End, Burgh by Sands.



Clay dabbin which was faced with brickwork. The upper floor was inserted at the beginning of the 18th Century. Uninhabited for some time, the front wall recently collapsed exposing the interior.



Crucks are often associated with clay dabbins. This example is on the north side of the Solway, at Canonbie.

The Traditional Process

The Dabbin Mix

- 3.1 The material used to construct a clay dabbin has usually been obtained from close to the building site with straw taken from the fields and earth from a hole in the ground. The hole then could be made into a pond. Clay or earth are very general terms and are used to describe the mineral subsoil which lies below the topsoil (which is rich in organic matter). The subsoil would be extracted in late autumn and left in a heap through the winter when natural weathering processes would break it down.
- 3.2 The quality of the subsoil varies considerably across the Solway plain, from gravelly, to very sandy through to clay and silt. The best material for building is one which has some of all of these types as this helps to reduce the degree of shrinkage when the wall is drying out. It is not common to find sufficient quantities of these all in the same profile and often other material would be added to make up the deficient portion. Historically mention is made of adding aggregate to the mixture (including road sweepings).
- 3.3 When repairing clay dabbins the original material should be examined so that the proportions of gravel, sand and silt can be identified. This can be done professionally or you can do it yourself if you have the necessary equipment (See Norton, Building with Earth, 1997). Sub-soils vary enormously in their composition; some may consist almost entirely of clay or silt while others may have large proportions of sand or gravel. If the material you are working with is deficient in one or more of these fractions (gravel, sand, clay and silt), then it is sensible to add material to ensure you have a well graded mix.
- 3.4 Clay is the vital ingredient as it is the binding material which coats the other material and binds them together. A serviceable mixture could contain 30% (by weight) of stone/gravel (from 5mm to 40mm); 30% of coarse and fine sand; 15% silt and 25% clay. There are examples on the Solway Plain where the proportion of silt and clay in total can be as high as 80% and these walls are as hard and compact as others which have 50% of stone and gravel. So there are no hard and fast rules.



Examining the material to be used in the building, removing any large stones, plant roots and other vegetable matter.



Spreading straw over the wetted clay and using the boot heel to trample it well in

3.5 The other main ingredient of the clay dabbin mix is straw. Straw helps to reduce shrinkage and it occurs as part of the dabbin mix as well as being used as a separate layer in the construction. When straw is added in sufficient quantity to the mixture described above it helps to reinforce the material as it acts as a physical binder increasing its resistance to shear failure. As the wet mix dries out, the silt and clay fractions will tend to crack. Both the straw and the coarser fraction of the mixture (coarse sand) will help to reduce the amount of shrinkage in the wall. Both wheat and barley straw were used, and as rye was a common crop in Cumbria, it is likely that rye straw would also have been used. Dung is often mentioned as an additive to clay mixtures for walling. This is correct but it was not added as a primary ingredient but as a result of animals being used for the mixing process. The clay and straw mix would be spread in a loose box or a pen and the animals would be kept within it until the material had been well-trodden. It could then be removed to the new construction. The modern clay dabbin builder may not have access to half a dozen calves and a loose-box and may have to resort to the wellington boot.

Mixing

3.6 The dry materials described above for the clay dabbin mix need no other additive except a limited amount of water. The mixing should take place on a solid, level surface, preferably something like concrete to prevent contamination from other material. The surface should then be watered before the subsoil is spread over it in a layer about 100mm deep. Lumps should be broken down and any large stones (over 50mm) should be removed and the layer can then be watered. A layer of straw is then spread over the wetted mix which has then to be trodden into the subsoil. (Approximately 25kg of straw per cubic metre of subsoil.) As this is done small amounts of water can be added to ensure none of the mineral matter is left dry. Once the straw has been pushed into the clay mix it then has to be turned, ideally onto an adjacent clear space. This will reveal more material that is still dry and additional

water may be added using a watering can.



Working on concrete, breaking up the large lumps of clay before adding the straw. Turning it over to ensure it is well wetted through



Working on a tarpaulin can make life easier, it also helps to keep the site tidier



Turning the mix over by rolling it in the tarpaulin



Treading the turned mix, heeling it well in and spreading it out before adding more straw

- 3.7 Depending on the amount of material being prepared it may take several similar operations until the appropriate amount of straw has been added and been thoroughly mixed in. This is very arduous and it is tempting to add more water to make life easier, however if too much water is added the mixture will slump when laid on the wall and any treading to compact it will be impossible. It will stick to boots and be squeezed off the plinth.
- 3.8 Getting the consistency of the mixture right does require careful attention to the amount of water being added. If too much has been put into the mixture then it is possible to recover it by adding more of the dry subsoil, if this is available, but it adds to the amount of material that has to be turned and then trodden which can be very tiring. If time is not an issue the mix could be left for a few days to dry out, until it has reached the right consistency.
- 3.9 The method just described is that which would have been the basis for traditional clay dabbin building. Today however if you have access to a JCB or a tractor and have a large enough area of concrete to work on, it is possible to take some of the back-breaking work out of this part of the process.
- 3.10 The material and its mixing by tractor are similar to that mentioned above but with greater quantities. The wellington boot is replaced with the tractor tyre and the spade for the bucket on the front of the tractor. Wet the area where the mixing is to be done but this time scatter a layer of straw over the ground before spreading the subsoil over it using the tractor bucket. Once the material has been levelled, water it using a spray hose or a watering can. Scatter more straw over the subsoil and then mix by driving over the shallow pile so that the tractor wheels compress the straw into the dabbin mix. This is then scraped up and turned over using the tractor bucket. The mix can then be driven over again. This process is then repeated with more straw and water being added as necessary to achieve the right consistency and composition.
- 3.11 Again great care needs to be taken with the amount of water being added.

Construction Method

The Plinth

- 4.1 All of the surviving clay dabbins have been constructed on a stone plinth, usually between 450mm - 600mm high and about 600mm - 700mm thick. This is to raise the clay wall above ground level to prevent ground water damaging the base of the wall. The plinth may consist of cobble, field stones or sandstone, occasionally brick has been used. The mortar binding these may be lime based, cement based or clay based. Lime mortar is the most



Stone plinth to prevent ground water damage to the base of the wall

appropriate in that it acts as a good binding agent but does not trap moisture within the wall. Cement mortar will bind the stonework together but it does trap moisture, preventing it from evaporating from the external face of the plinth. It may also damage the stonework used in the plinth if the stone used is softer than the cement mortar. Cement gradually replaced lime mortars and renders from about 1900 onwards (although it was being used in Cumbria from the middle of the 19th century) with consequential damage to many buildings and the loss of many clay dabbins.

- 4.2 Clay dabbins were built because this was the cheapest means of construction. The material was immediately to hand and the cost was negligible. It was not usual for lime (in the form of slaked lime) to be free and often the stone plinth would be constructed using earth or clay mortar. An earth mortar will hold the stonework in position as long as it remains dry but if it is subject to regular wetting the material will eventually wash out. This has happened in the past and the resulting gaps within the plinth have allowed the masonry to shift. Such movement can lead to cracks appearing in the clay wall and if not addressed, can lead to major problems. Grouting of the plinth using a low viscosity lime mortar can consolidate the masonry but specialist advice should be sought. Cracking within clay walls is dealt with in a later section.



Cracking probably caused by movement in the plinth

Laying the Clay Dabbin Mix

- 4.3 The clay mix should be pliable and sticky. The straw should be well mixed into the clay and should be well coated with the mixture. If during construction it starts to rain work should stop and the wall top should be covered with a tarpaulin or polythene sheet. The clay mix should also be covered.
- 4.4 Depending on the availability of labour the work can be divided into teams. The top of the plinth should be pre-wetted and then one person lifts some of the mix, usually with a long handled fork, onto the low plinth while someone stands on the wall to spread the material and then treads it into place. The layer should protrude a little beyond the line of the plinth (c. 50mm) and once a depth of c.100mm has been reached a thin layer of loose straw is spread over the surface of the lift. This will appear to be about 50mm deep but once the next layer has been laid on top of the straw its depth will reduce to about 15mm or less. Any straw projecting beyond the face of the wall can be trimmed off later. The second and subsequent layers can be laid in a similar fashion. As the wall increases in height the person on the wall beats the sides to ensure that they are vertical. This can also be achieved by paring the sides with the edge of a spade or something similar.
- 4.5 As the wall dries out cracks may appear and the wall can be beaten again to reduce these. If the wall has started to bulge then this is because the mix has been too wet. Do not continue to work on the wall if this occurs as it may become unstable. Allow it to dry out and then pare it back to the vertical. All of the trimmings can be re-used in the next mix. At low levels working on the wall is reasonably straightforward but once it reaches 1.5m - 1.7m it will be necessary to provide safety support for those getting up on to the wall and to protect them while they are working on it. (Above a certain height this safety measure is a legal requirement in any event). Once you have reached this height lifting the clay mix becomes more arduous and if the scaffolding is boarded out it can be used to create an intermediate level for pitching the clay mix. Scaffolding can get in the way and if the whole wall is scaffolded on both sides this can make the building process much more awkward and inconvenient. If this is the case scaffolding towers may be more acceptable and easier to work with.
- 4.6 Gable walls can be constructed in the same manner, the pitch of the roof being determined by the material to be used on the roof. Purlins and floor beams should be supported on timber pads and bedded into the wall. If the purlins need intermediate trusses for support, the tie beams should also be bedded on timber pads.



Layers of clay dabbin mixture used to construct the wall



Laying on the straw



Treading the dabbin and keeping the edge vertical



Details

- 4.7 Openings in the building need to be carefully considered and, where necessary, frames, lintels and sills can be built in at the appropriate height. Openings can be cut out of the clay once construction is finished but this is not easy. There are many examples of window openings in clay dabbins which have been created in this way and which have no lintels. This is not recommended for any new build.
- 4.8 Timber lintels can be placed over an opening and should have a good bearing of at least 200mm. These should be laid on wooden pads, one on either side of the opening, and which span the wall from the inside to the outside. This spreads the weight of the timber lintels and reduces the likelihood of any cracking. Stone sills or flags can be laid across the bottom of the opening. Flags can be laid at a slight angle and extend over the edge of the clay wall to allow water to drain away from the wall.
- 4.9 It is sensible to insert timber into the clay wall if fixing points are required for frames for doors and windows. Similar inset pieces should be placed wherever fixing points are required, for example for shelves, etc. or for making it easier to box in cable runs, etc.
- 4.10 Clay walls, inside and out, will almost always be rendered. Where timber or stone details are to be left exposed these should protrude beyond the face of the clay wall so that the render can run up to it and form a better edge than if it has to be feathered (thinned) to meet the feature.



Formerly cement rendered clay wall with sash window set into it. No lintel but a stone sill.



Above and below: Planning the window openings by measuring the height and inserting the timber lintels into the correct location and continuing to construct the structure



Common Problems and their Repair

Damp and Water Penetration

- 5.1 The thickness of a clay dabbin wall should be sufficient to prevent rain penetrating through to the interior. If it has an external lime render the degree of penetration will be reduced even further. The advantage of clay walls and lime render is that both allow any dampness to gradually evaporate from the external surface of the wall. If a clay dabbin shows signs of damp then it is necessary to establish the source. In the past this was expressed by Loudon (in his *Encyclopaedia of Architecture*, 1833) when discussing Devon cob buildings that the *"durability of cob is said to depend upon its having 'a good hat and a good pair of shoes', that is, a good roof and a good foundation."*
- 5.2 If the build up of moisture within a clay wall is not checked it will revert to a condition similar to the original clay mix when the building was being constructed. If this continues the wall can become unstable and may eventually collapse. Identifying the source of the damp is fundamental to properly maintaining a clay dabbin.
- 5.3 The roof and guttering are generally the easiest parts of the structure to examine for signs of water ingress. This may be from slipped or broken slates; or from leaking gutters; or broken or blocked downpipes, all of which should be relatively easy to repair. The capacity of the gutters and pipework should be examined to see if they are sufficient to cope with the run-off from the roof and if not they should be replaced.
- 5.4 Moisture penetrating from ground level can be more difficult to trace but it is essential to keep water away from the building. Generally speaking good drainage around the property will help to alleviate this. This can be achieved with a perforated land drain laid in the bottom of a trench which can be backfilled with small stones and gravel. This should be laid at a gradient sufficient to carry the water away from the building.



Severe cracking at the corner of this clay dabbin



Cement render breaking off the gable of this clay wall

- 5.5 Water penetrating the clay wall will gradually travel down the wall until it reaches a point where it is impeded and if it is unable to evaporate from the surface the material becomes soft and will start to erode. Cement renders are prone to cracking and this allows water to penetrate the wall. Once inside the wall the movement of water will be restricted by the cement render and prevent evaporation. The moisture content will gradually increase, eventually reducing the strength of the wall. This can result in movement, cracking or even collapse. In the past, when this has occurred, the general assumption has been that it is the clay wall which is to blame for the damage rather than the cement render.
- 5.6 If a wall is very damp and it has a cement render care should be taken when investigating the state of the clay dabbin. Removing patches of the render from the upper part of the wall first and gradually working down until the plinth is reached would be the preferred course of action. If the clay wall shows obvious signs of excessive damp, and the material is very soft and damp to the touch, then allow time for this part of the wall to dry out. A few days should see an improvement and, once dry, the removal of render can resume, gradually working down the wall and stopping where necessary. Once dried out, the strength of the clay dabbin wall will gradually return and it will then be possible to address any other problems that have been uncovered.



Cement rendered clay wall, trapped moisture was probably responsible for its eventual collapse

Renders

- 5.7 Clay walls that have not been rendered will erode but this will usually happen over a considerable period of time. Cement renders when first applied will prevent water penetrating the wall, eventually however such renders do crack and water can then penetrate this barrier. This can lead to the problems described above. The removal of cement renders can damage the underlying clay wall and in some instances it may be better to leave the render if there are no signs of damp or deterioration in the wall. If the render shows signs of cracking and the interior also shows signs of damp then the render should be investigated to determine whether or not it should be removed.
- 5.8 A considerable amount has been written on the different forms of lime render and it is not to be repeated here. The bibliography contains useful sources to find out where materials can be obtained and the methods used to apply them. It is sufficient here to point out that lime renders allow the clay dabbins to “breathe”, i.e. allow water vapour to evaporate from its surface. A lime render that shows cracking will allow water ingress but, as it can breathe, evaporation will eventually balance out the moisture content within the clay wall.
- 5.9 The use of hydrated or “bagged” lime, which is generally available from builders' merchants, should be avoided. Many builders when asked to use a lime render or mortar will mix hydrated lime in with an ordinary cement render/mortar mix. The bagged lime in the resulting mix will have little impact on the physical properties of the cement mortar.
- 5.10 There are two forms of lime which will provide an appropriate render or mortar. The first is putty lime which is available in the County or can be bought from elsewhere. Putty lime is like a thick cream cheese which when mixed with a coarse sand will provide a very acceptable render or mortar. The drawback of using putty lime is that it takes some time for it to achieve a reasonable set and during this time it is vulnerable to frost action. However if the render is protected from cold weather by the use of sacking or something similar then damage can be prevented. The alternative is to use hydraulic lime which can be bought in bags but which should not be confused with the hydrated lime mentioned above. The advantage of using hydraulic lime is that it does give a relatively quick set and the risk of frost damage is much reduced.
- 5.11 For appropriate mixes and other information see the bibliography.



Lime render as finishing coat

Hollows and Cavities

- 5.12 Surface hollows or cavities are very common in clay dabbins. If they are fairly gentle and do not create large overhangs then they can be left alone and simply rendered with the curves adding to the character of the building. Some of these will have been caused by erosion of the surface by weather and some will be the result of animals rubbing or licking the walls. The nature of the surface and the extent of the damage need to be assessed carefully before deciding on the remedy.
- 5.13 Hollows up to 100mm can be treated fairly simply and easily by cutting into the clay wall to provide a flat base on which it is possible to lay-in pre-dried clay blocks (see below). The clay blocks and the cavity need to be well dampened before use. The blocks can be laid as bricks in a lime or earth mortar or in a finer version of the clay dabbin mix (with less large aggregate and chopped straw so that you can get a fairly regular bed). Any spaces behind the blocks must be filled with the same mix. On larger areas there is often a need to key the blocks firmly to the original wall. To do this it is necessary to fix oak pegs or stainless steel rods across the mortar joint of the clay blocks and into the back wall. *Helibar* is a lightweight twisted reinforcing rod which works well here and also can be invaluable in tying across cracks.
- 5.14 Deeper hollows should be treated in the same way although with greater caution. It may be necessary to provide support for the wall above while you are working underneath. Larger clay blocks can be used but these also need to be tied back to the original wall. This is effectively underpinning and should be treated as such. If in any doubt about the structural integrity of the wall specialist advice should be obtained.



Large hollow in the clay wall



Cut clay to provide a flat base in the hollow



Clay bricks fill the rest of the hollow to create a sound repair

Clay Blocks

- 5.15 You can make your own timber mould which can be made to any size that suits your building. Blocks of two different sizes (for example - 350mm x 250mm x 100mm and - 225mm x 100mm x 75mm) can help to deal with different situations. Ideally, mix your own clay and straw, as mentioned earlier, and tightly pack the dabbin mix into the mould. As long as the mix is not sloppy the block can be tapped out onto a flat surface that is protected from the weather and allowed to dry. This will take several weeks and the blocks should be turned to finish the drying process.



*When making the clay block the mixture needs to be well compressed into the mould
Drying the blocks on a flat surface*



Drying the blocks on a flat surface



Clay blocks laid on top of the original wall to create a new wallhead

Rat Runs

- 5.16 Continuous cavities are sometimes found running along inside the length of the clay wall. They are common on or near farms and have probably been excavated by rats. In the past previous occupants will have attempted to block these up with anything that was to hand and can include broken glass and barbed wire. If they are extensive then they may affect the structural stability of the wall and temporary support may be necessary. Seek advice.
- 5.17 They can usually be repaired if the wall is reasonably intact. Clearing out as much of the run needs to be done carefully in view of the hazardous material you might come across. Once this has been done the interior surfaces need to be well-wetted and the holes filled with a grout of lime and coarse sand, followed by a mix with coarser aggregate which may need to be pushed into the run with a rod. Small pieces of broken clay block or brick which have been wetted can then be pushed into the hole until full. This may not have completely filled the rat run however the operation will have reduced the amount of unsupported clay dabbins and improved its stability. It may also be possible to attack one run from different ends.
- 5.18 If the run is too close to the surface the clay may break up and expose the cavity, if this occurs then it needs to be treated as for hollows.



Cracking

Minor Cracks

- 6.1 Small cracks which do not carry all the way through the wall can be treated by stitching across the crack using small pre-dried clay blocks. Alternatively a plain clay tile can be used. In either case a trench has to be cut across the crack which is deep enough and high enough to take the block or tile and a quantity of mortar.
- 6.2 Depending on the length of the crack you may need several of these stitches, one every 350mm or so. Start at the base and do one crack at a time.
- 6.3 The crack and the block need to be pre-wetted and then mortar placed into the stitch. Pushing the block into the stitch should squeeze mortar into the back and then around the inserted block. There should be sufficient mortar for it to eventually squeeze out onto the block and then the remainder can be tightly packed with clay mix and wetted dry lumps.
- 6.4 The gaps between the stitches, once damped down, can be filled in the same way with small lumps of wetted dry block and clay dabbin mix.
- 6.5 Slightly larger cracks will need wider and deeper stitches but they should be treated in the same way as above. If the crack goes through the wall it will be necessary to tackle it from both sides but the stitches should be at different heights. One side should be allowed to settle and dry off before the other side is attempted. When the block is pushed into the trench, the mortar should squeeze out of the front, thus ensuring that the cavity is filled with the dabbin mix.
- 6.6 These examples relate to straightforward cracks which have little structural significance.



Minor cracking

Major Cracking

- 6.7 Where a crack occurs near a corner, considerable care needs to be taken and propping may be required. Large cracks that appear to meet may already have separated sections of the clay wall. If this is the case, that section would have to be re-built. Again, care needs to be taken in how this is managed. If the gap is fairly short then this may be reconstructed using the pre-dried clay blocks. Starting at the base of the crack, each block needs to have a bed cut for it by hand. The background needs to be well wetted and the block mortared in quickly. Then the next bed should be cut out with the next block being mortared in.
- 6.8 As you work upwards the blocks should be laid like bricks so that there are no joints one above the other. Only cut out as



A major crack made worse with a roof with no gutter

much of the original clay as is necessary for the part currently being repaired. Where it is advisable to strengthen the repair, twisted stainless steel bars (such as Helibar) can be fixed into the original wall and mortared between the courses of blocks.

- 6.9 If the detached or collapsed section is large the narrower sections could be laid in blocks but as the area opens out and becomes accessible it may be possible to reconstruct the remainder using the traditional process described at the beginning of this document. The layers should gradually overlap the original wall as the repair progresses upwards. Whichever method is used the crack should be cleaned out first and then well wetted before laying new blocks or clay dabbin mix.



Above: Cracking on the corner of this building was originally repaired in brick with cement mortar. The much harder mortar led to erosion at the junction with the clay, creating cavities and making the wall unstable again. The repair was carried out using clay blocks and a dabbin mix for mortar.



Left: The first stage is to stabilize the adjoining clay wall by underpinning the original dabbin with clay blocks. Later this work can be tied into the repairs on the corner.

Plinth Repairs, Grouting and Pointing

- 6.10 The ground level around the exterior of the plinth should be similar to the interior floor level, or slightly lower, and the drainage should be away from the building. Any gaps in the plinth masonry should be repointed using a lime mortar. However if it is clear that there are gaps inside the plinth then this needs to be replaced, ideally with a similar mortar material. The problem is getting the material inside the masonry. To do this can be quite a specialised task as it involves introducing a grout (mortar which is less viscous and therefore can travel farther under gravity) into the plinth in such a way that it will fill the voids and thus consolidate the wall.
- 6.11 To achieve this it is necessary to make sure the pointing is sound at the lower levels, the theory being that the lower part of the wall fills with grout until it reaches areas that are unpointed at which point it leaks from the wall. The next level of pointing is carried out and the grouting continues until the top of the plinth is reached.
- 6.12 This no doubt sounds very laborious and time consuming but if completed properly the benefit to the building and its structural soundness cannot be exaggerated. The grout should be gravity fed and not introduced under pressure. Excessive amounts of grout can dislodge unbonded masonry and care needs to be taken to ensure this doesn't occur.
- 6.13 Many clay dabbins will not only have cement render but may also have cement pointing. If the plinth is cobble or slate the mortar is not likely to damage the stonework but it will still reduce the evaporation of water from the joint. If the plinth is a softer stone such as sandstone then weathering will be faster on the soft stone than the cement mortar. If the mortar is thinly applied as appears to be the case in much recent work then it may well fall off with little assistance. Remove as much as possible and repoint using a lime mortar. Otherwise leave it until it is ready to fall off rather than try and remove it and damage the stonework.



Lime pointing of the plinth

Leaning Walls

Roof and Wall Restraint

7.1 It was, and still is, common for owners of cottages to want to make the most of the space that they have by removing awkward beams which prevent the full enjoyment of the building. What is not usually considered is that if the original roof is altered by the removal of tie beams across the width of the building at eaves level or by the removal of collars near the purlins, then the weight of the roof has a tendency to spread outwards at the eaves, as it is no longer restrained by these timbers. Caught early on it would be possible to introduce new ties to stop this movement but once this has occurred it is difficult and expensive to reverse.

7.2 Cracks appearing in the cross-walls and gables, for example those above gable window lintels can indicate this spreading movement. Similarly vertical cracks near the side walls or the separation of the first floor beams and boards from the side wall suggest something similar. It is not uncommon to find clay dabbin walls leaning but providing this movement has stopped before it becomes critical, the thickness of the wall will ensure that it remains stable.

7.3 In the past when there has been movement in a wall the solution is often to build a buttress against the clay wall. Unfortunately if the wall is still moving the buttress may simply restrain one section of wall and not the whole wall. It is more beneficial if the ties which restrained this movement in the past are reintroduced in some way, either with new timber beams or, if this is no longer possible, then by introducing metal ties across the floors and roof structure.



The collars on these cruck frames help to prevent the walls from spreading apart



Cracking near the centre of the clay gable wall suggest that the side walls have started to move apart

7.4 There is the possibility that movement in the walls at high level may be the result of movement lower down. In particular this could be caused by ground settlement. In either instance you should obtain the advice of a structural surveyor who has experience in dealing with problems associated with clay dabbins.

The Wallhead

- 7.5 The top of the clay wall needs to be carefully protected from water ingress as many problems can arise if water gets into the wall in this way. Ensuring that the roof covering is sound is a maintenance priority. If the property has close eaves then the gutters and downspouts may also be sources of water getting onto the wallhead. Traditionally clay walls had very deep eaves with a thatched roof but with modern materials and techniques this has often been replaced with thin slate roofs where the eaves are now tight to the wallhead. The gable verge can also be a problem if the top of the wall is not adequately protected.



The top of the clay wall is gradually being washed away due to inadequate coverage of the roof.

- 7.6 The overhang of the roof is a significant part of keeping the clay dabbins character as well as a better means of casting off rainwater away from the clay wall. Although many no longer have thatched roofs, it makes considerable sense to maintain this detail. An overhang of 600mm will help to protect much of the wall.

Wall Reconstruction

- 7.7 In the past where large sections of clay dabbin wall have collapsed those areas that were unstable were removed and the remainder prepared for new clay to be laid in its place. In recent cases preparation for the rebuilding consisted of cutting back the surviving wall along a plane of about 45 degrees. New work was then laid in the same traditional way with a horizontal bed laid on the plinth, building up to the surviving wall, and then progressively overlapping the original (but now wetted) clay dabbin. In this way the new work always rests on the older layers with its weight bearing vertically on the wall below. This reduces the risk of the new work moving along what would otherwise be a natural slip plane.



Barn wall showing the junction between old and new clay work. The recess for the post, to which shuttering was fixed, is to the right.

7.8 An example similar to this form of repair was found recently in a barn at Wiggonby. The repair probably dates from the mid-nineteenth century. It differs in two respects from that described above. It was built up against the original clay wall at a much steeper angle than suggested above. Here it is about 70 degrees. Interestingly it appears to have been built using shuttering rather than the layered construction of clay dabbin work. Evidence of the vertical posts to which shuttering boards would have been nailed still survives. Original work on the left shows the traditional layered structure, whereas the newer work shows little evidence of layering. Instead the clay mix has a very different consistency, with many hollows and cavities caused by air being

trapped during construction, creating an open texture to the wall.

- 7.9 A handful of examples have been found where the traditional method appears not to have been used, possibly because of the lack of a free labour force as well as its replacement by new materials. The use of rammed earth or pisé de terre for walling is a traditional feature in parts of southern and eastern England. Its use was promoted in the nineteenth century as a cheap means of constructing cottages and farm buildings. The process here appears to be a variation as the mixture does not show signs of compression or ramming.



The half-way stage of rebuilding a section of a collapsed barn wall and the completed wall.



Alterations

- 7.10 If it is considered necessary to alter or extend a clay dabbin then great care is needed to ensure that the proposed works do not damage the original fabric, its structural integrity or destroy the architectural or historic interest of the building.
- 7.11 The way in which clay dabbins are constructed, in a continuous process with each part bound inextricably to its neighbour, means that any new breaks in this fabric need to be carried out in a way that maintains this bond. The thickness of the walls provide its strength and ability to carry the load of the structure above, yet many of those who work on these buildings today treat them as if they were modern cavity walls.
- 7.12 Of prime importance is to keep any removal of clay wall to a minimum. New openings should be discouraged and old openings re-used wherever possible. If a new opening is a necessity then it should be kept to a part of the building where a key piece of walling, which provides structural restraint, does not have to be removed. Creating openings one above the other is even more likely to create a line of weakness in the wall that could lead to future dislocation.
- 7.13 The building's structural framework needs to be carefully protected. Cutting through collars, tie beams and wall plates will reduce the integrity of these beams and the job they are meant to be doing. True, modern technical solutions such as the creation of steel frames to redirect loads and stresses can be inserted to allow beams to be removed or reduced but this is to the detriment of the surviving character of a building that has stood for at least several centuries. All of the significant elements of a property's historic or architectural features should be retained and if you are unaware of what these are you should ask for advice from your local authority.



Tie-beams cut through to give headroom upstairs

- 7.14 Alterations to try to alleviate damp, such as the introduction of damp proof membranes, should be re-considered in the light of the likely causes and sources of the damp. A membrane or chemical dpc should not be introduced into a clay dabbin wall. Either of these could create more significant structural problems without dealing with the cause of the damp. If in doubt ask a specialist for advice. The Society for the Protection of Ancient Buildings will be able to help with this.
- 7.15 A similar issue arises with regard to lifting sandstone flags to lay a damp proof membrane underneath. If it is necessary to lift the flags, sand or a mixture of sand and ashes will generally be uncovered. If this is no longer preventing damp from coming through the floor the depth of the sand could be increased or the flags could be relayed on a lime-ash bed to allow it to breathe. Either would be more appropriate than laying a polythene membrane under the flags, as the damp may simply reappear.
- 7.16 Where new work is built adjoining a clay dabbin the junction needs to be carefully detailed. The thermal properties of different building materials can create differential movement not only while the new work is drying out but also later when temperatures change with the seasons. This can lead to cracks appearing along the junction of the new and old materials. These may not be significant structurally but they can be a recurring render problem. Again specialist advice should be obtained as to the best way to treat such

junctions. Possible alternatives could include the use of pre-dried clay blocks used against the modern masonry and laid with ties or with a non-degradable material bedded into the courses which would act in a similar way.



Adding a new clay wall extension to an old clay dabbin, using clay blocks for the junction.

New Construction

- 7.17 Creating a new building from clay dabbin is a laudable objective and one which is eminently sustainable, however it is beyond the scope of this work. There are sources of information that can help anyone with such an idea. Possibly the best way to see what can be done would be to visit one of the professional builders who use this material. Unfortunately there are none in Cumbria yet, as far as I am aware, though Devon has several, including Kevin McCabe whose website shows what can be done with this material.
- 7.18 Building Regulations are a problem because it is unlikely that any Cumbrian Building Control Officer will have dealt with a new clay building. Devon again has had many years to appreciate the different approach that is needed for a traditional material like this. Of value in dealing with Building Control is Larry Keefe's book and also the DEBA booklet on how to comply with the Regulations.

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