Re-pointing

Principles, Materials and Methods

Hampshire County Council

Contents

Introduction

ABOVE: Shows tabular flint in a black ash mortar gauged with oil.

The character of walls of brick, flint and stone is derived from weathering characteristics, textures, and colours. The overall effect reflects the age of the masonry and the care and attention to detail made in the construction. One of the most important, though often overlooked elements in masonry walling, is the pointing which lies between the faces of the bricks and stones. Re-pointing is the most common masonry maintenance practice; it is also the practice most frequently carried out badly. It is often modified from the original in adverse ways which spoil the character and appearance of old masonry walls, leading to costly long term problems.

The key ingredient and binding agent used in producing good quality pointing mortars for old masonry is building lime. A successful re-pointing project requires the use of a skilled contractor able to survey, specify, cost, and carry out the work in a way which respects the character and appearance of the masonry and its setting. This work is especially important as it may adversely affect and devalue a listed building, Conservation Area or Area of Outstanding Natural Beauty.

"Pointing ... is crucial to the appearance, stability and durability of Britain's old buildings. The attractive appearance of this country's historic walls owes as much to the character of the jointing as to the bricks or stones themselves."

"Making the Point", English Heritage, 1994.

In addition to following traditions, there are sound environmental reasons for using lime materials. The use of lime mortars conforms to sustainable construction practices. Unlike cement mortars, lime mortars are soft enough to be removed allowing bricks and stones to be re-used. Lime can be re-worked for longer and there is less wastage in construction. Lime production also uses 30 –50% less energy than cement production. Pre-mixed dry, hydraulic lime mortars are now more widely available and are also produced in bulk quantities for more cost-effective new building projects in historic areas.

Illustrates the disastrous visual impact of replacement bricks and full, wide joints against the fine jointed early 18th Century brickwork against which it has been juxtaposed.

Shows the soft grey malmstone from the north-east of the county with sandy, yellow lime joints and dark garstone ''nails'', often referred to as galletting.

Shows chalk ashlar range work mixed with squared, knapped black flints and tiles in a cement:lime:sand composition mortar which is beginning to create problems for the permeable stone.

-pointing

"Pointing" describes the visible outer face of mortar joints where they appear on the surface of the wall. "Re-pointing" is the replacement of this outer face of mortar after it has been lost to weathering or damage. In much historic masonry, especially pre-17th century work, "pointing" is no more than the face of bedding mortar, which might or might not have a distinctive profile applied to it. In later work, the bedding mortar was raked back after the masonry had been raised and a plug of different mortar 10 or 15 mm thick was ironed onto the joint.

The pointing mortar will usually be different from the mortar used in the structural core of the walls and may be different from the bedding mortar. The colour, texture and profile of all face mortar has a profound visual effect on the wall. The composition of face mortar also plays a key role in reducing rain and wind penetration, and in allowing the wall to drain when wet, extending the life of the masonry.

History of Hampshire's Walling Materials

Hampshire is not rich in natural building stone but is most famously known as chalk country. Much of the geology is based on a major chalk formation which continues into the county eastward from Salisbury Plain and rises north from Winchester. Chalk block has been used since Roman times for structural work and as a facing of core walls, but much more commonly chalk was used as rubble and in the corework of medieval and later buildings (see photograph a). Chalk has also been used for moulded and sculpted work, especially internally. Many of the old chalk quarries found around the county are likely to have been the source of much of the building lime burnt for mortar in lime kilns located on large estates, farmsteads and small landholdings.

a.

In the east of the county a belt of malmstone or greensand surfaces around Selborne where it can be seen as a creamy-coloured, random or coursed rubble facing stone in many building types (see photograph b). The freshwater limestone quarries at Quarr Abbey and nearby Binstead on the Isle of Wight have provided valuable building stone for major buildings in medieval times. Many of these stones have been recycled for use in buildings and boundary walls since the dissolution of the monasteries. Some of the defensive forts along the Solent were constructed of these reclaimed stones. Walling stone was often re-used in chequered patterns by alternating blocks of freestone with flint.

b.

Flint is the most common building stone used in the county occurring as bands and nodules in the chalk and found in vast quantities on the sea beaches (see photograph c). Flint in the county, is rarely used alone

c.

in walling and is commonly used with brick, timber and chalk block in boundary walls and buildings. Squared, 'knapped' flints are often used in higher quality work. Flint and timber-framing characterise the vernacular appearance of historic buildings in the central chalk uplands. The handmade brick industry is now fairly small in the county though excellent earths were dug in the past to produce high quality red bricks (for use in walling d). Blue-grey bricks were also produced and used in decorative work.

d.

Traditional mortars for these walling materials are based on lime, the source of which is limestone. Lime was produced as closely as possible to the building projects they were to supply. In Hampshire, the chalk downs provided abundant sources of stone suitable for burning for lime, for agricultural and building use. The relatively pure chalk produced lime which would only harden very slowly after mixing with water and exposure to air.

These limes were described traditionally as "air limes". One type of chalk often used was a grey chalk-rock which yielded a weak hydraulic lime. Mortars were commonly more lime rich than today. A reference to one old mortar mix specifies:

"One-eighth wood ashes, one-eighth coal ashes, one-eighth dry sand, and one-eighth the white chalky clay malm, or marl found uniformly under the peat moors in the vallies … and 4/8ths lime, procured from the grey, chalk-rock in the neighbourhood of Petersfield; the whole put together and tempered a few hours only before it is used". [This is a one to one mix with the ashes contributing a weak hydraulic set]

Sometimes the chalk contains a small percentage of clay materials, principally silica and alumina, and a little iron. These stones, if fired at slightly higher temperatures than the purer chalk, would produce limes which would develop a "hydraulic set", when mixed with water. As the set of these limes occurred in water these limes were traditionally described as "water limes".

By the 18th century lime kilns existed on nearly every estate and farm, and more in coastal areas. Builders of that time would have been very familiar with the working properties and characteristics of their local limes though they were of variable quality and often not durable enough for the more demanding construction requirements of the day. From the mid-18th century scientists and the newly emerging profession of engineers began to forge links with entrepreneurs and industrialists in the search for cheaper, improved materials, urgently needed to construct fire resistant buildings to meet many new

developments of terraced housing, roads, bridges, tunnels, canals and harbour works. The re-discovery of Britain's indigenous, hydraulic lime sources by John Smeaton in the late 18th century marked a turning point in construction history. Smeaton's work led to the patenting of later natural and artificial cements.The new materials resulted in revolutionary changes to the scale and speed of civil engineering developments.

The patenting of Portland cements marked the beginning of the decline of lime and local lime kilns were abandoned as the cement industry grew. The survival of traditional building materials and the skills needed to revive their use seemed difficult to expect after the devastation of the World War II. In the small but significant sector of architectural conservation the use of lime for ancient monuments and historic buildings was kept alive due to the work of the Inspectorate of Ancient Monuments and Historic Buildings. The landmark 1912-13 report by Frank Baines on the "Use of Limes and Sands for Pointing" described the "whole question [of pointing] … as largely a matter of tradition, experience and rule-of-thumb work; no comprehensive record of the best manner of working has been published". Standard methods for work on ancient monuments were recommended with all pointing to be done with hydraulic Blue Lias or Aberthaw limes. These standard methods for pointing which Baines initiated and standardised, encouraged the survival of lime mortars for pointing and the skills needed to revive their use after the devastation of World War II.

Large quantities of reliable sources of hydraulic limes continued to be produced in England until the 1960s when the last of the big hydraulic lime companies closed in East Anglia. Today hydraulic limes are available for all forms of repair work for historic buildings, from suppliers importing from the continent and from one source in the U.K. The more common, pure, white-coloured air limes produced by the large limestone quarry industries, are available in putty form for more specialised conservation work.

The importance of reverting to limes, which are now readily available, cannot be overstated in the light of the damage cements are known to cause to historic masonry. Once cements are used the damage they cause to old brick and stone structures may be irreversible as they can be difficult to remove. Bad re-pointing can easily ruin the appearance of entire elevations and lead to the rapid erosion of the walling materials. Well-specified lime mortar has adequate compressive strength, good flexural strength (able to accept minor movements without cracking) and excellent water vapour permeability characteristics (allows the wall to 'breathe'). Cement mortars have poor "breathability" and are susceptible to cracking. Used in combination with old, porous stones or bricks cement mortar acts as a barrier to water evaporating from a wall, and is too brittle to allow for all the small movements of old masonry without cracking. Cement is not compatible with lime-mortared construction. Gauged mortars used in the past in mixtures such as 1 part lime, 1 part sand or aggregate and 6 parts cement (or 1:2:9 or 1:3:12) as common practice are no longer necessary with the increasing range of high quality hydraulic limes available.

Walls of this kind require careful study and anaylsis to avoid mistakes in interpretation. The original 1730s work was false-jointed and tuck pointed (see black perpendicular joints with white lime ''tucking''). Later crude lime pointing has confused the design.

General Principles for Specifying Lime Mortars

The aim of re-pointing is to replace the weathered outer face of joints with new mortar. Decisions about the need for re-pointing are often hastily made on the basis of rough estimates. There are too many cases where there is an excessive amount of re-pointing carried out without real justification, especially where the quantity is allowed to take precedence over the quality. The conservative approach of re-pointing selected, localised areas is always to be preferred to re-pointing entire walls; it risks less damage, is less costly and, if well designed, will quickly weather in. Old mortars are of value in themselves as they represent an irreplaceable record of past technology and building skills. As much of the old mortar as possible should always be retained.

Pleasantly weathered 18th Century mortar with localised damage from nailing and masonry bees. The wall is in fine, aesthetically pleasing condition and should not be touched. As with the bricks, the original mortar has its own intrinsic value.

The dominant factor in specifying a mortar mix is the age and condition of the historic fabric, not its exposure (whether severe, moderate or sheltered). The durability of old stones or bricks is more important than the mortars which must be ultimately sacrificial. Where the specification is for too dense and strong a material the masonry itself will be placed at risk. The design of the new material should be considered only after conditions and causes of eroded joints are fully

High quality penny-struck jointing .

understood. Matching the characteristic appearance of original unweathered mortars is of distinct importance. Permeability as well as the mechanical properties of flexibility, adhesion and frost resistance must be considered. No significant compressive strength is needed in re-pointing traditional buildings.

Survey and recording

Causes of failure, masonry conditions and extent of replacement need to be assessed and recorded by an experienced architect, surveyor or contractor. Areas of decay may be related to defective rainwater goods, splashback from hard landscaping, air pollutants, structural movement, vegetation, cement pointing, poor repairs and exposure. These problems should be understood and resolved prior to any lime mortar repairs otherwise they will continue to have an adverse impact on the pointing. Conditions indicating the need for re-pointing include:

The brickwork has been hacked to receive a plaster and misaligned joints indicate filled window and door openings.

Some building types for instance those typical of military installations have distinctive mortar traditions, such as the neat black ash pointing seen in the lower courses of brick. Unfortunately the poor quality, weather-struck seen in the top courses of brick is endemic, disfiguring and damaging to the wall and distorting the evidence of the original appearance.

- Excessive weathering back to a depth of more than the width of the joint;
- Severely eroded joints leaving inadequate support for bricks and stone and encouraging the ingress of water;
- Hard brittle joints exhibiting cracks or shrinkage especially where bricks or stones are decaying around them and pointing is standing proud of the masonry;
- Dense, impermeable joints trapping water and causing excessive wetting and drying of facing in the stones or bricks.

Good quality joints with textured, weathered faces which are keeping water out are not candidates for replacement. Lime mortar joints may appear soft and can be penetrated with a knife blade but this is not itself a sign of failure or the need for replacement. Typical areas that may need re-pointing are wall bases facing roads, exposed walltops, parapets, window arches, chimney stacks, cement pointing that is causing damage and washed out zones around rainwater hoppers or split pipes.

Recording all surviving original pointing, masonry conditions, the extent of jointing that needs replacing and related remedial works on a drawing or a large scale photograph will serve as a site/owners record and working document for contractors use on site. Where any questions arise over the composition or the significance of any materials specialist advice should be obtained.

Mortar Analysis

In special cases the recording of mortar profiles and an analysis and interpretation of the constituents will need to be made by a specialised contractor or professional advisor. The sampling and laboratory analyses of mortars is normally only necessary for special cases where there is a specific archaeological interest. Laboratory mortar analyses can be costly and time consuming and their purpose is to identify the proportions and constituent parts of an old mortar, not to provide a replacement mortar mix. Simple examination of small pieces of freshly broken unweathered original mortar using a hand lens of x10 magnification is useful to determine the general character. Additionally crushing and washing of the sample to look at the aggregates may be all the amount of analysis needed.

Re-pointing Specification

Building Limes

Lime acts as the binding agent for sand and grit in mortar ensuring a good workable mix. Types of lime vary, depending on their geological origin. Limestones, including chalk, provide the raw material in the U.K. and the continent. A “weak” hydraulic lime, of the kind which used to be described as “feebly hydraulic”, now classified as “NHL 2” is most generally useful. These limes are supplied as a bagged powder from specialist suppliers and from some builders merchants. One part of lime is mixed with two or two and a half parts of well graded aggregates to make a stiff but workable mix. Lime makes a mortar which is very “fatty” and plastic. No additives, such as plasticizers or cements are needed for historic building mortars.

Sometimes non-hydraulic lime, in the form, of “lime putty” is appropriate for mortar for building when the weather is good, the masonry is weak and exposure is sheltered. These mortars will only develop strength and resistance to wetting and drying and freezing very slowly with some taking years to cure. Pure limes of this kind were unlikely to have been used traditionally without some reactive additive such as ash or slag from the lime kiln or the addition of finely powdered brick or tile powder. This is why the weak hydraulic limes described above are much more useful and need less care to behave well. Commercially produced hydraulic limes from the continent have been slaked with minimum amounts of water, can be easily blended with aggregates and water and used directly. They have a “shelf life” and in general should be used as soon after burning as possible (normally 6 months). The purity of hydraulic lime is important to verify before purchasing as some continental products have unnecessary additives. Pure natural hydraulic limes are now classified NHL. If additives are present these will have the suffix ‘Z’. Classification HL is very general and products bearing this classification should be avoided.

The use of proprietary, pre-mixed mortars are not recommended for historic buildings unless there are special reasons for doing so. Bagged non-hydraulic lime powders such as “hydrated“ lime for mortar are not appropriate for traditional masonry as they are less reactive than good lime putty and are more suited to new building work with cements. Mechanical means of preparing joints, such as angle-grinders or masonry drills or for filling joints, such as gun-pointing are not recommended for historic masonry unless there are special reasons for doing so.

Thick, crude lime pointing plastered over original, largely sound 17th Century Brick joints. The whole appearance of the wall has been degraded unnecessarily; the original mortar, seen centre of picture, is in perfectly sound condition

Aggregates

Sands are usually described as “soft” or “sharp”. Many builders are used to working with “soft sand”, which makes cement mortars easier to work. With lime mortars “sharp”, angular coarse sand provides good strength and if well-graded, aids water vapour permeability while “soft” sands often provide good colour. The simplest aggregate blend is a concreting sand (which is gritty) and a soft “builders” sand in 50: 50 proportion. As a general rule mortars perform better if some porous aggregate such as graded limestone (not ‘stone dust’) is added in order to aid the curing and carbonation process by which mortars harden slowly by reacting with atmospheric carbon dioxide.

Fine jointed ashlar has been too difficult to point properly and cementitious mortar straps have been applied over the original joints, disfiguring the wall and preventing it from drying out. This is a straightforward lack of understanding and skill.

Scheduling Re-pointing Work

Woody vegetation such as ivy and buddleia can cause serious damage to brickwork if roots and tendrils are allowed to grow. In this case the corner of the boundary wall will have to be taken down and rebuilt.

Scheduling re-pointing work must prioritise the works in the context of other essential repair and maintenance work and consider the need for any consents from the local authority. In the case of alterations to the pointing of listed buildings and structures planning authorities are guided by Planning and the Historic Environment, *Planning Policy Guidance 15* (C.10) which states:

"The primary feature of a wall is the building material itself and the pointing should normally be visually subservient to it. There are occasions where decorative pointing is used, such as flint galleting, but in general pointing that speaks louder than the walling material is inappropriate. Any change in the character of pointing can be visually and physically damaging and requires listed building consent".

Where repointing work is planned on listed buildings and related outbuildings and boundary walls, local authorities should always be advised of the scale of the work and the materials to be used. The planning authority will normally require the owner to apply for Listed Building Consent if the works affects the character and appearance of the listed structure. If Listed Building Consent is required the Local Planning Authority may make the consent conditional on the use of lime mortars which match the original pointing in material, colour, technique and texture. A detailed specification/ schedule of work describing exactly what is required and what materials are to be used is essential, and where applicable, how the work is to be achieved for Local Authority approval or for a record for reference if work later proves to be unsatisfactory.

A test panel or panels of new pointing work is always recommended but especially where Listed Building Consent is required and may be needed for inspection and approval (in a discrete location) prior to any work proceeding. The panel will set the standard reference to compare the work carried out on the site. In some cases masonry specialists can be asked to prepare trial panels in order to train the contractors carrying out the work, in the use of lime mortars though this practice is not recommended for listed buildings. The planning, estimating, costing and securing of skilled masons and contractors with appropriate and proven experience can take some time as they may be in short supply in some areas. Remember the cheapest price is not necessarily the best price.

The urgency of repairs related to pointing such as any replacement of the stones or bricks, the height and access to the walls and health and safety issues will also need planning. Highway safety for the contractors, pedestrians and vehicles will have to be planned for if walls are adjacent to roads. Damaging vegetation will need to be allowed to die back well before it is removed and saturated walls should be allowed to dry out. One of the keys to successful lime mortar re-pointing work is to plan the work well in advance to avoid excessively wet, freezing conditions and hot weather. Work should not be carried out when temperatures are near freezing or freezing (at or below 5 degrees centigrade) or likely to fall.

In these cases the pointing speaks louder than the brickwork and stands in sharp contrast with the adjacent walls.

Re-pointing Methods

Brick panel in need of repointing.

Cutting out pointing with much deteriorated mortar really only requires raking and washing out, with localised cutting out of hard spots or cement patching. When using a plugging chisel ensure the blade fits comfortably into the joint width and that cutting out is always towards a void to prevent wedging and spalling arrises.

Prepared wall being washed out to remove soil, dust and debris. A back pack pressure spray fitted with a lance and adjustable nozzle is ideal. The wall must be damp until the mortar is placed.

Standard brick jointers are too wide to fit into many joints with the result that mortar cannot be packed from the back of the joint. The concave profile left by this tool is often inappropriate.

Small pointing trowels are also too wide to properly compact mortar into the joint, so that voids are often left. Trowels often leave a struck face which is inappropriate for historic work.

Cranked pointing keys of various widths to fit a wide variety of joints sizes are needed to point successfully. Note that the blade of the key fits easily into the joint.

The mortar is easily picked up on the key and placed from the back of the joint and properly compacted. The mortar should be stiff but workable and just wet enough to stick to the blade of the pointing key and mortar board. Excessive water content is a common problem and must be avoided.

Mortar compacted into clean, damp joints. The rough appearance of the work is typical of well packed joints with mortar hanging along the arris lines. The work cannot be finished for another 12 hours and needs to be protected with plastic sheet against rapid drying.

Finishing the joints first requires trimming off the surplus mortar with a small trowel or key. If the mortar is the right consistency, stains are not left on the masonry.

The surface of the mortar can either be profiled to match an existing style, such as double struck, or ''jointed'' with a jointing tool, or it can be given a ''weathered'' finish by washing with mist fine spray or by tamping with the bristle ends of a churn brush, further compacting the joint. Brushing should never be applied across the mortar as this leaves unsightly drag marks. Wet sponging should never be used as this leaves lime deposits on the bricks and stones which become obvious as the work dries out.

The finished panel has pointing that is simply flush but just recessed from the edges of the brick faces, with good texture, colour matching, no brush strokes.

Appendix

Mortar Mixes

Replacement pointing mortars must be weaker than the masonry, perform against the weathering stresses on the wall in question and match the original un-weathered mortars in overall appearance and in particular characteristics. The style of the joint is critical as it must blend in with the bonding pattern (or arrangement of the stone and/or bricks). Permeability is of particular importance, as well as the mechanical properties of strength, flexibility, adhesion and durability. Don't specify the mixing of extremely complicated mortar, but make sure the aggregates are well-graded, with at least 50% of sharp, angular sand.

TYPICAL RED VICTORIAN BRICKWORK

NHL2 lime	1 part
Soft sand	¾ part
Sharp sand	¾ part

This mix can be mixed in a concrete mixer the night before, left overnight and them mixed again the following morning for 10- 15 minutes to allow the fatty lime to bind to the sands.

WEAK CHALK MASONRY

Lime putty	1 part
Soft sand	½ part
Sharp sand	1 part
Limestone	½ part
Brick powder	½ part

MALMSTONE, SOFT BRICK OR FLINT

NHL 2 lime	1 part
Soft sand	1 part
Sharp sand	1 part
Limestone	½ part

HAND MADE, SOUND BRICK IN MARINE EXPOSURE OR FLINT (EXPOSED)

NHL 3.5 lime	1 part
Soft sand	1 part
Sharp sand	1 part
Limestone	1⁄2 part

SOUND LIMESTONE IN MARINE SEA WALLS

NHL 5 lime	1 part
Sharp sand	2 parts

NOTE: These examples are indicative only. The conditions and requirements will vary from site to site and mortar mixes must be adjusted to suit variations. Adjustments to mixes should always be made to match, as closely as possible, the consistency and texture of the original, unweathered mortar with the type and condition of stone or bricks and the degree of exposure.

Glossary of Re-pointing Terms

Aggregate:
The filler material such as sands and grits, blended with limes to control shrinkage and provide strength. They also provide colour and texture in mortars. In old mortars many types of aggregates were used such as crushed brick, sea shell, kiln slag and ash.

Binder:
Paste-like material, traditionally lime, which binds together aggregates, then hardens to hold them together.

Limes:
Class A limes: are now re-classified as calcium limes in BS EN 459-1: lime that sets through exposure to air by carbonation rather than reaction to water also known as fat or rich limes. Highly pure, normally white in colour and highly caustic. Hardens slowly in mortars and only useful in very sheltered conditions.

Class B limes:
Non-hydraulic limes burnt from less pure limestones or chalk, may have a slow hydraulic set. Now re-classified as calcium limes in BS EN 459-1.

Class C limes:
Natural hydraulic limes burnt from limestones with active clay constituents which set under water. They can vary between feebly, moderately and eminently hydraulic depending on the speed they set at. The three types will have values of 2, 3.5 or 5. They are specified for a variety of uses, including re-pointing.

Lime Production:
Non-hydraulic lime is produced by breaking the stone into lumps and heating it in a kiln. Flare kilns were often used in traditional lime production in which intermittent burning occurs, or draw kilns in which loading and burning are continuous. Lime was traditionally burnt at temperatures between 900 and 1200 degrees centigrade. During burning carbon dioxide and water are driven off and the calcium carbonate is converted into calcium oxide or "quicklime". The lump quicklime is normally slaked as part of the production process and is sold either as a dry bagged powder or as a lime putty.

Hydraulic lime:
Production occurs by burning limestone at higher temperatures of between 950 and 1250 degrees centigrade. During the burning process some of the calcium oxide combines with silica and alumina naturally present in the limestone forming calcium silicates and aluminates- these will provide the hydraulic set. Burning and slaking processes are more complex than with the pure limes. Performance will depend on the initial composition, burning and slaking processes used and suppliers should provide the chemical analysis and production data or guarantee the product against failure.

Lime Putty:
Mixing water with quicklime to form slaked lime, which when stored for at least 3 months (for mortars) forms a cream cheese consistency that can be mixed with aggregates and used, in optimum weather conditions, in sheltered conditions. Normally matured for 3 years for use in plaster.

Knocking Up:
Re-using a pre-mixed mortar by adding small amounts of water. Normally hydraulic limes, once mixed, can be used the next day

Permeability:
The ability to pass liquids or vapours through the pore structure of the stones or brick.

Pozzolanic material:
(Pozzalan) describes any naturally reactive material causing a set when mixed with lime and water. Rocks of volcanic origin such as trass were commonly used historically as were low-fired brick and tile powders. Powered ceramics are currently used but they must be carefully specified.

Materials Supply & Training

In Hampshire some lime products are available from builders merchants as lime putty and dry bagged hydraulic limes. There are specialist companies providing standard and made to order lime products, advisory services and training in the use of lime at Morestead and Bursledon. On the Hampshire/ Sussex border day courses on brickwork are offered at Singleton and residential courses are being offered at West Dean. Elsewhere in the country the SPAB offers introductory courses to homeowners and contractors on the use of lime in historic buildings. The Local Authorities within Hampshire have experience with local contractors who use lime mortars on listed buildings.

Bursledon Brickworks (Trading Ltd.),
Coal Park Lane, Swanwick, Southampton
Tel: 01489 576248

Cathedral Communications Ltd.,
The Building Conservation Directory 2004,
High Street, Tisbury, Wiltshire
Tel: 01747 871717
Website: **www.buildingconservation.com**

English Heritage,
The English Heritage Directory of Building Limes,
Shaftesbury, Dorset, Donhead Publishing Ltd., 1997.
Tel: 01747 828522 Website: **www.donhead.com.uk**

The Lime Centre, Long Barn, Morestead,
Winchester, Hampshire
Tel: 01962 713636 Website: **www.thelimecentre.co.uk**

Society for the Protection of Ancient Buildings,
37 Spital Square, London, E1 6DY
Tel: 020 7377 1644 Website: **www.spab.org.uk**

Weald and Downland Museum, Singleton, Chichester,
West Sussex, PO18 0EU
Tel: 01243 811301 Website: **www.wealddown.co.uk**

West Dean College Building Conservation Masterclasses,
West Dean College Chichester, West Sussex, P018 OQZ
Tel: 01243 811301 Website: **www.westdean.org.uk**

Recommended Reading

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