

ENGLISH HERITAGE
PRACTICAL BUILDING CONSERVATION

MORTARS, RENDERS & PLASTERS



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& PLASTERERS



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ASHGATE

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To the memory of John Ashurst (1937–2008), an inspiration and friend to all the editors, whose encouragement and support was a great motivation for this new series of Practical Building Conservation.

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PRACTICAL BUILDING CONSERVATION

MORTARS, RENDERS & PLASTERS

Series Editors: Bill Martin and Chris Wood

Volume Editors: Alison Henry and John Stewart

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John Ashurst, a principal contributor to this book and the principal author of the original *Practical Building Conservation* series, was a pre-eminent conservation authority and architect, both in the UK and abroad. **Richard Ireland**, plaster conservator in private practice and lecturer, advises on and carries out conservation of significant historic plasterwork in the British Isles.

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THE PRACTICAL BUILDING CONSERVATION SERIES

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This series of *Practical Building Conservation* technical handbooks supersedes the original five volumes written by John and Nicola Ashurst, and published in 1988.

The series is aimed primarily at those who look after historic buildings, or who work on them. The ten volumes should be useful to architects, surveyors, engineers, conservators, contractors and conservation officers, but also of interest to owners, curators, students and researchers.

The contents reflect the work of the Building Conservation and Research Team, their colleagues at English Heritage, and their consultants and researchers, who together have many decades of accumulated experience in dealing with deteriorating building materials and systems of all types. The aim has been to provide practical advice by advocating a common approach of firstly understanding the material or building element and why it is deteriorating, and then dealing with the causes. The books do not include detailed specifications for remedial work, neither do they include a comprehensive coverage of each subject. They concentrate on those aspects which are significant in conservation terms, and reflect the requests for information received by English Heritage.

Building conservation draws on evidence and lessons from the past to help understand the building, its deterioration and potential remedies; this encourages a cautious approach. New techniques, materials and treatments often seem promising, but can prove disappointing and sometimes disastrous. It takes many years before there is sufficient experience of their use to be able to promote them confidently. Nonetheless, understanding increases with experience and building conservation is a progressive discipline, to which these books aim to contribute.

The volumes also establish continual care and maintenance as an integral part of any conservation programme. Maintenance of all buildings, even of those that have deteriorated, must be a priority: it is a means of maximising preservation and minimising costs.

Most of the examples shown in the books are from England: however, English Heritage maintains good relations with conservation bodies around the world, and even where materials and techniques differ, the approach is usually consistent. We therefore hope the series will have a wider appeal.

Dr Simon Thurley
Chief Executive, English Heritage

ABOUT THIS BOOK

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Mortars, renders and plasters are common terms to describe diverse applications of generic building materials that are based on a binder, usually with the addition of an aggregate. These serve functional roles as bonding agents of masonry units or as protective coatings, often with decorative effect.

Traditional binders consisted of clay, lime and gypsum. These were later complemented by the development of natural and artificial cements. Lime-based mortars are given prominence in this book as they were of central importance to traditional building in England, and remain the material of choice in most repairs today. Earth-based mortars were also significant (these are treated within the *Earth, Brick & Terracotta* volume of this series). Many important historic features of the 19th century were executed in cement, and advice on their conservation is also provided. As cement mortars have otherwise proven detrimental to the preservation of much traditional lime construction, their general use is not advocated.

In the repair of historical buildings, mortars are commonly considered as new materials to serve the conservation of masonry. As a result of their renewable nature, these 'silent performers' are often undervalued in relation to structural masonry. Some mortar applications are indeed sacrificial, such as external pointing or render requiring occasional renewal to protect structural fabric. Poor understanding of their performance and relative significance, however, has led to the unnecessary removal of many sound and often very important historic materials. Mortars are an integral part of historic masonry, contributing, sometimes intangibly, to the authenticity and the inherent and often subtle aesthetic that makes old buildings so appealing.

This work gives guidance on the selection and use of appropriate mortars, renders and plasters for masonry repair, including modern sustainable materials. It also provides practical guidance on understanding the performance and significance of historic mortars and their conservation.

The organisation of this book is as follows: first, mortars, renders and plasters are described in terms of their technological evolution, historical applications and material properties; second, processes of deterioration are discussed, followed by approaches to the assessment of their condition as well as the range of appropriate options for their treatment and repair. Special related topics review paints for plasters and renders, conservation of historic natural cement, mortar floors, ruinous structures and decorative painted surfaces.

Since the publication of the first volume of *Mortars, Plasters & Renders* in 1988, interest in the topic has increased enormously, first as part of the lime revival of the late 20th century, and more recently in the use of lime in sustainable renovation and new construction. These developments have generated a great deal of research and publications on lime in general and historic materials in particular, with strong commercial responses in the supply of a wider range of products. This publication provides a broad perspective of contemporary theory and practice not otherwise found under one cover, including extensive historical research.

USING THESE BOOKS

For accessibility and ease of use, the information given in the text has not been footnoted, and rather than references, short lists of further reading are given at the end of the appropriate chapters. References to other sections within the text are given in **bold**, and references to other publications in *bold italics*. A more detailed bibliography is at the end of the volume, just before the index.

Links to other books in the *Practical Building Conservation* series are indicated throughout the text by the relevant volume symbol, showing that more information on the topic will be found in that volume.

The other volumes in the series are:

- Conservation Basics 
- Concrete 
- Earth, Brick & Terracotta 
- Building Environment 
- Glass & Glazing 
- Metals 
- Roofing 
- Stone 
- Timber 

Although every attempt has been made to explain terms as they first occur in the text, a glossary has also been included, and will be found after the appendices.

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MATERIALS
& HISTORY
OF USE

This chapter reviews the nature and methods of production of materials used historically, a brief history of the technological evolution of mortars, renders and plasters in England, and a description of their application in a range of functional and decorative contexts.

The plastic quality of mortars offers great versatility, from binding regular or irregular stones or bricks, to lining flues or forming utilitarian floors, to modelling of virtuosic decorative plaster or render, often embellished by paints.

For centuries, the composition of mortar, renders and plasters in England was based on raw materials largely derived from local geological resources, and modified by organic and inorganic additives to suit specific needs. During the Industrial Revolution, however, natural and artificial cements were developed, which provided a quicker set and greater compressive strengths. These properties were inherently different from most traditional construction materials, a fact that was already recognised in the 19th century. The artificial cement industry prospered as lime production declined. It was only years later that it was realised that a great deal of damage to historic fabric had been caused by the use of modern cement binders.

To resolve this problem, a concerted recovery of the lime-based tradition began in the late 20th century. A welcome commercial response has been the production of a broader range of lime mortars, each with specific potential. Understanding historic materials and their modern counterparts is vital in selecting appropriate materials for conservation.

INTRODUCTION

Good mortars are essential to the longevity of historic buildings in England. Whether mortar is used as bedding or pointing, or as protective render, it usually plays an important role in structural performance. Virtually all the ancient and medieval buildings that survive have done so because they were built by experienced tradesmen who had the knowledge and skills to blend lime and aggregates, and apply the resulting mortars successfully.

This expertise endured until the end of the 19th century, but the use of lime subsequently declined with the increasing availability of cement and, with it, much of the knowledge and good practice in its use. The ease of using cement meant that much experience, skill and thought were removed from the process. The additional advantage of its rapid set also permitted year-round working to become the norm and the onset of cold weather could simply be met by increasing the cement content in mortars. Towards the end of the 20th century the harm caused by cements became clear, prompting a revival in the use of lime. This entailed a great deal of scientific testing, site trials and training which aimed to better understand this 'lost craft'.



The lime revival was driven not only by pragmatism, but a fervent belief in the craft of lime.

Early conservation work using non-hydraulic lime mortars in the late 1970s resulted in some failures of pointing or rendering, particularly on very exposed sites. This affected confidence, but experiments with various pozzolanic additives showed that a quicker set could be achieved and early failure averted in these difficult situations, although careful protection was still needed. Using lime mortars for external work requires experience and thought, including attention to protection and effective curing. Non-hydraulic lime mortars can be a risky choice in exposed situations, but experienced craftsmen conversant with the materials can achieve successful results.

The re-introduction of natural hydraulic limes has brought lime mortars to many more practitioners. Their quicker set makes them more robust, and the initial preparation is relatively simple and comparable to that of cement. Problems may arise, however, when contractors assume that the same practices can be followed; namely, using a stronger hydraulic lime to counteract inclement weather, or assuming that this will be appropriate in exposed locations regardless of the condition of the surrounding masonry.

Even though a broad palette of materials is now available and widely used, every building repair is unique, requiring consideration of its particular circumstances. Copying previous specifications can lead to failure when the type and condition of the masonry or prevailing site conditions differ. It is usual in conservation work to repair in a 'like for like' manner, but this is not always appropriate. Weathered masonry can be more friable and need a weaker mortar than that originally applied. A ruined building, originally roofed, may require a mortar better able to deal with excessive wetting.

Many practitioners today argue that there is no need to use artificial cement in repair, unless this was used in the original construction. Lime or earth mortars would have been used before the 19th century and therefore should be regarded as traditional on buildings which predate the invention of cements.

A much greater understanding of how good mortars perform has been gained by the scientific investigations that have taken place over the last two decades. However, analysing problems will always remain a challenge because of the inherent difficulties in assessing conditions within the structure of aged walls. There is now much greater confidence in using lime mortars, particularly those which include a hydraulic set, although well-founded concerns remain that some of these might be too strong for some building stones, bricks or other substrates. Whilst laboratory analysis provides insight to mortar performance, it is ultimately the monitoring of repair work that provides meaningful evidence.

MORTARS, RENDERS & PLASTERS: 5 A HISTORICAL PERSPECTIVE

ANCIENT MORTARS

Mortar materials have an ancient pedigree, perhaps almost as old as the discipline of building itself. Much of the early use of mortar is known only from archaeological sites, such as the cache of lime plaster statues from 'Ain Ghazal in Jordan (c. 6500 BC), the famous red lime floor at Lepenski Vir in Serbia (c. 5600 BC) or the Egyptian haired gypsum and lime-gypsum plasters of the third millennium BC.

The earliest known illustration of mortar preparation and application is an Egyptian mural of 1950 BC. Ancient written records from Classical Antiquity describing the use of lime mortar and plaster are numerous. The first known are those of Cato (234–149 BC) and Pliny the Younger (62–113 AD), but the most important description of mortars, however, is within the book *De Architectura*, written by the Roman architect Vitruvius (27 BC–14 AD). This was much quoted in scholarly circles from the 15th century, until superseded by more scientific texts three centuries later.



Herod's Fortress at Masada
1st century BC

There is an intimate relationship between man and mortar materials, from extraction of binders and aggregates, to processing, mixing and applying them. This is expressed by the impressions of craftsmen's hands which both compact the mortar and provide a key for subsequent coats. John Ashurst places his hand within an imprint created two millennia ago.

MORTARS IN PRE-INDUSTRIAL ENGLAND

CRAFT & WORKMANSHIP

Sophisticated mortar technology for masonry construction was a Roman innovation. Most Roman construction in stone was of *opus caementicium*, with roughly-hewn stone faces and a core of rubble and lime mortar. **STONE**

The ingenuity and success of Roman mortar technology is well known, and the evidence of its contribution to building and engineering works survive to this day throughout the old Roman world, particularly in lime concrete construction. **CONCRETE**

Whilst archaeological evidence shows that basic vernacular Roman building was coarse (especially in terms of poorly prepared, earthy mortars), first-rate technology and requisite skills were available when needed. Experienced masons and engineers within Roman legions prepared the various mortars. This was not regarded as a menial task. Local labour was only used for unskilled chores such as the transport of raw materials.

The Romans imported this advanced building technology into England, exploiting local limestone for masonry, lime mortar and lime concrete, in the service of defence, engineering works and buildings of high status.

Right: Tomb in the Campagna, near Rome, by Giovanni Battista Piranesi (*le Antichità romane*, 1756). The massive tumble of cohesive lime concrete masonry (left) demonstrates the mastery of Roman construction.

Facing page:

Roman façade from Meonstoke, Hampshire (early 4th century AD). A portion of a collapsed wall which survived in burial conditions. The design utilised mortar to great decorative effect, with its strong bands and flints carefully framed in sculpted mortar.

