



Chilterns

**Buildings
Design
Guide**

Chilterns Brick

*Supplementary
Technical Note*

Chilterns Brick Supplementary Technical Note - Adopted Version

Acknowledgements

This Technical Note has been published by the Chilterns Conservation Board which would like to express its thanks to Dr. James Moir who has researched and written this Note. Thanks should also go to the members of the Brick and Flint Advisory Group who have given help and advice, and particularly to Jim Matthews (*HG Matthews Brickworks*), Eric Cheeseman

(*Bovingdon Brickworks*) and Martin Warner (*Dunton Brothers Brickworks*) who provided invaluable information, support and access to their respective brickworks; to Chris Green, editor of Hertfordshire Archaeology (Statistics) for making available the paper by Lyle Perrins on Hertfordshire Brickworks; to Ian Cook of Dunton Brothers Brickworks for technical advice; and to Colin White, Chilterns Conservation Board Planning Officer for his help in organising the Group and input into revisions to the text.

Brick porch (Stonor)



Particular thanks are also due to the following:

Tim Amsden,
 Martin Andrew (*Wycombe District Council*)
 Richard Bossons (*Architect*)
 Chris Brady (*BEAMS*)
 George Crutcher (*South Bedfordshire District Council*)
 Nick Doggett (*CGMS Consulting*)
 Roger Evans (*Former Buckinghamshire Historic Buildings Officer*)
 Sandy Kidd (*Buckinghamshire County Archaeological Service*)
 Susan Lisk (*Oxfordshire County Council Sites and Monuments Record*)
 Gary Marshall (*Regional Archaeologist, National Trust*)
 Ian Pritchett (*LJP Building Conservation Ltd.*)
 Derek Rogers (*Architect*)
 Alison Tinniswood (*Hertfordshire County Sites and Monuments Record*)

All photographs are by Dr. James Moir unless otherwise acknowledged. Main cover photograph by Dave Marriott.

The drawings on pages 22 - 25, 39 and 50 are by PEP Architects Ltd and Glyn Kuhn.

The Chilterns Conservation Board wishes to acknowledge the generous grant aid made available by the following organisations towards the cost of producing this Note:

The Countryside Agency, South East England Development Agency, Chiltern District Council, South Oxfordshire District Council, Dacorum Borough Council, South Bedfordshire District Council, Wycombe District Council, Bovingdon Brickworks Ltd, Dunton Brothers and H G Matthews.

Chilterns Buildings Design Guide - Chilterns Brick, Supplementary Technical Note © Published January 2006

No part of this publication may be reproduced or transmitted in any form without the prior permission of the Chilterns Conservation Board.

ISBN 0 -9545242-2-5

Foreword

The conservation of the Chilterns landscape and its biodiversity is a prime focus of the work of the Chilterns Conservation Board. But buildings are also a key feature of the Area of Outstanding Natural Beauty (AONB) and we have recognised their importance in the Chilterns Buildings Design Guide.

Brick and flint are two of the recurrent materials that feature in the vernacular architecture of the area. Much depends, though, on maintaining the traditional character that has built up over time. By seeking the best, both in constructing new buildings and in the repair of older buildings, we should see this happen.

In these days of mass produced alternatives, we need to promote brickwork of the highest

standard in our finest countryside in order to inspire top quality design in new development.

We are fortunate in the Chilterns to have brick makers who produce bricks in traditional ways from local materials. The best of our built environment is part of our heritage. This Technical Note on Chilterns Brick reflects methods which have been used in the AONB since the early C15th and seeks to ensure that they prosper and survive into the future.



Sir John Johnson

Chairman,
Chilterns Conservation Board
January 2006



*Long brick terrace
(Aldbury)*

Contents

Chapter 1	
Introduction	4
Chapter 2	
Background	7
Historical Manufacture of Brick	9
Historical Use of Brick	13
Chapter 3	
Using Brick Today	19
An Inspirational Inheritance	19
Regional Distinctiveness	20
Specification and Design	22
Building with Brick	22
Designing with Brick	26
1 Preliminaries	26
2 Massing	27
3 Openings	28
4 Material Combinations	30
5 Brick Selection	32
6 Bonding Arrangement	36
7 Design and Choice of Mortar	37
8 Detailing	40
9 Internal Use of Brick	44
10 Select Contractor	44
11 Obtaining Bricks	44
12 Review	45
Designing with Existing Brick	45
Chapter 4	
The Future	49
Glossary	50
Bibliography	53
Further Advice	53

Chapter 1

Introduction

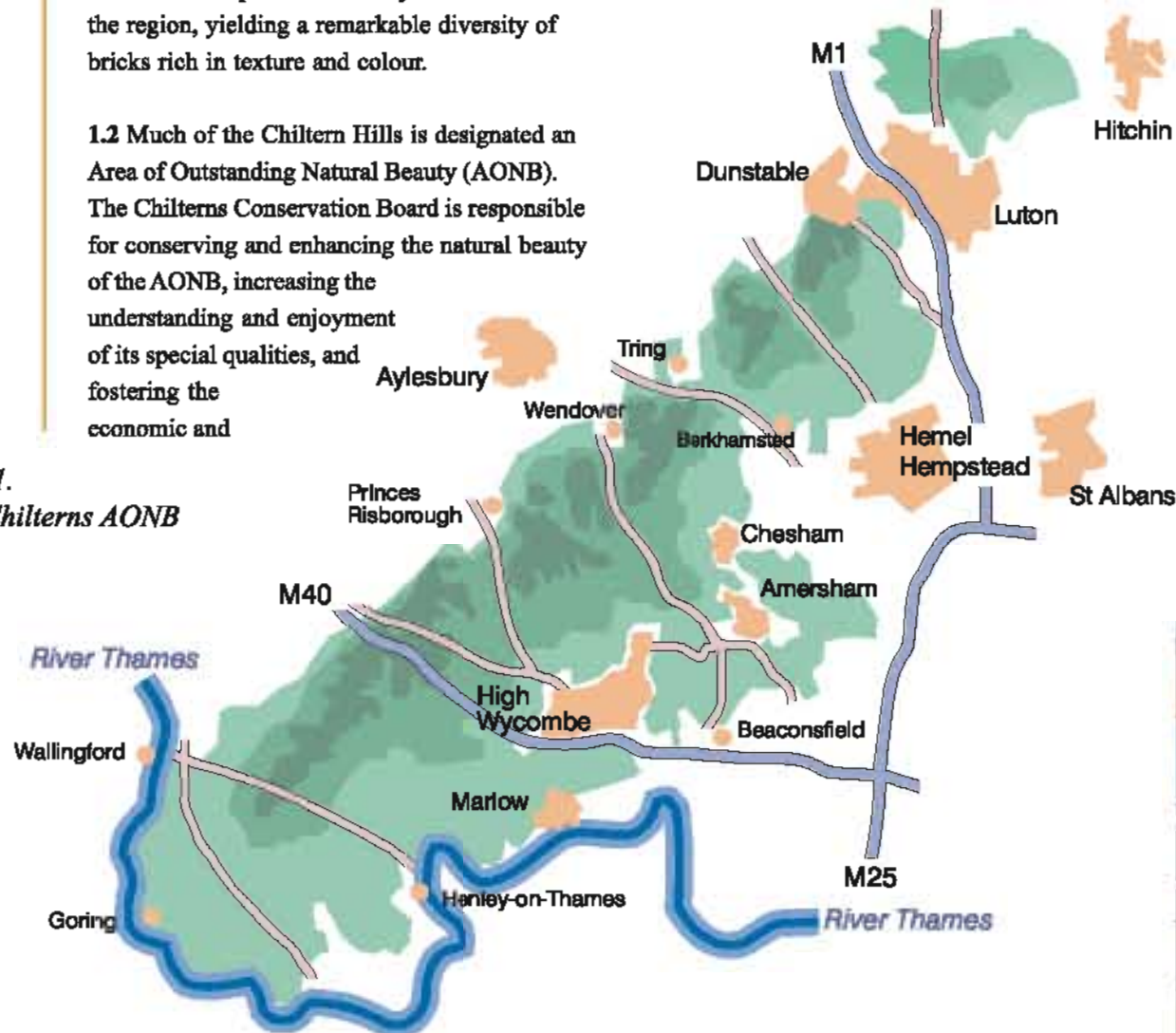
1.1 Brick is the most widespread of traditional materials found in the Chilterns. Brickfields, kilns and clamps were liberally scattered around the region, yielding a remarkable diversity of bricks rich in texture and colour.

1.2 Much of the Chiltern Hills is designated an Area of Outstanding Natural Beauty (AONB). The Chilterns Conservation Board is responsible for conserving and enhancing the natural beauty of the AONB, increasing the understanding and enjoyment of its special qualities, and fostering the economic and

social well-being of local communities within the AONB. It may offer assistance to local authorities with the aim of ensuring their policies and practices are co-ordinated and consistent with guidance that has been adopted.

1.3 To this end, the Chilterns Buildings Design Guide was published in 1999 to provide guidance on how to achieve high quality design in new developments. The Guide provides a framework for protecting and enhancing the identity of the traditional built character of the Chilterns, which has been steadily eroded by the use of standardised designs and inappropriate non-local materials. This series of Technical Notes is intended to supplement the Chilterns Buildings Design Guide by providing additional guidance on the appropriate use of locally available materials. The Chilterns Conservation Board acknowledges the existence of aesthetically pleasing and appropriate bricks that are made elsewhere that may be used in certain instances, e.g. to match a colour. However, the Board's preference is for the use of locally produced bricks wherever possible. (visit www.chilternsaonb.org the Chilterns AONB website for details of other Technical Notes).

Map 1.
The Chilterns AONB



Cluster of brick buildings (Hemel Hempstead)



1.4 The Objectives of the guidance are to:

- Raise awareness of the quality of the traditional built character of the Chilterns AONB by highlighting the importance of local brick, its characteristics, functions and uses
- Foster an interest in and create respect for the historical diversity of brick buildings in the region
- Re-establish traditional character in areas of the AONB where it has been damaged or eroded
- Protect the distinctive character of the built environment by encouraging good repair practices
- Encourage the sustainable use of a local, natural resource
- Promote the appropriate use of brick in new developments so as to create respect for the traditional built character of the AONB
- Encourage brickwork of the highest standards to inspire high quality design in new developments

1.5 The note covers all types of new buildings, extensions and conversions where brick is intended to be used, and also gives guidance on repair of existing brickwork. It is not a comprehensive historical and design statement. Nor is it meant to imply that all new designs must utilise *only* brick and slavishly copy buildings from previous eras. It illustrates a potential for excellence, diversity and flexibility in new design whilst still respecting the distinctive qualities of the area.

1.6 This guidance is intended to be used by all involved in the development process: owners; architects; designers; developers; builders; planning authorities; parish councils and any organisation or individual with an interest in the built environment of the Chilterns AONB.

1.7 The note is not a statutory document, but is a material planning consideration and will contribute to decision-making on planning applications. Local planning authorities will be invited to adopt it as a Supplementary Planning Document so as to ensure consistency across the 15 local planning authorities within which the AONB lies. If adopted, the planning authorities will expect all relevant planning applications in the AONB to demonstrate how these guidelines have been taken into account. Adherence to the guidelines does not mean that development proposals will necessarily be approved because other planning

policies will apply. Specific design and planning guidance is also likely to apply to buildings which have been listed or are situated in conservation areas. The local planning authority should be contacted for details.

1.8 This note was the subject of public consultation prior to adoption. The views of consultees were taken into account and in some cases changes were made. A copy of all the representations made during the consultation period and the Conservation Board's response is available from the Chilterns AONB office.

Sustainability

1.9 Brick plays a key role in enhancing the built environment of the Chilterns. Brickearth is ready to hand and, within the necessary constraints, can be dug, moulded and fired to produce a building

*New brick extension to existing historic building (Chenies)
(Photo Dave Marriott)*



Chilterns Brick Supplementary Technical Note - Adapted Version

material that will enrich local character whilst stimulating the regional economy through its manufacture.

1.10 Deposits are mostly adjacent to the brickyards so that transport costs are minimized. Today, bricks are produced by technically more efficient and environmentally-conscious methods than they were in the past. For current national levels of brick production, the rate of extraction amounts to no more than 3% of the tonnage of quarried materials in the UK. Over the last 25 years the energy requirement for the manufacture of bricks has been reduced by over 20%. Emissions from the firing process have been greatly reduced, excess heat from the firing process can be utilised to assist drying, and air-dried bricks are enjoying something of a renaissance, saving on kiln-drying costs.

1.11 Brickmaking operations in the Chilterns are essentially small-scale; restoration of the landscape takes place leaving very little trace of



From clayspit to...



...sell, or...



...pond (Photos by Dave Marriatt)



former operations and many worked-out quarries are now Sites of Special Scientific Interest. One local manufacturer is re-claiming rainwater for use in brickmaking; woodlands are being planted in the vicinity of the brickworks, with the aim of making the brick manufacturing process carbon-neutral.

1.12 The embodied energy content of brickwork is low in relation to the energy used within a building in a normal life span of 50-60 years and particularly low for the very long life characteristically observed for brick buildings. Bricks can also be re-used if combined with lime mortars. Only if unsuitable for brickwork should they be re-cycled as graded aggregates for sub-bases, hardcore and concrete or crushed into granules for use with compost.

Sustainability Checklist

- Do use bricks manufactured in the Chilterns
- Do design for re-usability

Stacks of newly-made bricks (Bovingdon Brickworks)



Some of the range of bricks produced today in the Chilterns (for full details see manufacturer's publications)



Chalfont Red / Red Multi



Light Multi / Antiques Multi



Multi / Bucks Multi



Dark Multi



Gray Brown

Background

2.1 Extensive deposits of clay-with-flints overlay the chalk bed rock of the Chilterns. In places, this clay has been eroded to form a marly composition, sometimes overlain by further deposits of clay and flint. This marly soil is ideal for brick-making; its wide distribution throughout the Chilterns is reflected in the large number of historic brickworks (*Map 2*).

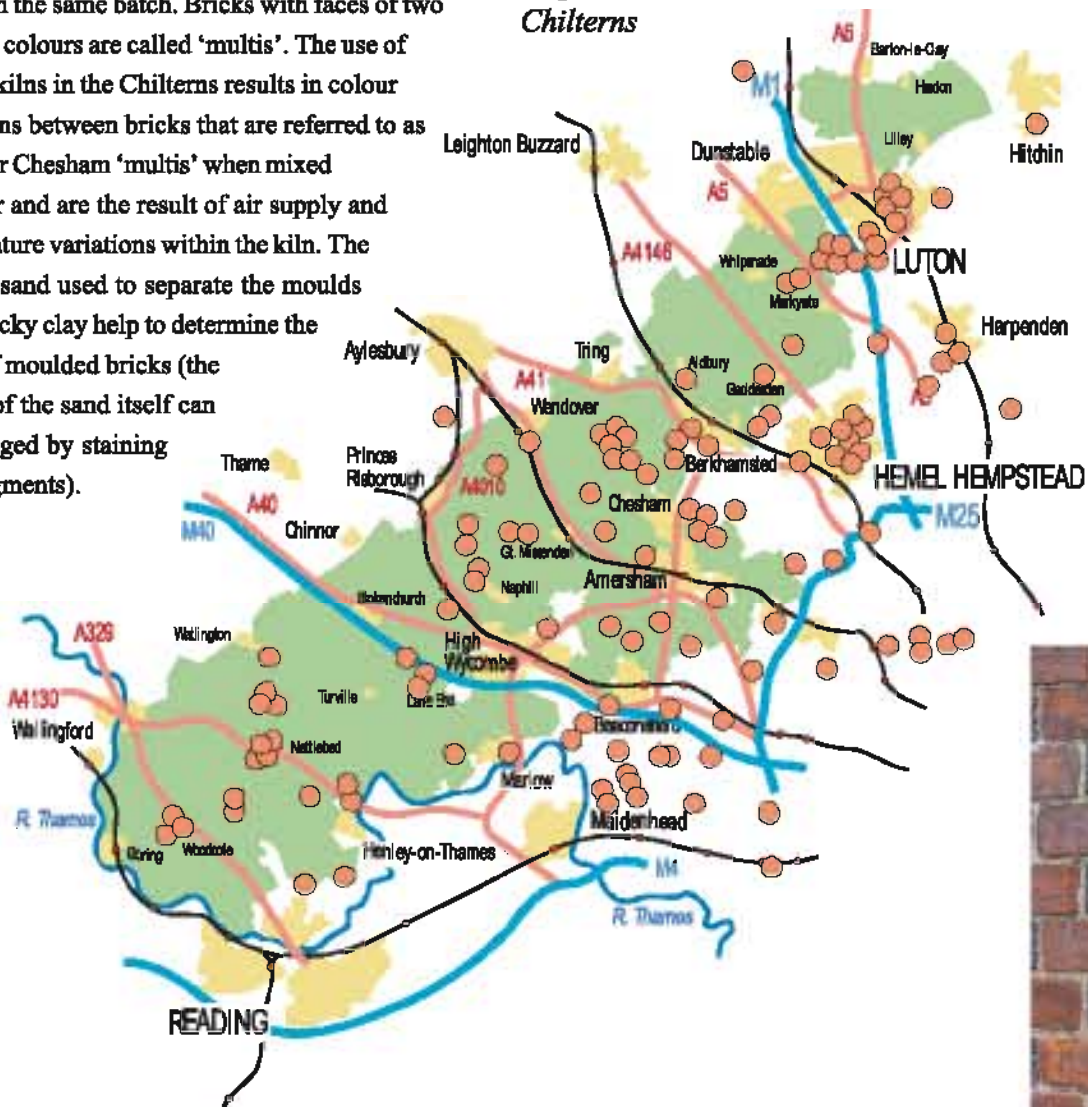
2.2 Although bricks are commonly red because of iron oxide in the clay, differences in clay type and impurities within it produce bricks with distinct local characteristics. The clays of the South-West Chilterns, where Eocene Reading Beds occur as isolated deposits, produce an orange or orange-brown brick. In the central area of the Chilterns the brickfields produce a type of distinct red-purple colour. In Hertfordshire and Bedfordshire, bricks tend to be of a purple-brown or purple-grey (as in Luton 'greys') colouring. To the east of the Chilterns, ground chalk present with iron oxide, as in London clay, produces yellow or buff London Stock bricks. Just to the north-west of the Chilterns, the Gault clays, containing a high amount of lime, produced a distinctive buff coloured or so-called white brick under controlled firing; some of these inevitably travelled over into the Chilterns area.

2.3 Beyond these variations in the chemical composition and colour of the clay, differences in hand moulding, fuel, firing time, temperature, and position within the kiln can all produce subtle variations of colour, texture and size even between bricks in the same batch. Bricks with faces of two or more colours are called 'multis'. The use of Scotch kilns in the Chilterns results in colour variations between bricks that are referred to as Bucks or Chesham 'multis' when mixed together and are the result of air supply and temperature variations within the kiln. The type of sand used to separate the moulds from sticky clay help to determine the faces of moulded bricks (the colour of the sand itself can be changed by staining with pigments).

Chilterns Brick Supplementary Technical Note - Adopted Version

Burnt headers with glazed or vitreous ends and used to create patterned or chequer effects were achieved by burning high potash fuels such as bracken or gorse in the kiln fire.

Map 2. Documented Brickworks in the Chilterns



Chapter 2

Glazed headers (Markyate)



Chilterns Brick Supplementary Technical Note - Adopted Version

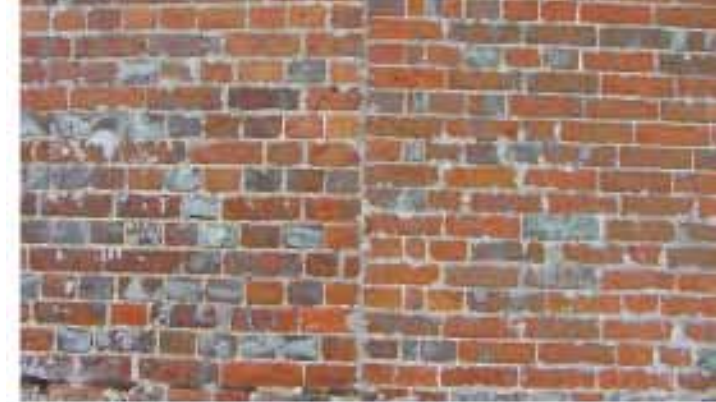
2.4 Further variety is created through the use of 'specials' – bricks created using distinctively shaped moulds. As well as the extensive range of standard specials (covered by BS 4729), brick manufacturers in the Chilterns will produce bricks to the specification of the designer. Such decorative bricks can add a distinctive ornamental quality in an appropriate context, whilst more elaborate sculptured designs can stamp 'one-off' buildings with a unique finish.

2.5 Bricks can be laid in a variety of bonds and the choice will again dramatically affect visual character. In south-west Bedfordshire, for example, many of the C18th buildings use a distinctive grey header. The monotonous use of stretchers in modern designs is an unfortunate outcome of the adoption of conventional cavity walling.

2.6 The appearance of brickwork is also materially affected by the composition of the mortar used and its finished profile in relation to the face and arrises of each brick. Cement mortar and soft sand superseded lime mortar and gritty aggregates in the C19th and C20th, although lime is deservedly experiencing a revival due to improved means of production, application and environmental

considerations. All mortars, whether lime or cement, should be designed to be appropriate for the masonry being constructed.

2.7 In the past, techniques and additives were sometimes employed to alter the finish and appearance of brickwork and mortar. An example was colour-washing bricks using brick dust as a base. Today, the principal additives employed are plasticisers to aid workability, and pigments to produce a distinctive colour. Pigments are sometimes used to tint bricks to enhance the surface colour, for cosmetic or design considerations.

*Contrasting mortars (Barton)**Colour-washed bricks (Berkhamsted)**Contrasting brick bonds (Ipsden)*

2.8 Since the C19th, improving transport connections allowed an increasing number of bricks to be imported into the Chilterns, creating formidable competition for local manufacturers. Greater choice could have extended the range and palette of architectural brickwork. While this was sometimes the case when applied to larger institutional buildings, the cumulative effect on the Chilterns has been to dilute local character, introducing alien types of brickwork.

The problem is compounded by the lack of skills and craftsmanship, which contribute to the blandness and poor quality of much new design in the Chilterns.

Bland modern brickwork*Chiltern specials
(H G Matthews
Brickyard)*

Historical Manufacture of Brick

2.9 Brick and tile-making in the Chilterns is known to date back to the C13th and C14th, although surviving examples of brickwork cannot be firmly dated earlier than the C15th. One of the oldest identified brick fields is at Crocker End, Nettlebed, which supplied Stonor Park with 200,000 'brykes' (the earliest use of the term in the region) from the kiln site in 1416-17. 'Les Flemyngges', likely to be immigrant brick-workers, were also employed on the job.

2.10 Up to 1965 when the Imperial Standard brick was adopted ($8\frac{5}{8}" \times 4\frac{1}{8}" \times 2\frac{5}{8}"$; 219 x 104.6 x 66.8mm.) many bricks did not conform to any standard. The earliest bricks were generally comparatively small; they became perceptibly larger during the C17 and C18th, when various Acts of Parliament specified minimum dimensions; the imposition of the brick tax in 1784, as a charge per thousand, led to a tendency to increase the size of bricks. However, despite increases the historical ability to handle a brick with one hand remained.

The Imperial Standard was superseded in 1974 by the slightly smaller metric brick with a nominal size of 215 x 102.5 x 65mm. It is, however, still possible to buy or have bricks made to Imperial sizes.

2.11 Medieval bricks were often burned in clamps, where layers of brushwood were interspersed between stacks of sun-dried bricks. This unpredictable method resulted in bricks of irregular character; those nearest to the fire being the darkest; being hard-burnt, they also shrank more.

2.12 By the C17th, production was increasing to meet the greater demand for brick at a more vernacular level. Bricks to build or extend great houses, such as Gorhambury, near St Albans were still often made by itinerants: John Bodimeade (who had kilns at Harrow and Barnet) was contracted to make on site the 816,675 bricks required to build Gorhambury, near St Albans between 1777 and 1792.

Chilterns Brick Supplementary Technical Note - Adopted Version

2.13 Apart from estate brickyards, some farmers and millers combined agriculture and brickmaking; brick-, tile- and lime-burning were also frequently grouped together as one occupation. Increasingly, brick industries flourished on the many areas of exposed commonland in the Chilterns, spawning 'squatter settlements'. In the southern Chilterns, Nettlebed continued as an important centre for brickmaking through to the early C20th, but brick manufacture tended to be small-scale, temporary and seasonal in nature.

2.14 Despite the artificial inflation of brick prices through the imposition of a tax on manufacturers in 1784 of 2s 6d per thousand bricks (raised in 1794, again in 1803 and repealed in 1850) brick became the predominant building material

Stonor Park - described as a 'positive museum of brickwork of all periods'



Chilterns Brick Supplementary Technical Note - Adopted Version

throughout the Chilterns, both stimulated by and responding to the dramatic increase of rural and urban populations in the early C19th.

2.15 Throughout the first half of the C19th the number of brickyards mushroomed. The concentration of new brickyards in and around the urban centres (often owned by local building firms) was matched by a growth in rural enterprises. Landowners owned brickyards, such as the Rothschilds at Buckland Common, operating between 1850 and 1900. Some brickyards gained a reputation for specialised items – a number in the mid Chilterns (eg Kirbys at Chalfont St Giles and Piners at Hedgerley) produced large quantities of tiles for lining bakers' ovens. Apart from Nettlebed (where over 50 men were employed by the principal brickmaker there) many of the rural yards employed less than five men. A considerable degree of mobility is indicated by the career of Isaac Mouldy, a brickmaker born in 1804 at Speen; he worked from 1841-51 at Clifton Hampden, 1852-3 at Islip, 1861 (as master bricklayer) at Long Wittenham and in 1877-83 at Culham.

*Small-scale brick production
(Dunton Brothers)*



Clay digging in 1924 (Bellingdon)

2.16 The number of smaller rural enterprises began to decline in the latter part of the C19th and early C20th, partly due to external competition from, for example, the Bedfordshire Fletton industry (by 1936 Stewartby employed 2,000 people and produced 500 million bricks a year), partly from competition from other materials such as metal and asbestos claddings, partly from the localised exhaustion of clay deposits, and partly from workforces defecting to less onerous or messy working conditions. The First and Second World Wars with the intervening Depression had a particularly crippling effect. Brick production ceased at Nettlebed in 1927 and at Stoke Row in 1940. Howard's at Prestwood was still employing about 80 men at peak periods in 1939; the

*Pugging Shed Bellingdon
Brickyard (late 1920's)*

brickyard temporarily closed in 1940, re-opened in 1949 and finally closed in the 1950s. Only three of the 23 brickyards operating before World War II within 5 miles of Chesham are still producing bricks today.

2.17 Clay was dug by hand in the late autumn, stockpiled and left for the frost and rains of winter to break it down and wash out some of the soluble materials it contained. This was known as souring. Many clay pits have returned to agriculture after use; surviving examples can be traced on commonland at Nettlebed, Marlow Common, and Cadmore End Common.

2.18 From spring to autumn bricks were made. Clay from the stockpile was taken for preparation by wetting and pugging (mixing) it to a dough-like consistency; pug mills (often horse-, wind- or sometimes steam-driven) being one of the first machines introduced into the brick-making process to facilitate the mixing.





Brickmaking by hand using wooden moulds (Bovingdon Brickworks)

2.19 Moulds, dusted with sand, were used to shape the clay into bricks, a skilled brickmaker making over 1500 bricks in a day. A removable stock at the base might be used to produce the ‘frog’ and/or

be stamped with the firm’s name or initials.

Machine-made bricks started to appear in the late C19th; the mainly small-scale enterprises in the Chilterns however only slowly adopted mechanised forms of brick production, if at all.



Local brickmaker’s name stamped in frog

2.20 The bricks were then dried in ‘hacks’ consisting of boards laid on the ground on which about 1500 bricks could be placed in a single layer, 5 layers being the maximum capacity. Except at larger works where the hack was placed in a shed, it was normally left out in the open, although caps or hoods could be drawn over during wet weather. After about 10 days, the “skintlers” took over and

rearranged the bricks on a fresh site 7 high, in a diagonal pattern using a skintlers’ barrow. They were then left for 11-30 days until being placed in a “crowders” barrow and moved to a kiln and laboriously stacked by hand before being fired.

2.21 To acquire durability, bricks must be fired for at least 24 hours at a temperature greater than 900°C. As the heat rises the character of the clay and its colour continues to change. Clamp firing, where the layers of brick and fuel were burned together, was still being practised in the Chilterns at the end of the C19th. The “clamp” consisted of a layer of sand on which the skintled bricks were laid in alternating directions, up to a level about 12ft high. If lime was being prepared as well, the lumps of chalk were placed in the hotter parts of the clamp. The flues, which ran from side to side in the clamp, were made of burnt bricks and the fire was applied to holes associated with the flues.

An eye-witness account of clamp kiln firing in the Chilterns was given in 1784 by Peter (Pehr) Kalm whilst staying at Little Gaddesden. “Cover kiln nearest fire with large lumps of chalk then with small chalk lumps, then air dried bricks. Two kiln pipes have fire with large pieces of wood to heat up. Then kept going with twigs for 2-3 days. When bricks and lime cooled somewhat, covered

Chilterns Brick Supplementary Technical Note - Adopted Version

over the top with bundles of moss and furze bound together and stop kiln mouths”.

2.22 The unusual bottle kiln at Nettlebed (now restored) indicates some Chiltern brickyards had moved over to more permanent firing methods by the C18th; this example of an updraught kiln could hold about 12,000 bricks. The bricks at the bottom, closest to the stoke holes, would be vitrified to a characteristic blue or grey-colour. By far the more common (and easier to build) alternative to the bottle design was the rectangular (or Scotch) kiln open at the top with a wide doorway at one or sometimes both ends. The side walls were built of old bricks set in clay with several openings (‘fire holes’ or ‘eyes’) built opposite one another in firebricks and fireclay. The dried ‘green’ (unfired) bricks were arranged in the kiln to form flues connecting with the fireholes. They were packed in alternating diagonal lines leaving spaces between the rows so the bricks would fire evenly. The ends of the kiln were then built up and plastered over with clay. The fires were kept low for 2-3 days to drive off any moisture and then allowed to burn briskly. The draught was regulated by partially stopping the fire holes with clay and covering the kiln top with boards, old bricks or earth to keep in the heat. It took three



Bottle kiln (Nettlebed)

Some bricks are still air dried in open hacks (HG Matthews)



Chilterns Brick Supplementary Technical Note - Adopted Version

days for the bricks to fire and then 2-3 days for the kiln to cool.

2.23 A typical kiln might be 60ft x 11ft x 12ft high, with fireholes 3ft wide, and a capacity of 80,000 bricks. Compared to clamp firing, the bricks were more evenly fired and took less time to dry because the greater temperature control enabled moister clay to be used, and even though the kiln required more fuel, the speed of firing and the absence of waste, rendered the process preferable. Some Chiltern brick makers even moved over to downdraught kilns (eg at Cadmore End, and Durrants Heath, Chalfont St Peter) where vertical

flues inside the kiln drew heat up and over the roof, before being drawn down through the stacked bricks. The kilns were fired using wood, charcoal, turf, bracken or furze, although coal was increasingly used from the early C19th by brickmakers with access to the canal and railway system; now most kilns are oil-fired. A few continuous Hoffman Kilns operated on the margins of the Chilterns in larger brickworks eg at Shiplake (1910-1935).

Unfired bricks loaded into Scotch Kiln (HG Matthews)



*Scotch Kiln (HG Matthews)
(Photo Dave Marriott)*

2.24 Today, the three brick manufacturers in the Chilterns produce about 14.5 million bricks annually (out of the 3 billion manufactured in the UK) and employ around 100 people. The end products have changed little since the C19th. Despite steady investment in new infrastructure and machinery, the same basic principles that applied then still govern the making of stock bricks at all three brickworks,

although inevitably slight variations at each stage produce subtle differences in appearance, colour and texture. The bricks are made with locally-dug clay, or a mixture of clay and loam, the only additives being sand (roughly 15%), anthracite or breeze (roughly 5%) and water. All three manufacturers use sand from Leighton Buzzard. Having been mixed the clay travels through one or two sets of rollers to screen out flints and other debris. The clay then either passes to the brick-making machine (at Matthews a Berry's moulding machine dating from the 1930's) or to the hand moulders.

Unloading fired bricks from a Scotch Kiln (Bovingdon Brickworks)

2.25 The percentage of hand-made bricks is approximately 10% at Bovingdon, about one third at Duntons and about a half at Matthews. At the Bovingdon and Dunton

brickworks, all the bricks are dried in gas-fired drying sheds for between three and six days; at Matthews a percentage are still air-dried in open-sided hacks depending on the season. The bricks then have to be transferred to the kilns, where they are stacked on edge by hand. All three manufacturers use oil-fired Scotch kilns (using

A gas-fired drying shed (Bovingdon Brickworks)



waste or gas oil); Matthews have four; Duntons five and Bovingdon six. The bricks are fired for about 24 hours at temperatures ranging from 900-1400 °C, the final colour of the brick being affected both by the intensity of heat and the position of the brick in the kiln. The bricks are then left to cool for 72 hours before being removed by hand, graded, sorted and finally stacked 500 to a pallet.

2.26 All three manufacturers produce facing bricks, ATRs, seconds, standard specials and non-standard specials. Matthews produces 'Chesham Multis'; 'Chalfont Reds' (using clay dug from Chalfont St Giles), grey browns and 'Luton Greys' (using a grit to replicate the flint road sweepings once used in the moulding process). Bovingdon produces 'Berry Multis' and Duntons 'Bucks Multis'. At Matthews, vitrified headers are also produced, and Bovingdon Brickworks produce specials with a bluish tint using a Northamptonshire sand. All three manufacturers offer bespoke services to produce specially shaped bricks or fully designed cut bricks.



2.27 The proportion of bricks both produced and used in the Chilterns varies from approximately one third of Bovingdon bricks to some 70% for Duntons and Matthews. The manufacturers are confident that they can supply all the bricks required for current and projected housing requirements in the Chilterns AONB. But the Chiltern brickmaking industry is, and will remain, small-scale, satisfying the growing 'niche' market for visually appealing and sustainable construction materials.

Historical Use of Brick

2.28 Few Roman and early medieval bricks are encountered in the Chilterns – although examples of 'lacing courses' can be seen used to decorative effect in the otherwise stone walls in and around St Albans, and re-used somewhat randomly in the walls of medieval buildings especially parish churches. During the C12th Roman bricks were used extensively at St Albans Abbey.

2.29 Stonor Park, described as 'a positive museum of brickwork', includes some of the earliest datable examples in the region. The C15th tower displays vitrified headers (employing potash to form an emerald green glaze) in diaper patterns, signalling their early adoption as a form of ornamentation. A single lozenge appears on one of the chimneys at Ewelme School, built almost entirely of brick some 20 years later, whilst embattled parapets, crow-stepped gables, corbelled chimneystacks and patterned infill in brick appear as decorative elements in other parts of this remarkable ensemble of buildings (church, almshouses, school and schoolmasters house).

The Church, Almshouses and School (pictured here) incorporate fine examples of brickwork of the 1430's (Ewelme)



C15th tower incorporating vitrified headers (Stonor Park)



Chilterns Brick Supplementary Technical Note - Adopted Version



The largest surviving Elizabethan house in the Chilterns (Mapledurham)

2.30 Brick steadily increased in popularity during the C16th. Substantial brick extensions were added at Stonor House in 1534–40. Other notable brick houses from this period are Chenies Manor of c.1530 and Mapledurham House, begun in about 1585 and the largest surviving Elizabethan house in the Chilterns. The latter illustrates a transitional phase, its gabled skyline and prominent chimneys investing it with an early Tudor feel, but the large windows and symmetrical façade embracing new Classical principles. Brick also appeared on a limited scale in churches, as in the tower of Whipsnade Church.

2.31 By the C16th, brick was also appearing in a supplementary role to other materials, for example in plinths to timber-framed buildings. Major examples in the Chilterns may have employed bricks as infill panels from the outset, but in the C16th and C17th, they also increasingly replaced former wattle and daub. Relatively narrow panels could employ herringbone patterns, but wider spans would tend to opt for more conventional coursed brickwork.



Timber framing with herringbone brick infill (Monks Risborough)

2.32 Although C15th examples can be found, brick chimneystacks appeared in ever increasing numbers, either being inserted into former open halls in the early C16th or as integral features of storeyed timber-framed buildings of the late C16th and early C17th. Flint also began to

emerge in the C16th in domestic contexts; its use being considerably enriched by the use of brick for dressings, quoins, cornices, strings and lacing courses.



Tudor chimney stacks (Amersham)

2.33 In the C17th, as fashions spread, the use of brick percolated down the social scale; apart from manor houses and their ancillary buildings such as stables and dovecotes, farmhouses and barns constructed wholly of brick began to appear. Sliding sash windows superseded mullion windows and openings began to be elaborated with brick dressings, some being rendered to imitate stone.

2.34 Because flint emerged in the C17th and C18th as an important building material, it is possible that there is a lack of appreciation of many fine brick and brick-fronted houses of the period in the

Georgian brickwork (Nettlebed)





Chequered pattern using burnt headers in Flemish bond (Nettlebed)

Chilterns. These occur in both urban and rural contexts; some are modest, some are much grander in scale; all are characterised by the use of local brick, a reminder that no Chiltern community was very far from a brick field. Disastrous fires in densely packed towns prompted a change from timber-framing to brickwork due to its fire-resistant qualities, a trend no doubt hastened by the Great Fire of London in 1666. Chequered patterns became a common feature. Door and window-heads were often constructed from tapered and rubbed red brick with close fitting joints known as gauged work. A cheaper alternative was to mimic



Finely gauged brickwork (Hemel Hempstead). Note the difference in joint width in the repaired area.

this exact brickwork by using 'tuck pointing'. This involved surrounding badly-cut or worn bricks with a base mortar the same colour as the brick itself, then inserting a white tucking mortar in a straight line between the bricks, to simulate neat jointing.



Tuck pointing (Berkhamsted)

2.35 Although there are no hard and fast rules, earlier buildings may demonstrate little regular bonding either because they employed bricks of various sizes or the brickwork was intended to be plastered. C16th and C17th brick buildings tended to employ the more linear pattern of English bond, while from the mid C17th Flemish

Random bond in C15th brickwork (Ewelme)



Chilterns Brick Supplementary Technical Note - Adopted Version



Fine C17th brickwork (Bradenham)

bond became more common. Header bond was used in some parts of the Chilterns. During the C18th more economical bonds such as English Garden Wall and Flemish Garden Wall were introduced; by 1800 the cheaper Rat-Trap and Dearne's bonds using variants of brick on edge courses (thus creating hollow pockets or voids) were being occasionally used. English bond enjoyed a revival in engineering contexts in the C19th. Stretcher bond emerged as the dominant bond with the introduction of cavity walls in the early C20th.

English bond (Amersham)



Chilterns Brick Supplementary Technical Note - Adopted Version



Brick was used for the walls of this massive threshing barn (Ipsden)

2.36 Brick was not confined to domestic buildings. On farms, although timber-framing remained the preferred material, stables and cowhouses often used brick; even some barns were built of it, the huge one at Ipsden, 24 bays long, being a particularly fine example. Cottages constructed of brick also began to appear in the C18th. At the other end of the scale, smart institutional buildings such as Chew School and

Almshouses in Dunstable were the gifts of rich benefactors.

2.37 As brick became more fashionable, the influence of pattern books began to be felt as house design moved towards symmetry in façade and room layout. Brick pilasters and dressings to doors and windows were incorporated using cut and rubbed brick, the softer red or orange rubber bricks contrasting with the brickwork of general walling. Brick also washed across earlier buildings, concealing former timber-framed frontages, a trend that continued into the C19th. After c.1720 some designers reacted against the late C17th predilection for warm red brickwork, and

introduced bricks whose aspects had more affinity with stone, ranging in colour from light yellow to dull brown. In the Regency Period, stucco became highly fashionable, cheap bricks being used behind the stucco skins. Terraced houses and villas sprouted in the market towns, to house the increasing urban population.



Brick was the favoured material for many smaller domestic buildings of the C17th and C18th (Monks Risborough)

2.38 Brick remained the principal walling material of the C19th, although its percentage share of the overall market declined, particularly among the cheaper houses where flint came to pre-dominate (paradoxically as a result of the expansion of



Fine example of C18th urban brickwork (Marlow)

Chiltern brickyards). Some estate landlords, such as the Rothschilds, used brick extensively and sometimes flamboyantly in their model villages and urban developments. It was particularly in the extensive programme of public and institutional building that brick flourished. New churches, and especially chapels, hospitals, schools, workhouses, banks and railway buildings experimented with precise, glazed, polychromatic and moulded brickwork to great effect in a range of revivalist styles.



Timber-framed building refronted in brick (Markyate)

Chilterns Brick Supplementary Technical Note - Adopted Version



Typical C19th estate housing (Cheries)

2.39 The most significant development of the C19th was the introduction of mass-produced machine-made bricks of a more regular shape and colour. Nowhere in the Chilterns did these totally supplant local-made bricks, which continued to be used for much of the housing, and as dressings to flint houses. Moreover, many local bricks in the



Flamboyant Victorian use of brick (Berkhamsted)

Chilterns were acquiring a reputation for their superior facing qualities, the export of best-quality bricks sometimes leaving only the seconds, overburned and stained bricks for local use.

2.40 There was some return to favour of thin, hand-made facing bricks as part of the Vernacular Revival movement at the end of the C19th. Honour's Prestwood brickyard, operating in the first half of the C20th, produced specialist bricks to match old bricks for repairs to buildings. Brickettes were extensively used for fireplace details. The Medmenham Pottery, lasting less than a decade (1897-1908) produced 'art pottery' but also unglazed terracotta ware, such as architectural decoration, tiles and mouldings.

Brick church (Whipsnade)



Carved brickwork of the early C20th (Hemel Hempstead)

Examples may be seen on houses at Monks Corner, Marlow Common and Westfield, Medmenham.

2.41 Prior to the First World War brickwork was characteristically heavy, solid construction employing hand-made bricks jointed with lime mortar. Wall thickness was frequently of two-bricks (450mm) or more. From the 1930s masonry construction underwent a profound change. The shortage of bricks and labour encouraged the use of machine-made common rather than hand-made facing bricks in housing estates. The drive for economy and application of structural engineering principles led to the widespread adoption of thinner, cavity walls jointed with hard cement mortars, changing the face of brickwork to an almost universal stretcher half-bond.

The severity of much C20th brickwork results from the use of half-bond stretcherwork



Chilterns Brick Supplementary Technical Note - Adopted Version



Standard designs produced much repetitive and uninspired use of brickwork in the Chilterns during the latter part of the C20th (Ewelme)

2.42 In the interwar period, speculative housing of mostly two-storey, semi-detached brick buildings incorporated numerous variations to imply individuality and exclusivity. Features included complete or partial rendering, painting or pebble dashing, tile hanging, wany-edged hardwood boarding or surface-fixed 'mock Tudor' timber framing. A surface treatment was applied to machine-made bricks (both extruded and pressed) to produce distinctive face textures, for example the rustic finish of

Fletton facing bricks. Their increasing availability, together with the closure of many Chiltern brickyards during the Second World War, also opened up the housing market to alternative walling materials. Tile-like bricks and prefabricated brick panels were developed to counter their spread.

Bold use of bricks manufactured by Bovingdon Brickworks Ltd (Caversham)

2.43 Since the 1970s reaction to prefabricated concrete design has led to a new interest in using bricks to create bold masonry statements incorporating corbelling, specials, and brick patterning. Pedestrianised town centres have been paved extensively with bricks. Celebration of the Millennium encouraged a new wave of brickwork in new or revamped institutional structures.

2.44 Lagging unfortunately behind the revival in the use of brick has been the attention paid to



Modern brickwork marred by poor pointing (Wallingford) (Photo C. White)



mortars, joints and pointing techniques. Early mortars were rich in lime and chalk. Because of the variability in brick sizes, mortar joints tended to be thick. With the production of more regular and accurate bricks, jointing techniques were developed to produce thinner and more refined jointing. Today, the almost universal use of Portland Cement has been accompanied by a rash of ugly pointing profiles. Very few bricklayers are trained in the use of lime mortars or in achieving the correct colour and texture of mortar. Virtually none is taught rubbed brickwork with its fine joints or the imitations it spawned such as scored jointing and tuck pointing.

Using Brick Today

An Inspirational Inheritance

3.1 Contemporary brickwork tends to have a consistency bordering on the monotonous, and the designer today has to work particularly hard to produce buildings with a vitality and resonance suited to the local environment. Buildings and structures of every shape and size have been constructed using brick. Those bricks in any traditional wall in the Chilterns will exhibit a subtle range of variation and it is this which gives brick construction its particular charm. This charm is enhanced by the particular combination of materials brick is encountered with in the region.



Variations in the bricks and brickwork contribute to the richness of the region's buildings (Chalfont St Giles)

3.2 Brick clay is still abundant in the Chilterns and when converted into bricks becomes a vital local resource which is too often exported out of the region for use elsewhere. Equally, too many projects in the Chilterns fail to specify locally-produced bricks. Bricks are of relatively low value in relation to their weight and bulk, making the cost of transport comparatively high.

3.3 One of the major problems however is not the availability of suitable materials but the lack of skills required to produce brickwork to a high standard.

Highest quality brickwork in combination with sympathetic materials (Great Gaddesden)

Chilterns Brick Supplementary Technical Note - Adopted Version



Despite detail being included brickwork can create a monolithic appearance, as here (Tring)

3.4 Poor specifications and designs compound the problem. The designer has the potential to do two things – maximise environmental benefits by specifying locally-produced bricks and mortars; and stimulate high quality brickwork by insisting on quality workmanship using correct detailing and finishes.

High quality specifications, well executed brickwork together with design flair and imagination are essential to produce brickwork of a sufficient standard to blend in with the region's rich heritage (High Wycombe)



Chilterns Brick Supplementary Technical Note - Adopted Version

Regional Distinctiveness

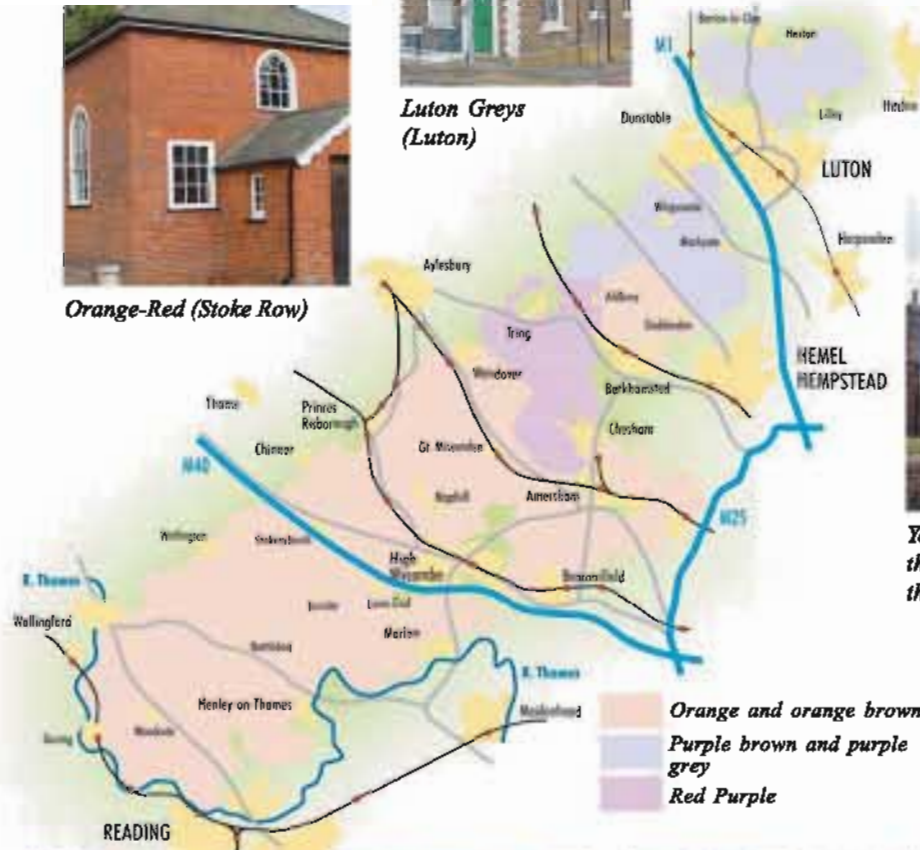
3.5 This note has already emphasised the wide historical application of brickwork in the Chilterns. On average between 58% and 65% of new houses are built of brick, and this excludes the percentage of brick employed in conjunction with flints, or as infill in timber framed buildings. Exemplary brickwork is thus found throughout the AONB, in both urban and rural contexts, and ranging from superior country houses down to the smallest cottage. Concentrations of other materials, such as flint, may tend to force brickwork in certain areas into a supporting, but no less significant role.

3.6 Within a region the size of the Chilterns, there are inevitably subtle local variations. The products of the three working brickyards today are noticeably different; within the fairly broad spectrum of fired finishes, Dunton's 'multis' nevertheless tend to exhibit a distinctive orange colour; Matthews' Chesham multis tend to burn a red-purple colour while Bovington 'Berrys' have a browner hue. In the past, the differences across the region were even more marked. The clays of the South-West Chilterns produced an orange or orange-brown brick.

Rich visual effects result from the varied, often deliberately contrived, mixture of bricks (Watlington)



Map 3. Illustrating distribution of dominant brick colouring in the Chilterns



Orange-Red (Stoke Row)



Luton Greys (Luton)



Yellow Gault bricks (Silsoe)



Purple (Markyate)



Yellow 'stocks' imported into the region, more prevalent in the north-east Chilterns



Orange (Bledlow)



Nettlebed 'Grizzlies'



Marlow Blues



Blood Reds (Hemel Hempstead)



*Gritty chalk-rich mortar
used in wide joints
(Britwell Salome)*

At Norris' Acorn Works at Hemel Hempstead, the finest 'blood' reds were made from the second half of the C19th up to the Second World War, such distinctive reds being characteristic of the central Chilterns. Moving north into Hertfordshire and Bedfordshire, the bricks tend to be of a purple-brown or purple-grey colouring, the most characteristic feature of these being the very 'gritty' composition of each brick, flecked with small pieces of shell and gravel. At Oaklands, St. Albans, for example, the clay contained stones which were crushed by cast iron rollers so that the bricks contained sharp edged flint flakes. Dressings of yellow 'stocks' are more often encountered in the north-east of the region. The brickyard at Stoney Hills, Bengeo produced 2½ million yellow bricks for Woodhall Park in 1780. In 1960 the yard was still producing c 500,000 hand-made and machine made bricks a year. In Marlow glazed headers appear as 'burnt blues'. The special mixture of clays and firing processes produced the characteristic Luton 'greys' (often combined with red brick dressings) and Nettlebed 'grizzles'. The

distinctive yellow or whitish bricks of the Gault clays to the west of the scarp inevitably spilt over into Chiltern settlements.

*Black mortar
(Berkhamsted)*

3.7 Whilst the local clays delineate distinctive regional hues, the richness of Chiltern brickwork is as much the result of contrived mixtures of bricks (sometimes produced from the same firing) either to distinguish elements of brickwork such as dressings, quoins, piers and voussoirs, or to break up otherwise flat surfaces of walls to create pleasing and often very subtle modulations in the overall finished effect.

3.8 The appearance of brickwork is also materially affected by the composition of the mortar used and this again will vary from place to place, depending on the choice and mix of binder and sand or aggregate.

3.9 In addition to these localised variations of colour and texture, bonding, technique and ornamentation help to create a rich palette of possibilities. Bricks can be laid in a variety of bonds and some were regionally biased such as the distinctive grey header bond found in south-west Bedfordshire. The principal challenge today is to overcome the monotonous use of stretchers by weaving design elements and techniques into forms which respect and enhance the special characteristics of our locally-produced bricks.



Header bond (Watlington)



Chilterns Brick Supplementary Technical Note - Adopted Version

3.10 Brickwork in the Chilterns tended not to be painted; stucco and plasters were a feature of the late C18th and early C19th, and some brickwork was undoubtedly limewashed. Rendered elevations were sometimes favoured in the early C20th. But on the whole, throughout the Chilterns the visual and aesthetic qualities of the fired bricks were simply allowed to express themselves without recourse to further surface treatment.



*Painting brickwork
creates its own
maintenance problems*

Regional Distinctiveness Checklist

- Do respect distinctive Chiltern traditions
- Do combine Chiltern-made bricks with other locally available materials such as flint, timber, clay peg-tiles
- Do use lime-based mortars and coarse aggregates
- Do experiment with appropriate, regional techniques
- Do use brick colours appropriate to the local built environment
- Don't paint or render new brickwork
- Don't dilute local character by importing alien bricks

Chilterns Brick Supplementary Technical Note - Adopted Version

Specification and Design

Building with Brick

3.11 Masonry walls are traditionally made with building blocks bonded together with a jointing material or mortar. The usual *work* size of bricks in common use is length 215 mm, width 102.5 mm and height 65 mm. Bricks are typically laid with a 10mm wide mortar joint, creating a *co-ordinating* size of 225 x 112.5 x 75 mm. To form a structural wall, bricks must be laid in a definite pattern or bond, so that no vertical joints in consecutive courses are above one another. Most modern brickwork is a half-brick thick in Stretcher bond, but increasing interest in the use

of structural and patterned brickwork and the need for sensitive repairs to historic buildings requires a broader understanding of bonding patterns.

3.12 All bricks manufactured in the Chilterns conform to British Standard Specification BS 3921 *Specification for Clay Bricks* (or BS EN 771-1 under European brick harmonisation) with regard to frost resistance, soluble salts, compressive strength, water absorption and size. Reclaimed bricks of course fall outside the established

standards. BS 5268 '*Code of practice for the use of masonry*' (The European standards are available as BSI Drafts for Development ENV Eurocode 6) covers the structural use of brickwork, materials, components and design and workmanship, but does not cover the use of natural lime mortars.

3.13 The Building Regulations provide significant constraints and opportunities for using brick, including references to the selection of materials and standards of workmanship. Approved Document A covers wall thicknesses, height of chimneys, foundations and claddings and refers to the required codes and standards. Deposited plans should detail the use of materials. The design must also conform to fire safety requirements and provide the necessary resistance to weather and ground moisture, insulation, ventilation and drainage. Approved Document L relating to the Conservation of Fuel and Power is ratcheting up the requirements for limiting heat loss; currently walls need to achieve U-values of 0.45 W/m²K. For small and residential buildings up to three storeys high the sizing of load bearing brick walls can be taken from Part C of Approved Document A. The alternative methods for these and other load bearing brick walls are given in BS 5628: Part 1 – '*Structural Use of Masonry*'. Brick walls must always be sufficient throughout their entire body to carry the design loads and induced stresses.

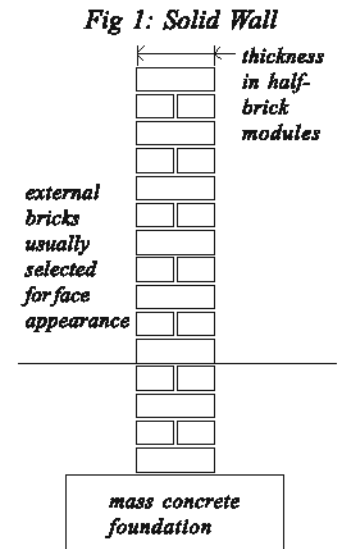
3.14 Brick walling requires a suitable foundation. Bricks used below ground level must be sufficiently durable. Brickwork should incorporate movement joints, damp proof courses and membranes, weep-holes and ventilation as required. Generally walls must be tied at the ends to an attached pier, buttressing or return wall to give lateral support to the wall.

3.15 Bricks can be used in the following ways:

i. Solid Walls

The thickness is determined by half brick modules (*Fig 1*). Solid walls allow more experimentation with brick bonding.

For hard landscaping, solid brickwork can be employed to create free-standing or earth-retaining walls (properly protected on the earth side) which can be staggered in plan or curved.



Brick wall under construction (Bradenham)



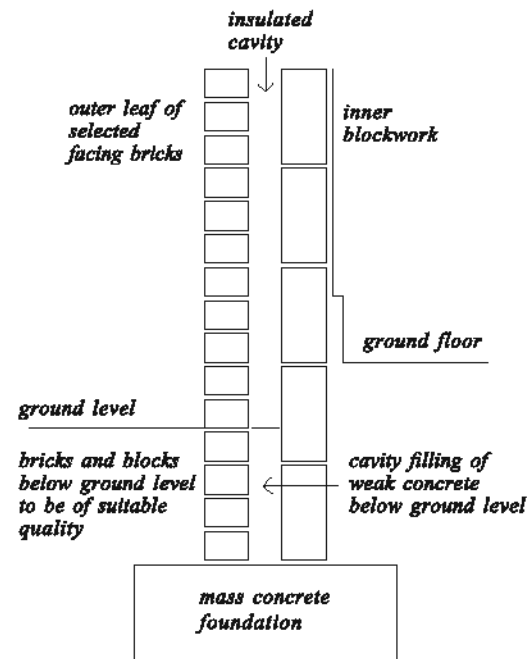
ii. Cavity Walls

Usually consisting of an outer brick leaf separated by a cavity from an inner skin most typically of blockwork, but sometimes of concrete or brick. The leaves should not be less than 90 mm thick; the cavity width can be between 50 and 300 mm. The two leaves of a cavity wall are tied together with wall ties (refer to BS 1243) at specified centres. Uninsulated cavity walls fall short of current requirements; cavities may therefore be partially filled with insulation boards or fully filled with batts. Alternatively, cavity walls may be injected with insulation some 6 months after construction. In filled cavity construction, thermal bridging must be avoided. Where additional reinforcement is required, the cavity might be filled with grouted steel rod or mesh. If using Imperial bricks with a standard metric concrete block inner skin, adjustable wall-ties may be required to overcome the differences in alignment of the bed joints created between the two. Steel, either as reinforcement or for post-tensioning, may be required to resist tension from lateral loads or to increase the bending strength of the brickwork (Fig 2).

iii. In Combination – Primary material

Brick can form a non-structural facing to another backing material such as blockwork, shuttered

Fig 2: Cavity Wall – inner block



concrete, steelwork or timber-framing (Fig 3). The latter method has been successfully applied for some time to the low-rise housing market; more recently, timber-framing up to six storeys high with a single leaf brickwork 102.5 mm thick has been successfully trialled. Vertically restrained brickwork has also been developed whereby the brickwork is built solidly between floors, locking together the brickwork and structural frame.

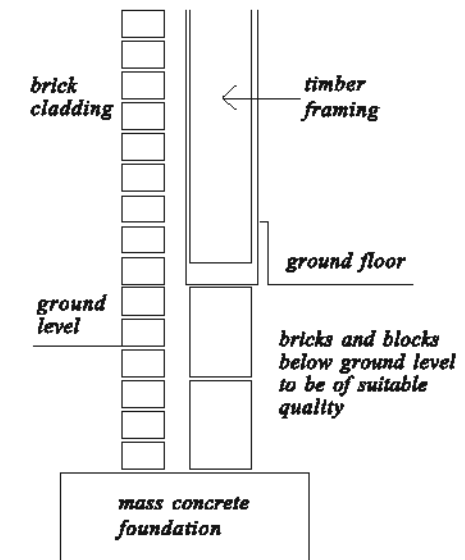
Chilterns Brick Supplementary Technical Note - Adopted Version

iv. In Combination – Secondary

Brick can be used:

- for the inner leaf of a cavity wall; the external leaf using other materials such as flint
- as non load-bearing panel walls in conjunction with framed structures
- as infill to timber-framing (e.g. herringbone brickwork)
- for dressings, piers, buttresses and quoins in association with, for example, flint
- as a decorative motif mixed with other materials such as flint or stone

Fig 3: Brick as non-structural facing



NB: gaps and compressible joints to accommodate differential movement of brickwork and timber frame are required, but for simplicity they are not shown in this diagram



Brick and timber (Amersham)

Chilterns Brick Supplementary Technical Note - Adopted Version

Brick in conjunction with stone, flint and timber (Benson)



v. Brick claddings and pre-assembly

The emphasis on buildability and pre-fabrication has encouraged research into factory-based production of brick panels and units. These applications may be suitable for larger industrial and commercial premises. Housing systems using brickwork with lightweight concrete backing have now been developed in Europe.

vi. Brick paviors

These can be used for floorings and pathways, both internally and externally. Flexible pavements are made of clay paviors laid on a bedding course

of sharp sand and have been extensively used for pedestrianised and trafficked areas since the late 1970s. Rigid pavements are formed by laying paviors on a mortar bedding course over a rigid foundation and fully mortaring the joints.



Brick paviors (Berkhamsted)

vii. Engineering

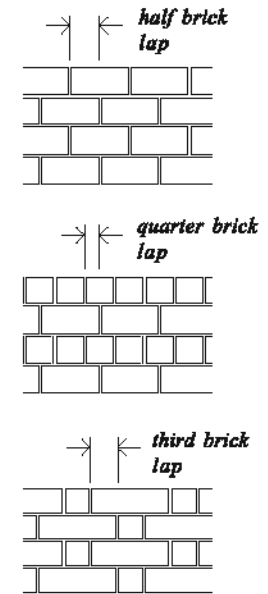
Brick can also be used in a variety of engineering situations – bridges, retaining walls, underpinning and drainage for example.

3.16 Bricks are laid in courses; the relationship between one brick seated over another expresses itself as a lap joint (Fig 4).

Lap forms:

- half bonding – used in half brick thick walls built in stretcher bond
- quarter bonding – used in bonds such as English and Flemish bond built with standard bricks
- third bonding – rare, used in bonds involving 290 x 90 x 90 mm modular bricks

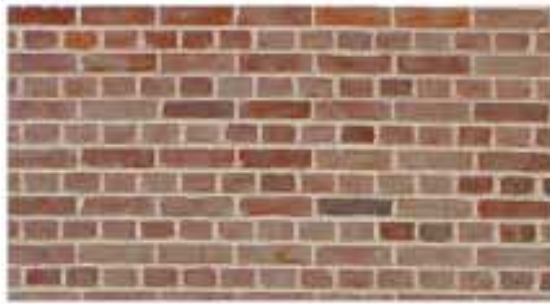
Fig 4: Lap Forms



3.17 Bricks can be laid in a variety of bonds (Fig 5). The principal ones are:

Stretcher Bond: all courses of stretchers. Most modern brickwork is a half-brick thick and laid in Stretcher bond. The appearance of a quarter-bond can be achieved by using half-bats or snap headers – these may be cut on site or, preferably, supplied as ‘specials’. For Stretcher bond using standard bricks, 60 bricks are required per sq.m.

Non-structural brick cladding (Berkhamsted)

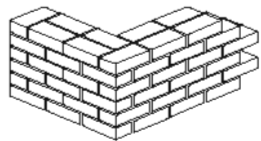


English bond using locally-produced bricks laid with lime mortar (Mapledurham)

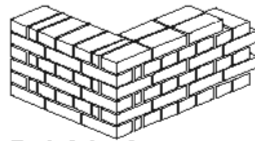
English Bond: alternate courses of stretchers and headers. In a one-brick thick wall, English bond requires more facing bricks than other bonds (89 facing bricks per m²)

Flemish Bond formed by laying headers and stretchers alternately in each course. (79 facing bricks per m² in a one-brick thick wall).

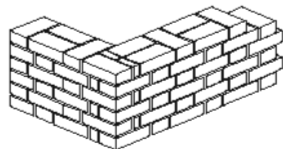
Fig 5: Bonds



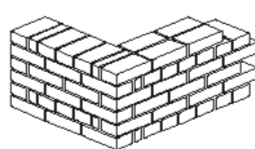
Stretcher bond



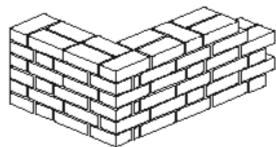
English bond



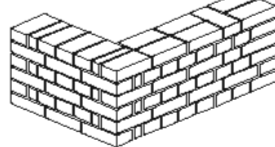
Flemish bond



English garden wall bond



Flemish garden wall (Sussex) bond



English cross bond



Modern brickwork is usually constructed in stretcher half bond

English Garden Wall Bond using 1 course of headers to 3 or 5 courses of stretcher. Requires fewer headers than English bond and has the advantage when building one-brick thick walls if both sides are to be fairfaced.

Flemish Garden Wall Bond using 1 header to 3 stretchers in every course, enabling a fair face to be kept on both sides of a one brick thick wall.



Flemish garden wall bond

English Cross Bond – a header placed next to end stretcher in every other stretcher course; the staggered stretchers enabling patterns or diapers to be picked out in different bricks

Construction Checklist

- Do keep facework free from mortar smears and droppings
- Do observe good practice when forming cavities
- Do build in thermal insulation into cavity walling with great care to minimize any potential for rain penetration
- Do use templates for curved walls, arched openings, corbelling and tumbled-in brickwork where appropriate
- Do set out brickwork dry at ground level
- Do lay to line – though some modification of the technique may be necessary when laying some soft-mud or stock bricks
- Do lay hand-made bricks consistently with the frog up so that the creases read as a 'smile' on the face
- Do keep the bonding wherever possible
- Don't use imported bricks of inappropriate size and texture
- Don't needlessly destroy historic brickwork

Chilterns Brick Supplementary Technical Note – Adopted Version

Designing with Brick

3.18 Each project will have its unique characteristics, but the following 12-stage process aims to be inclusive of all the main factors that require consideration when designing brick buildings for the Chilterns AONB. Good design is not primarily a question of style and taste. It involves both creativity and adherence to a set of time-honoured, objective principles that determine whether a building works well for all users and the community.



New buildings designed with respect to the existing context and proportionate use of vernacular materials (Right: Lower Farm, Britwell Salome – 1999 Winner and Below: Crown Meadow, Amersham – 2004 Winner, Chilterns Buildings Design Awards)



Stage 1: Preliminaries

3.19 Before specifying brick as a walling material consider the following:

a. Building type, usage and context

What is the function of the building and is the building envisaged fit for its purpose? If new, is the building residential, industrial, commercial, or is it an ancillary/secondary building? Will it need to blend into an existing group of buildings or can its isolated position be exploited to advantage? If extending a brick building, consider how best to integrate new and old. If any consolidation to existing brickwork is required, the survey should identify the areas to be repaired and the most appropriate methods to ensure they are carried out with due regard to the surviving historic fabric.

b. Primary material choice

Decide whether brick fits with the context of the project. Will it be the principal material or would it be more appropriate used as dressings to flint. Consider the immediate built environment – has brick been extensively used in the area in the past? What types of brick have been used?



Historic brickwork should be consolidated using appropriate repair methods

c. Planning and legal restrictions

At an early stage in the design process contact should be made with the Local Planning Authority for advice regarding development and change of use, or the Conservation Officer if an existing building is listed or situated in a Conservation Area. Contact should also be

made with the local Building Control Service for advice on building regulations. The Planning Officer for the Chilterns Conservation Board may be contacted for advice, and the guidance given in this Technical Note should be applied to the project.

d. Site restrictions and potential

Consider the site carefully. The severity and frequency of wind-driven rain should be assessed by reference to BS 8104 taking account of geographic location and shelter offered by land formation and other buildings and trees. Would brick be appropriate to all elevations? Are the boundary walls or paved surfaces using brick? Do not overcrowd a cramped site with an overabundance of brickwork, particularly in rural areas.

e. Client requirements

Carefully consider the owner's or client's preferences, who may be seeking distinguished architecture or sustainable solutions in harmony with other existing buildings. Ensure the client is fully briefed regarding the particular design opportunities of brickwork and the importance of employing locally-produced bricks.

f. Capital resources

Cost implications will tend to favour building in brick over other materials. It is not widely recognized that the cost of bricks will typically be less than 5% of the total construction costs of a house. Reclaimed bricks may be twice as expensive as new bricks.

g. Environmental and maintenance considerations

The environmental case for choosing locally-produced bricks has already been made (see p. 5). Well-crafted brickwork using durable bricks with correct mortar specification will require less maintenance than most other building materials – both traditional and modern.



Bold use of hand-made specials (Markyate)

Stage 2: Massing

3.20 Decide on the massing of the building, the relationship of walls to roof shape, and the aspect of the building. Can the project incorporate curved walls – either as an aesthetic feature or for structural advantage? Will the roof/wall interface be delineated by, for example, the use of gables or hips? Can angles and splays be successfully incorporated, perhaps using corbelling to convert to right-angled corners? Is there an opportunity to surface model the brickwork by projecting or recessing bricks or using honeycomb brickwork (omitting certain headers or stretchers to create ventilation and decoration)?

Design Checklist

- Do consider ways of breaking up the monotonous appearance of stretcher bond
- Do investigate use of local bonding techniques
- Do ensure extensions are carefully constructed to blend in with the existing structure
- Do design new brickwork to a high specification
- Do respect historic diversity in brickwork
- Do research techniques and styles in the immediate area and so avoid producing work that has no regard to local precedent

Bricks do not need to make 'boxes'. Note also the restrained use of glazed headers to break up the elevations further (Marlow)



Chilterns Brick Supplementary Technical Note - Adopted Version

Stage 3: Openings

3.21 Decide on the positions, sizes and shapes of openings. The elevational appearance of a building is strongly influenced by their distribution and character. The traditional proportional dominance of solid wall over window should be borne in mind. Openings designed as multiples of the bonding used will avoid breaking the bond. The positions of all window openings and 'reveal' bricks should be identified when setting out the first few courses to ensure that perpend continues unbroken for the full height of the wall.

3.22 Decide on style, character and material for openings. A local estate might have exerted a considerable influence on the local style of window opening, which should be respected in new design work.

3.23 Openings consist of a sill, jambs and a head. Attention should be paid to the correct specification of horizontal and vertical damp proof courses and avoidance of thermal bridging in cavity walls.

3.24 Jambs are usually straight cut but chamfered bricks may be appropriate in certain circumstances.

3.25 Sills range from those that minimize run-off over the wall below by providing raised upstands at the end of a sill, often splayed or chamfered, as well as drip through to a flush detail. Sills may be constructed of purpose-made projecting or flush bricks but traditionally timber or occasionally stone were used and help to better articulate the opening.

3.26 The primary function of any support over an opening is to carry the loads above the opening and transfer them safely to the adjoining masonry. Because brickwork is bonded the area to be supported is assumed to be an equilateral triangle, as opposed to monolithic walling where the rectangle of wall above the support is taken as the load. The geometrical profile of brick arches will transfer loads to the abutments on each side. With solid walling, the arch has to be constructed over a temporary support until the mortar allows the arch to become self supporting. With the rise of cavity walling and structural inner frames in the C20th, the structural necessity of the arch diminished, many arches becoming symbolic substitutes. 'Arches' are no longer usually self-supporting and require steel lintels or bracketed

The building of this skew-arched canal bridge illustrates that the skills required to produce high quality engineered brickwork have not been lost (Little Tring - Special Project Award in the Chilterns Buildings Design Awards 2001)



hanging systems to transfer loads to the inner leaf. They should be constructed with proprietary galvanised or stainless steel cavity trays. However, a growing interest in using structural brickwork increases the need for careful design.

3.27 Arches can be built 'rough', 'axed' or 'gauged', in ascending order of cost, skill and fineness of joint. Rough arches are built from standard, parallel-sided bricks, any taper required being provided in the mortar joints. Axed arches can be built using standard arch bricks (for semi-circular arches) or with voussoirs fair cut on site. Although Chiltern bricks are not suitable for use as rubbers (Chalfont Reds have been used to create a semi-rubbed effect), local manufacturers can source rubbed bricks for high quality gauged brickwork, usually built with fine joints of lime putty 3 mm or less. As an aid to designing and

The size and distribution of openings adds variety to the elevations and articulates the use of internal spaces (Hambleton)



High quality arch recently constructed with rubbed bricks and lime putty (Chenies)





In cavity-walled structures the brickwork of the 'arch' is no longer self-supporting and either is omitted entirely (top storey) or is applied as a decorative facing to hide the steel or concrete lintel behind (ground floor)

building archwork, all three brickworks provide a service for preparing drawings, calculating the sizes of voussoirs and cutting them to shape before delivery in sets. Arches can take the following forms:

• Flat arch

The use of exposed concrete lintels and sills should be resisted. Simple soldier courses without 'keys' or voussoirs can look abrupt and clumsy. If used, every brick must be perfectly plumb. Straight hood moulds can relieve flat arches.



Flat arch (Little Missenden)

• Cambered arch

Arch with a flat top and a slight rise to the span (slight in proportion to length).



Segmental arch with alternate voussoirs in contrasting brickwork (Marlow)



Pair of 2-centred arched doorways (Chinnor)

• Segmental arch

Rough arches are made up usually of one or two rings of bricks. Two courses of headers, the bottom laid on edge, are also common.

• 2, 3 or 4 - Centred arch

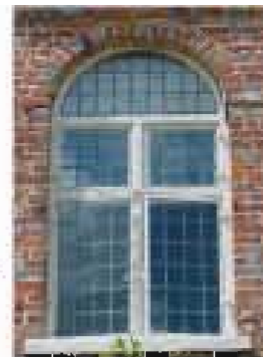
Derived from medieval precedents and used in revival styles.



4-centred arched doorway (Latimer)

• Semi-circular arch

These can simply be constructed 'rough' or using standard specials consisting of tapered headers and stretchers for 'ideal' spans. Bulls-eyes are constructed of two identical semi-circular arches but using a trammel rather than temporary supports to set out the lower half.



Semi-circular arched window (Little Missenden)



Elaborate aprons in rubbed brickwork and gauged segmental arches (Hemel Hempstead)

Chilterns Brick Supplementary Technical Note - Adopted Version



Brick mullions (Hambleton)

3.28 Windows in brick buildings are usually of timber construction and are best recessed in the opening. Blind arches may be appropriate features for articulating openings, particularly wide openings with soldier arches. Aprons might appear below windows in Georgian or Revival buildings. Blind windows have been incorporated in designs in the past to achieve symmetry; some however may have resulted from the Window Tax.



Blocked window with elegant scrolled lintel. Note also the dentil cornice detail (Wendover)

Blind window (Stonor)



Chilterns Brick Supplementary Technical Note - Adopted Version



Fanlight doorcase (Princes Risborough)

3.29 External doors should be of simple construction, preferably of timber, unless the context calls for a more flamboyant design. The arch design for the door opening should be consistent with that employed for the windows.

3.30 Porches are a characteristic feature of many Chilterns buildings. Brick porches can be added successfully to brick or

Brick and timber porch (Aldbury)



Fanlight (Benson)

brick-and-flint structures, if designed in proportion, without overelaborate detail, and if not fully enclosed.

Openings Checklist

- Do locate position of openings according to the bond chosen when setting out
- Do recess window frames in openings
- Do use timber for window and door frames
- Do fix built-in frames with approved cramps, plugs and fixings
- Do protect openings with adequate horizontal and vertical DPCs
- Do space voussoirs and arch bricks evenly
- Don't oversize openings

Stage 4: Material Combinations

3.31 Decide on how to combine other materials with brick in the overall scheme. Pay particular attention to the proportions employed so that no material simply becomes a 'token' inclusion.

Blockwork

3.32 Blockwork is frequently used in conjunction with brick, often as the inner leaf in cavity walls or to 'complement' external exposed brickwork; as it has to be rendered this can unnecessarily break up elevations or invest a building with an over-fussy appearance.



Brick and blockwork



Timber

3.33 Brick has been in use as an infill material to timber since at least the C16th. Timber-framed and weather-boarded buildings also often sit on brick (or brick with flint) plinths. Care needs to be taken that the tannin from oak does not 'streak' the

*Brick and timber
(Bourne End)*

brickwork. A farmstead group will often consist of a balanced group of brick, brick-with-flint and timber-framed buildings. Brick is also used as an outer skin to new timber-frame buildings.

Earth

3.34 Although few earth buildings survive in the Chilterns, brick was sometimes used for plinths and dressings.



*Composite materials
(Monks Risborough)*



Brick and flint (Stonor)

Flint

3.35 For the correct use and specification of brick in conjunction with flint, see the Chilterns Flint Supplementary Technical Note. If flint is used as the principal facing material, the thickness of the main outer leaf will need to be thicker than a conventional masonry wall and will require a backing of brick or block.

Stone

3.36 Because of its cost and relative scarcity in the Chilterns, stone was sparingly used and is more often associated

*Brick and stone
(Bisham)*



Chilterns Brick Supplementary Technical Note - Adopted Version

with prestigious buildings such as churches or estate buildings. In the Chilterns it has mainly been derived either from quarries at Totternhoe or at Denner Hill. Other limestones and sandstones had to be imported into the region. Stone is occasionally used for parapet cappings, sills and dressings and is sometimes combined with brick in formal diaper and chequerboard patterns.

Metals

3.37 Bricks were used as plinths for iron railings. Metal ties were often used to restrain bowing brickwork. Aluminium and steel can be combined well with good quality brickwork to

create exciting designs, but need to be sensitively integrated into the building so as not to 'jar' with the surrounding environment.

Glass

3.38 Brickwork can accommodate large sheet glazing to good effect when correctly detailed and positioned. Coloured or stained glass can work well with brick in appropriate contexts.

*Brick and glass
(Marlow)*



*Brick and metal
(Berkhamsted)*



*Chilterns Brick Supplementary Technical Note - Adopted Version***Tile**

3.39 Tiles are used universally throughout the Chilterns for roofing, as cappings to brick walls; for repairs; to level out courses and sometimes as quoins and lacing courses.

*Brick with tiles (Nettlebed)***Thatch**

3.40 Thatch was once much more common on humble brick buildings such as outhouses and lean-tos, although few examples survive today in the Chilterns. Thatch and brick are occasionally encountered in the scarp areas, close to the arable Vale of Aylesbury.

Slate

3.41 While many brick buildings are roofed with peg-tiles, slate has been used since the C19th as at Lane End, Bolter End, Lee Common or Stoke Row.

Brick and thatch (Watlington)*Brick and slate (Marlow)***Material Combinations Checklist**

- Do combine other materials with brick in balanced proportions
- Do use brick in conjunction with other sustainable, local materials such as flint
- Do experiment with combining steel, glass and new materials with brickwork whilst respecting the local context
- Don't spoil good brickwork by combining it with materials of poor quality

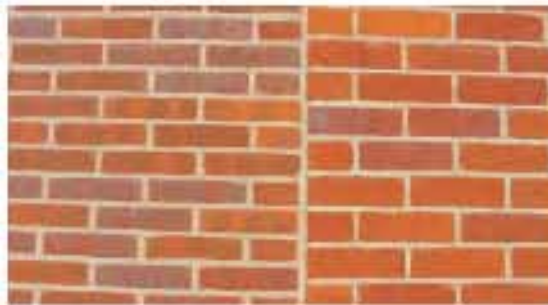
Stage 5: Brick Selection

3.42 Bricks are available in a wide variety of strengths, types, textures, and colours. There are currently over 1200 types of brick made in the UK. Facing bricks are specially made or selected to give an attractive appearance. Common bricks are suitable for general construction work, with no special claim to give an attractive appearance. Engineering bricks have defined high strength and low water absorbency. They are sometimes used as facing bricks. Information and samples should be sought from suppliers; brick matching services are also available. The Chilterns are remarkable for the choice and variety of bricks – both machine- and hand-made – still manufactured in the region. The type of brick produced provides an 'instant' traditional look to buildings, allowing them to sit so well in the Chilterns landscape. Be aware that some bricks made abroad are given names resembling those of Chiltern makes.

Size

3.43 It is often assumed that new bricks are made in the one metric work size (215 x 102.5 x 65mm) and producing a co-ordinating size (ie allowing for mortar) of 225 x 112.5 x 75 to BS 3921. However, this is a standard; acceptable tolerances allow some deviation and the skilled bricklayer will vary

cross-joints to accommodate any variation. Moreover most manufacturers make and hold in stock bricks of various imperial sizes. 'Thin' bricks are often associated with repair and restoration work of pre Georgian buildings. Some clay bricks, often sold as ATRs ('all through the range' or 'as they rise') refer to stock bricks that are drawn from the kiln and delivered to site unsorted for quality. They can be used for brickwork that is to be rendered; those fired in Scotch Kilns are also suitable for facing work when properly intermixed with standard grade bricks.



Bricks are available in different sizes ('Tudors' to left; metric to right)

Strength

3.44 Bricks are classified by the crushing strength, which can vary greatly. The majority of clay bricks range from 20 to 90 N/mm². The overall strength of brickwork is of course also related to the bonding used and to a lesser extent the strength of the mortar (see below).

Fire Resistance

3.45 Often a feature perhaps taken for granted, bricks are eminently fire-resistant.

Frost Resistance

3.46 The nature of the clay deposit and firing characteristics govern a brick's frost resistance. Bricks are subjected to freeze thaw cycle tests and under BS 3921 are classified into three categories of frost resistance, 'F', 'M, & 'O'. BS 5628, Table 13 explains where these should be specified in building works. Frost damage should not occur in Moderately Frost Resistant clay bricks if the brickwork is protected from saturation by appropriate detailing. In particularly exposed situations, more durable bricks of 'F' quality should be specified. Further advice should be sought from suppliers.

Soluble Salts

3.47 New bricks are classified by two categories of soluble salts content, 'L' and 'N' as defined in BS 3921. Where there is a high risk of brickwork becoming saturated for substantial periods of time there can be a risk of sulphate attack on the mortar. The obvious remedy is to protect the brickwork from long periods of saturation. When

Chilterns Brick Supplementary Technical Note - Adopted Version

this is impractical use bricks of L (low levels of salts) designation.

Alternatively use bricks of N (normal levels of salts) designation and appropriate mortar. Water soluble salts may also cause unsightly efflorescence if there is insufficient 'umbrella' detailing or codes of practice relating to workmanship are not followed.

Water Absorption

3.48 The water absorption of a clay brick is significant in the definition of Engineering and DPC bricks in BS 3921 and in the calculation of flexural strength in the design of structural brickwork. Highly absorbent, hand-made bricks may absorb water from the mortar too quickly if extremely dry and will require wetting. The suction rate may be reduced by docking or slightly spraying them so that the surface is left damp rather than wet. In use the effect of rainwater on low absorption bricks (where it freely runs off) will be very different to absorbent bricks where the rain will be absorbed to dry out later. Rainwater run-off can lead to unsightly streaking or staining and requires correct detailing of gutters, drips and sills.



The effects of efflorescence



Differential weathering of bricks (Piccotts End)

Chilterns Brick Supplementary Technical Note - Adopted Version

Movement Joints

3.49 In cavity walls, moisture movement occurring during the life of a brickwork wall and cyclical thermal movement require movement joints to be provided in accordance with BS 5628-3, particularly for south - and west - facing elevations and when the cavity wall is fully filled with cavity insulation. Movement joints inevitably affect the appearance of the building and therefore should either be detailed as a feature (and finished neatly with an appropriately coloured sealant) or preferably placed unobtrusively eg concealed behind a rain water pipe. The use of lime mortar may reduce or remove the need for expansion joints altogether.

Colour

3.50 Most locally produced bricks in the Chilterns were red, ranging from those with orange tinges to nearly purple. Generally they were a mellow red in colour. Colour variations become most pronounced in buildings dating from around the mid C19th. Uniformity of colour in 'superior' buildings was

Glazed headers were used only in the front elevation of this newly erected drying shed at HG Matthew's yard



achieved in the past by hand-picking bricks from the kiln. At a vernacular level, cottages might exhibit a more mottled appearance. In the late C20th, certain colours predominated. A preference for brown bricks in the early 1970s gave way to one for red bricks in the 1980s, particularly the hard smooth reds similar to engineering bricks. In the 1990s there was a preference for light buffs and pale yellows. More recently, the tendency has been to favour more mellow effects by mixing colour ranges of bricks from different parts of the kiln in selected or specified combinations. The subtle range of effects that can be created through blending and mixing, decreasing or increasing the proportions of light to heavily-burnt bricks, is often not exploited to its full advantage.

Glazed Headers

3.51 The widespread use of glazed headers is a distinctive feature of vernacular buildings of the area. H.G Matthews are able to produce them in significant quantities with a range of properties, and they are beginning to re-appear in new-build projects.



Yellow brick used for dressings (Amersham)

3.52 A range of techniques or design solutions can be adopted to create variations in the colour effects:

- ***Use different bricks for different elements of the building***
The front and side elevations, for example, can be constructed using different bricks; quoins or pilasters can also be picked out in this way.

- ***Banded work or strings***

These give a horizontal emphasis to a wall. The bricks used for banding may also vary in texture or bond and sometimes size.



Banded work (Hemel Hempstead)

- ***Patterning***

Many different diaper patterns can be created with coloured bricks or glazed headers. Using projecting bricks can also create a patterned diaper effect.



Patterning for personal effect (Markyate)

■ Polychrome brickwork

Often applied to C19th work, the schematic use of different coloured bricks can particularly help to enhance grander, institutional buildings.



Polychrome brickwork (Berkhamsted)

3.53 Limewash was sometimes applied to exterior brickwork. Colourwashing bricks with red brick dust mixed with water was often combined with the use of scored jointing and tuck pointing. Sometimes the colour wash was applied only to the dressings; sometimes to the whole elevation – both were designed to reproduce the effect of using gauged brickwork. Painting brickwork with modern paints is not recommended. If buildings were intended for stucco or plastering, less attention was paid to the quality of the facing bricks.

3.54 The technique of tinting brickwork by applying colour-fast oxide-based pigments in a potassium silicate medium to give a permanent tint to the surface of brick masonry has been used successfully for about 40 years. The treatment can be used to rectify a mismatch of bricks and/or mortar, or to correct colour banding or a patchy appearance resulting from a failure to blend bricks adequately during bricklaying. The technique has been used by designers to create a particular colouration that could not be achieved by the selection of bricks alone. Tinting has also been used to create features of contrasting brick colour in the bond pattern of brickwork after its completion. Yet another application is the work of sculptors who can enhance form and line of carvings in brickwork with complementary or contrasting tints. Tinting should only be entrusted to specialist contractors.



Brickwork formerly coated with limewash (Bisham)

Chilterns Brick Supplementary Technical Note - Adopted Version

Appearance

3.55 Locally produced bricks were generally handmade without the sharp and hard edge of modern machine-made bricks. The textures of clay brick range from glazed and smooth, through lightly textured to rough and pitted surfaces. Moulded soft-mud bricks tend to have a fairly open texture partly derived from the relatively coarse sands used to aid separation from the moulds. Finer sands are needed to produce smoother surfaces such as those required for gauged brickwork. The hand-making process provides a characteristic surface texture known as 'creasing' and the effect of laying the brick frog up makes the surface creases 'smile'. 'Stack' and 'kiss' marks, formed during firing may also appear on the surface. Gauged brickwork using 'rubbers' can be used to great effect to create niches etc. within areas of otherwise bland brickwork.

Buildability

3.56 Bricks have one of the longest unbroken histories of use of any building material in the Chilterns. Bricks are easily transported and delivered to site. Some 6-10 sq. m of brickwork can be completed a day (cf 1- 1.5 sq. m. of flintwork). Brickwork can be carried out in most weather conditions so long as it is properly protected.

Chilterns Brick Supplementary Technical Note - Adopted Version

Reclaimed Bricks

3.57 Reclaimed bricks may have developed a particular character, being fully matured and weathered. Because they involve no further manufacturing, reclaimed bricks can be regarded as a sustainable building material. They have a certain cachet and are less widely available. However, they must be technically appropriate for new work, should always be carefully sourced and should not be used in exposed or wet locations. Demolition will cause bricks once selected to perform a particular job centuries ago to become jumbled; bricks suitable for internal use (non frost-resistant) may now be required to resist weathering. Bricks that once lined chimney flues are often indiscriminately turned and used as face bricks. There are no specific assurances regarding durability, so indemnity insurance policies should cover the specification of reclaimed brick. Even then, warranties will be of little value if the bricks begin to spall after 5 or 10 years. Reclaimed bricks may be contaminated by sulphates or carry spores of dry rot. They are sometimes specified or stipulated in ignorance, in the mistaken belief that handmade bricks are no longer available. There should be a presumption against wasting re-usable bricks (and the Board supports the re-use in appropriate circumstances), though they should be used with caution and rarely for facing work. The use of simulated reclaimed bricks should always be avoided.

Stage 6: Bonding Arrangement

3.58 Unless a severe uniformity is consciously aimed for, stretcher bond should, as far as possible, be broken up and enlivened by alternative bonding arrangements. Investigate to see whether certain bonds are common to the area. Some may require further research as this guide has not featured all the variants. Ensure the correct bonds are used if dark headers are being employed to create a chequered effect (eg Flemish bond). Adjustment of the bond for several courses of brickwork can be used to create subtle banding effects; care is required to match the band bricks to the principal bricks used. Soldier courses might be incorporated to articulate storey changes but consideration must be given to their structural effect and to the method of returning the course at corners. Herringbone, basket-weave and interlacing bonds might be incorporated in panels to decorative effect. Curved walls may require a header bond which can appear a little harsh; stretcher bond will accentuate 'faceting' and 'overhang'; for the best appearance, curved walls should be built with radials. Where a bond has to be broken, ensure the discontinuity is positioned either at both ends or at the centre of walls and window openings. Whichever bond is selected, wandering perpend should be avoided.

Brick Checklist

- Do dimension brickwork to minimize the need for broken bond and cutting bricks
- Do issue instructions early where bricks with tighter limits of size or special shape are required
- Do ensure bricks are properly blended
- Do conceal movement joints where used
- Do use reclaimed bricks appropriately
- Don't use reclaimed bricks indiscriminately – ensure they are fit for their purpose



The poor use of reclaimed bricks detracts from the appearance of this brick elevation

Stage 7 Design and Choice of Mortar

3.59 The colour, thickness, profile and texture of mortar joints all affect the final appearance of brickwork.

3.60 The factors controlling the strength of any particular mortar mix are the ratio of binder to aggregate plus the water:binder ratio. Sharp sands with angular particles including some 4-5mm grit produce the strongest mixes. A less coarse aggregate may be needed for the finer joints of quoins and dressings. Builder's sand must not be used in lime mortar. Not only will it totally influence the mortar colour, but will substantially reduce the strength and durability of the mix. The correct choice of binder is essential. The most commonly used binder in bricklaying mortars is ordinary Portland cement (OPC).

A strong cement based mortar is usually inappropriate; shrinkage cracking around the bricks will allow water ingress, with possible damage both to the mortar and bricks, particularly in frosty conditions. Traditional mortars are made with sand and lime, the lime being made by burning limestone or chalk. The use of lime in mortars particularly



Example of chalky, gritty mortar laid in even beds and finished flush. Note the stack marks on some of the bricks (Ewelme)

helps to improve their bond with clay bricks that have a high water absorption. There is a British Standard, BS EN 459-1 that recognizes lime as a binder in its own right (without the addition of cement). A range of limes is available, choice will depend on the strength, porosity, durability, and flexibility required. A generally recommended mix is 1 part moderately hydraulic lime (NHL 3.5) to 2½ parts well-graded washed sharp sand. In particular areas (e.g. below DPC level, or copings) a stronger mix (1:2) may be required. Hydraulic limes, as distinct from simple hydrated lime, are suitable for most forms of modern masonry construction and are capable of producing sufficient strength and rate of setting for many thin wall brickwork applications. The elasticity and porosity of lime mortar allows a brick wall to breathe, moisture to evaporate and fine cracks to 'heal'. The subtle

texture of lime mortar enhances the visual qualities of brickwork. Sand and premixed lime is also available as 'coarse stuff'; hydraulic lime is now also available in large batches; its production uses less energy and generates less CO₂ than Portland cement; its use is ecologically friendly and even allows the wall to

be dismantled and reconstructed in the future without loss of material.

3.61 The mix should aim to completely integrate the sand and lime. Enough water should be used to make it workable; stiffer mixes are less prone to shrinkage, particularly for pointing. The mortar should be mixed in accordance with the manufacturer's technical literature. Test panels help to arrive at the desired effect, and can assist in agreeing the intended finish with planners, conservation officers and building control officers.

3.62 Some bricks may need to be soaked in water before use because of their high absorbency – otherwise the mortar would dry and lose its adhesion. New work should be protected from sudden drying by wind or warmth in the summer or frost in the winter, and from driving rain at any time, in order to aid carbonation and prevent lime leaching, leading to unsightly staining of the new brickwork. Polythene sheeting and/or damp hessian (which can be sprayed if it starts to dry out too quickly) should be hung just clear of the wall. Conversely dry hessian and insulation/tarpaulins will be needed to keep it protected from frost in winter – even heated blankets may be required in extremely cold conditions. The ideal



Messily applied lime mortar with a poor attempt at scored jointing

Chilterns Brick Supplementary Technical Note - Adopted Version



Weathered pointing overemphasises the horizontal joints by creating shadow lines

Double struck or beak pointing exaggerates the joints



conditions for using lime are moist and warm (as close to 15°C as possible).

3.63 Joints generally account for approximately 20% of facing brickwork but mortar thicknesses and regularity dramatically affect the final appearance of brickwork. When laying some soft-mud bricks, they may be slightly distorted and therefore require 'tilting' one way or the other in order to get the brick face into the same vertical plane as the wall. If using Imperial bricks of 1965 standard size in metric gauged brickwork ie four courses to 300mm, bed joints will be thinner compared with when traditionally gauged (four courses to 12") or when using metric bricks at four courses to 300mm. It should be appreciated this will affect the overall appearance of the brickwork.

3.64 The most appropriate joint profile for handmade bricks is flush, where the excess mortar is cut off with the trowel and then finished either with the end grain of a piece of wood or coarse cloth (bagging). Beating the face of the brickwork with a dry churn brush (stiff bristled brush) may help to expose the aggregate and clean off excess mortar. The timing of the final finishing of the joints has to be carefully judged to avoid smearing wet mortar or over-ironing a joint which is too



Bucket-handle pointing

dry. The surface texture of the joint can be fairly rough with sharp sand/coarse aggregate and small lumps of unburnt lime or chalk often exposed on the surface. In some situations, particularly where bricks are eroded or arises are rounded, slightly recessing the joint behind the front face of the brick is acceptable, but is not advisable in exposed conditions or where the bricks are only moderately frost resistant. Other types of joint are

- *weathered* (mortar joint in which the mortar has been pressed in at the top (or side in vertical joints) by the bricklayer's trowel)
- *reverse struck* (creating a small, vulnerable ledge on the lower brick)
- *double struck or beak pointing* (creating a 'point')
- *bucket handle* (producing a bland appearance and possibly leaving 'tramlines')
- *raised strap pointing*

These are unlikely to produce a pleasing final appearance, although the first three may possibly be encountered on historic buildings. These and other modern finishes generally exaggerate the joint at the expense of the bricks. (Fig 6)

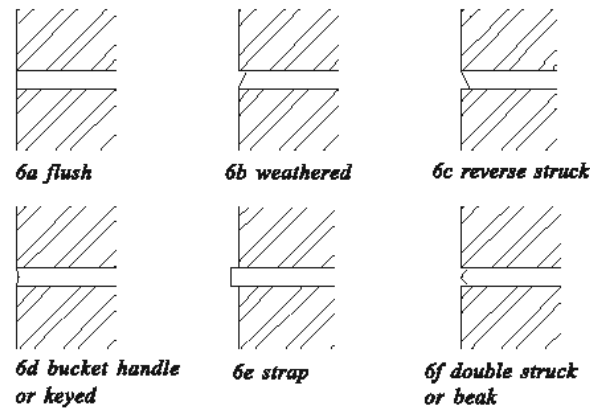
3.65 Various other techniques can be used to change the finished appearance of the mortar:

- *weather struck and cut pointing* – commonly used for repointing, not practicable to form as part of the jointing process.
- *scored joints* – a joint in which a groove has been impressed by running the point of the trowel against a straight-edge so as to give the appearance of very precise brickwork.
- *tuck pointing*, imitating 'gauged' brickwork, is unfortunately highly specialised and tends to be confined to repair work.

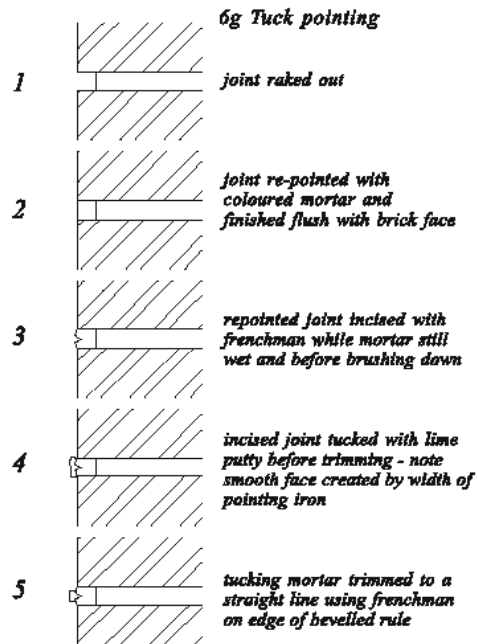


Scored or penny struck joints (Berkhamsted)

Fig 6: Joint profiles (pointing)



Tuck pointing (Berkhamsted)



Mortar colouring can be used to form patterned brickwork. Consistent results are only possible by using premixed mortar rather than adding pigments on site.



Black mortar (Markyate)

Mortar Checklist

- Do point so that the joint is flush or slightly recessed behind the front face of the brick
- Do ensure consistent use of profile jointing tools and technique
- Do consider using appropriately textured mortars
- Do use well-graded building sand
- Do use appropriate lime mortars
- Do ensure joints in internal and external angles are neatly formed
- Do ensure brickwork is kept to correct gauge to maintain regular bed joints
- Do anticipate and prepare for cold or excessively dry weather
- Don't spoil the brickwork with inappropriate mortar
- Don't use 'sloppy' mortars
- Don't use soft yellow 'builder's sand' or inappropriate aggregates for mortars
- Don't allow mortar smears over the brickwork face
- Don't use weather struck pointing, beak pointing or raised strap pointing
- Don't brush the finished work too soon
- Don't use 'anti-freeze' admixtures

Chilterns Brick Supplementary Technical Note - Adopted Version

Stage 8: Detailing



Specials used in plinth
(Hemel Hempstead)

3.66 A close inspection of brickwork in existing buildings around a proposed development might well reveal subtle local details that may be possible to incorporate into new building work. However, it should be recognized that detailing in the past evolved so as to help the building perform in a certain way. It is equally important that *correct* detailing is applied to modern brickwork

to maximise performance – allowing water to run off effectively for example. Equally, the possibility of brickwork being enlivened in a multitude of ways is frequently missed because it is often not appreciated that brick manufacturers can produce a huge array of non-standard specials.

Special brick moulds
(H G Matthews)



3.67 Standard specials (to complement the standard metric brick) are divided into 10 groups and contain over 300 variations. These are covered by BS 4729 'Specification for Dimensions of bricks of special shapes and sizes'. Standard specials (Fig 5, see p25) include:

- half-round and saddleback copings and cappings
- bullnoses for corners and reveals or for cappings and sills, imparting a more robust appearance
- angle bricks such as single or double cants with a 45° splay or other angles and squints for particular applications
- plinths (chamfered on the face or end to provide for the difference in thickness between the plinth and main wall). Sometimes inverted in modern work to simulate corbelling
- stop bricks to provide a transition from a special shape to a 'standard' brick
- arch (or 'culvert') bricks are tapered bricks for voussoirs

Quoins in expressed panels with rubbed and cut bricks (High Wycombe)



- radial bricks for building curved brickwork. Six standard specials are available to give ideal outer radii from 450mm to 5.4m.
- brick slips usually as thin facings for internal or sheltered wall
- soldier bricks for turning corners in soldier courses
- bonding bricks – for use where unusual bonding would otherwise require cutting bricks on site

Plinths

3.68 Plinth bricks can be used to reduce from one wall thickness to another. Conventional plinth bricks have a 45° chamfer but more curvilinear profiles were used in the past to visual effect.

Panels – recessed/expressed

3.69 Surfaces can be broken up by recessing or expressing panels. Other shapes such as lozenges have been effectively used in brickwork designs.

Recessing used to create panels



Niche dating from 1684 (Berkhamsted)



Corbelled Brickwork

3.70 The main purpose of corbelling was to provide structural support for walling, in front of the main wall, or roof trusses, floors or beams, but the opportunity was sometimes taken to enrich the structure with mouldings or carvings. True corbelling cannot be used in brickwork of cavity wall construction. If a corbelled appearance is required a support system is used, often with inverted plinth bricks – these may require considerable modification to suit a system.

Parapet walls

3.71 These are exposed to the elements on three faces and will therefore require careful design and construction. Good quality copings, adequate DPCs, correct flashing detail at the interface of roof and parapet and correct specification of mortar are essential.



Rubbed, cut and moulded bricks used to corbel out base of parapet (Wendover)



Ridge stack (Gossons End)

3.72 Medieval chimneys were often corbelled out at first floor level. C16th chimneys were elaborate, sometimes octagonal, rectangular or lozenge-shaped. Gable stacks often acted as solid buttresses and had tiled off-sets sometimes incorporating tumbled-in brickwork; others were occasionally corbelled out with crow-steps. By the C17th and C18th, stack design had tended to become more restrained, but sometimes incorporated panels or dressings in keeping with classical facades. During the C19th, brick chimneys once again became more elaborate, particularly on estate buildings. Stacks and chimneys have, regrettably, become less relevant to modern building design, but rural house designs in particular are left impoverished by their absence. Where they are included, the chimneys must be carefully detailed and positioned as they are one of the most exposed of building elements and must conform to Building



Gable stack with moulded cap to brick shaft (Aldbury)

Stacks and Chimneys

3.72 Medieval chimneys were often corbelled out at first floor level. C16th chimneys were elaborate, sometimes octagonal, rectangular

Chilterns Brick Supplementary Technical Note - Adapted Version

Regulations. The height of an unrestrained chimney should not be more than 4.5 times its least width at the level it penetrates the roof surface. The flue terminal or chimney pot should be bedded into at least 3 to 4 courses of brickwork and be adequately flaunched. The top of the stack may incorporate oversailing courses.

Quoins and Piers

3.73 Corner quoins are often three courses high though it is not uncommon to see them four, five or more courses high. In the Chilterns, quoins or piers often present a toothed appearance, "in" and "out" on successive courses. English and Flemish bond brickwork and their variants require the use of quoin 'closers'. Occasionally brickwork corners are rusticated by sinking every fourth or fifth mortar course and chamfering the edges of adjacent bricks. A simpler form is block bonded corners, possibly using contrasting colours. Quoins should be raised as control points, racking back to avoid toothing. Tumbling-in brickwork was sometimes employed to reduce an attached pier. One-brick, 215mm wide piers pose special problems if bricks of variable length are being used.



Three course quoin brickwork (Marlow)



Single course quoin brickwork (Marlow)

Chilterns Brick Supplementary Technical Note - Adopted Version



Dog-tooth platband (Berkhamsted)

Platbands

3.74 Platbands in brick buildings occur at storey level to accommodate joists. One course is sometimes quite sufficient, although up to four or five bricks deep are sometimes encountered; these can be enriched with recessed or projecting cogged or dog-tooth detailing. Other decorative friezes are sometimes employed although a restrained approach almost never looks wrong.



Quirky projecting platband. Note also the treatment of the brickwork above the windows (Great Misenden)



Variant platband (Watlington)

Eaves

3.75 Eaves usually require some overhang to protect the wall below. Eaves can be matched to any detailing carried out at storey levels.



Tumbled-in brickwork

Corbelling an eaves course can simulate a classical entablature, although it can look clumsy if the projection of one brick over another is excessive. Eaves can be enriched by dentilation, consisting of a regular pattern of projecting headers spaced centrally over stretchers in the course below.



Contrasting eaves



Gables and Verges

3.76 Gables in cavity walls must be adequately tied to the inner leaf which in turn should be adequately strapped to the roof trusses. Tiled and slate roofs do not create pronounced verges



Restrained verge (Marlow)

although dentilation may help to delineate verges. Bargeboards were never commonly used.

The use of cavity walling has restricted the use of tumbled in brickwork, crow-stepped gables and Dutch gables – but these have provided an attractive way of occasionally finishing gables in the Chilterns in the past.



Crow-stepped gable (Bisham)



Dutch-style gable (Hemel Hempstead)



Elaborately swept and capped wall (Marlow)

Copings and Cappings

3.77 Properly designed copings and cappings protect brickwork and provide an architectural finish to freestanding walls. Local brickyards provide a variety of handmade special coping bricks – apex, half-round, ogee, double bullnose. In the Chilterns half round bricks often associated with splayed plinth bricks and purpose-made curved or angled top coping bricks (or tile creasing) are much used for wall tops. Brick on edge cappings with or without tile creasings became common in the C20th, reflecting the popularity of flush detailing during the 1970s and 1980s; they require particularly careful design and construction. For ‘superior’ work, natural stone was also used in the past for copings. The performance of the coping will be affected by alignment, the DPC, mortar specification and movement joints.

Buttresses

3.78 Brick buttresses (sometimes incorporating small panels of flint) can also incorporate tumbled-in brickwork.



Brick buttresses (Stonor)

Dated bricks; date panels



Dated brick (Chesham)

3.79 A dated brick can provide a simple indication of the date a structure has been built or altered. More elaborate panels have been used in the past to record a variety of details relating to the owners, builders or benefactors and the reasons for the construction.



Date panel with moulded and carved brickwork (Amersham)

Dated dovecot building (Aldbury) with glazed headers



Chilterns Brick Supplementary Technical Note - Adopted Version

Moulded and Carved Brickwork

3.80 Examples of carved brickwork survive from the C15th including coats of arms. Brickwork today can be carved in situ or as pre-prepared panels. Alternatively the green bricks can be carved before firing. Such carving can enliven particular elevations with sculptures.

Terracotta

3.81 Terracotta has been used to ornament brickwork by capping it with finials, or incorporating decorative friezes and panels.



Terracotta plaque (Coleshill)

Brick Detail Checklist

- Do ensure dressings are correctly detailed
- Do ensure special bricks blend with the standard bricks
- Do consider including a dated brick
- Don't exceed extent of brick corbelling recommended in the Masonry Code of Practice (BS5628)

Chilterns Brick Supplementary Technical Note - Adopted Version

Stage 9: Internal Use of Brick

3.82 Brickwork has not, generally, in the past been 'exposed' internally except in some particular locations.

3.83 Paving and flooring bricks were often used for flooring, particularly in service areas.

3.84 Traditional fireplaces would often have chamfered brick jambs and hearths in exposed brickwork, sometimes incorporating niches and bread ovens. There are also some nice examples of centred brick arches being used instead of the more common timber lintel. Fireplaces are now being built in modern houses as luxury features. The fireplace should be completed in accordance with the Building Regulations. Chimney breasts can be positioned within the room or externally. Alternatively, the fireplace opening may be placed on an internal wall. The opening must be at least



Careful reconstruction of a 18th hearth (Chiltern Open Air Museum)

338mm (1½ bricks) deep and the jambs at least 200 mm (1 brick) wide.

3.85 Bricks were sometimes used in stairs, particularly down to cellars or occasionally in spiral stairs. Timber is usually used for exposed edgings.

3.86 In service areas, brick was extensively used to create piers to support slab shelving or stone sinks, or to construct washing and brewing coppers. The brickwork would most likely have been limewashed.

Stage 10: Select Contractor

3.87 Craftspeople producing high quality workmanship are difficult to secure; locating a suitable contractor with the skills, for example, to set out arches or cut bricks to shape may require a generous lead-in time. Translating good designs into high-quality, consistent brickwork and mortar joints depends on close liaison between designers, construction managers and craftsmen. Care is required by the bricklaying team in checking deliveries for blemishes; storing and protecting materials; constructing reference and sample panels; avoiding colour patchiness by



Brick cellar stair (Bledlow)

blending packs and inconsistent mortar and mortar colour; selecting, cutting and laying the bricks correctly and cleanly; and adequately protecting newly built brickwork.

3.88 Bricklayers are trained to build to line, level and plumb using more regular types of bricks. Inexperienced bricklayers may therefore have insufficient experience of setting out 'dry' using co-ordinating sizes and laying irregular bricks (if these are to be used) so as to maintain regular profiles, perpends and bed joints. Too few craftspeople have sufficient experience with lime mortars to be left to use them as a matter of course. Ask to see other examples of their work. Traditional bricks have a greater size variability and this should be born in mind when undertaking a new scheme as the bricklayer's craft and skill will become of greater significance in attaining a good job.

Stage 11: Obtaining Bricks

3.89 Specials may require a long lead-in time, usually 6-12 weeks depending on quantity and complexity. Check that sufficient supplies - paying attention to numbers of 'handed' versions - are available to complete the work and that, if required, they match the standard bricks being used. Ensure manufacturers are offering the necessary guarantees and warranties, particularly if soft, orange bricks are being specified.



Worn and crazed brick paving dating from the 17th (Beaumont End)

Check on what wastage rates are being supplied – they will tend to be higher if ATRs are being used instead of facing bricks.

Stage 12: Review

3.90 Finally, review all decisions and make changes if required. A thorough review of this nature will lead to a high quality specification, ensuring that the type of construction and mortar specification is appropriate and blends well with existing brickwork in the vicinity.

Internal Brickwork Checklist

- Do use exposed brickwork for constructing open hearths
- Do use common bricks for internal walls for subsequent rendering
- Do use breathable paints for painting new internal brickwork
- Do carefully consider whether to expose historic internal brickwork
- Don't paint or render historic fabric where it was intended to be exposed
- Don't destroy old brick flooring



Extensions should be blended into the existing dwelling (Flawsden) (Photo by C White)

Designing with Existing Brick

3.91 Extensions and conversions will involve disturbing historic brickwork. Most listed buildings in the Chilterns have some brickwork in their structure. Always carefully examine exposed brickwork for inscribed dates (which may well give a clue as to a building's phasing), tally marks etc. It is important to have a thorough understanding of the brick - its origins, texture, size, colouring and weathering properties, and the techniques and craft of construction,



Brickwork in poor repair

Chilterns Brick Supplementary Technical Note - Adopted Version

such as the bond and especially the composition of the mortar and the finished joint or pointing profile – when conserving and repairing old brickwork. Incorrect diagnosis and the use of inappropriate methods of repair and unsuitable mortars are amongst the most common causes of damage to the character, appearance and structural soundness of historic brick walls.

3.92 Traditional brick walls will tend to have shallow or non-existent foundations. Ground movement will cause them to lean or crack. Roof thrust can create similar problems. Bricks may have cracked or split due to unequal settlement or overloading. Whilst ivy trailed over a brick wall may look attractive, it is a cause of numerous structural problems, since the plant feeds on the lime in joints. Dressings of softer brick may wear back first. Brick stacks may have become detached from the material they are stitched into. Bulging brickwork, large cracks or fractures should be carefully investigated by a suitably experienced structural engineer. It is advisable to monitor the situation for six months or a year to establish whether the movement is historic or live.



Two examples of carefully-executed restoration (Chertsey above and Wandover below)



Chilterns Brick Supplementary Technical Note - Adopted Version



Patchwork repairs to brickwork using cement-based mortars are very difficult to disguise or reverse

3.93 Before carrying out work, always consult your local authority Conservation Officer. If the house is listed or in a Conservation Area, you may need consent or planning permission before attempting any alterations or repairs if the proposed repair or repointing is not a matching like-for-like repair using the same mortar composition, finished pointing profile and matching brick and bond. Intervention should be the minimum necessary to retain the brickwork in a safe and sound condition.

3.94 Damaged or spalled bricks should be cut out carefully to prevent damage to surrounding bricks. By using a fine, sharp chisel surrounding joints



Contrasting mortars used to great effect to distinguish dressings (using lime putty on the arch and tuck pointing to the quoins) from the main elevation brickwork in black mortar

can be cut out and raked back before removing the failed brick. Modern bricks can be found to match earlier bricks and to course with existing Imperial dimensioned work in matching brickwork in which case it is the height of the unit that has most significance. The most common Imperial compatible bricks are 80mm, 73mm (2^{7/8}"), 67 mm (2^{5/8}") and 50 mm (2" wide). Exact replacement is, however, rarely possible; it may be necessary to obtain bricks from outside the Chilterns AONB to achieve the correct colour match. Care must be taken to save old bricks wherever possible. Many architectural salvage firms retail salvaged bricks. New bricks that are far brighter than the surrounding courses can be soot-washed before inserting into the old wall. Mortar ('plastic') repair to spalled brickwork should only be considered in exceptional circumstances and in small areas of individual bricks. Brick dust can be used to colour the mortar.

3.95 Where rebuilding is necessary, particular attention should be given to the selection of matching bricks, their texture, strength, durability, jointing technique and marrying together the new and existing work. It should be borne in mind that the colour and surface of existing historic brickwork will have been affected by weathering, so exact replication may be difficult to achieve. However, choosing new locally-made



Effect of sand-blasting late C18th brickwork with glazed headers



bricks that employ clays and production methods based on the original will help to ensure they acquire a similar patina over time.

3.96 Repointing is generally only needed when the mortar has clearly failed and is powdery, loose and crumbling or has eroded away through weathering or decay. Even good repointing will upset the visual balance of a previously well-weathered brick wall. In many cases good brickwork is ruined by bad repointing, which destroys both individual bricks and the wall as a whole, or by unsympathetic and structurally harmful external treatments. Slightly weathered mortar is very rarely the cause of dampness and water penetration through a wall. Repointing should not be seen as a means of ‘toughening up’ or ‘waterproofing’ a wall, and should only be considered on structural need rather than appearance. If existing joints or pointing need to be forced when raking out it is unlikely that repointing is necessary. Repointing is a process requiring considerable skill and experience. Sample panels (small areas of repair carried out in advance of the main work, to demonstrate that the workmanship and materials match the originals) should be used wherever possible. In dealing with a historic building, it is vitally important to employ skilled craftspeople.

3.97 Avoid any method of pointing that encourages water to penetrate between the bricks. Failed joints should be raked out by hand to a depth of at least the width of the joint and

generally no more than twice the width. Mechanical cutting discs/angle grinders will damage the bricks or increase the width of the joints. The joints should be cleaned of dust and residual mortar particles by brushing and then thoroughly flushed out with clean water (avoiding saturation). As the repointing is carried out, if the joints have dried, they must be rewetted before placing the new mortar so as to control suction, especially in warm or drying conditions.

3.98 Avoid using cement-rich mortars when pointing or repointing. While they set harder and quicker than lime-based putty they are too hard, remaining intact during any movement of the wall and thus tearing the bricks which surround them. They also encourage water and harmful salts to evaporate through the bricks, rather than through the impervious cement. For conservation repairs, advice from producers of specialist mortars should be sought, so as to achieve as close a match in texture and composition as possible to the existing historic mortar. Lime-based mortars are flexible and porous – rainwater can evaporate through the mortar into the air and not be trapped inside the fabric of the brick itself.



Avoid using hard cement mortars for repairwork

A mix such as 1 part lime putty: 3 parts sand – well washed and well graded with a large proportion of coarse sharp sand may be a suitable mix. In areas with more exposed brickwork more durable mixes, made with stronger hydraulic limes and sand, may be required. A pointing iron or wood spatula should be used (not a steel trowel) to push the mortar into the joint as firmly as possible.

3.99 Repointing should not be attempted in frosty weather: the water content of wet mortar is high, and freezing conditions cause this water to expand, and the drying mortar to crack.

3.100 Some mortars were traditionally blackened after hardening, in order to direct attention to the face of the bricks. These should be reproduced wherever possible. If the new areas of repointing are obviously standing out in the old wall, in some circumstances it may be desirable to tone down the surface by applying a soot wash. This is prepared by immersing a cloth bag of soot in a bucket of water for about 24 hours. Apply the soot wash repeatedly until the desired tone is achieved. Commercial wash preparations are also available but advice should be obtained from English Heritage regarding their application.

Chilterns Brick Supplementary Technical Note - Adopted Version

3.101 Close reference should be made to the existing historic finishes – look for unweathered jointing in protected areas of walls, such as under wide eaves or hidden corners or in recesses behind buttresses or piers. It is strongly advised to leave brickwork unpainted. Paint layers do not allow the brick wall to ‘breathe’, trapping moisture inside the brick itself. Most bricks have hard spots (‘kiss marks’) which reject paint coatings, resulting in an uneven finish. Painting previously unpainted brickwork in listed buildings will require permission.

3.102 Simple water washing – either by hand or sprays – is always the best method of cleaning brickwork; hydrofluoric acid in dilution can be used to clean heavily soiled bricks. All are best performed by specialists. High-powered dry or wet sand blasters or water lances will remove much of the surface of the brick and mortar as well as the dirt and must never be used. Other chemical cleaners are not recommended, since they generally contain soluble salts which help erode the brickwork. Old limewash has to be removed from brick walls



Carefully restored brickwork will enhance the street scene (Amersham)

using a clay poultice. Water-thinned paints can be removed with water, after softening with steam; polyurethane paints or other commercial emulsions – which, when applied to exterior brick or stone surfaces, tend to trap moisture within the wall – have to be removed with hot air paint strippers or, less ideally, with non-alkali chemical paint removers. Generally, it is extremely difficult to remove emulsions without also removing the surface of the brickwork itself. The removal of paint from brickwork will inevitably damage the wall to some extent. With listed buildings advice should be sought from the local planning authority.

3.103 Where dampness and decay is present, the causes must be carefully identified before arriving at ‘stock’ solutions such as proprietary treatments or chemical injection which depends on the fluids entirely filling the pores or completely pushing out the water in front of the advancing injection fluid. They are commonly injected into the brickwork, instead of the mortar joints, because the only continuous pathway by which water can rise up and through a wall is via the mortar beds. Effective measures may be simple constructional, corrective repairs such as fixing drainage and gutters, reducing ground levels, removing impervious materials, increasing ventilation and removing obstacles causing cold bridging.

Repair Checklist

- **Do** seek specialist advice for repairing brickwork
- **Do** think carefully before repointing brickwork
- **Do** identify the causes of damp before specifying solutions
- **Do** restrict repair to the minimum necessary to keep brickwork in a safe and sound condition.
- **Do** match replacement bricks, mortar and jointing with the existing wall
- **Do** use tradesmen experienced in repairs to historic brickwork
- **Don't** spoil existing brickwork with unsympathetic repairs
- **Don't** use harmful cement based mortars for repairwork
- **Don't** sand or grit blast existing brickwork
- **Don't** use ‘waterproof’ coatings on any brickwork
- **Don't** use power tools to take out decayed joints or pointing

The Future

4.1 The current clay reserves for all three brickworks in the Chilterns are estimated to last for some 20-25 years, however, the future of brickmaking in the region hinges on supportive mineral and planning policies to encourage and promote the use of a local, sustainable resource.

4.2 Solid wall technology is currently undergoing a renaissance, offering opportunities to re-evaluate the performance characteristics and detailing of brickwork along more 'traditional' principles, but also experimenting with the use of hollow bricks as on the continent either rendered, or faced with brick. Unfired earth blocks could also be produced by brick yards for solid wall construction, faced with fired brick or render. Research into the use of natural clay plasters is also demonstrating their potential for creating healthy living environments.

4.3 Research into high performance, low energy (lime) mortars will clearly have an impact. Technological solutions are emerging to cater for volume production in local mortar plants with delivery to site in large silos (currently 22 cubic metre capacity).

4.4 Research into local techniques and production processes has already ensured that glazed headers can once again be produced; efforts are being directed into producing a wider range of colours and textures such as yellow stocks; in particular, it may be possible to open up clay deposits in parts of the Chilterns and move the clay to existing brickworks in the region rather than requiring new infrastructure to be developed at those sites.

4.5 This guide has highlighted some aspects of detailing in Chiltern buildings which will hopefully encourage brick manufacturers to respond with a range of 'Chiltern' specials as an alternative to, or in addition to, the 'standard' specials currently available.

4.6 Much attention is being paid both to sustainability and skills training in the construction sector. Larger developers will increasingly be driven by sustainability agendas, and local manufacturers need to respond with sustainability policies and manufacturing practices to position their product favourably in this wider market place. A holistic, more integrated approach to brickwork is emerging which ties together manufacturing, buildability, quality in design and construction. Manufacturers in the Chilterns already produce quality bricks – they

Chilterns Brick Supplementary Technical Note - Adopted Version

deserve to be better utilized by designers, developers and clients who should insist on their use to produce good quality buildings that are appropriate to the Chilterns landscape. Construction firms and builders will also need to constantly develop the necessary expertise and skills to ensure the appearance of the bricks is complemented and enhanced by workmanship of the highest quality.

Chapter 4



Exciting and bold design under construction using sustainable materials (Berkhamsted)



Glossary

Apron: projecting panel below a window sill, sometimes ornamented, popular in the C18th

Arris: any straight edge of a brick formed by the junction of two faces

ATR: stock brick drawn from kiln and delivered to site unsorted for quality

Axed arch: arch formed of bricks cut to appropriate wedge shape by the bricklayer

Basket-weave bond: usually formed as a panel consisting of three stretchers stack bonded with three 'soldier bricks' adjacent

Bats: part or broken section brick used in bonding brickwork sometimes as an alternative to a closer

Beak jointing: mortar joint in which top and bottom of mortar have been pressed in at an angle. See Fig 6 (p 39)

Blind Window: deliberate recess in wall having jambs, sill and head but without a window frame to simulate window opening. To be distinguished from a window which has subsequently been blocked

Bonds: The way that each course of bricks is laid and the relationship between one brick over another

Brickearth: silty clay or loam in a shallow deposit. Traditionally used for making clay bricks

Brickettes: specials manufactured to smaller than standard size

Bucket handle joint: joint with a concave, slightly recessed profile formed by drawing a rounded section tool along the joint. See Fig 6 (p 39)

Cambered Arch: arch with a slight rise to the span, slight in proportion to the length. See Fig 7.

Capping: Construction or component at the top of a wall or parapet not providing a weathered overhang (c.f. coping)

Chamfered brick: brick with one arris removed creating a flat face bevelled at 45° to the original faces

Churn brush: a stiff, long bristled brush that can be used for brushing out mortar joints and stipple finishing softer mortar when repointing

Clamp: a large stack of moulded, dry clay bricks containing crushed fuel, which is then fired

Clay spade: spade with hollow centre designed for digging in sticky brick clays

Closer: brick cut or moulded to expose a half-header to complete a bonding pattern, especially at the return of a wall or round an opening

Common brick: a brick for general purpose applications where appearance is not of significance

Coping: construction or component at top of a wall that is weathered and grooved, and overhangs the wall surface below to throw water clear & provide protection (c.f. capping)

Corbel: Projection from a wall or reveal designed to support a weight such as a beam.

Corbelling: the use of a series of projecting headers or courses for structural or decorative purposes

Cornice: a moulding used to mask the eaves or above an opening

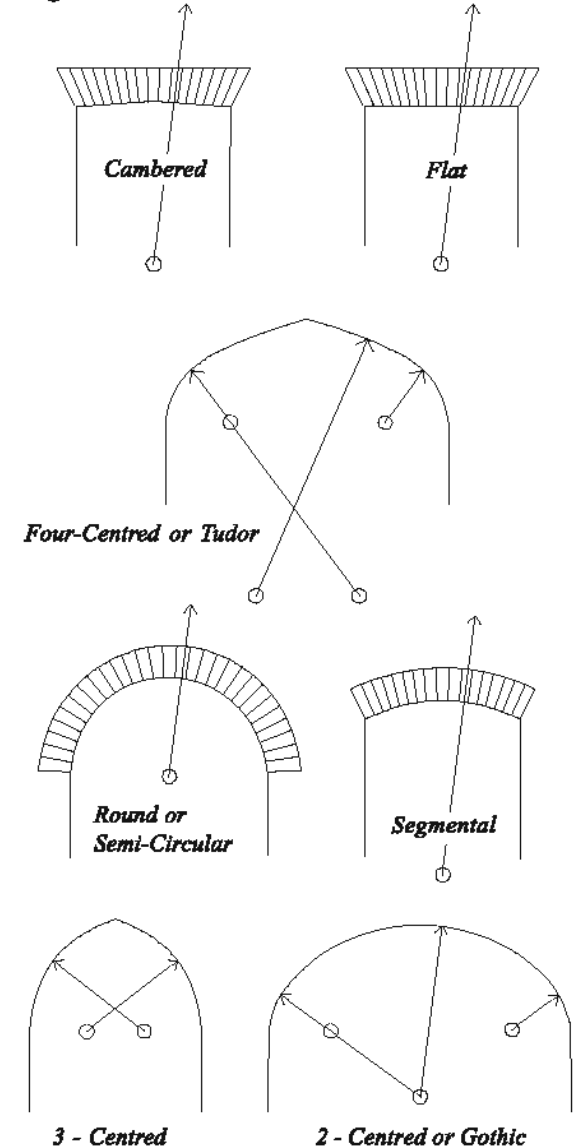
Crow-step: the finish of a gable parapet in a series of horizontal platforms like large steps. Popular in C17th brickwork

Dearne's bond: alternate courses of headers and bricks laid on edge in 9-in thick wall. The headers act as ties, the bricks laid on edge having a 3-in cavity between.

Dentillation: a decorative course or courses in which alternate headers project to give a toothed appearance

Diaper pattern: decorative pattern of diagonal intersections or diamond shapes produced by contrasting coloured bricks in a bond arrangement

Fig 7: Arches



Dog toothing: a decorative course or courses in which two faces are set at 45° to the face of the brickwork, either recessed or projecting

Double struck joint: mortar joint in which the mortar has been recessed at the top and bottom to leave a rounded bead. See Fig 6 (p 39)

Dressings: masonry used to form decorative features at window and door openings and quoins

Drop Arch: see Fig 7. Also known as 'two-centred arch'.

Embattled parapet: upper part of a wall bounding or screening a roof, balcony, terrace or bridge with alternating raised and dropped sections

English bond: alternate courses of headers and stretchers. See Fig 5 (p 25)

English cross bond: as above, but with each alternate course of stretchers moved over half a brick to give a stepped effect to the joints. See Fig 5 (p 25)

English garden wall bond: more than one course of stretchers between the header courses. See Fig 5 (p 25)

Entablature: the horizontal part of a Classical order carried by the columns, and consisting of architrave, frieze and cornice

Faceting: each brick brought to a shallow pyramid on its face

Flat Arch: use of soldier course of bricks on edge or on end to make the head of an opening. See Fig 7.

Flanchéd, flanching: the sloping fillet of mortar embedding the base of a chimney pot

Flemish bond: alternate headers and stretchers in each course. See Fig 5 (p 25)

Flemish garden wall bond: three stretchers used between each pair of headers. See Fig 5 (p 25)

Flush jointing: mortar joint which has been finished flush with the brickwork. See Fig 6 (p 39)

Frenchman: a knife with a rib to groove and trim joints

Frog: usually one, sometimes two indentations in one or both bed faces of some types of moulded or pressed bricks

Gable: triangular section of wall above eaves level supporting a pitched roof

Gauged arch: arch made with fine joints of soft bricks sawn to shape then rubbed to a smooth surface. To produce a structural arch, all bricks are cut to come to a centre and are on a radius

Gauged brickwork: brickwork built with fine joints of 3mm thickness or less, often using bricks which have been ground or rubbed

Hack: wooden frame for drying bricks

Half-bat: a bat which has been cut or manufactured to be half the length of bricks used in a wall

Half bonding: see Fig 4 (p 24)

Handed: denoting the left or right hand as specified

Head: top of door or window opening

Header: the end face of a standard brick

Header bond: only headers used in each course

Herringbone brickwork: single or double bricks laid in slanting courses, resembling 'arrow heads', each course slanting in the opposite direction to the one below. Often used in infill panels to timber-framing

Hip: the diagonal ridge between two roof pitches at right angles to each other

Hoffman kiln: a permanent enclosure in which bricks were fired, circular on plan and designed for the continuous production of bricks. The kiln had many chambers through which the stacks of bricks were moved with ducts and flues arranged for firing and drying

Hood mould: moulding with returns over a window or door opening to deflect rainwater run off

Jamb: side of door or window opening

Kiss mark: discoloration of the surface of bricks resulting from the method of stacking unfired bricks on top of each other in the kiln

Lacing course: one or more courses of bricks serving as horizontal reinforcement to walls of flint etc.

Marly: containing clay with a natural lime content

Mullion: vertical members dividing a window

Perpend (perp): vertical joint between bricks, sometimes refers to a notional line controlling the verticality of such joints

Pier: local thickening of a wall to improve its stiffness and resistance to lateral loads

Pilaster: flat version of column, a slim rectangle on plan, with each moulding and element also rendered rectangular. All orders appear in pilaster form

Platband: flat horizontal moulding between storeys

Plinth: visible projection or recess at the base of a wall or pier

Polychromatic: patterns using bricks of different colours

Pug mill: device for mixing and refining clay for brickmaking. Consists of a tub of iron with a shaft (usually turned by a horse) from which projects a set of knives arranged in a spiral fashion. Clay was inserted at the top, mixed by the knives and forced out through an opening in the bottom to be taken away to be moulded into bricks

Quarter bond: see Fig 4 (p 24)

Quoin: angle or corner of a masonry wall at a return

Radial brick: special shaped brick of curved form for use in brickwork curved on plan

Rat-trap bond: bricks laid on edge with alternate headers and stretchers in each course, resulting in a cavity between each pair of stretchers

*Rat-trap bond
(Watlington)*



Chilterns Brick Supplementary Technical Note - Adopted Version

Reveal: area of walling at the side of an opening at right angles to the general face of the wall

Reverse struck jointing: mortar joint in which bottom of mortar has been pressed in by bricklayer's trowel c.f. 'weathered joint'. (Sometimes also referred to as 'overhand struck joints') See Fig 6 (p 39)

Rough arch: arch made of bricks which have not been moulded or cut to voussoir shape. The necessary taper is provided in the mortar joints. Usually made of one or two rings of brick-on-edge

Rubber: soft clay bricks, made to be easily ground to accurate sizes for use in gauged brickwork

Scored jointing: mortar joint in which grooves have been impressed by running the point of the trowel against a straight edge to give the appearance of very precise brickwork. Also known as a 'ruled' or 'penny' joints

Segmental arch: arch in which the underside & upper edge of the bricks form segments struck from the same centre. See Fig 7

Semi-circular arch: see Fig 7 (Also known as a 'Round arch')

Sill: bottom of window opening

Skintled brick: green brick placed diagonally in the back; this is done after the drying process has progressed sufficiently for the bricks to be moved.

Snap headers: half bats, with one end exposed, used to provide a bonding pattern, as in the outer leaf of a cavity wall

Soldier course: a course of bricks laid on end, standing upright like soldiers, often delineating floor joist levels

Soldier arch: arch constructed of bricks laid on end, as above

Splay: the angle, greater than a right angle, which one surface makes with another. In effect often a large chamfer, particularly seen on reveals

Stack mark: indentations on the surface of bricks resulting from the method of stacking unfired bricks on top of each other in the kiln.

Stock: in pallet moulding the stock is an iron-faced block of wood fixed to the surface of the moulder's bench. The mould fits over the stock. The thickness of the brick is regulated with the aid of stock pins which limit the drop of the mould onto the stock

Stock bricks: soft-mud bricks, traditionally hand-made

Strap pointing: Pointing method in which the mortar projects beyond and over the faces of the bricks, often in a box-like profile. Sometimes referred to as 'ribbon' pointing

Stretcher: the longer face of a brick showing in the surface of a wall

Stretcher bond: only stretchers used in each course, the usual bond for cavity walls. See Fig 5 (p 25)

String: a horizontal band, sometimes of dentilated or dog-tooth brickwork, often at an intermediate floor level

Stucco: smooth finished render usually painted

Three centred arch: see Fig 7.

Third bonding: see Fig 4 (p 24)

Trammel: timber batten, pivoted at one end, used to set out curved work

Tuck pointing: grooves cut into brickwork to which are applied fine lines of lime putty to give a regular and accurate joint pattern

Tumbled-in brickwork: courses of brickwork laid at right angles to the slope of a gable or chimney-breast and tapering into horizontal courses

Two-centred Arch: see Fig 7. Also known as 'drop' arch.

Vitrified: clay or sand turned into a glass-substance under intense heat

Voussoir: wedge-shaped brick or stone used in a gauged arch

Wall tie: metal or plastic component used to link two leaves of a cavity wall or tie cladding to a backing

Wany edged: natural curve of the edge of a plank of wood caused by using rough-sawn timber

Wattle and daub: An infill to timber-framing made of interwoven sticks or laths covered in clay or chalk mixed with straw, etc.

Weathered joint: mortar joint in which the mortar has been pressed in at the top (or side in vertical joints) by the bricklayer's trowel. See Fig 6 (p 39)

Weep-hole: vertical joint left free of mortar or formed with plastic slots or small clay pipes to allow water to drain away from a cavity wall above a damp-proof course or the rear of retaining walls.

Wicket hole: aperture through which bricks are loaded and unloaded in a kiln



Dated brick (Bledlow)

Bibliography

- Ashurst, J., *Brick, Terracotta and Earth*, English Heritage Practical Building Conservation, Vol.2, 1988
- Avoncroft Museum of Buildings, *Bricks and Brickmaking*, 1978
- Bond, J., Gosling S., Rhodes J., *Oxfordshire Brickmakers*, Oxfordshire Museum Service Publications Number 14, 1980
- BDA, *Brickwork Design & Detailing, Structural Brickwork, Brickwork Information Sheets*.
- Brick Development Association, *Successful Brickwork*, 2nd edn., 2000
- Brunskill, R.W., *Brick Building in Britain*, 1997
- Buckinghamshire County Museum, *Gazetteer of Buckinghamshire Brickyards 1800-1980*, 1980
- Carey, J., *Tuck Pointing in Practice*, Society for the Protection of Ancient Building, Information Sheet 8, N.D.
- Chilterns Conference, *Chilterns Buildings Design Guide, A Countryside Design Summary*, 1999
- Chilterns Conservation Board, *Chilterns Buildings Design Guide, Chilterns Flint: Supplementary Technical Note*, 2003
- Clifton-Taylor, A. and Brunskill, R.W., *English Brickwork*, 1977
- Cox, A., *Brickmaking*, Bedfordshire County Council, 1979
- East Hertfordshire District Council, *Brick Pointing and Repair, Historic Buildings & Conservation Areas Guidance Notes*, N.D.
- Hayward R., *The Brick Book*, 1978
- Hepple L., & Doggett, A., *The Chilterns*, 1992

Hertfordshire Conservation File, *Bricks in Hertfordshire*, N.D.

Hughes, P., *The Need for Old Buildings to 'Breathe'* Revised, Society for Protection of Ancient Building, Information Sheet 4, 1987

Hydraulic Lime Mortar for brick, stone and block masonry' Donhead ISBN 1-873394-64-0

Knight, T., *Creative Brickwork*, Brick Development Association, 1997

Lloyd, N., *A History of English Brickwork*, 1925, reprinted 1983

Oxley, R., *Survey and Repair of Traditional Buildings: A sustainable approach*, 2003

Parissien, S., *Georgian Brickwork*, A brief guide to the types and repair of Georgian Brickwork, The Georgian Group Guides No.2, N.D.

Perrins, L., *Hertfordshire Brickworks: A Gazetteer* Draft ms. Article for *Herts Archaeology* Vol 13, 2003.

Reid, K., *Panel Infillings to Timber-Framed Buildings*, Society for the Protection of Ancient Buildings, Technical Pamphlet 11, 1989

Teutonico, J. (ed.), *The English Heritage Directory of Building Limes*, 1977

Wight, J., *Brick Building in England from the Middle Ages to 1550*, 1972

Williams, G.B.A., *Pointing Stone and Brick Walling*, Society for the Protection of Ancient Buildings Technical Pamphlet 5, 1986

Woodforde, J., *Bricks to Build a House*, 1976

Further Advice

For any new development proposal you should initially contact a Development Control Planning Officer in the Planning Department at your local council. Additionally, if your proposal involves a listed building or is in a Conservation Area, you should contact a Conservation/Listed Buildings Officer. You will also need to contact your Local Building Control Service.

Details of all the councils that cover the Chilterns AONB can be found at the Chilterns AONB website: www.chilternsaonb.org

The website will also contain details of suppliers, practitioners and other useful contacts. This list may change from time to time, so it is recommended that you check it regularly if you undertake projects at different times.

For further information and advice contact the Chilterns Conservation Board at the following address:

Chilterns AONB Office
The Lodge 90 Station Road
Chinnor Oxon. OX39 4HA



Tel: 01844 355500 Fax: 01844 355501

Email: office@chilternsaonb.org

Published with assistance from



an Area of Outstanding Natural Beauty