Historic England

Cambridgeshire

Building Stones of England

The Building Stones of England

England's rich architectural heritage owes much to the great variety of stones used in buildings and other structures. The building stones commonly reflect the local geology, imparting local distinctiveness to historic towns, villages and rural landscapes.

Historic England and the British Geological Survey (BGS), working with local geologists and historic buildings experts, have compiled the Building Stones Database for England to identify important building stones, where they came from and potential alternative sources for repairs and new construction.

Drawing on this research, plus BGS publications and fieldwork, guides like this one have been produced for each English county. The guides are aimed at mineral planners, building conservation advisers, architects and surveyors, and those assessing townscapes and countryside character. The guides will also be of interest if you want to find out more about local buildings, natural history, and landscapes.

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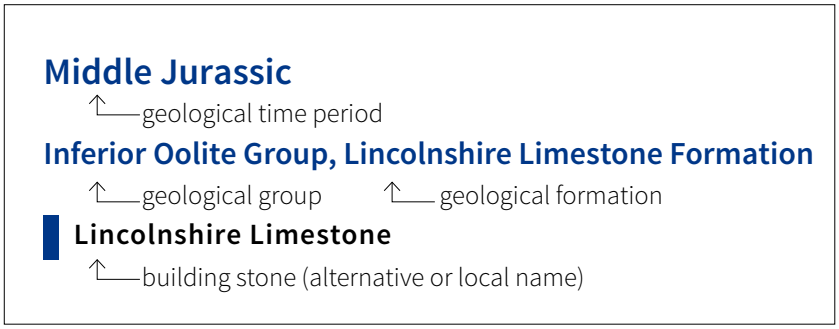
Front cover: Ely Cathedral. Barnack Stone. © travelbild / Alamy Stock Photo.

How to Use this Guide

Each guide describes the local building stones in their geological timescale order, starting with the oldest layers through to the youngest. The guide ends with examples of other notable building stones from other parts of England and further afield.

Geological time periods, groups, formations and building stones

Each building stone is listed under the relevant geological timescale, group and formation. A formation may be divided into members and where relevant these are referenced in individual building stone sections.



Bedrock geology map and stratigraphic table

To help you with the geology of the area, there is a bedrock geology map and a stratigraphic table which shows the layers of rocks and the associated building stones in this geological timescale, group, formation order.

Page numbers for each building stone are included in the stratigraphic table for ease of reference. The page numbers are inverted to correspond with the geological age order.

Contents list

If you click on the page number for a building stone in the Contents list, you will go straight to the relevant section in the guide.

Building stone sources and building examples

A companion spreadsheet to this guide provides:

- More examples of buildings. Information is included on building type, date, architectural style, building stone source, and listed/ scheduled status
- A list of known (active and ceased) building stone sources such as quarries, mines, pits and delphs
- Additional information on building stones including lithology, grain size, sedimentary structures, key identification features, and notes on failure/weathering, and use.

The Building Stone GIS map allows you to search the Building Stones Database for England for:

- A building stone type in an area
- Details on individual mapped buildings or stone sources
- Potential sources of building stone sources within a given proximity of a stone building or area
- Buildings or stone sources in individual mineral planning authority area.

Further Reading, Online Resources and Contacts

The guide includes geological and building stone references for the area. A separate guide is provided on general Further Reading, Online Resources and Contacts.

Glossary

The guides include many geological terms. A separate Glossary explaining these terms is provided to be used alongside the guides.

The guides use the BGS lexicon of named rock units.

Mineral and local planning authorities

This guide covers the mineral planning authority areas of Cambridgeshire County Council and Peterborough City Council Unitary Authority, and the local planning authority areas of the Fenland, Huntingdonshire, East Cambridgeshire, South Cambridgeshire and City of Cambridge.

Contents

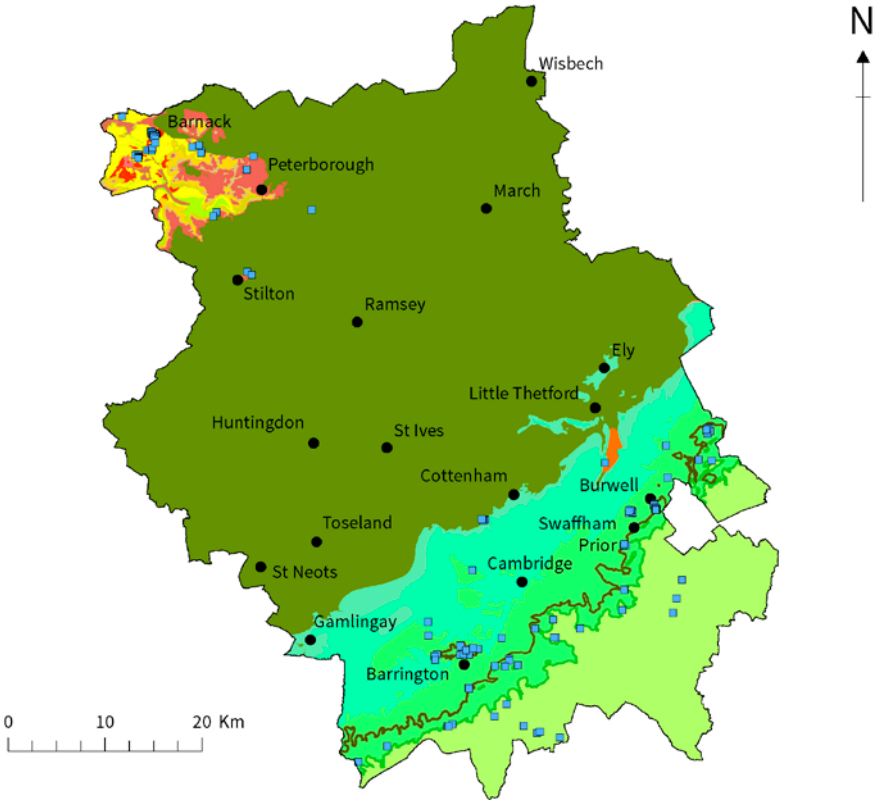
1 Introduction

The geology of Cambridgeshire can be regarded as an extension of that of the adjoining parts of neighbouring Lincolnshire, Northamptonshire, Bedfordshire and Norfolk. This is reflected in the building stone used within the county.

In the north and west of Cambridgeshire, most of the Huntingdonshire District sits on Jurassic clays overlain by glacial till. A small area in the north-western corner of the county, to the west of Peterborough, is underlain by Middle Jurassic limestones. The geological succession here includes the Lincolnshire Limestone Formation, which is the source of a variety of attractive building stones much used throughout Cambridgeshire. The limestone is widely used in the buildings in the villages and small towns in this part of the county. The same formation also supplied stone for cathedrals and high-status buildings in Peterborough and Ely and for many of the college buildings in Cambridge. In many cases, supplies of locally worked Lincolnshire Limestone were supplemented by very similar limestone imported from Northamptonshire and Lincolnshire.

Much of central and eastern Cambridgeshire is dominated by the distinctive low-lying and flat landscape of the Fens, and the bedrock geology here mainly comprises Upper Jurassic clays. Occasional outcrops of Lower Cretaceous sandstones and ironstones have yielded workable stone for local construction purposes, but much of the stone employed in buildings in this area has been imported from North West Cambridgeshire, Northamptonshire and Norfolk via the regional network of waterways. The gently rolling and hilly landscape of south Cambridgeshire is formed from Upper Cretaceous chalk and flint, overlain in places by boulder clay and fluvio-glacial gravel deposits containing various pebbles and cobbles. Chalk, Quarry Flint, Quaternary Flint and harder pebbles and cobbles have been widely used for local building purposes in this area.

Bedrock Geology Map



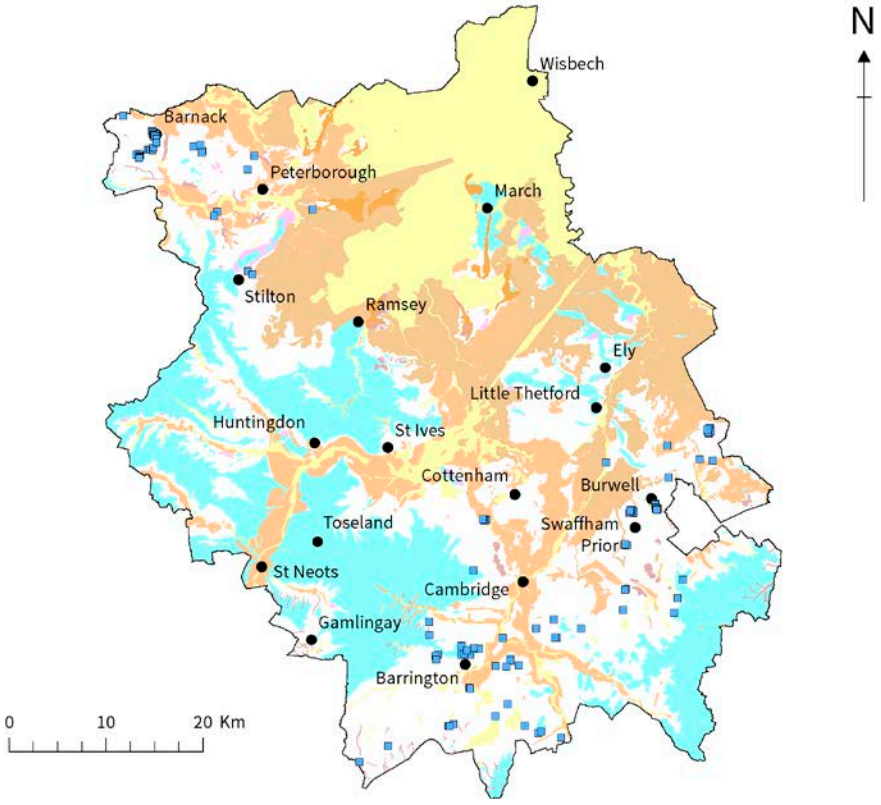
Key

- Building stone sources

Bedrock geology

- White Chalk Subgroup — chalk
- Melbourn Rock Member — chalk and limestone
- Grey Chalk Subgroup — chalk
- Totternhoe Stone Member — chalk and calcarenite
- Gault Formation — mudstone
- Woburn Sands Formation — sandstone
- Sandringham Sands Formation — sands
- Ancholme Group — mudstone, siltstone, limestone
- Upware Limestone Member — limestone
- Cornbrash Formation — limestone
- Blisworth Limestone Formation — limestone
- Great Oolite Group — mudstone, sandstone, limestone
- Upper Lincolnshire Limestone Member — limestone
- Lower Lincolnshire Limestone Member — limestone
- Grantham Formation — sandstone, siltstone, mudstone
- Northampton Sand Formation — ironstone, ooidal
- Whitby Mudstone Formation — mudstone

Superficial Geology Map



Key

Building stone sources

Superficial geology

Tufa — tufa, calcareous

Alluvium and tidal flat deposits — clay, silt, sands and gravels

Head — sands, gravels, silt, and clay

Lacustrine Deposits and Peat — clay, silt and peat

River terraces — sands, gravels and clay

Glaciofluvial and Glaciolacustrine Deposits — sands, gravels, silts and clay

Glacial tills — clays, sands, gravels, boulders

Stratigraphic Table

Geological timescale	Group		Formation	Building stone	Page
Quaternary	various		various	Pebbles and cobbles (Fieldstone) Quaternary Flint (Field Flint, Brown Field Flint, Clay-with-flints) Sarsen stone (Silcrete)	39 38 37
Upper Cretaceous	Chalk Group	White Chalk Subgroup	Seaford Chalk Formation		
			Lewes Nodular Chalk Formation	Chalk (Chalk Block, Clunch)	36
			New Pit Chalk Formation	Quarry Flint (Fresh Flint)	35
			Holywell Nodular Chalk Formation (including Melbourn Rock Member)	Melbourn Rock	34
		Grey Chalk Subgroup	Zig Zag Chalk Formation (including Totternhoe Stone Member at base)	Totternhoe Stone (Burwell Rock, Burwell Stone, Cambridgeshire Clunch)	33
			West Melbury Marly Chalk Formation		
Lower Cretaceous	Selborne Group		Gault Formation		
	Lower Greensand Group		Woburn Sands Formation	Woburn Sandstone (Sandrock, Ironstone, Ragstone, Carstone, Fenstone)	32
				Ely Sandstone	31
				Cottenham Sandstone (Puddingstone)	30
Upper Jurassic	Ancholme Group		Kimmeridge Clay Formation		
			Ampthill Clay Formation		
			West Walton Formation	Upware Limestone	28
			Oxford Clay Formation		
Middle Jurassic			Kellaways Formation		
	Great Oolite Group		Cornbrash Formation	Cornbrash Alwalton Marble	27 26
			Blisworth Limestone Formation		
			Rutland Formation		
	Inferior Oolite Group		Lincolnshire Limestone Formation	Lincolnshire Limestone Upper Lincolnshire Limestone Barnack Stone (Barnack Rag) Lower Lincolnshire Limestone Wittering Pendle (Wittering Pendle Flagstone)	 25 24 24 23
			Grantham Formation		

Building stones in geological order from the oldest through to the youngest layers.

2 The Use of Stone in Cambridgeshire's Buildings

Background and historical context

There are more than 7,300 listed buildings and 223 conservation areas in Cambridgeshire. More than 1,100 of the listed buildings lie within Cambridge city.

Timber was the main material used for the construction of secular buildings of all sizes throughout the medieval period, except in the Middle Jurassic limestone outcrop area to the north-west of the county and the Soke of Peterborough. Despite the dominance of timber frame and limited quantities of building stone, there is a long history of the use of stone in castles, large houses, ecclesiastical buildings, the college buildings of the University of Cambridge and the construction of river bridges and railway stations.

Chalk was available in South Cambridgeshire, with occasional outcrops of sandstones and ironstones occurring within and south of the Fens and the Bedfordshire Greensand Ridge in the far south-west of the county. Quarry Flint, Quaternary Flint and glacial and riverine pebbles and cobbles were widely used in the south and along the valley of the Great Ouse. In the Middle Jurassic limestone area west of Peterborough, building stone was quarried around Barnack. It was exploited from the Roman period, although by 1460 the best of the stone had already been exhausted.

Figure 1: Bridge over River Great Ouse, St Ives. Barnack Stone.

From Roman times, various types of Lincolnshire Limestone were transported from nearby Northamptonshire and Lincolnshire to all parts of the county and beyond, via the River Nene, Fenland drains and rivers. This limestone was widely employed in monasteries, churches, Cambridge colleges and other prestigious buildings across the county. In the Middle Jurassic limestone area, Barnack Stone and other Lincolnshire Limestones were used in a wide range of buildings and walls. Villages with historic buildings constructed entirely of buff-coloured Lincolnshire Limestone are characteristic of the area.

From at least the 10th century, religious communities had a significant influence on the landscape, the economy and the extraction and use of building stone. Abbeys on the edge of the Fens were established at Peterborough (*c* 650) and Ramsey (969) and on the fen islands at Ely (673) and Thorney (*c* 670). Peterborough Abbey owned quarries at Barnack, and at times Ramsey and Thorney abbeys also had quarrying rights. Stone from Barnack was widely used across the county and beyond in monastic and church buildings; it was also employed in the 12th-century construction phases of Peterborough and Ely cathedrals.

The city of Cambridge has a particularly rich architectural history and has the second-oldest university (founded in 1209) in the English-speaking world. Much of the stone employed in the Cambridge colleges was imported.

There are at least 580 churches in Cambridgeshire. In many areas of the county, they are the most significant stone-built structures. Most of the pre-Reformation churches developed piecemeal over the centuries and exhibit a mixture of features, fabrics and building materials. After the Norman invasion in the 11th century, there was a massive expansion in church building. The wealth of the abbey estates and Cambridge colleges enabled them to generously support the construction of churches in the manors they held, and by the 13th century churches had been built in many villages.

Despite the impacts of economic collapse and the Black Death during the second half of the 14th century, church building and alteration continued. Increasing economic wealth in the late 14th to 15th century, combined with changes to religious practices and beliefs beliefs in the 16th century, led to new work being undertaken on most churches. Fine towers and clerestories were added in many places, and 14th-century ashlar broach spires are a landmark feature of Cambridgeshire west of the River Cam.

Apart from churches and monastic buildings, the earliest stone-built structures in Cambridgeshire were castles, fortified manors and bishops' palaces. Little remains of the county's Norman castles other than earthworks, but elements of fortified manors remain at Hemingford Grey (*c* 1130), Northborough, and Longthorpe Tower (*c* 1263), Peterborough.

By the late 14th century, sheep farming had become extremely profitable and, as a result, high-quality buildings started to be built across the county. In the Middle Jurassic limestone area to the north-west of the county, they

Figure 2: Longthorpe Tower, Longthorpe. Cornbrash Limestone.

were frequently built of stone. During the period 1580 to 1640, many village houses were transformed from medieval open hall buildings into more comfortable homes, by having chimneys inserted and an upper floor added. In the north-west of the county, stone buildings, constructed of locally occurring limestones, dominate villages such as Barnack, Elton, Eye and Helpston. Roofs were generally constructed using Collyweston Stone slate.

From the middle of the 17th century, houses were increasingly built in a classical style. In the north of the county, stone was used for many such buildings, including Walcot Hall, Southorpe (1678), and Thorpe Hall, Longthorpe (1653–6). Many older houses in the area were remodelled during the 18th century, including Elton Hall, Milton Hall and Kimbolton Castle, mainly using imported Weldon Stone and Ketton Stone. Few major new mansions were constructed in Cambridgeshire during the 19th century, although many houses, such as Anglesey Abbey, were modified, rebuilt and extended.

The rapid population increase in the 19th century led to the construction of new churches. Some 36 new parishes were created between 1845 and 1897, especially in Fenland towns such as Chatteris, March and Wisbech. The by-then extensive railway network allowed the importation of building stone from a wider area, although brick was common too.

Brick production rapidly increased to meet the demand for materials, although the use of clay bat, chalk block, rubble and lightweight timber frames for lower quality buildings also became more common. Stone continued to be used in towns for prestigious civic, commercial and other buildings, including the Cambridge colleges.

The 20th century saw major changes to the Cambridgeshire landscape, including the construction and widening of major roads, such as the A1 and the A14, industrial-scale gravel extraction along the Ouse Valley, the establishment of several large wartime airfields, the creation of Grafham Water, the development of Peterborough New Town (from 1967) and the expansion of Cambridge and market towns and villages across the county. The use of stone in connection with such projects was often limited to municipal and commercial buildings constructed during the Edwardian period, and more specifically to the dressings of brick buildings. In Cambridge, the university authorities often insisted on street-facing elevations being built entirely of stone. Stone was used to clad new university and commercial buildings in the city throughout the 20th century and it continues to be employed in the 21st century. In the north-west of the county, limestone is still used for cladding new housing.

National Character Areas (NCAs)

Local landscape character and the combination of history, cultural and economic activity, geodiversity and biodiversity have been mapped for the whole of England and National Character Areas (NCA) defined (see Further Reading, Online Resources and Contacts). For each NCA there is a profile document which describes the natural and cultural features that shape the landscapes, how the landscapes have changed over time, the current key drivers for ongoing change, and a broad analysis of each area's characteristics and ecosystem services. The profiles include notes on local vernacular and building materials which are expanded in the following section on the nine NCAs covered in this guide:

NCA 46 The Fens
NCA 75 Kesteven Uplands
NCA 85 The Brecks
NCA 86 South Suffolk and North Essex Clayland
NCA 87 East Anglian Chalk
NCA 88 Bedfordshire and Cambridgeshire Claylands
NCA 89 Northamptonshire Vales
NCA 90 Bedfordshire Greensand Ridge
NCA 92 Rockingham Forest

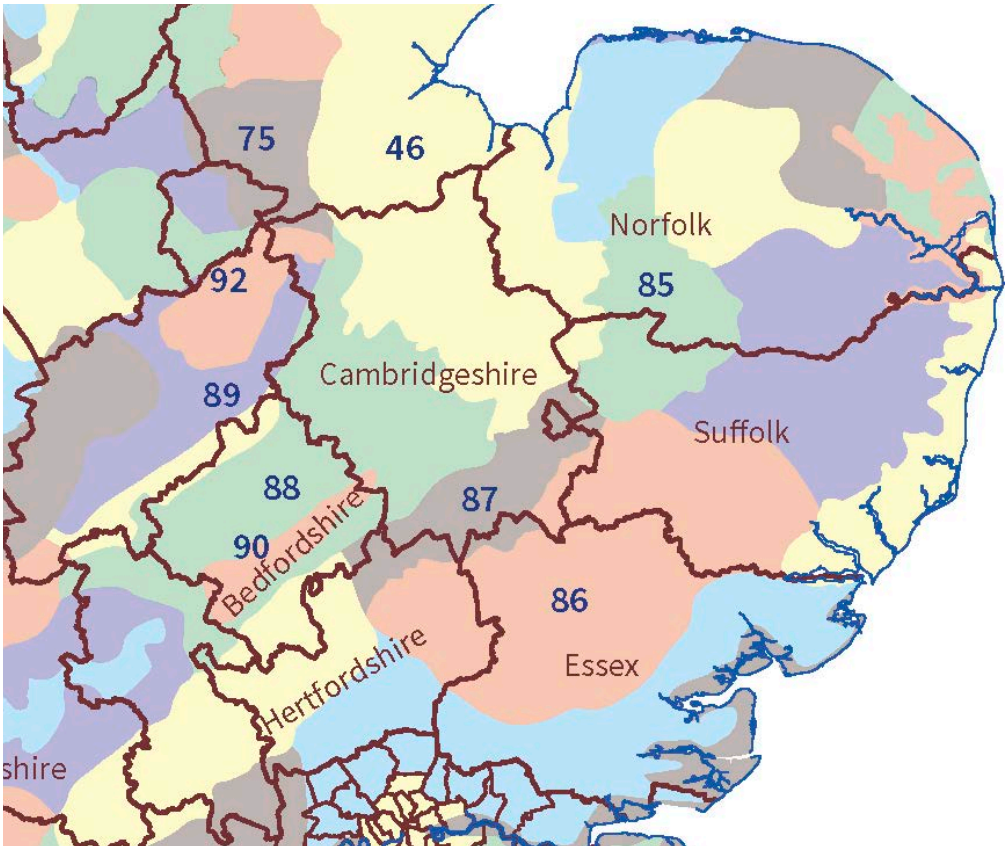


Figure 3: Map showing the National Character Areas (and the NCA numbers).

The Fens

The Fens cover large areas of central and north-eastern Cambridgeshire and south-eastern Lincolnshire. The great Fenland island abbeys of Ely and Thorney and the fen-edge abbeys of Peterborough and Ramsey became important economic centres that managed the draining of substantial areas of the Fens. The wealth generated from cattle and sheep farming is reflected in the fine medieval buildings of Peterborough, Ely and Cambridge and the churches of the fen-edge settlements, such as St Ives and Burwell.

The only building stones available within the Fenland area came from the 'island' outcrops. On the Isle of Ely, Lower Cretaceous Ely Sandstone was used extensively in monastery buildings from the 12th to the 14th century. Chalk and Totternhoe Stone were brought from the southern margins of the Fens from quarries such as those at Burwell, Swaffham Bulbeck and Reach. Chalk was used in Ely Cathedral, Denny Abbey and many other medieval churches and buildings. Lincolnshire Limestone, including Barnack Stone, was transported via the River Nene, the Car Dyke and Fenland drains. Ely Cathedral is primarily built of Barnack Stone and hosts many decorative elements carved in chalk and Purbeck Marble. Barnack Stone and Collyweston Stone slate (the latter used for roofing) were also widely employed in churches and monastic buildings of the fen island settlements.

Throughout the medieval period, timber frame, mostly rendered, was largely used in town houses, farms and cottages. From the 14th century, brick was used for re-facing, repair and extension works, and from the 17th century it was widely employed for a range of secular buildings, from cottages to substantial town houses.

Figure 4: Ely Cathedral, Ely. Barnack Stone.

From the 17th century, the comprehensive draining of the Fens transformed them into rich agricultural lands. Parliamentary enclosures during the 18th and 19th centuries enabled large tracts of the still-open fen to be drained and divided into fields. The larger Fenland settlements expanded, and a substantial number of new small churches and farmsteads were built. These were generally constructed of brick, but some made use of stone, such as the Church of St Etheldreda at Coldham (1876), which employed coursed carstone from Norfolk. Other imported stones included Ancaster Stone and Bath Stone. Flint was used occasionally for churches, such as St Peter's Church at Prickwillow (1866) and the Church of St John the Evangelist at Littleport (1869). A range of imported stone was also used for dressings to brick buildings in Fenland towns and occasionally for entire buildings. This mix of imported materials reflected the increasing ease of rail transport.

Kesteven Uplands

The Kesteven Uplands NCA lies at the junction of the county with Lincolnshire, Northamptonshire, Leicestershire and Rutland. Only a small area of Cambridgeshire, lying west of Peterborough along the county boundary with Lincolnshire, falls within the NCA.

The area includes the villages of Bainton, Etton, Helpston, Glinton and Maxey, sited above the floodplain of the River Welland. Many buildings are constructed of Lincolnshire Limestone, with Collyweston Stone slate roofing and some thatch. Village walls are frequently built of limestone rubble. Brick was increasingly used from the 18th century for houses and non-conformist chapels. Many of the villages have grown substantially in the 20th century, and much new housing has employed limestone cladding.

The churches of the area share characteristics with those in Northamptonshire. The Church of St Stephen at Etton (1220–60) is one of the most complete Early English churches in the country. It has a stone broach spire in Northamptonshire style and is constructed of coursed Lincolnshire Limestone, with lead and slate roofs. The Church of St Benedict at Glinton (12th–15th century), also constructed of Lincolnshire Limestone, has one of the finest 15th-century octagonal recessed needle spires in England.

Figure 5: St Benedict's Church, Glinton. Lincolnshire Limestone.

Significant fortified medieval residences survive at Woodcroft Castle, south-east of Helpston, and at Northborough. At Woodcroft Castle (13th century), the limestone ashlar west side of the original building, the central gateway, the north round tower and the moat survive. At Northborough Manor (*c* 1330–40), only the hall and gatehouse of a large manor house remain.

Burghley House is one of the largest and grandest houses of the Elizabethan era, built by William Cecil, Lord High Treasurer to Queen Elizabeth I, between 1555 and 1587. It was constructed of oolitic Lincolnshire Limestone from King's Cliffe, Northamptonshire, and it has Collyweston Stone slate roofs.

The River Welland is crossed by a series of stone bridges constructed of various types of Lincolnshire Limestone. Examples of these include the three-arched bridges at Stamford (19th century) and Deeping Gate (1651), and the 17th-century bridge between Uffington and Barnack.

Brecklands

A very small part of the Brecklands NCA is found in the far east of Cambridgeshire, to the east of Newmarket. Only the village of Kennett and part of Chippenham parish, including the hamlet of Badlingham, fall within the area.

The Church of St Nicholas at Kennett (12th century) is built of Quaternary Flint and pebble rubble, with Lincolnshire Limestone dressings. Kennett School and School House (1865) are built of knapped flint, with gault brick quoins and red brick banding and decoration to the window arches, with a slate roof.

South Suffolk and North Essex Clayland

The NCA covers much of Suffolk, Essex, East Hertfordshire and a relatively small part of the south-east of Cambridgeshire. It includes the villages of Balsham, Bartlow, Carlton, Castle Camps, Horseheath, Linton, Shudy Camps, West Wickham, West Wratting and Weston Colville. The area was well wooded and sparsely settled well into the late medieval period, even until the 19th century in places. The main villages appear to be Saxon in origin; most of the parishes consist of long strips of land extending from the chalklands in the north-west to the claylands in the south-east.

Only one section of rubblestone masonry from the Norman castle at Castle Camps remains, although some of its stone was reused in Castle Farmhouse (18th century). Kirtling Tower was a moated castle dating from the 12th century and rebuilt in the 15th century. In the 16th century, a Tudor house replaced the earlier buildings. The main house was demolished in 1801, but the red brick gatehouse of *c* 1530, with its limestone dressings, remains.

The churches of the area are generally built of Quarry Flint or Quaternary Flint, with pebble rubble and sometimes chalk. Examples include All Saints Church at Kirtling (12th–13th century), St Mary's Church at Bartlow

(12th–15th century) and St Mary's Church at Woodditton (13th century). St Mary's Church at Ashley (1845) is built of large flint pebbles, some knapped, with Bath Stone and Gault clay brick dressings. St Mary's Church at Weston Colville is unusual in having Gault clay brick framing to the flint chancel, which was rebuilt in 1825.

Few village buildings survive in the area from before the 16th century, and most date from the 17th century onwards. One-and-a-half or two-storeyed buildings of plastered timber-frame construction are characteristic. Long straw thatch or plain clay tiles were mainly used for roofing until the 19th century. Brick was used from the late 16th century for ridge and side stacks to repair or encase timber-frame buildings. Local brick works are recorded in many places from the 18th century. Flint with brick and weatherboarding was used for a wide range of buildings, including houses, schools, cottages and farm outbuildings built after enclosure during the late 18th century or early 19th century. Welsh Slate became available in the 19th century.

Figure 6: Former school and school house, Kirtling. Quaternary Flint and brick.

East Anglian Chalk

In Cambridgeshire and adjoining areas, the East Anglian Chalk ridge extends from east of Ashwell in Hertfordshire, south of Cambridge, past Newmarket and further east into Suffolk. The chalk hills and plateau ridge are largely capped by boulder clay. The west of the area is drained by the Rhee and Granta rivers, which converge to form the River Cam just south of Cambridge. This then flows via Cambridge into the Fens to join the Great Ouse. Much chalk was extracted from settlements such as Burwell, Swaffham Bulbeck and Swaffham Prior, which developed along the spring line east of Cambridge, where the chalk drops to the Fen margin.

Buildings in the Cam Valley and western chalklands utilise a mixture of materials, including timber frame, red and gault brick, flint and chalk, under thatched and tiled roofs. Brick was used from the 16th century but became more commonplace from the 18th century. Chalk, Totternhoe Stone and Melbourn Rock were widely extracted for building at many locations,

including Barrington, Hinton, Cherry Hinton, Eversden, Foxton, Haslingfield, Melbourn, Meldreth and Orwell. Chalk was used extensively in the medieval period, and large quantities were transported to Cambridge in the 13th and 14th centuries and used in the construction of the colleges and for decorative features. Chalk rubble was utilised in many types of buildings, from churches to footings, chimneys, boundary walls and small farm buildings.

Churches of the area feature a wide range of materials. For example, All Saints' Church at Melbourn (13th century) and St Andrew's Church at Orwell (12th century) are built of knapped Quarry Flint nodules, Quaternary Flint, Melbourn Rock, Lincolnshire Limestone and brownish quartzite pebbles. The Church of St Vigor at Fulbourn (13th century) is constructed of Quaternary pebbles and cobbles with some Quaternary Flint and chalk ashlar; the dressings are Lincolnshire Limestone and Bath Stone. All Saints Church at Barrington (13th century) is built primarily of dressed chalk block and Totternhoe Stone.

Figure 7: St Andrew's Church, Orwell. Quarry Flint, Quaternary Flint, Melbourn Rock, Lincolnshire Limestone and quartzite pebbles.

The area along the fen margins has been a source of chalk and Totternhoe Stone (known locally as Burwell Stone), and quarries at Burwell, Reach and Swaffham Bulbeck have been worked since Roman times. Settlements in this area include Bottisham, Burwell, Swaffham Bulbeck and Swaffham Prior.

During the 12th and 13th centuries, relatively small monastic foundations were built at Burwell, Fordham, Lode, Isleham and Swaffham Bulbeck. After the Dissolution of the Monasteries by Henry VIII, the majority were converted to houses, such as at Anglesey Abbey, Lode, where some walls of coursed chalk with Barnack Stone survive, and Swaffham Bulbeck, where the 13th-century undercroft of the priory survives below an 18th-century brick house built on the site. It has original walls of coursed chalk with finely jointed and coursed knapped flint.

The 12th-century Priory Church of St Margaret of Antioch at Isleham is one of the best examples in the country of a small Benedictine priory church that has remained substantially unaltered. It is built of Burwell Stone, with some herringbone masonry with Quaternary Flint nodules and some Quarry Flint. The plinth and dressings are of Barnack Stone.

Figure 8: Priory Church of St Margaret of Anticoch, Isleham. Burwell Stone, Quaternary Flint and Quarry Flint.

Figure 9: Priory Church of St Margaret of Anticoch, Isleham. Burwell Stone.

St Mary's Church in Swaffham Prior has a 12th-century chancel and a massive octagonal tower built using brown quartzite pebbles with chalk ashlar and Quaternary Flint nodules; the dressings are of various types of Lincolnshire Limestone. Large blocks of Sarsen stone have been used in some places, such as in the east wall of the 14th-century chancel.

A few houses survive from before 1500, such as Lordship House in Swaffham Bulbeck (13th century). It is built largely of chalk. More modest houses were often only one storey high and built of local chalk blocks. Houses erected between 1700 and 1820 that survive are mostly of chalk, but dressed or fronted in brick.

Further drainage of the Fens, enclosure and rapid population growth in the 19th century led to the construction of new cottages, houses, farmsteads and agricultural buildings. Occasionally, these were built of chalk, often faced in Gault clay bricks. Burwell Stone was used for the Baptist Chapel and dovecotes at Crowland and for Stevens' Mill, a 19th-century tower windmill at Burwell. Clay Bat was used for many structures, from walls to houses and warehouses.

The eastern uplands of the area include the villages of Dullingham and Stetchworth, which lie close to the boundary with the South Suffolk and North Essex Claylands NCA. St Peter's Church at Stetchworth shows the development that is typical of many churches in the south-east of Cambridgeshire; namely, the chancel is 13th century and the nave was rebuilt in the 15th century. Also, in common with many other churches, it is constructed of Quaternary dressings. The tower parapet has decorative flint flushwork more typical of Suffolk churches.

Bedfordshire and Cambridgeshire Claylands

The Bedfordshire and Cambridgeshire Claylands form a large area of low-lying land that runs through south central England, from Somerset to Lincolnshire. Nearly half of the county lies within this NCA, which includes the major settlements of Cambridge, Grantchester, the Gransdens, St Neots, Huntingdon, St Ives and Peterborough.

The use of building materials in this NCA is complex, with considerable variation being evident in different geographical areas relative to the River Great Ouse. However, in general terms, rendered timber construction with thatch or plain tiles was the main method used for more lowly houses and cottages until the early 19th century. Brick was utilised for larger houses and farmhouses from the 17th century and generally became the dominant form of construction from the 18th century. Weatherboarding was often used as the cladding for farm buildings from the 17th century. Welsh Slate became widely available from the 1850s, following the construction of the railways.

Churches north and west of the Great Ouse typically employ flint, Quaternary pebbles and cobbles, and Lincolnshire Limestone in their construction. Many have stone spires or towers. Fine examples occur at Alconbury (the 13th-century Church of SS Peter and Paul) and Great Stukeley (the 15th-century Church of St Bartholomew). Much use was made of Lincolnshire Limestone from Barnack and imported varieties from Northamptonshire, in addition to Collyweston Stone slate for roofing. Imported varieties of Lincolnshire Limestone were also employed in some grand 18th-century houses, such as Kimbolton Castle, which is ashlar-faced in Weldon Stone and Ketton Stone.

In Peterborough, Lincolnshire Limestone (including limestone from Barnack) was used in prestigious buildings dating from the medieval period to the 20th century. Many examples can be seen in Priestgate, and Peterborough Cathedral itself is largely built of Lincolnshire Limestone from Barnack.

The principal remains of Ramsey Abbey include the Lady Chapel (13th century), the gatehouse (15th century) and part of the precinct wall. They are built of Lincolnshire Limestone rubble, including Barnack Stone. Stone from the abbey was reused in Cambridge colleges in the 16th century, and also in the towers of Ramsey, Godmanchester and Holywell churches.

There are occasional examples of historic limestone buildings occurring in the western part of the area, such as at Stilton. Here, the Bell Inn (1642) is built of coursed Lincolnshire Limestone rubble, with Ketton Stone dressings and a Collyweston Stone slate roof.

Figure 10: Bell Inn, Stilton. Lincolnshire Limestone with Collyweston Stone slate roof.

Within and close to the valley of the Great Ouse, many of the churches are built of Quaternary pebbles and cobbles, often with chalk and other limestone, either coursed or as random blocks. Barnack Stone ashlar and dressings are common. Woburn Sandstone, brought from the Bedfordshire Greensand Ridge NCA, was often employed in towers and spires. Good examples include St Mary's Church at Eaton Socon (14th–15th century) and St Mary's Church at St Neots (15th century). Random knapped flint rubble and pebbles were also used in some churches and school buildings such as Eynesbury and in the 19th-century vicarage at St Neots. Fine examples of 14th to 15th-century stone-built bridges (constructed of Lincolnshire Limestone and including Barnack Stone ashlar) remain at Huntingdon and St Ives.

South and east of the Great Ouse, west of Cambridge, chalk was often used in ecclesiastical buildings. The Church of SS Andrew and Mary at Grantchester has a 14th-century chancel built of dressed chalk ashlar, with chalk rubblestone and dressings. Chalk was also employed for the west end of St Andrew's Church at Wimpole (1749). Occasionally, chalk was used in the area for chimney stacks and fireplaces and for infill in timber-frame buildings. During the 18th and 19th centuries, where chalk was locally available, it was often used for cottages and extensions to larger houses.

Figure 11: St Mary's Church, Eaton Socon. Woburn Sandstone.

Quaternary Flint was utilised in many churches, such as St Mary's Church at Ickleton (11th century), where there is an early use of Barnack Stone for dressings. Barnack Stone was also used for walling, for example, at St Andrew's Church at Histon (13th century). Quaternary pebbles and cobbles were widely employed, including, for example, in the Church of SS Pandonia and John the Baptist at Eltisley (13th century) and the Church of St Michael at Toseland (12th century). The latter was rebuilt and extended using Norman masonry in 1873–97.

South of the Great Ouse, the area north of Cambridge lies partially on an outcrop of Lower Greensand. The local, dark brown, pebbly Cottenham Sandstone (puddingstone) was used in several churches in the area. In All Saints' Church at Cottenham, the 15th-century nave contains blocks of Cottenham Sandstone, Upware Limestone and Lincolnshire Limestone with Quaternary pebbles and cobbles (mainly quartzite and chert pebbles). The

lower stages of the 13th-century tower incorporate occasional ashlar and blockwork of Barnack Stone. The 12th to 15th-century All Saints' Church at Rampton is similarly constructed of a mixture of materials, including irregular blocks of various Lincolnshire Limestones along with Upware Limestone, brownish quartzitic pebbles and scattered blocks of Cottenham Sandstone, along with some bricks. The dressings are of Lincolnshire Limestone and chalk.

Figure 12: All Saints' Church, Cottenham. Cottenham Sandstone, Upware Limestone and Lincolnshire Limestone, with Quaternary pebbles and cobbles and Barnack Stone.

In the far south-west of the NCA, close to the Bedfordshire Greensand Ridge, Woburn Sandstone was employed in several churches, such as St Bartholomew's Church at Great Gransden (15th century) and St Mary's Church at Longstowe (19th century with a 14th to 15th-century west tower), along with Lincolnshire Limestone rubble and Quaternary pebbles and cobbles. The dressings are typically of chalk and Lincolnshire Limestone freestones.

Northamptonshire Vales

Two small areas of this NCA occur in Cambridgeshire. The main area is essentially the valley of the River Nene, and it includes the villages of Elton, Stibbington, Water Newton, Sibson, Wansford, Ailsworth, Sutton and Castor. A very small area of the NCA east of Thrapston and Raunds in Northamptonshire also falls within Cambridgeshire, including the villages of Keyston and Bythorn.

The River Nene has been used as a transport corridor for thousands of years. Large quantities of building stone from quarries upstream in Northamptonshire and from Barnack have been transported along this route since Roman times.

The use of various forms of Lincolnshire Limestone (and Collyweston Stone slate or thatch for roofing) is characteristic of the area. In addition to dwellings ranging from cottages to stately homes, the limestone is used for village walls, bridges, agricultural buildings and water mills. The employment of other building materials was rare until the 19th century, when brick started to be used in a range of buildings.

Wansford is the largest settlement within the area and it has many buildings constructed of limestone. One example is the 17th-century Haycock Inn, constructed in coursed limestone rubble, with freestone and ashlar dressings and Collyweston Stone slate roofs and limestone ashlar ridge stacks. The 12-arch Wansford Bridge (1577) is built of Barnack Stone.

The 13th-century Church of All Saints at Elton (with the west tower, clerestory, south aisle and south porch added in *c* 1500) is mainly constructed of Lincolnshire Limestone from King's Cliffe and Barnack. However, the west tower and south porch are of Ketton Ashlar, with dressings of Barnack and Ketton Stone.

In the southern area of the NCA, the use of stone is far less common. Many of the buildings in Keyston and Bythorn were constructed of rendered timber frame or brick with thatch or plain tile roofs. Types of Lincolnshire Limestone were used occasionally for houses. For example, the 17th-century Stone House at Keyston is built of limestone rubble with a plain tiled roof. Stone was also used for outbuildings to 19th-century brick houses. The 13th-century Churches of St John the Baptist at Keyston and St Lawrence at Bythorn both have 14th-century west towers with octagonal broach spires. They are mainly constructed of Weldon Stone and Barnack Stone, which have been employed as rubblestone and squared blocks and ashlar.

Figure 13: Church of St John the Baptist, Keyston. Weldon Stone and Barnack Stone.

Bedfordshire Greensand Ridge

The Bedfordshire Greensand Ridge is a narrow outcrop of Lower Cretaceous sandstone and ironstone that extends from Gamlingay in Cambridgeshire to Leighton Buzzard in Bedfordshire. In Cambridgeshire, it forms a small area of high ground around Gamlingay.

Buildings built in the medieval period were constructed of rendered timber frame, but most of the other surviving historic buildings in the area date from the 16th century onwards. The use of brick became increasingly dominant from the 17th century for a wide range of buildings for re-facing timber-framed buildings and for chimney stacks such as the 1655 almshouses at Gamlingay. By the 19th century, Gault clay brick with Welsh Slate roofing tended to be the main choice of materials for the construction of farm buildings.

The NCA's building stones, gravels and clays have long been exploited as mineral resources. Woburn Sandstone was quarried from at least the medieval period. Its use was largely confined to the construction of high-status buildings, such as parish churches and bridges, due to its high variation in quality and its susceptibility to weathering and erosion. The extraction of this sandstone as a building material was often secondary to the quarrying of sand, gravel and Fuller's earth.

The Church of St Mary at Gamlingay provides an attractive example of the use of local stone. It was extensively rebuilt in the 14th and 15th centuries, using Woburn Sandstone and Quaternary pebbles and cobbles, with chalk and Lincolnshire Limestone dressings.

Figure 14: Church of St Mary, Gamlingay. Woburn Sandstone.

Rockingham Forest

Only the eastern part of this NCA is within Cambridgeshire. It lies west of Peterborough, on the northern side of the Nene Valley, and extends from Wothorpe and Wittering (in the west) to the boundary of Peterborough city

in the east. The villages of Sutton, Ailsworth, Castor, Thornhaugh, Wittering, Wothorpe, Barnack, Southorpe, Ufford, Marholm and Werrington are all located on the undulating limestone plateau that characterises this area.

The famous Lincolnshire Limestone quarries at Barnack were active from the Roman period until the 18th century. Stone from these was used for many fine ecclesiastical buildings (including Peterborough and Ely cathedrals). The stone was also transported by water to Cambridge and used in many buildings throughout East Anglia.

Many of the characteristic villages and buildings in this area are constructed from locally sourced Barnack Stone and often feature roofs of Collyweston Stone slate. Lincolnshire Limestone, including Barnack Stone, is used extensively in a wide range of farmhouses, village houses, cottages, agricultural buildings and other structures. These include Village Farmhouse Dovecote, Castor (18th century), Barnack Windmill (late 18th century), Barnack Water Mill (18th century) and Castor Water Mill (19th century). It is also used for field and garden boundaries, particularly in Barnack and Ufford.

The Church of St Kyneburgha at Castor (12th century) is one of the most important Norman churches in the county. It has a Norman crossing tower, nave and chancel as well as Norman north and south transepts. The Church of St John the Baptist at Barnack has an 11th-century nave and tower, 13th-century south aisle and porch, and early 14th-century chancel. It is built of the local limestone and has Collyweston Stone slate roofs. With its Saxon 'long and short' stone work and short spire, the tower is one of the oldest in England.

Landed estates and their associated houses and parks are also a feature of the area. For example, Walcot Hall at Southorpe is a grand Carolean house (*c* 1674–8), built of Lincolnshire Limestone ashlar with Collyweston Stone slate roofs.

Figure 15: Church of St John the Baptist, Barnack. Barnack Stone.

3 Local Building Stones

Middle Jurassic

Inferior Oolite Group, Lincolnshire Limestone Formation

The Lincolnshire Limestone Formation embraces a suite of highly variable, pale grey to yellow-buff, commonly ooidal and bioclastic limestones of Middle Jurassic age. Many varieties have previously been identified and named as distinct building stones, their names usually being based on their historical source locations.

Wittering Pendle (Wittering Pendle Flagstone)

Wittering Pendle is a fine-grained, thinly bedded, golden-yellow to buff-yellow sandy limestone. It is very hard and crystalline compact, and sparsely fossiliferous. It is similar to Collyweston Stone slate but less easily split.

The source quarries at Wittering were shallow and had been filled in and ploughed over by the end of the 19th century. Historically, the limestone was excavated in large irregular slabs, which ranged in thickness from 2 to 5cm, and it was sufficiently hard and impermeable to have been utilised as flooring in stables, cottages and back kitchens. The stone has a restricted area of usage to the west of Peterborough and it is seldom encountered as an external building stone. However, the best examples of this latter use are found in the Priestgate and Cathedral Square (Cumbergate) areas of Peterborough.

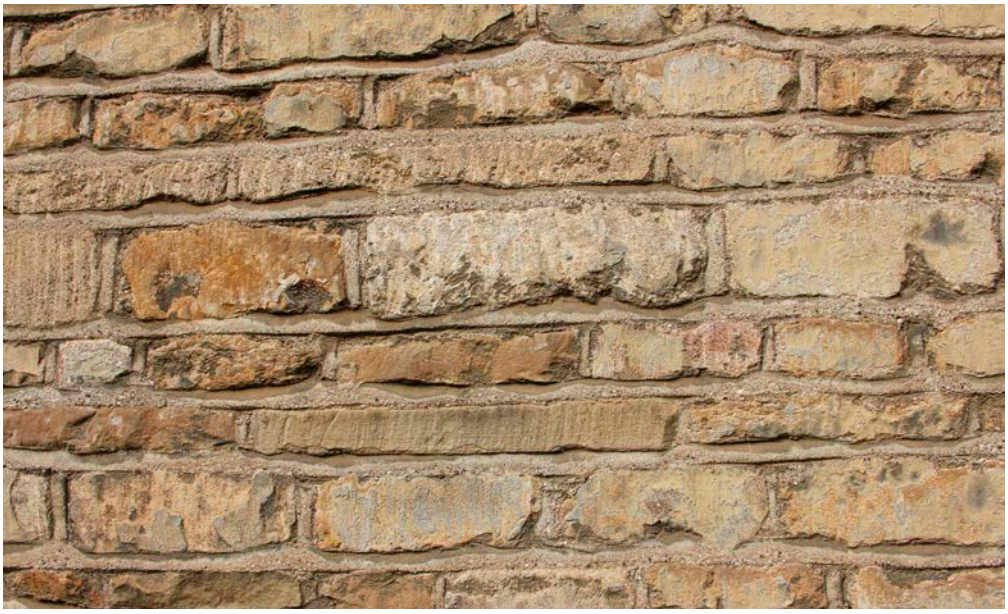


Figure 16: 51 Priestgate, Peterborough. Wittering Pendle.

Figure 17: Commercial building, Cathedral Square, Peterborough. Wittering Pendle.

Lower Lincolnshire Limestone

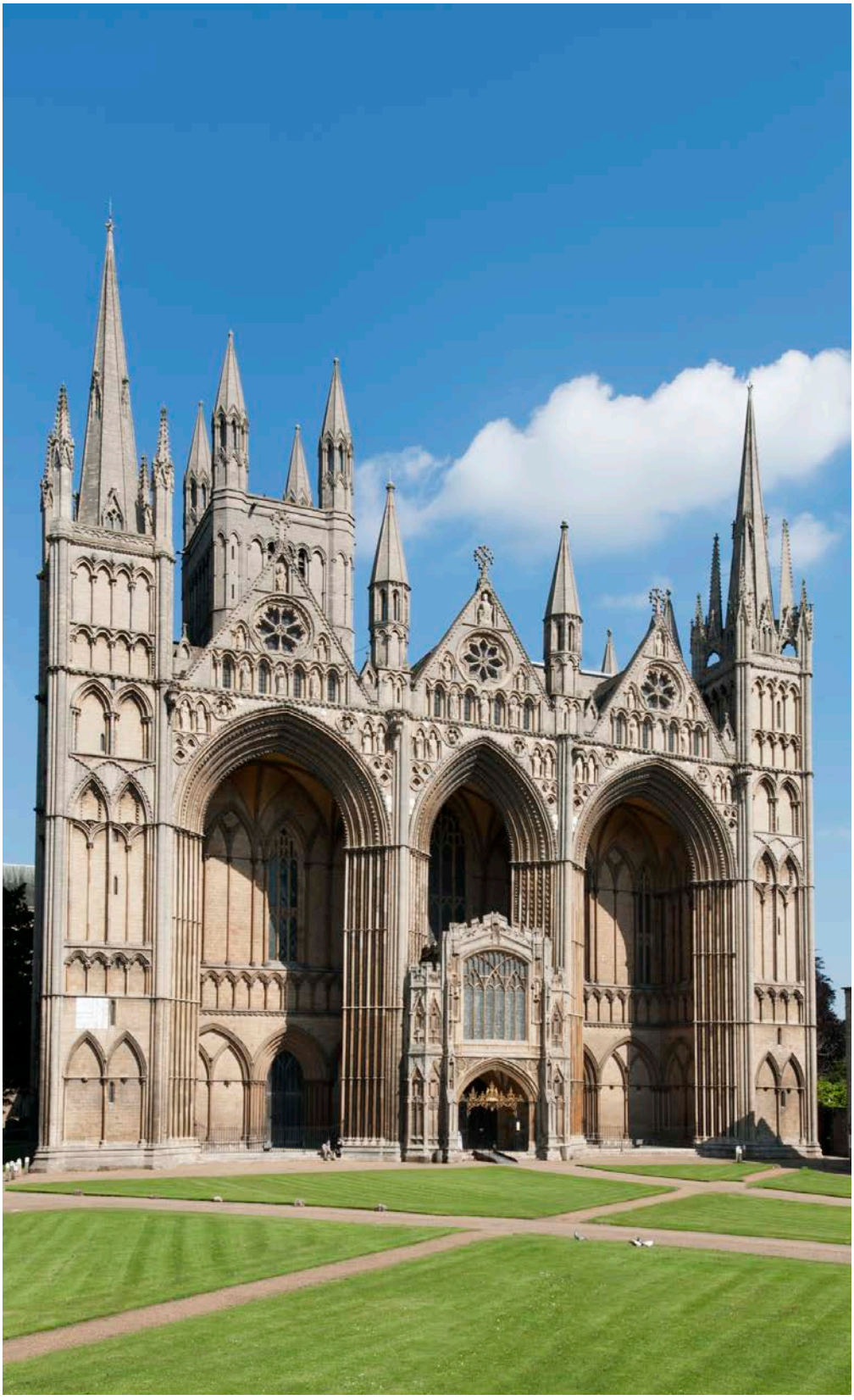
The Lower Lincolnshire Limestone Member comprises pale grey, buff to mustard-yellow, fine-grained, calcilutitic limestones. Some beds may be sandy and/or contain dispersed ooids and bioclasts, but these do not usually display the conspicuously ooidal and/or bioclastic textures that are characteristic of limestones from the Upper Lincolnshire Limestone Member. Limestones from the Lower Lincolnshire Limestone Member are typically thinly bedded and tabular compared to those of the Upper Lincolnshire Limestone Member.

Barnack Stone (Barnack Rag)

Barnack Stone is a hard, pale buff-coloured, coarse-grained, ooidal and bioclastic limestone cemented with sparry calcite. The stone usually displays cross-bedding, and differential weathering imparts a rough appearance and feel to exposed surfaces.

Barnack Stone is one of the most important and widely used building stones in Cambridgeshire. It has been extensively employed in many prestigious and ecclesiastical buildings throughout the county and it has been used for rubblestone walling, window and door dressings and high-quality ashlar. The presence of Barnack Stone is a characteristic feature of many older churches, although the best quality stone, occurring in the original quarries at Barnack, was exhausted by 1460. Thereafter, Barnack Stone was either reused from pre-existing buildings, or alternative varieties of Lincolnshire Limestone were sourced and employed.

Figure 18: Peterborough Cathedral, Peterborough. Barnack Stone.



Upper Lincolnshire Limestone

The Upper Lincolnshire Limestone Member comprises pale grey, buff to pale yellow, medium to coarse-grained, calcarenitic limestones. These are often distinctly ooidal and/or bioclastic and they can be massive or cross-bedded. Weathered surfaces often, but not always, take on a paler colour. Most of the Lincolnshire Limestone freestones originate from the Upper Lincolnshire Limestone Member.

Figure 19: Ramsey Abbey, Ramsey. Lincolnshire limestones, including Barnack Stone.

Figure 20: Wall adjoining Ramsey gatehouse, Ramsey. Lincolnshire limestones, including Ketton Stone and Barnack Stone.

Great Oolite Group, Blisworth Limestone Formation

Alwalton Marble

Alwalton Marble is a very distinctive pale grey to orangish- or brownish-coloured limestone, which is packed with the fossil remains of thick-shelled oysters and other bivalves. It was quarried along the Alwalton Lynch escarpment adjacent to the River Nene (near Peterborough) during the 12th and 13th centuries. Its main use was as a polished limestone (marble) for interior decorations in large prestigious houses, churches and cathedrals, including Peterborough and Ely cathedrals. Occasionally, it was used externally, such as for the shafts of the 13th-century doorway in the west face of Peterborough Cathedral.

Figure 21: Peterborough Cathedral, Peterborough. Alwalton Marble.

Great Oolite Group, Cornbrash Formation

Cornbrash

The Cornbrash Formation mainly comprises thinly to poorly bedded bioclastic limestones, which are generally pale grey when fresh but quickly weather to a buff-brown or yellowish colour. Many beds are sandy and some exhibit a distinct laminae. Some beds were evidently richly fossiliferous, and individual blocks of this stone can be packed with thick-shelled bivalve and brachiopod fossils.

Use of Cornbrash as a building stone is mainly confined to the north-west corner of Cambridgeshire, including Peterborough. It readily lends itself to being roughly dressed into thin tabular blocks. Examples of its use (in association with Barnack Stone and other lincolnshire Limestones) can be seen in several villages located on or close to its outcrop, such as Upton and Helpston. Particularly fine examples of Cornbrash limestone can be seen in the Priestgate and Longthorpe areas of Peterborough, including Longthorpe Tower and nearby cottages along Thorpe Road.

Figure 22: Thatched cottages, Longthorpe. Cornbrash.

Figure 23: Cottage wall, Longthorpe. Irregular blocks of Cornbrash.

Upper Jurassic

Ancholme Group, West Walton Formation

Upware Limestone

Upware Limestone is a medium to coarse-grained, light grey to buff-coloured, calcareous sandstone or sandy limestone, which is occasionally ooidal or contains fossil molluscs, echinoids and corals. It weathers to a dull yellow-brown or yellow-orange colour due to the presence of a ferruginous (iron-bearing) calcite cement.

Upware Limestone has a rather limited and localised use as a building stone in Cambridgeshire, mainly restricted to the area between Little Thetford, Barway, Upware and Stretham. Here, it is employed as an occasional rubblestone, the best examples of which can be seen in church walls at Stretham (St James) and Little Thetford (St George).

Figure 24: Church of St James, Stretham. Lincolnshire Limestone and Upware Limestone.

Figure 25: Church of St George, Little Thetford. Upware Limestone and Lincolnshire Limestone rubblestone.

Lower Cretaceous

Lower Greensand Group, Woburn Sands Formation

Cottenham Sandstone (Puddingstone)

Cottenham Sandstone is the name assigned to a very distinctive dark brown, ochreous, pebbly sandstone, which typically takes on a mottled appearance with patches of black iron-rich staining upon weathering. Lithologically, the stone exists as either a coarse-grained sandstone or conglomerate. The clasts within the conglomeratic blocks are sub-angular to elliptical and largely composed of pale buff-coloured sandstone. Pieces of greyish quartzite are also commonly seen. The stone is devoid of fossils; some blocks display an alignment of the elliptical clasts, whereas in others the fabric is random.

Cottenham Sandstone has a very limited occurrence in Cambridgeshire and appears to be restricted to the area north of Cambridge around Cottenham and Rampton. It has been employed sparingly as isolated blocks or clusters of blocks in walls in several local church walls, the best examples being at Cottenham (Church of All Saints) and Rampton (also Church of All Saints).

Figure 26: Church of All Saints, Cottenham. Cottenham Sandstone.

Figure 27: Church of All Saints, Rampton. Cottenham Sandstone and local pebbles and cobbles.

Ely Sandstone

Ely Sandstone is the new name for distinctive yellow buff-coloured sandstones commonly employed as building stones in walls around Ely, but especially in the vicinity of the cathedral and along Minster Place. The sandstones are porous and coarse grained; many blocks contain small sub-angular quartz clasts, 2 to 4mm in size, and some are conglomeratic and contain sub-angular to sub-rounded clasts of whitish, yellow, brown or dark grey quartzite and dark brown-blackish phosphatic nodules. Apart from faint cross-lamination in some blocks, the sandstones are structureless and lack fossils. They are relatively soft and readily spall upon weathering, although the harder clasts stand proud of the rock surface in the coarser grained pebbly blocks.

The sandstones are thought to originate from within the Woburn Sands Formation, and they appear to be restricted to the Ely area of Cambridgeshire. In Ely itself, the stone is typically used for walling, with individual blocks being employed in a rough undressed form as general rubblestone. Particularly good examples occur in walls along Minster Place, especially near the Bishop's House and eastwards towards the Porta.

Figure 28: The Porta, Ely. Ely Sandstone and Lincolnshire limestones.

Figure 29: Wall by the Bishop's House, Minster Place, Ely. Ely Sandstone.

Woburn Sandstone (Sandrock, Ironstone, Ragstone, Carstone, Fenstone)

Woburn Sandstone is a fine to medium-grained, ferruginous sandstone. It has a very distinctive, dark purplish-brown to deep orange-brown or dark buff colour, which typically becomes greenish-grey upon weathering. Darker patches of iron oxide staining, often forming intricate banded patterns (Liesegang banding), are commonly developed in individual blocks. Fossils are scarce and mainly represented by non-marine bivalves and gastropods, usually preserved as internal moulds (voids) within the rock.

Woburn Sandstone is easily recognisable even from a distance. It has seen use all along its outcrop in central Cambridge, which extends north-eastwards from Gamlingay to Ely.

Particularly good examples can be found at the churches at Gamlingay (St Mary the Virgin), Great Gransden (St Bartholomew) and Longstowe (St Mary). It usually takes the form of roughly dressed tabular blocks in walls and is variously coursed.

Figure 30: Church of St Mary, Gamlingay. Woburn Sandstone with Quaternary pebbles and cobbles and dressing of chalk and Lincolnshire Limestone.

Figure 31: Church of St Mary, Gamlingay. Woburn Sandstone.

Upper Cretaceous

Chalk Group, Grey Chalk Subgroup, Zig Zag Chalk Formation

Totternhoe Stone (Burwell Rock, Burwell Stone and Cambridgeshire Clunch)

The Totternhoe Stone Member is at most a few metres thick in Cambridgeshire (although the base and top of the unit locally grade into the associated chalk deposits, thus making the boundaries difficult to recognise). The unit reaches its full thickness of nearly 7m in the Swaffham Prior area. Totternhoe Stone is a distinctly harder unit of chalk within the Grey Chalk Subgroup and typically comprises creamy to pale brownish-grey, chalky calcarenites. It often appears sandy due to the presence of coarse fossil fragments. The lower beds (known as 'brassil' to the quarry workers) may contain small pinkish-brown (though green-coated) phosphatic nodules; the upper beds (locally known as 'bond' rock) comprise a pale brown, gritty chalk devoid of nodules. The nodule-free chalk of the upper beds has been extensively used for building.

Totternhoe Stone has been employed as a building stone wherever it occurs in Cambridgeshire. Particularly fine examples can be seen in the villages of Burwell, Barrington, Fordham and Isleham.

Figure 32: Church of All Saints, Barrington. Totternhoe Stone.

Figure 33: Church of All Saints, Barrington. Totternhoe Stone.

Figure 34: Granary and maltings to Burwell Manor House, Burwell. Burwell Stone.

Chalk Group, White Chalk Subgroup, Holywell Nodular Chalk Formation

Melbourn Rock

Melbourn Rock is a hard variety of chalk that is off-white to buff in colour and exhibits a blocky, fractured texture. Thin, connecting marl bands are often present. The Melbourn Rock Member ranges in thickness from about 3m in the Chiltern Hills area to between 2 and 7m around Hitchin. It can be difficult to distinguish from other chalk block when employed as a building stone, but its use is seemingly fairly limited in Cambridgeshire. It features in All Saints' Church, Melbourn, for example.

Figure 35: Church of All Saints, Melbourn. Melbourn Rock and various other stones.

Chalk Group, White Chalk Subgroup, New Pit Chalk Formation

Quarry Flint (Fresh Flint)

Quarry Flint occurs as bands or isolated nodules within the chalky limestone beds of the White Chalk Subgroup. It is an extremely fine-grained (cryptocrystalline) and hard form of silica containing microscopic quartz-crystal aggregates. Quarry Flint usually occurs as irregularly shaped nodules that are 10 to 20cm across, or as (sub-)rounded pebbles or cobbles. Occasionally, it is also found as weakly banded tabular sheets or layers up to 20cm thick. The colour is very distinctive: fresh nodules have a white outer cortex with a black or dark grey interior.

Quarry Flint breaks with a characteristic conchoidal fracture, producing razor-sharp fine edges. The cleaved surfaces may exhibit banding resulting from the alternation of layers of slightly different composition. Flint nodules may contain cavities lined with translucent botryoidal chalcedony or small transparent quartz crystals. Some nodules contain well-preserved fossils, with echinoids, sponges, bivalves, burrow structures and occasionally belemnites being encountered.

Quarry Flint is used occasionally in Cambridgeshire, often in association with Quaternary Flint. It was employed in a variety of ways, including as knapped, faced, trimmed or cleaved-faced stone and sometimes in squared chequerwork. Examples can be seen in the villages of Woodditton and Melbourn.

The extremely hard and resistant nature of Quarry Flint-type nodules has resulted in them being recycled by natural processes into younger deposits. These reworked types of flint, which show specific characteristics, are described in the Quaternary section.

Figure 36: Church of All Saints, Melbourn. Quarry Flint nodules, blocks of Lincolnshire Limestone and brown quartzite and Quaternary pebbles and cobbles.

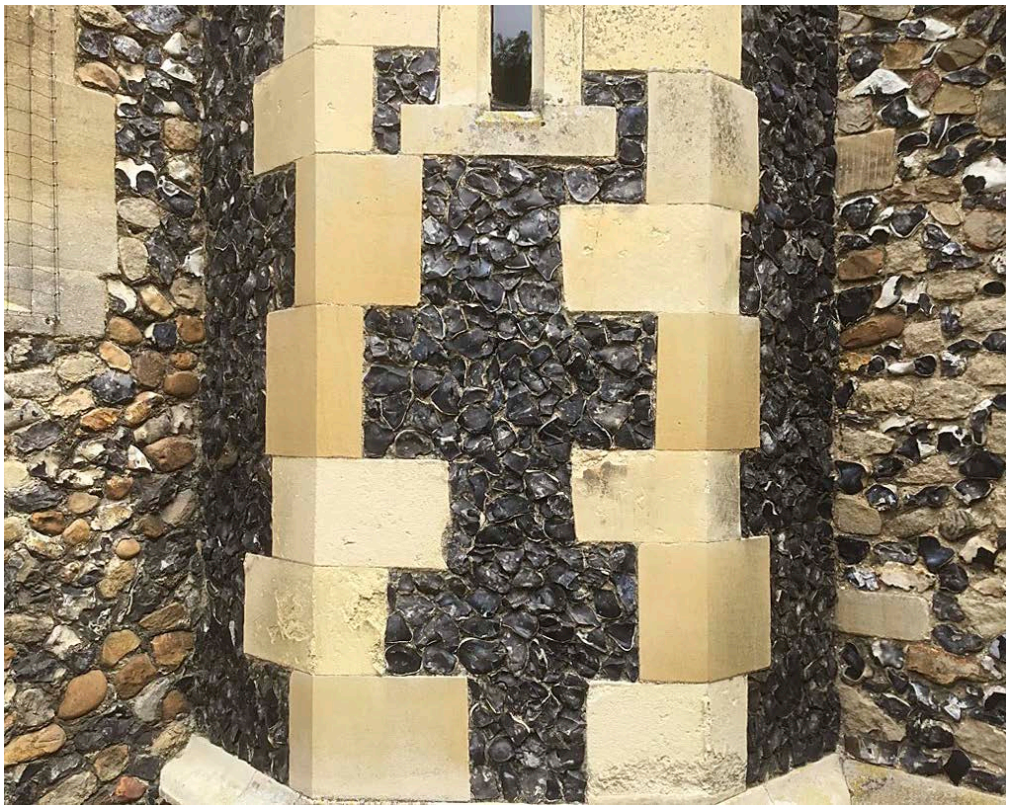


Figure 37: Church of All Saints, Melbourn. Knapped Quarry Flint nodules with varieties of Lincolnshire Limestone, Melbourn Rock and Quaternary pebbles and cobbles.

Chalk Group, White Chalk Subgroup, Lewes Nodular Chalk Formation

Chalk (Chalk Block, Clunch)

The white chalky limestones of the Upper Cretaceous White Chalk Subgroup are among the most distinctive and easily recognised building stones in Cambridgeshire. They are white to very pale grey or pale buff, typically structureless limestones, which in places contain fossil oysters (inoceramids) and echinoids, and occasionally crinoids, brachiopods and belemnites. Chalk is generally unsuitable for exterior masonry as repeated wetting and drying (coupled with frost action) causes the relatively soft rock to powder and disintegrate into small angular brash. Softer forms of the stone, when used externally, may show concave weathering away from mortar lines.

Cambridgeshire has a long history of quarrying and mining for chalk and flint, and there is a considerable number of medieval to 19th-century quarries in the county. The mining of chalk was particularly common from the 18th to the 20th century, usually for agricultural lime and lime mortar and for the production of bricks. The harder varieties were also employed as building stone.

In southern and eastern Cambridgeshire, chalk is typically used as a rough walling stone (often accompanying other stone types, especially various forms of flint and Quaternary pebbles and cobbles) or for decorative purposes, including window or doorway dressings (for example, the Norman-style doorway of St Michael's Church at Toseland). A particularly attractive example of the use of chalk and Totternhoe Stone blockwork can be seen at the Church of All Saints, Barrington.

Quaternary

Various groups, various formations

Sarsen Stone (Silcrete)

Sarsen stones occur as rounded or elongated cobbles or boulders of up to 60cm in length. They are grey to pale brown in colour, becoming creamy-buff on weathered surfaces, and they have a very fine-grained saccaroidal (sugary) texture, comprising sub-rounded quartz grains set within a silica matrix that is visible on fractured surfaces. Sarsen stones are very hard and resistant to weathering. Their surfaces are often smooth and may occasionally show poorly defined bedding structures.

Sarsen stones are seldom encountered in Cambridgeshire, but isolated examples can be seen in the walls of St Mary's Church at Swaffham Prior and as footings at St Michael's Church at Toseland.

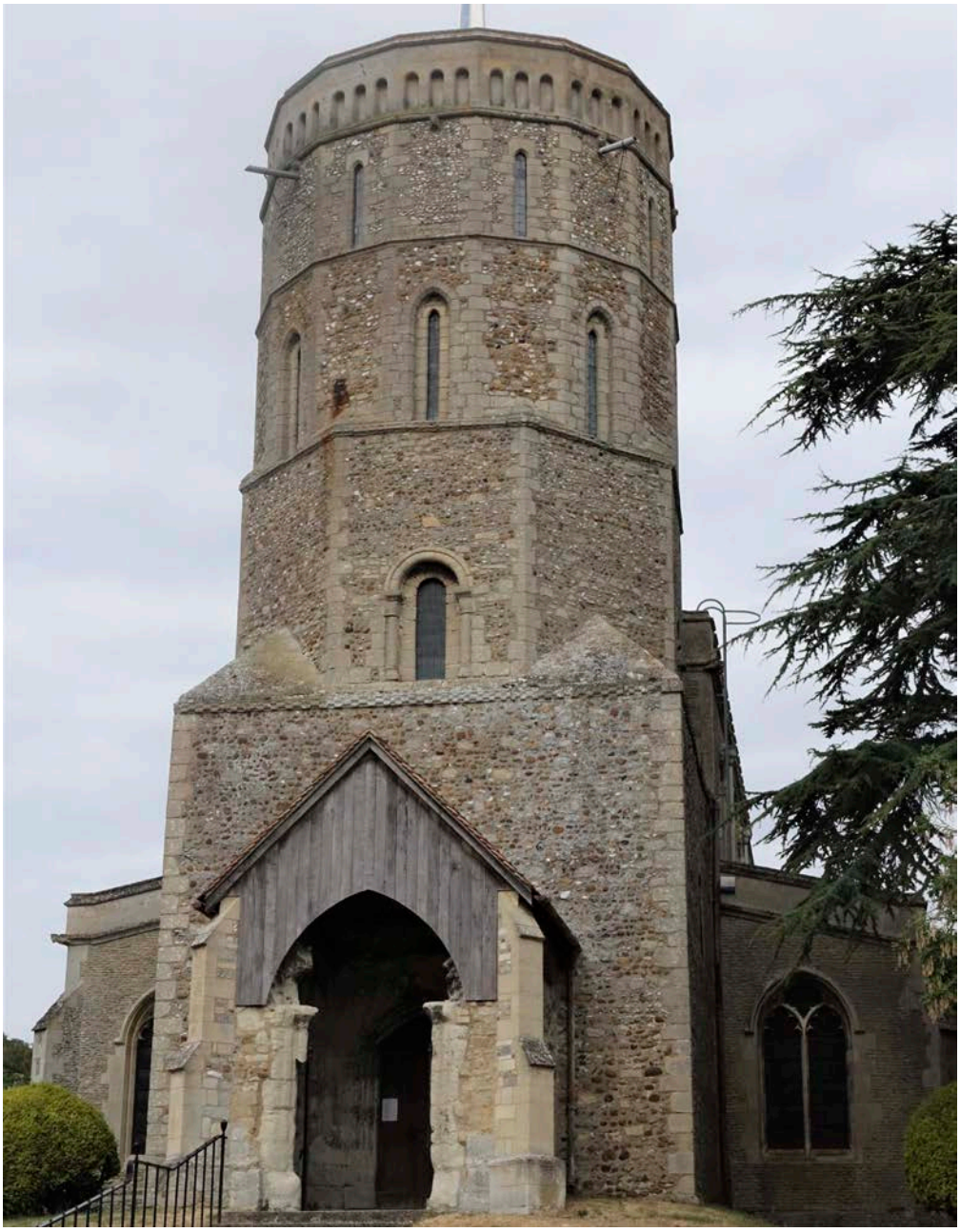


Figure 38: Church of St Mary, Swaffham Prior. Chalk, Lincolnshire Limestone, Quaternary pebbles and cobbles and Sarsen stone.

Figure 39: Church of St Mary, Swaffham Prior. Sarsen stone and Lincolnshire Limestone.

Quaternary Flint (Field Flint, Brown Field Flint and Clay-with-flints)

Quaternary Flint typically occurs as irregularly shaped nodules that are found lying on the surfaces of fields or within deposits of 'clay-with-flints', or as pebbles within fluvio-glacial sands and gravels. The size of the nodules typically ranges from 10 to 30cm. The colour is variable: less weathered flint nodules or pebbles have a cream outer cortex with darker coloured (greyish) interior; weathered flints, in contrast, or those that have lain in soil or superficial deposits for a long period of time, may be variously discoloured or bleached, and often have brown stained interiors due to the precipitation of iron hydroxides from percolating ferruginous waters. This weathered appearance helps distinguish field flint from the much fresher looking Quarry Flint.

A combination of hardness, durability and resistance to weathering has resulted in Quaternary Flint being much used as a building stone wherever it is encountered in Cambridgeshire. Many walls and buildings throughout the county employ Quaternary Flint in one form or another, and the stone has been used extensively in many towns and villages.

As a walling stone in Cambridgeshire, Quaternary Flint was mainly employed as nodules or pebbles laid randomly or roughly to course, but occasionally as knapped, faced, trimmed or cleaved-faced stone in random or decorative arrangements. The stone can be seen in many churches and walls in towns and villages, especially in the southern half of the county. Particularly fine examples can be seen in the village of Ashley, where the 19th-century Parish Church of St Mary is built mainly of Quaternary Flint nodules with elaborate Bath Stone dressings.

Figure 40: St Mary's Church, Ashley. Quaternary Flint pebbles.

Figure 41: Cottage, Ashley. Quaternary Flint.

Pebbles and cobbles (Field Stone)

Accumulations of Quaternary-aged fluvio-glacial deposits in Cambridgeshire encompass a diverse range of poorly sorted, relatively soft and unconsolidated sediments. These vary in composition, but they sometimes contain harder pebbles and cobbles that mainly comprise various forms of weathered, grey-coloured flint along with orange-brown to brown-coloured chert and quartzite. The latter is typically encountered in walls as hard, well-rounded, ovoid pebbles that may have derived from the Triassic Chester Formation of the West and East Midlands. Pebbles and cobbles of other compositions also occur and include various sandstones and limestones (some Jurassic), Lower Cretaceous ironstone (carstone), together with occasional metamorphic, igneous and volcanic rocks, including basalt, rhyolite and tuff.

Cambridgeshire's fluvio-glacial deposits were formerly exploited for construction materials on mainly a local scale, and the harder pebbles and cobbles yielded as a by-product of this activity served as a convenient source of stone for nearby buildings.

The use of pebbles and cobbles in buildings in Cambridgeshire (especially church walls) is quite widespread. Particularly good examples can be seen in churches at Fulbourn (St Vigor), Gamlingay (St Mary), Great Gransden (St Bartholomew), Isleham (St Andrew), Melbourn (All Saints), Orwell (St Andrew), Toseland (St Michael) and Trumpington (SS Mary and Michael).

Figure 42: All Saint's Church, Gamlingay. Brown quartzite pebbles and cobbles, with Quarternary flint nodules and Woburn Sandstone.

Figure 43: Church of St Michael, Toseland. Quaternary pebbles and cobbles.

4 Examples of Imported Building Stones

Although the Middle Jurassic to Upper Cretaceous bedrock succession of Cambridgeshire has yielded a variety of indigenous building stones, ready supplies of good quality building stone are limited in some areas, and extensive use has, therefore, been made of stones imported into the county from other parts of England.

Upper Carboniferous

Millstone Grit Group, Marsden Formation

Naylor Hill Gritstone, West Yorkshire

A hard, medium to coarse-grained sandstone, sometimes pebbly and feldspathic, with a distinctive granular appearance (arising from sugar-like, grey quartz grains) and occasional small flakes of white mica. It exists in various colours, ranging from pale grey to a buff or pale brown colour (particularly when weathered). Patches and bands of orangish iron oxide staining (expressions of Liesegang banding) are commonly developed. It is a very durable stone, with good abrasion resistance, and it is, therefore, employed mainly for flooring and paving.

Figure 44: Cathedral Square, Peterborough. Naylor Hill Gritstone paving slabs.

Pennine Coal Measures Group, Pennine Lower Coal Measures Formation

Elland Flags, York Stone, West/South Yorkshire

Buff to pale grey or greenish grey, typically fine-grained sandstones, which are often micaceous and laminated, but occasionally show small-scale cross-bedding features. Usually weathers evenly but may separate along mica-rich horizons. Little used as a building stone in Cambridgeshire, being employed mainly as flagstones, paving stones or plinths.

Figure 45: Garret Hostel Bridge, Cambridge. York Stone paving slabs.

Permian

Zechstein Group, Cadeby Formation

Magnesian Limestone, North Yorkshire

Grey-buff to pale yellow-white, fine to medium-grained, crystalline dolostone, commonly displaying vestiges of ooidal and bioclastic fabric. It was most impressively used in the construction of King's College Chapel, Cambridge.

Figure 46: King's College Chapel, Cambridge. Magnesian Limestone from Tadcaster, Yorkshire.

Mansfield Stone (White Mansfield Stone), Nottinghamshire

A distinctive, often uniform, buff-white, sandy dolostone or dolomitic sandstone. Thin seams of pale green clay are present in some blocks. It is employed very occasionally in Cambridgeshire as a facing and decorative stone. One of the best examples of its use can be seen at Cornhill in Wisbech.

Figure 47: 1 Cornhill, Wisbech. White Mansfield Stone.

Triassic

Sherwood Sandstone Group, Helsby Sandstone Formation

Hollington Stone (White Hollington Stone), Staffordshire

Pale yellow or creamy buff-coloured variety of the normally pale red or red-brown, fine to medium-grained sandstone. It characteristically displays expressions of cross-bedding, observed in many blocks in buildings. Employed only occasionally in Cambridgeshire, it was used in the columns of the town hall in Peterborough (1928).

Figure 48: Town Hall, Peterborough. White Hollington Stone.

Lower Jurassic

Lias Group, Bridport Sand Formation

Ham Stone (Ham Hill Stone), Montacute, Somerset

A coarse-grained shelly limestone that is readily sawn and dressed. When freshly cut, the stone has a light golden yellowish-brown colour, which darkens with age and weathering. The latter picks out the weaker, less well-cemented seams and cross-bedding features, which are characteristic of this sandy limestone. Relatively little used in Cambridgeshire, the best examples are provided by the Master's Lodge, Trinity Hall, and dressings on Westcott House, a theological college in Cambridge.

Figure 49: Master's Lodge, Trinity Hall, Cambridge. Ham Stone.

Middle Jurassic

Inferior Oolite Group, various formations

Doulting Stone, Somerset

A cream-coloured, cross-bedded fossiliferous limestone with a uniform, coarse 'sugary' texture formed by abundant crinoid debris set in a matrix of calcite. Rarely used in Cambridgeshire, the best example can be found at New Court, Pembroke College, Cambridge.

Figure 50: New Court, Pembroke College, Cambridge. Doulting Stone.

Inferior Oolite Group, Lincolnshire Limestone Formation

Collyweston Stone slate (Collyweston Slate), Northamptonshire

Collyweston Slate originates from a cross-bedded, sandy limestone horizon (ranging from a few centimetres to nearly a metre in thickness) within the Lower Lincolnshire Limestone Member. The slates are worked by splitting along the cross sets, which are defined by enrichments of mica flakes and shell fragments.

Although the renowned source area of Collyweston Stone slate is around Duddington, Collyweston and Easton in north Northamptonshire (and much of the stone used in Cambridgeshire likely originated from underground workings in this area), there is some evidence that Collyweston Slate may also have been obtained as a by-product from old ironstone and Wittering Pendle quarries at Burghley Park and Wittering, respectively.

Figure 51: Bell Inn, Stilton. Lincolnshire Limestone with Collyweston Stone slate.

Lincolnshire Limestone, Northamptonshire

Lincolnshire Limestone ranges from pale cream to pale grey-coloured limestones, which weather to shades of buff-yellow; textures may be ooidal and/or bioclastic. The stone may or may not display cross-bedding features, and it is variably porous. Lincolnshire Limestone has been very widely and commonly employed throughout Cambridgeshire and is suitable for a broad range of uses, including ashlar and decorative work.

Figure 52: Burghley House, Stamford. Lincolnshire Limestone.

Ketton Stone, Northamptonshire

A porous, cream to pale yellow-coloured (occasionally pale pink-stained), ooid-rich limestone with a well-sorted texture. It lends itself to being quarried in large blocks and is regarded as a high-quality freestone. It has been described as the 'perfect oolite' because of its uniform texture.

Figure 53: Wren Library, Trinity College, Cambridge. Ketton Stone.

Widely employed throughout Cambridgeshire, one of its best known and documented uses is in the Wren Library at Trinity College, Cambridge (designed by Sir Christopher Wren in 1676 and completed in 1695).

Clipsham Stone, Clipsham, Rutland/Lincolnshire

A rather poorly sorted, medium to coarse-grained, ooidial, peloidal and bioclastic limestone. It is usually pale cream or greyish buff in colour, but features sporadic blue patches. A high-quality, relatively fine-grained, silver white-coloured variety is used for internal features, such as fireplaces. 'Blue-hearted' blocks weather over time to the more typical greyish buff colour. Occasionally encountered in Cambridgeshire, Clipsham Stone was used in the dressings of churches and other ecclesiastical and civic buildings. It was widely used as a substitute for Barnack Stone in the repair of older buildings.

Figure 54: Peterborough Museum, Peterborough. Clipsham Stone.

Ancaster Stone, Ancaster, Lincolnshire

A medium to coarse-grained, creamy-white to pale yellow-coloured (although rather ochreous in places), ooidal and bioclastic limestone. Weathered surfaces commonly display a distinctive 'streaky bacon-like' patterning. In Cambridgeshire, Ancaster Stone, along with other imported Inferior Oolite limestones, tends to have been used in the construction of prestigious buildings, especially colleges, or for the dressings of churches or chapels.

Figure 55: St John's College, Cambridge. Clipsham Stone and Ancaster Stone.

Great Oolite Group, Chalfield Oolite Formation

Bath Stone, Bath, NE Somerset and possibly Corsham area, Wiltshire

A creamy-white to buff-yellow, ooidal limestone (freestone), used occasionally in Cambridgeshire and typically found in association with Victorian new-build and church refurbishment schemes, especially as ashlar and window and door mouldings. A particularly noteworthy example of its use as ashlar is the Church of SS Mary and Nicholas at Trumpington, near Cambridge, which dates from the 14th century. Its window mouldings were replaced and the building largely re-clad in Bath Stone by Butterfield in 1858 and 1876–7.

Figure 56: Church of SS Mary and Nicholas, Trumpington. Bath Stone.

Upper Jurassic

Portland Group, Portland Stone Formation

Portland Stone (including Whitbed and Roach varieties), Isle of Portland, Dorset

A near-white or very pale-coloured limestone that (at its 'basebed' guise at least) is typically a fine and even-grained freestone. It has seen widespread use across Cambridgeshire, especially in urban areas in carved form. It has been used for milestones, obelisks, monuments, war memorials, gravestones, fountains and columns. Portland Stone is also employed as a high-quality walling stone for ashlar and cladding panels, notably in several university buildings and administrative centres in Cambridge.

Figure 57: Cripps Building, St John's College, Cambridge. Portland Stone.

Lower Cretaceous

Purbeck Group, Durston Formation and Lulworth Formation

Purbeck Stone, Dorset

A dark grey-green, shelly limestone, often containing pale-coloured sections of fossil gastropods and oysters. It has been used mainly internally for ornamental work, but has seen occasional use externally as flagstone and walling stone.

Figure 58: St John's College, Cambridge. Purbeck Stone paving.

Lower Greensand Group, Woburn Sands Formation

Small Carr (Block Carr), West Norfolk

A hard, fine to coarse-grained, ferruginous sandstone, varying in colour from very dark purplish-brown to yellowish-brown (which is sometimes evident in a single building). Typically, it is employed in tabular form, with individual blocks varying from 2 to 5cm in thickness, but occasionally reaching 10cm.

It is used to a limited extent in eastern Cambridgeshire, mainly around March and Ely. It is highly distinctive and easily recognised wherever employed.

Figure 59: Cottage, Cambridge Road, Ely. Small Carr.

Big Carr (Snettisham Carr), West Norfolk

A rich orange, dull orange or yellowish brown, medium to coarse-grained ferruginous sandstone, commonly featuring irregular veins and joint coatings of brownish-black iron oxide. It is typically seen as tabular blocks (thicker than Small Carr) and set in regular courses (for example, at St Peter's Church, Wimblington) or used in randomised fashion (for example, at the Methodist Chapel, St Ives). Like Small Carr, Big Carr was little used in Cambridgeshire, being mainly confined to 19th-century buildings located in eastern parts of the county.

Figure 60: Church of St Peter, Wimblington. Lincolnshire Limestone with bands of Big Carr.

Igneous stone types

Cornish Granite, Cornwall

A light-coloured, usually pale grey granite with a mottled appearance caused by the intergrowth of grey quartz and white feldspar crystals (phenocrysts), with small amounts of darker iron magnesian minerals scattered throughout the rock. Occasional larger feldspar crystals are also present, but they are fewer and less obviously aligned than in Devon Granite (described below). It is usually seen dressed and polished and employed as a facing or ornamental stone on buildings such as banks, offices, and so forth.

Figure 61: Cathedral Square, Peterborough. Cornish Granite facings.

Late Carboniferous to Early Permian

Dartmoor Intrusion

Dartmoor Granite (Blackstone Granite), Devon

A coarse-grained igneous rock comprising an interlocking network of grey-coloured quartz crystals with (often larger phenocrysts and small amounts of darker iron magnesian minerals. Small, sparkly flakes of mica are also present. The large white feldspar crystals are sometimes preferentially aligned and may display good crystal shapes. Dartmoor Granite is a very hard-wearing, durable stone that is usually employed in Cambridgeshire for paving setts, kerb stones and occasionally memorial stones.

Figure 62: War memorial, Elton. Dartmoor Granite.

Neoproterozoic and Palaeozoic

Various, including South Charnwood Diorites

Granodiorites and diorites, various sources including Leicestershire

Variously coloured, medium to coarse-grained igneous rocks comprising a network of interlocking crystals of quartz (typically pale grey in colour) and feldspar (often white or pink-red in colour), with varying amounts of ferromagnesian minerals (black or dark green in colour). A range of granodiorites and diorites from various sources are employed in Cambridgeshire for different purposes, including ornamental stonework. They are durable and hard wearing and, therefore, often used for paving setts or kerb stones.

Figure 63: Priestgate, Peterborough. Granodiorite kerb stone.

Figure 64: Minster Precincts, Peterborough. Diorite paving sett.

Metamorphic stone types

Slates, various sources including Cumbria and Wales

Several different types of metamorphic slate are known to have been imported into Cambridgeshire and used for roofing purposes. Welsh Slate, for example, was commonly employed in many of the county's villages, towns and cities. Good examples can be seen in Cambridge city centre and along Wentworth Street in Peterborough. Other types of metamorphic roofing slate used in Cambridgeshire include Westmorland Slate.

Figure 65: White Horse, Stetchworth. Bath Stone and Westmoreland Slate.

Ancaster Stone became particularly favoured in the late 19th century. Jurassic limestones from Somerset were also used during the 19th century; for example, Ham Stone was used in the renovation of the Master's Lodge at Trinity Hall by Anthony Salvin (1852) and Doulting Stone was employed in the construction of the New Court at Pembroke College (1883).

The University of Cambridge has continued to expand since the Second World War with new colleges, including Churchill (1960), Darwin (1964) and Robinson (1974), being founded and built. Stone continues to be used, largely as cladding, such as in the influential Cripps Building, St John's College (1967), and the McGrath Centre, St Catharine's College (2013). Both used Portland Stone (Portland Roach) panels.

5 Further Reading

The Further Reading, Online Resources and Contacts guide provides general references on:

- Geology, building stones and mineral planning
- Historic building conservation, architecture and landscape.

There is also a separate glossary of geological terms.

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Figures

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