Historic England

Kent

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.

This guide is based on original research and text by Joan Blows.

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Front cover: Rochester Castle, Rochester. Kentish Ragstone. © George Brice / 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.

Middle Jurassic
↑— geological time period

Inferior Oolite Group, Lincolnshire Limestone Formation
↑— geological group ↑— geological formation

Lincolnshire Limestone
↑— building stone (alternative or local name)

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 Kent County Council and unitary authority area of Medway Council; and the local planning authority areas of Sevenoaks, Dartford, Gravesham, Tonbridge and Malling, Maidstone, Tunbridge Wells, Swale, Ashford, the City of Canterbury, Folkestone and Hythe, Thanet and Dover.

Contents

1 Introduction

The indigenous Kent building stones are all of sedimentary origin and they were predominantly quarried from the Cretaceous rocks of the county. They comprise mainly sandstones and sandy limestones. Flint, chalk, tufa and conglomerate have also been used in the past as vernacular building stone.

The subtropical or tropical environments in which these sediments were deposited ranged from non-marine to marginal to open marine conditions. The non-marine sediments were laid down under fluvial, deltaic and estuarine conditions, giving rise to substantial lateral and vertical variability in the resultant clastic sequences (sandstone, siltstone and mudstone). The deposits of the marginal and marine environments were predominantly calcareous in nature.

Regional tectonic movement in the Early Tertiary period led to uplift, folding and erosion of these sediments, leaving an eroded west to north-west trending anticline across the county, a feature known geologically as the Wealden anticline. Folding of these strata was accompanied not only by faulting but also by the formation of a number of minor subsidiary folds, which has led to a locally complex structural pattern.

Geographically, Kent includes the northern part of 'the Weald', bounded to the north by the chalklands of the North Downs. Within the Weald, there are distinct, low-lying clay areas known as the Low Weald. These are separated by two areas of higher ground: a sandstone region at the centre of the anticline, known as the High Weald, and the Greensand Ridge (mainly sandy limestone) further to the north.

The early use of the county's stone resources by the Romans is evident, for example, in the Saxon Shore Forts at Reculver and Richborough.

In the 11th century, the Norman invasion introduced new building techniques and ideas. This was followed by the construction of many large ecclesiastical buildings and castles in Kent. At this time, the lack of sufficient quantities of durable local freestone suitable for dressing and carving within the county, and the ready access by sea to the more familiar limestones from their homeland, such as Caen Stone, saw the importation of stones by the Norman builders into the south-east of England. They were used in many new large building schemes, such as Canterbury Cathedral.

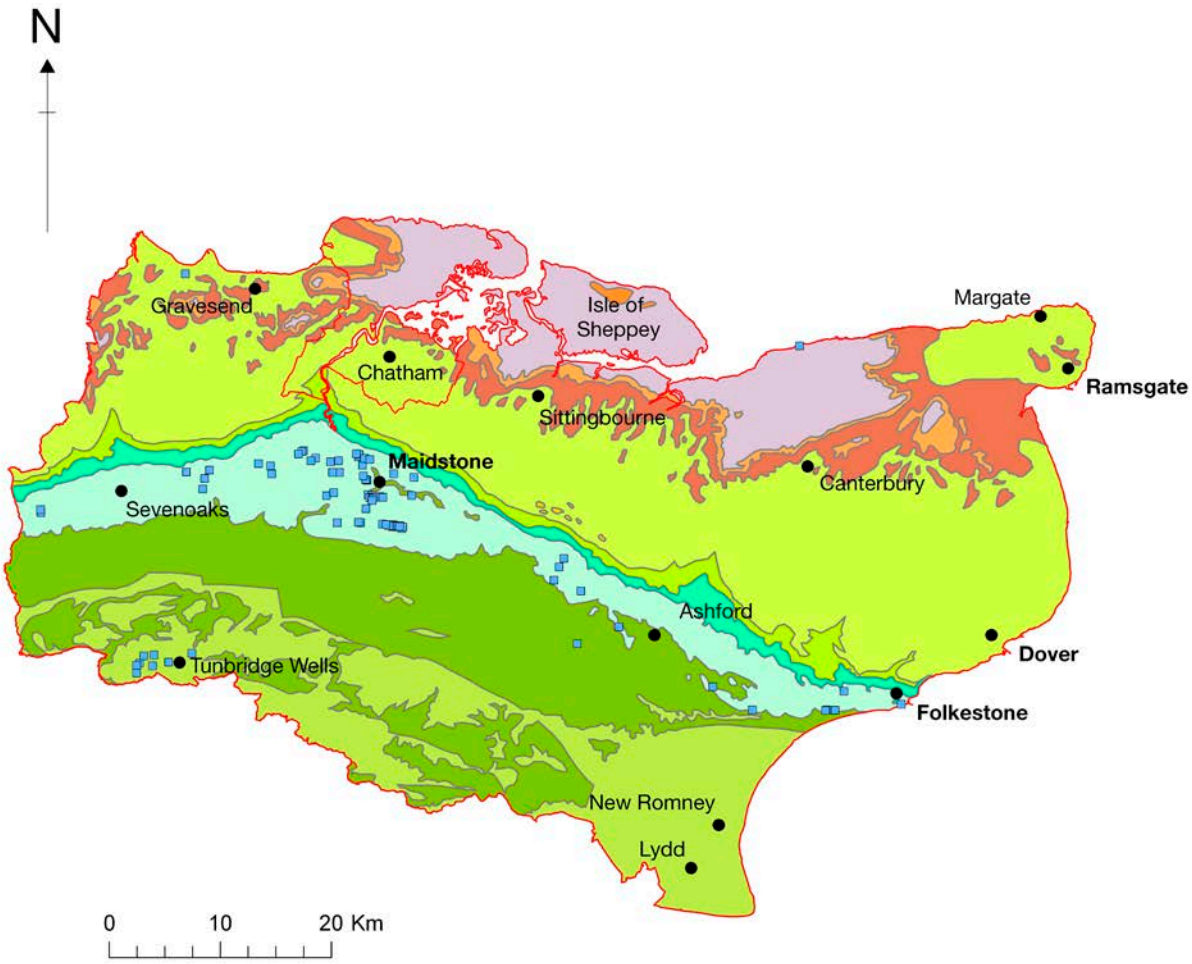
The Dissolution of the Monasteries in the 16th century made substantial quantities of Caen Stone available for reuse in subsequent building construction. Often, the stone was employed alongside other vernacular stones and local building materials, such as timber, brick, tile and recycled material from Roman structures. Good examples include the walls of St Augustine's Abbey and the north wall of the Church of St Mary, both in Canterbury. In fact, many of the historic buildings of Kent display an eclectic mix of construction materials.

Generally, Kent's building stones were used within a short distance of the quarries from which they were worked. One major exception is Kentish Ragstone, which is a durable sandy limestone. In addition to its widespread use locally, this building stone was transported in substantial quantities by boat along the Rivers Medway and Thames to London, where it was used extensively for building in the city and in neighbouring counties from Roman times to the 19th century.

There has been widespread use of building stones imported from France, notably Caen Stone. This was much used by the Normans, for example in Canterbury for the construction of the cathedral and St Augustine's Abbey. Stone was also imported from the Boulonnais area, northern France and from the around Poitiers, west-central France.

Figure 1: St Augustine's Abbey, Canterbury. Re-used building stones.

Bedrock Geology Map



Key

Building stone sources

Bedrock geology

Neogene Rocks (undifferentiated) — gravel, sand, silt and clay

Bracklesham Group and Barton Group (undifferentiated) — sand, silt and clay

Thames Group — clay, silt, sand and gravel

Lambeth Group — clay, silt, sand and gravel

Thanet Sand Formation — sand, silt and clay

White Chalk Subgroup — chalk

Grey Chalk Subgroup — chalk

Gault Formation and Upper Greensand Formation (undifferentiated) — mudstone, sandstone and limestone

Lower Greensand Group — sandstone and mudstone

Wealden Group — mudstone, siltstone and sandstone

Wealden Group — sandstone and siltstone, interbedded

Stratigraphic Table

Geological timescale	Group		Formation		Building stone	Page
Quaternary	various		various		Tufa Ferricrete Quaternary Flint, Beach Cobbles, Field Flint, Beach Pebble Flint, Ships' ballast	25 25 24
Tertiary	Bracklesham Group		Bagshot Formation			
	Thames Group		London Clay Formation		Septaria nodules	23
	Lambeth Group		Harwich Formation			
			Woolwich and Reading formations		Sarsen Stone	23
			Upnor Formation		Winterbourne Ironstone	22
	not assigned		Thanet Sand Formation		Thanet Sandstone	21
Upper Cretaceous	Chalk Group	White Chalk Subgroup	various		Chalk Flint	20 18
		Grey Chalk Subgroup	various			
Lower Cretaceous	Selborne Group		Upper Greensand and Gault formations		concretionary sandstone	18
	Lower Greensand Group		Folkestone Formation		Ightham Stone Oldbury Stone Folkestone Stone Folkestone Formation Doggers	17 17 17 17
			Sandgate Formation			
			Hythe Formation		Kentish Ragstone (Ragstone, Sevenoaks Stone) Hassock Hythe Formation Sandstone	12 12 12
			Atherfield Clay Formation			
	Wealden Group		Weald Clay Formation		Wealden Limestone Large Paludina Limestone (Bethersden Marble, Winklestone) Small Paludina Limestone	10 10 10
			Tunbridge Wells Sand Formation	Grinstead Clay Member	Cuckfield Stone	8
				Ardingly Sandstone Member	Ardingly Sandstone	8
			Wadhurst Clay Formation		Wadhurst Clay Sandstone Wadhurst Clay Ironstone	8 8
			Ashdown Formation		Ashdown Sandstone Top Ashdown Sandstone	6 6

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

2 Local Building Stones

Lower Cretaceous

The oldest Kent building stones have been sourced from the two distinct Lower Cretaceous lithological units. The lower unit is a thick non-marine clastic succession comprising the Wealden Group. The upper unit comprises marine sandstones and limestones of the Lower Greensand Group. Both groups contain rock units sufficiently hard and durable to have yielded building stone.

Wealden Group

The changing depositional environments have produced two distinct rock assemblages within the Wealden group: a lower sandstone-dominated sequence and an upper clay/mudstone-dominated sequence.

The Wealden Group comprises the Ashdown, Wadhurst Clay, Tunbridge Wells Sand and Weald Clay formations. Each of these formations includes beds worked for building stone in Kent. The principal building stones of this group are the sandstones that are found in the south and west of the county. These sandstones were quarried in numerous relatively small-scale pits. Currently, however, there are no working Wealden sandstone quarries in Kent and many of the old quarries are now largely unrecognisable in the landscape.

Figure 2: Lecture Hall, Tunbridge Wells. Wealden Group Sandstone.

The use of building stones from the Wealden Group in Kent is evident in medieval churches, prestigious domestic properties and municipal buildings, where they have been commonly used as sandstone ashlar blocks. Elsewhere, the sandstone has been employed as smaller coursed blocks or rubblestone, for example, as plinths to timber-frame buildings, in bridge construction, for paving or in boundary walling.

Wealden Group, Ashdown Formation

Top Ashdown Sandstone, Ashdown Sandstone

The Wealden sandstones assigned to this formation are typically fine grained and light coloured (off-white to orange), with distinctive rhythmic laminations in places. The principal sandstones come from the upper part of the Ashdown Formation.

These sandstones crop out in the south of the county, notably around Penshurst, where some of the material is cross-bedded and ferruginous. A 1.5 to 6m bed of massive sandstone, known as the Top Ashdown Sandstone, has been identified locally. However, the non-marine depositional setting has resulted in considerable lateral variations in lithology, and these variations are reflected in the stone types used in the buildings in the areas close to the Ashdown Formation outcrop. The Church of St John the Baptist in the village of Penshurst, which sits on the Ashdown Sandstone, is constructed of ashlar blocks of predominantly buff sandstone, much of which has weathered pale grey.

The rhythmic, parallel laminated structure in the stonework is much in evidence, and colour variations from off-white to light orange-brown can occur within each ashlar block. Some of the off-white sandstone is notably fine grained.

Figure 3: Timber frame and stone building, Penshurst. Wealden Group Sandstone.

Figure 4: Queens Mews, Hawkhurst. Wealden Group Sandstone.

Figure 5: Castle Inn, Chiddingstone. Wealden Group Sandstone plinth.

Wealden Group, Wadhurst Clay Formation

Wadhurst Clay Ironstone, Wadhurst Clay Sandstone

The Ashdown Formation is overlain by a predominantly argillaceous (clay/mudstone) sequence, the Wadhurst Clay Formation, which also contains beds of siltstone/sandstone, limestone and ironstone that provided building stone locally. A number of thin calcareous sandstone beds were used as local building stone in the Tenterden area. The ironstone beds that formed the basis of the famed Wealden iron industry were largely worked from the basal part of this formation, but there is no evidence that they were used to any great extent as building stones.

Wealden Group, Tunbridge Wells Sand Formation

Ardingly Sandstone, Cuckfield Stone

The overlying Tunbridge Wells Sand Formation was the primary source of Wealden Group Sandstone in Kent, with many lithological characteristics similar to the sandstones of the Ashdown Formation. The sandstones are generally fine to medium grained, often cross-bedded and flaggy in places.

To the west of Tunbridge Wells, the formation is divided into two sandstone units separated by a clay layer known as the Grinstead Clay Member. This clay layer is divided informally into upper and lower parts by the development of a thin, cross-bedded, fine-grained sandstone, known as the Cuckfield Stone (named after the village in West Sussex). Numerous small building stone quarries operated near Goudhurst, producing Wealden sandstone for local use. The variety of colours and textures can be seen in individual buildings from different phases of construction. For example, at the medieval Church of St Mary at Goudhurst, the colour variations and laminations in some of the beds provide distinctive features. The 19th-century construction of the mansion house in the grounds of Scotney Castle

Figure 6: Mansion house, Scotney Castle, Lamberhurst. Wealden Group Sandstone.

Figure 7: Regency terrace, Tunbridge Wells. Wealden Group Sandstone.

near Lamberhurst used sandstone from quarries within the estate. The colour, texture and weathering patterns within the ashlar blocks are widely evident in the building's fabric. All Saints' Church at Staplehurst makes extensive use of Tunbridge Wells Sandstone in parts of its external fabric, including St George's Chapel and the tower.

A massive, hard sandstone bed, more uniform in appearance, occurs towards the top of the Lower Tunbridge Wells Sand Formation and it is known as the Ardingly Sandstone Member. This sandstone, which is medium grained in the Tunbridge Wells area but finer grained to the west, produces prominent topographic features, notably around Royal Tunbridge Wells. These include the High Rocks, which is a Site of Special Scientific Interest, and Toad Rock, classed as a national monument. Quarries in the formation are known around the town, and Ardingly Sandstone is used quite widely within the centre of Tunbridge Wells.

The only quarry currently producing Wealden sandstone is located outside the county, at West Hoathly in West Sussex.

Wealden Group, Weald Clay Formation

Small Paludina Limestone, Large Paludina Limestone (Bethersden Marble, Winklestone), Wealden Limestone

The uppermost formation within the Wealden Group succession of Kent is the Weald Clay Formation. It contains several discontinuous beds of fossiliferous freshwater limestone. The Wealden limestones that have been most widely used are characterised by the presence of numerous fossils of the large freshwater gastropod *Viviparus flaviorum*. These limestones have been given a variety of local names, including the Large Paludina Limestone and Small Paludina Limestone, and they occur in beds up to 300mm thick. In Kent, one of these fossiliferous limestones is widely known as the Bethersden Marble (the term 'marble' being used because the stone is capable of taking a polish), and it has been employed extensively for decorative work, paving and building stone. Although this building stone is named after the village of Bethersden, the limestone has been dug from various locations across the county. Some Wealden limestones have also been called Winklestone because the small gastropods present are similar in character to the modern periwinkle shell.

Wealden limestones have been used as external paving and kerb stones in the village of Biddenden, but their texture can best be seen in the flooring and internal decorative work of Canterbury Cathedral, and in churches such as St Margaret's at Bethersden. The moulding around the rim of the Norman font in the Church of St John the Baptist at Harrietsham provides a good example of finely carved Bethersden Marble.

Figure 8: Paving, kerbing and channel blocks, Biddenden. Wealden Limestone.

Figure 9: All Saints Church tower, Biddenden. Bethersden Marble.

Externally, Wealden limestone was employed as a durable building stone in the construction of the 15th-century church towers at Tenterden and Biddenden, where it was successfully used for quoins and coursed walling stone. The Norman herringbone stonework at All Saint's Church at Staplehurst was built using slabs of Small Paludina Limestone.

The Dering Arms near Pluckley station provides an example of the use of Bethersden Marble, which crops out to the south of the village, with Kentish Ragstone blocks. There is also some local use of Wealden limestones in the fabrics of churches in the Romney Marsh area, including Horne's Place Chapel at Appledore and SS Peter and Paul's Church at Newchurch.

Figure 10: Dering Arms Pub, Pluckley. Bethersden Marble with Ragstone blocks.

Lower Greensand Group

The Lower Greensand Group succession of the Weald Basin comprises the Atherfield Clay, Hythe, Sandgate and Folkestone formations. The deposits of this group include clays, sandstones and sandy limestones, which were deposited under shallow marine conditions. The sediments commonly contain the green iron-silicate mineral glauconite, which is sometimes visible as individual grains in the sands and limestones and sometimes gives a greenish hue to the stones. Weathering of the glauconite can occur, giving rise to an orange-brown coating or staining. In Kent, neither the Atherfield Clay Formation nor the Sandgate Formation appears to have rock units suitable for the production of building stone.

The principal building stone of the Lower Greensand Group, from the Hythe Formation, is a hard sandy limestone known as Kentish Ragstone, which forms the marked ridge along the northern edge of The Weald (the Greensand Ridge).

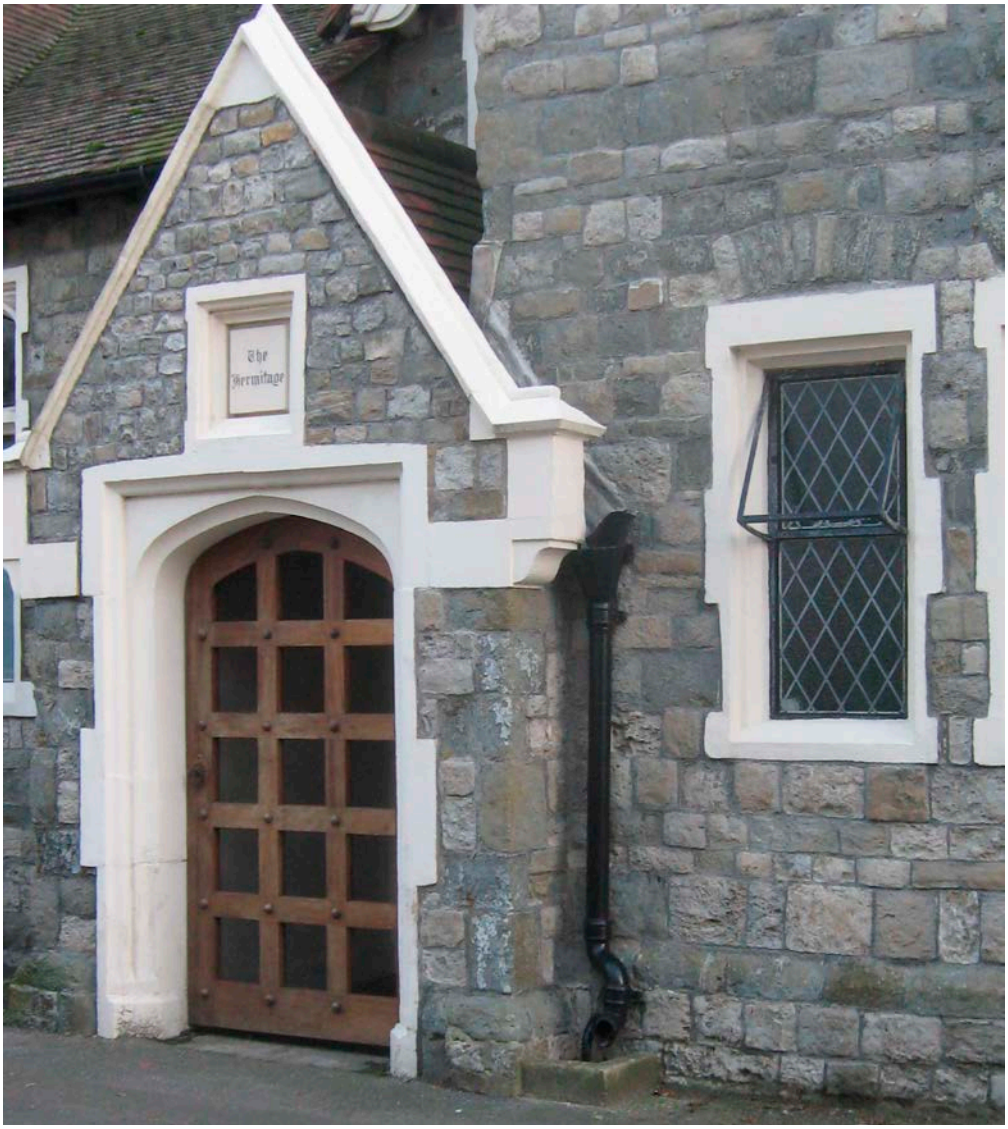
Lower Greensand Group, Hythe Formation

Hythe Formation Sandstone, Hassock, Kentish Ragstone (Ragstone, Sevenoaks Stone)

The Hythe Formation consists of interbedded layers of hard, well-cemented, sandy and glauconitic limestone (called Kentish Ragstone) and softer, poorly cemented layers of argillaceous sandstone or calcareous sandstone (called Hassock). However, this simple division into Kentish Ragstone and Hassock is insufficient to portray the considerable lithological variations that can occur within the formation, both vertically and laterally. Indeed, a wide spectrum of stones is seen between these two end members. The individual beds of Ragstone suitable for building purposes are relatively thin, being up to 900mm in thickness generally. Considerable variation in the characteristics of the Kentish Ragstone can be seen across the county.

Figure 11: Knole House, Sevenoaks. Kentish Ragstone.

Figure 12: The Hermitage, Sandgate. Kentish Ragstone.



Ragstone is a common term used to describe many building limestones in England and it appears to have a number of different meanings. Here, it refers to a sandy limestone, which presents an irregular, rough or ragged surface when hand cut and dressed. Sometimes, the coarse shell debris also weathers out to form a rough surface.

Kentish Ragstone is typically a medium-grey limestone, occasionally with associated nodular or bedded chert layers. Variations in the proportions of quartz grains, glauconite and carbonate cement/matrix have contributed to the differing workability and weathering characteristics of the stone.

Figure 13: Westgate Towers, Canterbury. Kentish Ragstone.

Quarrymen gave numerous local names to the individual stone beds, or ‘lanes’, but these old names have now fallen into disuse. The various bed names are believed to have identified stones suitable for different building purposes locally: ashlar, rubblestone, paving and so forth. Although the generic term ‘ragstone’ denotes the relative difficulty in working the material to produce dressed stone, historic examples of more high-quality dressed stone and tracery are evident throughout the county. However, ragstone is more commonly seen as rubblestone walling, either coursed or uncoursed. It is the only Kent stone that has been widely transported for use outside the county boundaries.

Examples of the use of Kentish Ragstone by the Romans can be seen in the foundations of their triumphal arch at Richborough and in the 3rd-century jambs of the city gates in Canterbury. In the 11th and 12th centuries, cherty Kentish Ragstone rubblestone was used extensively in both Rochester Castle and in the cathedral. It was widely employed from the 12th to the 16th century for church construction in London and Essex, as well as in Kent.

The use of Kentish Ragstone went into decline during the 17th century as other materials (brick, Portland and Bath Stones, for example) became more fashionable and readily available. Nonetheless, quarrying continued, and extraction from underground mines in the Maidstone area is well known. By the late 20th century, however, Kentish Ragstone was used very little for building purposes.

Finer-textured Kentish Ragstone (particularly greenish or dark bluish-grey varieties) has also been used in string courses, plinths and tracery work, but it is sometimes less durable in such situations.

The Hythe Formation has been quarried across the county. At the eastern end of the outcrop, in the Folkestone–Hythe area, the stone is generally pale grey, without coarse quartz grains, and shelly in places. However, some darker beds occur, notably the dark green sandy limestone in the vicinity of Hythe and Sellindge. The use of well-selected and well-worked stone could give a durable and pleasing finish, even in an exposed location. The defensive Napoleonic retaining wall at Battery Point, along the seafront at Sandgate, provides a good example.

In the east of the county, Kentish Ragstone was historically taken for building stone from the foreshore outcrops, evidenced by the modern marine borings in some dressed stone blocks.

The Maidstone–Borough Green area contained the greatest concentration of quarries, many of which worked beds of good quality building stone. The Kentish Ragstone from these quarries was generally medium grey, with some chert and locally small brown phosphatic nodules. Further west in the county, the Hythe Beds become more distinctly sandy and the stone tends to become more greenish-brown/orange-brown in colour as it weathers. A chert band, known locally as the Sevenoaks Stone, occurs at the top of the ragstone sequence in the vicinity of the town itself.

The skill needed to produce high-quality ragstone is evident in the 18th-century Sevenoaks School, where the mortar is galleted with stone fragments.

Around Westerham and westwards towards Surrey, the beds comprise non-calcareous sandstone. In this part of the county, not only was the stone quarried from the surface, but it was also mined in the area around Hosey Common for building purposes. Hythe Formation Sandstone was used at Hosey Common.

In recent years, there has been a perceived shortage of suitable Kentish Ragstone for building purposes, leading to the import of substitutes from further afield. Careful selection of stone blocks based upon their petrographic characteristics, together with appropriate methods of extraction and working of the stone, can be used, however, to identify suitable ragstone resources for new work and restoration. There is currently just one working ragstone quarry in the county: Hermitage Quarry near Maidstone. This quarry mainly produces crushed rock aggregate, but it is also able to supply rubblestone and dimension stone for masonry work.

Figure 14: Medieval barn, Westenhanger Castle, Hythe. Kentish Ragstone.

Lower Greensand Group, Folkestone Formation

Folkestone Formation Doggers

In the lowest part of the Folkestone Formation at Sandling Junction near Hythe there are hard, carbonate-cemented sandstone concretions, or doggers which were used locally for walling stone.

Folkestone Stone

The Folkestone Formation more typically consists of medium to coarse-grained sandstone. Towards the eastern end of the county, from Stanford to Folkestone, a facies change resulted in the deposition of a grey, coarse-grained, glauconitic, calcareous sandstone. This was used at the 12th-century Church of SS Mary and Eanswythe at Folkestone, for example.

This lithology is known as Folkestone Stone, although the same term has been used to describe ragstone from the Hythe Formation, which was also quarried from the Folkestone area. The stone from the Folkestone Formation can be distinguished by the presence of coarse, sub-rounded, quartz grains within the sandstone. Elsewhere in the town, high-quality ashlar of the local sandstone is a prominent feature of many buildings of the late 19th and early 20th centuries.

Figure 15: The Church of SS May and Eanswythe, Folkestone. Folkestone Stone.

Oldbury Stone, Ightham Stone

Bands of ferruginous sandstone or ironstone occur (particularly around the Borough Green area) and cherts have been noted in the outcrops of the Sevenoaks area. The names ‘Ightham Stone’ and ‘Oldbury Stone’ have been given to the durable building stones won from the hard, siliceous deposits within the Folkestone Formation in the vicinity of the villages of Ightham and Oldbury. These stones have given a very distinctive character to buildings in the Oldbury village area.

Other hard, ferruginous sandstone bands occur at several levels within the Folkestone Formation, and these were commonly used in the past for setts, by laying the stones end-on with the bedding planes vertical. Examples can be seen at Westerham.

This sandstone has also been used as rubblestone (alongside ragstone, brick and tile) in houses found in the villages of the Wrotham–Borough Green area, notably in Wrotham Heath and Trottiscliffe.

Selborne Group, Upper Greensand Formation, Gault Formation

Concretionary sandstone

The Selborne Group includes the Gault Formation and the Upper Greensand Formation. Blocks of concretionary sandstone from the base of the Gault Formation were used with dressed flints in the old Fisher Gate at Sandwich. Over much of Kent, the glauconitic sandstones that normally characterise the Upper Greensand Formation are not well developed. Despite the considerable importance of this sandstone unit elsewhere in South East England as a source of building stone, there are no known sources in the Kent area.

Upper Cretaceous

Chalk Group, various formations

Flint

Nodular and tabular layers of flint (cryptocrystalline silica) are found within the Chalk Downs. Extensive remnant flint deposits are also commonly found in the Pleistocene gravels and beach gravels of the area. Flint has been used extensively since Roman times for building in areas close to the North Downs and the coast. It forms an extremely durable building stone and it is employed in various contexts, either in its ‘as found’ form of irregular nodules with a weathered white cortex, or as knapped (dressed) and coursed flints displaying a typical black vitreous finish, as seen at St Mary’s Church at Lower Hardres. Flint has also been used for plinths to medieval timber-framed buildings in Canterbury.

Different periods of construction within one building are often revealed by changes in the patterns of flint. St Paul’s Church at Canterbury is an example of this.

The finest coursed, knapped flintwork sometimes incorporates galleting, in which small flint slivers are inserted in the mortar between the blocks to increase the strength and durability of the mortar. Flint wall construction normally requires the use of dressed dimension stone or brick to form quoins and window and door surrounds. In addition to the local Kentish Ragstone, various imported Jurassic limestones have been used for this purpose,

including Middle Jurassic Bath Stone, Cotswold limestones and Weldon and Clipsham Stones (both Lincolnshire Limestone Formation). Flint is also used extensively for rubblestone fill in wall cores, as seen at Richborough Castle.

Figure 16: St Mary's Church, Lower Hardres. Coursed flint.

Figure 17: Timber frame building, Canterbury. Flint plinths.

Figure 18: St Paul's Church, Canterbury. Flint.

Chalk

Chalk dominates the Upper Cretaceous succession of Kent. The Chalk crops out extensively throughout the North Downs and includes horizons of relatively hard stone, but it was not widely used as an external building stone because of its poor durability. It was, however, employed in medieval times as rubblestone wall cores, for internal masonry walls and as block work in vaulted ceilings. Such ceilings can be seen at Westgate Tower in Canterbury, St Mary's Church at Minster and SS Peter and Paul's Church at Eythorne. It was particularly useful in this context because it is a soft stone, easy to work into shaped blocks and of relatively low density. Infrequently, chalk has been used externally with success, for example as ashlared chalk blocks in a former 18th-century malthouse at Boxley.

Figure 19: Malthouse, Boxley. Chalk ashlar.

Tertiary

Tertiary layers cropping out in Kent comprises the Thanet Sand, Upnor, Woolwich, Reading, Harwich, London Clay and Bagshot formations. These formations are generally soft and poorly consolidated, but they do contain some harder cemented horizons that were used locally for building purposes in Kent.

Group not assigned, Thanet Sand Formation

Thanet Sandstone

The 12th-century towers at St Mary's Church at Reculver provide an example of the use of Thanet Sandstone. It is a laminated fine sandstone that can still be seen as beds and doggers in the Thanet cliffs and on the foreshore nearby.

The stone can be seen sporadically as individual 'slabby' blocks in East Kent, for example within the pre-12th-century city wall in the Northgate area of Canterbury.

Sometimes, the isolated blocks show evidence of their foreshore origin by virtue of the presence of marine borings. The Roman fabric of Richborough Castle includes Thanet Sandstone, together with London Clay septaria, Puddingstone, Upper Greensand, Kentish Ragstone, Carrera Marble, Neidermendig lava and tufa.

Figure 20: City wall, Northgate, Canterbury. Thanet Sandstone.

Figure 21: Thanet beach. Thanet Sand Formation sandstone and doggers.

Lambeth Group

The Lambeth Group, comprising the Upnor Formation, Woolwich Formation and Reading formations, is a variegated succession of variably cemented, coarse-grained, pebbly sandstones, which are occasionally glauconitic, ferruginous or calcareous in character.

Lambeth Group, Upnor Formation

Winterbourne Ironstone

This formation principally comprises fine to medium-grained, variegated, glauconitic sands with blackened flint pebbles. Close to the boundary with the overlying Woolwich Formation is a hard, ferruginous sandstone (the Winterbourne Ironstone) which has seen limited use locally for building stone. One notable example is the Church of St John the Baptist at Boughton.

Woolwich Formation and Reading formations

Sarsen Stone

Isolated occurrences of a hard, quartz-cemented sandstone known as Sarsen stone provided a local source of building material in the Medway area. These sandstones represent only the remnants of a far more extensive, largely uncemented, sandstone unit that covered much of the area during the Palaeogene. Examples can be seen in the Kit's Coty and White Horse megaliths, near Aylesford.

Thames Group

This formation comprises a succession of sandy and silty, glauconitic mudstones and clays, within which occur large tabular and spheroidal calcareous concretions: septaria nodules.

Thames Group, London Clay Formation

Septaria nodules

These calcareous nodules are developed within the lower part of the London Clay Formation, and they were principally quarried as a raw material for the manufacture of cement (Roman cement), often from foreshore outcrops. They are sometimes seen in the fabric of buildings built close to the coast, such as Richborough Castle and the Church of St Martin at Herne in East Kent, where they have been used alongside a variety of local stone types.

Figure 22: Church of St Martin, Herne. Septaria nodules.

Figure 23: Church of St Martin, Herne. Septaria nodules, knapped flint and Thanet Sandstone.

Bracklesham Group, Bagshot Formation

In Kent, this formation exists only as a small outcrop on the Isle of Sheppey, where it principally comprises pale coloured, variegated, loose sands with flint gravels. No hard indurated bands are evident in the succession and it is unlikely, therefore, that the formation was a significant source of local building stone.

Quaternary

Quaternary Flint, Beach Cobbles, Field Flint, Beach Pebble Flint, Ships' ballast

Many of the flint cobbles used in buildings in Kent show the brown weathered coatings of flints sourced from the Tertiary and later deposits.

Beach cobbles are occasionally seen in smaller buildings along the coast, whereas sandstone boulders from the Hythe Formation have been recorded in several churches in the Romney Marsh area. A variety of more exotic stones (igneous and metamorphic) is also seen in the fabric of churches in the area, and these are likely to have derived from off-loaded ships' ballast.

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Ferricrete

In the Stour Valley, beds of locally developed pebbly conglomerate from the river terraces were occasionally worked and used as a local building stone. Where these are iron cemented, the term 'ferricrete' is adopted. Ferricrete walling can be seen, for example, in the 14th-century construction of the Church of All Saints at Westbere and Holy Cross Church at Hoath.

Coarse-grained, ferruginous, cemented gravel blocks and quoin stones have also been described in the fabric of the churches at Appledore and Kenardington in the Romney Marsh area.

Figure 24: St Nicholas' Church, Sturry, near Canterbury. Ferricrete.

Tufa

Tufa is a freshwater carbonate deposit formed around springs. During the Pleistocene, the development of these tufa deposits appears to have been extensive. There are a number of locations in Kent, commonly associated with springs at the margin of the Hythe Formation or Chalk Group outcrops, where tufa deposits are still forming. Many older deposits have been quarried away, however, having served as sources of lime or occasionally building stone.

Tufa is characterised by its hard and durable nature when lithified. Its highly porous structure and, therefore, low density make it ideal for use as wallstones and for vaulting in churches. It is believed that supplies of tufa for building were exhausted by late Norman times.

Blocks of pale-coloured, porous, tufaceous limestone can be seen forming the quoins and dressings of the walls in the 12th-century St Leonard's Tower at West Malling. Locally derived tufa blocks were also used extensively in the construction of the Roman Pharos (lighthouse) at Dover.

A number of churches in the Romney Marsh area have some tufa blocks in their fabric (for example, at Lympne, West Hythe, Appledore and New Romney, some having been reused from the Roman Fort at Lympne), as have several Norman churches in the Maidstone area.

Figure 25: St Leonard's Tower, West Malling. Tufa quoins and dressings.

3 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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