

Oxfordshire

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 Bill Horsfield.

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Front cover: Filkins. Forest Marble roof slates, walls and fences. © Manor Photography / Alamy Stock Photo.

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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 area of Oxfordshire County Council and the local planning authority areas of the City of Oxford, Cherwell, South Oxfordshire, Vale of White Horse, and West Oxfordshire.

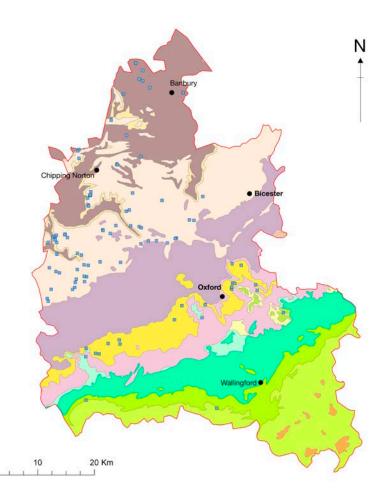
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1 Introduction

The oldest rocks in Oxfordshire crop out in the north of the county and are of Lower Jurassic age. Younger Jurassic and Cretaceous formations progressively crop out towards the south. The harder limestone and chalk lithologies form escarpments, while clay underlies the intervening vales. The character of Oxfordshire's stone buildings is very much determined by the nature of the local stone, which leads to a fascinating variation of styles across the county. With the exception of the Jurassic ooidal freestone quarried around Taynton, few building stones were of sufficient quality to be used much beyond their immediate source area. Now, only a handful of building stone quarries remain active in the county, supplying Marlstone and the Chipping Norton Limestone. The other building stones described in this guide are no longer available from working local quarries.

Bedrock Geology Map



Key

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		Building stone sources	Portland Group — limestone and calcareous sandstone
I	Bedr	ock geology	Corallian Group — limestone, sandstone, siltstone and mudstone
		Lambeth Group $-$ clay, silt, sand and gravel	West Walton Formation, Ampthill Clay Formation and Kimmeridge Clay Formation — mudstone, siltstone and sandstone
		White Chalk Subgroup — chalk	Kellaways Formation and Oxford Clay Formation — mudstone, siltstone and sandstone
		Grey Chalk Subgroup — chalk	Great Oolite Group — sandstone, limestone and argillaceous rocks
		Gault Formation and Upper Greensand Formation — mudstone, sandstone and limestone	Inferior Oolite Group — limestone, sandstone, siltstone and mudstone
		Lower Greensand Group $-$ sandstone and mudstone	Lias Group $-$ mudstone, siltstone, limestone and sandstone
		Wealden Group — sandstone and siltstone, interbedded	

Derived from BGS digital geological mapping at 1:50,000 scale, British Geological Survey © NERC. All rights reserved

Stratigraphic Table

Geological Group			Formation	Building stone	Page		
timescale							
Tertiary	various		various	Sarsen Stone	15		
			Newhaven Chalk Formation				
	Chalk Is Group	White Chalk Subgroup	Seaford Chalk Formation	Chalk (Clunch) Flint	12		
			Lewes Nodular Chalk Formation		13 12		
Upper			New Pit Chalk Formation				
Cretaceous			Holywell Nodular Chalk Formation				
		Grey Chalk Subgroup	Zig Zag Chalk Formation (including Totternhoe Stone)				
			West Melbury Marly Chalk Formation				
Lower	Selborne Group		Upper Greensand Formation and Gault Formation				
Cretaceous	Lower Gr Purbeck	eensand and groups	various				
	Portland		Portland Formation	Portland Limestone	11		
	Ancholme Group (part)		Kimmeridge Clay Formation, Ampthill Clay Formation				
	Corallian Group		Coral Rag Formation	Coral Rag	10		
Upper			-	Wheatley Limestone	10		
Jurassic			Stanford Formation	Headington Hardstone Headington Freestone	9 9		
			Kingston Formation				
			Hazelbury Bryan Formation				
	Ancholme Group (part)		West Walton Formation				
			Oxford Clay Formation				
			Kellaways Formation				
	ldle assic Great Oolite Group		Cornbrash Formation				
			Forest Marble Formation	Forest Marble	8		
NAT JUL					White Limestone Formation	White Limestone Bladon Stone	8 7
Middle			Hampen Formation				
JUIASSIC			Taynton Limestone Formation	Taynton Stone	6		
			Charlbury Formation	Stonesfield Slate	5		
			Sharp's Hill Formation				
			Chipping Norton Limestone Formation, Horsehay Sand Formation	Chipping Norton Limestone	5		
	Inferior Oolite Group		Salperton Limestone Formation				
	Lias Group		Whitby Mudstone Formation				
Lower			Marlstone Rock Formation Marlstone (Horton Stone, Banbury Ironstone)		4		
Jurassic			Dyrham Formation				
			Charmouth Mudstone Formation		1		

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

2 Local Building Stones

Lower Jurassic

Lias Group, Marlstone Rock Formation

Marlstone (Horton Stone, Banbury Ironstone)

Marlstone, also known as Hornton Stone or Banbury Ironstone is an iron-rich limestone up to 10m thick, quarried from the Middle Lias (Lower Jurassic) of North Oxfordshire. It weathers to a distinctive golden orange-brown colour but can appear bluish-green when unweathered. It contains abundant shelly fossils, usually clusters of brachiopods. Marlstone was used for both walls and dressings in small and large buildings. However, the stone is susceptible to weathering and spalling, and in some buildings, it was later replaced with a more durable ooidal limestone. Both freestone and a rougher, more rubbly stone were quarried.

The distinctive warm-coloured Marlstone characterises the cottages in many villages, including Great Tew, Deddington, Adderbury, Bloxham, Wroxton, Hook Norton and Hornton, as well as churches such as St Mary's at Adderbury and stately houses such as Broughton Castle and Chastleton House. In Oxford, the deep colour of Marlstone led to its use in ornamental work on high-profile buildings such as the University Museum and Christ Church Meadow buildings.



Figure 1: Wroxton village. Marlstone. Figure 2: Chastleton House, near Moreton-in-Marsh. Marlstone.



Middle Jurassic

Great Oolite Group, Chipping Norton Limestone Formation, Horsesay Sand Formation

Chipping Norton Limestone

This is a buff to white, medium to coarse-grained ooidal limestone (some 2 to 5m thick). It lies, stratigraphically, below the Taynton Limestone and is similar in appearance. However, it is quite variable and sometimes has a flaggy character with occasional bands full of broken shells. Quarried from around Chipping Norton and Charlbury, it was used as a durable freestone in the buildings of these towns and other local villages. The more flaggy lithologies provided roofing for St John the Evangelist's Church at Taynton, and Castle Barn Quarry still produces roof slates from this formation. The Rollright Stones, a 4,000-year-old stone circle, are thought to be constructed from a hard siliceous variety of the Chipping Norton Limestone.

Great Oolite Group, Charlbury Formation

Stonesfield Slate

The Stonesfield Slate is a flaggy, grey, micaceous and sandy limestone, found as concretionary masses within the Charlbury Formation in a thin sheet of very limited extent around the village of Stonesfield. It can be split into thin slates, which were widely used until the mid-18th century for the roofs of Cotswold cottages and Oxford colleges, including Merton College, Wadham College and St Anne's College library. Thin beds of the stone (up to 2m thick) were mined from underground layers accessed from narrow hillside adits and shafts. By exposing the moist, freshly dug slabs to the natural action of winter frosts, they became easy to split. The stone slates are greyish-cream in colour and not as thin or smooth as the true slates of metamorphic origin from the quarries of Wales and the Lake District. The smallest slates were used in the upper parts of a roof, grading into larger and heavier slabs towards the eaves. The local slate industry lasted from the late 16th century to the early 20th century and the original occurrence has now been totally worked out.



Figure 3: Glympton. Stonesfield Slate roofs.

Great Oolite Group, Taynton Limestone Formation

Taynton Stone

This is a buff to white, coarse-grained ooidal limestone (5 to 7m thick), typically cross-bedded and with abundant shell fragments. It weathers to a light or golden-brown colour, sometimes with a striped appearance due to differential erosion of beds of varied grain size or cementation. Well cemented, strong and durable, it was quarried for many hundreds of years from five quarries around Burford, and the best quality stone came from locations covered by some 5m of overlying Hampen Marly Beds (Hampen Formation). Seams were, thus, often followed some distance underground from the quarry face. From the Taynton Quarry itself, blocks up to 2m in height could be obtained, but similar stone was quarried nearby at Swinbrook and Milton in Oxfordshire, and at Barrington, Windrush and Sherborne across the border in Gloucestershire. Stone from the Milton quarries has proved less durable over the years.

Both freestone and rubble blocks were extracted and used not only locally to build the stone houses and churches in towns such as Burford, but also for many Oxford buildings, including Merton College's Mob Quadrangle; the Divinity School; Oriel College library; and New College, west block. Buildings across Oxfordshire used the freestone in quoins and dressings together with local walling stone. It was shipped further down the Thames for use at Windsor Castle in Berkshire and St Paul's Cathedral, London. The stone used at St Paul's has since decayed and it has been replaced with Portland Stone. Figure 4: The Divinity School, Oxford. Taynton Stone.



Great Oolite Group, White Limestone Formation

Bladon Stone

Quarries at Bladon near Woodstock have produced a creamy or whitish, cross-bedded, calcite-cemented, shelly oolite some 4m thick, from near the top of the Great Oolite. It was used in the construction of Merton College library in Oxford, and extensively in 19th and 20th-century buildings in the city for both coarsed rubble walling and dressings. Examples include Somerville College, Rhodes House, the New Bodleian Library, the Radcliffe Science Library and the University Geology and Botany Departments.



Figure 5: Weston Library, University of Oxford. Bladon Stone.

White Limestone

This is a creamy or whitish, fine-grained, thinly bedded limestone, from near the top of the Great Oolite Group of the Middle Jurassic. The bioturbated limestone contains a scattering of ooids and pellets, and fragments of bivalve and brachiopod shells. It is used as a flaggy, rubbly walling stone in domestic buildings and churches along the south flank of the Cotswolds, in a belt from Minster Lovell to Ardley.

Great Oolite Group, Forest Marble Formation

Forest Marble

The term 'Forest Marble' was first applied by geologist William Smith to a grey, coarse-grained, cross-bedded ooidal limestone, crowded with blueblack fragments of oyster shells, from the Upper Bathonian at the top of the Great Oolite Series. The stone could be polished for decorative use and was used for ornamentation both internally and externally. The portico columns of Canterbury Quad at St John's College, Oxford, were cut from Forest Marble limestone. The stone was quarried from the Wychwood Forest area, from around Filkins and from the quarry at East End, North Leigh. The best stone came from the quarries at Longround and Horsebottom to the north-east of Filkins, where all of the older cottages were built of Forest Marble.

A more flaggy facies was used for roofing, steps and stone paving and also as upright slabs for fencing. In the 1920s and 1930s, Sir Stafford Cripps provided locally quarried Forest Marble for building council homes and the Village Centre in Filkins and for the Morris Memorial Cottages in Kelmscott.



Figure 6: Fencing slabs. Forest Marble.

Upper Jurassic

Corallian Group, Stanford Formation

Headington Freestone

This is another variety of limestone from the Headington quarries, providing a creamy-white or buff-coloured ashlar freestone found in many Oxford buildings. Although widely used from the 15th century onwards, the poorer quality material quarried from the early 18th century weathered badly within a couple of centuries. The stone develops a hard, blackish crust that blisters and exfoliates, so many buildings have since required re-facing with more durable freestones, such as Clipsham Stone from Lincolnshire. In Oxford, Headington Freestone still survives in the lower storey of the Radcliffe Camera, in the upper walls of Oriel College Hall and in Trinity College Chapel.



Headington Hardstone

This is a massive, well-cemented limestone from the Headington quarries, east of Oxford. It is whitish-yellow in colour, with sparse bioclastic material and ooids. The stone weathers with a typically pock-marked surface due to the variable erosion of softer mud-filled burrows that cross-cut the fabric. It could be cut easily but hardens on exposure to become a durable building stone that has survived in place for up to five or six centuries.

Large blocks were widely used in the plinths of Oxford buildings such as the Radcliffe Camera, Radcliffe Square and the Examination Schools on the High Street. It was used for the bell tower at New College, with quoins and dressings of Taynton Stone, and later for the gate pillars at Oxford County Hall. Weathered blocks in the Radcliffe Camera have been replaced with Portland (Fancy Roach) Stone.

Figure 7: Radcliffe Camera, Oxford. Headington Freestone used on lower storey.

Wheatley Limestone

This is a pale grey, well-cemented, bioclastic limestone, up to 15m thick. It is equivalent in age and transitional to the Coral Rag, and represents a shelf slope facies of broken shells, coral debris and sparse ooids. It is more versatile than the Coral Rag as a building stone and was quarried from the Wheatley and Oxford areas from the end of the 13th century. It was used for the walls of the First Quad at New College in Oxford and in villages to the south and east of the city. Much was sent to Windsor Castle, but after the 14th century the use of the Headington stones became more prevalent.



Figure 8: High Street, Wheatley. Wheatley Limestone.

Corallian Group, Coral Rag Formation

Coral Rag

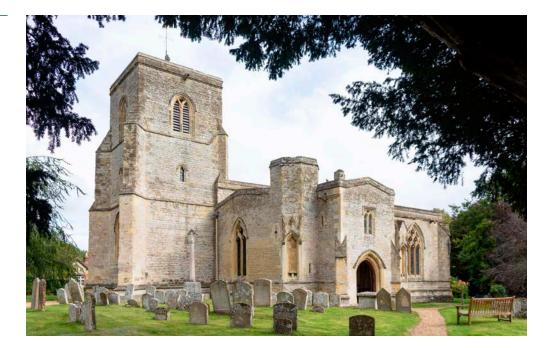
The Coral Rag is a rubbly grey shelly limestone (up to 10m thick) from near the top of the Upper Jurassic Corallian Group. It contains large lumps of corals, both branching and massive. The branching corals may weather out to give tubular cavities. It is relatively hard and resistant to weathering, but the poorly bedded rubbly character means that it is difficult to shape into regular building blocks and could not be used for dressings. Quarried from the hills around Oxford, the Coral Rag was widely used in the oldest Oxford buildings, such as the late Saxon tower of St Michael at the North Gate and St George's Tower at Oxford Castle, and also for the early 13th-century city walls. A similar rubbly coral-rich stone from the Faringdon area was used for the walls of the 13th-century Great Barn at Great Coxwell and for many of the older Faringdon buildings. Figure 9: St Michael's Church tower, Northgate, Oxford. Coral Rag.



Portland Group, Portland Formation

Portland Limestone

This creamy-white, non-ooidal, sandy and gritty bioclastic limestone from the upper Portland Formation is locally rich in shell fragments. Large Portlandian ammonites may be seen incorporated in some cottage walls. It was once quarried as a freestone from a thin bed (up to 2m thick) in the area of east Oxfordshire around Great and Little Milton, and Great and Little Haseley. Roughly cut, irregularly sized blocks were used in local cottages and for the walls of St Mary's Church at Great Milton. Figure 10: St Mary's Church, Great Milton. Portland Limestone.



Upper Cretaceous

Chalk Group, various formations

Flint

Flint is a very hard vitreous stone composed of silica material. It occurs as irregular nodules, rarely more than a few hundred millimetres in size, within the White Chalk. The newly excavated nodules have a black core and an outer coating of porous whiter 'cortex', which may become yellow stained from prolonged contact with clays or soils. Flint splits along conchoidal fractures. It is, however, highly resistant to weathering and can, therefore, be employed in walls as a protective outer layer.

Flints can be used in their original nodular form, to give a wall of rubbly appearance, or can be split or knapped to give a glassy surface, which is then arranged to face outwards. In skilful hands, the flints can be knapped into rectangular blocks that can be laid in courses like bricks. However, the shiny impervious surfaces of fully knapped flints do not bond as well with mortar as those flints that retain their porous cortex. Stone or brick courses were often incorporated in a flint wall to give it extra strength.

Locally gathered field flints, embedded in mortar, were used to build the rough walls of Saxon and Norman churches, such as St Leonard's at Wallingford. However, their small size precluded use as quoins or as window or door mouldings, for which another material, commonly brick or limestone, was generally used. By the 13th and 14th centuries, the flints were being laid in horizontal courses and were often knapped. In later church building, the flints were more carefully selected and were often knapped more precisely to give squared blocks that could be laid in regular courses, as seen in the Church of St Mary-le-More at Wallingford, for example, or employed together with squared limestone blocks to give decorative chequerwork patterns. Limestone continued to be used for carved window dressings and door mouldings, for cornerstones and buttresses. This use of flint with limestone characterises the majority of church buildings in the chalk downs. Weathered flints are common in the soil profiles throughout the chalk districts.

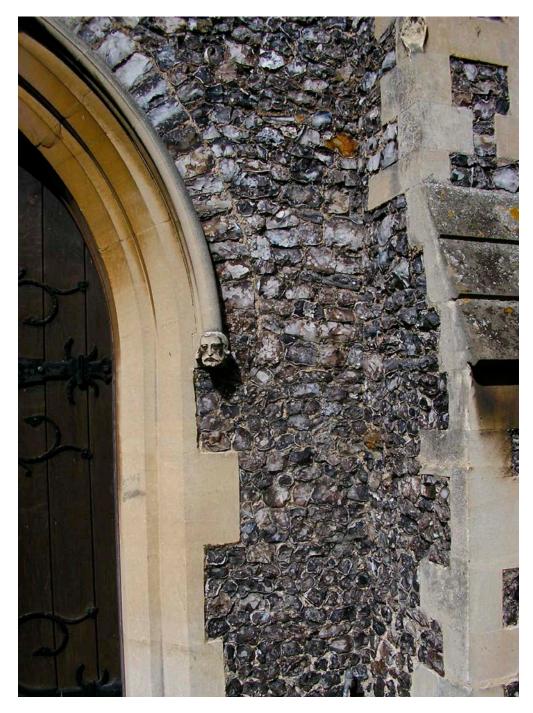


Figure 11: Church of St Mary-le-More, Wallingford. Knapped flint.

Chalk (Clunch)

A relatively durable creamy-white chalk was obtained from a restricted area of south-west Oxfordshire. It was easy to cut and could be shaped into uniform rectangular blocks, up to 500mm across, for use in regularly coursed walls. Quoins and dressings were normally of a harder limestone or brick, and extra support was provided around windows and doors using wooden beams, brickwork or other stone. Chalk is porous (its porosity can be around 30 per cent) and it was essential to have 'good shoes and a hat' to prevent the chalk absorbing water and spalling. This meant that cottages needed a foundation plinth of brick or Sarsen Stone and an overhanging roof (typically thatch) to keep the chalk dry. Chalk stone buildings are seen in the South Oxfordshire villages around Ashbury, Compton Beauchamp, Uffington and Woolstone. The substantial hunting lodge of Ashdown House near Upper Lambourn was built of fine white chalk stone with quoins and dressings of stronger limestone. The chalk is thought to have been quarried from a hard band, such as the Melbourn Rock (3m thick), within the Grey Chalk. In recent years, a quarry at Compton Beauchamp was reopened temporarily to provide stone for repairs at Ashdown House. A similar stone is seen in a few buildings around Watlington and Shirburn, at the foot of the Chilterns in the south-east of the county.

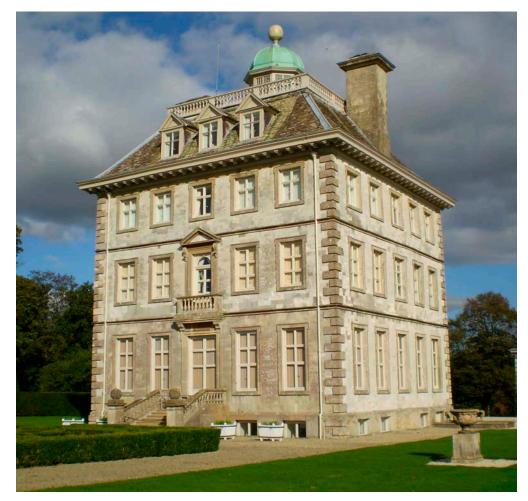


Figure 12: Ashdown House. Chalk with limestone quoins and dressings.

> A less durable creamy-grey-coloured chalk is seen in buildings along the base of the chalk escarpment, from Blewbury through Wallingford, Benson, Warborough and Watlington. This is a softer, friable chalk that is not easily shaped into regular blocks. It has low strength and weathers poorly, tending to absorb water and spall as a result of winter freezing. Such chalk, known as clunch, was used for the regularly coursed walls of the 400-year-old Smalls House in Mackney, but it has deteriorated over the years. More often, it is seen in roughly coursed boundary walls or rubbly infill panels, again resting on a base of less porous material (brick, Sarsen Stone or flint) and with a protective coping of brick or tile. One source of such chalk was the Chalk Pit at Blewbury, which provided a poor quality chalk building stone from the Melbourn Rock Member. Other similar material may come from the underlying Upper Greensand. Totternhoe Stone from Bedfordshire has often been used as a replacement.

Figure 13: Boundary wall. Chalk clunch with a tile capping and flint base.



The substantial hunting lodge of Ashdown House near Upper Lambourn was built of fine white chalk stone with quoins and dressings of stronger limestone. The chalk is thought to have been quarried from a hard band, such as the Melbourn Rock (3m thick), within the Grey Chalk. In recent years, a quarry at Compton Beauchamp was reopened temporarily to provide stone for repairs at Ashdown House. A similar stone is seen in a few buildings around Watlington and Shirburn, at the foot of the Chilterns in the south-east of the county.

Tertiary

Various groups, various formations

Sarsen Stone

Sarsen stone occurs as large sandstone blocks up to several metres in length, which are found as isolated boulders resting on the chalk bedrock in the valleys of the Marlborough Downs in southern Oxfordshire. These are the durable scattered remnants of a sandstone, equivalent to the friable Palaeocene sands found in the London Basin. Huge Sarsen stones were used in their natural unshaped state 5,000 years ago by the Neolithic builders of the Wayland's Smithy long barrow and the Avebury stone circle. The stone is a hard, silica-cemented, quartz sandstone, which in these structures has resisted weathering for thousands of years. However, being so hard, it was not easy to cut and shape. Thus, Sarsen stones were initially used in buildings in their original unhewn condition. Small unshaped stones are seen in rough-coursed walls around Ashbury and Uffington, with dressings made of brick, or as the foundation plinths of chalk or clunch buildings.

Sarsen stones are also widespread as marker stones along roadside verges. In later years, the stones were heated using an open fire to break them up into blocks. These were suitable for walls and cornerstones, but not for intricate carved stonework around windows. Working the stone into regular blocks became easier in the mid-19th century with the introduction of machinery.



Figure 14: Wayland's Smithy Neolithic tomb. Sarsen Stone.

Figure 15: Old Forge Cottage, High Street, Ashbury, Vale of White Horse. Uncoursed Sarsen Stone rubble with brick quoins and dressings.



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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