

## London's History in Stone

The study of the geology and geological materials in the built environment is called urban geology. This phrase encompasses both the bedrock and superficial geology of cities and its engineering and structural properties, but it also includes the study of building stones and other geologically derived construction materials. Stone is a fundamental aspect of our built heritage. The understanding of stone and building in stone is a growing sub-discipline in Architectural History and Archaeology and the study of quarries, quarrying and stone transportation is a field of social history in its own right. A knowledge of architectural stone is important in the conservation of historic buildings and the use of stone as a load bearing material in architecture is once again becoming important in the development of London. As such, urban geology is very much one of London Geodiversity Partnership's remits.

London has a long history of building in stone, lasting over two thousand years. Brick earths were quarried locally but prestigious buildings, fit for a capital city, required stone! The Romans built with Kentish Ragstone and this remained the main stone used in London until the 17th Century, when Portland Stone made its first appearance in the capital. Portland Stone went on to be London's iconic building stone, but it was soon joined by Cornish and Scottish Granite. Paving stones came from the South Pennines and roofing slates from North Wales, Cumbria and Scotland. Internationally imported stone also has a long history of use in London, from decorative marbles imported from the Mediterranean region in the Roman period to the large-scale import of Carrara Marble in the 17th Century. The 19th and 20th Centuries saw the arrival of exotic stones from Scandinavia, India, Brazil and Australia. All of these materials have enriched both the architectural and the geological experience of residents, workers and visitors to London. There is much to be learned about rocks, minerals, fossils, facies and environments from studying building stones. The understanding of building stones is also of fundamental importance to the heritage, conservation and restoration of historic buildings and the preservation of local character in London.

Stone is and always has been a fundamental material used in the built environment. It is strong, load-bearing and can be cut into blocks or carved to form decorative features. It is far more sustainable than manufactured materials including brick, concrete, steel and glass because it requires minimal processing. Stone only requires to be raised from its quarry, cut into shape and transported to the building site. It is easier to maintain constant temperatures in stone buildings and undeniably, stone is beautiful! It is often the case that the predominant building stone used in the urban environment will dictate its local character. These properties and aesthetics were well understood by the architects, masons and slaters who have constructed the city of London over the last two millennia.

London is built on Eocene clay and poorly consolidated Palaeogene sediments. These are more than adequate for making bricks and early London would have been mainly a city built of brick, timber and plaster with roofs of thatch. The only truly local stone used in London's architecture is ferricrete, iron-cemented river gravels. This was used in Mediaeval buildings and can be seen in buildings including Harmondsworth Barn and several west and north London churches. However, unlike cities such as Paris or Rome, London has no local, high-quality building stones. From the Roman period onwards stone has been imported for important buildings. Kentish Ragstone (Hythe Formation, Lower Greensand Group) was used to build London's Roman Wall and buildings including the amphitheatre, which now lies beneath the Guildhall in the City of London. These Roman remains were later 'quarried' to provide stone for Medieval building projects in the city. The Guildhall is built from Kentish Ragstone, probably much of it taken from Roman amphitheatre. Other important Ragstone buildings are White Tower of the Tower of London, the Jewel Tower in Westminster and numerous city churches.

Another stone used in the Medieval period (and probably earlier) was ferricrete. This is not a particularly prestigious or attractive stone and is not seen in the buildings of central London. However, it was used locally to where it was found, typically around north and west London. Ferricrete was used to construct the foundations of Harmondsworth Great Barn and was used in churches including St Mary's Tower in Hornsey and St Mary's Monken Hadley.

Following the Great Fire of London in 1666, Portland Stone (Portland Limestone Formation) became the most important of London's building stones. It was the favoured stone of Sir Christopher Wren and his

circle of architects and who included Robert Hooke and Nicholas Hawksmoor. Portland Stone has given the City of London in particular its 'local character' and is used in buildings including The Monument to the Great Fire, St Paul's Cathedral, the Government buildings of Whitehall, the British Museum and University College London and all 52 of Wren's city churches and most of the town halls of the London Boroughs. Portland Stone still remains one of the most important construction stone used in London today.

From the second half of the 18<sup>th</sup> Century onwards, the use of stone diversified in the capital. Transport of stone became easier, first through the construction of the canals and then the railway network. Steam ships could bring stone from coastal quarries into the London docklands. Granite was brought from Cornwall and Scotland, Sandstones were brought from the north of England, particularly the 'York Stone' (Pennine Coal Measures Group) paving flags, slate was brought from North Wales. The import of marbles from Italy and France and the wider Mediterranean area allowed for sumptuously decorated interiors for civic, religious and public buildings.

The 20<sup>th</sup> Century brought modern construction techniques and materials to London. Skyscrapers and office blocks are constructed of reinforced concrete, steel and glass, but many have stone cladding on both interiors and exteriors. Through the 1970s to 1990s, a taste for exotic, polished 'hard rocks' including granites and gneisses proliferated leading to imports of stone from Scandinavia and the Baltic, Brazil, India, North America and beyond.



### Building Stone

From early in London's history, stone was the main material used in London to build important structures including castles, churches and civic buildings. In the Roman and Medieval periods Kentish Ragstone was the principal building stone, but the Permian Magnesian Limestone was considered a more aesthetic material, despite the cost of transport from Yorkshire to London. This stone was used to build Westminster Hall. However locally formed ferricrete was used in Medieval buildings such as [Harmondsworth Barn](#). Sarsen from Bagshot Heath was used in the construction of Windsor Castle. In the 18<sup>th</sup> and 19<sup>th</sup> Centuries, Jurassic [Portland Stone](#) became the pre-eminent building stone used in London.

Important buildings in Portland Stone are the York House

Watergate (a very early use of this material; above), the Royal Naval Colleges at Greenwich, St Paul's Cathedral, the British Museum and University College London and many, many others. By the 19<sup>th</sup> Century, sandstones were being imported from the Pennines and on occasion, from Scotland. Edinburgh's Craigleith sandstone was used for Chandos House in Marylebone and Millstone Grit sandstone was used for the City of London Magistrates Court. Magnesian Limestone made a reappearance in the mid 19<sup>th</sup> Century construction of the Palace of Westminster and the Jurassic Lincolnshire Limestones and Bath Stone were also used for a good number of buildings.



### A 21<sup>st</sup> Century Stone Renaissance?

Over the last century, stone has taken second place to concrete, steel and glass in London's buildings, and where stone has been used, it has mainly been in the form of thin slabs for cladding and revetment. However, the realisation that stone is more sustainable than steel and glass, because it requires minimal processing, means it is making a comeback as a building material. Buildings including 12, Clerkenwell Close use load-bearing French Chomerac Stone and the temporary 'Stone Demonstrator' construction shows that substantial buildings can be built from load-bearing stone bricks, in this case of Portland Stone and Darney Sandstone. Stone is also being salvaged from demolition sites. The public toilets on Maida Hill (left) are made from reused larvikite and rapakivi granite from

Norway and Finland respectively.





### Roofing Slates

For obvious reasons, roofing slates are the least easy to observe of London's building stones. In the medieval period, thatch would have been the main roofing material but occasionally 'tilestones' such as so-called Collyweston Slate (left), a thinly-bedded, fissile, Jurassic limestone from Northamptonshire were used, for example, on London's Guildhall. In the 19<sup>th</sup> century, roofing slates were brought from the Cambrian and Ordovician slate belts in North Wales, from the Ordovician green slates of Cumbria, and sometimes from the Scottish west Highland and Highland Border slate belts.



### Engineering Stone: Bridges and Embankments

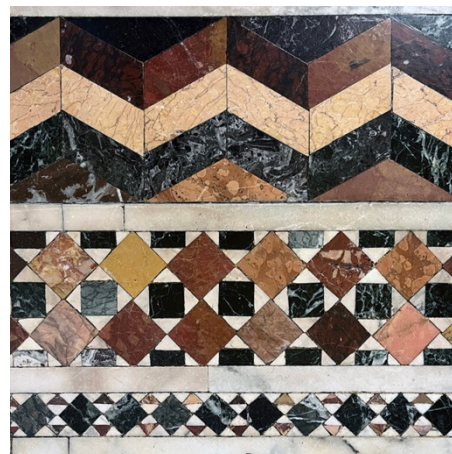
Granite is the supreme engineering stone, with high compressive and flexural strength, it can support the greatest loads. Cornish and Dartmoor granites are available in large blocks, and are the most used granites in London's architecture and engineering works. Granites from Cornwall, Leinster and Wicklow, Newry, Scotland and France were used to construct the Thames Embankment and the docks. Foggintor Granite was used for Nelson's Column, Ross of Mull Granite was used to support the Holborn Viaduct and De Lank Granite was used for London Bridge. Granite is also used for London's kerb stones and was also used for the setts used to pave 19<sup>th</sup> Century London. Pavements frequently employ York Stone, a generic name for sandstone flagstones derived from the

Carboniferous Millstone Grit and Coal Measures Groups of the southern Pennines. Caithness stone paving is also used paving in a few locations, for example, around the Cutty Sark in Greenwich.

### Decorated Interiors: Ornamental Stones

Interiors decorated in exotic ornamental stones have been popular since the Roman period. Marbles and porphyries, both able to take a good polish, were used to decorate London's Roman amphitheatre.

Porphyries from Egypt and Greece, Mediterranean and British marbles (including true marbles in the geological sense and hard limestones) and Italian serpentinites were used in the 13<sup>th</sup> Century Cosmatesque pavement at [Westminster Abbey](#). Purbeck marble was used in old St Paul's and now paves the piazza in front the Cathedral. In the 17<sup>th</sup> Century black and white marble from Belgium and Italy was used to pave the marble floors in the Queen's House at Greenwich and the interior of St Paul's Cathedral. The taste for ornamental marbles exploded in the 19<sup>th</sup> and early 20<sup>th</sup> Centuries, with the construction of marble encrusted interiors, including the National Gallery's foyer, Westminster Cathedral, The Fitzrovia Chapel (right), [The Brompton Oratory](#), the Courts of Law, [the Russell Hotel](#), the [Natural History Museum](#) and the Blackfriars public house.



### Stone in Sculpture and Installations

A wide range of both local and exotic stones are used for memorial and public sculpture in the capital. Traditionally, granite was used for plinths to bronze statues, mostly erected in the 19<sup>th</sup> Century. In Parliament Square, stone plinths are carefully chosen to represent the statue above. Churchill stands on Cornish Granite, whilst David Lloyd George stands on a block of Caernarfonshire slate and Jan Christian

Smuts stands on a block of South African gabbro. Contemporary artists have turned to more exotic and decorative stones. John Aiken's sculpture *Monolith & Shadow* at UCLH is a Precambrian conglomerate from Brazil. Sabine Marcelis's installation '[Swivel](#)' (right) in St Giles uses brightly coloured stones to construct rotating chairs and Sean Sully's sculpture '[Landline](#)' in Hanover Square represents geological strata in the form of coloured, polished marbles.



### Stone and London's War Memorials

Stone-constructed [War Memorials](#) often use stone that reflects either the soldier or troops being commemorated or the theatre of war. Portland Stone has always had resonance in the use of British War memorials, both at home and abroad and is the stone most frequently used for Commonwealth war graves. The Malta Memorial EC3R (left) is made from Oligocene limestone from the island of Gozo, and the ANZAC War Memorial at [Hyde Park Corner](#) is made from a charnockite from Western Australia.



### Stone in London's Cemeteries

London's great Victorian cemeteries are exceptional places to search for exotic stones, especially granites and other igneous intrusive rocks. LGP has a geotrail for [Kensal Green Cemetery](#), the place of burial of a number of 19<sup>th</sup> Century geologists and engineers including George Bellas Greenough, Henry de la Beche and Isambard Kingdom Brunel. The monument to Indian-born lawyer Dawoda Dabojee (left), also in Kensal Green is constructed from Vindhyan sandstone brought specially from Rajasthan, India.

### Random Rocks and Fossil Trees

A number of rough blocks of stone and the odd fossil tree have been used as memorials, monuments and simply as novelty installations. These include Late Jurassic fossil trees stumps at [Regent's Park](#) and on Tooting Bec Common, boulders of Archean Lewisian Gneiss at various locations in [Bromley](#) and Sarsen Stones in Gordon Square WC1E (right), in Hanwell in Ealing, in [Harrow](#), in [Lampton Park](#) in Hounslow, in [Ruislip](#), [Kingston-upon-Thames](#) and the eponymous whetstone at [Whetstone](#) in North London. Glacial erratics have also been sourced to create public sculpture, including Anthony Gormely's 'Planets', at the British Library, Simon Hitchen's 'Glorious Beauty' in Earl's Court and also for Hilly Fields Stone Circle in Lewisham.







### Global Heritage Stone in London

The International Union of Geological Sciences (IUGS)'s Subcommission on Heritage Stone designates [Global Heritage Stones \(GHS\)](#) based on their use in UNESCO World Heritage Sites and/or their impact in national and international architecture from antiquity to the present day. Welsh Slate and Portland Stone are designated GHS resources for the UK and are both widely used in London. An important Indian GHS, Jaisalmer Limestone is used in the [Shri Sanatan Mandir](#) in Alperton, West London (left). Many other GHS resources such as Norwegian larvikite, Italian Carrara Marble, German Jura Limestone and Irish Connemara Marble are also to be found in London's buildings.



### London Brick and Artificial Stones

Brick and other ceramic materials have always been important in building London. London Clay and the overlying Claygate Beds are suitable for brick making and the Pleistocene-Holocene loess deposits, the Brickearths, are as their name suggests, very suitable for making bricks. Brickworks were located in [Wickham Lane](#) in Greenwich, in Willesden Green, on Hampstead Heath and in Notting Hill. Extensive brickfields were established in West London which were active until the end of the 19<sup>th</sup> Century.

Ceramics have also been used in the form of artificial stones such as Coade Stone and its imitators. The caryatids on St Pancras Church are an artificial stone. Pulhamite was a concrete-based materials used to building 'rock-works' in parks and gardens and resembled natural outcrops. It has been used in [Battersea Park](#), [Bromley Park](#), [Sundridge Park Manor](#) and at [Knighton Wood](#).