

# BUILDING AND CONSTRUCTION MATERIALS

## THE USE OF CONSTRUCTION MATERIALS

Building and construction materials are non-metallic rocks & minerals, which have properties to suit their purpose. They tend to be cheap, highly available and they are brought in bulk. The local geology greatly influences the architecture of Britain. For instance, in Aberdeen, buildings are built using Granite, in Bath with buildings make use of the local limestone and in Chester, the buildings use sandstone.



## THE TYPES OF BUILDING MATERIALS

### Building stone

**#Building stone (dimension stone)** is cut and dressed into blocks to be used in buildings, interior design for flooring/kitchen surfaces, and for curbstones.

Common building stones: Limestone, sandstone, granite, marble and slate.

Slate is a fissile rock (splits easily into thin sheets owing to its cleavage planes) and so is ideal for making into roofing tiles.

Key features of building stones are:

- Competent with a high load bearing strength.
- Well jointed so blocks are easily extracted or soft enough to allow for sawing into blocks.
- An attractive appearance.
- Occurring in thick, uniform units with few structures or weaknesses to ensure good-quality products.
- Impermeable and resistant to both chemical and mechanical weathering.



## Aggregate

- **Natural aggregate:** is sand and gravel extracted from recent Quaternary river, fluvial-glacial and shallow marine deposits. The sand and gravel must not contain vast amounts of impurities such as clay. Natural aggregate is extracted from beds that are linear without inclination or any vertical variation since this will reduce the consistency of the product.
  - Pure quartz (orthoquartzite) sand is useful for making glass.
  - Sand is used as an abrasive in industry, for mortar, concrete and ballast in construction.
  - Pebbles that are rounded are used in concrete since when it is poured they must be able to slide over each other.
- **Crushed rock aggregate:** is mainly used for road construction. The hard rocks are crushed for construction. They commonly include igneous rocks, gneiss, limestone or greywacke, along with industrial waste such as slag from the iron blast furnace.

## Roadstone

This is crushed aggregate mixed with bitumen (hydrocarbons) and used for road surfacing. Roads are constructed in layers, with a high loadbearing base-course that is overlain by a top-wearing course. It is essential that the rocks used be:

- Strong with a high impact strength in order to withstand the high load from traffic.
- Resistance to abrasion from car tyres as well as resistance to mechanical weathering such as freeze thaw.
- Impermeable and resistant to chemical weathering or corrosion from chemical spills/ salting of roads in the winter.
- Skid resistant, each chipping must be made of more than one mineral with a different hardness so that they wear down at different rates, thus preventing polishing.
- Bound well to the bitumen.

**#Bitumen** = a black viscous/semi-solid fraction of hydrocarbons obtained as a residue from distillation of crude oil. It is used for road surfacing and roofing.

**#Aggregate** is the general term used to describe unconsolidated construction materials of sand and gravel size.

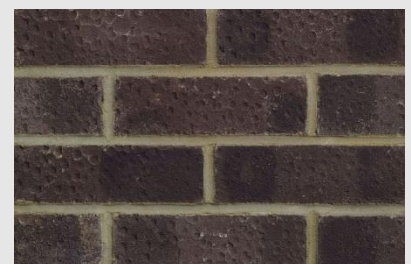
On balance, **rocks such as dolerite and basalt are best**. Granite is not a good choice since it suffers polishing. In reality, mainly local sources are used, so roadstones vary enormously.

## Brick clay

Bricks are made from clay, mudstone or shale. Different compositions produce different coloured and types of bricks. The clay is molded into the required shaped and fired in a kiln at high temperatures. Thick beds with a constant composition are required.

About 40% of British bricks are made from the Jurassic Oxford Clay.

This has a **high carbon content** which acts as an **internal fuel** when the bricks are fired, **reducing energy costs** and making the process **more uniform**.



Epoch	Stage	Age Ma	Buckinghamshire		Lithostratigraphy
			Oxfordshire	Bedfordshire	
Upper Jurassic	Portlandian	146	Purbeck Fm. Portland Limestone Mb. Portland Sand Mb.		Purbeck Formation Portland Formation
	Kimmeridgian		Kimmeridge Clay Formation		Ancholme Group
	Oxfordian		Amphill Clay Formation West Walton Formation	Corallian Group	
Middle Jurassic	Callovian	157	Oxford Clay Formation		Great Oolite Group
	Bathonian	161	Kellaways Formation Cornbrash Forest Marble Blisworth Clay White Limestone Fm. Rutland Formation Stuarthe Limestone Fm.		
	Bajocian				Inferior Oolite Group Upper Middle Lower
	Aalenian		Grantham Fm. Northampton Sand Fm.		

### Manufacture of cement and concrete

#**Cement** = a mixture of crushed limestone, clay or shale and water.

Limestone provides **calcium carbonate** while clay provides **silica and alumina**. The mixture is roasted in a **rotary kiln at 1500°C** and **5% gypsum** ( $\text{CaSO}_4$ ) is added to ensure the cement does not settle too quickly.

#**Concrete** = a building material made from a mixture of broken stone or gravel, sand, cement, and water. It forms a stone-like mass on hardening.

### Key definitions

- ❖ **A quarry** is an open cast mine for hard rocks.
- ❖ **Drilling and blasting** is the process by which shot holes are drilled into a rock and filled with explosives that are detonated to break up the rock.
- ❖ **A pit** is an opencast mine for poorly consolidated material such as sand, gravel, clay and coal.
- ❖ **Dredging** is the method by which material is scraped or sucked from the river or seabed.

## EXTRACTION OF INDUSTRIAL ROCKS AND MINERALS

The vast majority of industrial rocks and minerals are mined from opencast quarries.

This type of mining often has similar environmental issues associated with opencast metal mining but often on a much larger scale.

Hard rock quarries employ drilling and blasting to extract rocks. If there are joints already, in place then extraction is easier and the material comes out in natural block shapes. Wire saws are also used in the cutting of softer rock material.

Unconsolidated sands and gravels are extracted from opencast mines (pits) or by dredging a sea or river bed.

In most cases, so much material is extracted from open cast mines that there is an overburden and there is not enough material to fill the excavation back.

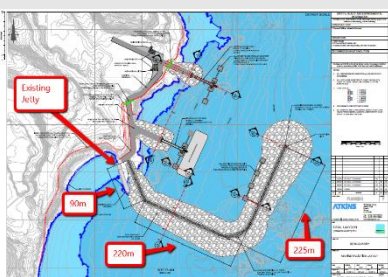
If the open pit mine reaches below the water table then the excavation site will fill with water and become flooded once pumping and extraction ceases.



After excavation, open cast mines leave a scar on the landscape and so many restoration techniques are considered. Some of which include: flooding to create a reservoir or lake that could be used for wildlife or recreation. Sometimes they are used as landfill sites for waste disposal.

### Two controversial strategies to satisfy our demand for these commodities are:

1. **The development of coastal super quarries:** These are large quarries situated in coastal areas so aid the opportunity to transport large amounts of rock material across the world at lower costs by shipping. However, coastal areas are considered areas of outstanding natural beauty and so many people consider this type of approach to mining as a 'not in my back yard' attitude (NIMBY) to the environment.
2. **Offshore dredging for marine aggregates:** This would disrupt marine ecosystem and could lead to the contamination of vast oceans (chemicals & oil spills & rock dust). It may also change the direction of sea currents so disturb aquatic migration or the rates of coastal erosion.



## CASE STUDY – GLENSANDA SUPER-QUARRY

Glensandar is located in the West of Scotland in the Lochaber area. It is on a remote inaccessible part of the west coast near Oban.

- A huge super quarry is responsible for the shipping of 7,000,000 tons of granite aggregates all over the world annually with reserves of 800 million tonnes.
- Granite is extracted by drilling and blasting methods and is crushed on site. It is then shipped from the coast to Southern areas.
- To minimize visual impact from the coast, it is situated 1 mile inland and cuts down into a 1,600 feet mountain, using conveyor belts to extract the granite aggregates up to the quarry.

All the aggregate used to build the English half of the channel tunnel was sourced from Glensandar quarry.

While the quarry provides a major source of employment for the local area, many locals have said that the landscape has been ruined and the environment polluted.

Despite this, the Highland Council gave Holcim, the company operating the super-quarry, the go ahead to increase the quarry size from 125 Ha to 206 Ha.

