

Construction UNIT 1

Knowledge organisers

1.1 The sector

INFRASTRUCTURE

- Buildings
- Roads
- Railways
- Bridges
- Pipe systems for clean water
- Sewerage systems
- Powerlines for electricity and telecommunications
- Pipe systems for gas

Designer/ Architect



- Creates new buildings/ renovates existing buildings
- Produces designs to meet the clients requirements
- Considers all regulations, laws and legislations, and environmental requirements
- Produces detailed drawings for the contractor

Site/ contract manager



- Responsible for coordinating construction site activities
- Organises resources of labour, plant and materials
- Undertakes the day-to-day activities on site
- Is responsible for health and safety on site and for the welfare of workers.

The construction industry is responsible for the **designing, building** and **maintenance** of all the buildings that surround us. These include all buildings in which we live, work, shop and socialise in.



To **function** as intended, these buildings need to be connected by transport networks (roads, railways, bridges, tunnels)

They also need to receive essential services (energy, telecommunications, water, sewerage) provided by a system of pipes and powerlines

MECHANICAL ENGINEER

VENTILATION/ AIR CONDITIONING

LIFTS/ ESCALATORS

HEATING

ELECTRICAL ENGINEER

Communication lines- phone, internet, IT network

Energy supply

Security alarms, fire detection, sprinkler systems

Lighting

PUBLIC SERVICE ENGINEER

Plumbing for water supply/ domestic hot water

Drainage for waste water

Storm water drainage

Quantity Surveyor



- Makes payment to subcontractors and suppliers •
- Produces a final account at the end of a project •
- Is responsible for the control of budgets and control of cost.

Surveyor



- Assesses the land, surrounding environment, wildlife
- Tests the quality of land for building
- Produces structural solutions
- Assesses potential risks within a project.

1.2 The built environment lifecycle

Industries which get the raw materials from the earth- Mining for metals, quarrying for aggregates (stone), forestry for timber and oil extraction for plastics



1. Raw material extraction

Taking the raw materials and turning them into usable forms, such as timber logs into planks, clay into bricks, ore into steel beams, oil into plastic window frames.

2. Manufacturing



Using the materials to build new buildings, extensions, conversion or civil engineer projects like roads, bridges, sewerage systems.

3. Construction

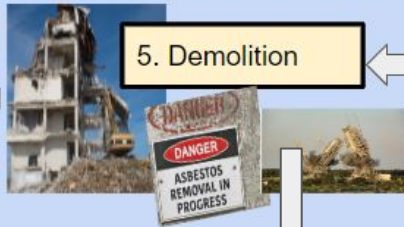


Cleaning, checking, repairing and servicing the building and systems, such as checking fire and smoke alarms, servicing boilers, cleaning the building.

4. Operations and maintenance



5. Demolition



6. Disposal



Getting rid of all the materials from the demolition. They can be reused in their natural form, recycled into something else or put in a landfill. Some materials are used as cut and fill



Excavation materials can be retained on site by a balanced cut and fill excavation.

Greenfield sites
Areas of land which have not previously been built on.
Usually countryside/ rural areas. **Building on these sites needs permission, and is often seen as harmful to the environment/ landscape. It does provide more housing, cleaner living areas and it gives developers a blank canvas to design and build on. However it creates less green space for locals and visitors.**



Brownfield sites
Areas of land which have previously been built on.
Usually urban/ inner city areas. **Building on these sites usually is easier for planning permission but may have costly clean up/ demolition needs. Local traffic, buildings, transport routes and people can be affected. Positives are that it regenerates an area and can provide safer and more attractive areas.**



Destroying the building using explosives, machinery or hand. Must have a plan including live utilities, public safety and hazardous materials.

ADVANTAGES/ DISADVANTAGES OF RAW MATERIAL EXTRACTION INDUSTRIES

- Advantages**
- Jobs
 - Revenue/ economy
 - Well being of people- improved area
 - Materials needed

- Disadvantages**
- Air, noise and water pollution
 - Damage to landscape
 - Loss of habitat
 - Hazardous areas

1.3 Types of buildings and structures.

Residential Dwelling- a building designed to be lived in.

- Used as habitation
- Are the smallest types of building
- Vary by location- flats in urban areas, detached in rural areas
- Made of timber/ brick mostly
- Are in demand due to shortage of affordable housing

DETACHED HOUSE



Stand alone, front and back gardens, more rural areas, larger in size



Share 1 common wall with another house, often have a drive and gardens

SEMI DETACHED HOUSE

Connected to a row of houses, saves space in towns, small gardens, limited parking



TERRACED HOUSE

FLAT

Several rooms over 1 floor, in a larger building, multi story. Saves land in busy areas



SOCIAL



ENVIRONMENTAL



ECONOMIC



Effects on people

Effects on the environment

Financial effects

Non- Residential Dwelling- a building designed not to be lived in.

commercial

Shops hotels



Used to provide services or retail products
Used for business owners to make a profit
May be adapted or purpose built
Often in retail centres/ city centres

religious

Church mosque



Places of worship
Vary considerably in terms of age, size, and architectural style
Can be elaborate, with towers, domes.

community

School Library hospital



Used by members of the community
Located in a convenient location
May be modern or old, or converted for its purpose

industrial

Factory warehouse



Larger buildings
Often used for storage, processing or manufacturing
May be part of a new development eg) industrial park

agricultural

Farm house Cattle store



Associated with farming and agriculture industry
May be older and constructed of more traditional materials such as stone
May be a large modern facility for a specific purpose eg) milk production, but still set in rural location

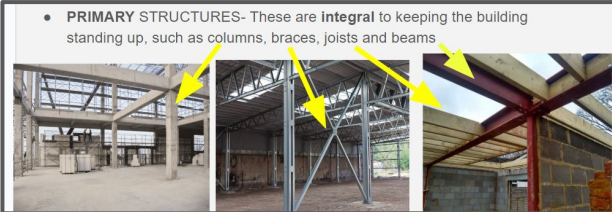
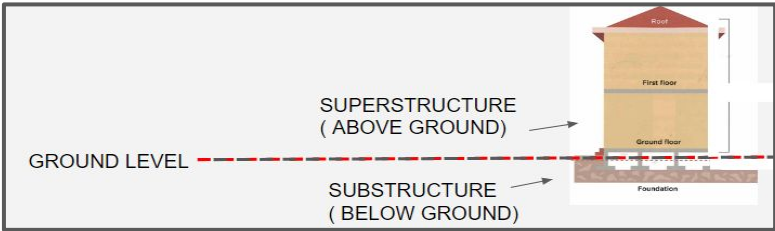
recreational

Gym cinema



Vary considerably in size and style
May be buildings in their own right or extensions to another building
May be for a specific purpose or multi use

Static load	Dynamic load	Impact load
A load which remains still (roof)	A load which moves and varies (people)	A sudden load (falling object)



Secondary structures

These are the structures that hold things up but are not **crucial** to the building's structural **integrity** such as stud walls, lintels and trusses.



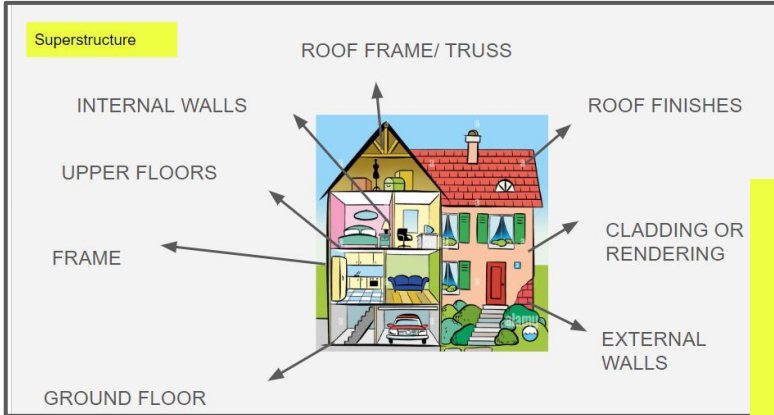
Building Services materials

For this topic we will look at some of building services materials:

- Plastic and Copper pipework for plumbing and heating services.
- Plastic rainwater goods and drainage systems.
- Copper cable for electricity and communication systems.



1.4 Renewable technologies and materials



RENEWABLE MATERIALS

ROOF TRUSS	TIMBER, STEEL
ROOF FINISHES	SLATE, CONCRETE TILES
EXTERNAL WALLS	BRICK
CLADDING	TIMBER, ALUMINIUM, STEEL, FIBREGLASS
INTERNAL WALLS	TIMBER, STEEL, BLOCK
GROUND FLOOR	CONCRETE
INSULATION	WOOL, FOAM
BEAMS, JOISTS	TIMBER, STEEL
LINTELS	STEEL, CONCRETE

Substructure

Foundations: safely transmit the loads of the building to the sub-soil, to settle within acceptable limits for settlement, to support the loads of the building for its lifespan

Renewable Technologies and Materials.

These use natural energy from sources such as wind, sun, rivers to produce electricity. They will never run out, unlike our coal, oil and gas sources. There are benefits to using renewable technologies.....

Renewable Technologies and Materials.



Wind turbines

Harness the power of the wind to create electricity'

Benefits- Saves money on electricity bills. Environmentally friendly, generates power day and night, can sell excess to NG.

Drawbacks- Expensive to set up, not attractive, less effective when no wind, have to clear land to install them, can emit noise, need planning permission.

Renewable Technologies and Materials.

SOLAR PHOTOVOLTAIC

The direct conversion of light into electric using semiconducting materials. Benefits- efficient in summer, excess energy can be sold to the national grid, they are efficient enough to power household appliances and needs.

Drawbacks- Not efficient in winter, expensive to set up.



SOLAR THERMAL

Uses energy from the sun to heat fluid, which in turn generates heat or electricity.

Benefits- more efficient and cheaper than SP, environmentally friendly way of heating water, can sell excess to NG.

Drawbacks- Expensive to set up, shorter life span than SP, less effective in winter.



Renewable Technologies and Materials.

HEAT PUMPS

AIR	GROUND	WATER
		
Heat pumps take the air from outside and turn it into heat which can be stored for later use.	Heat pumps are made up of a network of water pipes buried underground, the natural heat found underground warms the water and it stored for later use.	Heat pumps use the water from natural lakes, ponds and rivers. Water is pumped by suction and heat energy is generated,

Benefits

Low running costs
Less maintenance needed
Safer than gas
Reduce carbon emissions
Can cool as well as heat
Long lifespan

Drawbacks

Expensive to set up
Hard to install
May need other heat supplies at times
They do need electricity supply to work

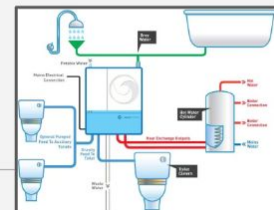
Hydro electricity

The use of moving water to create energy.



Grey water reuse

Collecting bath and shower water to use for watering plants, flushing toilets etc



Rain water harvesting (RWH)

Collecting rainwater and using it to flush toilets, in washing machines, watering plants etc



1.5 Buildings and structures



Our built environment includes many historic buildings, some of which have been given listed status. This means the building has some architectural or historical interest and must be protected.



Ornamental plasterer



Ornamental carpenter



Blacksmith



Stonemason

Heritage and traditional construction methods

It is essential that the maintenance and renovation of such buildings is undertaken by experienced and qualified tradespersons who specialise in traditional methods. This is to....



- Ensure the history and character of the building is maintained
- Preserve heritage for future generations
- Comply with planning regulations within conservation areas

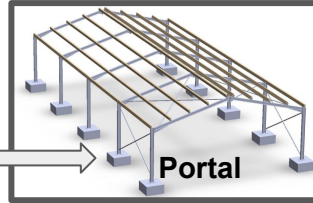
Individual cells or rooms which are made of concrete. Walls are all load bearing. Usually restricted to 6-1 storeys due to weight. Noise and fire resistant. Often used in flats/apartments.

Cellular



Vertical columns permanently fixed to horizontal/diagonal beams and trusses. Made from steel, or reinforced concrete. Advantages- lightweight, low cost, can be pre fabricated, good for large buildings such as agricultural, warehouses etc

Portal



The weight of the building is carried by a framework of columns and beams. This frame supports the walls, roof and internal floors. Used for tall buildings and skyscrapers. More flexibility for external materials such as cladding/ glass. Smaller buildings will have timber frames, but larger buildings will have steel and reinforced concrete frames.

Rectangular



Older buildings also need a good maintenance program to keep them from decay, damage and deterioration. It is important that materials and methods of construction match the original design as much as possible and that as much of the original features are kept wherever possible.

Building renovation includes installing essential services such as heating, lighting, ventilation, security etc. There are certain rules developers must consider....

Mitigation- reduce the severity of change to the building when installing new services.

Minimisation- choose effective and affordable options to minimise change to the building

Reversibility- consider how the removal of these services will eventually affect the building.

1.6 Sustainable construction methods

Pollution and the preservation of natural environments and habitats

The most important factor in preserving the natural environment when undertaking a construction project, is limiting the pollution of water, air and ground surfaces. It is vital that an environmental risk assessment is done in order to put specific measures in place to prevent or reduce pollution. (mitigation) These include.....

Dust suppression- use mesh screens, fine water mist to reduce dust.

Avoid burning any materials on site

Use non toxic paints and solvents and segregate any hazardous substances to avoid contamination



TASK- Complete the diagram

Covering materials such as stones, cement so they don't get washed into rivers

Reduce noise pollution by using less noisy machinery and power tools

Collect any waste water and dispose of it responsibly

Certain areas in the UK are protected because of their environmental, historical or cultural value to the nation

They may have protected status:

AONB- Area of natural beauty

SSSI- Site of special scientific interest

What is sustainable construction?



Sustainability is 'meeting the needs of the present without compromising the ability to meet the needs of future generations.'

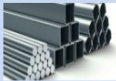
Sustainable construction aims to create a world which will improve the lives of future generations by using environmentally friendly construction methods. In order to achieve this, builders and designers aim to meet the following targets:

1. Improve energy efficiency
2. Use sustainably sourced materials
3. Reducing waste
4. Reducing pollution
5. Protecting the natural environment



Strategy 1- Reducing carbon emissions in construction

Sustainable materials- All materials used in construction have some impact on the environment, but these materials all help sustainability and the environment because they can be regrown, reused or recycled.

Wood	Steel	Reclaimed brick	Straw bales	Wool	Slates/ tiles
Roof, internal walls, cladding	Roof, external frames, lintels	External and load bearing walls	Insulation in brick/ steel walls	Insulation in brick/ steel walls	Roof finishes
					

Strategy 2- Waste disposal

It is important to **classify** materials first. Materials need to be identified and put into separate categories so each can be dealt with correctly- REUSED, RECYCLED, or DISPOSED of.



Financial benefits of using sustainable construction methods

As well as the legal and moral necessity of implementing sustainable construction methods, there are also lots of financial benefits to building 'green' buildings. They are cheaper to run, and use less global energy.

Minimising waste- less over ordering and less leftover material

Using sustainable materials- recycled timber, reclaimed bricks etc

Reducing energy consumption- new technologies such as heat pumps etc

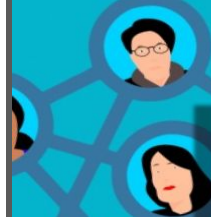


Cultural and social benefits of sustainable construction

Sustainable construction is concerned with improving the wellbeing of all stakeholders- including construction workers, local residents, and occupiers.

Reducing pressure on local infrastructure- reduce traffic congestion and ensure transport networks run smoothly

Improving householder's comfort- use intelligent heating, lighting, ventilation systems



Tiler

- Prepares and levels off the surface
- Cuts tiles to correct size using manual or electric tile cutter
- Fixes tiles with adhesive
- Grouts tiles



Bricklayer

- Works from plans/ specifications
- Lays rows of bricks/ blocks
- Shapes and trims bricks using chisels or power tools
- Applies mortar with trowel
- Checks vertical and horizontal alignment with spirit level/ plumb line
- Uses stretcher bond or other types of layout



Painter and decorator

- Wallpapers. Paints interior walls and woodwork
- Strips old paper and paint
- Fills holes and cracks in surfaces
- Stains and varnishes timber work



Trades, employment and careers

The construction industry requires a range of skills and work to be carried out by various trades, be that on a new build, a renovation or heritage project. The following trades are the most common, although there are many more within the sector.

WE HAVE ALREADY LOOKED AT THE PROFESSIONAL ROLES WITHIN THE SECTOR-

- Architect
- Surveyor
- Quantity surveyor
- Site manager

AND THE ENGINEERING ROLES-

- Mechanical engineer
- Public services engineer
- Electrical engineer
- Structural engineer

Plasterer



- Prepares and levels surfaces
- Mixes plaster
- Applies wet plaster to walls, ceiling, outdoor areas
- Creates ornamental plaster work such as ceiling decoration
- Fixes plasterboard on to stud walls (drylining)

1.7 Trades and employment

Plumber



- Follows regulations (gas safety)
- Installs cold and hot water systems, boilers and heating.
- Cuts and joins pipes
- Installs showers, washing machines
- Unblocks drains

Carpenter/ Joiner

Joiner

- Marks and measures wood from technical drawings
- Cuts wood by hand or machine
- Joins wood to form structures such as staircases, windows, door frames, roof trusses

Carpenter

- Installs wall partitions, roof trusses, doors, skirting, cupboards, kitchens
- Replicates ornamental mouldings
- Fits interior woodwork in shops, public buildings.



Electrician



- Installs, inspects and tests electrical services and equipment
- Follows relevant safety regulations
- Installs street lighting and traffic lights
- Fits electrical sockets and switches
- Rewires buildings in need of updating

1.8 Health and Safety

The **RISK** is the likelihood that a person may be harmed if they are exposed to a **HAZARD**, which is anything with the potential to cause harm. These include....

- Heavy machinery, equipment and vehicles
- Working at height
- Manual handling and lifting
- Slips, trips and falls
- Working in enclosed spaces
- Working with live electricity/ gas
- Dust and noise
- Exposure to chemicals and hazardous substances
- Falling objects
- Fire, and hot work such as welding



Working in enclosed spaces

Risks such as poor ventilation, gases, risk of flood, trapping or explosion makes working in enclosed spaces very dangerous. There are recommendations to prevent such occurrences.

- Training for employees on dangers and rescue procedures
- Testing for flammable and toxic gases
- Use of breathing apparatus
- Wearing rescue harness or lifeline
- Person posted outside the entrance
- Rescue procedure in place



LEGISLATION

HASAWA Health & Safety at Work Act 1974

Ensures that staff have adequate training and provisions.

Demands a safe working environment

Ensures the workplace provides relevant information and supervision

The management of Health & Safety at Work Regulations 1999
Ensures employers carry out risk assessments, manager, training, policies and risk assessments

Manual Handling Operations Regulations 1992
Regulations which aim to prevent risks from lifting or moving heavy loads.
Recommends the use of aids such as forklift trucks, hoists etc

**RIDDOR
The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations**
Requires employers to record all accidents, injuries and deaths relating to employees and the public, caused by or relating to the workplace.

PUWER Provision and Use of Work Equipment Regulations 1998

Ensures all equipment used at work is suitable, safe, maintained and inspected.

Ensures employees are adequately trained to use the equipment.

Demands safety measures such as guards, emergency stops etc

HSE The Health and Safety Executive

The government body set up to enforce health and safety rules are adhered to in the workplace.

Types of PPE



Working at height

The most dangerous activity with the most deaths, working at height carries many recommendations.

- Use scaffolding, guard rails, harnesses, mobile elevated work platforms (MEWP).
- Avoid working in bad weather
- Provide training
- Ensure all equipment has been tested and checked.

Safety when working with gas, water and electricity

Working with these utilities undoubtedly carry risks to workers and the public. There are laws in place to prevent such accidents.

- All workers must have the correct qualifications Eg) Gas safety registered
- Regular checks and inspections to take place
- PPE must be worn
- Supply must be cut off before working on it

