# Knowledge Organiser: Design & Technology / Construction (Component 1) OVERVIEW

## A1 Low rise construction requirements

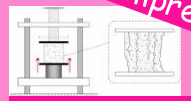
Timber grading

Deciduous (D) = Hardwood

Coniferous (C) = Softwood

Concrete testing

Compressive



Tests how much pressure set concrete can take

Slump

Tests the ratio of cement and water

## A2 Sustainability

Timber cladding

Renewable materials

Grass sedum roof

Brownfield

Has previously been built on

Greenfield

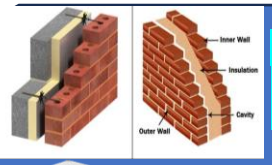
Has never been built on

Prefabrication

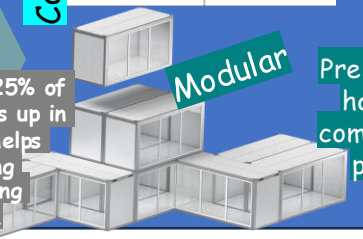
Currently, an estimated 25% of construction material ends up in landfills. Prefabrication helps reduce waste by optimising material usage and enabling offcut reuse or recycling.

## A3 Common structural forms

Cavity wall:




Outer layer = bricks
Middle layer = insulation
Inner layer = blockwork



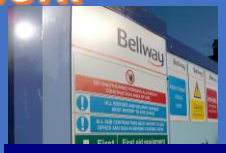
Modular

Prefabricated parts that have been made before coming to site and can be put together in lots of different ways!

## B1 Pre-construction work

Temporary fencing

Temporary lighting




Health and safety signs

HSE Health & Safety Executive

The **Health and Safety Executive (HSE)** is Britain's national regulator for workplace health and safety.

Site clearance


Site layout plan

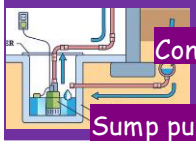
## B2 Sub-structure groundworks

Steel

Timber

Trench support

HAZARDS
Working in confined spaces



Sump pump

Control of sub-soil water

Gravity drainage

FOUNDATIONS

Pile

Trench fill


Raft

Strip

## C1 Walls

Sills

Lintels

Windows

Damp proof course (DPC)

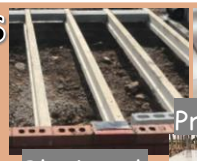
What does a wall do?

- Thermal insulation
- Sound insulation
- Containing electrical and plumbing fittings

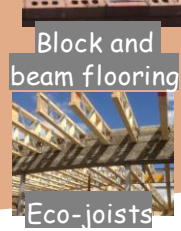
Structural support of:
Walls
Floors
Ceilings

## C2 Floors

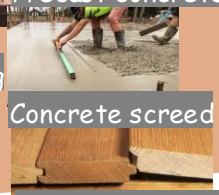
**What do floors do?**
A = They transfer the load from walls to the foundation



Precast concrete



Block and beam flooring



Concrete screed



Eco-joists



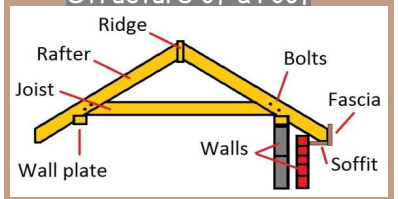
Tongue-and-groove

**Types of floors:**
- solid
- timber
- precast concrete beam and block
- engineered timber
- eco-joists

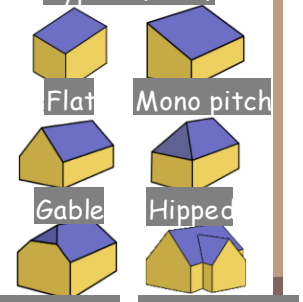
**Types of floor finish:**
Screeded
Tongue-and-groove

## C3 Roofs

Structure of a roof




Types of roof




## D1 The type of work in the construction industry

Civil engineering

Transport

Commerical

Education


Healthcare



Residential

## D2 The built environment



Coastal defences



Water ways



Roads



Railways



Cycle paths

# A – Understand the performance requirements for low-rise construction

## A1 Low rise construction requirements

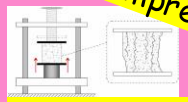
**Timber grading**

Deciduous (D) = Hardwood

Coniferous (C) = Softwood

**Concrete testing**

**Compressive**



Tests how much pressure set concrete can take

**Slump**

Tests the ratio of cement and water

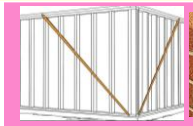
**Weather resistance** – To prevent water and moisture entering a building

Soffit boards

Flashings

Weather sealants

**Lateral and vertical restraint**



Wind bracing

Straps

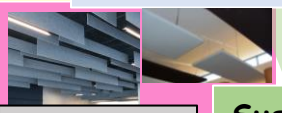
To prevent walls and roof structures moving due to pressure from wind.

**Thermal insulation** – To prevent the entry of cold air to a building

Fibreglass

Double/ triple glazing

**Sound insulation** – To prevent sound entering or exiting a building



Acoustic panels

**Fire resistance** – To stop or slow down the spread of fire.

Plasterboard

Fire doors


Intumescent paint

## A2 Sustainability

Timber cladding

Renewable materials

Grass sedum roof

**Brownfield**

Has previously been built on

**Greenfield**

Has never been built on

**Prefabrication**

Currently, an estimated 25% of construction material ends up in landfills. Prefabrication helps reduce waste by optimising material usage and enabling offcut reuse or recycling.

**What is the purpose of sustainable construction?**

Sustainable construction aims to reduce the amount of natural resources used so that they don't run out. The aim is to **preserve resources** for future generations by using **renewable materials and energy sources**.

**Alternative energies** (Renewable energy)

Solar (Sun)

Wind

Hydro (water)

**Building orientation**

In the UK, windows should face **SOUTH** to maximise the amount of natural light.

**Advantages:** Less electricity used for heating and lighting due to more sun exposure.

**Disadvantages:** Too much heat could cause building users to use fans and air conditioning which uses energy.

**Sustainable materials**

Bamboo

Cobb (straw)

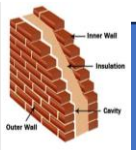
Timber

Cork

Wool insulation

## A3 Common structural forms

**Cavity wall:**

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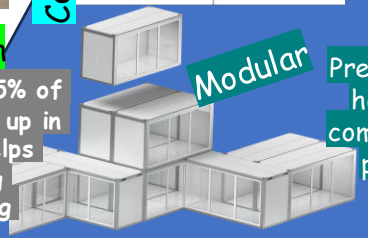
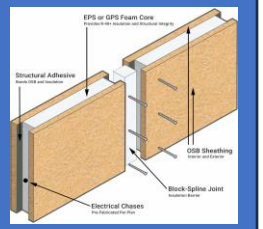
**Modular**

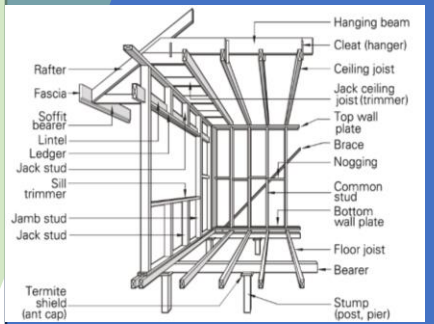


Prefabricated parts that have been made before coming to site and can be put together in lots of different ways!

**Structurally Insulated Panels (SIPs)**

Another form of **prefabrication**, SIPs are pre-insulated panels with two layers of manufactured board and a layer of foam in the middle. SIPs are a faster form of construction as they are already built and insulated.




**Timber Frame**

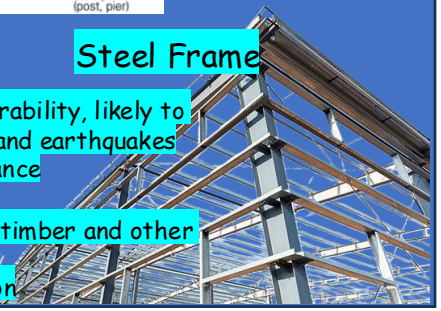
**Advantages:**
>Eco friendly using renewable materials
>Quick form of construction

**Disadvantages:**
>Not as fire resistant
>Not as moisture resistant

**Steel Frame**

**Advantages:**
>High strength and durability, likely to withstand high winds and earthquakes
>Excellent fire resistance

**Disadvantages:**
>More expensive than timber and other forms
>Potential for corrosion



# B – Explore how sub-structures are constructed

## B1 Pre-construction work

DESK BASED

Legal requirements:

- Producing a construction health and safety plan
- **Construction phase plan**
- Method statements and **risk assessments**
- **Liaison with principal designer**
- Statutory notices

The **Health and Safety Executive** (**HSE**) is Britain's national regulator for workplace health and safety.

**Storage compound**

A designated area for storing materials, chemicals and supplies

**Hoists**

Used to move materials, equipment up and down floors

**Batching plant**

A machine that makes concrete

SITE BASED

Site clearance

Clearing trees and vegetation

Temporary lighting

Health and safety signs

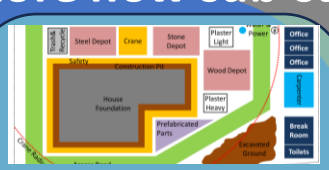
Temporary fencing

ENABLING WORK

Temporary support of existing structures

Protection of existing utilities (water, gas, electricity, drainage)

Creation of access (entry) and egress (exit) routes



**Site layout plan**

- **Offices**
- **Welfare facilities**
- **Toilets**
- **Drying rooms**
- **Changing rooms**
- **First aid room**
- **Canteens**
- **Storage compounds**
- **Temporary roads**
- **Site boundaries**
- **Building footprint**
- **Existing services**
- **Traffic flow**

**Fixed plant** (industrial equipment)

- **Cranes**
- **Silos**
- **Hoists**
- **Batching plant**

**Fire precaution measures**

- **Assembly points**
- **Fixed firefighting equipment**

## B2 Sub-structure groundworks

**WHAT IS A FOUNDATION?**

A foundation is the lower part of a structure, usually made from materials such as concrete, stone, timber and steel.

**WHAT IS THE PURPOSE OF A FOUNDATION?**

- To safely transmit the loads of the building to the sub-soil
- To settle within acceptable limits
- To support the loads of the building
- To spread the load of the building evenly over an area
- To transfer loads to deeper, higher bearing soil or rock

TYPES OF FOUNDATION


**Raft**

To support a large building loads across a wide area

**Strip**

Used with good load bearing soil

**Pile**

Used with poor load bearing soil

**Trench fill**

Quick, easy and cheap, use for smaller projects

**Pad**

Used with poor soil to create a strong, yet shallow foundation

| HAZARDS | RISKS | CONTROL MEASURES |
|---|---|---|
| Poor soil quality | Collapse of the sides of the excavation | Steel and timber trench supports |
| Working in confined spaces | Muscle strain, injury | Risk assessment, emergency exit and response plan |
| Overburden (unwanted soil) | Collapse of the overburden pile | Safe and even storage |

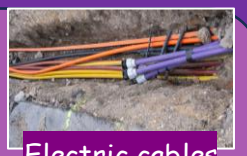
Trench support

Steel panel

Timber

HAZARDS Working in confined spaces

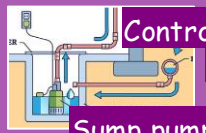
Gas pipes



Electric cables

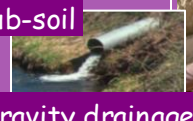
Trench box

Interlocking sheet pile



Control of sub-soil water

Sump pump



Gravity drainage

Water pipes

# C - Explore how superstructures are constructed

## C1 Walls


A damp proof course (DPC) is placed between the layers of bricks to prevent rising damp!

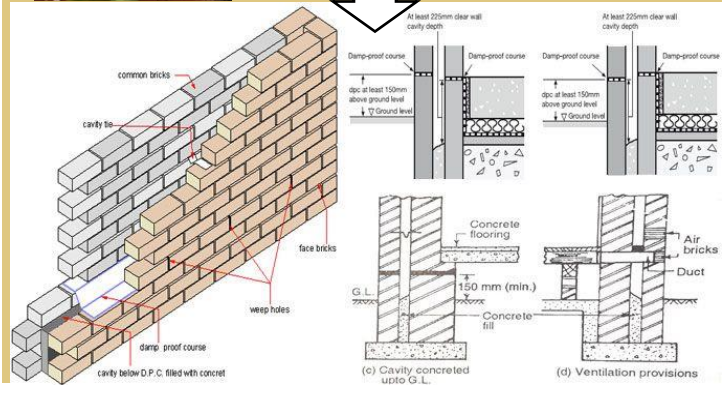
Types of wall:
- **Cavity masonry**
- Timber frame
- Metal stud
- Solid blockwork
- SIPs (Structually Insulated Panels)
- High density blockwork

**What does a wall do?**

- Thermal insulation
- Sound insulation
- Containing electrical and plumbing fittings
- Transfer the weight (load) of the roof to the foundation.
- Supporting the floors and ceilings
- Provide shelter and security

**Weephole**: A gap left in between bricks on purpose to allow water and moisture to drain out.

Cavity walls have a layer of bricks and blocks, with a layer of insulation in the middle. Walls are often shown using a cross-section diagram like the one below.



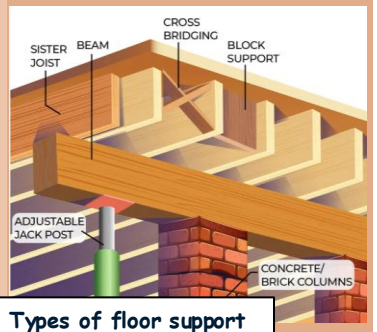

## C2 Floors

**What do floors do?**

A = They transfer the load from walls to the foundation, they provide a level surface and prevent sound from travelling

**Types of floors:**
- solid
- timber
- precast concrete
- beam and block
- engineered timber
- eco-joists

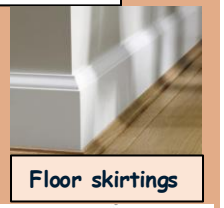
**Types of floor finish:**
Screeded
Tongue-and-groove


Types of floor support

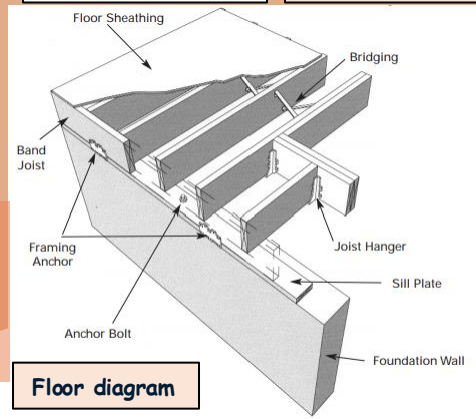
**Monolithic element** = a structural component constructed as a single, continuous unit, often from a single material like concrete, without any joints or seams. This creates a unified, solid structure, enhancing strength, stability, and potentially reducing construction time.

Monolithic elements



Floor skirtings

In construction, a **joist** is a horizontal structural member that supports floors and ceilings.




Floor diagram

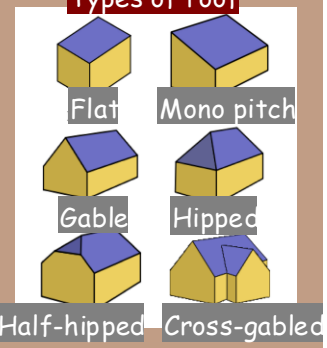
## C3 Roofs

**What does a roof do?**

To provide a method of discharging rainfall away from the building **(guttering)**

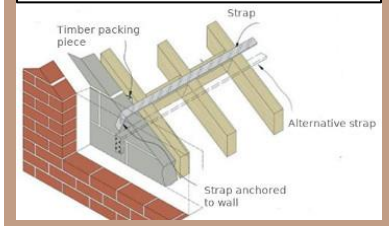
To provide additional accommodation/space **(loft conversion)**

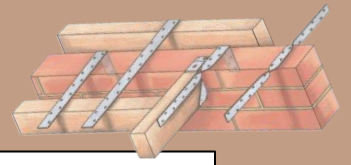
Types of roof



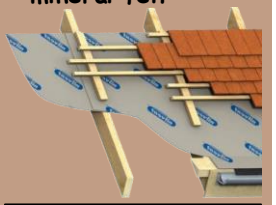

**Materials used**
- **treated softwood**
- **breather membrane**
- **tile felt**
- **tile battens**
- **ceramic roof tiles**
- **concrete interlocking roof tiles**
- **slate**
- **mineral felt**

**Metal strapping is used to attach the wooden frame to the walls**



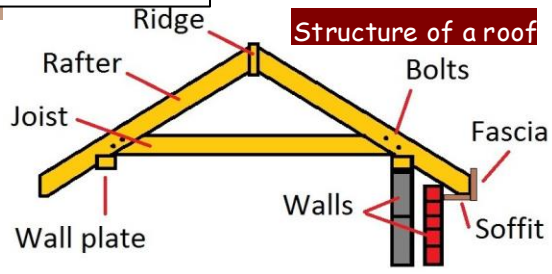



Lateral and vertical restraint straps



Softwood, breather membrane and ceramic roof tiles on a roof

**Structure of a roof**



# D1 The type of work in the construction industry

**CIVIL ENGINEERING** The design, construction and maintenance of infrastructure:
Bridges
Flood defenses
Wind turbines
Tunnels
Civil engineers are creative problem solvers. They work in harmony with the natural environment to keep towns and cities running and to build a more sustainable world.

**INDUSTRIAL**

**The design, construction and maintenance of industrial buildings:**
**>Factories**
**>Warehouses**
**>Distribution centres**
**>Manufacturing facilities**
**>Power plants**
**>Chemical processing facilities**
**>Mining facilities**

When building, industrial construction floor plans are very important because they need to promote smooth foot traffic and coordinate manufacturing and distribution. This is because industrial construction is made to be functional over stylish. It needs to support heavy equipment and must meet industry-specific requirements that require special permitting and occupancy requirements.

**Refurbishment**, also called **renovation** is the process of improving broken, damaged, or outdated structures. Renovations are typically done on either commercial or residential buildings.

Sometimes, when buildings are refurbished, their **use** is changed. An example of this is **Great Northern** in Manchester. The warehouse used to be an **industrial** building but was **refurbished** to be used as **commercial and leisure.**

Buildings may be refurbished to:

- Improve their appearance
- Make them more **accessible**
- Change how the building is used
- Increase the value of the building


Civil engineering


Transport


Commerical


Education

Healthcare


Residential

# D2 The built environment

## Transportation systems

Roads, motorways and underground tunnels are the main transportation system in the UK. The UK has a road **network** totaling around 262,300 miles.

Public transportation systems such as railways for trains and trams reduce **congestion** in towns and cities by reducing the amount of cars and other private vehicles on the road.

Cycle paths also help reduce congestion by making cycling a safer and more desirable option in built-up areas.

**Key words:**

**Congestion:** so crowded with people or traffic that it restricts free movement.

**Network:** A group or system of connected parts, people or objects.


Roads


Railways


Cycle paths

## Coastal and flood defences

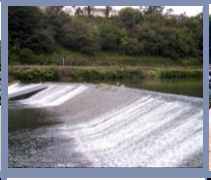
**The UK is an island nation – therefore coastal and flood defences are really important to prevent flooding of our towns and cities.**

Other coastal defences include: SEA WALLS, BARRIERS, GATES, LOCKS, LEVEES, BUNDS AND RESERVOIRS. **Task: research these to improve your knowledge!**

**Gabion** – a cage filled with rocks to absorb wave energy.

**Groyne** – a long narrow structure built out into the sea from the beach to limit the movement and loss of beach material

**Revetment** – a sloping structure built to absorb waves and reduce coastal erosion.

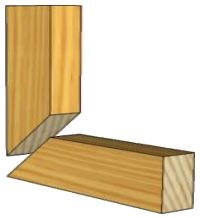


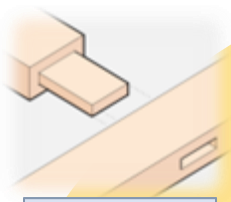
**Weir** – a barrier that goes across a river to control the flow and adjust the water level.

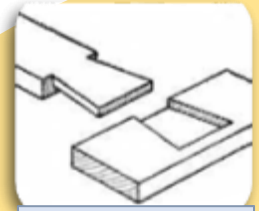
**Embankment** – a raised bank wall designed to carry a road, prevent floods or hold back water.

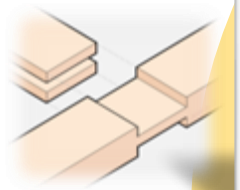
# CONSTRUCTION IN PRACTICE

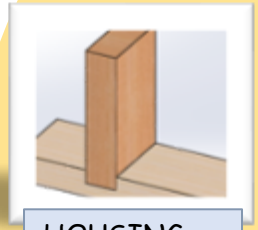
## JOINERY TECHNIQUES:


MITRE

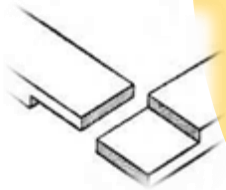

MORTISE AND TENON

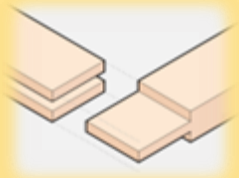

DOVETAIL HALVING


T BRIDLE


HOUSING


DOWEL JOINT


CORNER HALVING


CORNER BRIDLE


TEE HALVING

## FINISHING TECHNIQUES:


SURFACE FILLING


SANDING

## WASTING TECHNIQUES:


CUTTING


DRILLING


CHISELING


PLANING

## ASSEMBLY TECHNIQUES:

ADHESVIVES (GLUES)


MECHANICAL FIXINGS


MOULDING


CAPPING RAIL

## RISK ASSESSMENTS: BEFORE ANY HIGH-RISK ACTIVITY (SUCH AS USING TOOLS AND EQUIPMENT) YOU MUST COMPLETE A RISK ASSESSMENT USING A RISK RATING MATRIX

**RISK RATING:**
Multiply the severity (how bad it could be) by the likelihood (what is the chance of it happening?)

| HAZARD | ASSOCIATED RISK | PEOPLE AT RISK | SEVERITY (S) 1 = NEGLIGIBLE 5 = CATASTROPHIC | LIKELIHOOD (L) 1 = RARE 5 = ALMOST CERTAIN | INITIAL RISK RATING (S x L) | PROPOSED CONTROL MEASURES | UPDATED LIKELIHOOD | FINAL RISK RATING (S x U) |
|---|---|---|---|---|---|---|---|---|
| PHYSICAL POLLUTION (SAWDUST) | BREATHING PROBLEMS, EYE IRRITATION | STAFF, STUDENTS, VISITORS | 3 | 4 | 12 HIGH | VENTILATION AND EXTRACTION SAFETY GOGGLES | 1 | 3 LOW |
| SOUND POLLUTION (SOUND OF TOOLS AND EQUIPMENT) | DAMAGE TO EARS, LOSS OF HEARING | STAFF, STUDENTS, VISITORS | 3 | 2 | 6 MODERATE | LIMIT ON THE AMOUNT OF MACHINES IN USE EAR DEFENDERS WHEN NEEDED | 1 | 3 LOW |
| REPETITIVE USE OF EQUIPMENT | REPETITIVE STRAIN INJURY | STAFF, STUDENTS | 2 | 2 | 4 MODERATE | USERS TRAINED AND MONITORED WHEN WORKING. TAKE A BREAK WHEN FEELING DISCOMFORT. | 1 | 2 LOW |
| USE OF SHARP TOOLS: CHISEL | STABBING INJURY | STAFF, STUDENTS | 5 | 3 | 15 EXTREME | USERS TRAINED IN THE CORRECT AND SAFE USE OF EQUIPMENT. ACTIVITY SUPERVISED BY A SUPERIOR | 1 | 5 MODERATE |
| USE OF SHARP TOOLS: SAWS | CUTS AND GRAZES | STAFF, STUDENTS | 3 | 3 | 9 HIGH | USERS TRAINED IN THE CORRECT AND SAFE USE OF EQUIPMENT. ACTIVITY SUPERVISED BY A SUPERIOR | 2 | 6 MODERATE |
| USE OF SHARP TOOLS: WOOD PLANE | CUTS AND GRAZES | STAFF, STUDENTS | 2 | 3 | 6 MODERATE | USERS TRAINED IN THE CORRECT AND SAFE USE OF EQUIPMENT. ACTIVITY SUPERVISED BY A SUPERIOR | 1 | 2 LOW |
| USE OF BLUNT TOOLS: MALLET AND HAMMER | BRUISING, BROKEN BONES | STAFF, STUDENTS | 3 | 4 | 12 HIGH | USERS TRAINED IN THE CORRECT AND SAFE USE OF EQUIPMENT. ACTIVITY SUPERVISED BY A SUPERIOR | 2 | 6 MODERATE |

Risk rating matrix

| | | Likelihood | | | | |
|---|---|---|---|---|---|---|
| | | 1 Rare | 2 Unlikely | 3 Possible | 4 Likely | 5 Almost certain |
| Severity | 5 Catastrophic | 5 Moderate | 10 High | 15 Extreme | 20 Extreme | 25 Extreme |
| | 4 Major | 4 Moderate | 8 High | 12 High | 16 Extreme | 20 Extreme |
| | 3 Moderate | 3 Low | 6 Moderate | 9 High | 12 High | 15 Extreme |
| | 2 Minor | 2 Low | 4 Moderate | 6 Moderate | 8 High | 10 High |
| | 1 Negligible | 1 Low | 2 Low | 3 Low | 4 Moderate | 5 Moderate |

# What is a client?

A client is someone who pays you to perform a service. In construction, this could mean many things - from designing a building to constructing a roof. It is important to think about their **needs** and **requirements** when working for a client.

# Budget

The budget for a project is the combined costs of all activities, tasks, and milestones that the project must fulfill. In short: it's the total amount of money you'll need to finish the project that should be approved by all the stakeholders involved. **When working out the budget, you should include costs of amenities – see the examples!**

**Amenities**

**Toilet £80 (B&Q)**

**CCTV system £425**

**Double steel fire escape £1,924**

# What is a brief?

A brief is a document that outlines what a project needs to be and the details of what the final outcome needs to have. In construction, a brief will usually include:

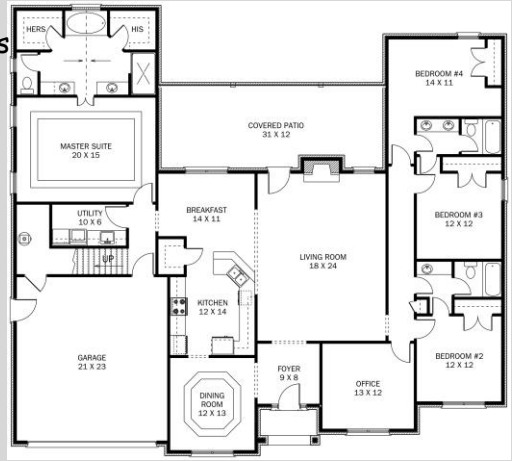
- The type of building
- What the building will be used for (intended purpose)
- How much money is available for the project (client budget)
- How the project needs to be built
- Details about where the project will be built

# Elevation

**To show the position of building elements (windows, doors) and to show how the building would look from street level.**

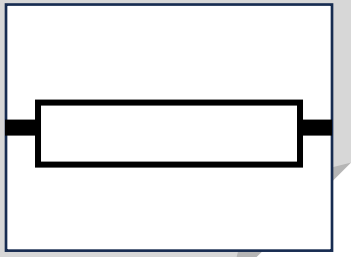
# FLOOR PLAN

A floorplan is a top-down view of a building showing all the rooms. The doors and windows are shown using special symbols:

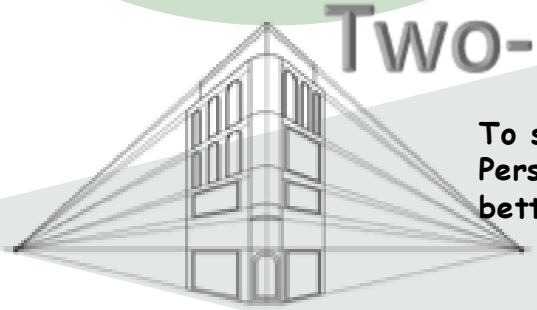



Doors are shown like this on a floorplan. The curved shape shows how the door would open either into or outside a room/building. **How should a double door look?**

Windows are shown like this. The walls are double thick lines, and the window is shown by a box to represent the thickness of the window frame, so it should stick out slightly!



# Two-point perspective



**To show how the building would look from street level. Perspective drawings are more immersive and give a better insight into how the building will actually look.**

All angles lead to the two points, usually identified by a cross.

# Component 3: Working out a construction budget

## STEP 1:

To start you would need to create a list of main features that will be included in your building:

Example:

- Doors (How many? What type of door would you include?)
- Flooring
- Roof types
- Structural frame types (Modular? Timber? Steel portal frame?)

## STEP 2:

An example of a google search:

"How much does concrete screed flooring cost per square metre?"

## STEP 3:

For each item, you will need to work out the total cost

Example (for a 300m² building):

I am planning to use concrete screed flooring for my building as it is hard wearing and will withstand heavy use.

After looking at Checkatrade.com I found that floor screed with mesh reinforcement costs an average of £29 per m² https://www.checkatrade.com/blog/cost-guides/screed-floor-cost/

The building is 300m² so £29 x 300m² = £8700

## STEP 4:

**Finally, you need to work out and include any labour costs:**

An example google search would be:
"How much would the labour cost be to install a toilet?

You would then need to include the link for where you got your quote and type it in: https://www.myjobquote.co.uk/costs
An example sentence would be: I have researched on 'myjobquote.co.uk' and found that installing a toilet would cost between £100 and £400 for labour costs.

**How much will you spend on labour?**

The average toilet installation labour costs are around **£100 to £400**, and the average length of time for this type of job is approximately 2 to 4 hours.

**It is important that you include a link to reference where you got your information from!**

**How much does a screed floor cost?**

| Floor screed calculator | Cost + VAT (Range low - high) | Average cost |
|---|---|---|
| Floor screed cost (75mm thick) | £18 - £20 per m² | £19 per m² |
| Screed with mesh reinforcement | £28 - £30 per m² | £29 per m² |
| Liquid screed cost | £19 - £24 per m² | £21.50 per m² |
| Fast drying screed cost | £18 - £22 per m² | £20 per m² |
| Labour costs | £12 - £16 per m² | £14 per m² |

Last updated: July 2024
Our costs are ballpark averages - get a local tradesperson to quote now

## How do I type the m² symbol?

Type the number you want to square, then type 2, select the 2, and press **Ctrl + Shift + =**. This will make the 2 a superscript. **You can also press ALT + 0178 to create this in word.**