chapter 4

Principles of building

OVERVIEW

Whatever type of building is being constructed there are certain principles/elements that must be included, for example a block of flats and a warehouse will all have foundations, a roof, etc.

In Chapter 1, you learned about different types of building. In this chapter, you will have a more in-depth look at the elements behind the main principles of building work.

This chapter will cover the following topics:

- Structural loading
- Substructure
- Superstructure
- Primary elements
- Secondary elements
- Finishing elements
- Services.

These topics can be found in the following modules:

CC 2003K	CC 2003S

This chapter will only look briefly at the components contained within buildings. For more detailed information on carpentry components, check the relevant chapter in this book For all other components, check the relevant book from Heinemann's Carillion Construction series.

Structural loading

The main parts of a building that are in place to carry a load are said to be in a constant state of **stress**.

There are three main types of stress:

- Tension pulls or stretches a material and can have a lengthening effect.
- Compression squeezes the material and can have a shortening effect.
- Shear occurs when one part of a component slips or slides over another causing a slicing effect.

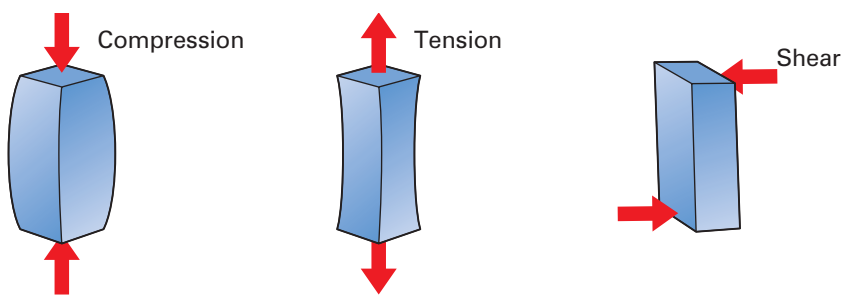

Figure 4.1 The three types of stress

To cause one of these types of stress a component or member must be under the strain of a load. Within construction there are two main types of loading:

- Dead load – the weight of the building itself and the materials used to construct the building, covering components such as floors and roofs.
- Imposed loads – any moveable loads like furniture as well as natural forces such as wind, rain and snow.

To cope with the loads that a building must withstand there are load-bearing structural members strategically placed throughout the building.

There are three main types of load bearing members:

- Horizontal members – One of the most common type of horizontal members is a floor joist, which carries the load and transfers it back to its point of support. The horizontal member, when under loading, can bend and be in all three types of stress, with the top in compression, the bottom in tension and the ends in shear.

Definition

stress - a body that has a constant force or system of forces exerted upon it resulting in strain or deformation

Remember

Where you are in the country will determine what materials you use for constructing. For example, some places with a lot of snowfall will require stronger structures to deal with the extra load from the snow

The bending can be contained by using correctly stress-graded materials or by adding a load-bearing wall to support the floor.

- Vertical members – Any walls or columns that are in place to transfer the loads from above (including horizontal members) down to the substructure and foundations have vertical members. Vertical members are usually in a compression state.
- Bracing members – Bracing members are usually fitted diagonally to form a triangle which stiffens the structure. Bracing members can be found in roofs and even on scaffolding. Bracing is usually in compression or tension.

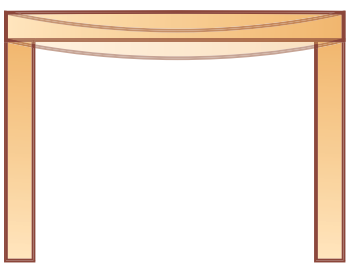

Figure 4.2 Horizontal structural members

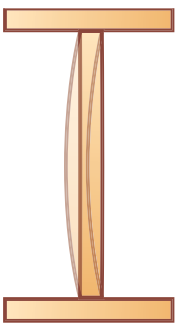

Figure 4.3 Vertical structural members

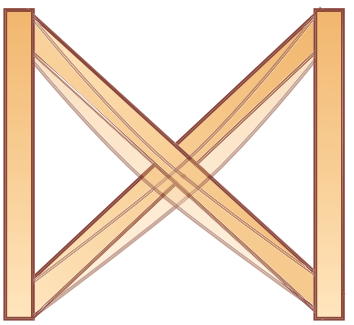

Figure 4.4 Bracing structural members

Substructure

All buildings will start with the substructure – that is, all of the structure below ground and up to and including the damp proof course (DPC). The purpose of the substructure is to receive the loads from the main building (superstructure) and transfer them safely down to a suitable load-bearing layer of ground.

The main part of the substructure is the foundations. When a building is at the planning stage, the entire area – including the soil – will be surveyed to check what depth, width and size of foundation will be required. This is vital: the wrong foundation could lead to the building subsiding or even collapsing.

All buildings have a substructure

Did you know?

During the surveying of the soil, the density and strength of the soil are tested and laboratory tests check for harmful chemicals contained within the soil

The main type of foundation is a strip foundation. Depending on the survey reports and the type of building, one of four types of foundation will usually be used.

- Narrow strip foundation – the most common foundation used for most domestic dwellings and low-rise structures.

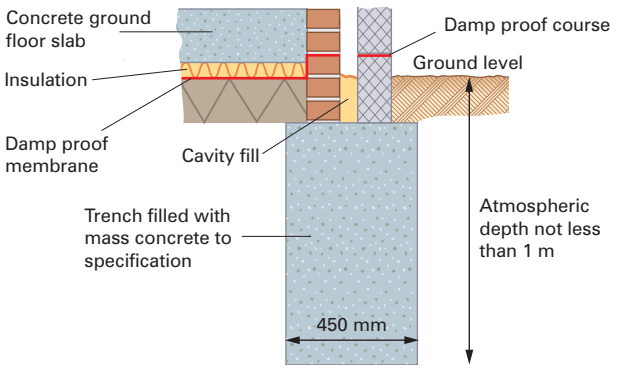

Figure 4.5 Narrow strip foundation

- Wide strip foundation – used for heavier structures or where weak soil is found.

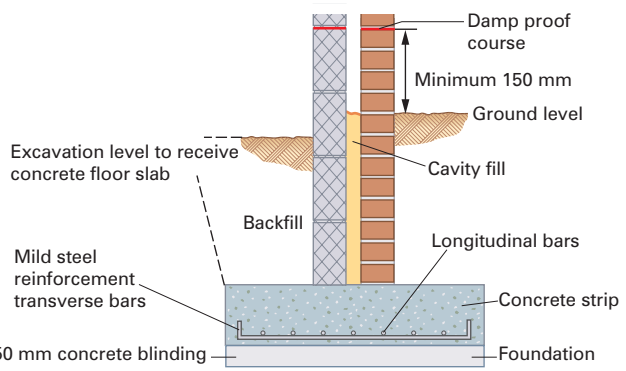

Figure 4.6 Wide strip foundation

- Raft foundation – used where very poor soil is found. This is basically a slab of concrete that is thicker around the edges.

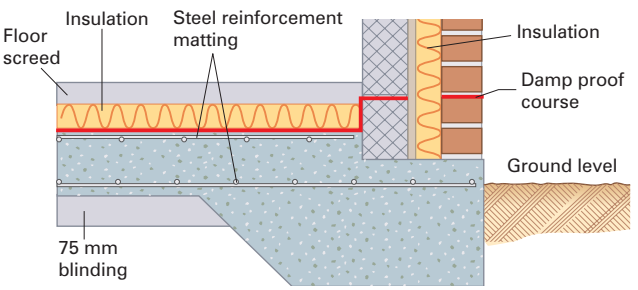

Figure 4.7 Raft foundation

- Pad foundation – where pads are placed at strategic points, with concrete beams placed across the pad to spread the load.

Once the substructure is in place, the building is then built on top of it.

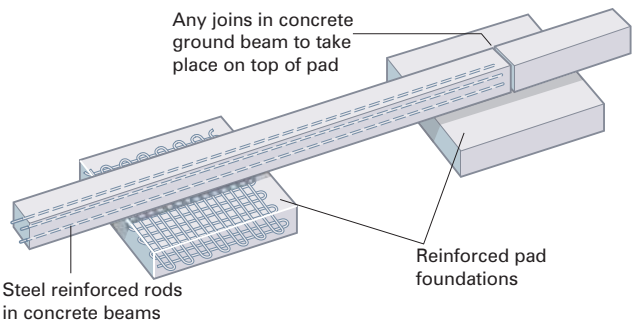

Figure 4.8 Pad foundation

Superstructure

The superstructure covers everything above the substructure, from walls to floors to roofing. The purpose of the superstructure is to enclose and divide space, as well as spread loads safely into the substructure.

Within the superstructure, you will find the primary, secondary and finishing elements, as well as the services.

Primary elements

The primary elements are the main supporting, enclosing and protecting elements of the superstructure. They divide space and provide floor-to-floor access.

The main primary elements are:

- walls
- floors
- roofs
- stairs.

Walls

There are two main types of wall within a building: external and internal.

External walls

External walls come in a variety of styles, but the most common is cavity walling. Cavity walling is simply two brick walls built parallel to each other, with a gap between acting as the cavity. The cavity wall acts as a barrier to weather, with the outer leaf preventing rain and wind penetrating the inner leaf. The cavity is usually filled with insulation to prevent heat loss.

Timber kit houses are becoming more and more common as they can be erected to a wind and watertight stage within a few days. The principle is similar to a cavity wall: the inner skin is a timber frame clad in timber sheet material, covered in a breathable membrane to prevent water and moisture penetrating the timber. The outer skin is usually face brickwork.

There are also other types of exterior walling, such as solid stone or log cabin style. Industrial buildings may have steel walls clad in sheet metal.

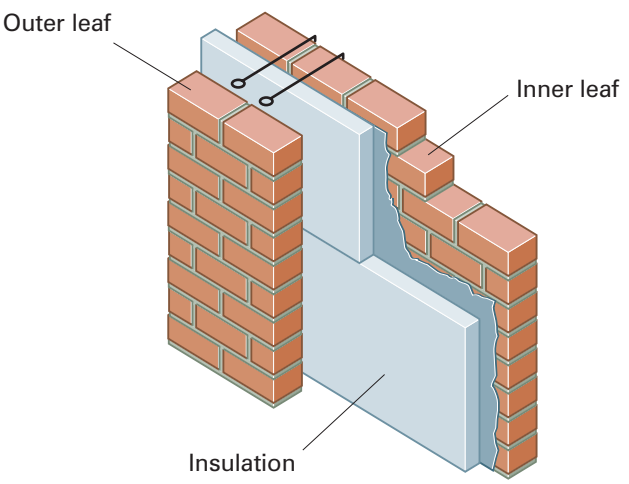

Figure 4.9 A cavity wall

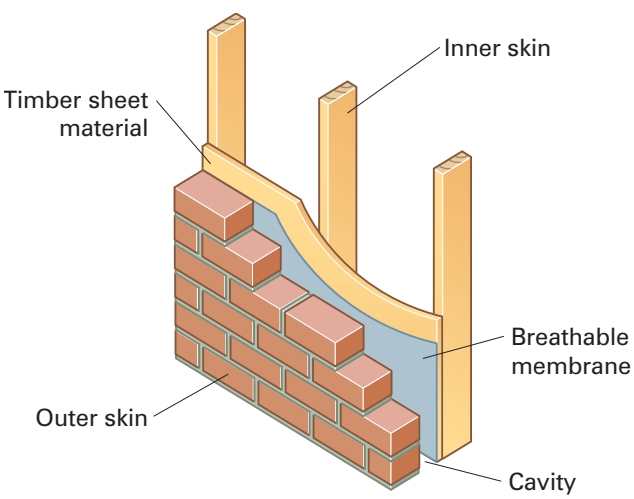

Figure 4.10 A timber and cavity wall

Safety tip

Load-bearing walls must not be altered without first providing temporary supports to carry the load until the work has been complete

Internal walls

Internal walls are either load bearing – meaning they support any upper floors or roof – or are in place to divide rooms into shapes and sizes.

Internal walls also come in a variety of styles. Here is a list of the most common types.

- Solid block walls – simple block work, either covered with plasterboard or plastered over to give a smooth finish, to which wallpaper or paint is applied. Solid block walls offer low thermal and sound insulation qualities but advances in technology and materials means that blocks such as thermalite blocks can give better sound and heat insulation.
- Solid brick walling – usually made with face brickwork as a decorative finish. It is unusual for all walls within a house to be made from brickwork.
- Timber stud walling – more common in timber kit houses and newer buildings. Timber stud walling is also preferred when dividing an existing room, as it is quicker to erect. Clad in plasterboard and plastered to a smooth finish, timber stud partitions can be made more fire resistant and sound/thermal qualities can be improved with the addition of insulation or different types of plasterboard. Another benefit of timber stud walling is that timber noggins can be placed within the stud to give additional fixings for components such as radiators or wall units. Timber stud walling can also be load bearing, in which case thicker timbers are used.
- Metal stud walling – similar to timber stud, except metal studs are used and the plasterboard is screwed to the studding.

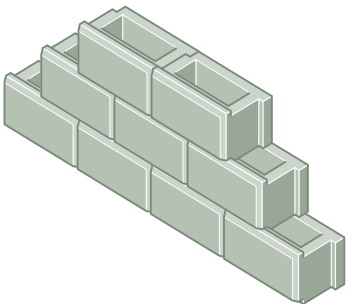

Figure 4.11 Solid block wall

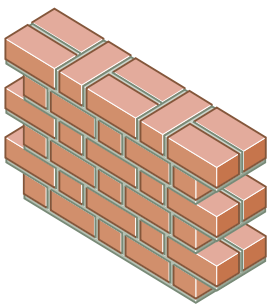

Figure 4.12 Solid brick wall

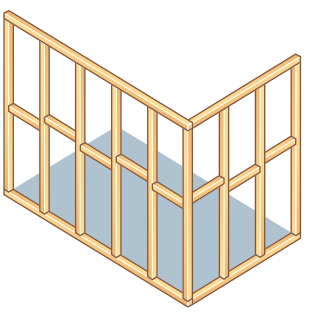

Figure 4.13 Timber stud wall

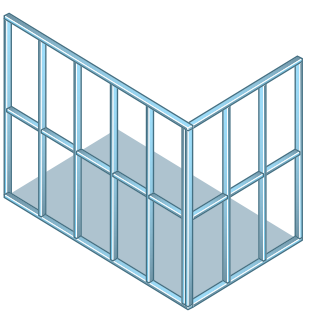

Figure 4.14 Metal stud wall

- Grounds lats – timber battens that are fixed to a concrete or stone wall to provide a flat surface, to which plasterboard is attached and a plaster finish applied.

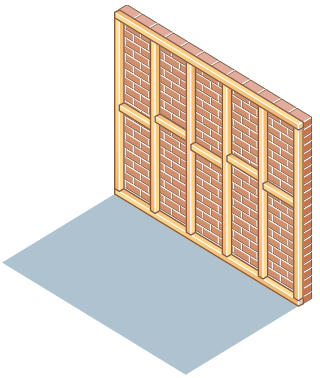

Figure 4.15 Ground lats

Floors

There are two main types of floor: ground and upper.

Ground floors

There are a few main types of ground floor. These are the ones you will most often come across.

- Suspended timber floor – a floor where timber joists are used to span the floor. The size of floor span determines the depth and thickness of the timbers used. The joists are either built into the inner skin of brickwork, sat upon small walls (dwarf/sleeper wall), or some form of joist hanger is used. The joists should span the shortest distance and sometimes dwarf/sleeper walls are built in the middle of the span to give extra support or to go underneath load-bearing walls. The top of the floor is decked with a suitable material (usually chipboard or solid pine tongue and groove boards). As the floor is suspended, usually with crawl spaces underneath, it is vital to have air bricks fitted, allowing air to flow under the floor, preventing high moisture content and timber rot.
- Solid concrete floor – concrete floors are more durable and are constructed on a sub-base incorporating hardcore, damp proof membranes and insulation. The depth of the hardcore and concrete will depend on the building and will be set by the *Building Regulations* and the local authority. Underfloor heating can be incorporated into a solid concrete floor. Great care must be taken when finishing the floor to ensure it is even and level.
- Floating floor – basic timber floor constructions that are laid on a solid concrete floor. The timbers are laid in a similar way to joists, though they are usually 50 mm thick maximum as there is no need for support. The timbers are laid on the floor at predetermined centres, and are not fixed to the concrete base (hence floating floor); the decking is then fixed on the timbers. Insulation or underfloor heating can be placed between the timbers to enhance the thermal and acoustic properties.

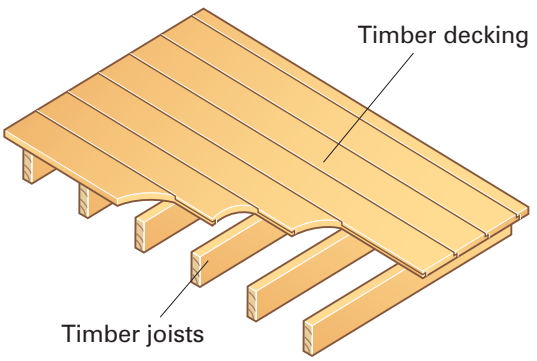

Figure 4.16 Suspended timber floor

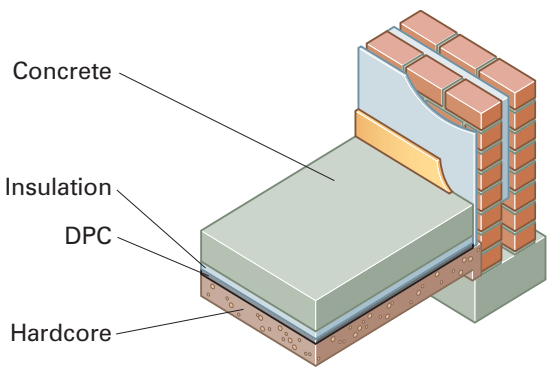

Figure 4.17 Solid concrete floor

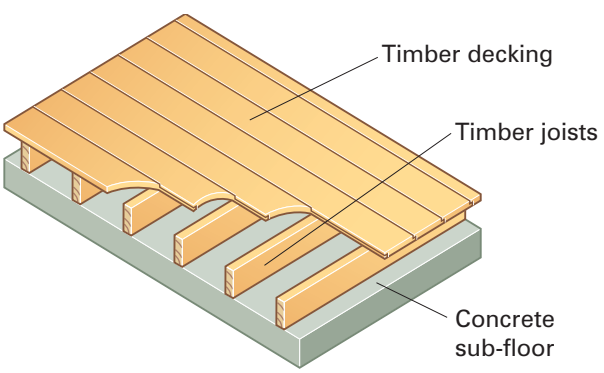

Figure 4.18 Floating floor