

# FOUNDATIONS

## PURPOSES OF FOUNDATIONS

- To sustain the dead load of the building as well as all other loads superimposed on it
- To transmit these loads to the sub-soil and distribute them over an area of bearing surface sufficient to ensure an even settlement of the structure
- To protect the structure from damage due to movement of the soil which is caused by shrinkage or swelling

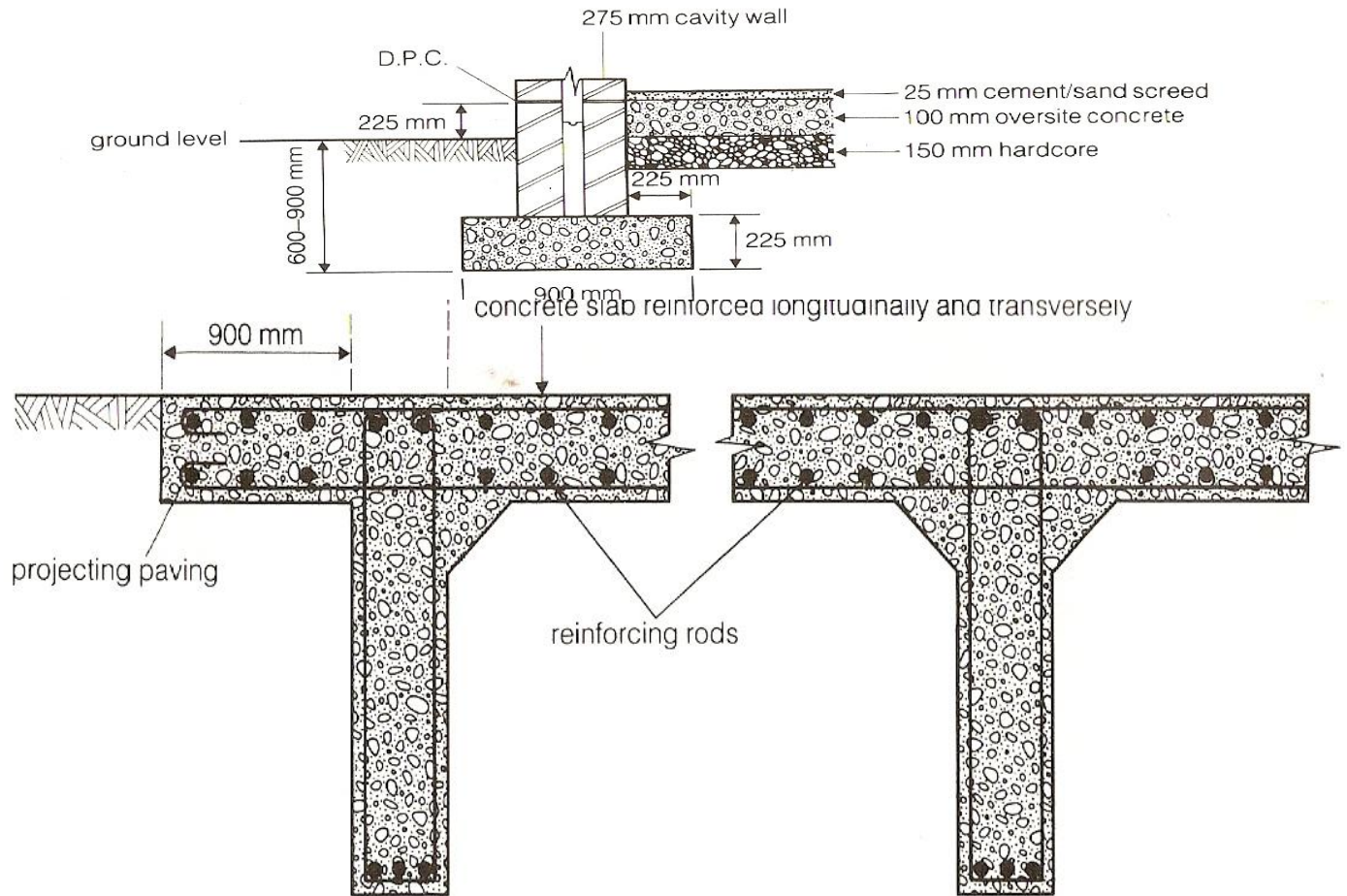
## TYPES OF FOUNDATIONS

### Factors to consider

- Type of building or structure – whether domestic building or factory, whether a bungalow or a multi- storey structure
- Nature of soil and site conditions.
- The load the foundation is expected to carry
- The possible effects of weather elements such as rain

The four types of foundation are:

- Strip foundation
- Pad foundation
- Raft foundation
- Pile and beam foundation
-



- **STRIP FOUNDATION**

This is the common type of foundation adopted on one to two (and sometimes up to four storey buildings) on firm non-shrinkable sub-soils such as gravel or laterite. A strip foundation normally consists of a continuous strip of concrete which provides a continuous ground bearing for load bearing walls (see fig 1

## **PAD FOUNDATION**

These are isolated foundations consisting of reinforced concrete meant to support reinforced concrete or steel piers especially in framed buildings. The thickness of the foundation must not be less than 150mm (see fig 2)

## **RAFT FOUNDATIONS**

A raft foundation is one which covers the entire of the building and may extend beyond it. It consists of concrete that is suitably reinforced and up to 300 mm thick raft foundations are rarely used (see fig 3)

## **PILE AND BEAM FOUNDATION**

This type Of foundation is an alternative to deep strip foundations. The piles enable the builder to have the weight of the building carried by a firm ground below the poor top soil. Piles are used for buildings where the soil is poor: for bridges, decks around harbours and for jetties. The use of piles and beams avoids

the cost of digging trenches (which must be b1.0m deep for strip foundations) and he cost of the necessary concrete or brickwork required to build up the walls in these deep trenches

Short –bored pile foundations consist of a series of short concrete piles, cast in holes that are bored in the ground and spanned by light beams, usually of reinforced concrete. The holes are about 1.8m to 3.0m deep and 300mm in diameter the concrete is poured in immediately after the hole has been bored; it the n tamped and consolidated in position (see fig 4).

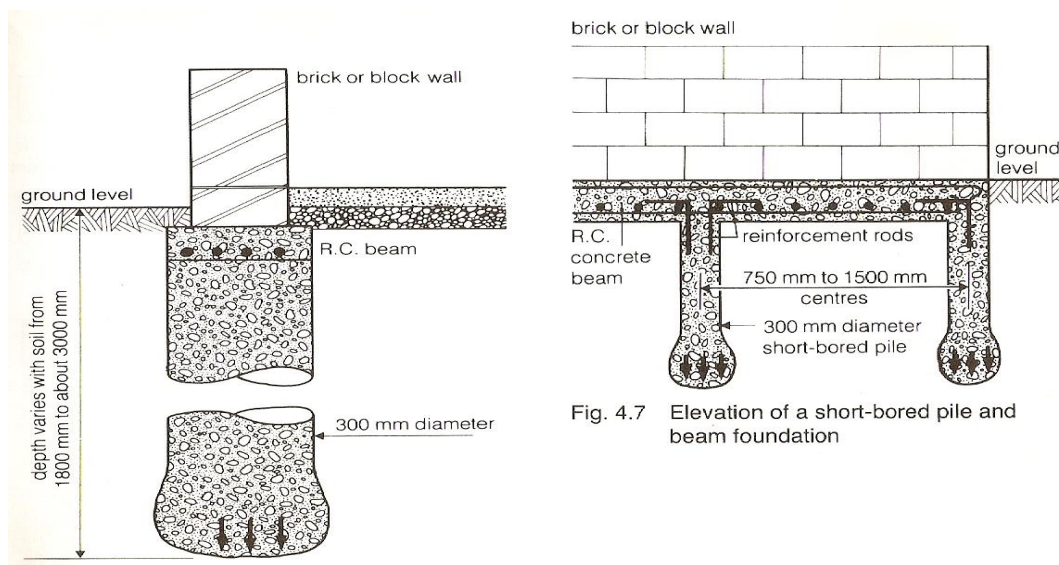


Fig. 4.7 Elevation of a short-bored pile and beam foundation

## FLOORS

### FUNCTIONAL REQUIREMENT OF FLOORS

#### GROUND FLOOR

- Support without failure the loads imposed on it by people and furniture, in the case of domestic buildings; in factories, warehouses , etc floors should be strong enough to carry all incidental loads including wares and machinery.
- Prevent dampness inside the building by providing a damp proof membrane in or below the floor. Suspended ground floors should be properly ventilated to avoid the accumulation of moist air underneath

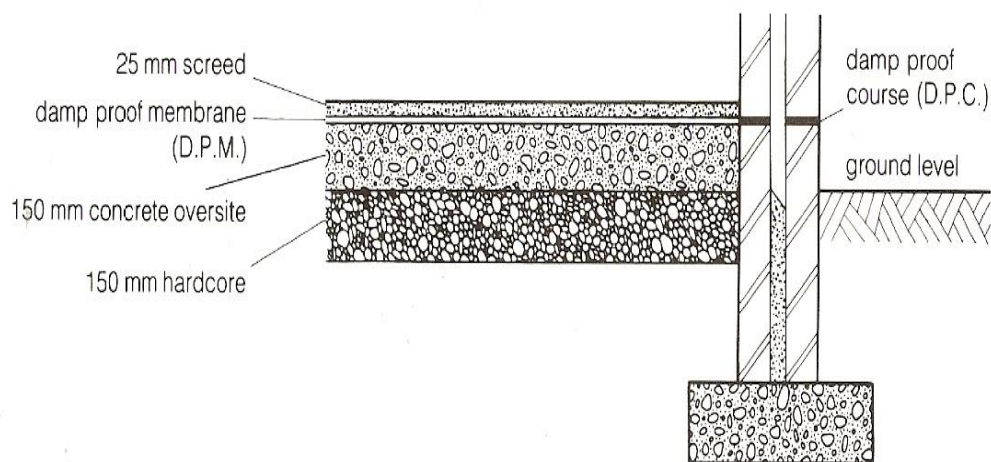
- Prevent the growth of vegetable matter and other living organisms inside the building
- Be reasonably durable so as to require minimum maintenance or replacement work
- Provide a surface finish with a standard of appearance, comfort, safety, cleanliness and heat retention suitable to the needs of the inhabitants of the building

## UPPER FLOORS

- Sustain its own weight and carry any other weights imposed on it, e.g. the weight of walls, roofs, persons and their possessions.
- Offer fire resistance especially in very tall buildings , in buildings where there are many occupants and in buildings where large combustible goods are stored
- Minimize noise transfer from upper floor to the lower floor
- Be reasonably durable
- Span the building economically and be fairly quickly erected or constructed
- Provide an acceptable surface finish which is safe , comfortable, clean and of good appearance

## SOLID GROUND FLOORS

The most



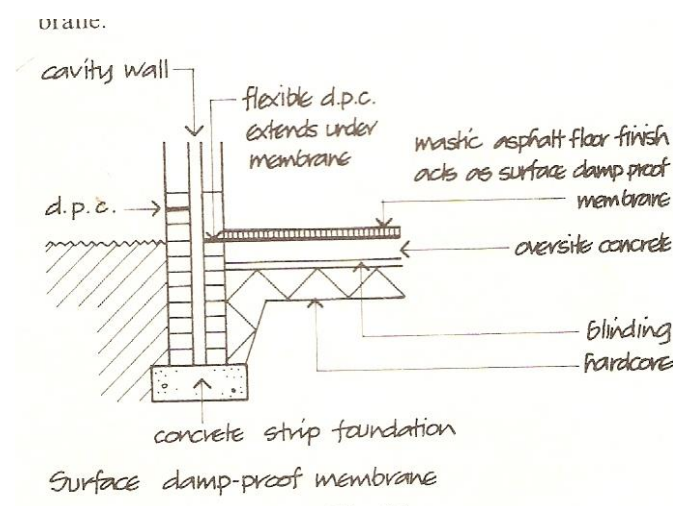
Economical form of ground floor is one constructed of concrete laid on solid ground. Solid ground floors have the following advantages:

- They are relatively cheap especially on level sites
- The quantity of walling required is less than that required for suspended floors
- They do not require under floor ventilation
- They are not susceptible to dry rot unlike timber floors
- They offer a wide selection of floor finishes **fig 5**

### DISADVANTAGE

A solid floor does not provide a satisfactory surface finish and therefore an additional floor finish must be provided

### SURFACE DAMP MEMBRANES

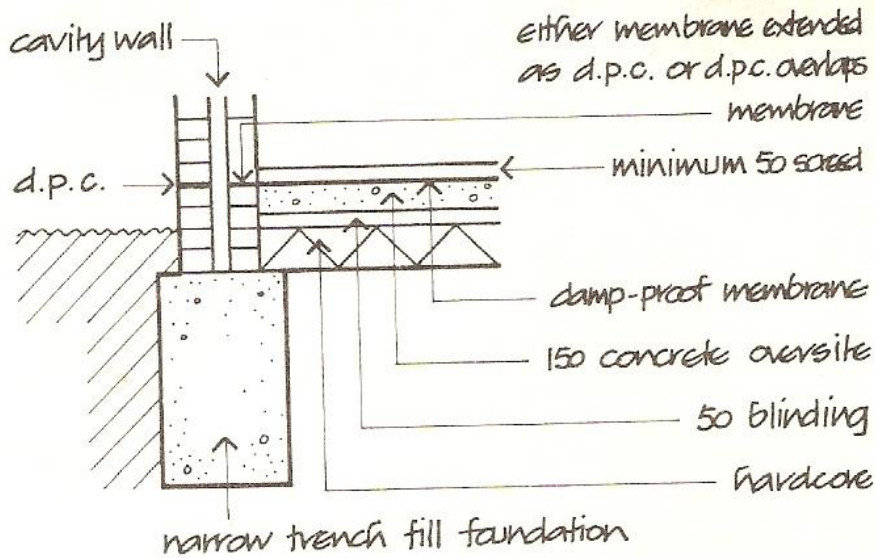


On building sites that retain moisture due to a high water table and on sloping sites where water may run down to the building and wherever the site concrete is likely to become damp, it is good practice to use a damp proof membrane **fig 6**

### TYPES OF DAMP PROOF MEMBRANES

- Sandwich membranes used below floor screed
- Damp proof membrane below site concrete

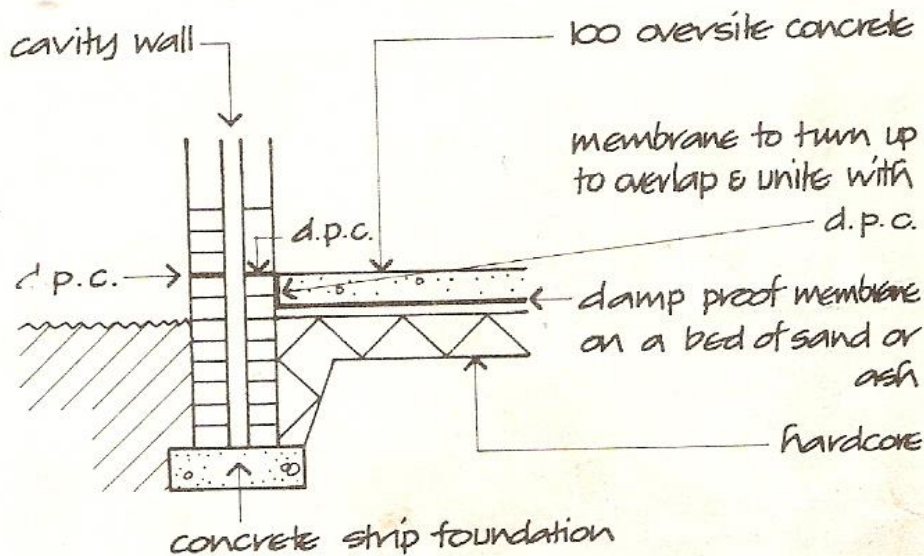
### SANDWICH MEMBRANES USED BELOW FLOOR SCREED



Sandwich damp-proof membrane

Where ground conditions are likely to cause appreciable dampness in the concrete slab, it is usual to introduce a damproof membrane sandwiched between the concrete oversite and the screed **fig 7**. The screed or top layer of the concrete should be at least 50mm thick to minimize the possibility of folding, due to the unrestrained shrinkage. A screed concrete layer on a sandwich membrane will take a month for each 25 of its thickness to dry out sufficiently for laying floor finishes

### DAMP PROOF MEMBRANE BELOW SITE CONCRETE



Below site concrete damp-proof membrane

On sites where the ground is persistently wet or damp, at or close to the surface, and also when the under-floor heating is used, it may be advantageous to

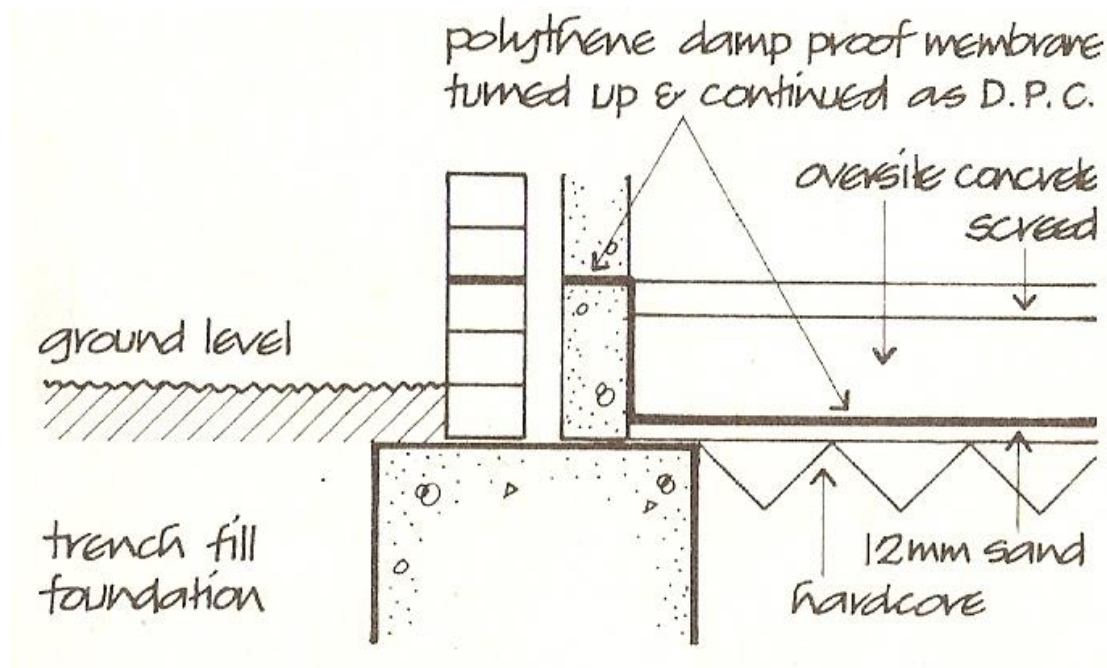
use a damp-proof membrane under the site concrete. The membrane is laid or spread on the blinding of comparatively dry concrete spread over the hardcore (see fig 8). The membranes will delay the drying out of concrete to the extent of one month for each 25 thickness of concrete

## MATERIALS FOR DAMP-PROOF MEMBRANES

- Hot pitch or bitumen
- Bitumen solution, bitumen/rubber emulsion tar/rubber emulsion
- Mastic asphalt or pitch mastic
- Polythene or polyethylene sheet.

## POLYTHENE OR POLYETHYLENE SHEET

Polythene or polyethylene sheet is used as a damp-proof membrane with over



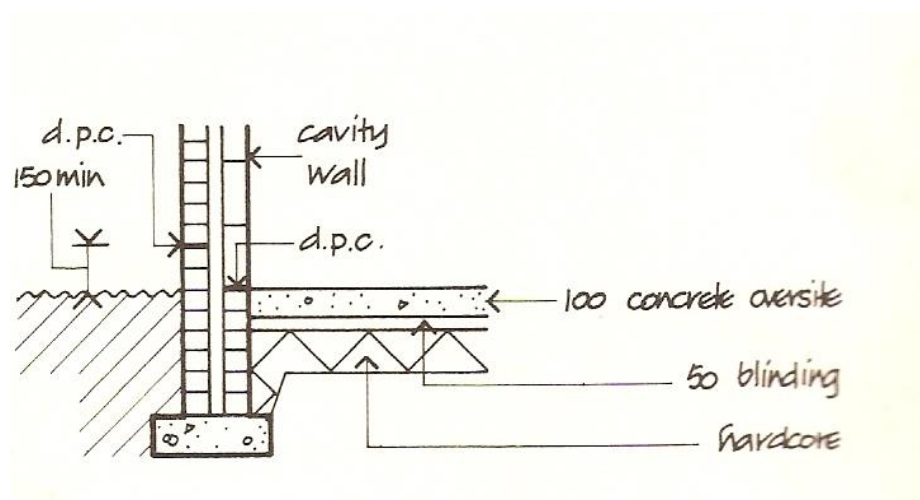
site concrete for all but severe conditions of dampness. The sheet should be at least 0.25mm thick (1000 gauge) to avoid damage during installation the sheet is supplied in 4m x 25m long. When used as a sandwich membrane the sheet should laid on a blinding layer of sand or compacted fuel ash spread over the hardcore to a thickness of 12.

The sheets are spread over the blinding and lapped 150 at joints and continued across surrounding walls under the d.p.c., for the thickness of the wall. **Fig 9**

## DAMP-PROOF COURSES

The function of a damp-proof course is to act as a barrier to the passage of moisture or water between the parts separated by the damp-proof course. The movement of moisture or water may be upwards in the foundation of walls and ground floors, downwards in parapets and chimneys or horizontal where a cavity wall is closed at the jambs of openings.

## DAMP-PROOF COURSES ABOVE GROUND



There should be a continuous horizontal damp-proof course above ground in walls whose foundations are below ground, to prevent moisture from the ground

rising through the foundation to the wall above ground, which would otherwise make the wall damp and damage wall finishes. The damp-proof course above ground should be continuous for the whole length and thickness of the wall and be at least 150 above finished ground level. **Fig 10**

## MATERIALS FOR D.P.C ABOVE GROUND

The common materials used for d.p.c. are;

- Bitumen
- Polythene sheet

Bitumen d.p.c are flexible and can withstand distortion due to moderate settlement in walls without damage. They may extrude under heavy loads without affecting their efficiency as a barrier to moisture. Bitumen dpc's, which are made in rolls to suit wall thickness, are bedded on a level bed of mortar and lapped at least 100 or the width of the d.p.c. at running joints and intersections.

Bitumen is most used for d.p.c because it is economical, flexible, reasonably durable and convenient to lay.

### **POLYTHENE SHEET**

It should be black low density polythene of single thickness not less than 0.46mm weighing approximately 0.48kg/m<sup>2</sup>. Polythene sheet is flexible, can withstand distortion due to moderate settlement in a wall without damage and is an effective barrier against moisture. It is laid on even bed of mortar and lapped at least the width of the d.p.c at running joints and intersections. Being a thin sheet material, polythene makes a thinner mortar joint than a bitumen d.p.c., and is often preferred for that reason.

## **WALLS**

Walls enclose space, protect the building from weather and offer privacy and security to the occupants and their property

### **CLASSIFICATION**

Walls are classified as:

**Load bearing walls.** These carry vertical imposed loads in addition to their self-load. The imposed loads include those from floors, roofs and other structural walls together with any live loads which these elements may carry. External walls are load bearing.

**Non- load bearing walls.** These support no other loads except their own weight. They include walls under windows, dwarf walls and some partitions

### **Functional requirement of walls**

- Walls should be able to support upper floors and roofs together with all loads imposed on them. The load bearing capacity of a wall is affected by such factors as the nature of the foundation, the strength of the material used in constructing the wall, and its capacity to withstand stress set up under the load
- Walls must be resistant to damp penetration
- Walls should provide adequate thermal insulation. Walls should be constructed to:
  - Prevent excessive loss of heat from within the building
  - Prevent a large heat gain from outside in hot weather.
  - Prevent condensation
  - Reduce expansion and contraction of the structure.
- Walls should provide sufficient sound insulation. This requires that:
  - They be of large mass for less response to vibrations of air pressure
  - They be air tight for improved sound insulation
  - They be not stiff to minimize vibration

## Walling materials

### Bricks

Types of bricks

- **Commons.** These are suitable for general brick work
- **Facings.** These are made to give an attractive appearance
- **Engineering bricks.** These are very strong bricks designed to bear loads

### Brick bonds

Bonding refers to the arrangement of bricks that make up a wall

### Types of bonds

#### Stretcher bond

A wall of stretcher bond has all bricks laid as stretchers on every course.

To avoid continuous vertical joints a *half bat* is used to commence or finish alternate courses. The bond is used for walls that are half a brick thick.

## Header bond

This is used on one-brick thick walls. The wall is so built that every brick shows a header face on each side of the wall.

## Flemish bond

This consists of alternate header and stretcher faces in every course. This bond offers an attractive appearance and is reasonably strong.

## English bond

This consists of alternate courses of headers and stretchers. It is a very strong bond.

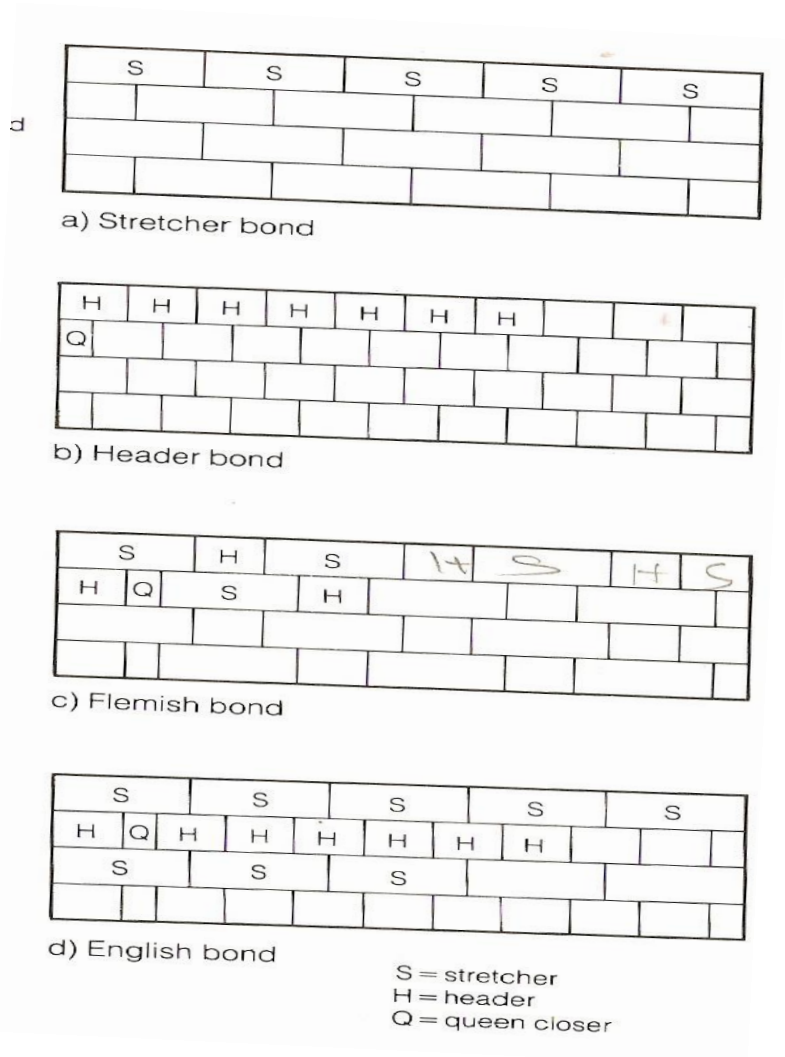
## Concrete

Concrete walls can be in the form of blocks or slabs cast in situ or obtained pre-cast

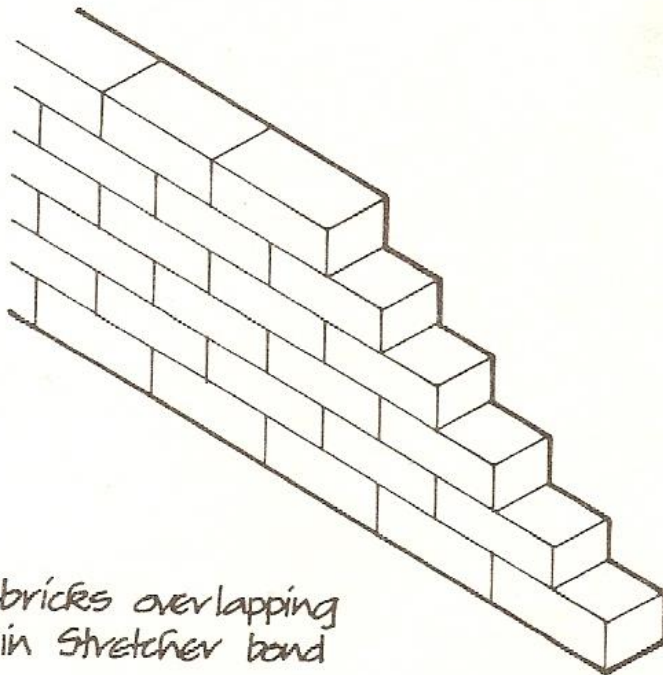
## Stone

Natural stone is an old walling material. It may be used alone or together with other types of walling materials. It cut in different sizes.

**NOTE:**



Blockwork is carried using stretcher bonds **fig 11**

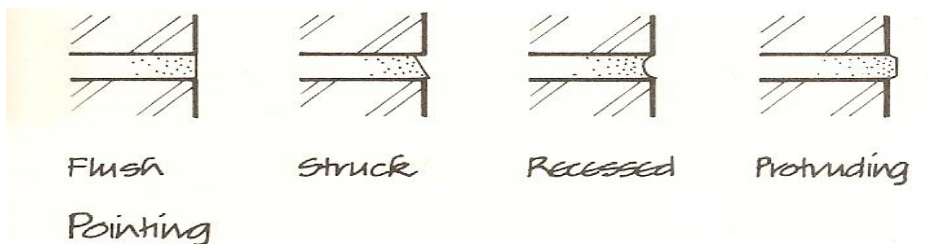


## Pointing

Pointing is used to describe the filling of the mortar joints in the external faces of brickwork. Brick work is pointed for two reasons:

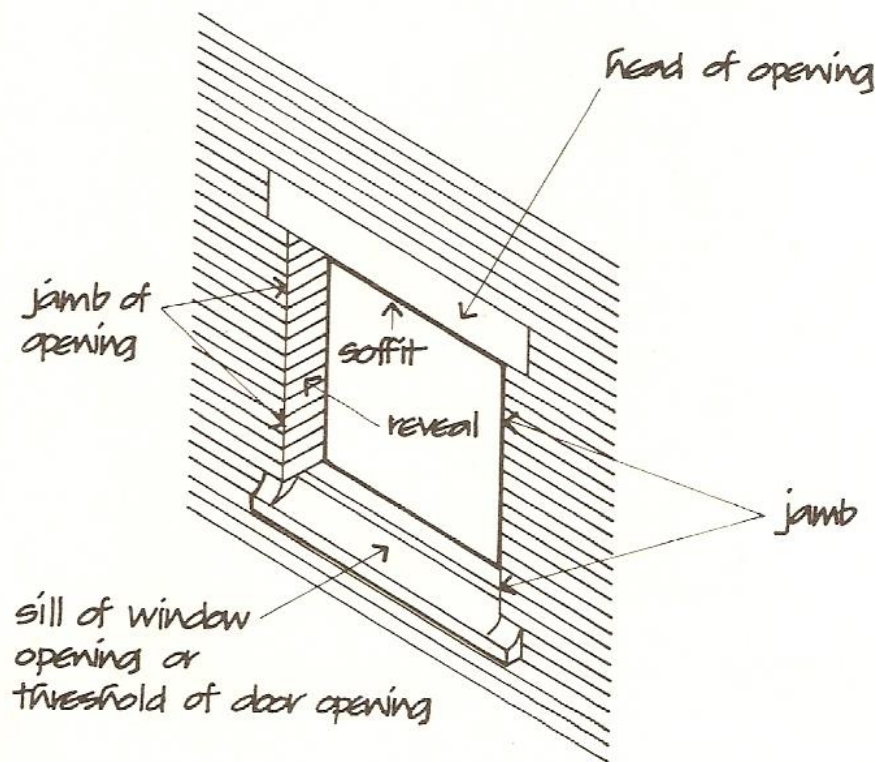
- To ensure that all horizontal and vertical mortar joints in external brickwork are solidly filled with mortar to make them watertight
- For decorative reasons

The types of pointing are **flush, struck, recessed and protruding** (see fig 12)



## Openings on brick and block walls

Openings are put in walls to accommodate doors and windows. To bridge the opening between walls and ensure continuity of wall construction (lintels and ring beams) and arches may be constructed. Fig 13



## ROOFS

### Functional requirements

- **Weather resistance.** A roof should be able to keep off rain, wind, sun etc. the covering may depend for its effectiveness on the ability of the structure to provide the required pitch or fall
- **Strength and durability.** The roof structure must be able to sustain both the dead load of the roof and any superimposed loads due to rain, wind or workmen during maintenance
- **Thermal insulation** Important where there are variations in temperature between the dry and rainy seasons

- **Sound insulation.** Roofs should be able to provide adequate insulation against sound from external sources
- Fire resistance. Protection against fire is one of the most important considerations in the choice and design of roofs
- Durability. The durability of a roof is largely a function of the roof covering. The water-proof property of the covering may be destroyed by:
  - The decay of non-durable material or breakage of small roofing units such as tiles.
  - The disturbance or stripping of the roof by wind
  - The splitting of a sheet covering

## Roof structure

### Consideration factors

- Plan or shape of a building
- Appearance or aesthetic considerations
- Cost of construction
- Ease of effecting repairs etc

### Roof terminology

**Common rafter.** A sloping timber extending from the eaves to the ridge of a roof

**Jack rafter.** A short rafter between the hip rafter and the eaves or between the valley rafter and the eaves

**Ridge.** The highest part, or apex, of a roof

**Ridge piece.** The horizontal piece of timber forming the ridge and which the rafters meet

**Eaves.** The overhanging or lowest parts of a sloping roof

**Purlins.** Horizontal timbers in a roof, at right angles to the rafters and carried on them. Purlins support the roof covering.

**Hipped end.** The sloping triangular end of hipped roof.

**Hip.** The edge or angle formed, when two roof surfaces meet to form an external angle which exceeds 180°.

**Gable end.** A gable end is formed when the wall is carried up to the underside of the roof

**Valley.** A valley is the opposite of a hip; it is formed when two sloping roof surfaces meet to form an angle of less than 180° on the outside of the roof. Timbers along hips and valleys are known as hip and valley rafters respectively

**Verge.** The edge of a sloping roof which overhangs a gable

**Rise.** This is vertical distance from the wall plate to the ridge

**Span.** This is the distance from the inside of one wall across to the other wall

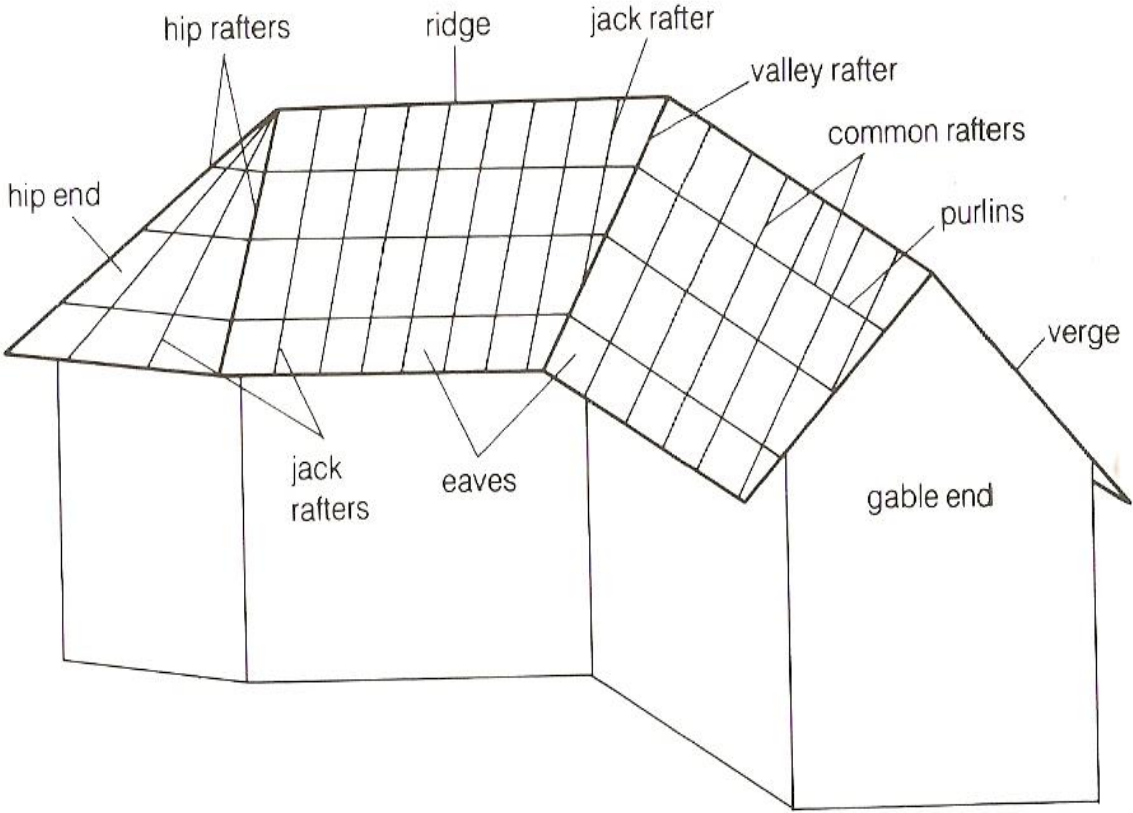
**Pitch.** This refers to the ratio of the rise to the span. That is,

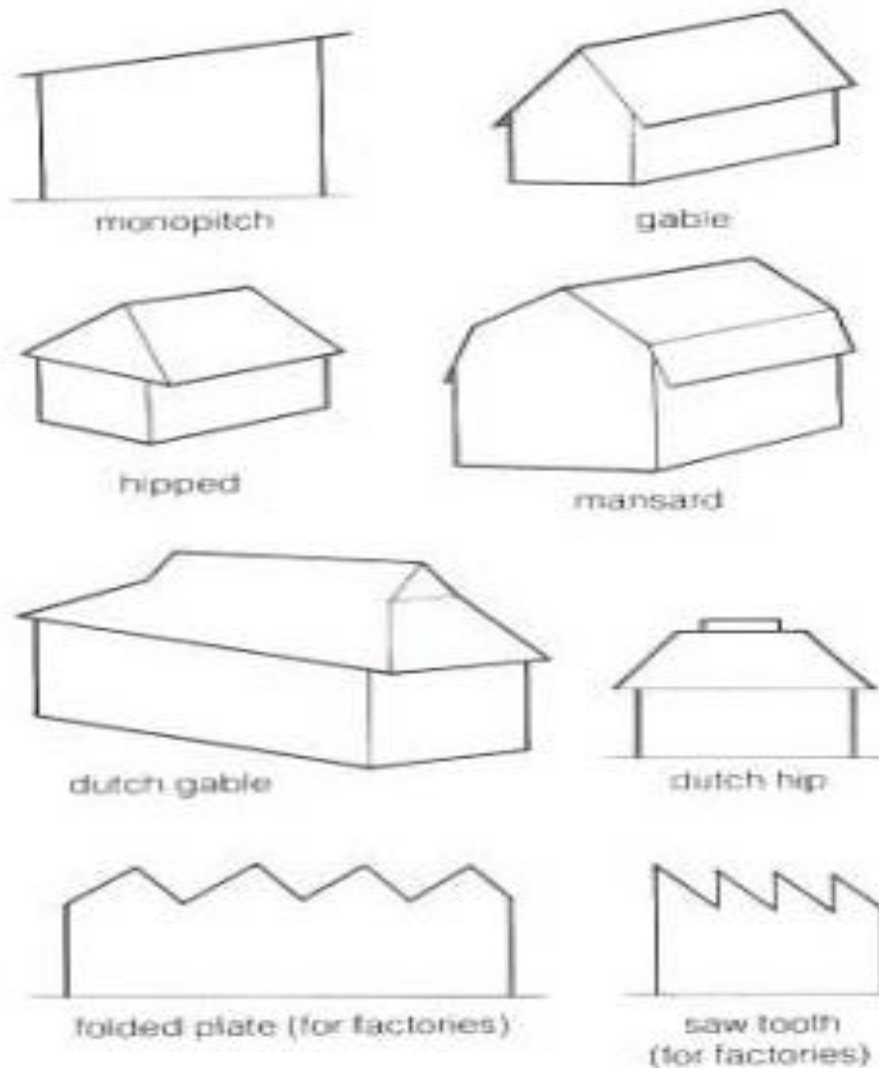
$$\text{Pitch} = \text{rise} / \text{span}$$

The pitch is sometimes expressed in degrees

**Slope.** This given in degrees and refers to the inclination of the roof to the horizontal

**Wall plates.** These receive the feet of the common rafters and distribute their loads evenly over the wall (see fig 1)





## Types of roofs

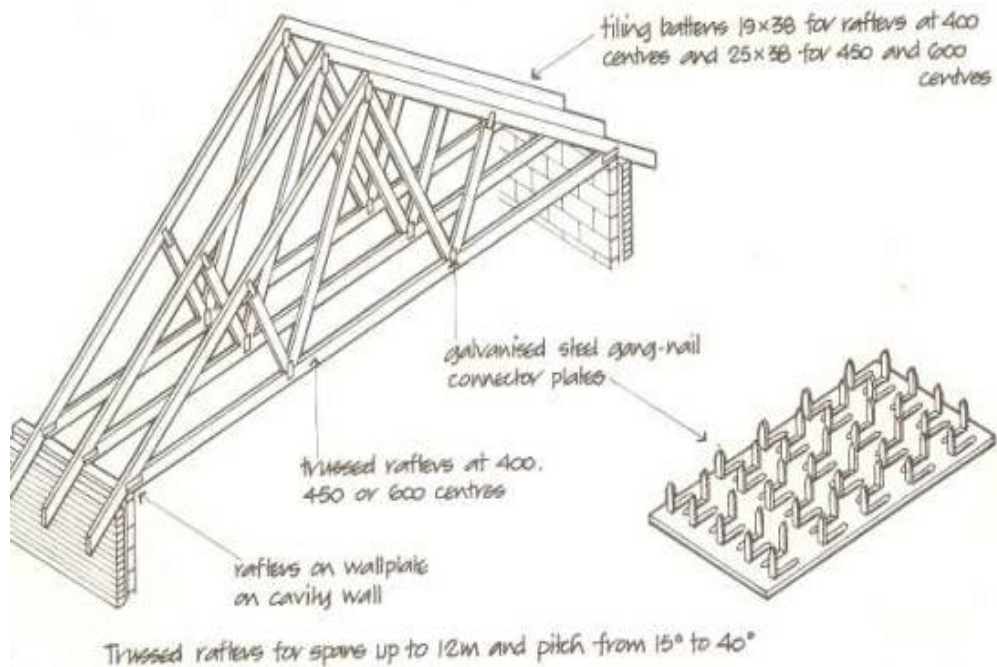
### Classification of roofs

Roofs are classified into pitched and flat roofs

### Trussed rafters

These are fabricated from stress graded timber, accurately cut to shape and assembled and joined with steel connector plates. The preparation and fabrication can be mechanized for accuracy the trussed rafter is

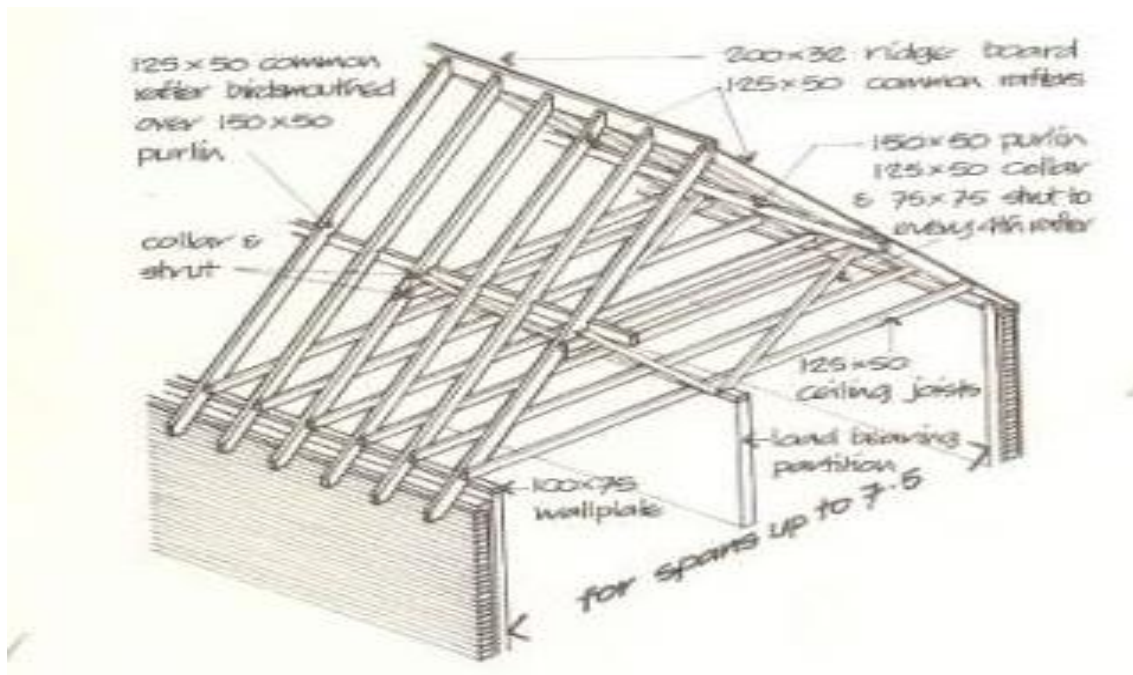
assembled and the connector plates are machine pressed across the junction of abutting timber members to form a strong rigid joint



A typical trussed rafter is shown in [fig...](#) consisting rafters, ceiling joists and internal webs. The trussed rafters are nailed to a timber wall plate, bedded on the external walls, at centre to suit the roof covering. As the rafters are trussed, there is no need for a ridge board or intermediate support between supporting walls. The eaves of the roof may be finished with flush eaves or open or boarded projecting eaves in the traditional pitched roof construction. The span is up to 4.5m

### **Purlin or double roof**

A purlin is a continuous timber fixed horizontally under the roof rafters to give them support between the ridge and the wall plate. The purlin in turn is supported by means of timber struts which bear on to a load bearing partition ([see fig](#)). Purlins support the rafters mid-way



between the ridge and the eaves and they are supported by struts at intervals of about 1.8m along their length. Collars fixed every fourth rafter serve to brace the roof and provide a secure fixing for the purlins which bear on them. The size of the purlins depends on the weight of the roof and their unsupported length between struts. With struts not more than 1.8m apart, a 125 deep by 50 thick purlin is used for most rafters.

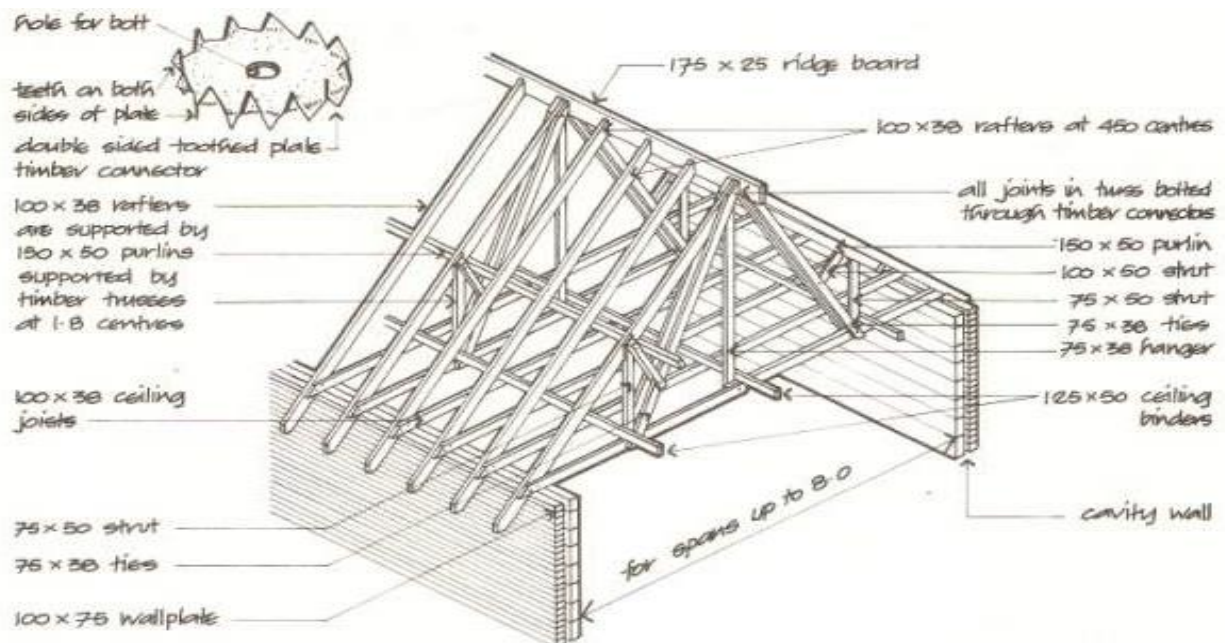
Collars of the same section as the roof rafters are fixed to every third or fourth rafter. Struts are usually of 75 square in section. The foot of the struts is fixed to a timber wall plate bedded in mortar on the load bearing partition.

The load bearing partition does not have to be central between the external walls in order to give satisfactory support to struts which in turn support purlins. If there are load bearing partitions running at right angles to the ridge roof they can be used to support struts.

## Timber trusses

A strongly constructed roof depends for support on load bearing partitions conveniently placed and this affects the planning of the rooms. To avoid use of struts to support purlins and load bearing partitions to support the struts use is made of timber trusses. The word truss means tied together and a timber roof truss is a triangular frame of flight section timbers securely fixed together. The timber trusses span between external walls and are placed about 1.8m apart and they serve to support purlins which in turn support the roof rafters. See fig. The timbers are bolted together using galvanized timbers connectors

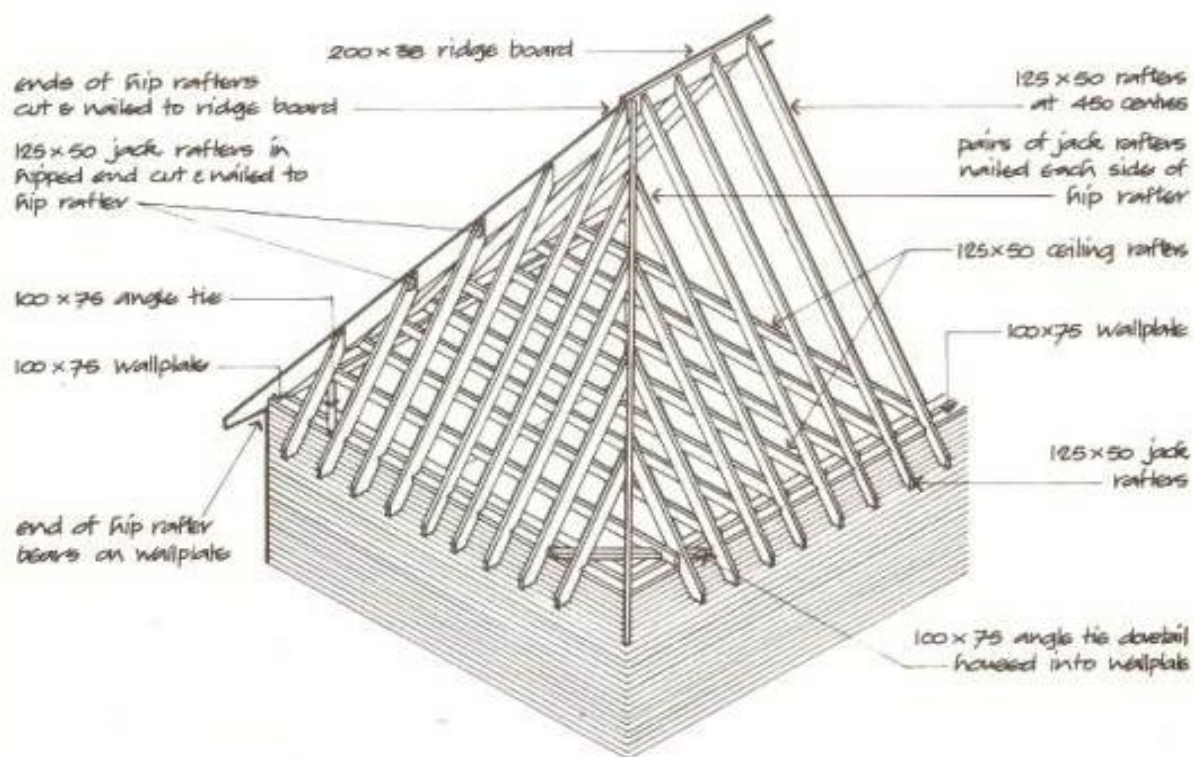
## Hips



The hipped ends of roof are pitched at the same slope as the main part of the roof and the rafters in the triangle of the hipped end are pitched up to a hip rafter. The hip rafters carry the ends of the cut rafters in the

hipped end and those of the main roof slopes. The hip rafter is usually 38 thick and 200 to 250 deep. The cut jack rafters are nailed each side of the hip rafter as shown in fig

Because the hip rafter carries the ends of several jack rafters it tends to overturn the walls at the corner of the building where it bears on the wall plates and to resist this angle tie should always be fixed across the angle of the roof as shown in the figure.



## FLAT ROOFS

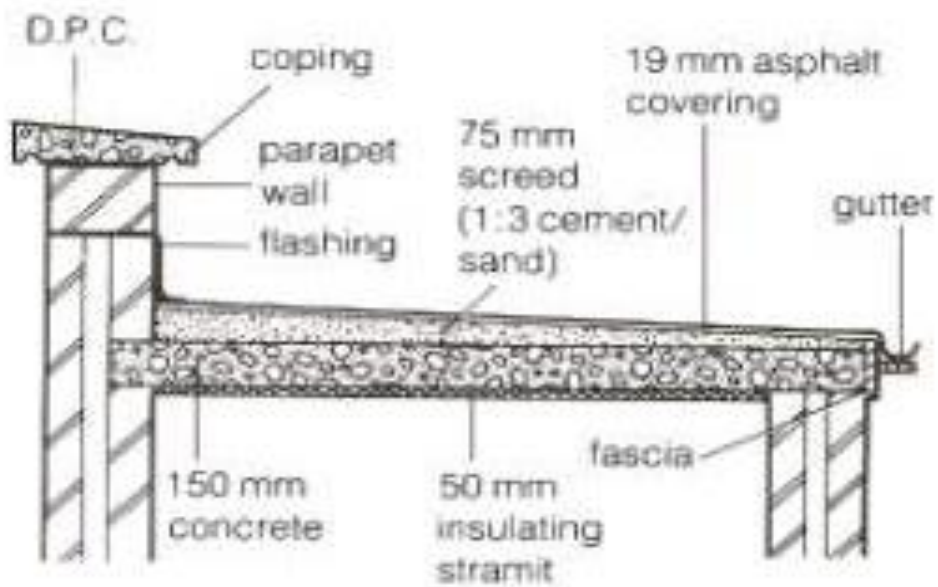
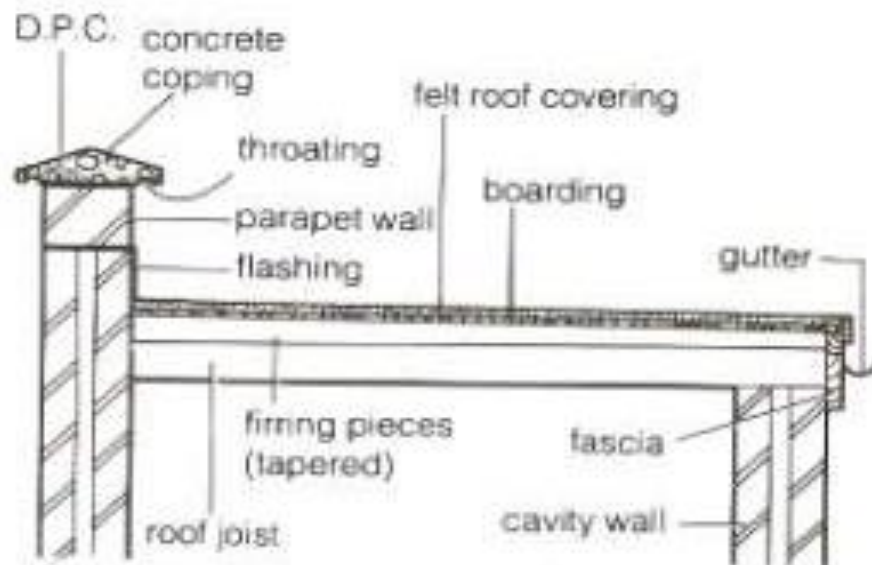
Roofs less than 10° pitch are regarded as flat. It is cheaper than a pitched roof. It has the following shortcomings;

- It is a poor thermal insulator; it is very cold in cold weather and unbearably hot in hot weather.
- It tends to give building the appearance of being unfinished

Insulation is improved by addition of light weight material during construction. Parapet walls are built around flat roofs to improve their appearance. To prevent water saturating the wall (which is exposed) a concrete coping is used to cover it. The underside of the coping is provided with a throat to prevent rain water running along the underside of the stone to the wall.

## **ROOF DRAINAGE**

A well designed roof should not allow water to stand on it as this will lead to leakage. When available or if possible a single length of roof covering is better than various lengths joined or capped together. Concrete roofs should be provided with sufficient slope for water to run off. Gutters and chutes should be provided where necessary and these should not be allowed to be blocked. They should be cleared from time to time to ensure efficient drainage. The angle between the parapets and flat roofs should be provided with adequate flashings to ensure easy run off of water. Figs 1& 2 below.



roof fall = 1 in 40 to 1 in 80

**DOORS**

## **WATER SUPPLY**

### **COLD WATER SERVICES**

The term services pipe is used to describe pipes in a building which are under. The term rising main is also used in the same sense.

### **COLD WATER STORAGE**

A cistern is a water storage container which is open to the air and in which water is at normal atmospheric pressure. Cisterns are usually manufactured from mild steel plate or sheet welded or riveted together and galvanized after manufacture. The cold water storage cistern must be fixed not less than two meters above the highest fitting it is to supply with water. The most convenient place for it is the space below a pitched room, in a tank room or chamber above a flat roof or at some high level below the roof. Fig .

### **BALL VALVE**

The service is run up the building and is connected to the cistern through a stop valve to disconnect the supply for rewashing or renewal of the ball valve. The water supply to the cistern is controlled by a ball valve which is fixed to the cistern above the water line.

### **OVERFLOW DISCHARGE/WARNING PIPE**

As a precaution against failure of the valve, and consequent overflow of the cistern, an overflow pipe is connected to discharge excess water and give a warning. The overflow pipe is preferably double the size of the service pipe.

### **DISTRIBUTING PIPE SYSTEM**

The distributing pipe is connected 50mm above the bottom of the cistern to prevent any sediment that may have collected, entering the pipe. A gate valve is fitted to the pipe adjacent to the cistern, isolating the whole system from the cistern in the event of repairs and renewals. The aim of the layout in the pipe work is economy in the length of pipe runs, and on this depends a sensible layout

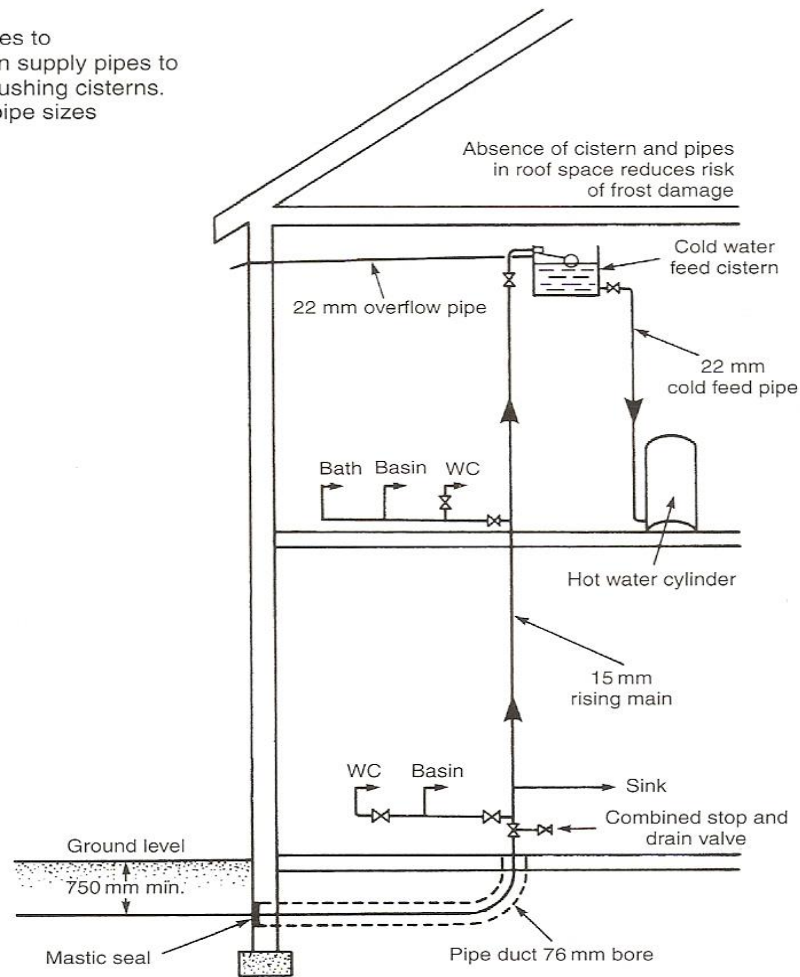
## of sanitary fittings.

For efficient operation, a high pressure water supply is essential particularly at periods of peak demand. Pipework is minimal and the storage cistern supplying the hot water cylinder need only have 115 litres capacity. The cistern may be located within the airing cupboard or be combined with the hot water cylinder. Drinking water is available at every draw-off point and maintenance valves should be fitted to isolate each section of pipework. With every outlet supplied from the main, the possibility of back siphonage must be considered.

Back siphonage can occur when there is a high demand on the main. Negative pressure can then draw water back into the main from a submerged inlet, e.g. a rubber tube attached to a tap or a shower fitting without a check valve facility left lying in dirty bath water.

### Notes:

- (1) Servicing valves to be provided on supply pipes to storage and flushing cisterns.
- (2) Copper tube pipe sizes shown.



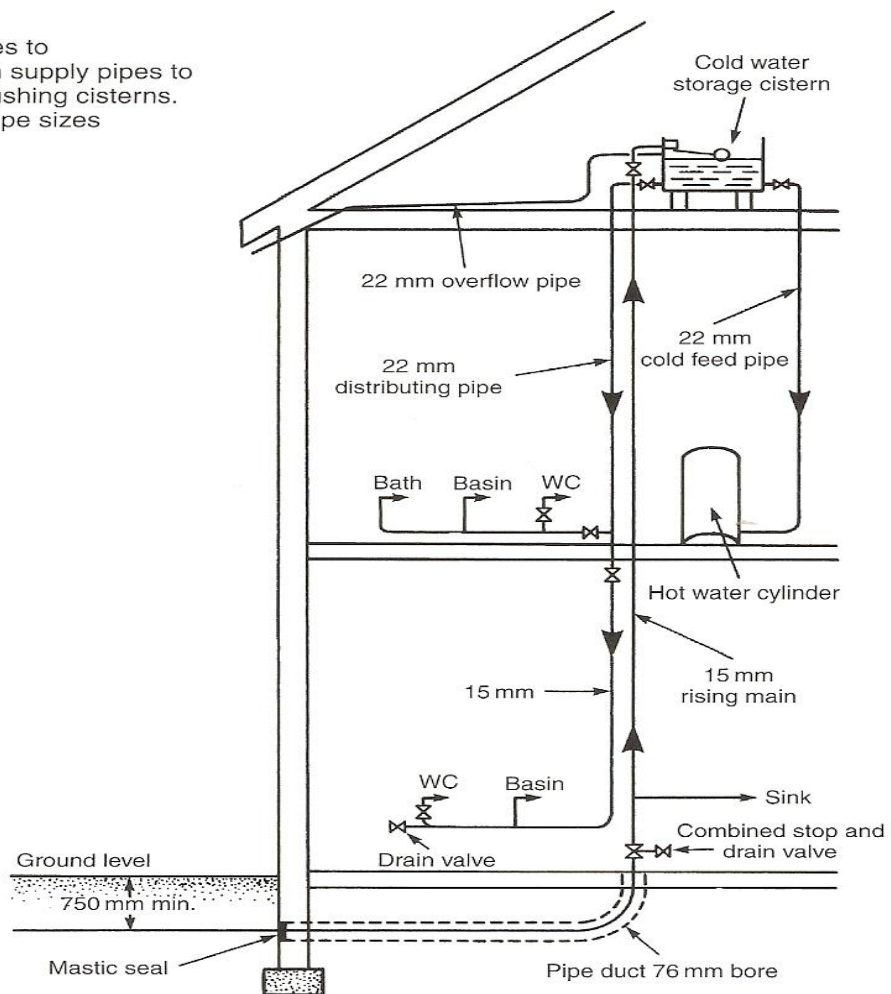
Ref.: The Water Supply (Water Fittings) Regulations 1999.

## Indirect System of Cold Water Supply

The indirect system of cold water supply has only one drinking water outlet, at the sink. The cold water storage cistern has a minimum capacity of 230 litres, for location in the roof space. In addition to its normal supply function, it provides an adequate emergency storage in the event of water main failure. The system requires more pipework than the direct system and is therefore more expensive to install, but uniform pressure occurs at all cistern-supplied outlets. The water authorities prefer this system as it imposes less demand on the main. Also, with fewer fittings attached to the main, there is less chance of back siphonage. Other advantages of lower pressure include less noise and wear on fittings, and the opportunity to install a balanced pressure shower from the cistern.

**Notes:**

- (1) Servicing valves to be provided on supply pipes to storage and flushing cisterns.
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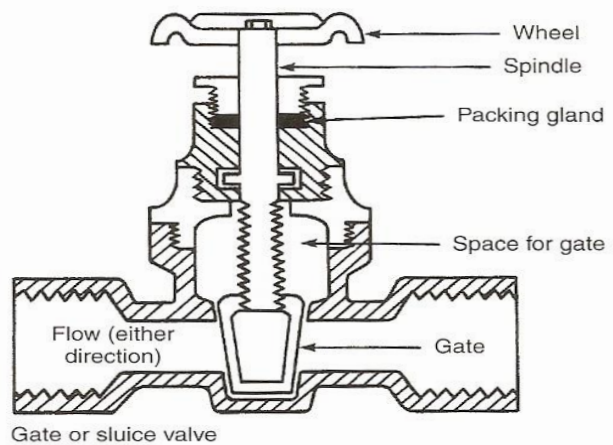
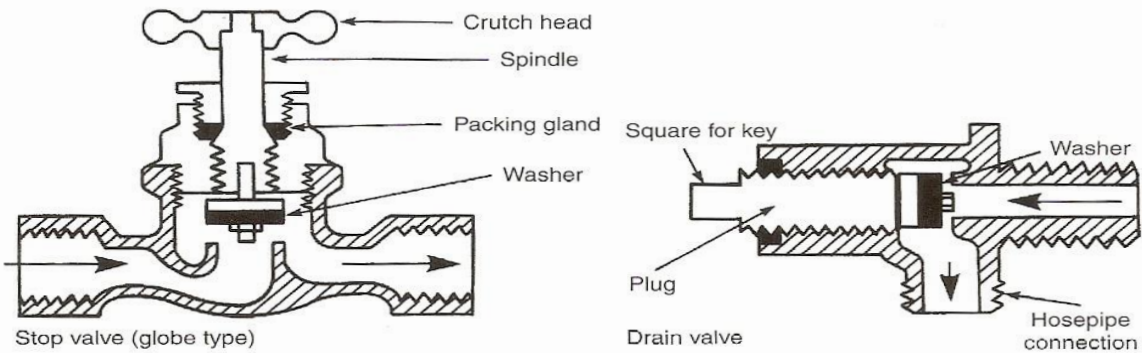
Draining or emptying plugs should be provided where pipe work cannot be drained to taps so that the whole distributing system may be drained for renewal or repair of pipe work or when the building is left vacant.

The globe-type stop valve is used to control the flow of water at high pressure. To close the flow of water the crutch head handle is rotated slowly in a clockwise direction gradually reducing the flow, thus preventing sudden impact and the possibility of vibration and water hammer.

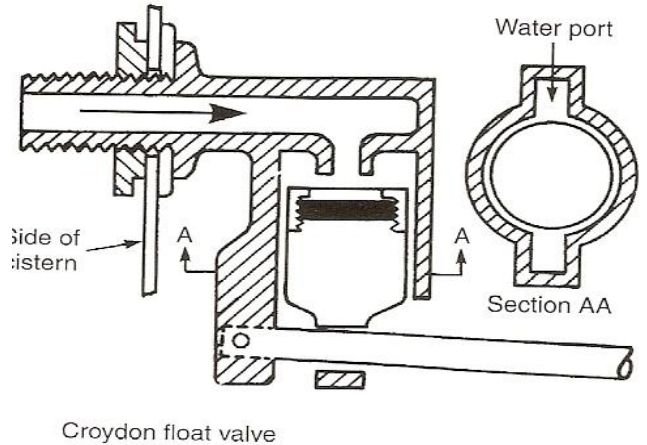
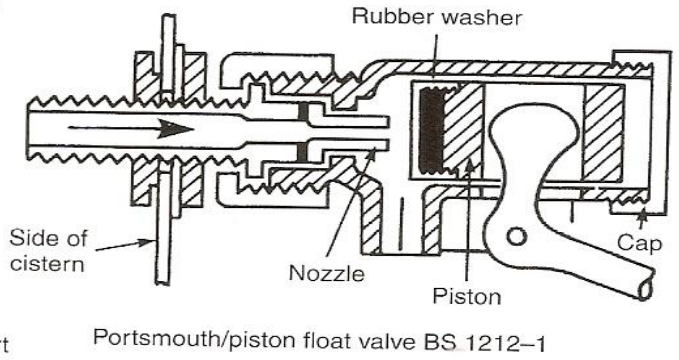
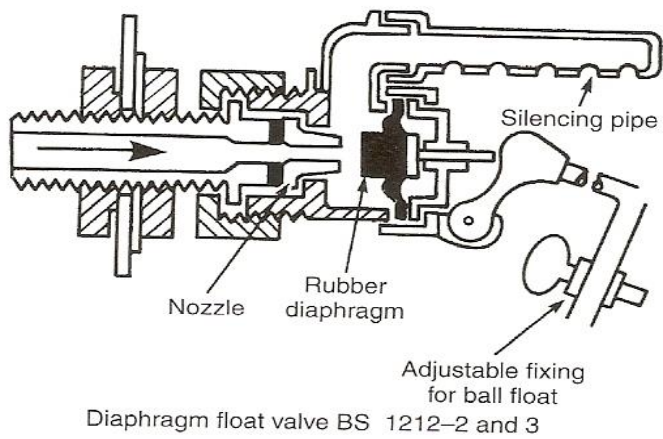
The gate or sluice valve is used to control the flow of water on low pressure installations. The wheel head is rotated clockwise to control the flow of water, but this valve will offer far less resistance to flow than a globe valve. With use the metallic gate will wear and on high pressure installations would vibrate.

The drain valve has several applications and is found at the lowest point in pipe systems, boilers and storage vessels.

For temperatures up to 100°C valves are usually made from brass. For higher temperatures gun metal is used. Brass contains 50% zinc and 50% copper. Gun metal contains 85% copper, 5% zinc and 10% tin.

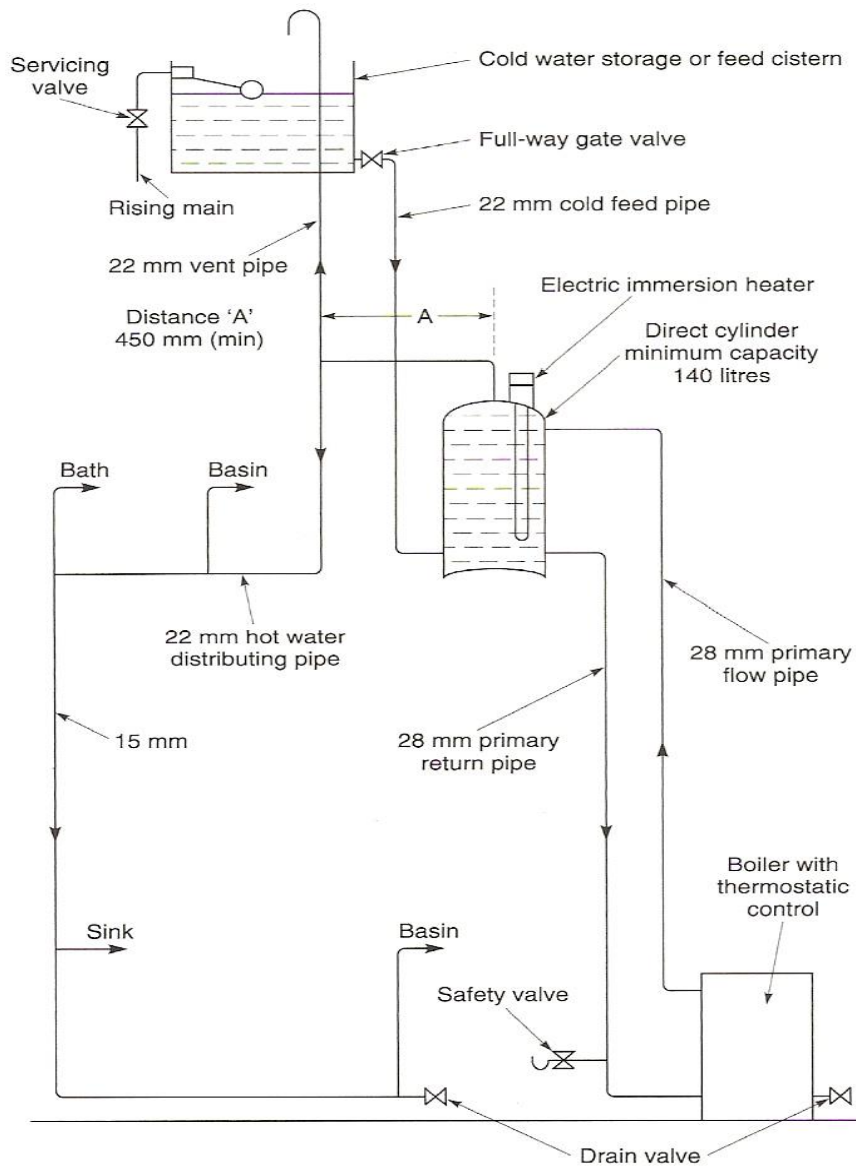


Float valves are automatic flow control devices fitted to cisterns to maintain an appropriate volume of water. Various types are in use. The diaphragm type is the least noisy as there is less friction between moving parts. The Portsmouth and Croydon-type valves have a piston moving horizontally or vertically respectively, although the latter is obsolete and only likely to be found in very old installations. Water outlets must be well above the highest water level (see page 41) to prevent back siphonage of cistern water into the main supply. Nozzle diameters reduce as the pressure increases. High, medium and low pressure valves must be capable of closing against pressures of 1380, 690 and 275kPa respectively.



## Direct System of Hot Water Supply

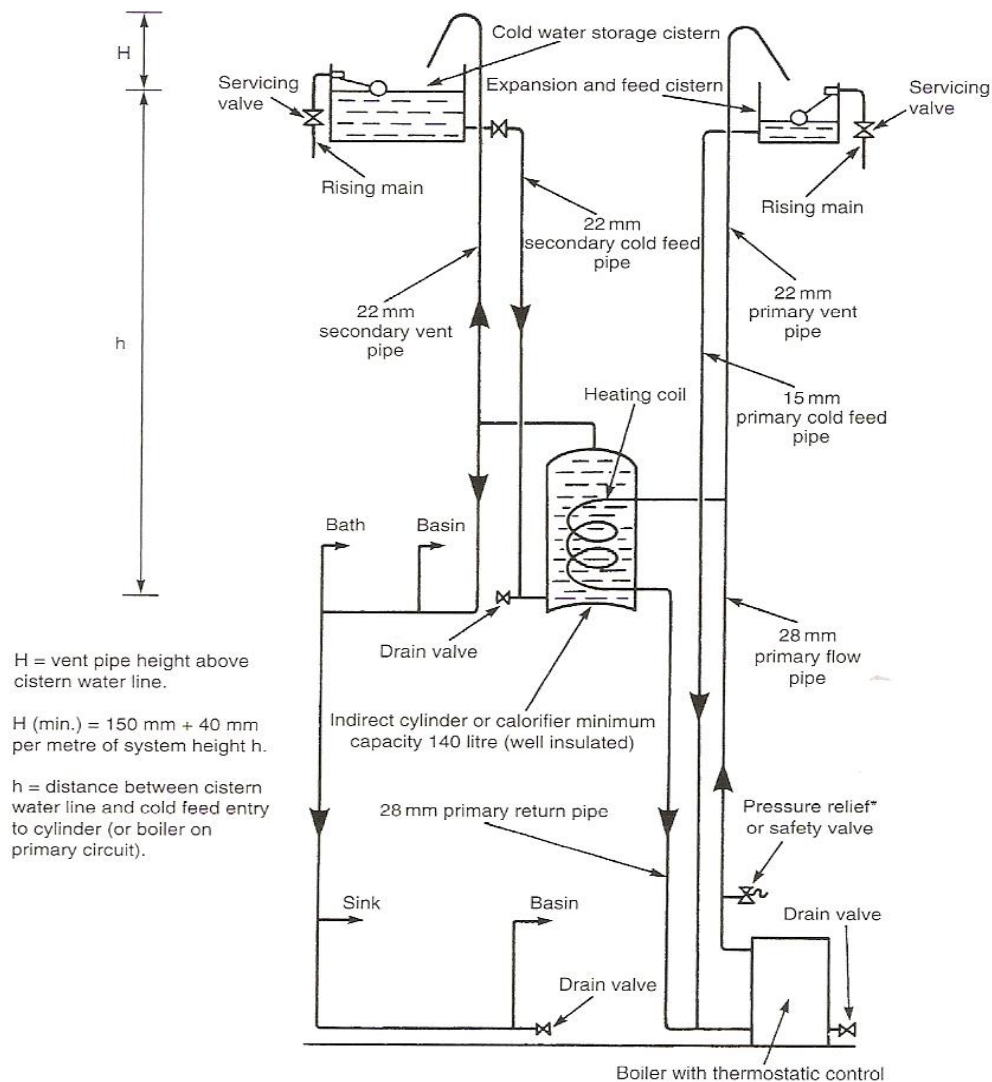
The hot water from the boiler mixes directly with the water in the cylinder. If used in a 'soft' water area the boiler must be rust-proofed. This system is not suited to 'hard' waters, typical of those extracted from boreholes into chalk or limestone strata. When heated the calcium precipitates to line the boiler and primary pipework, eventually 'furring up' the system to render it ineffective and dangerous. The storage cylinder and associated pipework should be well insulated to reduce energy losses. If a towel rail is fitted, this may be supplied from the primary flow and return pipes.



Note: All pipe sizes shown are for copper outside diameter.

## Indirect System of Hot Water Supply

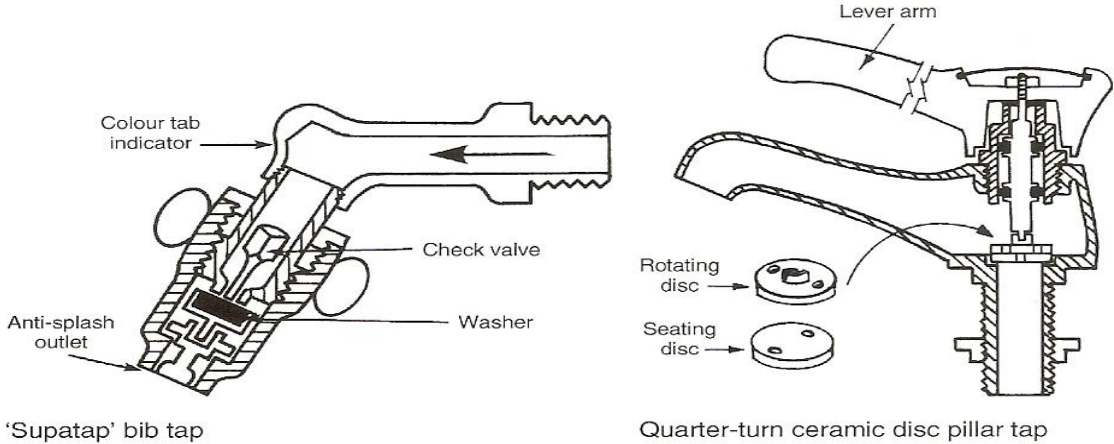
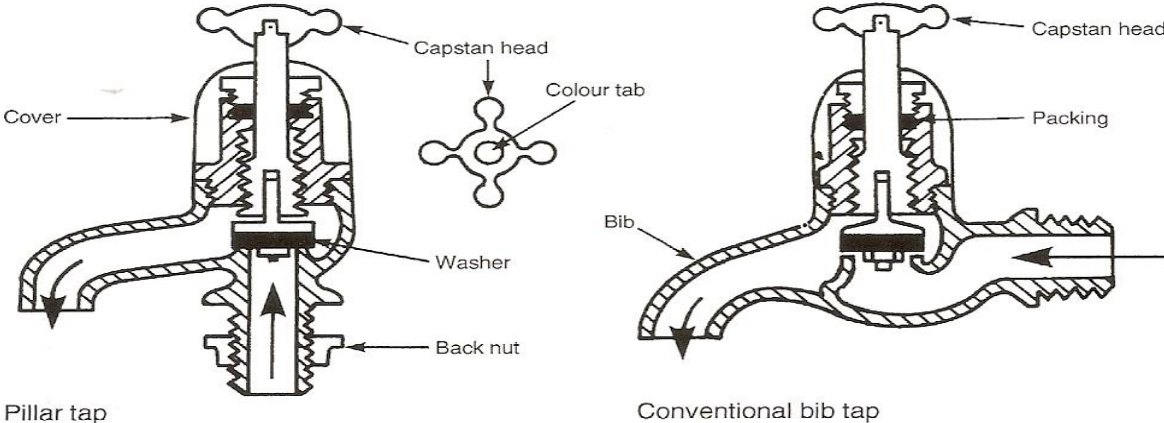
This system is used in 'hard' water areas to prevent scaling or 'furring' of the boiler and primary pipework. Unlike the direct system, water in the boiler and primary circuit is not drawn off through the taps. The same water circulates continuously throughout the boiler, primary circuit and heat exchange coil inside the storage cylinder. Fresh water cannot gain access to the higher temperature areas where precipitation of calcium would occur. The system is also used in combination with central heating, with flow and return pipes to radiators connected to the boiler. Boiler water temperature may be set by thermostat at about 80°C.



\*A safety valve is not normally required on indirect open vent systems, as in the unlikely occurrence of the primary flow and vent becoming obstructed, water expansion would be accommodated up the cold feed pipe.

The pillar tap is used to supply water to basins, baths, bidets and sinks. Combined hot and cold pillar taps are available with fixed or swivel outlet. The outlet of these taps must be bi-flow, i.e. separate waterways for hot and cold water to prevent crossflow of water within the pipework.

The bib tap is for wall fixing, normally about 150mm above a sanitary appliance. The 'Supatap' bib tap permits a change of washer without shutting off the water supply. It is also available in pillar format. Quarter-turn taps are easy to operate by hand or elbow, therefore are suitable for use by the disabled and medical practitioners.



## **DRAINAGE SYSTEMS**

### **SANITARY PIPEWORK ABOVE GROUND**

#### **DISCHARGE PIPES**

**Soil pipe- waste pipe.** The discharge from WCs and urinal is described as soil water and pipes that take the discharge- the soil pipe. The discharge from basins baths and sinks described as waste water and the pipes that take the discharge – waste pipes the main vertical pipe that collects discharges from WCs is termed the soil pipe, or soil stack, and the pipes from WCs to the stack are called soil branches. The vertical pipe collecting discharges is the waste pipe, waste tack, to which waste branches discharge when one single pipe collects both soil water and waste water , as in he single stack system it is called soil stack, as the size f the pipe is determined by the soil water discharge. Most sanitary work is single stack. The single stack is termed the discharge pipe or stack, the soil no longer being used.

#### **SINGLE STACK SYSTEM**

For economy of sanitary pipe work the single stack system is used today in both domestic and public buildings. The single- vertical pipe collecting discharges from all sanitary appliances is the discharge stack and the pipes from all appliances to the stack, discharge pipes. The single discharge stack takes the discharge pipes from the first floor WC. The swept- bend entry of WCs and limitations of length and slopes of other discharge pipes are shown.

# THE SINGLE STACK SYSTEM

## Notes

1 The single stack system was introduced by the Building Research Establishment and reduces the cost of soil and waste systems. Branch vent pipes are not required but the lengths and falls of the waste pipes must be carefully governed to prevent loss of trap water seals. The trap water seals on the waste traps must be 76 mm deep.

2 The slopes of the branch pipes are: sink and bath, 18 to 19 mm/m; basin 20 to 120 mm/m; WC 18 mm/m (min).

3 The vertical stack must be straight below the highest sanitary appliance.

4 The branch bath waste must be connected to the stack 200 mm below the centre of the WC branch connection.

5 The use of an S trap type WC lowers the connection of the WC branch pipe into the stack and the 50 mm bore parallel branch pipe may be omitted.

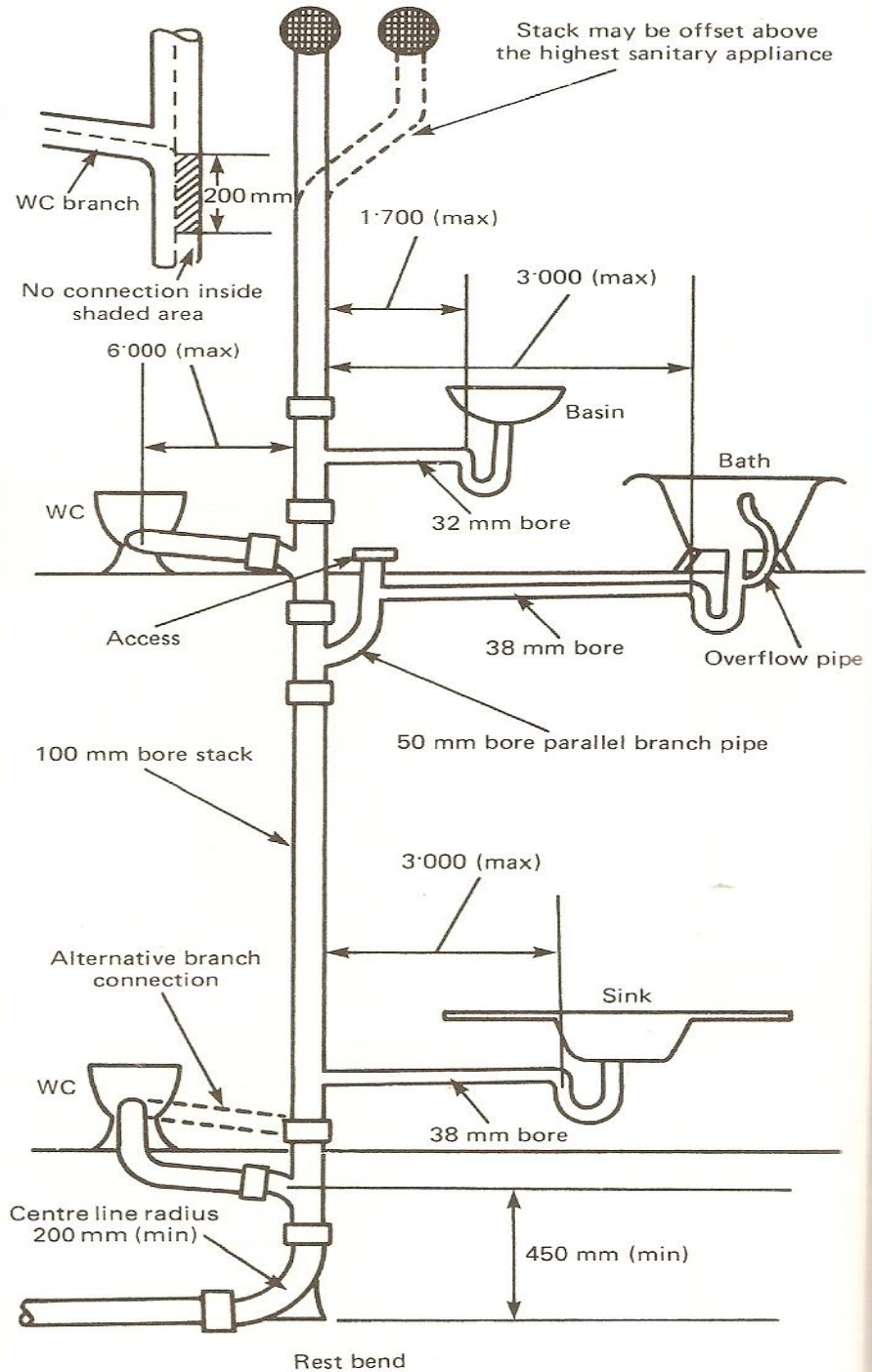


Fig 10

## THE TWO-PIPE SYSTEM

### Notes

1 The two-pipe system is the most expensive of the soil and waste disposal systems and should therefore only be used in circumstances where the sanitary appliances are widely spaced. In buildings such as hospitals, schools, factories and even houses, wash basins or sinks may be sited in rooms some distance from the main soil stack and it is then necessary to connect these appliances to a separate waste stack.

2 The waste stack may be connected to the horizontal drain either via a rest bend or a back-inlet gully.

3 In the system, waste appliances such as basins, sinks, bidets and showers are connected to a waste stack and soil appliances such as WCs are connected to the soil stack.

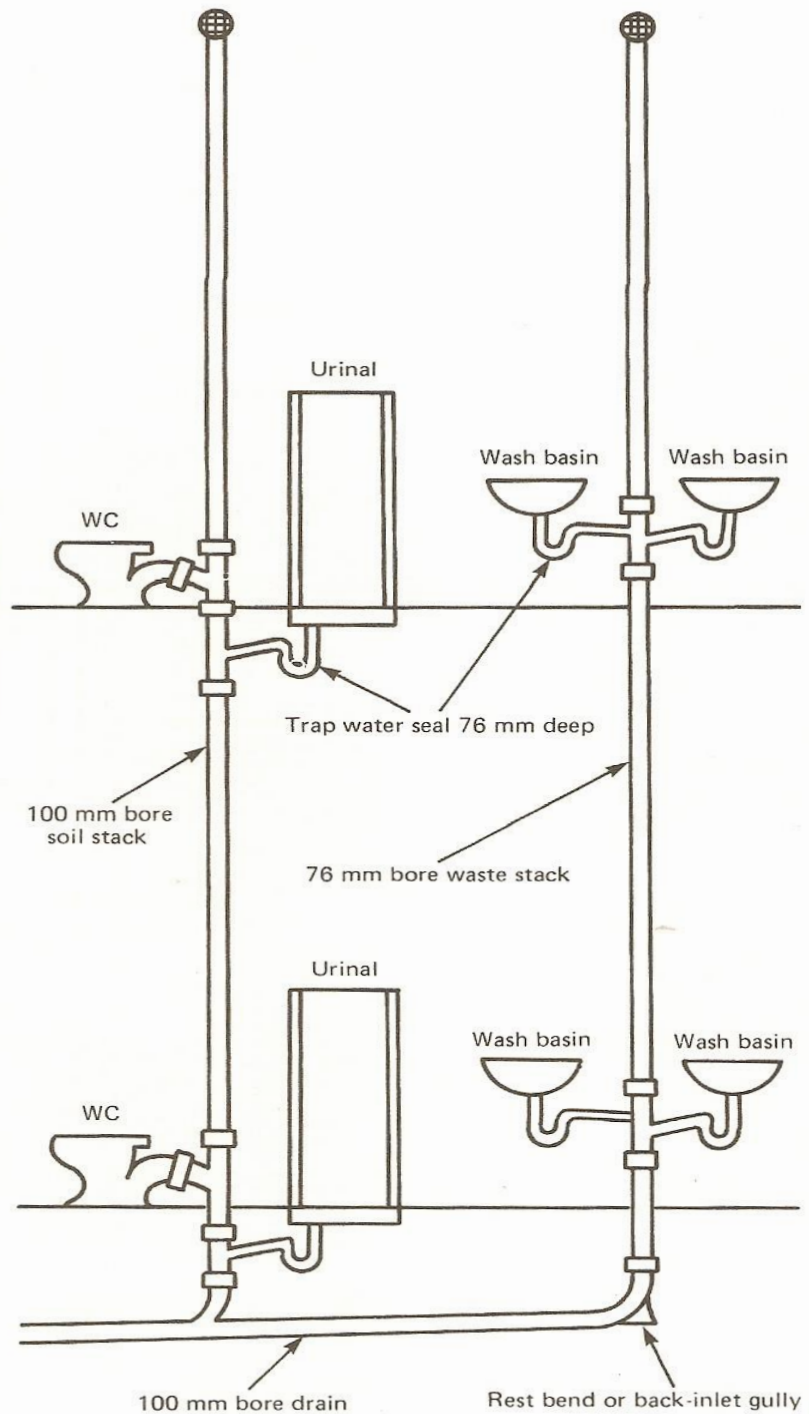


Fig 14

# APPLIANCES

