Brick, Stair, Roof

CE 200 Details of Construction

BRICK

The term brick is used to denote a building unit made of shaped clay, but in modern times it is used to refer to any stone or clay based building unit that is joined with cementitious mortar when used in construction.

Types of Bricks:

Bricks may be categorized in different ways, like material used, Shapes, Process of Manufacturing etc.

Based on Raw Materials and Method of Manufacturing (fired or non-fired), there are five common types of bricks:

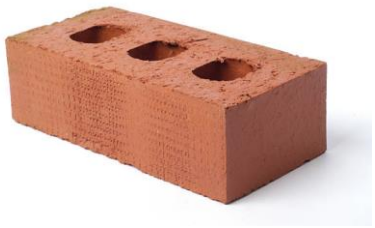
- Burnt clay bricks
- Sand lime bricks (calcium silicate bricks)
- Concrete bricks
- Fly ash clay bricks
- Firebrick

Burnt Clay Bricks

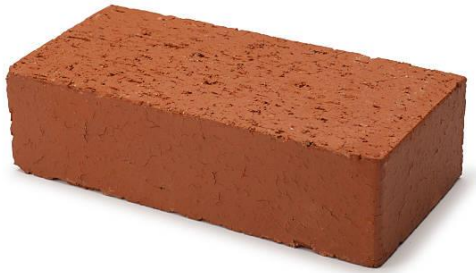
Burnt clay bricks are the classic form of brick, created by pressing wet clay into molds, then drying and firing them in kilns. This is a very old building material—the type of brick found in many of the ancient structures of the world. In appearance, these bricks are solid blocks of hardened clay, usually reddish in color.

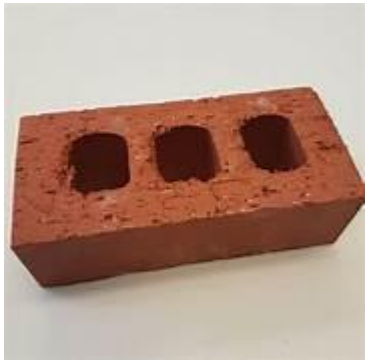


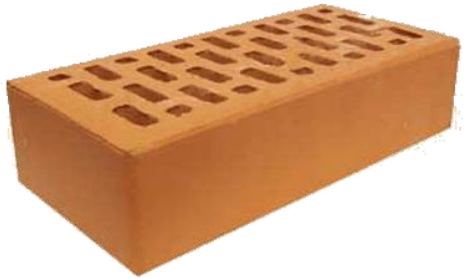




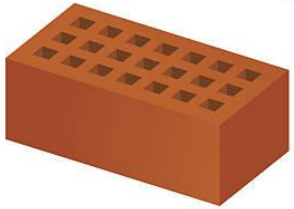


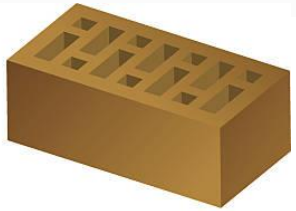


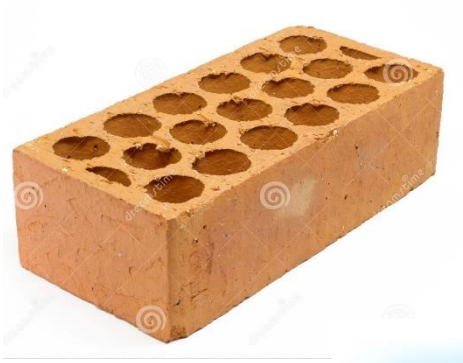


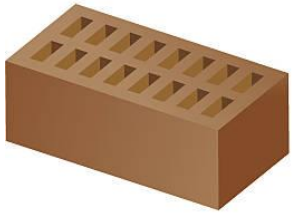


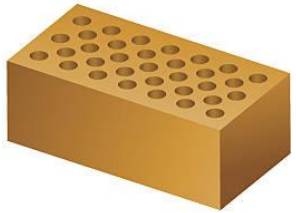


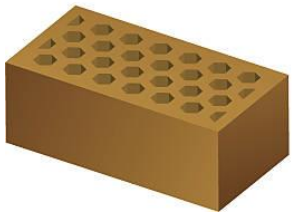


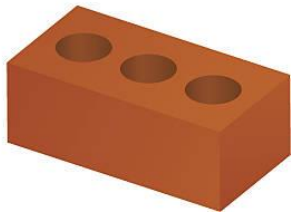


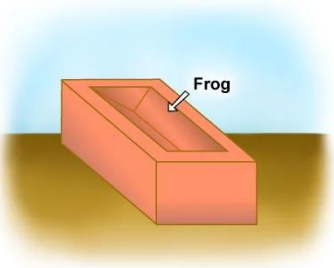


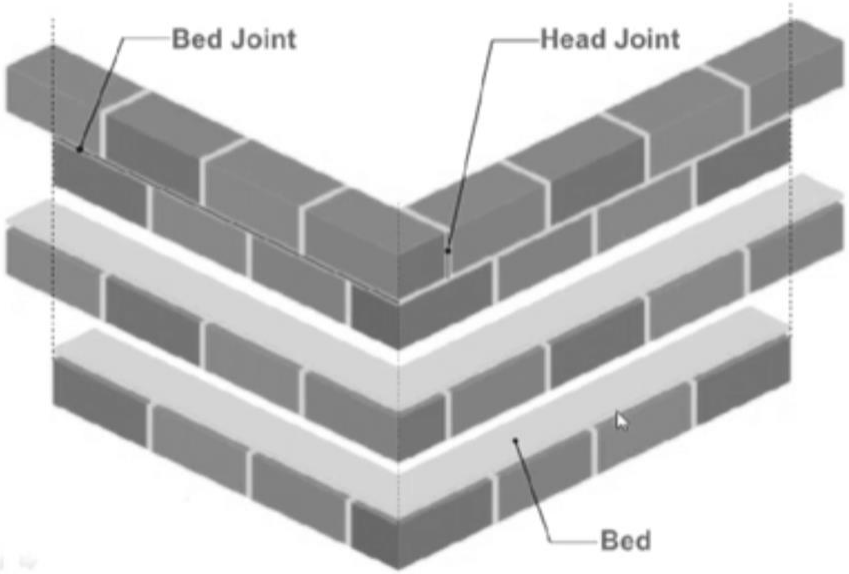


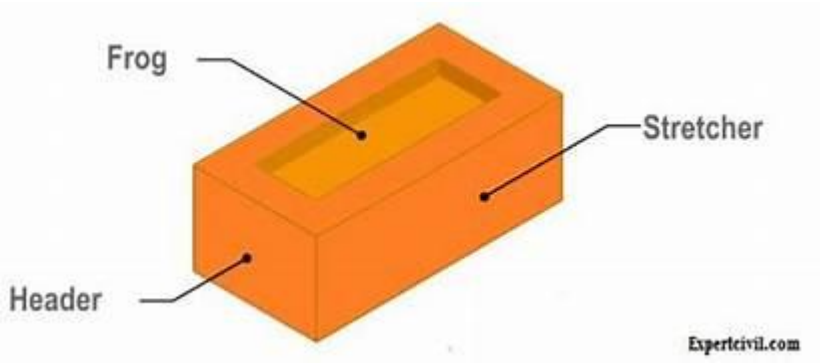




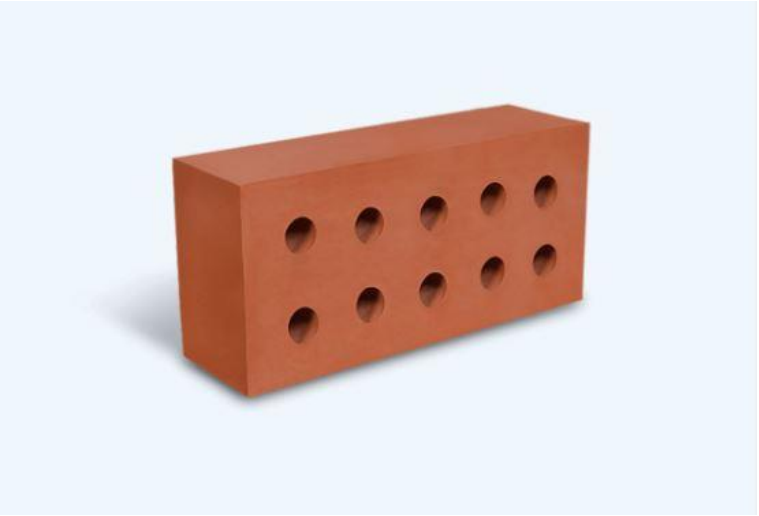



Frog


Bed Joint
Head Joint
Bed


Frog
Stretcher
Header
Expertcivil.com


Standard Dimension of Brick in Bangladesh
9½ in
2 3/4 in
4 ½ in



No	Image	Product	Dimensions	Weight (Kg)	Crushing Strength (PSI)	Absorption Capacity (%)
1.		1st Class Solid Brick	Length 9¼ Width:4½ Height 2½	3.5 Kg	5250	10
		Medium Class Solid Brick			4000	12
		Picket Brick	Length 9 Width:4½ Height 2½	3.4 Kg	7000	08
2.		3 Hole Engineering Brick	Length 9½ Width:4¾ Height 2¾	3.2 Kg	5250	10




MUB
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MUB

Sand Lime Bricks

Sand lime bricks (also known as calcium silicate bricks) are made by mixing sand, fly ash and lime. Pigments may also be added for color. The mixture is then molded under pressure to form bricks; the materials bond together by a chemical reaction that occurs as the wet bricks dry under heat and pressure. These bricks are not, however, fired in kilns in the same manner as burnt clay bricks.





Concrete Bricks

Concrete bricks are made from solid concrete and are growing in popularity among homeowners. Concrete bricks are usually placed in facades, fences, and provide an excellent aesthetic presence. These bricks can be manufactured to provide different colors if pigments are added during production. This is non-fired brick.





Fly Ash Clay Bricks

Fly ash clay bricks are manufactured with clay and fly ash. Because fly ash contains a high volume of calcium oxide, this type of brick is sometimes described as self-cementing. However, it expands when exposed to moisture. This tendency to expand, however, can also produce pop-out failure. Fly ash clay brick has the advantage of being lighter in weight than clay or concrete brick. This is non fired bricks.





Fire Bricks

Also known as *refractory bricks*, these are manufactured from specially formulated earth with a high aluminum oxide content. After burning, these bricks can withstand very high temperatures without their shape, size, or strength being affected.





Some Brick Structures

- Duplex Home



- Mosque's Dome





- Pavement

Some Brick Structures (contd.)

- Arches



- Arch bridge



Bangladesh Standard Specification BDS 208

Compressive Strength:

Grade	Mean for twelve halved bricks	Minimum for individual halved bricks
S	280 kg^f/cm^2	245 kg^f/cm^2
A	175 kg^f/cm^2	154 kg^f/cm^2
B	140 kg^f/cm^2	105 kg^f/cm^2

Water Absorption:

Water absorption by weight shall not exceed 20% for bricks of B grade and 15% for bricks for A grade and 10% for bricks of S grade.

Grade S: This of bricks may be used for breaking into aggregate for plain and reinforced concrete and for making base course for pavement

Grade A: This type of bricks may be used in construction of buildings of long duration.

Grade B: This type of bricks may used for one stored building, temporary shed, where intended durability is not very high.

Brick dimensions

Conventional Dimension:
General Dimension: 10”x5”x3”(With mortar)
Nominal size: 9.5”x4.5”x2.75” (Without mortar)
As per BDS 208:
Length : 24cm Width: 11.5 cm and Height/Depth: 7cm

Brick Bats: A fragment of brick.

General Principle to be observed in Brick masonry construction

Article 9.3;
Page no: 231;
Building Construction by Sushil Kumar

There are **25** points that should be thoroughly studied.

9·3. GENERAL PRINCIPLES TO BE OBSERVED IN BRICK MASONRY CONSTRUCTION

Brick masonry is classified as first class or second class according to the type of bricks used (whether first class or second class) and according to the method of laying. The strength of masonry work, however, depends very much upon the type of material used, nature of workmanship and supervision. Bad workmanship assisted by lack of supervision may lead to unsound construction inspite of the materials used being of the best possible type. The general principles which should be observed for a sound brick masonry construction are given below. (The technical terms used in this chapter have already been described in the chapter on Stone Masonry.)

(1) The bricks used in a good work should be sound, hard and well burnt with uniform size, shape and colour. They should have no cracks or flaws and a fractured surface should be free from holes, grit or lumps of lime etc. The surface of the bricks should be such that no mark should be made when scratched by the finger nail. The bricks when struck together should produce metallic ringing sound and they should not break when dropped from a height of 90 to 120 cm. on the ground. The bricks should not as a rule absorb water more than 20% of their weight when dry, when immersed in water for twenty-four hours.

(2) The bricks should be thoroughly soaked in clear water before use for suitable period so that the water just penetrates the full depth of bricks. This not only helps in removing the dirt, dust and other soluble salts (which cause efflorescence) from the bricks, but also reduces their tendency of suction of water from wet mortar. *In case, however, masonry is to be carried out in mud or fat lime mortar, the bricks should not be soaked in water before use.*

(3) The bricks should be laid on a full bed of mortar. They should be slightly pressed into the bed mortar while laying so as to ensure proper adhesion. All the courses should be laid truly horizontal and all the vertical joints should be truly vertical.

CS Scanned with CamScanner

(4) All the joints should be properly flushed and filled with mortar so that no cavity is left in between.

(5) In case of walls two brick or more in thickness, the joints should be grouted at every course in addition to bedding and flushing with mortar.

(6) No brick-bats should be used in the work except when it is absolutely necessary for obtaining the specified bond.

(7) Brick work is generally laid in the English bond. In all cases, it should be ensured that a proper bond is maintained throughout the work.

(8) Only specified mortar of a good quality should be used in the work, taking great care that uniform mortar joint is obtained throughout the construction. Thickness of joints should not exceed 13 mm in any case.

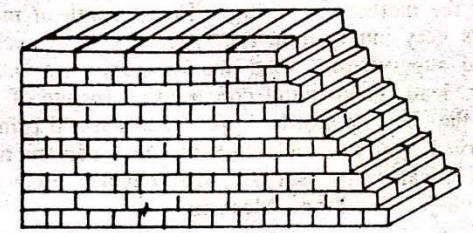


Fig. 9·1

Raking back of a brick wall

(9) Unless brick -on-edge is specified, the bricks must be laid on their proper beds with their frogs pointing upwards.

(10) The courses of bricks at the plinth, window sill, floor/roof level and at the top of parapet wall should invariably be laid with brick on edge.

(11) The progress of work in raising masonry should be such that all the connected brick work should be carried up in uniform layers at one level. It should be ensured that no part of the wall should preferably rise more than 100 cm. than the rest of it. When it is not possible, the work should be raked back according to the bond. The walls should be raised up truly vertical.

(12) The buttresses, counterforts etc. should be built up course by course, maintaining proper bond with the main wall and should not be added or joggled afterwards.

(13) Iron fixtures like pipes, hold-fasts of doors and windows etc., which are to be fixed in the brick wall should be embedded in cement mortar or in cement concrete.

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(14) The face joints are generally raked to a minimum depth of 10 to 15 mm. when the mortar in the joints is still green. This is done to provide proper key for the plastering or pointing.

(15) Plastering should be done after about 28 days of completion of brick masonry. This permits adequate time for the shrinkage in masonry and concrete to take place before plastering operation is carried out.

(16) In works where plastering or pointing is not desired, the mortar joints should be struck flush and finished at the time of laying.

(17) All the finished masonry work should be kept wet for at least seven days.

(18) When an existing wall has to be strengthened by making it thicker, 20 cm x 20 cm x 10 cm. (dimensions of one brick) recesses are cut in the existing wall. The recesses are staggered taking care that one recess is made in every sq. metre of the wall. This enables the new work to be properly bonded to the old one. This operation is termed as *back-bonding*.

(19) When it is desired to increase the length of the wall under construction at a future date, the wall is stopped with a toothed end. This is necessary to ensure continuous bonding between the old and the new work.

(20) It is found that with an average winter-summer temperature differences of about 100°F, a brick masonry wall expands by about 10 mm. in every 30 m. length of wall. Hence it is desirable to provide minimum 18 mm. wide expansion joints after every 30 to 45 m. length of wall.

(21) When timber floor or roof is required to be supported on masonry walls, the ends of timber joists (supporting the floor or roof) should rest on corbels or brackets as far as possible. In cases where the ends of timber joists have to be built into the wall itself, it is necessary to apply suitable preservative treatment to the embedded portion of the joists and in addition some space should be left around them to minimise chances of attack by termite and to ensure free circulation of air.

(22) Bed blocks of stone, concrete or reinforced concrete should be provided at the ends of beam (it may be of timber, steel or R.C.C.) carrying heavy loads.

(23) The bearing of R.C.C. floor or roof slab resting on brick masonry walls should not be less than the effective depth of slab or 10 cm., which ever is more.

(24) As a general practice, quoin brick should be headers and stretchers laid in alternate courses and the bond is developed by placing a quoin closer next to the queen header.

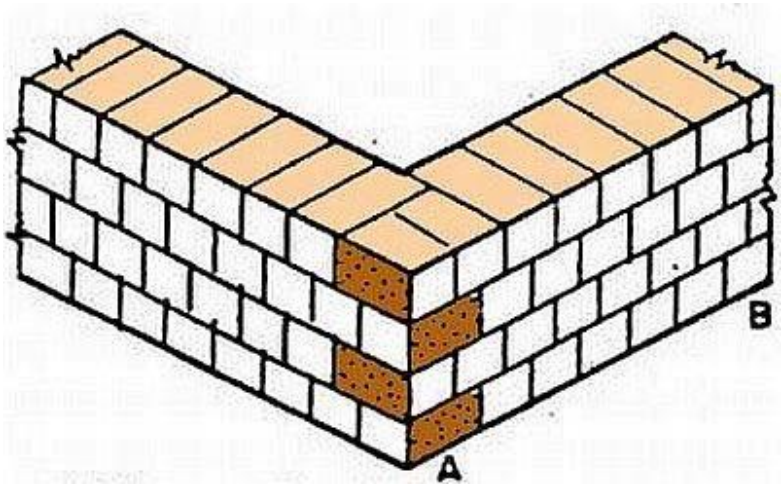
(25) Half brick partition walls should be reinforced with suitable

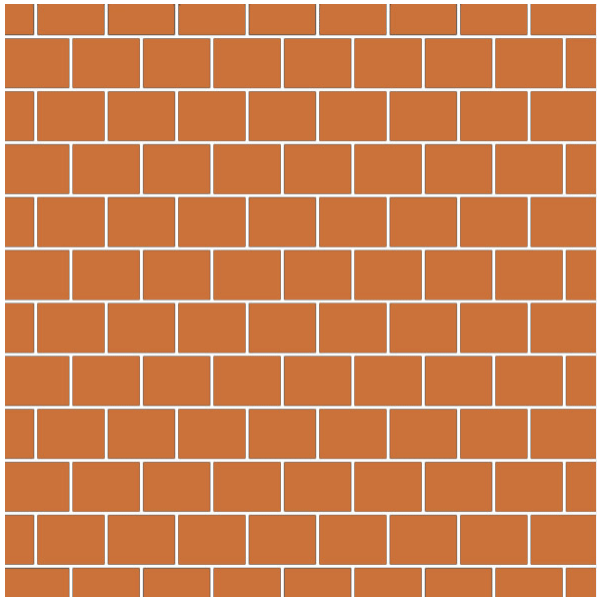
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Types of Bond

There are several types of bond for brick. Some commonly used are:

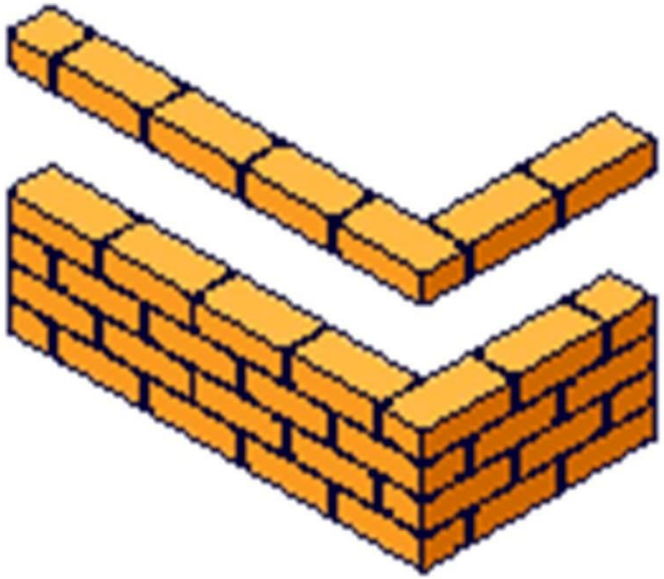
- **Header Bond**
- **Stretcher Bond**
- **English bond**
- **Flemish bond**
- **Herringbone Bond**

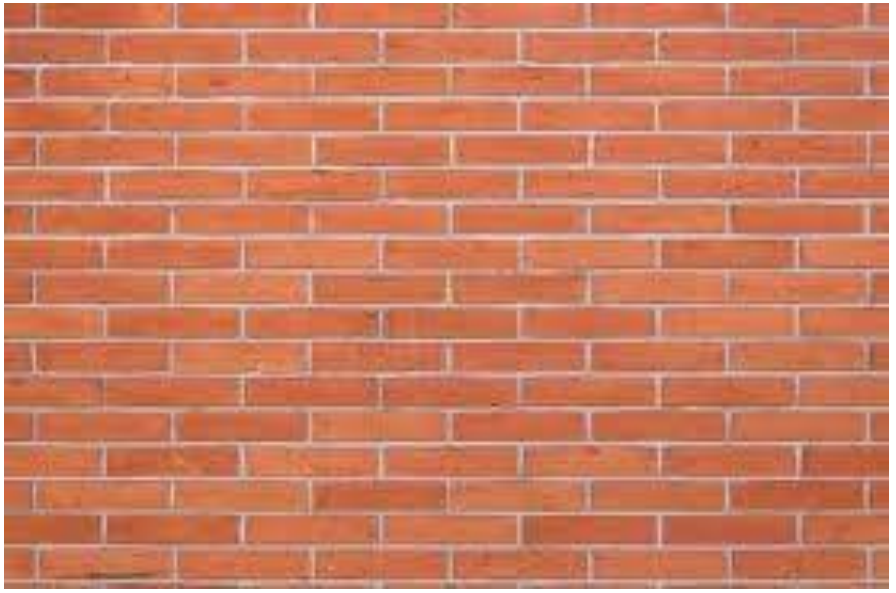




•Since header bonds lacks strength in pressure transmission along the length of the wall, it is not preferable to use this kind of bond for load bearing walls.
•Header bond is useful when the design demands curved surfaces to be constructed. In such cases, stretcher bond cannot be used. Apart from using it for curved surface, it can also be used for the brickwork in foundations.

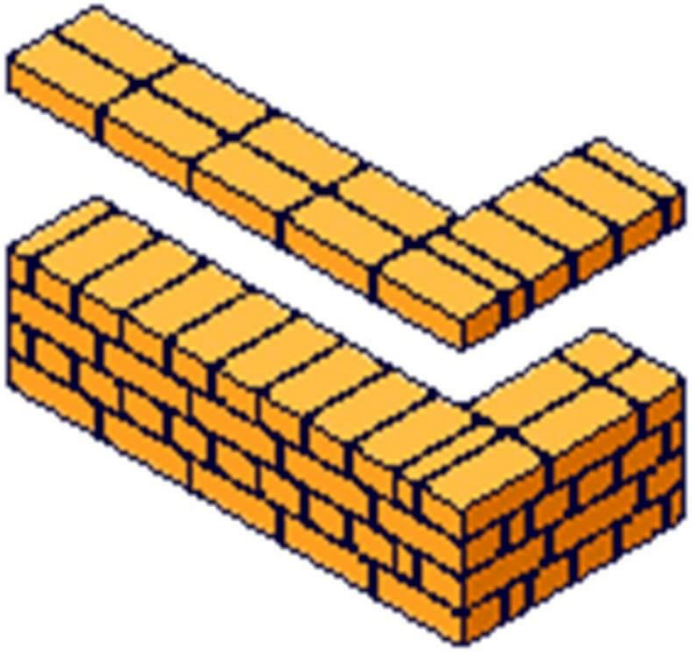
Header Bond





A commonly used bond, a pattern is made only using stretchers, with the joins on each course centred above and below by half a brick.
This type of bonding is not particularly strong.

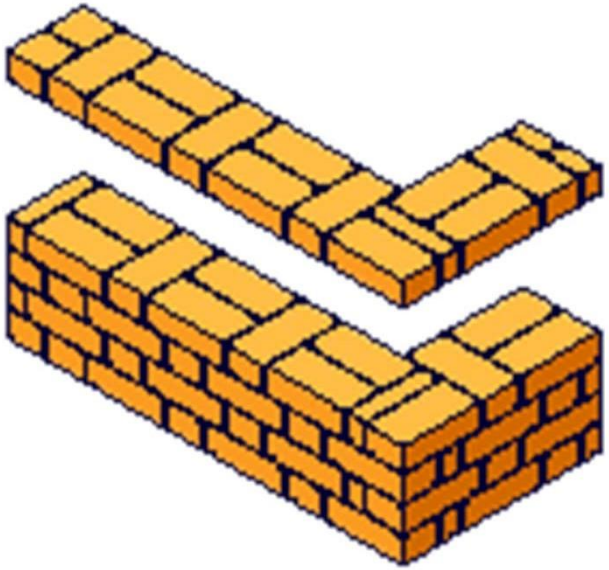
Stretcher Bond





This is a pattern formed by laying alternate courses of stretchers and headers.
The joins between the stretchers are centered on the headers in the course below.
This is one of the strongest bonds but requires more facing bricks than other bonds.

English bond

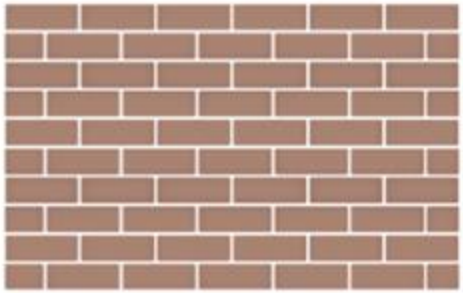




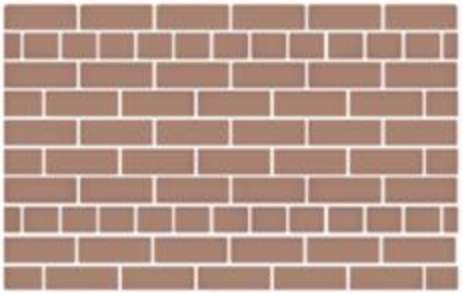
This is formed by laying headers and stretchers alternately in each course.
The headers of each course are centered on the stretchers of the course below.
This bond is strong and often used for walls which are two-bricks thick.

Flemish bond

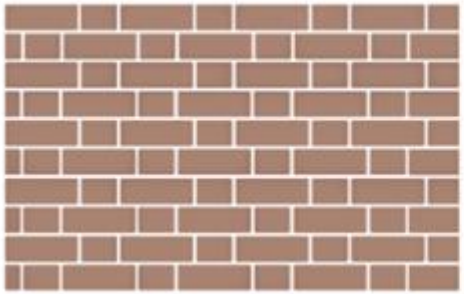
Stretcher Bond



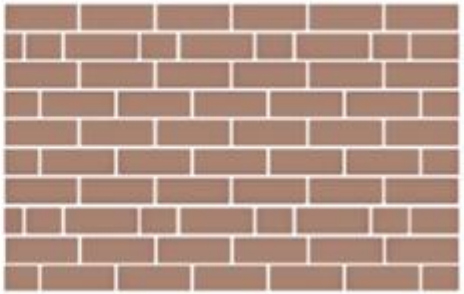
Common Bond
(Full headers every 6th course)



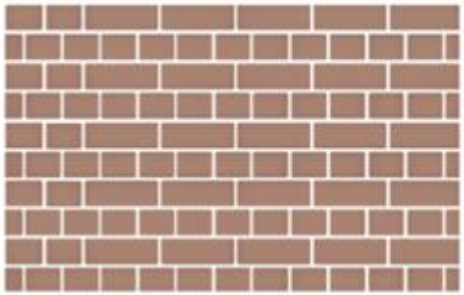
Flemish Bond



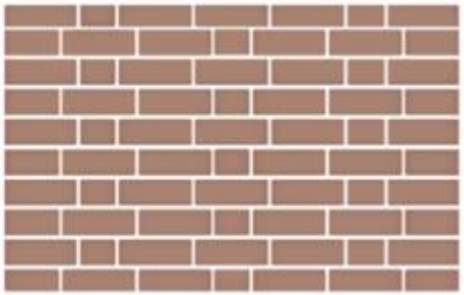
Common Bond
(Flemish every 6th course)



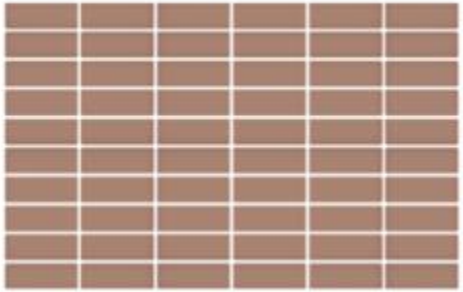
English Cross or Dutch Bond



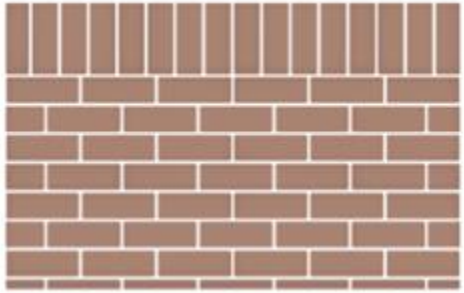
Garden Wall Bond

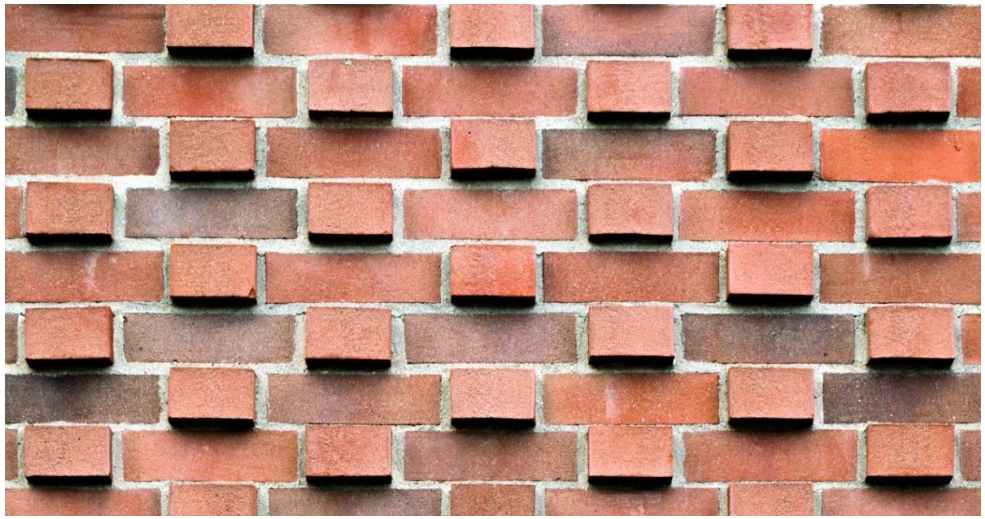


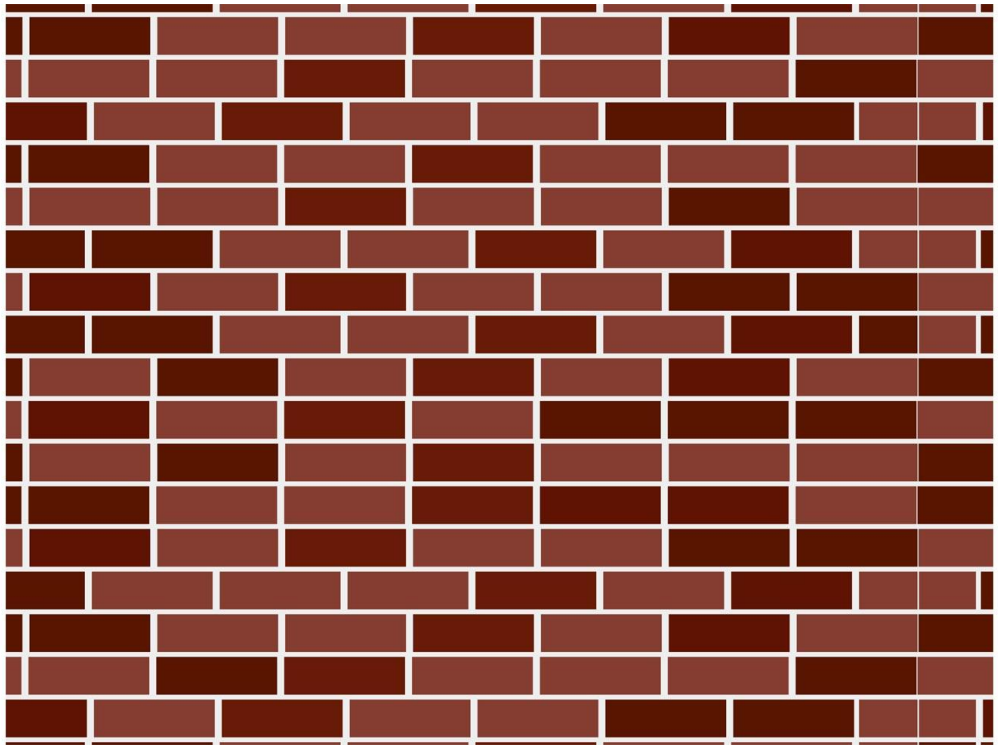
Stack Bond

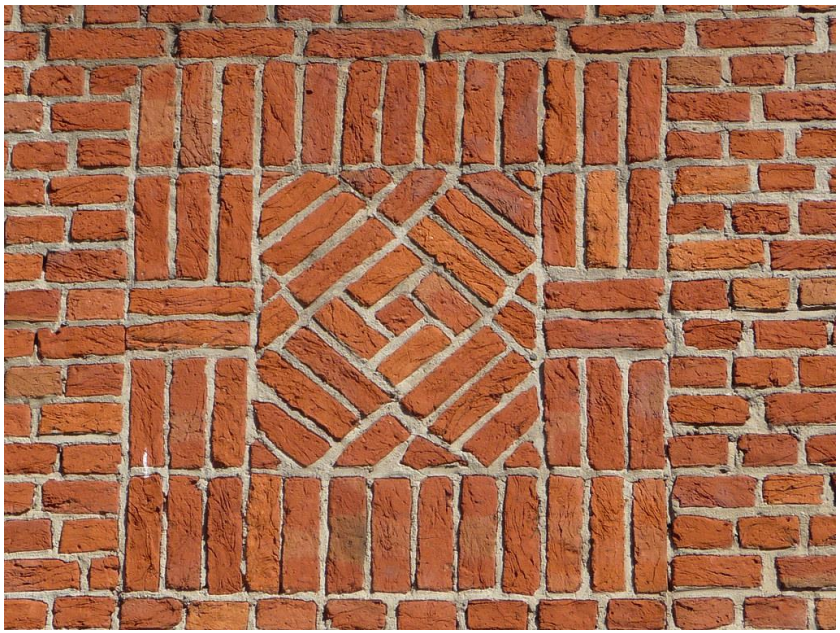


Soldier Course (with Stretcher Bond)

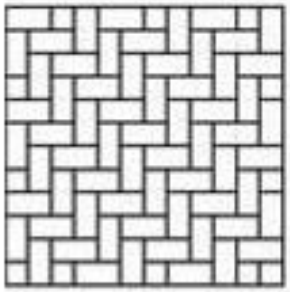




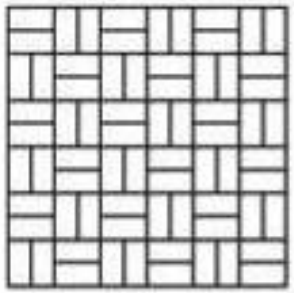




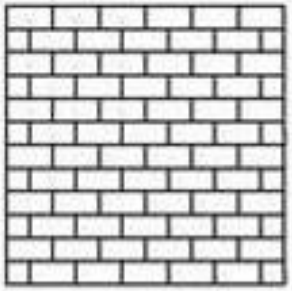
PAVING PATTERNS FOR BRICKS



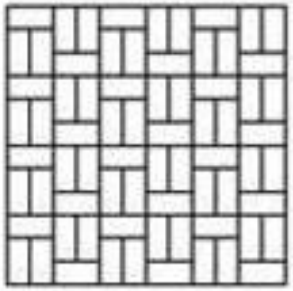
90 Degree Herringbone



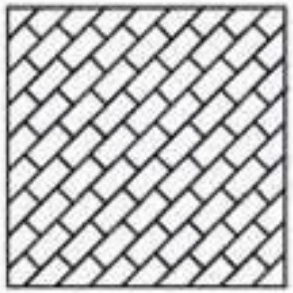
Double Basketweave



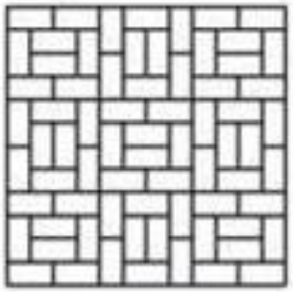
Running Bond



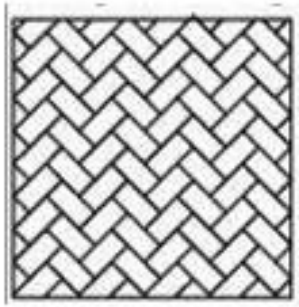
Single Basketweave



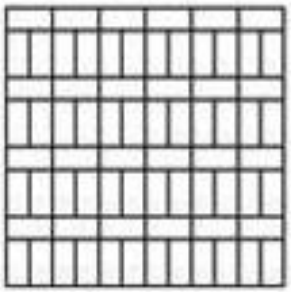
45 Degree Running Bond



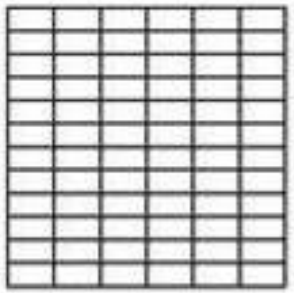
Boxed Basketweave



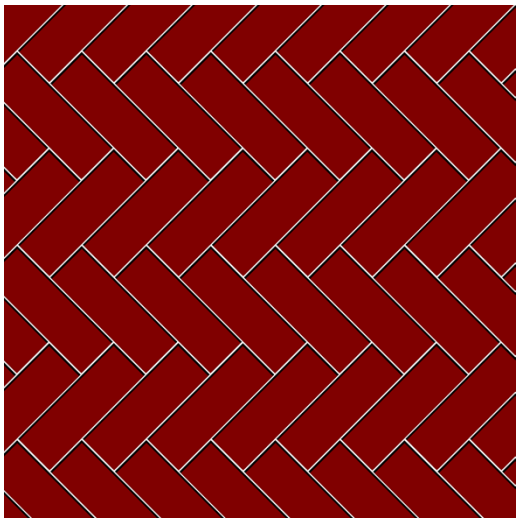
45 Degree Herringbone



Combination Stack/
Running Bond



Stacked Bond





In **herringbone bond** bricks are laid at an angle of 45° to the direction of the row, instead of horizontally. Alternate courses lie in opposing directions, resulting in a zigzag pattern.

Herringbone Bond













Defects in Brick Structures

- Sulfate Attack
- Crystallization of salts from bricks (Efflorescence)
- Corrosion of embedded steel
- Shrinkage on drying

Sulphate Attack

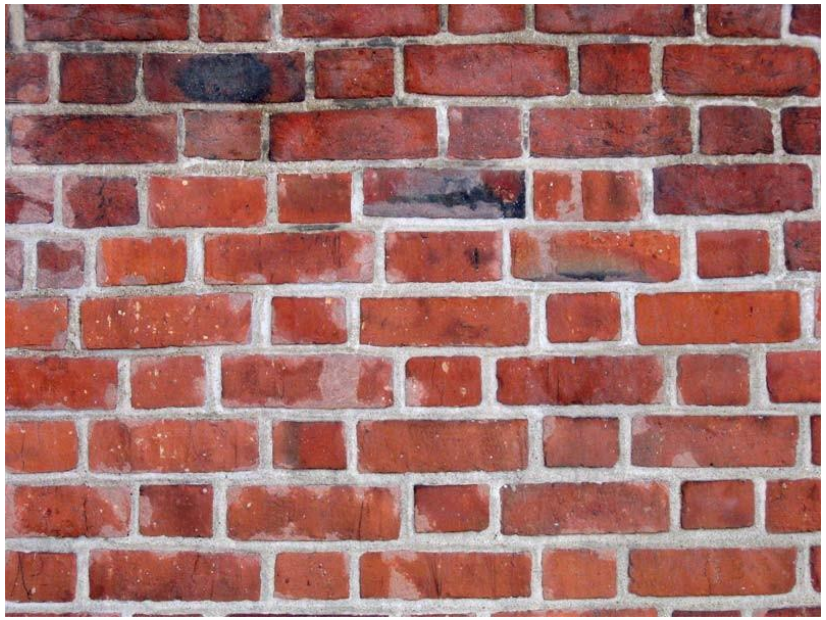
It is caused by a reaction between sulfates in solution and a constituent of Ordinary Portland Cement known as tricalcium aluminate. he reaction between the sulfates and the tricalcium aluminate forms a compound known as calcium sulfo-aluminate. This compound expands as it forms, leading to cracking in the mortar joints, followed by general deterioration and the loss of the mortar's 'bonding' function.



Efflorescence

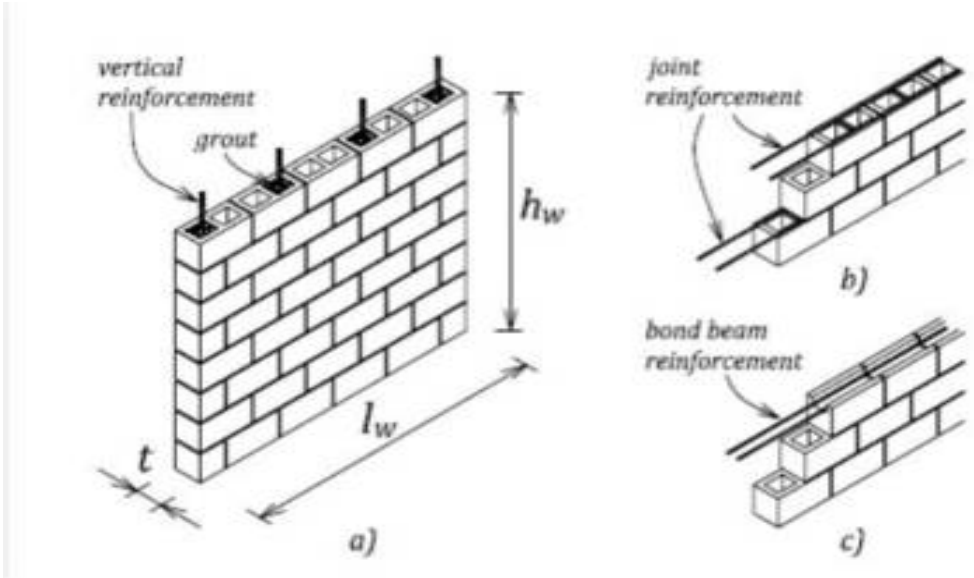
Efflorescence is caused by soluble salts in solution being brought to the surface as water in the wall dries out. It is usually a harmless, temporary problem,. The main concern is the unsightly appearance caused by the white staining that it produces.

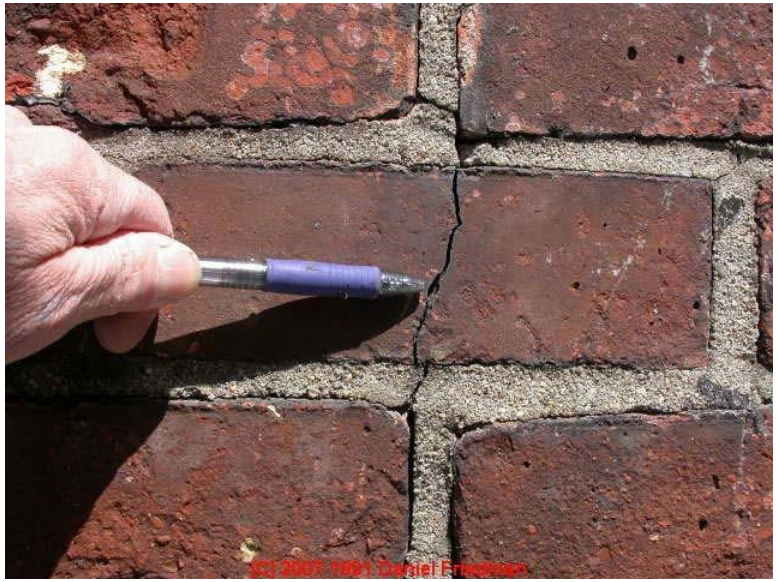




Corrosion of Embedded Steel

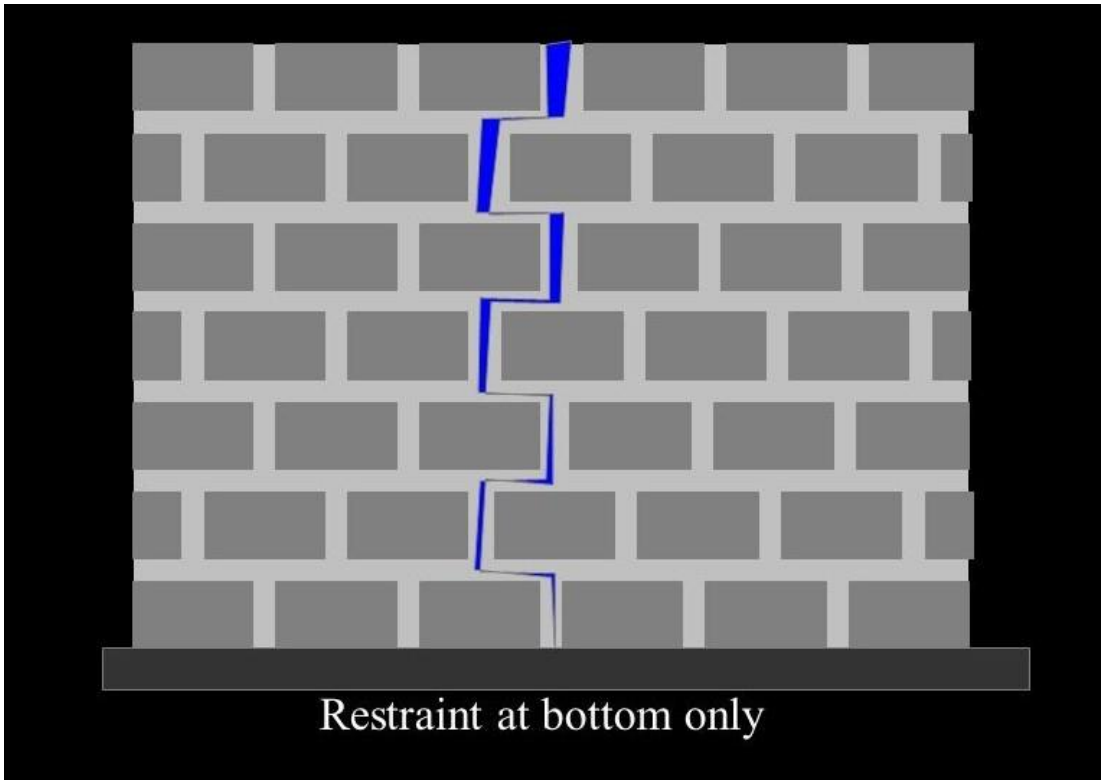
If steel embedded in brick work get corroded, it expands, creates pressure on brick work. Subsequently brick work cracks.





Shrinkage or Drying

Brick work swells with the absorption of water and subsequently shrinks when water evaporates.
In the process of shrinking it develops cracks in the masonry joints.

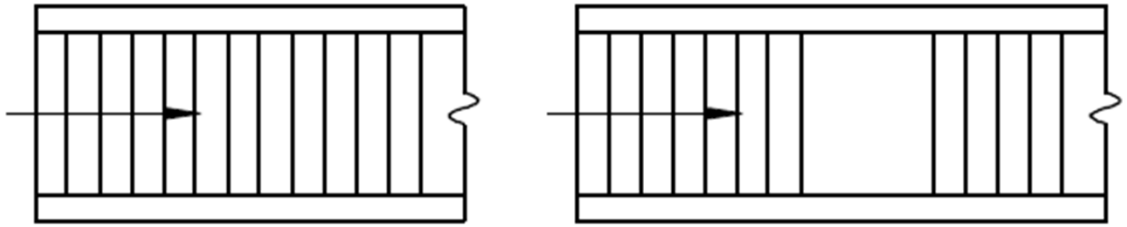


STAIR

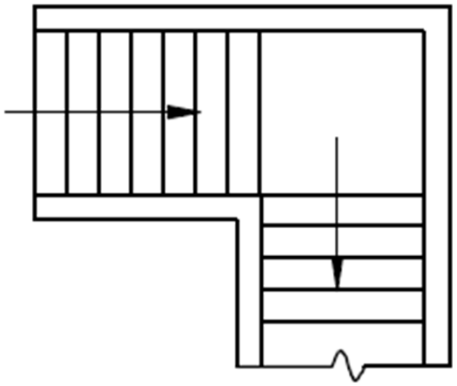
Stair

- Series of steps provided as a means of vertical movement between various floors.
- Stair-case: Enclosure containing the complete stairway.
- Materials used in stairs: timber, stones, bricks, steel, plain concrete or reinforced concrete.

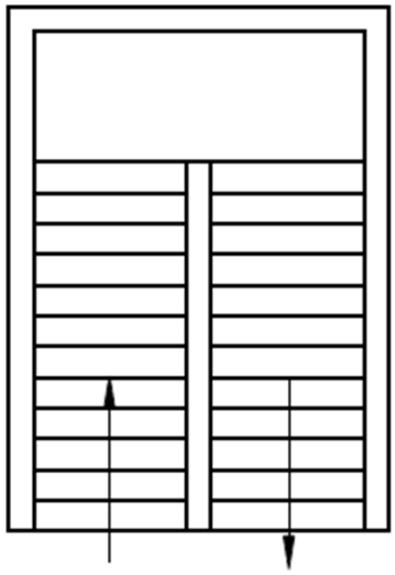
Common Types of Stairs



Straight flight stairs

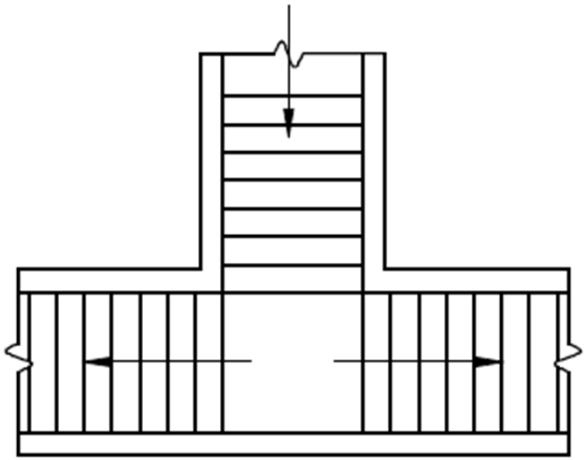


Quarter-turn stair

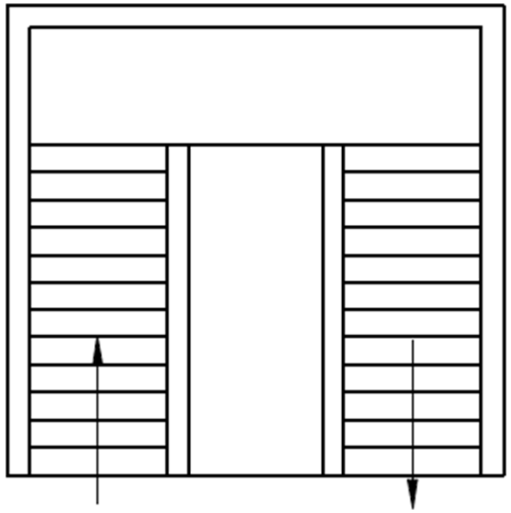


Half-turn stair

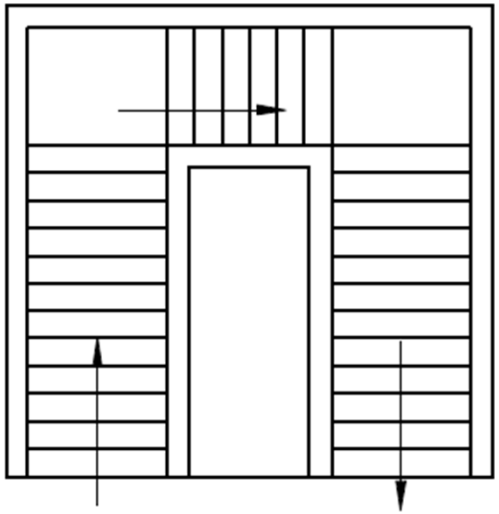
Common Types of Stairs (cont..)



Branching stair

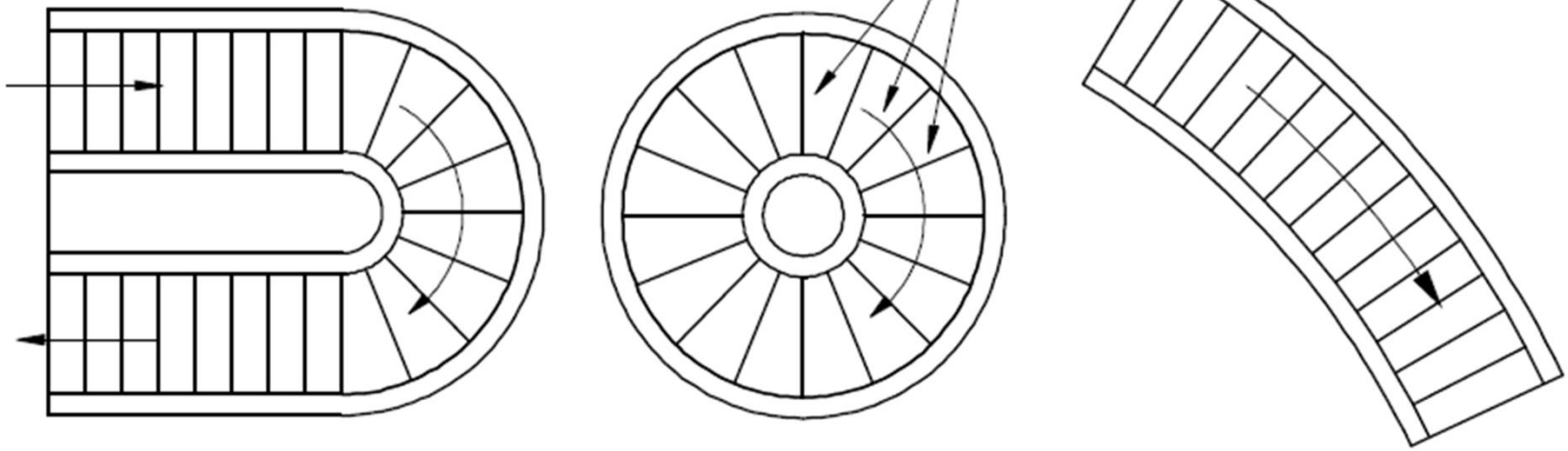


Open-well (half turn)



Open-well with quarter turn landing

Common Types of Stairs (cont..)



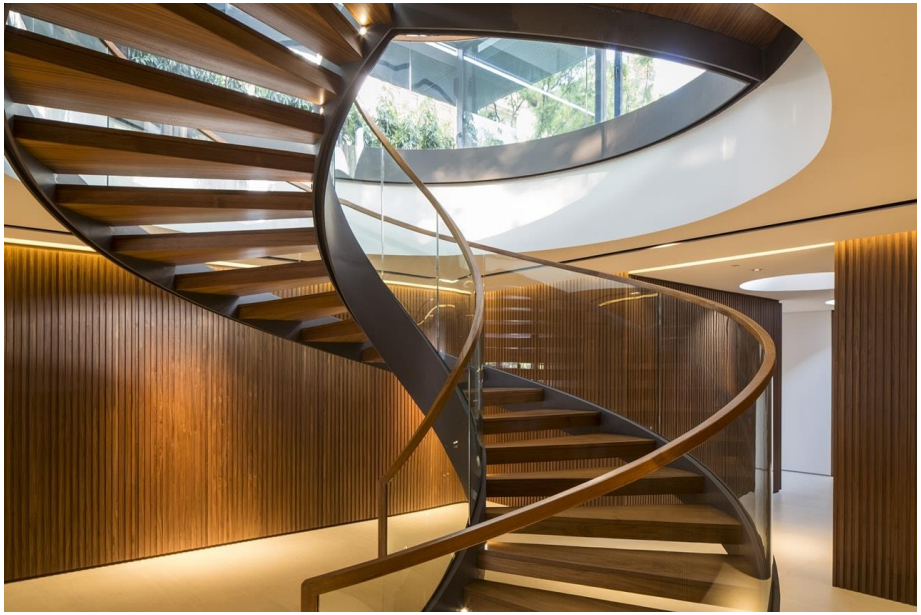
Circular

Spiral

Elliptical

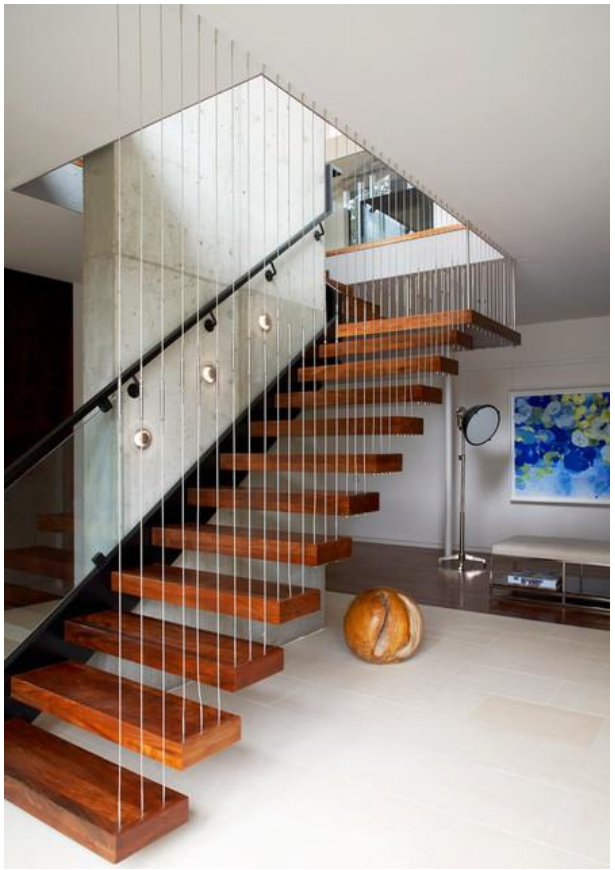
Geometrical stairs












© Complete Stair Systems Ltd

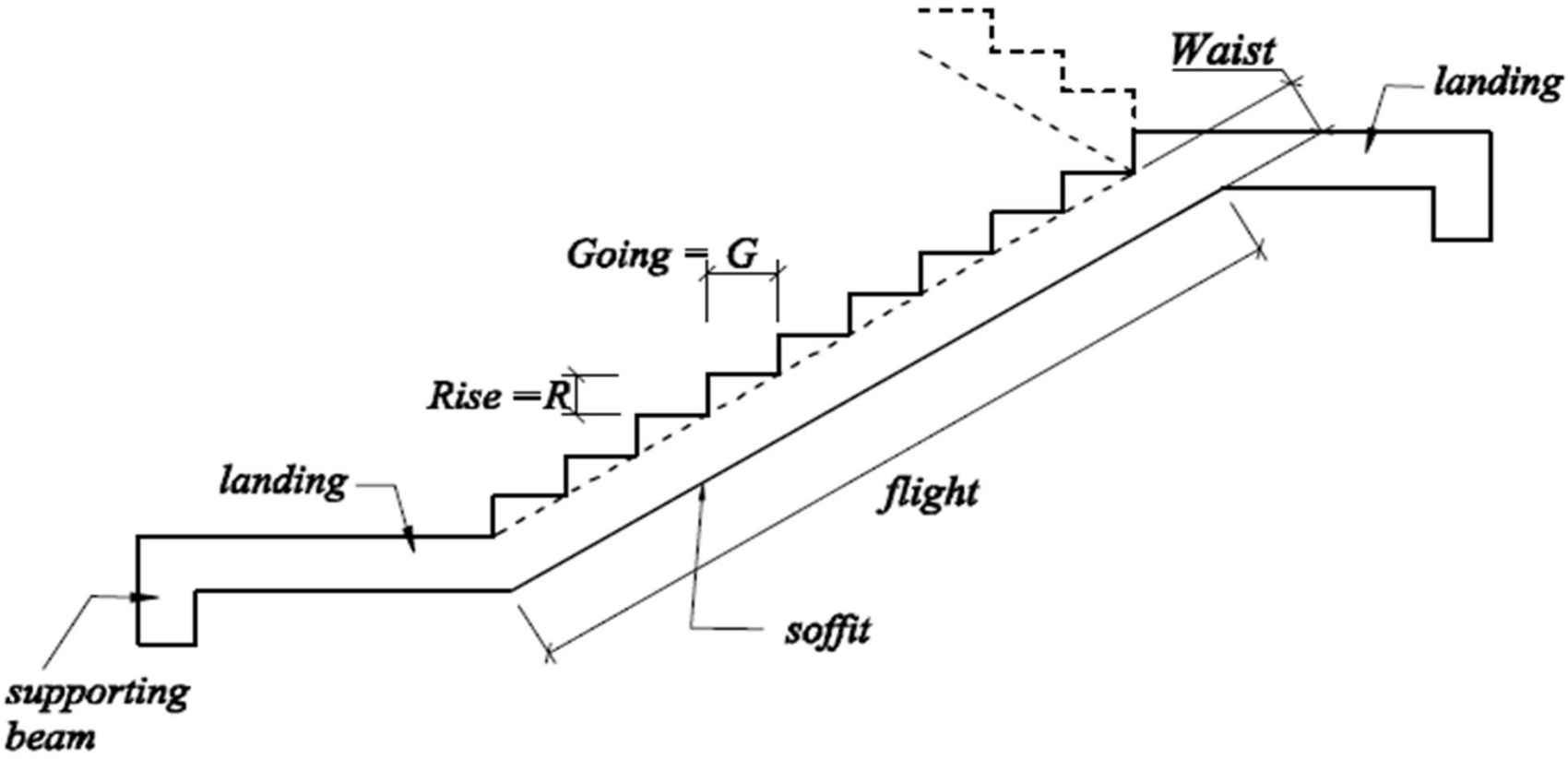


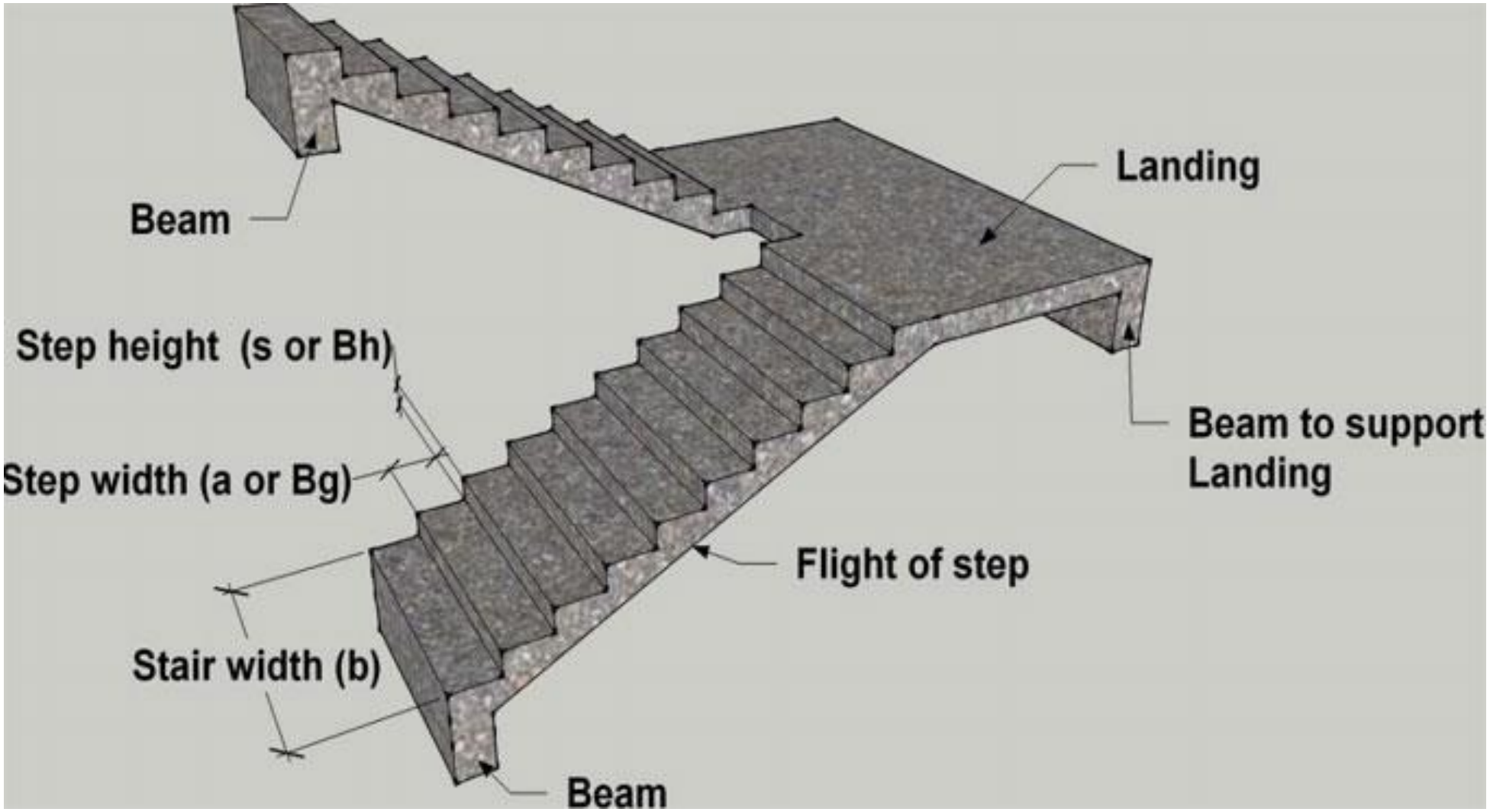


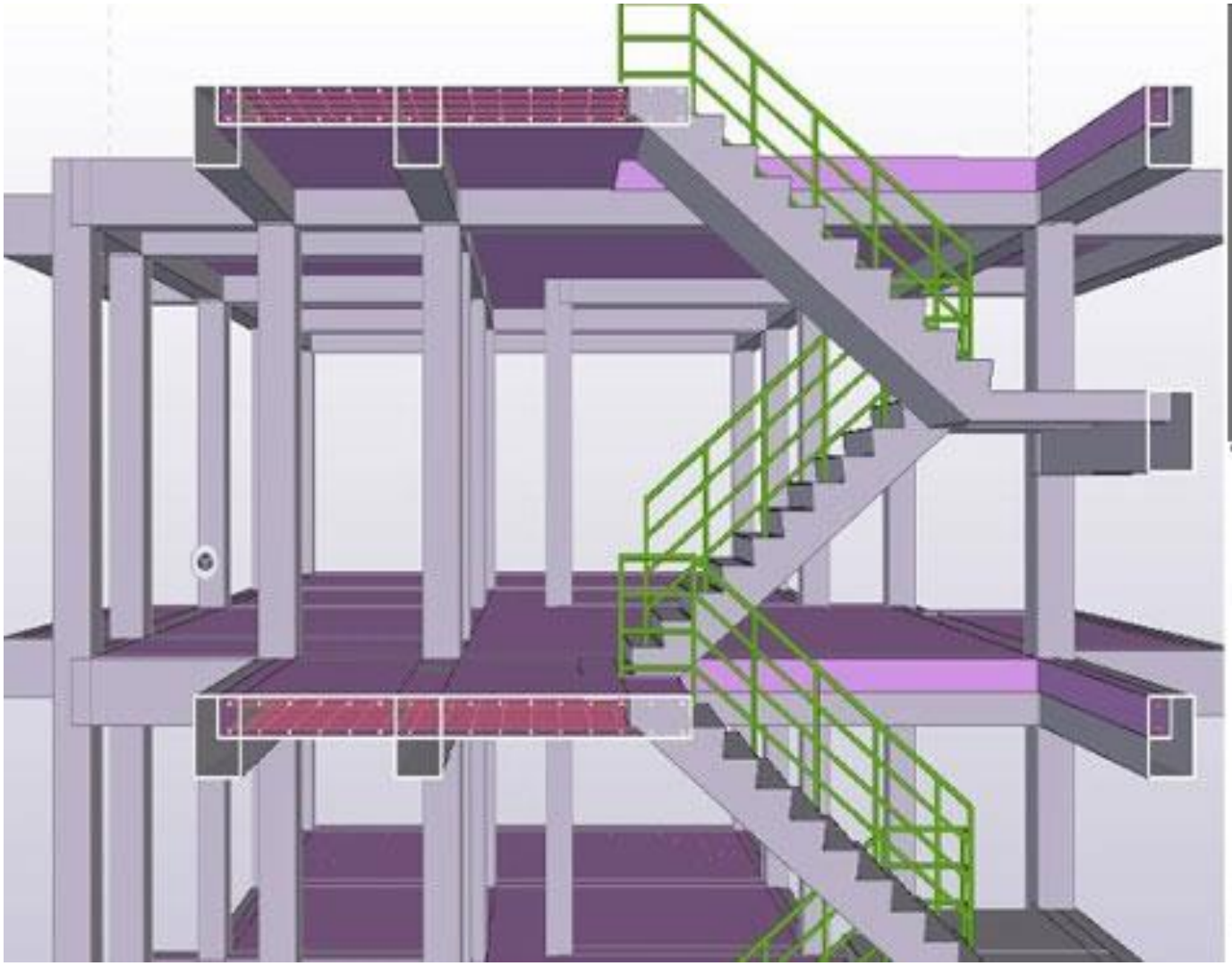
Technical terms related to stairs

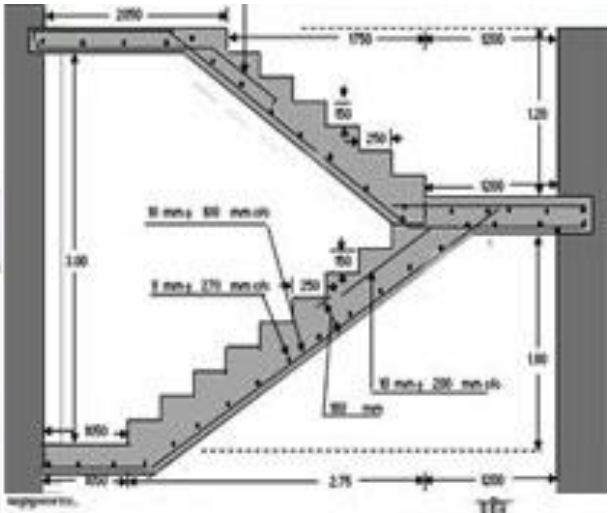
- **Flight:** Series of steps without landing
- **Landing:** Platform provided between two flights
- **Steps:** Made from a series of horizontal treads with risers in between
- **Tread:** Horizontal upper portion of a step on which the foot is placed during ascent/descends
- **Riser:** Vertical portion of a step
- **Rise:** Vertical distance between two consecutive treads

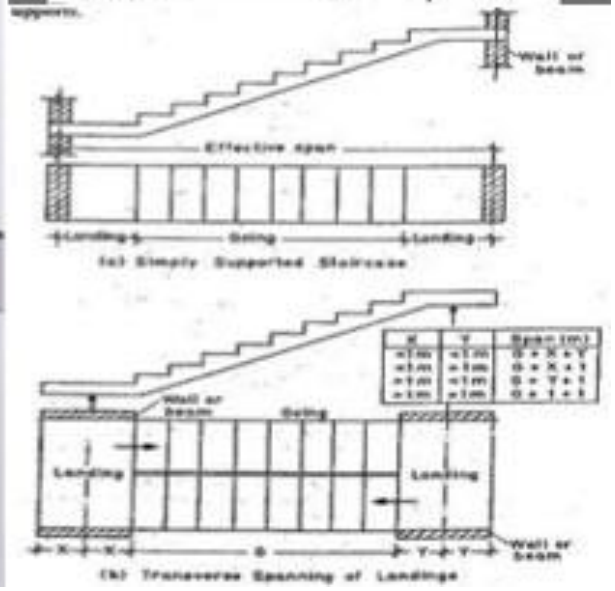
Technical terms related to stairs (cont..)




Beam
Landing
Step height (s or Bh)
Step width (a or Bg)
Beam to support
Landing
Flight of step
Stair width (b)
Beam

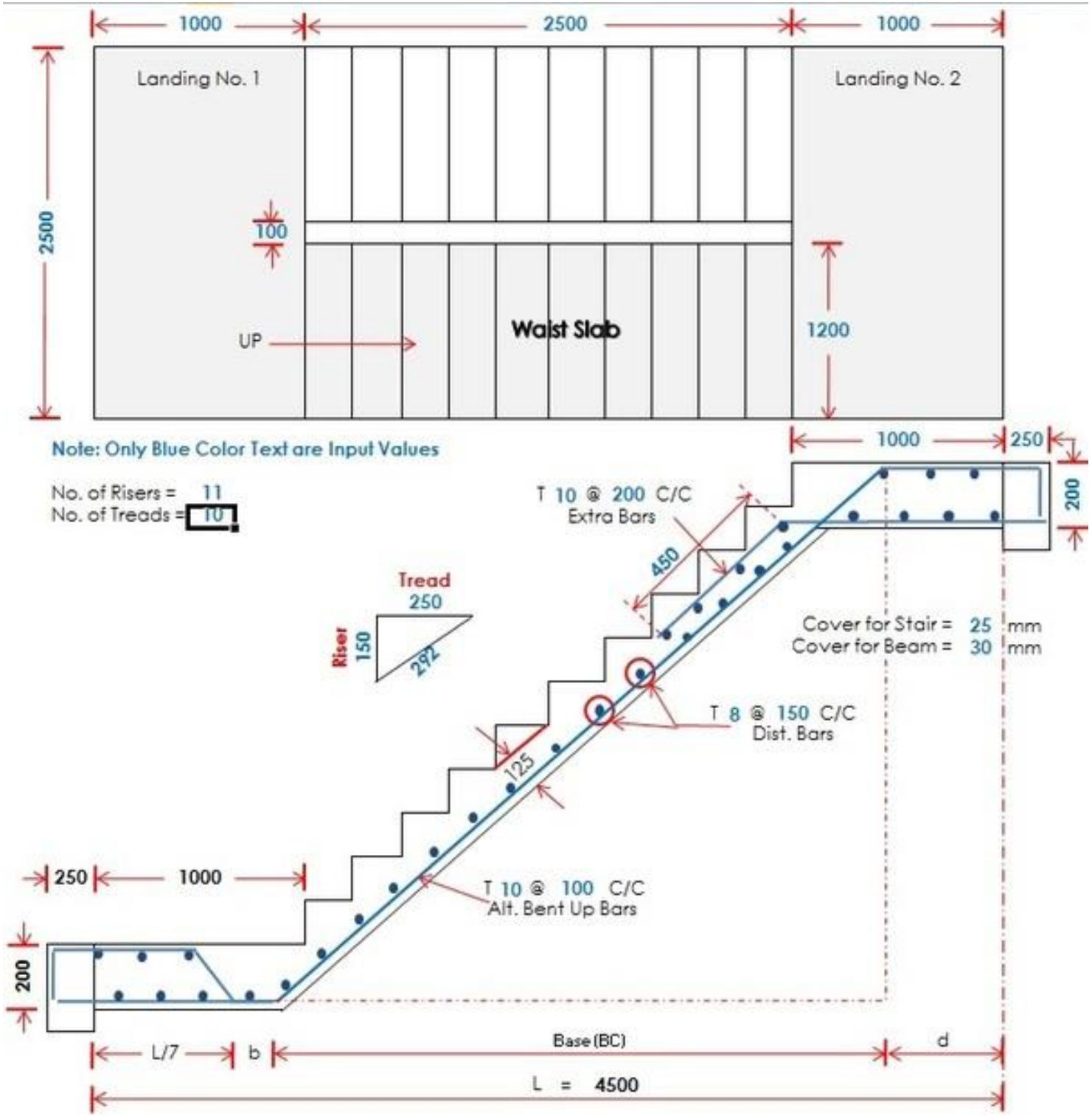






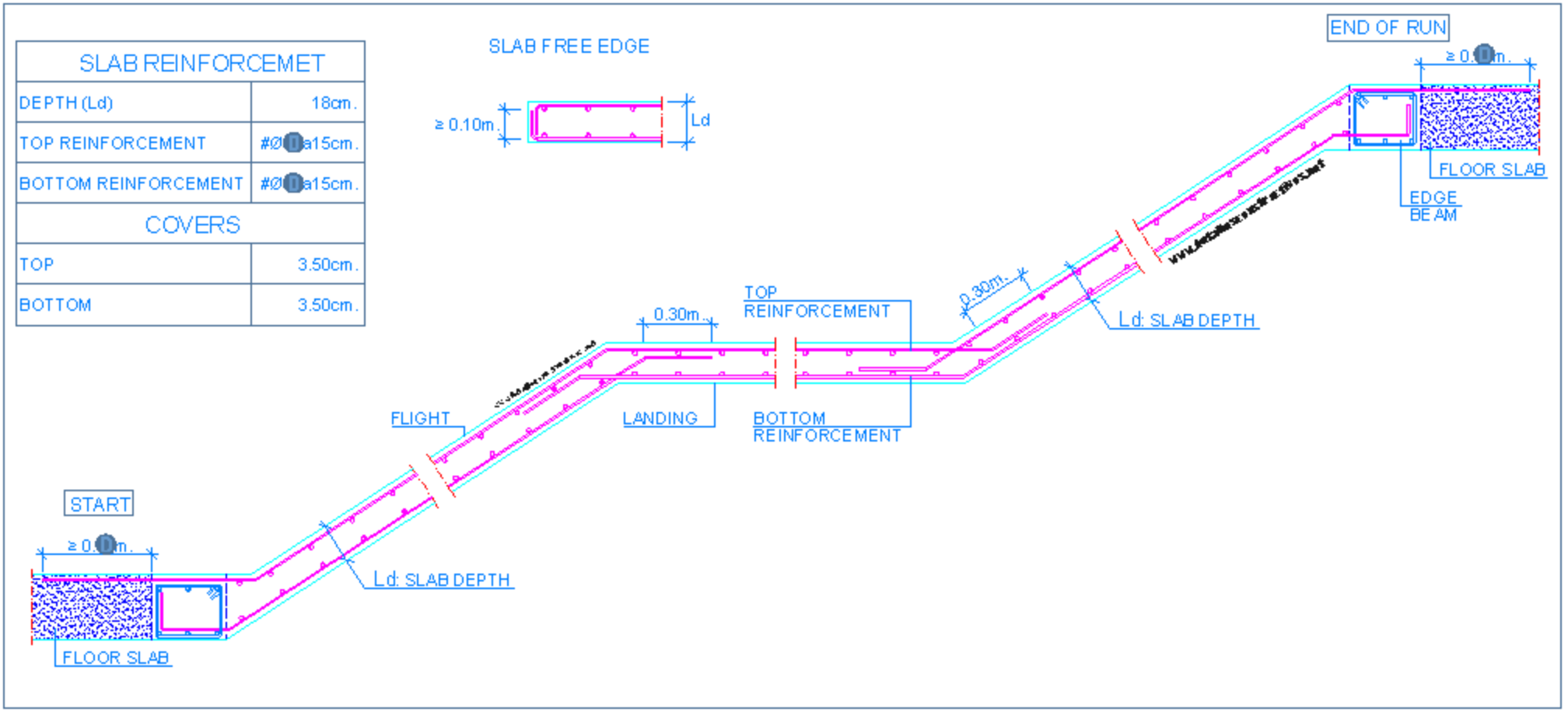
(a) Simply Supported Staircase

(b) Transverse Spanning of Landings


1000
2500
1000
Landing No. 1
Landing No. 2
2500
100
UP
Waist Slab
1200
Note: Only Blue Color Text are Input Values
No. of Risers = 11
No. of Treads = 10
1000
250
200
T 10 @ 200 C/C
Extra Bars
450
Tread
250
Riser
150
292
Cover for Stair = 25 mm
Cover for Beam = 30 mm
T 8 @ 150 C/C
Dist. Bars
125
250
1000
T 10 @ 100 C/C
Alt. Bent Up Bars
200
L/7
b
Base (BC)
d
L = 4500

REINFORCED CONCRETE STAIR SLAB

SLAB REINFORCEMET	
DEPTH (Ld)	18cm.
TOP REINFORCEMENT	#Ø[illegible]a15cm.
BOTTOM REINFORCEMENT	#Ø[illegible]a15cm.
COVERS	
TOP	3.50cm.
BOTTOM	3.50cm.



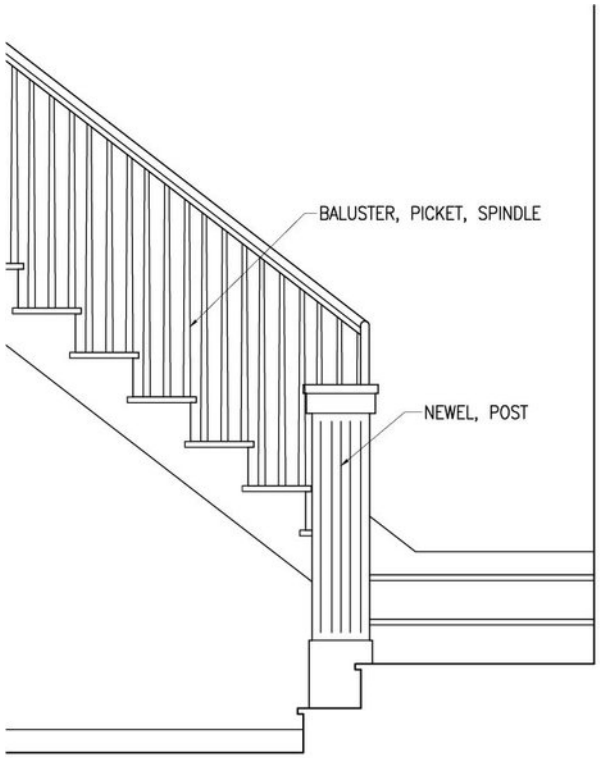
Technical terms related to stairs (cont..)

- **Going:** Distance measured horizontally from the face of one riser to the face of the next riser
- **Nosing:** The exposed edge of a tread, usually projecting with a square, rounded or splayed edge
- **Waist:** The least thickness of a stair slab
- **Soffit:** Bottom surface of a flight
- **Pitch:** Angle with the horizontal

Technical terms related to stairs (cont..)

- **Head-room:** Clear vertical distance between tread of a step and soffit of the flight immediately over it
- **Hand-rail:** Rail of metal/wood on the side of a stair fixed at about waist high parallel to the slope of stair provided to render assistance to the users
- **Baluster:** Vertical member provided for protection and to support the handrail; Placed between steps and handrails
- **Newel:** Post supporting the hand rail where the balustrade changes its direction




BALUSTER, PICKET, SPINDLE
NEWEL, POST

Requirements of a good stair

- **Location:** Sufficient light and ventilation
- **Width:** Varies with situation; however should follow the standard recommended dimensions according to the building types
- **Length of Flight:** For comfort 3≤no. of steps≤12
- **Pitch:** 25°≤pitch≤40°
- **Head room**: Minimum 7'-8'
- **Materials:** Having fire resisting qualities
- **Width of landing:** Not less than width of stair
- **Dimension of a step:** For comfort tread = 10"-12" & riser = 4"-6"

ROOF

Details of Roof

- **General elements of roof**
  - Parapet
  - Roof covering
  - Overhead water tank
  - Lift machine room
  - Rain spouts
  - Plumbing lines
- **Special elements of roof**
  - Swimming pool
  - Garden
  - Cycle track
  - Community centre
  - Telecommunication tower
  - Helipad



Parapet Wall



Telecommunication Tower over Roof



Helipad over Roof

Assignment

Discuss about uses of roofs for special facilities