

**ANJUMAN COLLEGE OF ENGINEERING & TECHNOLOGY**  
**SADAR,NAGPUR**  
**FIFTH SEMESTER**  
**SUBJECT:-BUILDING CONSTRUCTION & MATERIAL**

**DEPARTMENT OF CIVIL ENGINEERING**

## Unit-II

Brickwork :Qualities of good bricks, classification of bricks tests on bricks as per as codes.  
Terms used in brickwork, commonly used types of bonds in brickwork such as header, stretcher, English and  
Flemish bonds, principles of construction. Reinforced brickwork, brick knogging.  
Parapets, copings, sills and corbels, brief introduction to cavity walls, load bearing and partition walls.  
Masonry construction using cement concrete blocks and clay walls, load bearing and partition walls.  
Masonry construction using cement concrete blocks and clay blocks.  
Precast construction : Introduction to method and materials. Precast elements likes poles, cover, jallies, steps  
corbets, truss element etc.

**BRICKS:-**Bricks are manufactured by moulding clay in rectangular blocks of uniform predetermined size, drying them and then burning them in a kiln. Clay is a plastic earth, constituted largely of sand and alumina with traces of chalk, iron ,manganese dioxide, etc.

### **Size and weight of bricks**

The actual size of a brick is 190mm X 90mmX 90mm. withmortar thickness , size od such as bricks become 200mm X 100mmX 100mm

The weight of  $1\text{m}^3$  of brick earth is about 1800kg .hence the average weight of a brick will be about 3 to 3.5 kg.

### **Qualities of good bricks:-**

- 1) The bricks used in a good work should be sound , hard and well burnt with uniform size, shape and colour.
- 2) They should have no cracks or flaws and a fractured surface should be free from holes , grit or lumps of lime etc.
- 3) The surface of the bricks should be such that no mark should be made when scatched by the finger nail.
- 4) The brick when struck together should produce metallic ringing sound.
- 5) They should not break when dropped from a height of 90 to 120cm on the ground .
- 6) The bricks should not absorb water more than 20% of their weight when dry , when immersed in water for 24 hours.

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- 7) The brick should be thoroughly soaked in clear water before use for suitable period so that the water just penetrates the full depth of brick. This not only helps in removing the dirt, dust and other soluble salts from the bricks but also reduce 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 brick should not be soaked in water before use.

**Classification of bricks**

Quality wise masonry bricks are classified into three classes

- i) First class bricks
- ii) Second class bricks
- iii) Third class bricks

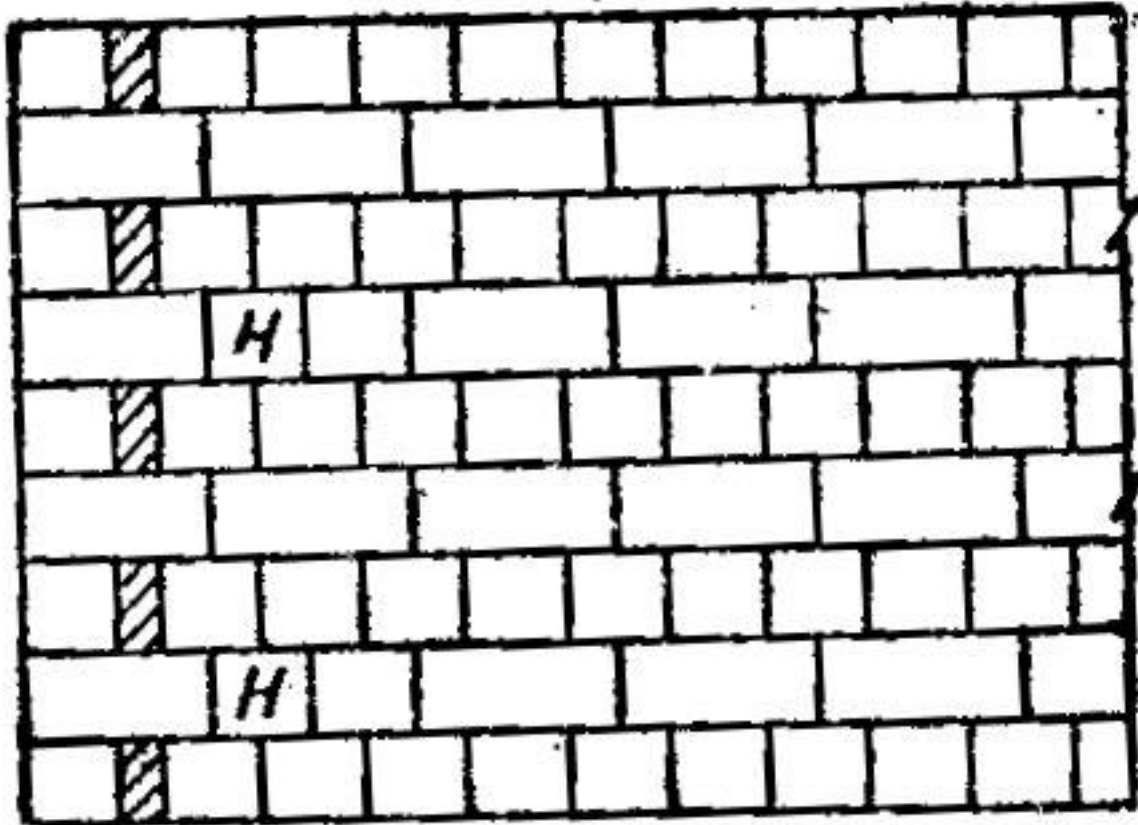
- **First class bricks:-** First class bricks are those which strictly conform to the standard size of modular bricks, i.e. 19cmX9cmX9cm actual size, such that ten layers of brick laid in mortar will form masonry of 1 meter height . Good brick are manufactured from good quality plastic earth which is free from saline deposits. They are well burnt; hard ringing sound is emitted when two bricks are struck together . they have straight edges and even surface . They are free from cracks, chips , flaws and nodules of lime. When immersed in water for one hours, they do not absorb water more than one –sixth of their weight on drying , they do not show any sign of efflorescence.
- **Second class brick:-** second class brick also conform to the standard size, but they are slightly irregular in shape and colour. They are also fully burnt, and ringing sound is emitted when two bricks are struck together . when immersed in water for one hour. They do not absorb water more than  $\frac{1}{4}$ <sup>th</sup> of their weight.
- **Third class bricks:-** these are the one which are quite irregular in their size, shape and finish. They are not burnt fully due to which they are of reddish yellow colour. These bricks have low crushing strength. They are not used for quality brick masonry.

**Some Defination**

- 1) **Stretcher :-** this is a brick laid with its length parallel to the face or front or direction of wall .the course containing stretchers is called a stretcher course .
- 2) **Header:-** A header is the shorter face of the brick .(i.e. 9cm X9cm) this is a brick laid with its breadth or width parallel to the face or front or direction of a wall. The course containing headers is called a header course.

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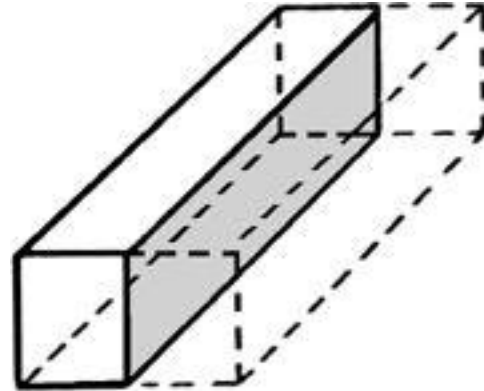
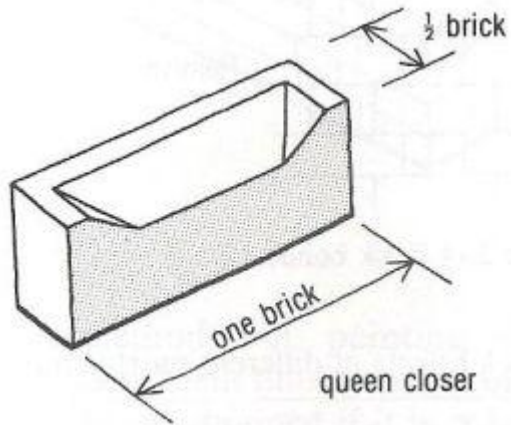
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- 3) **Lap:-** The horizontal distance between the vertical joints in successive courses is termed as a lap and for a good bond, it should be  $\frac{1}{4}^{\text{th}}$  of the length of a brick
- 4) **Perpend :-** the vertical joints separating the bricks in either length or cross direction are known as the perpend and for a good bond the perpend in alternate course should be vertically one above the other.
- 5) **Bed :-** bed is the lower surface (19cmX 9cm) of the brick when laid flat is known as bed .
- 6) **Bed joint:-** the horizontal layers of mortar upon which the brick are laid is known as bed joints.
- 7) **Closer:-** it is a portion of a brick with the cut made longitudinally and is used to close up bond at the end of the course. A closer helps in preventing the joints of successive courses to come in a vertical line . Closer may be of various type.
  - i) **Queen closer:-** this is obtained by cutting the brick longitudinally in two equal parts. It can also be made from two quarter bricks, known as the quarter closers, to minimize the wastage of bricks. A queen closer is generally placed near the quoin header to obtain the necessary lap.

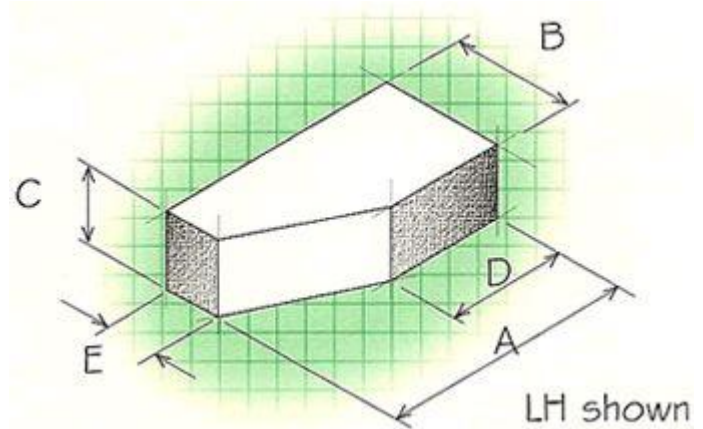
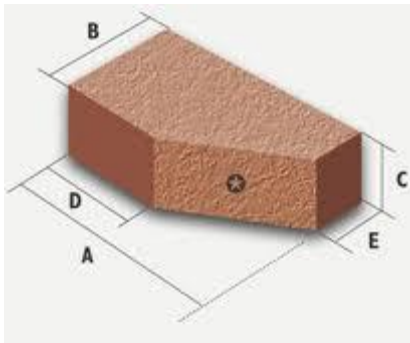
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**Fig:- Queen closer**

- ii) **King closer:-** this is obtained by cutting a triangular portion of the brick such that half a header and half a stretcher are obtained on the adjoining cut faces. A king closer is used near door and window opening to get satisfactory arrangement of the mortar joints.

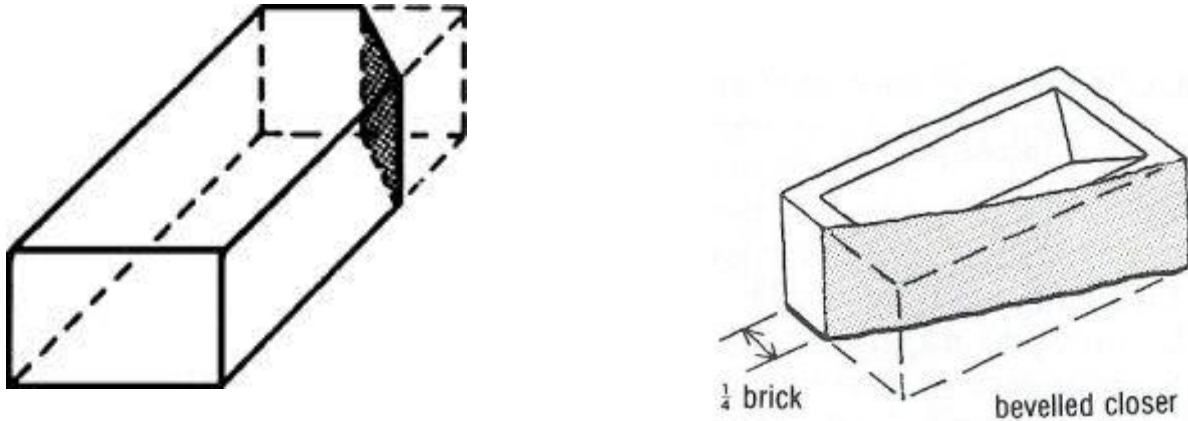


**Fig:- King closer**

- iii) **Bevelled closer:-** This obtained by cutting a triangular portion of half the width but of full length. A beveled closer appears as closer on one face and as a header at the other face. It is used for the splayed brickwork

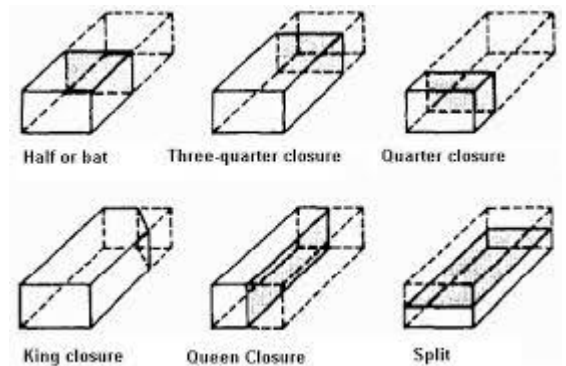
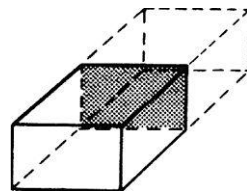
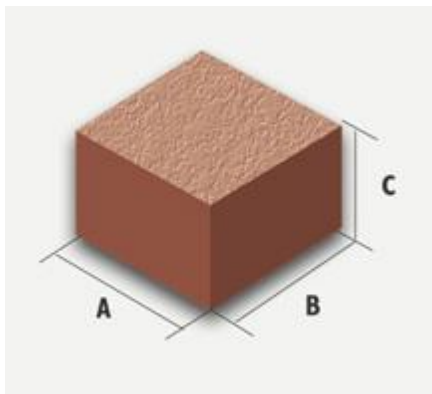
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**Fig:- Mitred closer & Bevelled closer**

8) **Bat:-** This is a piece of brick , usually considered in relation to the length of brick and accordingly known as half bat or three quarter bat.



**Fig:- Brick bat**

9) **Bull nose :-** A brick moulded with a rounded angle is termed as a bull nose and it is used for a rounded quoin. A connection which is formed when a wall takes a turn is known a quoin . the

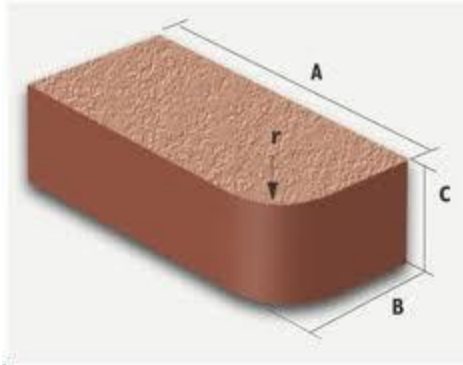
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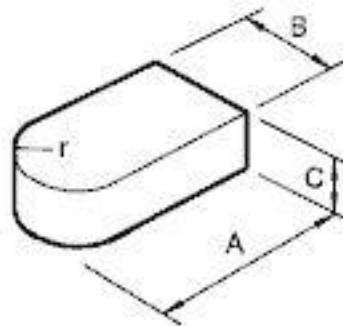
centre of the curved portion is situated on the long centre- line of the brick.

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Cownose



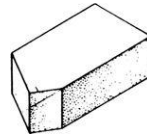
**Fig:-Bull nose**



**Fig:- cow nose**

**10) Cow nose:-** A brick moulded with a double bull nose on end is termed as a cow nose.

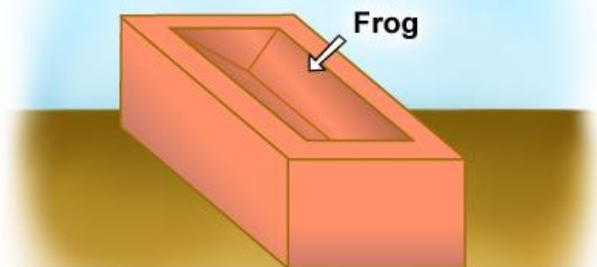
**11) Squint quoin:-** A brick which is cut or moulded such that an angle other than a right angle is formed in plan is known as a squint quoin.



**Fig:- squint quoin**

**12) Frog:-** A frog is a mark of depth about 10mm to 20mm which is placed on the face of a brick to form or key for holding the mortar. The wire cut bricks are not provided with frogs. A pressed brick as a rule has frogs on both the faces. A hand made brick has only one frog

**13) Racking back:-** The termination of a wall in a stepped fashion is known as the racking back

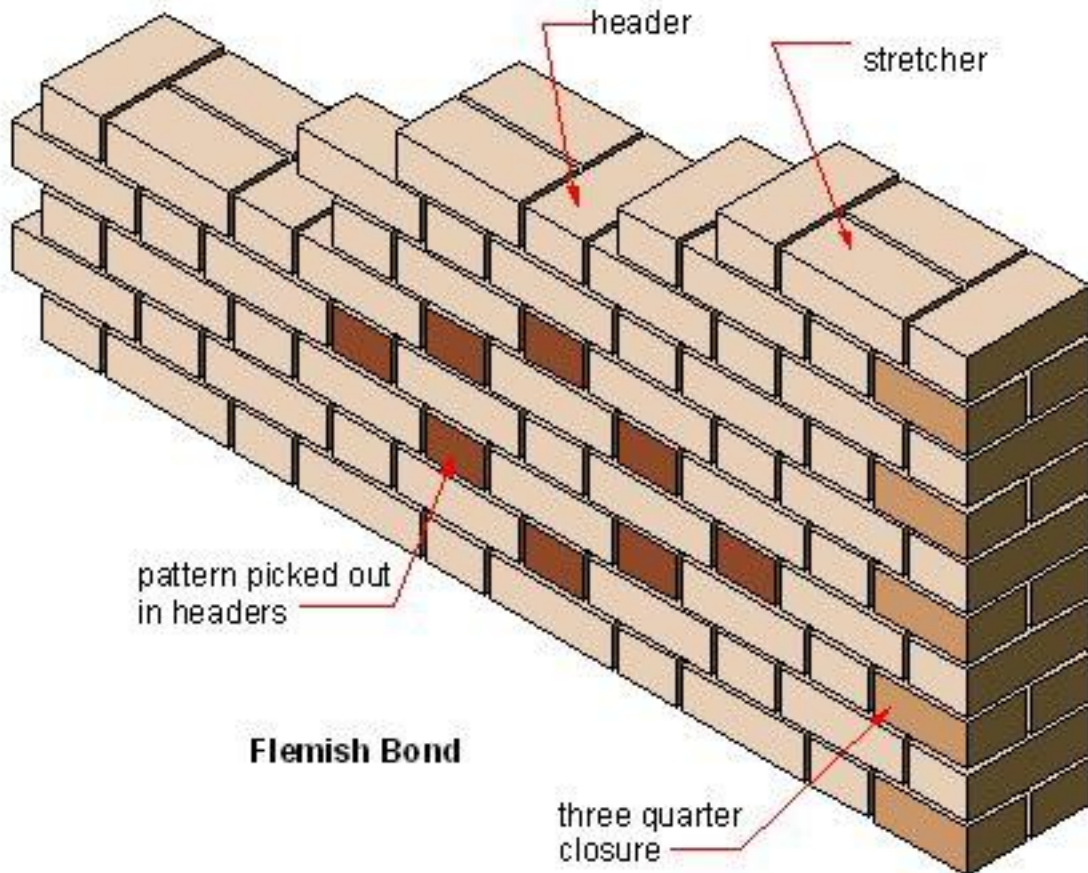


**Fig:-brick frog**



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**Fig:- Racking back**

**14) Tothing:-** The termination of a wall in such a fashion that each alternate course at the end projects is known as the course at the end projects is known as the tothing & it is adopted to provide adequate bond, when the wall is continued horizontally at a later stage.



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**Commonly used types of bond in brick work**

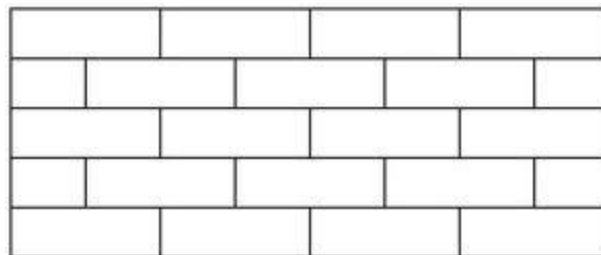
The brick being of uniform size can be arranged conveniently in a variety of forms. Some of the rules to be observed for getting a good bond are as follows:-

- The amount of lap should be minimum one-fourth brick along the length of wall and one-half brick across the thickness of the wall.
- The brick should be of uniform size to get uniform lap.
- The stretcher should be used in the facing. The hearting should be carried out with header only.
- The use of brickbat should be discouraged except under special circumstances.
- The vertical joints in the alternate courses should be along the same perpendicular.

The various types of bonds with their patented names have been constructed. Following are the types of bonds in brickwork:-

- 1) **Stretcher bond**    2) **header bond**    3) **English bond**    4) **Flemish bond**
- 5) **garden-wall bond**    6) **Raking bond**    7) **Dutch bond**    8) **Brick-on-edge-bond**
- 9) **English cross bond**    10) **Facing bond**

**1) Stretcher bond:-** In this type of bond, all the bricks are arranged in the stretcher courses. Fig shows the elevation of a wall with the stretcher bond. The stretcher bond is useful for one-brick partition walls there are not headers in such walls. As this bond does not develop proper internal bond, it should not be used for walls having thickness greater than that of one brick wall.



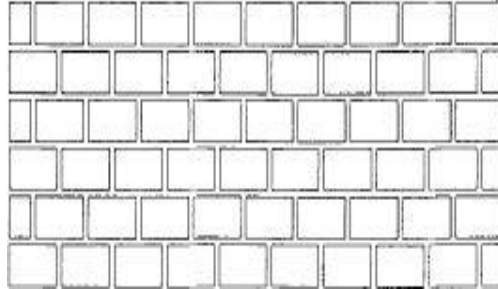
**Stretcher Bond**

**2) Header bond :-** In this type of bond all the bricks are arranged in header courses. Fig shows the elevation of a wall with the header course. The overlap is usually kept equal to half the width of brick and is achieved by using three-quarter brickbat in each alternate course as quoins. This bond does not have strength to transmit pressure in the direction of the length of the wall. Hence it is not suitable for load-bearing walls. However, this bond is used for curved surface in brickwork because stretchers, if used for curved surface, would project beyond the face of the wall.



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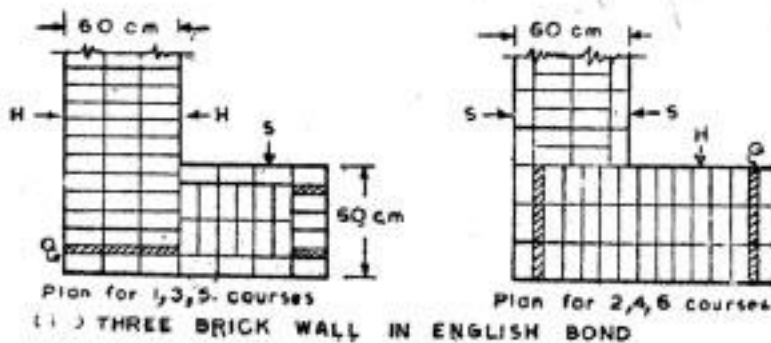
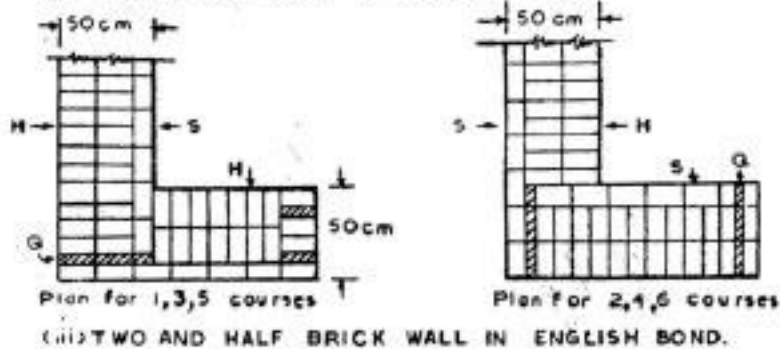
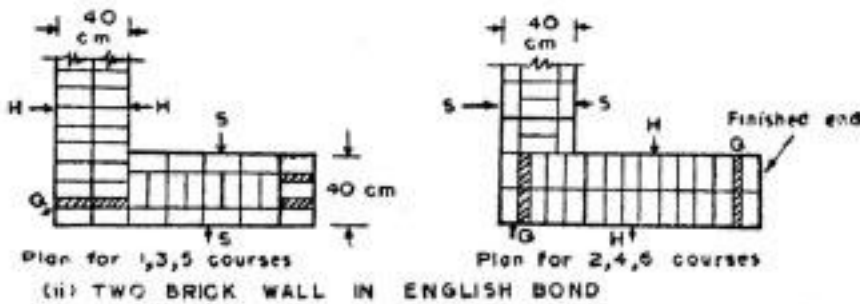
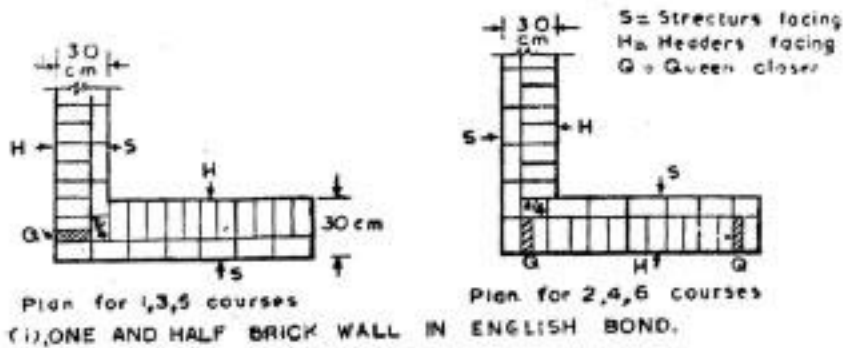
**Fig:- Header Bond**

**3) English bond :-** This type of bond is generally used in practice . it is considered as the strongest bond in brick work. Following are the features of an English bond.

- ❖ The alternate courses consist of stretcher and header.
- ❖ The queen closer is put next to the quoins header to develop the face lap.
- ❖ Each alternate header is centrally supported over a stretcher
- ❖ If the wall thickness is an even multiple of half- brick , the same courses shows header or stretcher in both the front and the back elevation but if the wall thickness is an uneven multiple of half-brick a course showing stretcher on the face shows header on the back and vice-versa.
- ❖ The brick in the same course do not break joint with each other. The joints are straight.
- ❖ In this bond, the continuous vertical joints are not formed except at certain stopped ends.
- ❖ In this bond,the continuous vertical joints are not formed except at certain stopped ends.
- ❖ The number of mortar joints in the header course is nearly double than that in the stretcher course. Hence care should be taken to make the header joints thinner; other wise the face lap disappears quickly.
- ❖ A header course should never start with a queen closer as it is liable to get displaced in this position.
- ❖ The queen closer are not required in the stretcher courses.
- ❖ In the stretcher course , the stretcher have a minimum lap of one-fourth of their length over the headers.
- ❖ For walls having thickness of two bricks or more, the bricks are laid as stretches or header only on the face course of the wall.the interior filling is done entirely with the header.

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- **Flemish bond:-** in this type of bond the header are distributed evenly and hence, it creates a better appearance than the English bond.

Following are the peculiarities of a Flemish bond:-

- ❖ In every course, the headers and stretchers are placed alternatively.
- ❖ The queen closer is put next to the quoin header in alternate courses to developed the face lap.
- ❖ Every header is centrally supported over a stretcher below it.
- ❖ The Flemish bond may be divided into two groups
  - a) Double Flemish bond.
  - b) Single Flemish bond

In double Flemish bond the header and stretchers are placed alternatively in front as well as the back elevation-

For this type of bond , the half bats and three- quarter bts will have to be used for number of half bricks. For walls of thickness equal to even number of half bricks, no bats will be required and a stretcher or a header will come out as a stretcher or a header in the same courses in front as well as back elevation . this bond gives better appearance than the English bond. But it is not so strong as the English bond as it contains more number of stretchers .

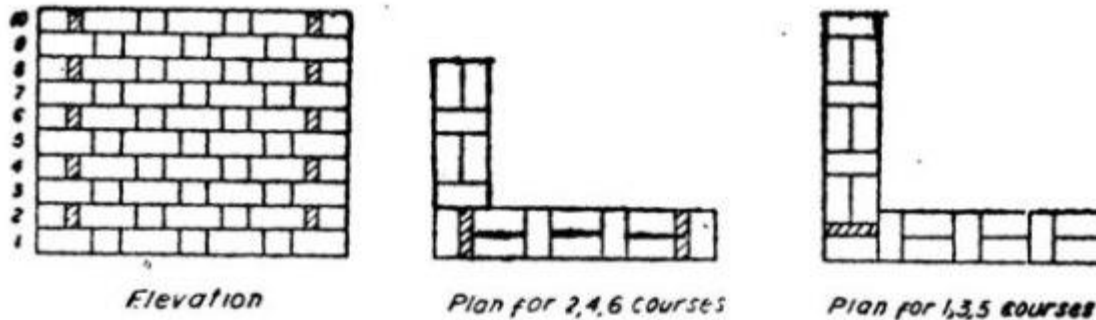
For this type of bond , the half bats and three-quarter bats will have to be used for walls having thickness equal to odd number of half bricks. For walls of thickness equal to even number of half bricks, no bats will be required and a stretcher or a header will come out as a stretcher or a header in the same courses in front as well as back elevation. This bond gives better appearance than the English bond, but it is not so strong as the English bond as it contains more number of stretchers.

- ❖ This bricks in the same course do not break joints with each other. This joints are straight.
- ❖ In this bond, the short continuous vertical joints are formed.
- ❖ The brickbat are to be used for walls having a thickness equal to uneven number of half-brick  
The comparison of English bond & Flemish bond can be made with respect to the following aspect.
  - The Flemish bond is formed to possess more strength than the Flemish bond for wallhaving thickness greater than 1 ½ bricks.
  - The Flemish bond grants more pleasing appearance than the English bond.

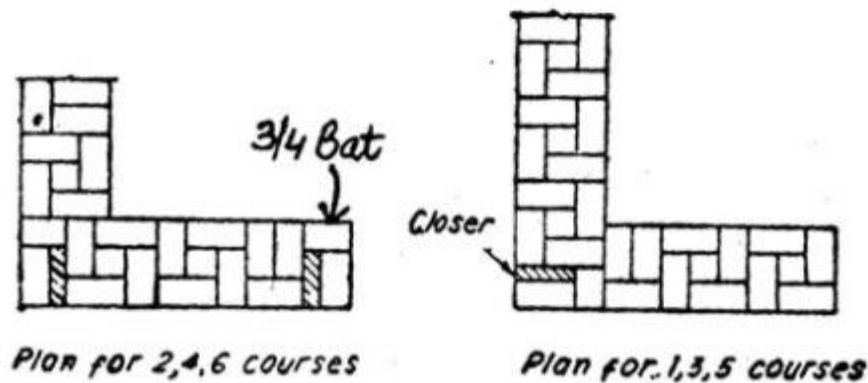
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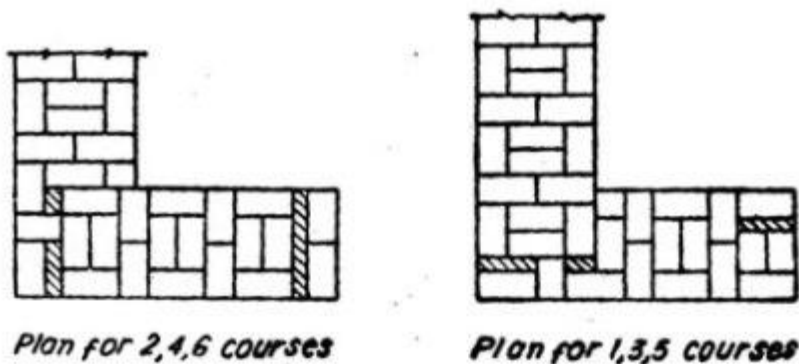
- It is possible to make use of broken bricks in the form of brickbats in case of the Flemish bond. However more mortar will be required.
- The construction with the Flemish bond requires greater skill as compared to the English bond.



**One-brick wall double flemish bond.**



**One-and-a-half-bricks double flemish bond.**



**Two-bricks double flemish bond.**

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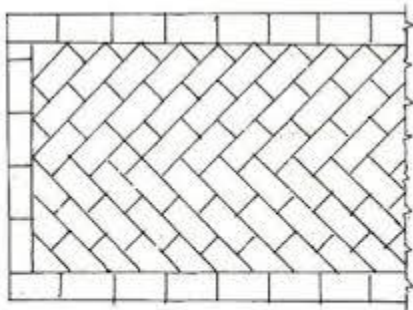
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- **Garden wall bond:-**This type of bond as the name suggests, it is used for the construction of the boundary walls, compound walls, garden walls etc. the wall is one brick wall and its height does not exceed two meters. The wall may be constructed either in the English bond or the Flemish bond. In the English garden wall bond, one header course is provided to three or five stretcher courses. The quoins are placed in alternate courses and a quoin closer is placed next to the quoin header in a header course to develop the necessary lap.



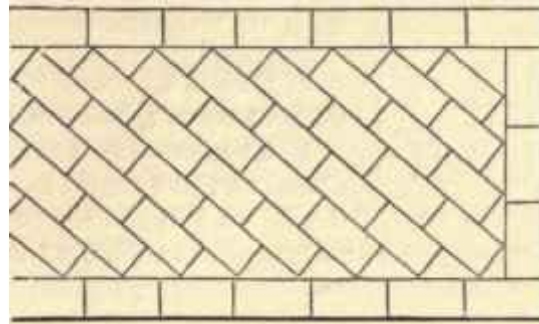
**Fig:- garden wall bond**

- **Raking bond:-**



Plan showing arrangement of bricks  
in Herring-bone bond.

**Fig:- diagonal bond**

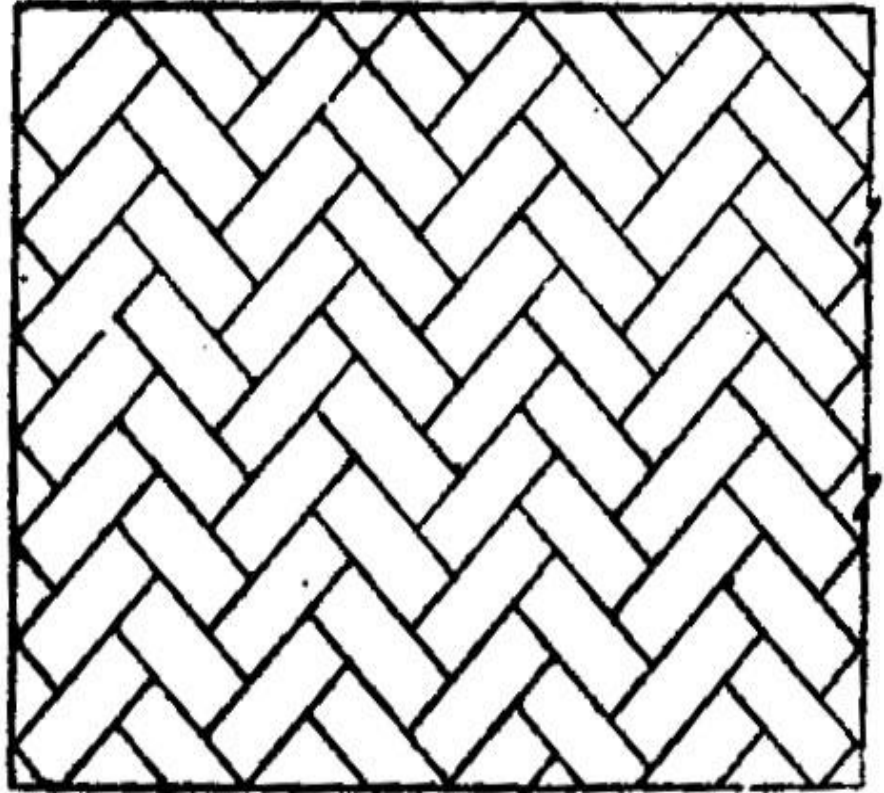


**Fig:- Herring-bone bond**

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This bond is used in thick walls. In this type of bond, the bonding bricks are kept at an inclination to the direction of the wall. Due to this, the longitudinal stability of thick wall built in English bond is very much increased. This bond is introduced at certain interval along the height of the wall. Following are special features of raking bond;



- 1) The bricks are arranged in inclined direction, in the space between the external stretchers of the wall.
- 2) The raking or inclination should be in opposite direction in alternate courses of raking bond.
- 3) Raking bond is not provided in successive courses. It is provided at a regular interval of four to eight courses in the height of a wall.
- 4) The raking courses are generally provided between the two stretcher courses of the wall having thickness equal to even multiple of half-brick, to make the bond more effective.
- 1) **Diagonal bond:-** In this type of bond, bricks are arranged at  $45^\circ$  in such a way that extreme corners of the series remain in contact with the external line of stretcher bricks cut of triangular shapes and of suitable sizes are packed in the small triangular spaces at the ends, this bond is best suited for walls which are 2 to 4 bricks thick. The bond is introduced at regular vertical interval, generally at every fifth or seventh course. In every alternate course of the bond, the direction of bricks is reversed.
- 2) **Herring-bone bond:-** This bond is more suitable for walls which are thicker than four bricks thick. Bricks are arranged at  $45^\circ$  in two opposite directions from the center of the wall thickness, the bond is introduced in the wall at regular vertical interval. In every alternate course, the direction of bricks are changed. The bond is also used for ornamental finish to the face work, and also for brick flooring.



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3) **Zig-zag bond:-** This bond is similar to herring-bone bond, except that the bricks are laid in zigzag fashion, this bond is commonly used for making ornamental panels in the brick flooring.

7) **Dutch bond:-** this is another modified form of English bond. In this bond the corner of the wall are strengthened. special features of this type of bond is as follows:-

- Alternate courses of header and stretcher are provided as in English bond.
- Every stretcher course starts at the quoin with a three-quarter bat.
- In every alternate stretcher course, a header is placed next to the three-quarter brick bat provided at the quoin.

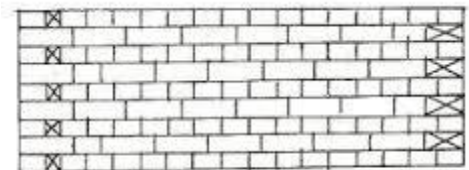
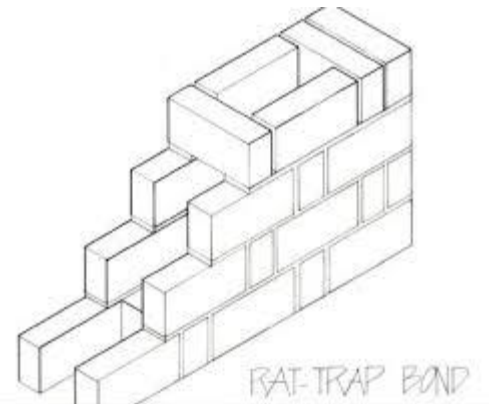
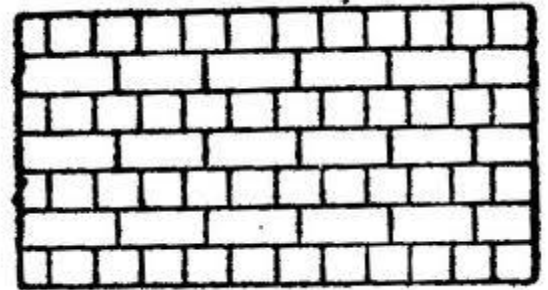
8) **Brick on edge bond:-** in this type of bond, the bricks are laid on edge instead of bed. this bond is economical as it consumes less number of bricks and less quantity of mortar. It is however not strong and hence it is used for the construction of garden walls, compound wall, partition walls etc.

In this bond, the bricks are laid as headers and stretchers in alternate courses in such a way that the headers are laid on bed and the stretchers are laid on edge. Thus a continuous cavity is formed.

9) **English cross bond:-** this is another modified form of the English bond and it is used to add beauty in the appearance of the wall. The elevation of a wall with English cross bond is shown in fig.

The peculiarities of this bond are as follows:

- The alternate courses are of header and stretchers
- The queen closer are placed next to the quoin header.
- A header is introduced next to the quoin stretcher in every alternate stretcher courses.



Elevation of wall in English cross-bond.

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**10) Facing bond:-** in this type of bond a header courses is placed after several stretcher courses . it is used under the following circumstances.

- If the facing and backing brick vary in size and shape , the facing bond is adopted .the least common multiple of the thickness of facing and backing bricks decides the distance between the successive header courses. For instance if the nominal thickness of facing bricks is 100mm and that of backing bricks is 80mm, the header course is provided at a vertical interval of 800mm.
- If the facing bricks are expansive and if it is desired to economise , the facing bond is adopted . A header course is placed after every three or five stretcher courses.  
It is found that the facing bond is not structurally good and hence the distribution of load is not uniform.

**Principle of construction**

- ❖ The vertical joints not be continuous.
- ❖ The number of broken bricks to be used should be reduced to a minimum.
- ❖ The connection should be structurally strong enough to resist the differential settlement.

**Reinforced brickwork**

When strength is the main criterion in the design of a brick wall, it is desirable and economical to incorporate reinforcement of steel in the body of the brickwork and it is adopted under the following circumstances

- i) When the brick work has to resist tensile and shear stresses, the reinforced brickwork is used.
- ii) In order to prevent the dislocation of brickwork for structures constructed on soils of unequal bearing capacity , the reinforced brickwork is adopted.
- iii) The reinforced brickwork becomes helpful for construction of brickwork which has to work as a beam over an opening
- iv) For constructing retaining walls in brickwork for floor slabs of short span, the reinforced brickwork can be used effectively.
- v) When it is desired to increase the longitudinal bond, the reinforced brickwork can be used successfully.
- vi) When the brick wall is likely to be subjected to heavy compressive loads, the reinforced brickwork can be adopted.
- vii) The reinforced brickwork can also resist lateral loads and hence it can be used in seismic areas also.

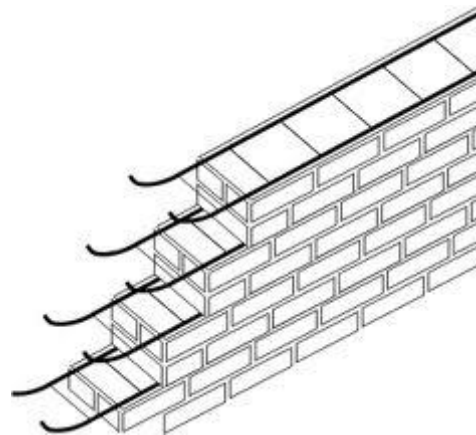
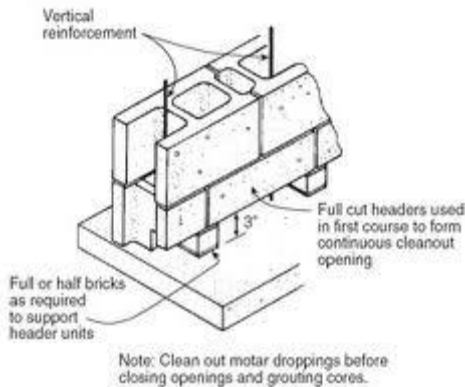
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The reinforced brickwork uses first class bricks having high compressive strength. For embedding the reinforcement, the dense cement mortar is used. The reinforced material may be

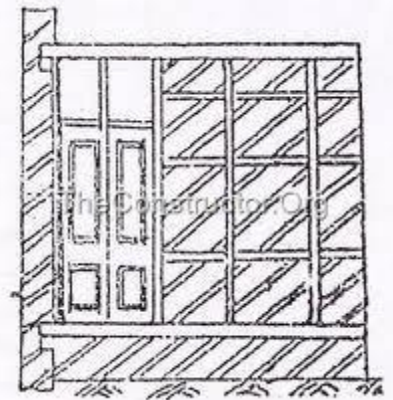
may be  
horizontally

placed either  
or vertically.



The advantages claimed by this type of construction are manifold. It is cheap, durable, fire – proof, easy to construct and in most of the cases it result in the increase of floor space due to adoption of the brickwork of less thickness.

**Brick nogging:-**Brick noggin is the term used to denote brick work built up between wooden quarters or framing .the upright or posts are 150mmX 120mm in size , placed at a central distance of 1.50 meters apart. The horizontal member are ribs of planking (known as noggin member). All the faces of the timber in contact with the masonry is well coated with boiling coalter & the faces of timber exposed to view , on completion is given three coats of specified paint. The bricks are laid in the opening of the framework and are placed in such a way that equal projection of timber are left on both the sides. Brick work is done in lime or cement mortar. After the completion of brick work the surface of brick work is kept thoroughly wetted before plastering. Nails are driven into the ledge of the timber frame work t o give a hold to the cement lime plaster with which both faces of the brick work is then finished off of a thickness to be flush with the faces of the post. The plastering is cured for three weeks . if the wooden member are of shorter width and the entire exposed surface is to be plastered , a metal lath is fixed on both the sides of nogging and the entire area is then plastered. This arrangement will check the plaster from peeling off from the wooden members.



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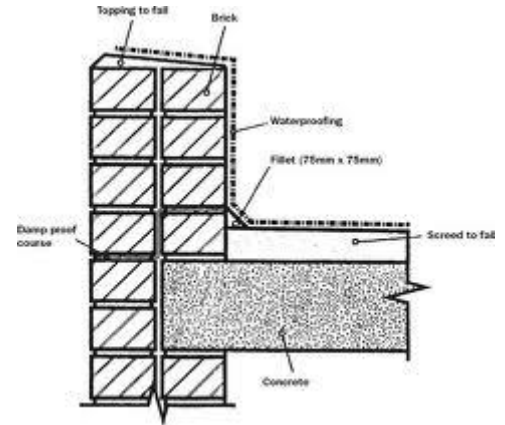
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**Parapets :-** It is the portion of low height wall constructed along the edge of the roof to protect the users parapet acts as a protection solid balustrade for the users . In the case of pitched roof, parapet is constructed to conceal the gutter at the eaves level.

**Coping:-** It is a covering of stone, concrete, brick or terracotta, placed on the exposed top of a wall to prevent seepage of water . it may also be provided on the top of compound wall. A coping is suitably weathered and throated.

**Sills;-** the bottom surface of a door or a window opening is known as a sill. Sill is thus the horizontal member of brick , stone ,concrete or wood provided to give support for the vertical member of the opening and also to shed off rain water from the efface of the wall immediately below the opening . sill stones when provided are so dressed that they prevent the entry of water to the interior of the building.

**Corbel :-** A corbel is a projecting stone which is usually provided to serve as support for joist, truss , weather shed etc.corbel are generally moulded and given ornamental treatment . corbel should extend at least two thirds of their length into the wall, so that they do not overturn or come out of the wall.



### **Brief introduction to cavity wall**

A cavity wall or hollow wall is the one which consist of two separate walls, called leaves or skins, with a cavity or gap in between. The two leaves of a cavity wall may be of equal thickness if it is a non-load bearing wall or the internal leaf may be thicker than the external leaf, to meet the structural requirement . the two portion of the wall may be connected together by metal pins or bonding bricks at suitable interval Cavity walls are often constructed for giving better thermal insulations to the building . it also prevent the dampness to enter and acts as sound insulation . Thus they are normally the outer walls of the building. The size of cavity varies from 4 to 10cm. the inner and outer skins should not be less than 10cm each.

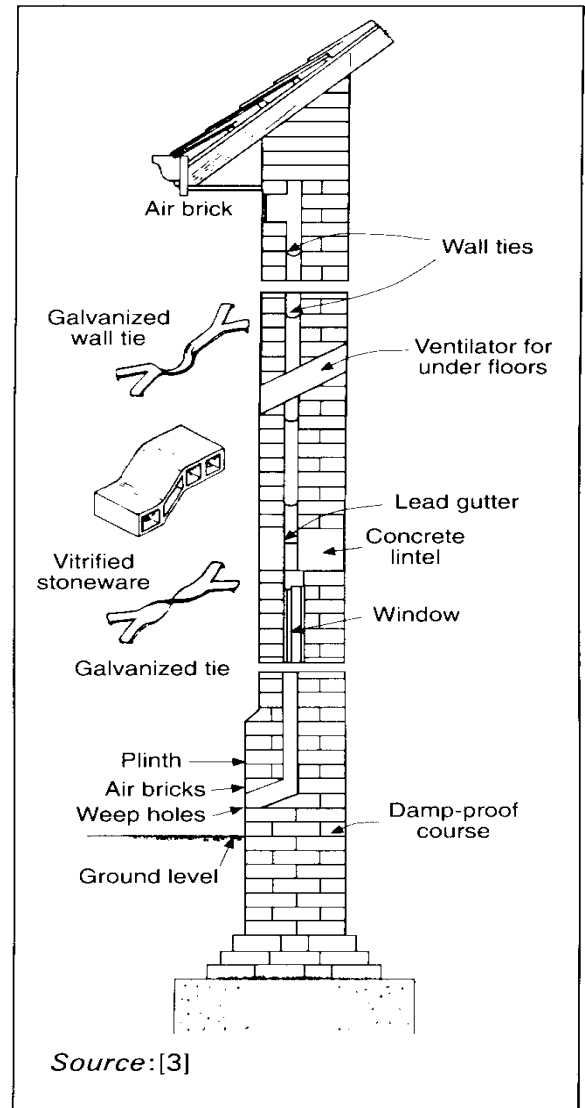
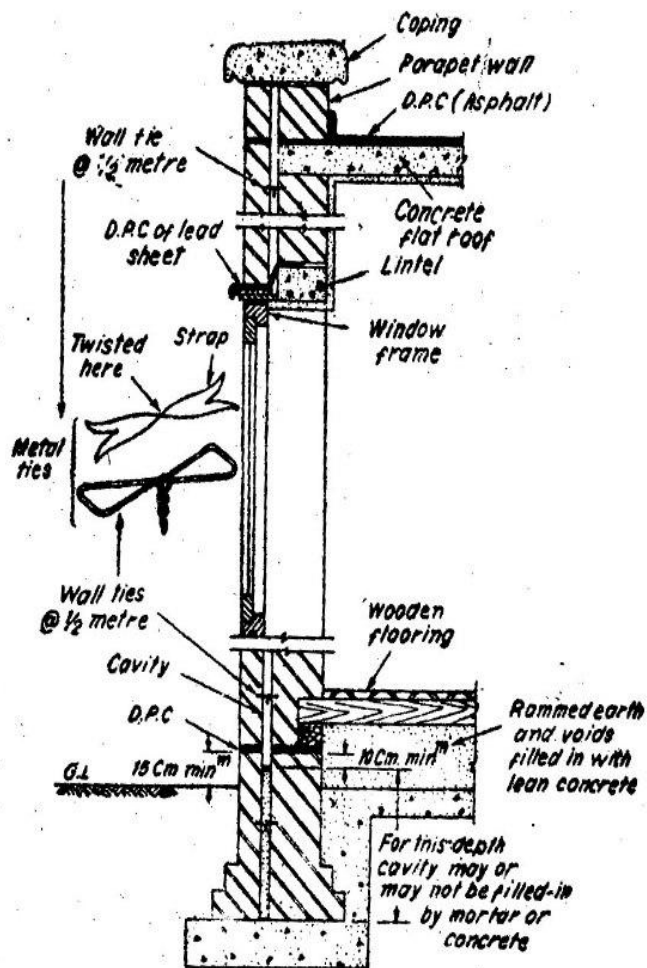
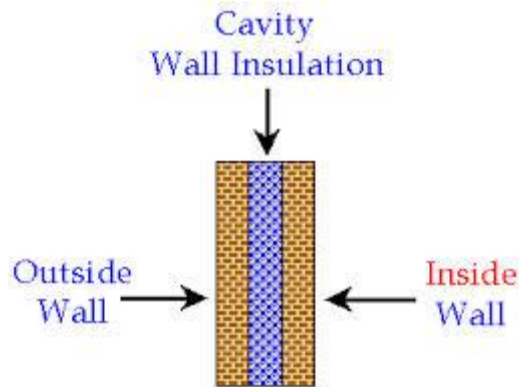
### **Details f construction of cavity wall:-**

A cavity wall is constructed of two leaves –inner and outer with a hallow space in between them as shown in fig;

The width of cavity varies from 50mm to 100mm and it stands vertically . the outer wall is generally of  $\frac{1}{2}$  brick thickness and the inner wall may be of  $\frac{1}{2}$  or 1 brick thickness. The two portion of the wall are connected by means of metal ties or specially prepared bonded bricks.

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The metal ties and bonding are shown in fig. respectively. The metal ties are generally of iron or mild steel and they are coated with tar or galvanized so as to have protection against rust. Where corrosion is heavy the metal ties of copper or bronze may be adopted. The metal ties are placed at a horizontal distance of 900mm and at a vertical distance of 450mm. The arrangement of ties is kept staggered. The outer wall is generally constructed in stretcher bond. But it may be constructed in the Flemish bond or English garden bond or Flemish garden wall bond by using bats. As far as possible there should be no intimate contact between the two leaves of the cavity wall.

**Advantages:-** cavity wall have following advantages over other walls.

- 1) There is no direct contact between the inner and outer leaves of the wall. Hence the external moisture cannot travel inside the building.
- 2) The cavity between the two leaves is full of air which is a bad conductor of heat. Hence transmission of heat from external face to the inside the room is very much reduced. Cavity walls have about 25% greater insulating value than the solid walls.
- 3) Cavity walls also offer good insulation against sound.
- 4) The nuisance of efflorescence is also very much reduced.
- 5) They are cheaper and economical.
- 6) Loads on foundation are reduced because of lesser solid thickness.

**Load Bearing and Partition wall**

Load bearing walls are those which are designed to carry super-imposed loads (transferred through roofs etc) in addition to their own weight.

A partition wall is a thin internal wall which is constructed to divide the space within the building into rooms or areas. It may either be a non-load bearing partition wall or a load bearing internal wall.

**Masonry construction using cement concrete block and clay wall;**

Concrete masonry or cement concrete masonry uses cement concrete blocks, either hollow or solid for wall construction with or without stone facing. A hollow unit is defined as that unit which has a core-void area greater than 25% of the gross area. Various types of concrete masonry units, depending upon shape and size, are manufactured and these can be grouped into two heads.

- i) Regular concrete blocks
- ii) hollow concrete units



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Regular concrete blocks are manufactured from dense aggregate and they are used in load bearing walls. Hollow concrete units are manufactured from light weight aggregates. They may be used both for load bearing as well as non-load bearing walls. They are light in weight. The wall thickness is 6 to 12cm .

**Manufacture of concrete masonry**

The following points should be kept in mind while manufacturing the concrete masonry bricks.

- 1) The cement –aggregate ratio should not be leaner than 1:6.
- 2) The aggregate should have a mixture of fine aggregate 60% and coarse aggregate (6 to 12mm size) 40% . the fineness modulus of the aggregate should be between 2.9 to 3.6.
- 3) Block should be taken out from the mould only when concrete has sufficiently set.
- 4) Concrete should not have very lean consistency . if hand moulding is done, the hollows are vertical .proper compaction should be obtained.
- 5) Machine casting is preferable to hand casting, to obtain better finish.
- 6) After taking the blocks out of mould they should be kept under shade for at least 24 hrs, and then immersed in water tank for curing for at least one week. After that the blocks may be stacked with cells horizontal.
- 7) Blocks should be used only after about 3 to 4 weeks of their taking out of the curing tank.
- 8) The compressive strength of block should not be less than  $3 \text{ N/mm}^2$  after 28 days curing.

**Construction of wall:**

The method of constructing the wall with concrete block is the same as that used for brick masonry. First, the corner or ends of the wall are constructed with few courses of blocks. Mortar is applied to the bottom of the concrete block at the horizontal face member only. For vertical joints the mortar is applied to the projection at the side of the blocks. For building the portion in between the corner, the string is spread between the two horizontal end blocks of a course and the blocks are laid in between .the final closing block is fitted carefully.

The following points should be kept in mind while supervising the construction work.

- ✓ Before use, it should be ensured that the blocks are dry. They should not be drenched in water before use.
- ✓ Blocks of successive courses should be so laid that vertical joints are staggered.
- ✓ The joints should be 5 to 10mm thick and should be uniform

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- ✓ The mortar used for construction should not be stronger than the concrete mix used for manufacture of block. Generally cement lime sand mortar of mix proportion 1:1:10 is used.
- ✓ The block used for external walls should have absorption less than 10% for internal wall, the absorption should be less than 15 %
- ✓ Concrete block have high thermal expansion due to which walls cracks at corner, long walls may have cracks even at its mid length . hence at the junction of wall solid concrete block or hollow filled with concrete should be used.

**Supervision of the brickwork**

- i. The brick to be used should conform with the requirement of the specification of the work.
- ii. The brick should be saturated with water so as to prevent adsorption of moisture from the mortar . this is effectively done by providing a tank at the site of work and by immersing the brick for a period of at least 2 hrs before the brick are actually placed in position.
- iii. The brick should be properly laid on their beds. The mortar should completely cover the beds as well as the sides of brick. The bricks should be laid with the frog uppermost.
- iv. The brickwork should be carried out in proper bond.
- v. The brick work should comply with the requirement of the specification for the work.
- vi. The mortar to be used for the work should be of quality & of proportion as specified.
- vii. As far as possible , the brickwork should be raised uniformly . but when this is not possible or when across wall is intended to be inserted after sometime the step or toothing is should be provided.
- viii. In the brickwork the brick bats should not be used except as closers. All the brickbats of size less than half-brick should be rejected & not allowed to be used in the construction.
- ix. The single scaffolding should be adopted to carry out the brickwork at a higher level. The required headers are taken out to create supports for the scaffolding & they should be inserted when the scaffolding is removed.
- x. The brickwork should be carried out as per line and level. The vertical faces should be checked by means of a plumb bob & the inclined surface, if any should be checked by means of wooden templates.
- xi. After construction ,the brickwork should be well- watered for a period of about two to three weeks, if lime mortar is used & for a period of about one to two week, if cement mortar is used.

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**Defects in brick masonry**

The brick masonry may develop the defects mainly due to the following four reasons:-

- 1) Corrosion of embedded fixture
- 2) Crystallization of salts from bricks
- 3) Shrinkage on drying
- 4) Sulphate attack

- 1) **Corrosion of embedded fixture:-**The iron or steel fixture like pipes masonry may get corroded in presence of dampness. The metal expands in volume due to corrosion & it leads to the cracking of brickwork. To avoid this defect, these fixture should be embedded in dense mortar with a cone of 15mm to 25mm.
- 2) **Crystallization of salts from bricks:-** This defects is developed when brick containing excessive soluble salts are used in the masonry work. When such brick come in contact with water. The soluble salts are dissolved and fine whitish crystals are seen on the surface of brick. This phenomenon is known as the efflorescence & it presents an ugly appearance. the brushing and washing of the effected surface from time to time may be adopted as a remedy for this defect.
- 3) **Shrinkage on drying:-** the brick work normally swells with the absorption of water & subsequently shrinks when the water evaporates due to atmospheric heat etc. the cracks in the masonry joints are developed in the process of shrinkage . this defect can be minimizes by using good quality bricks & by protecting masonry from moisture penetration..
- 4) **Sulphate bricks:-** the sulphate salts present in brick react with alumina of cement in case of cement mortar & with hydraulic lime in case of lime mortar. Due to this reaction, there is increase in the volume of mortar & it leads to the chipping & sapling of bricks this defects is prominent at location. Where the brickwork is exposed like boundary walls, parapets or where it is likely to be in contact with moisture like manholes retaining walls etc. to prevent this defect, the material should be chosen in such a way that the entry of water into the body is brickwork is checked.