BUILDING CONSTRUCTION

Unit - 6
Basic Civil Engineering

6.1 FOUNDATION

6.2 STONE MASONRY

6.3 BRICK MASONRY

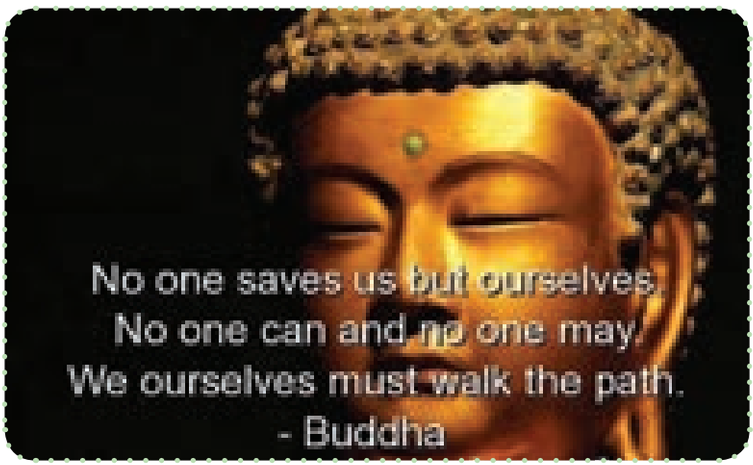


TABLE OF CONTENTS

6.1 Foundation
- 6.1.1 Introduction
- 6.1.2 Objectives to provide foundatuion
- 6.1.3 Types of Foundation
- 6.1.4 Shallow Foundation
- 6.1.5 Deep Foundation
- 6.1.6 Setting out of Foundation
- 6.1.7 Causes of Failure of Foundation and its Remedies

6.2 Stone Masonry
- 6.2.1 Introduction
- 6.2.2 Terms Used in Stone Masonry
- 6.2.3 Dressing of Stones
- 6.2.4 Classification of Stone Masonry
- 6.2.5 Points to be Considered in the Construction of Stone Masonry

6.3 Brick Masonry
- 6.3.1 Introduction
- 6.3.2 Terms used in Brick Masonry
- 6.3.3 Types of Bonds in Brick Work
- 6.3.4 Tools used in Brick Masonry and Stone Masonry
- 6.3.5 Points to be Considered in the Construction of Brick Masonry
- 6.3.6 Thickness of Brick Wall
- 6.3.7 Difference Between Stone Masonry and Brick Masonry

6.1 FOUNDATION

Learning Objectives

At the end of this lesson you shall be able to

- State the types of foundation.
- Explain various types of foundation.
- Understand the setting out work for foundation.
- List out the causes of failure of foundation and their remedies.

6.1.1 Introduction

Foundation is the most important and strongest part of a building. Every building has two important parts, one part below the ground level (Sub-structure) and another part above the ground level (Superstructure). The structure constructed below the ground level to transmit the total load of the structure above it safely to the earth is called foundation.

DO YOU KNOW?

In the film "Padithal mattum pothuma" – Kannadhasan wrote a song.

அடிப்படை இன்றி கட்டிய மாளிகை காற்றுக்கு நிற்காது!

அழகாய் இருக்கும் காஞ்சிரைப் பழங்கள் சந்தையில் விற்காது!

6.1.2 Objectives to provide foundation

I. Foundations are constructed to distribute the total load of the structure uniformly to the soil below and to prevent unequal settlement.

ii. The foundations gives stability, strength and protection to the structure from wind, storm and rain.

iii. The foundation gives levelled and hard surface for the construction above the ground level.

6.1.3 Types of Foundation

1. Shallow foundation.
2. Deep foundation.

6.1.4 Shallow Foundation

These foundations are constructed in ordinary buildings with low depths.

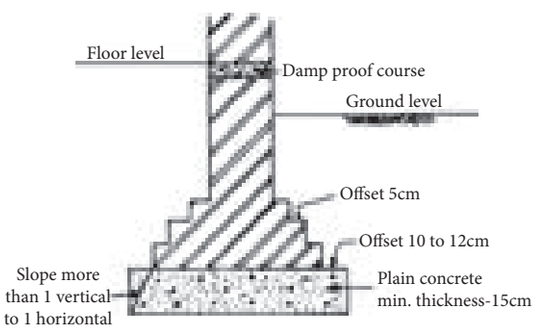
Types of Shallow Foundation

1. Wall footing (or) spread footing.
2. Isolated footing.
3. Combined footing.
4. Continuous footing.
5. Inverted arch footing.
6. Strap footing.
7. Grillage foundation.
8. Raft foundation.

6.1.4.1 Wall Foundation (or) Spread Footing

The foundation of the wall is a continuous strip of concrete or stepped footing. The stepped footing is also called as spread footing. It is provided to distribute the load of the structure on large area of the soil.

This is the cheapest type of foundation and is largely used for ordinary building. The concrete ratio used for foundation may be 1:3:6 or 1:4:8.



Method of designing the breadth and depth of wall foundation:

1. Breadth of foundation = Total load per metre /allowable bearing capacity of soil.

2. Depth of foundation. It is designed by Rankine's formula

$$h = \frac{p}{\gamma}\left(\frac{1-\sin\phi}{1+\sin\phi}\right)^2$$

Where,

h = minimum depth of foundation

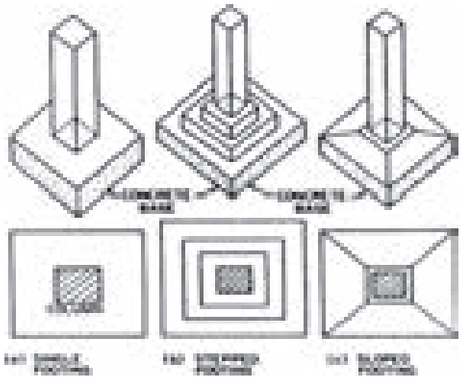
p = gross bearing capacity

γ = density of soil

ϕ = angle of repose or internal friction of soil.

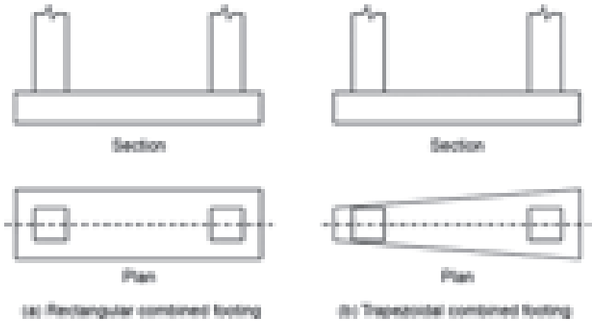
6.1.4.2 Isolated Footing

These foundations are formed for individual concrete (or) brick pillar. The base structure is formed as stepped or slopped footing. Reinforced concrete foundations are used to provide foundation for heavy weight pillars.



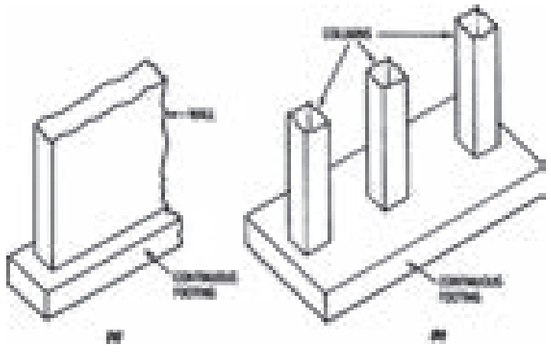
6.1.4.3 Combined Footing

A combined footing supports two or more columns in a row. The combined footing may be rectangular (or) trapezodal in shape. The centre of gravity of combined loads and the center of gravity of the footing should coincide.



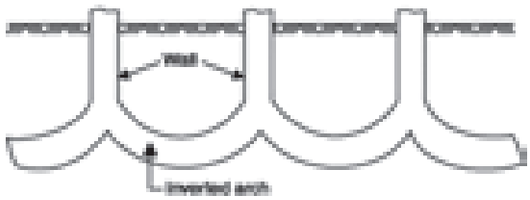
6.1.4.4. Continuous Footing

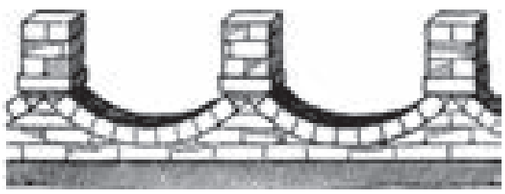
In this type of footing a single continuous RC slab is provided as foundation of two or more columns in a row. This type of footing is best where earthquake is liable to act. This footing prevents unequal settlement. Sometimes deeper beam is provided between the columns.



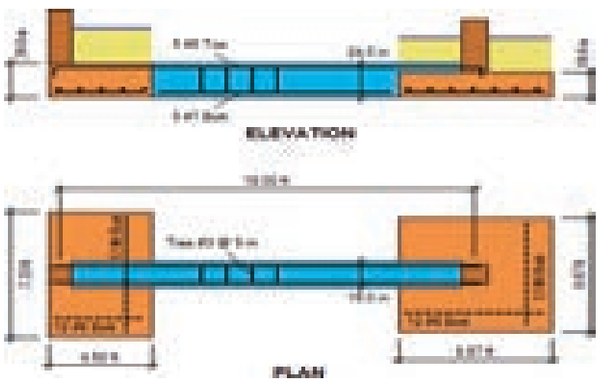
6.1.4.5. Inverted Arch Footing

While forming the foundation on soft and fine soil these footings are used to reduce the depth of foundation. Through the inverted arch the whole load acting are transferred by spreading to wider area. Mostly these are used for bridges and multi-storeyed building in olden days. As it is curve in shape it bears heavy load due to its arch action. This type is rarely adopted now-a-days.





6.1.4.6 Strap Footing



BURJ KHALIFA.

The 'Burj Khalifa' is a mega tall skyscraper in Dubai, United Arab Emirates.

Total height is 829.8m (2,722 ft). It has been the tallest structure in the world since its topping out in late 2008.

ACTIVITY 1

Prepare a report about 'Burj Khalifa' with pictures.

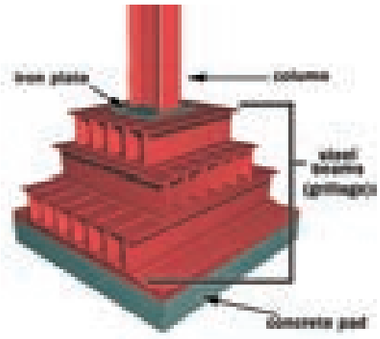
Strap footing consists of two or more individual footings connected by a RC beam. These beams are called strap beams. This type of footing may be used where the distance between the columns is more.

6.1.4.7. Grillage Foundation

These foundations are used to transmit heavy loads from steel column to the soils

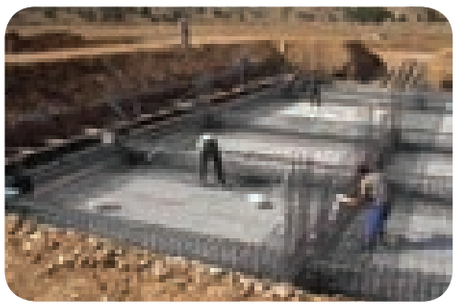
having low bearing capacity. Deep excavation of soil can be avoided by using this foundation. This type of foundation is lighter and more economical.

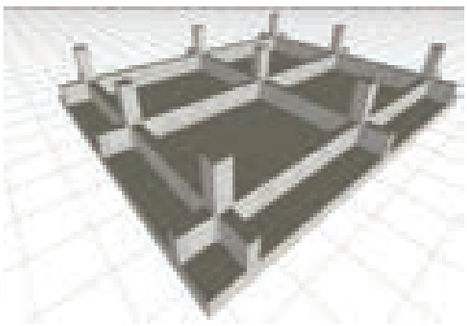
This type of foundation is often used at the base of the steel column. It consists of one, two or more tiers of steel beams superimposed on a layer of concrete. Adjacent tires being placed that right angle to each other.



6.1.4.8. Raft Foundation

A raft or mat is a combined footing that covers the entire area beneath the structure and supports all the columns. The raft foundation is economical than isolated footing, if the sum of the base areas of the isolated footing exceeds about half the total building area.





6.1.5 Deep Foundation

These foundations are suitable when buildings are to be constructed in poor soil (low bearing capacity of soil) or hard rock is only available in high depth. It is classified into two types.

1) Pile foundation
2) Well foundation

6.1.6. Setting Out Of Foundation

It is a process of marking the centre line of a building in the proposed site of construction for earth work excavation.

The following steps are to be followed for setting out of foundation:

i. The land where the building is to be constructed should be cleaned and levelled by removing all the vegetation and undulations.
ii. Dimension of the room to be constructed is studied carefully. Say 4.80 m x 3.30 m.
iii. Now the centreline sketch should be prepared.
iv. If the wall thickness is 0.20 m, the centre-line dimension will be 5.00 m x 3.50m.
v. As per the centre line drawing the centreline of front wall should be marked (points 1 and 2) by driving steel pegs and strings are to be tied to it.
vi. The length of front wall is marked as A and B in that line according to the drawing.
vii. By using right angle, the line is extended from the point B and C is marked as per measurement.
viii. The same procedure is continued until it reaches the point A.
ix. Now, we can get a rectangle bounded by strings.
x. Then the diagonals AC and BD are checked. It should be equal.

The deepest foundation.

'Petronas tower' also known as Petronas Twin Towers became the structure having the deepest seated foundation in the world. It is situated in Kuala Lumpur, Malaysia.

- The whole foundation rested on 104 piles.
- To reach the safe bed rock, the piles were extended to the depth ranging from 200 to 374 feet.
- The piles were embedded by thick raft of 15 feet in depth.
- The concrete raft foundation, comprising 4,70,000 cubic feet of concrete was continuously powered through a period of 54 hours for each tower.

It takes 12 months to complete the foundation.

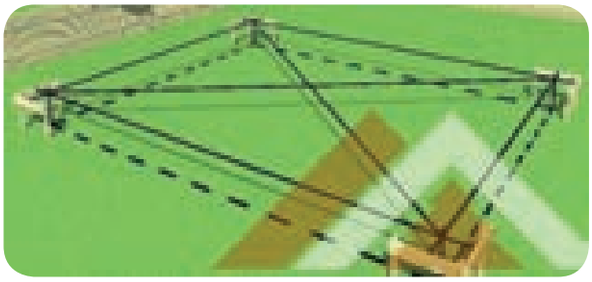
Search link: http://en.m.wikipedia.org>wiki>petronas tower

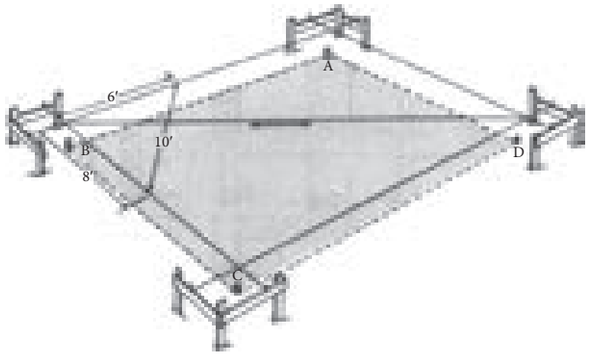
ACTIVITY 2

Prepare a report about deepest foundation structure with pictures.

xi. Now, the half of the width of the foundation should be marked on either sides of the centreline using white powder.

xii. Thus a building is set out at site for excavation.





6.1.7 Causes of Failure of Foundation and Its Remedies

Causes:

1. Unequal settlement of the sub soil.
2. Unequal settlement of the masonry.
3. Withdrawal of moisture from the sub soil.
4. Lateral pressure of the super structure.
5. Horizontal movement of the earth.
6. Transpiration of trees and shrubs.
7. Atmospheric action.

ACTIVITY 3

Collect pictures of various types of foundation, various foundation failures and prepare an album.

6.1.7.1 Unequal Settlement of the Sub Soil

When the load of all the parts of building is not even, the unequal settlement occurs. Based on the intensity of the load it may be low or high. This is because the bearing capacity of soil which is not uniform in all places. Cracks are formed in the building due to the variations in the settlement of soil.

Method of Prevention

i. Foundations should rest on hard rock or hard moorum.

ii. Type and design of foundation should be selected according to the nature of soil by considering the safe bearing capacity of the soil.

DO YOU KNOW?

The tallest building in the world.

'Jeddah Tower' is a skyscraper under construction in Jeddah, Saudi Arabia. If completed in 2020 as planned, the Jeddah Tower will reach an unprecedented height, becoming the tallest building in the world as well as the first structure to reach the one-kilometer-high mark.

6.1.7.2 Unequal Settlement of the Masonry

The mortar joints in the wall and other building portion may shrink and this may lead to unequal settlement of the building portion.

Method of Prevention

i. The water used to mix the cement mortar should be in correct proportion.

ii. Height of raising the super structure should be uniform. It should not exceed 1.5m / day.

iii. Curing of the masonry should be adequate.

6.1.7.3 Withdrawal of Moisture from the Sub Soil

Failure of foundation occurs where there is variation in the height of water table. The cracks are formed when the soil shrink due to the sudden reduction of water table from top to bottom.

Method of Prevention

The foundations are provided with piles to the extreme or should rest on hard rock in those places.

6.1.7.4 Lateral Pressure on the Superstructure

The lateral pressure due to lateral movement of the earth tends to turn the super structure.

Method of Prevention

The base of the foundation wall should be much wider.

6.1.7.5 Horizontal Movement of the Earth

When buildings are constructed in the low level area and on the river bed where the soil is loose, the foundation may fail due to the horizontal movement of earth.

Method of Prevention

To avoid sliding of soil, bearing walls or pillar with plates may be constructed.

6.1.7.6 Transpiration of Trees and Shrubs

The moisture content of soil is absorbed by the penetration of roots from the trees and plants around the foundation of the building. So cracks are formed due to the shrinkage of soil.

Method of Prevention

i. The foundations should be beyond the roots of tree. Minimum depth should be one meter.

ii. The fast growing trees and trees requiring more water should be 8 meter away from the building.

6.1.7.7 Atmospheric Action

The important factors affecting the foundation are sun, wind and rain. Chemical reactions takes place when the chemical substances in the rain water come in contact with earth, resulting in adverse effects.

Method of Prevention

i. Foundation should be deep upto where the rain water cannot reach.

ii. After the masonry works are finished, sides of wall should be filled with earth and consolidated well. Rain water should be drained properly and it should not stagnate near the walls.

Leaning tower of Pisa, Italy

The tower's tilt began during construction in the 12th century, caused by an inadequate foundation on ground too soft on one side to properly support the structure's weight. The tilt increased in the decades before the structure was completed in the 14th century. It gradually increased until the structure was stabilized by efforts in the late 20th and early 21st centuries

Model Questions

PART I (1 Mark)

Choose the correct answer

1. Cement concrete ratio used for foundation is ……..
   a. 1:3:6
   b. 1:4:6
   c. 1:5:6
   d. 1:2:6
2. Foundation provided to protect from Earthquake is …….
   a. Wall footing
   b. Continuous footing
   c. Combined footing
   d. Pile foundation
3. Foundation provided for construction of bridges is …….
   a. Pile foundation
   b. Spread foundation
   c. Inverted arch foundation
   d. Wall foundation.

PART II (3 Marks)

Answer in one or two sentences

4. Define foundation.
5. What are the types of deep foundations?
6. Write the Rankine's formula to calculate the depth of foundation and write the notation.

PART III (5 Marks)

Answer shortly

7. Explain the types of wall foundation with sketches.

PART IV (10 Marks)

Answer in detail

8. What are the causes of failure of foundation and explain any five methods of prevention?

Part – I Answers

1. (a) 2. (b) 3. (c)

6.2 STONE MASONRY

Learning Objectives

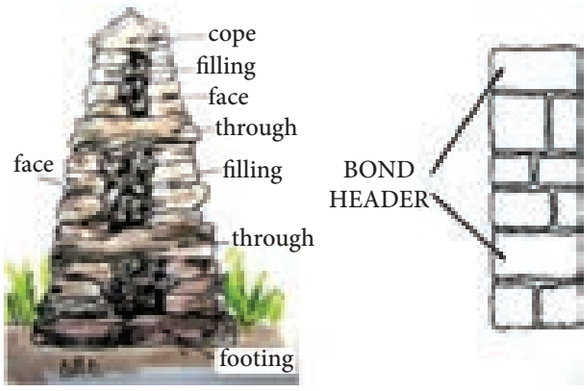
At the end of this lesson you shall be able to

- Understand the technical terms used in stone masonry.
- List the classification of stone masonry.
- Know about dressing of stones and its types.

6.2.1 Introduction

If construction is carried out using stones with cement or lime mortar, it is known as **stone masonry**.

6.2.2 Terms Used In Stone Masonry



i) Natural Bed

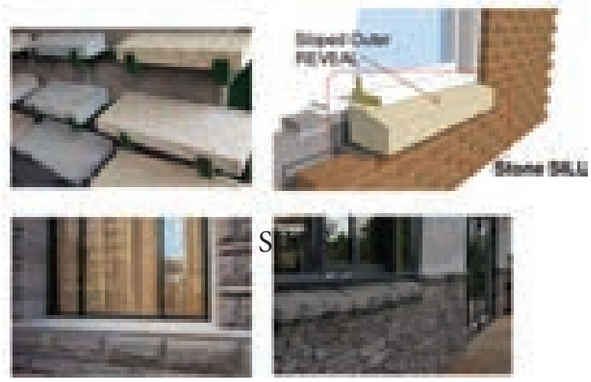
The surface on which the materials was originally deposited in the formation of rock is known as natural bed.

ii) Quoins

The external corner or angles of a wall are known as quoins and the stones or bricks forming the quoin are known as quoin stones or quoin bricks.

iii) Sill Level

The bottom surface of a door or window opening is known as sill level.



iv) Corbel

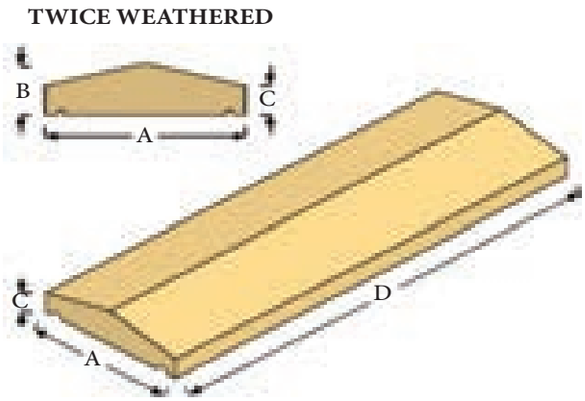
It is projection provided on the face of the wall by projecting stones. The projection is used to serve as a support for wall plates (wooden beam) for roof trusses, beams, etc.

v) Spalls

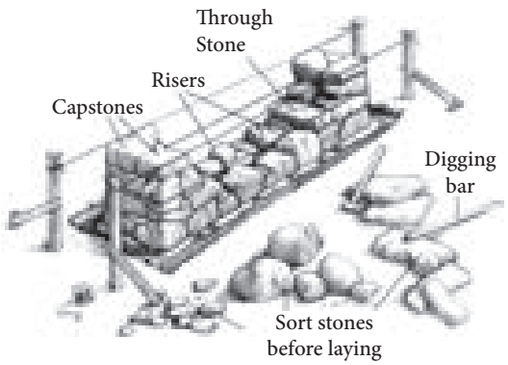
Stone chips broken off from large size stone during dressing and shaping are known as spalls. These are used as filling stones.

vi) Weathering

It is a term to indicate the bevelled top surface of the stone. It is sloped so as to allow easy drain of rain water.

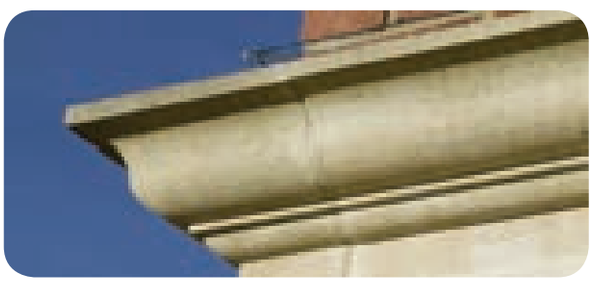


vii) Through Stones



In stone masonry, some stones at regular intervals are placed through the full thickness of wall to develop bond. Such stones are known as through stones.

viii) Cornice

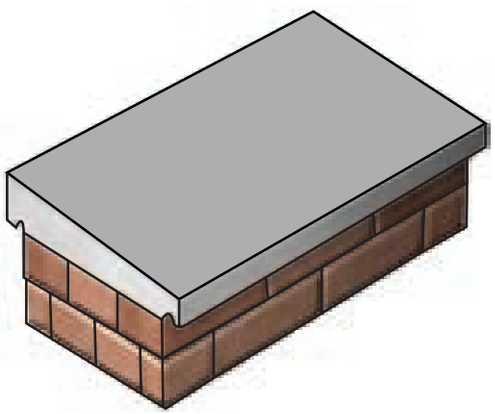


This is a moulded course of masonry having large projections. It may be provided at the junction of the wall and ceiling near the top of the building.

ix) Coping

It is course of stone, concrete or bricks provided at the top of the wall so as to protect the wall from seepage of rain water through joints. This course is generally provided at the top of a parapet wall or compound wall.

x) Throat

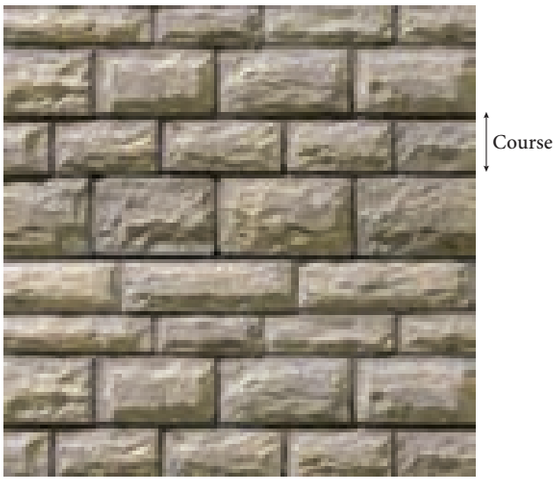


It is a small groove cut on the underside of sill, coping, cornice and projected chajja to discharge the rain water without trickling down to the walls.

xi) Course

A layer of stones or bricks is known as a course.

Thickness of a course = Thickness of a stone or brick + Thickness of one mortar joint.



xii) Plinth

The projecting course at ground floor level is known as the plinth. It is also used to indicate the height of floor level from ground level. It is sometimes moulded and given ornamental treatment.

The offset at plinth level is sometimes omitted for the architectural purpose.

xiii) String Course

It is continuous horizontal course of masonry, generally provided at every floor level. This course remains projecting from the face of the wall and is intended to improve the elevation of the structure.

xiv) Lacing Course

The horizontal course provided to strengthen a wall of regular small stones is known as a lacing course.

6.2.3 Dressing of Stones

The process of cutting stones into suitable sizes and shapes is known as dressing of stones.

Objectives of Dressing

i. To convert the stone pieces into desired shape and size.
ii. To make thin mortar joints there by reducing the mortar consumption and to improve the quality of work.
iii. To give the desired surface finish.
iv. To make transport easy and economical.

Types of Dressing

1. Hammer Dressing.
2. Chisel Dressing.
3. Punched Dressing.
4. Furrowed Dressing.
5. Combed Dressing

6.2.3.1 Hammer Dressing

A hammer dressed stone shall have no sharp and irregular corners and shall have comparatively even surface. All the sharp and irregular corners of the stone obtained by quarrying shall be knocked off by using the flat face of a scrabbling hammer. The surface shall be dressed with the pointed end of the hammer.

6.2.3.2 Chisel Dressing

Stones available from the quarry is first dressed with hammer and then

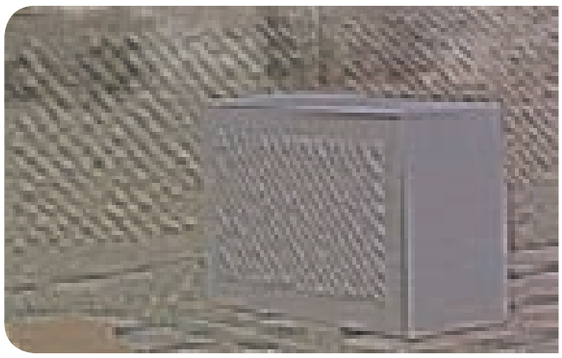
smoothly dressed by means of a pointed chisel. So that, all the projections are removed and a fairly smooth surface is obtained. This type of dressing is commonly adopted for ashlar work.

6.2.3.3 Punched Dressing

This is another form of rough dressing usually used for lower portions of the buildings. The exposed face of the stone is dressed with the help of a punch, thus making depressions or punch hole on it at some regular distance.

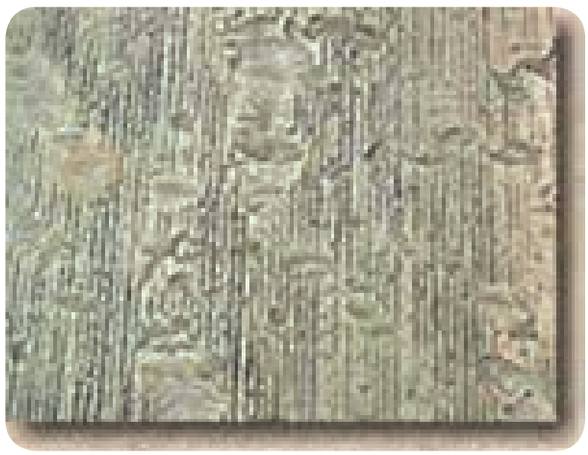
6.2.3.4 Furrowed Dressing

This type of finish is applied to the fillets or flat bands of cornices, string courses, doors and windows, etc. A margin of about 20mm width is sunk on all the edges of the stones and the central portion is made to project about 15mm.



6.2.3.5 Combed Dressing

Combed finish is suitable for soft stones. Steel combs of sharp teeth is dragged on the surface of soft stones. This is done in all directions of the stone surface. This also called as dragged finish.



6.2.4 Classification Of Stone Masonry

The stone masonry classified as

1. Rubble masonry
2. Ashlar masonry

6.2.4.1 Rubble Masonry

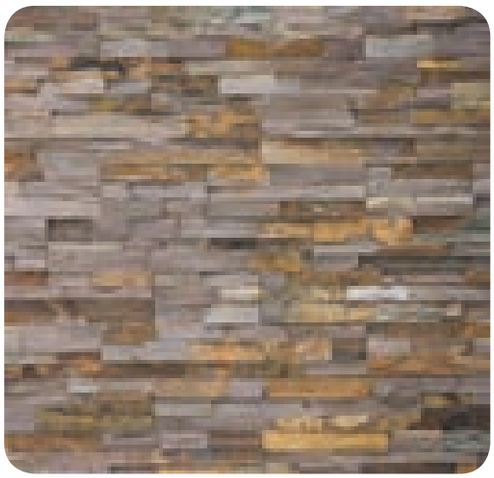
In this masonry, stones are not dressed. They are used in the masonry as obtained from the quarry. It may be shaped with the help of hammers just by removing excess projection before using in the masonry.

Types of Rubble Masonry

I. Coursed rubble masonry.
ii. Un-coursed rubble masonry.
iii. Random rubble masonry.
iv. Dry rubble masonry.

Coursed Rubble Masonry

In this type of rubble masonry, the height of stones vary from 5cm to 20cm. The stones are sorted out before the work starts. The masonry work is then carried out in courses such that stones in a particular course are of equal heights. This type of masonry is used for the construction of public buildings, residential buildings, etc.



Un-coursed Rubble Masonry

In this type of rubble masonry, the stones are not dressed. But they are used as they are available from the quarry, except breaking some corners. The courses are not maintained regularly. The larger stones are laid first and the spaces between them are then filled up by means of spalls. The wall is brought to a level at every 30 cm to 50 cm. This type of rubble masonry being cheaper and is used for the construction of compound walls, godown, garages, labour quarters, etc.

Random Rubble Masonry

The stones of irregular sizes and shapes are used for the construction of this masonry. The stones are arranged so as to have a good appearance. More skill is required to make this masonry structurally stable. The face stones are chisel dressed and the mortar joints does not exceed 6mm to 12mm. This type of masonry is used for the construction of residential buildings, compound walls, etc.

ACTIVITY 4

Collect informations and pictures about the structures and temples using stone masonry.

Dry Rubble Masonry

This is similar in construction of the coursed rubble masonry, except that no mortar is used in the joints. This requires skill in construction. This type of masonry is used in compound walls, pitching bridge approaches, retaining wall, etc.

DO YOU KNOW?

Brihadisvara Temple, Thanjavur.

It was built by emperor Raja Raja Chola and completed in 1010 AD. The temple turned 1000 years old in 2010. King Raja Raja Chola had the main temple built completely with granite. It is hard to imagine how, in that age, more than 1,30,000 tones of granite was brought to the temple site, especially given that there is no granite quarry within a hundred kilometres of the temple site.

Search link: htpps://en.m.wikipedia.org>wiki>Brihadisvara temple.

6.2.4.2 Ashlar Masonry

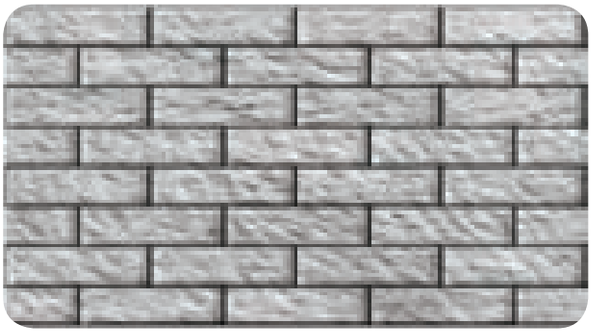
In this masonry the entire construction is done using square or rectangular dressed stones. The stones

used in this masonry are dressed with chisel. The height of stones varies from 25cm to 30cm.

Types of Ashlar Masonry

I. Ashlar fine masonry.
ii. Ashlar rough tooled masonry.
iii. Ashlar rock masonry.
iv. Ashlar chamfered masonry.
v. Ashlar block in course masonry.

Ashlar Fine Masonry



In this type of masonry, the beds, sides and faces are finely chisel dressed. The stones are arranged in proper bond and the thickness of the mortar joints does not exceed 3mm. This type of construction gives perfectly smooth appearance. It is costly in construction.

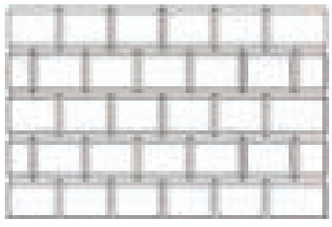
Ashlar Rough Tooled Masonry

In this type of ashlar masonry, the beds and sides are chisel dressed. But the face is made rough by means of tools. The thickness of mortar joints does not exceed 6mm. This type of work is also known as bastard ashlar.

Ashlar Rock Masonry

In this type of ashlar masonry, a strip about 25mm wide is made by means of a chisel, is provided around the perimeter of the exposed face of every stone. But the remaining portion of the face is left in the same form as received from quarry. The projections on the exposed face known as the bushings exceeding 80mm in height are removed by a hammer. This type of construction gives massive appearance.

Ashlar Chamfered



In this type, 2.5cm chisel drafting around the face is made at an angle of 45˚ with the help of chisel. Another chisel drafting about 10mm to 12 mm wide is again made around the perimeter inside the chamfered drafting. The remaining

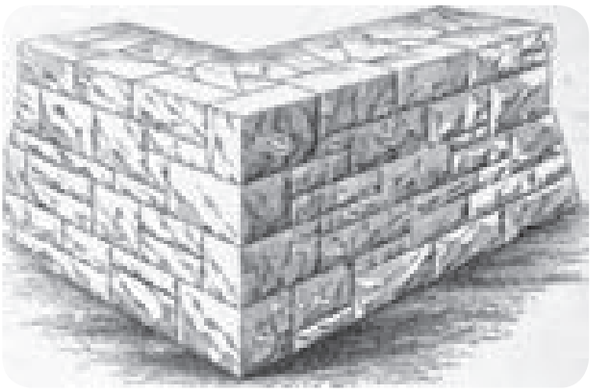
DO YOU KNOW?

The Most Beautiful and Famous Stone Buildings.

1. The Taj Mahal, India.
2. The Colosseum, Rome, Italy.
3. Great Pyramid, Giza, Egypt.
4. Washington Monument.

space is left as such. However projections of more than 8cm are removed with the help of hammer.

Ashlar Facing or Ashlar Block in Course



This masonry may be called as combination of rubble masonry and ashlar masonry. The faces of the stones are generally hammer dressed and the thickness of mortar joints does not exceed 6mm. The depth of courses varies from 20cm to 30 cm. This type of construction may be used for heavy engineering works such as retaining walls, sea walls, etc.

6.2.5 Points to be considered in the construction of Stone Masonry

I. Thestonesusedshouldconfirmtherequired specifications.

ii. The stone should be well watered before use.

iii. All the stones should be laid on the natural bed. The load should act at right angle to the natural bed.

iv. The dressing of stones should be properly done.

v. Proper bond with sufficient number of through stones should be provided in construction.

vi. No tensile stress should develop in the masonry.

vii. Good quality of mortar should be used in construction.

viii. Stone work should be raised uniformly.

ix. In the stone work, small pieces and chips should not be used.

x. The stone work should be carried out as per line and level.

xi. It should be cured for the required period.

ACTIVITY 5

Prepare an album about the most beautiful stone buildings.

Model Questions

PART I (1 Mark)

Choose the correct answer

1. The load from the stone masonry should act at …… to the natural bed.
   a. Slope
   b. Straight
   c. Right angle
   d. Horizontal
2. The name of stone used in external corners is ……..
   a. Corbel stone
   b. Sill stone
   c. quoin stone
   d. Weathering stone.
3. The size of stone used in coursed rubble masonry is ……
   a. 2cm to 50cm
   b. 5cm to 20cm
   c. 7cm to 9cm
   d. 1cm to 20cm
4. The bottom surface of a …… is called as sill.
   a. Door or Window
   b. Ventilator
   c. Beam
   d. Roof

PART II (3 Marks)

Answer in one or two sentences

5. What are the types of masonry?
6. Mention the types of dressing of stones.

PART III (5 Marks)

Answer shortly

7. Explain the terms used in stone masonry.

PART IV (10 Marks)

Answer in detail

8. List the types of rubble masonry and brief any two of them.
9. What are the types of ashlar masonry? Explain any two.

Part – I Answers

1. (c) 2. (c) 3. (b) 4. (a)

6.3 BRICK MASONRY

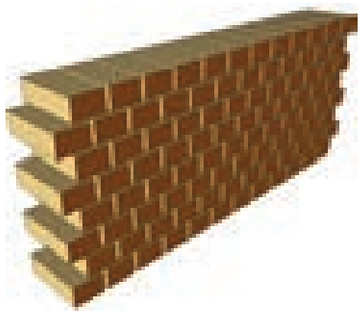
Learning Objectives

At the end of this lesson you shall be able to

- State the terms and tools used in masonry.
- Understand the types of bonds in brick work.
- Compare stone masonry and brick masonry.

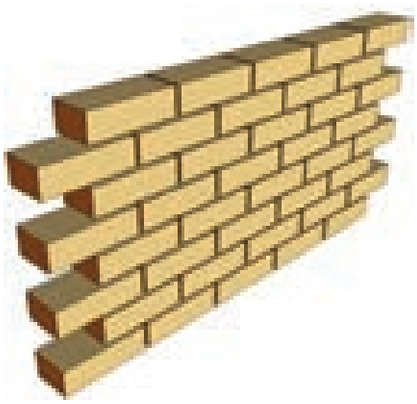
6.3.1 Introduction

Construction of brick units binded together with cement or lime mortar is termed as **Brick Masonry**.



6.3.2 Terms Used in Brick Masonry

i. **Stretcher :** It is a full brick which is laid with its length parallel to the face of the wall. If all the bricks are laid as stretchers, the course is named as stretcher course.



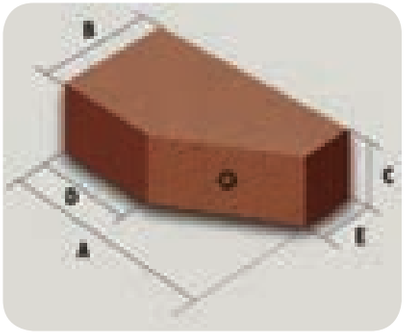
ii. **Header:** It is full brick which is laid with its length perpendicular to the face of the wall. A course of brick work entirely composed of headers is named as header course.

iii. **Bed:** It is the term used to indicate the lower surface of brick in each course.

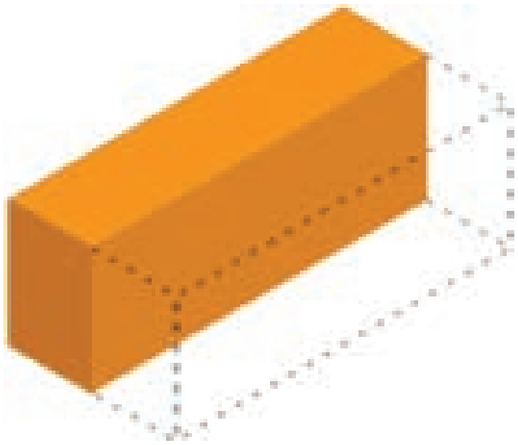
iv. **Bond:** The interlocking arrangement of bricks, so as to avoid the occurrence of continuous vertical joints is known as bond.

v. **Closer:** It is a piece of brick used to create bond in brick work.

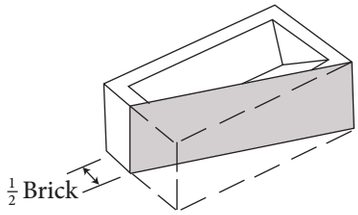
vi. **King Closer:** It is a brick which is cut in such away that, the width of one of its corner is half of that of a full brick.



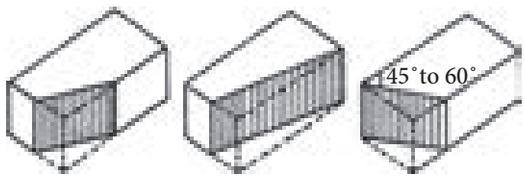
vii. **Queen Closer:** It is a term applied to a brick which is half as a full brick. Queen closer is made by cutting a brick length wise into two portions.



viii. **Beveled Closer:** It is similar to king closer, the only difference is that the whole length of brick is bevelled for maintaining half width at one end and full width at the other end.

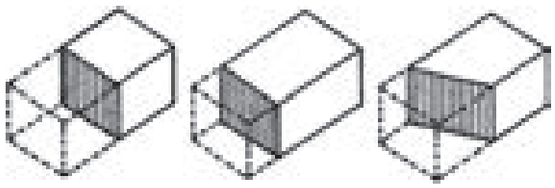


ix. **Mitred Closer:** It is a brick whose one end is cut splayed or mitred for the full width.



King Closer Bevelled Closer Mitred Closer

x. **Brick Bat:** It is the portion of a brick cut across the width or a brick cut by some fraction of its length. If a brick is cut by half size it is called as **half bat** and if cut by three quarter size it is called **three quarter bat**.



Half Bat Three Quarter Bat Bevelled Bat

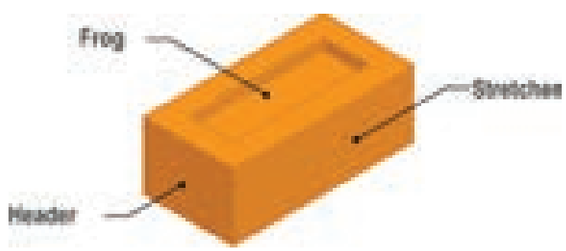
xi. **Lap:** The horizontal distance between two vertical joints of successive brick course is termed as lap. This should atleast 1/4th of length of brick.

xii. **Arris:** The edges of the bricks are called as arises. Arrises should be sharp and unbroken.

xiii. **Bed Joint:** Joints parallel to the bed of bricks or stone in a course are termed as bed joints.

xiv. **Perpends:** It is the vertical joint on the face of a wall in between two alternate bricks.

xv. **Frog:** Depressions provided in the face of the brick is called as frog. It forms a key for holding the mortar.



ACTIVITY 6

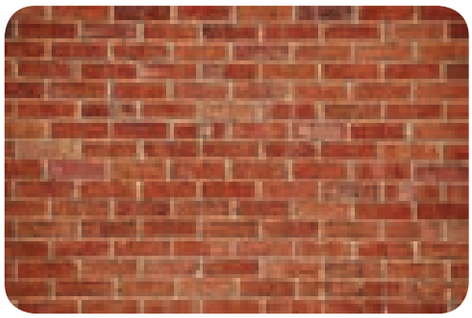
Visit a construction site during the process of brick masonry and prepare a report about that.

6.3.3 Bonds in Brick Works

The different types of bonds commonly adopted in brick work:

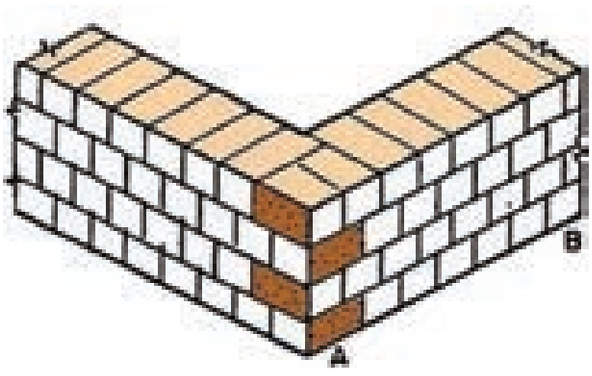
1. Stretcher bond.
2. Header bond.
3. English bond.
4. Flemish bond.
5. Garden wall bond.
6. Raking bond.
7. Dutch bond.
8. Brick on edge bond.

6.3.3.1 Stretcher Bond



In this arrangement of bonding in brick work, all the bricks are laid as stretchers. The thickness of the wall is half brick. It is commonly adopted in the cavity walls and partition walls.

6.3.3.2 Header Bond



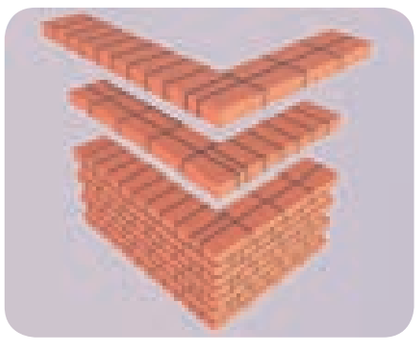
In this type of bonding, all the bricks are laid as headers on the face. It is used for walls curved on plan. The thickness of the wall is equal to one brick.

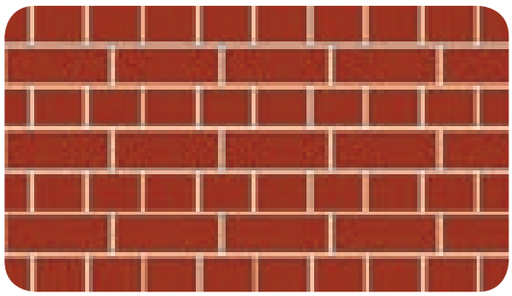
6.3.3.3 English Bond

This is the most commonly used bond because it is stronger than the other bonds.

The important features of English bond

i. The bond consists of alternate course of headers and stretchers.
ii. A queen closer will be placed next to the first header in each header course.
iii. A course consisting of headers on front face will show headers on the back face also in one brick, two brick, and three brick thick walls.
iv. In walls having their thicknesses equal to an odd number of half bricks (i.e. 1½ brick thick walls or 2½" brick thick walls and so on). The same course will show stretchers on one face and headers on the back.
v. Continuous vertical joints are eliminated.
vi. More quantity of cement mortar consumes in header course than stretcher course. As for as possible less quantity of cement mortar should be used for header course. Otherwise vertical joint will be formed in next course.





6.3.3.4 Flemish Bond

The important features of Flemish bond:

i. Each course consists of alternate header and stretchers.

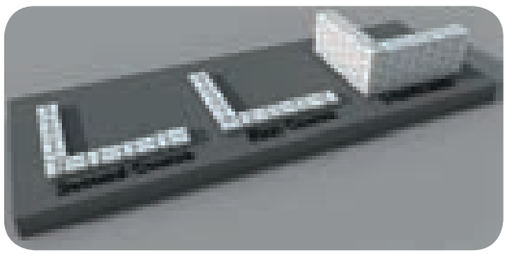
ii. Queen closers are placed in alternate courses next to the quoin header.

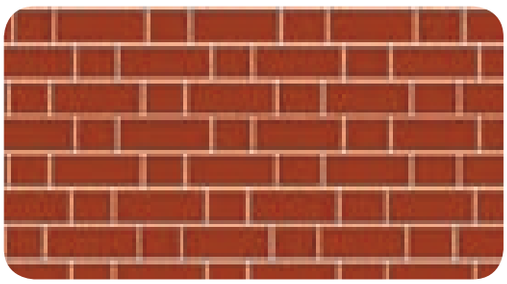
iii. When 1½, 2½ brick walls are constructed, bat bricks are also used with full brick. For 1, 2, 3 brick wall construction, only full bricks should be used.

iv. Flemish bond is weaker than English bond.

v. Continuous vertical joints may occur in Flemish bond.

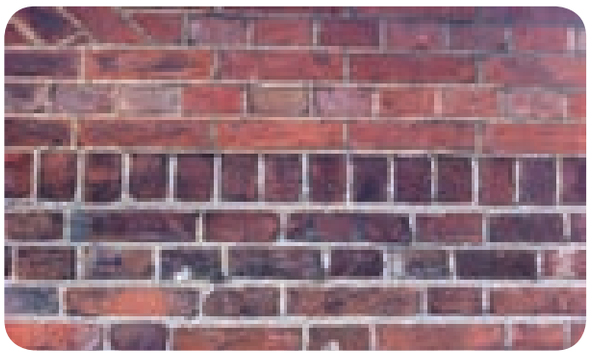
vi. Flemish bond renders the appearance of the face work more attractive and pleasing.





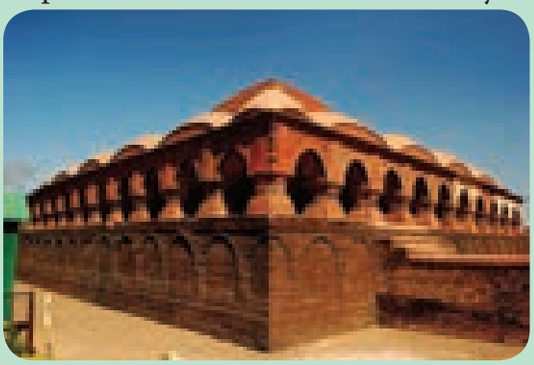
6.3.3.5 Brick on Edge Bond

This type of bond uses stretcher bricks on edges instead of bed. The bond is weak in strength but it is economical. Hence it is used for garden walls, compound walls, etc.



Oldest Brick Temple in India

Rasmancha in Bishnupur, West Bengal is the oldest brick temple in India. It is the only temple of its kind in the whole country.



6.3.4 Tools Used in Brick Masonry and Stone Masonry

I. **Trowel**: It is used to lift and spread the mortar and also for cutting bricks.

ii. **Plumb Rule and Bob**: It is used to check the verticality of the wall.

iii. **Spirit Level**: It is used to check the horizontality of the surface.

iv. **Line and Pin**: It is used to construct the walls straight and uniform.

v. **Straight Edge**: It is used to check the vertical and straight alignment of walls.

vi. **Mason Square**: It is used to set right angles.

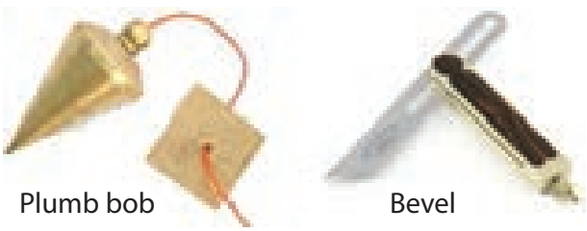
vii. **Hammer**: It is used for breaking and rough dressing of stones.

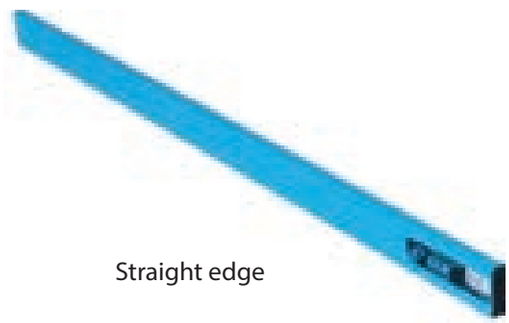
viii. **Crowbar**: To break the stones in quarry.

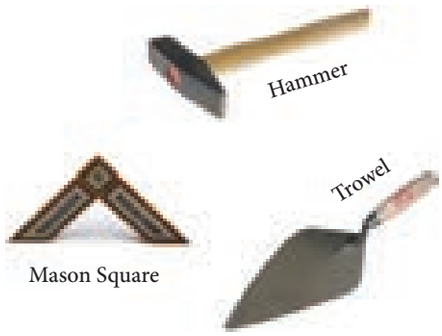
ix. **Chisels**: To dress stones.

x. **Pick Axe**: To split stones and for rough dressing.

xi. **Bevel**: To set out angles.







Line & Pins

Chisel

6.3.5 Points to be considered in the construction of Brick Masonry

I. The bricks used in a good work should be sound, hard and well burnt with uniform size, shape and colour.

ii. The bricks should be thoroughly soaked in water before its use. It reduces their tendency of suction of water from wet mortar.

iii. Only specified mortar of a good quality should be used.

iv. No brick bats should be used in the work except as closers.

v. The progress of work in raising masonry should be in uniform layers at one level.

vi. Brick work should be ensured that a proper bond is maintained throughout the work.

vii. The bricks should be laid on a full bed of mortar. The frog in the brick should be at the top and filled with mortar to ensure proper bonding.

viii. Scaffolding should be adopted for construction at higher level.

ix. All the course should be laid truly horizontal and all the vertical joints should be truly vertical. The verticality should be checked with plumb bob.

x. All the finished masonry work should be kept wet for at least seven days.

ACTIVITY 7

Prepare an album of rich heritage monuments and temples situated in India.

6.3.6. Thickness of Brick Wall

Thickness of brick wall is decided by considering the following:

1. The total load acting on the walls.
2. The total height of the wall.
3. The quality of materials used for the construction of wall.
4. The length of the wall.
5. The height between one floor to the other.

Formula to find the thickness of wall is:

$$A = \frac{P}{O}$$

$$T \times L = \frac{P}{O}$$

$$\text{Thicknes of wall 'T'} = \frac{P}{L \times O}$$

Where,

P = Total load on the wall

A = Area of the wall

L = Length of the wall

T = Thickness of the wall

O = Permissible bearing capacity

6.3.7 Difference Between Stone Masonry and Brick Masonry

S.No	Stone Masonry	Brick Masonry
1	The stones obtained naturally are dressed to a particular shape and used for masonry work.	The bricks are burnt in kiln and used for masonry work.
2	Stone masonry is very strong.	Strength of brick masonry is lesser than stone masonry.
3	Water tight stone masonry may be constructed.	Water tight masonry work is not possible.
4	Stone masonry does not have the property of water absorption. So this masonry is suitable for bathroom and toilets than brick masonry.	Brick walls are having the property of water absorption. To protect the walls from the dampness cement plastering is necessary.
5	Stone masonry is hard and construction is tough.	Construction of brick masonry work is easy.
6	Bonding property is not much high in stone masonry and consumption of cement mortar is also high.	Good bonding can be made in brick work. Less quantity of cement or lime mortar is used.
7	Lifting and handling of stones are not easy. So speed of masonry work is slow.	As the size of brick is small, handling and lifting is easy. So masonry work is faster.
8	In hilly areas stones are highly available. So construction cost is low.	Other than hilly area cost of brick work is economical.
9	We cannot directly use the stone which are taken from stone quarry. It should be dressed to some extent. So cost becomes high.	We can use the bricks directly from the kiln. So cost becomes low.
10	Minimum width of stone masonry should be 30 cm. Construction of stone masonry below this width is not possible.	We can construct brick walls from 10 cm thickness.
11	Heat absorption property is high for stone masonry.	Heat absorption property is not much high.

Model Questions

PART I (1 Mark)

Choose the correct answer

1. The bottom surface of brick in each course is ……
   a. Bond
   b. Bed
   c. Arris
   d. Perpend
2. The portion of brick cut across the width is …….
   a. Queen closer
   b. King closer
   c. Brick bat
   d. Mitred closer
3. Flemish bond is ….. than English bond.
   a. Thicker
   b. Thinner
   c. Stronger
   d. Weaker
4. ……. is used to set right angles in walls.
   a. Trowel
   b. Spirit level
   c. Plumb bob
   d. Mason square

PART II (3 Marks)

Answer in one or two sentences

5. Define queen closer.
6. What is the use of plumb bob?
7. List the types of bonds in brick work.
8. Write short notes on frog.

PART III (5 Marks)

Answer shortly

9. List the tools used for brick masonry.
10. Explain any five terms used in brick masonry.

PART IV (10 Marks)

Answer in detail

11. Explain English bond brick work with neat sketch.
12. Explain Flemish bond brick work with neat sketch.

Part – I Answers

1. (b) 2. (c) 3. (d) 4. (d)