LAB MANUAL ON CONSTRUCTION WORK SHOP PRACTICE & MS PROJECT

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Experiment No-01

AIM OF THE EXPERIMENT: -Study of tools required for construction of masonry.

THEORY: -

- Every construction tool is necessary to achieve good results in the whole project.
- Along with these tools, the workers should also use some safety tools to prevent them from the unexpected accidents.
- Construction tools lists for building construction works such as concrete brick masonry, levelling, wood works, floor works, slab works, brick laying, plastering etc is provided.

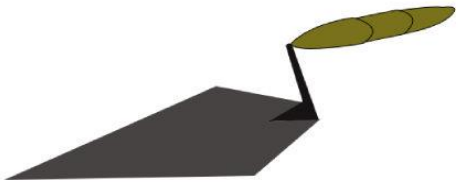
CONSTRUCTION TOOL LIST FOR BUILDING CONSTRUCTION : -

Some important construction tools and their uses are listed below.

Bolster, Boning rod, Brick hammer, Bump cutter/ screed, Chain/pins lewis, chisel, circular saw, concrete mixer, crow bar, Digging bar, Drill machine, End Frames, float, Gloves, Hand saw, Head pan, Hoe, Jack Plane, Ladder, line & pins, Mason's square, Measuring tape, pick axe, plumb bob, putty knife, earth rammer, rubber boots, safety helmet, sand screen machine, scratchers, sledge hammer, spade, spirit level, straight edge brushes, trowel, vibrator, wheel barrow.

01. Trowel:-

The basic masonry trowel is made up of stainless steel with a plastic/ wooden handle. The ends of trowel may be bull nosed or pointed. This is used to lift and spread mortar in joints during masonry construction. There are different kinds and sizes of trowels used in masonry work.



02. Corner Trowel:-

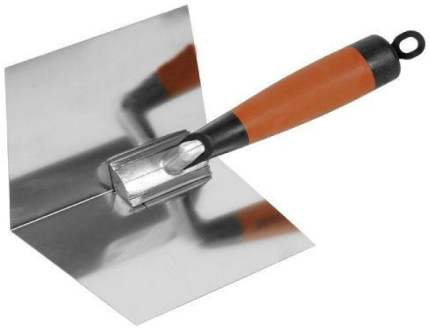
It is one of the common modifications of the basic trowel. It is used for shaping corners of the wall. They are two types of Corner Trowel.

(A) Outside Corner Trowel

There are different designs of outside corner trowel but the one shown at left side with shorter flanges is the most common. These outside corner trowel can have a sharp 90-degree angle or a bull nose (rounded) edge.

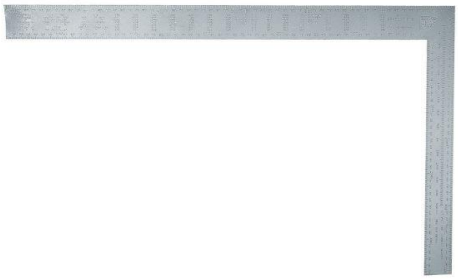
(B) Inside Corner Trowel

These are more common than the outside corner trowel, just because corner aid is used on the outside corners. They have standard features, comparable to an outside corner tool but also have adjustable models that can get wider or narrower, depending on the angle of the corner.



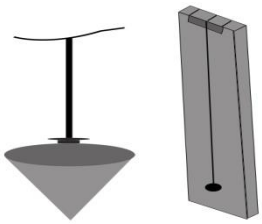
03. Setting Out Square or Mason Square

It is used to set out right angles at the corner of masonry wall. This is very important and basic tool used in masonry work. This tool has “L” shape. It is made of flat steel having each arm about 0.5 m long.



04. Plumb Rule and Bob

This basic masonry tool is used to check the verticality of walls. It consists of a string tied to a weight at bottom called bob and straight wood board with uniform edges called plumb rule. On its center a groove is provided in which plumb bob is placed. When the rule is placed vertically with the wall, the plumb bob must be in the groove line indicating the perfect vertical wall. If the plumb ball does not fall on the groove line, the wall will not be vertical.

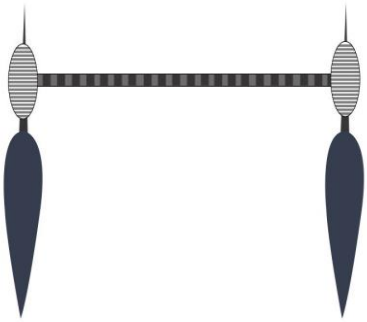


05. Spirit Level

It is used to check the horizontality and verticality of the surfaces. Spirit level is made of hard plastic or wood with bubble tube in the middle. The bubble tube is partially filled with alcohol in such a way that, an air bubble is formed in it. The spirit level is placed on surface of masonry wall and bubble is checked. The surface is called leveled when the bubble in the tube settles at middle of tube.

06. Line and Pins

It is used to maintain the alignment of the work-in-progress. Line and pins consist of a string whose ends are connected with two solid metal rods with pin points. It is used to level line and the alignment of brick course while brick laying in brick masonry work.



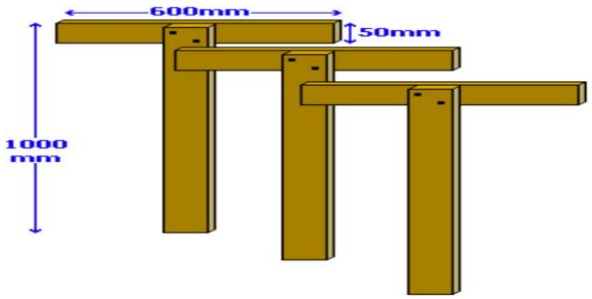
07. Water Level

It is used to transfer and check level. It is a simple tool to measure the level at two different points. It is a tool that works on the principle that water always seeks its own level. It consists of flexible tube with liquid, and the liquid at both ends.

08. Boning rods

They are It is used for levelling from two fixed points in surveying. It consists of an upright pole having a horizontal board at its top, forming a ‘T ‘shaped rod. Boning rods are made in

set of three rods, and many consist of three ‘T’ shaped rods, each of equal shape and size, or two rods identical to each other and a third one consisting of longer rod with a movable or detachable ‘T’ piece. The third one is called traveler or traveling rod.



09. Spades (phavadas)

They are used to mix mortar and also used to place cement, mortar, concrete in head pan. Spade is also used to dig the soil for foundation trenches etc. It consists of metal plate at the end of long wooden handle.

10. Mortar Pan / ghamela

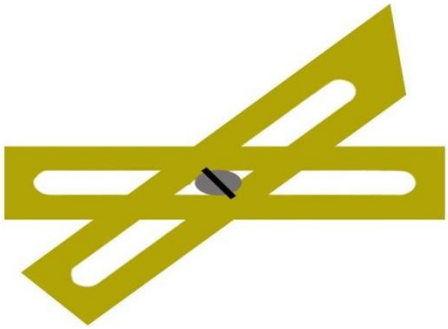
Mortar pan is commonly used in construction sites and is made of iron or plastic. It is a vessel made of rigid plastic or steel used to hold or carry sand, cement, mortar and concrete. It is also used to mix mortar and to lift mortar on working site. To use a mortar pan, fill it with a quantity of material i.e. sand, cement, mortar etc. that you are comfortable with carrying.

11. Jointer

A jointer in masonry construction is a tool in the form of a striking iron or a striking tool used to finish the horizontal or the vertical mortar joints. A jointer or brick jointer is a hand tool designed to imprint grooves into recently filled mortar joints at the stage when they are starting to set. Using a brick jointer helps to improve and visual impact and the lifespan of the mortar. Jointer is used to refer to any tool which can shape the mortar between bricks.

12. Bevel

It is employed to set out angles. It comprises of two slotted blades of steel and fixed with each other with thumb screw. It is a tool consisting of two rules or arms joined together and opening to any angle.

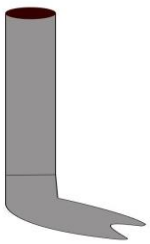


13. Pick Axe

It is employed for rough dressing of stones and to split the stones in the quarry. It has a long head pointed at both ends.

14. Crow Bar

It is employed for dressing the surface of stones. This consists of an iron edge with a number of teeth from 3 mm to 9 mm.



15. Chisel

They are used with mallets and with hammers. A chisel is used for normal splitting, roughing out and shaping the stone. Chisels are available in different sizes with bladed, flat, tapered and other shaped chipping points. Blade of chisel is made from iron or metal and the handle is made from wood.

16. Wood handled chisel

It is used to dress soft stones. A chisel is a tool with a characteristically shaped cutting edge of blade on its end, for carving or cutting stone by hand. Its handle is made from wood or plastic.

17. Drafting Chisel

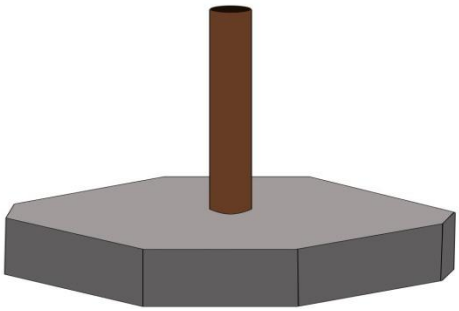
It is a chisel especially used for cutting a border or line at the edge of a stone. They come in different types of size. Grooves are made with the drafting chisel at the all four edges of stone. And, these stones are used in plinths and at corners in building.

18. Tooth Chisel

Tooth chisel is also used for fine dressing. It is a hand-held tool of metal consisting of a long shaft, with a toothed cutting edge at one end. It is again usually hit with a mallet or metal hammer. The number of teeth on this cutting edge varies, generally between three and five, but a variation with two teeth also exists. The tooth chisel is normally used between roughing-out and finishing, to clear away the rough marks left by the point chisel and prepare the surface for finer work.

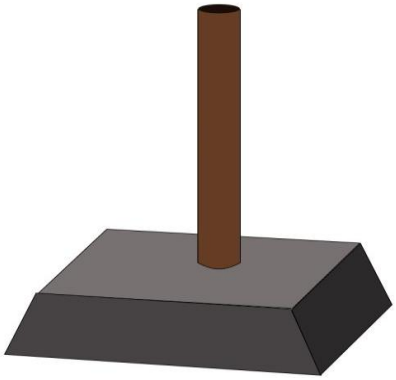
19. Spalling Hammer

It is a stone mason's tool. It is a heavy hammer used for cutting, shaping and rough dressing of stones. It has a beveled striking face. It is a large hammer usually with a flat face and straight peen for rough dressing and breaking of stone.



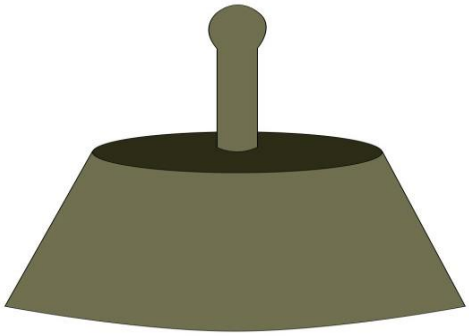
20. Mash Hammer

A mash hammer is also known as a stone mason's hammer. It is used to hit and drive chisel for rough dressing of stone. It is double-sided with two striking faces, most often used in stone masonry work. It should only be used to strike stones, but can also be used for such tasks as chipping away mortar in stone masonry. This hammer consists of a wooden handle to which is attached a heavy head, usually made of metal.



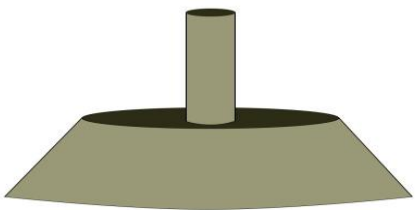
21. Mallet (Wooden Hammer)

It is a basic tool used for shaping of stone. It is a wooden hammer used for driving wooden headed chisels. It usually has a large head.



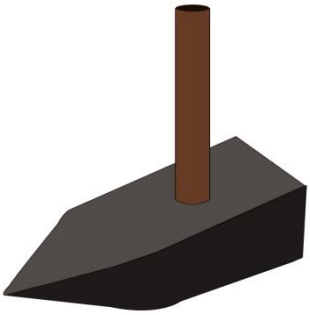
22. Dummy (Iron Hammer)

It is used for carving of stones. It has also large round shape head which is made of iron. Its handle is made up of wood.



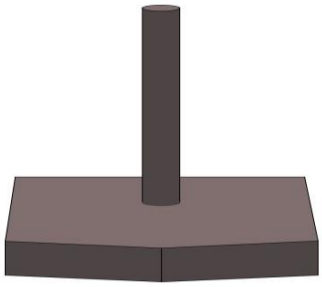
23. Scabbling Hammer

Scabbling also called scappling is the process of reducing stone while dressing of stone. In scabbling dressing, only irregular angels are taken off with a scabbling hammer. Hence scabbling hammer is a tool used to break small projections of stones or removing irregular bushings from the face of stone. It has a large head made of iron and wooden handle.



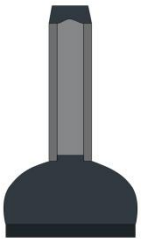
24. Club Hammer

It is used to strike arrow -headed chisels. It is also useful for light demolition work, driving masonry nails, and for use with a steel chisel when cutting stone. Its weight drives the chisel more deeply into the material being cut than any lighter hammers. It also consists of iron head and wooden handle like other stone masonry tools.



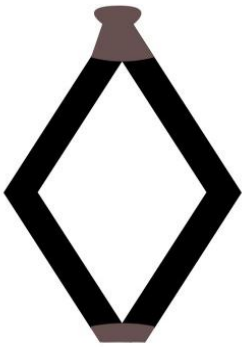
25. Pitching Tool

Pitching tool is a hand driven tool comprising of a long edge with a thick point. The ‘working-edge’ of the pitching tool has a broad flat face that is generally ground to an angle just slightly-off the perpendicular. It is mainly used to make stones of required size. If the carving block of the stone has flat-sawn faces, then this tool can be used to remove a great deal of waste material at the initial stages of carving.



26. Gauge

It is employed to dress stones for spring, course, cornice, coping etc. It is made of metal.



27. Punch

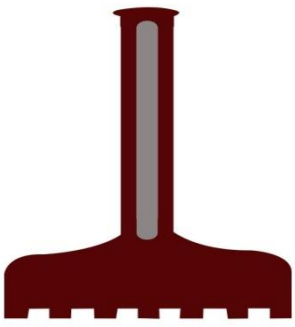
It is employed to dress the hard stones roughly. It is one-piece rod-shaped tool made from metal designed to be struck by hammer. It's one end is pointed and other is round shape.

28. Point

It is employed for roughly dressing the hard and tough stones. Point is also used for roughing out areas and knocking off high spots in stones. Point tool is used after any initial work with the pitching tool. Both point and punch are used to rough-out the form but the latter tapers to a small cutting edge of stone whereas the former tapers to a single point of the stone.

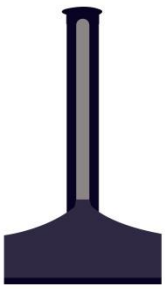
29. Claw Tool

It is employed for dressing the surface of stones. This consists of an edge with a number of teeth from 3 mm to 9 mm. Claw tool is used after the coarse carving with the point tool. The claw tool, with its row of pointed teeth, acts like a rake to even out the surface irregularities left by the point. While using this tool, care should be taken to ensure all of the chisel's teeth are in contact with the stone, in order to prevent breakage.



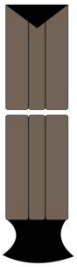
30. Nicker (Broad tool)

The mason's nicker (Broad tool) is made from high quality steel. The blade is thicker and beveled on both sides to create a cutting blade. It is held at right angles to the stone and hit with a hammer to split the stone.



31. Jumper

It is a long drilling tool consisting of an iron bar with a chisel-edged steel tip at one or both ends, operated by striking it against the rock, turning it a little with each blow. They are used to bore holes for blasting purposes in a quarry by quarry workers and masons.

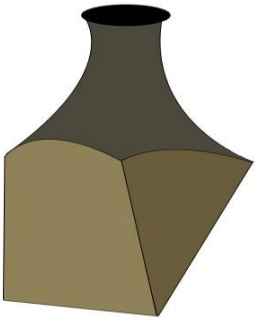


32. Wedge and Feathers

It is an oldest yet, one of the best tools to split the stone. It is a three-piece set tool. Each set of tool consists of a metal wedge (also called plug), and two shims (also called feathers). The feathers are tapered and curved at the top and wide at the bottom. When the two feathers are arranged on either side of the wedge, the combined width of the set is the same at both ends. They are employed for cutting the stones after they have been bored with a jump.

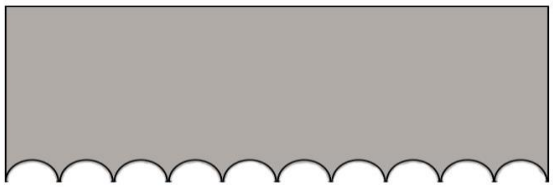
33. Gad

Gad is a small, steel, wedge-shaped tool used for splitting of the stone.



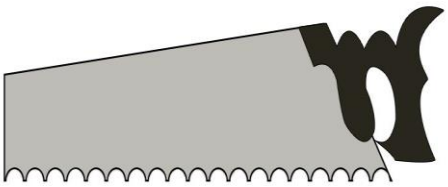
34. Drag

It is employed to level a stone surface. It consists of blades set at alternating angles, between 15 and 30 degrees, over the length of a block of wood. The blades are toothed to provide even removal of surface material. Some drags can be fitted with specially shaped blades to follow convex surfaces.



35. Hand Saw

It is used to cut soft stones. It is a saw with wide cross-cut toothed steel blade and wooden/plastic handle at one end. I It is used by one hand.



36. Circular Saw

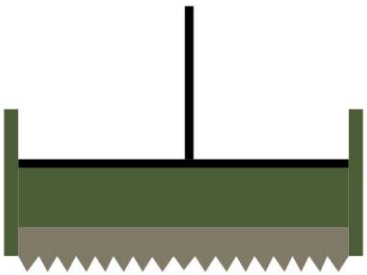
A circular saw is either hand held or affixed to a substrate. It runs on electricity and is provided with a toothed or abrasive blade/disc which has the ability to cut different materials including wood, stone, brick, metals, plastic by using a rotary motion that spins around an arbor.

37. Cross-cut-saw

It is used to cut hard stones. It is designed specifically for rough cutting. It has a comparatively thick blade, with large, beveled teeth. Traditional 2-man crosscut saws (felling saws) have a handle on each end and are meant to be used by two people to cut stones.

38. Frame Saw

This is used to cut large blocks of stones. It consists of a comparatively narrow and flexible blade held under tension within a (generally wooden) rectangular frame called sash or gate. The blade is held perpendicular to the plane of the frame, so that the stone passes through the center of the frame.



39. Brick Hammer

It is used for rough cutting of bricks in different shapes and sizes. One end of the hammer is square and another end is sharp-edged. It has one flat traditional face and a short or long chisel shaped blade. It is also used to push the bricks if they come out from the course line.

40. Lump Hammer and Bolster

Lump hammer is used for light demolition work or to break masonry. In order to cut brick accurately, a steel chisel with a very wide blade called bolster is employed.

41. Double-end Comb Hammer or Skutch

It is used to remove surplus material after cutting of bricks by bolster, for greater accuracy. The Hammer has two groove components for double sided use. Comb of hammer is a made from iron or similar metal whereas handle is made up of plastic or wood

42. Straight Edge

Straight edge act as extensors to mason's level. They are used when levels are shorter than the area that needs to be measured or assessed. The middle section of the top of the straight edge should be horizontally parallel to the bottom section. It is used for checking the straightness of brickwork.

43. Brickwork Gauge Rod

It is similar to straighten edges on which levels of different courses of bricks including sills and lintels are marked. It may be as long as the height of the ceiling. It is used to confirm that courses are maintained at correct levels.

44. Bricklaying Trowel

It is a flat triangular trowel used in bricklaying for cutting brick and spreading mortar or cement. The trowel is also used to tap bricks down on to the bed and can be used for

random cutting of soft bricks. They come in various shapes and sizes depending on the task.

Result:- We came to know about these instruments which are used in constrcution field.

Experiment No-02

AIM OF THE EXPERIMENT: - Study of layout plan of a building .

APPARATUS REQUIRED: -

1. Tape (30 mtr. Length)
2. Peg
3. Rope

MATERIALS REQUIRED: -

1. Lime
2. Sand

THEORY: -

- Layout of a building or a structure shows the plan of its foundation on the ground surface according to its drawings so that excavation can be carried out exactly where required and position and orientation of the building is exactly specified.
- It is set out according to foundation plan drawing and specifications provided by the engineer or an architect.
- The layout plan is a plan of a layout which include the site plan, parks, gardens, community drainage, etc.
- It is also the plan which is used for the construction of commercial buildings.
- Different types of drawing are used in construction such as architectural drawings, structural drawings, electrical , plumbing and finishing drawings.
- These drawings provide layout plans and details for construction of each and every part of the building. Drawings plays an important role in construction field to convey the ideologies and perspective of the designer to the layman at site.
- The drawings may be used to indicate the overall appearances, inside or outside the structure, or they may be used to indicate precise measurements and other details for construction.

Types of Construction Drawings:-

- They are different types of drawing used for the construction process depending upon the purpose they serve. Construction drawings are divided into 5 types.

1. **Architectural Drawing :-**

- Architectural Drawing can be termed as the mother drawing for all the other drawings used for construction .

- It contains all the details of the project such as location site plan, working plan, section drawing and elevation drawing.

1.1 Site Plan :-

- This is primary drawing used for marking out the plan on the ground. It represents the location, orientation and information about site's topography, land scarping utilities & site work.

1.2 Working Plan :-

This drawing gives the information of horizontal dimensions of the building, thickness of walls, clear spaces inside the building and column locations.
It also shows the openings required in the building such as doors, windows & ventilators.

1.3 Section Drawing :-

Section drawings represents the materials of construction to be used, heights and measurements of the different components of building, types of structural component such as type of slab, column, etc. It represents the drawing when the building is cut through a vertical plane.

1.4 Elevation Drawing :-

Elevation drawings represent the information of openings, size and shape of external surface, height of building and finish of the building after completion. These drawings are made by having aesthetic view of the building.

2. **Architectural Drawing**

Structural drawing can be termed as the backbone drawing of the building. It consists of all the information about the structural intervention that are coming on a building. It contains many types of drawing with very minute details and description.

2.1 General Note :-

This is more of a code and by laws of the buildings. No drawing is found in this , but the details of all the structural drawings are mention in this such as concrete mix, lapping length, curing time, abbreviation, codes and other work procedure.

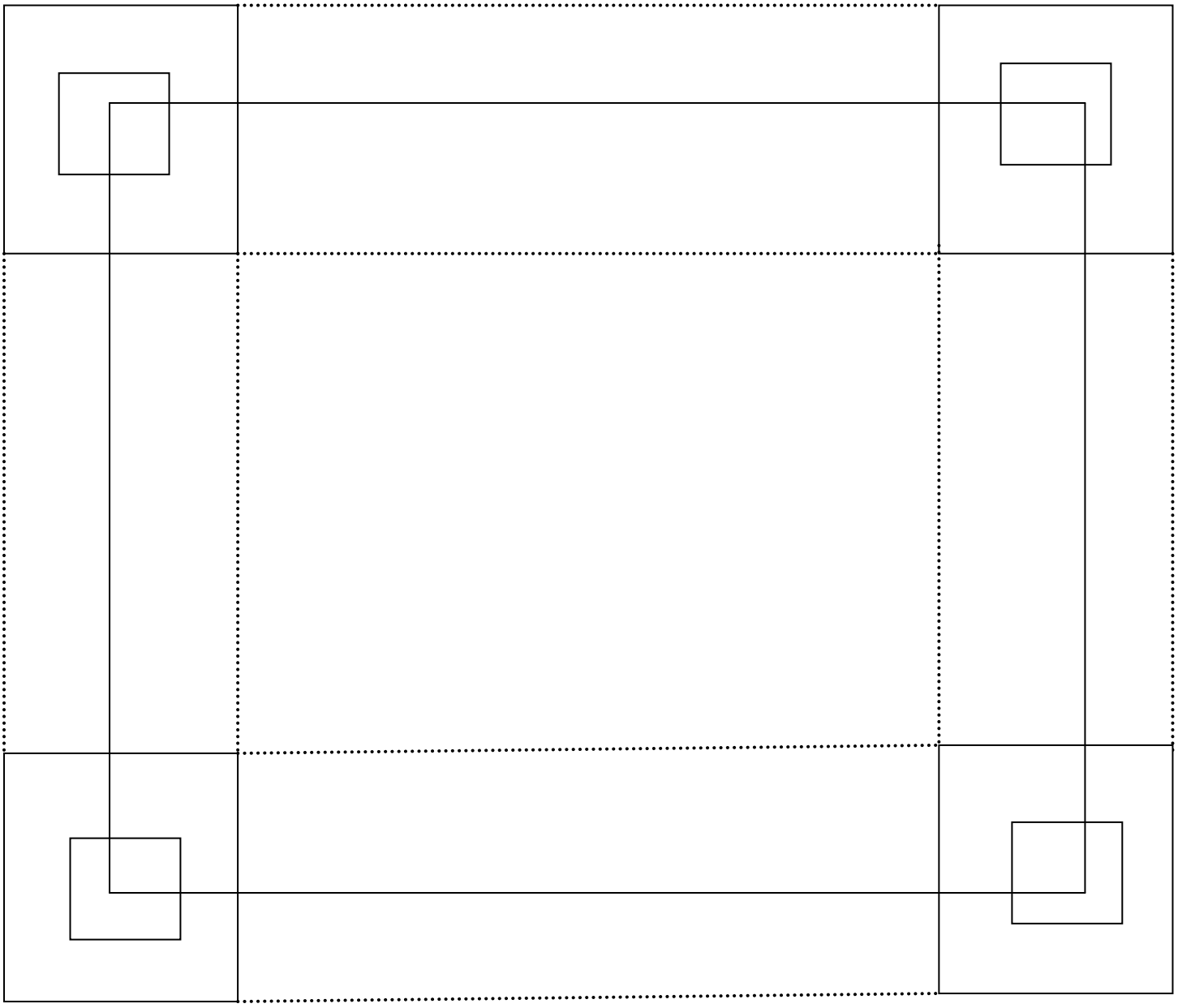
2.2 Excavation Drawing :-

This is drawing represents the footing excavation dimensions, column portion, footing plan and grid lines of column.

Procedure :-

- First we took a point on the ground surface and marked it as "A" with peg.
- After that we measured form a triangle by 3 mtr. and 4 mtr. in adjacent side and made hypotenuse as 5 mtr.
- Similarly we marked all four sides on layout plan by this Pythagorean theorem.
- After that by using Tape we marked out all sides as required in the layout plan.
- After that we marked footing size on each corner by taking 500* 500 mm.
- After that we marked column size on each corner by taking 300 * 300 mm .

- After that we marked all sides by lime and sand .



CONCLUSION: -

We performed Layout of given building successfully.

Experiment No-03

AIM OF THE EXPERIMENT: - To construct a 1 &1 ½ Brick thick walls in English Bond including a corner.

APPARATUS REQUIRED: -

1. Trowel
2. Trey
3. Straight edge

MATERIALS REQUIRED: -

1. Brick
2. Cement
3. Sand
4. Water

THEORY: -

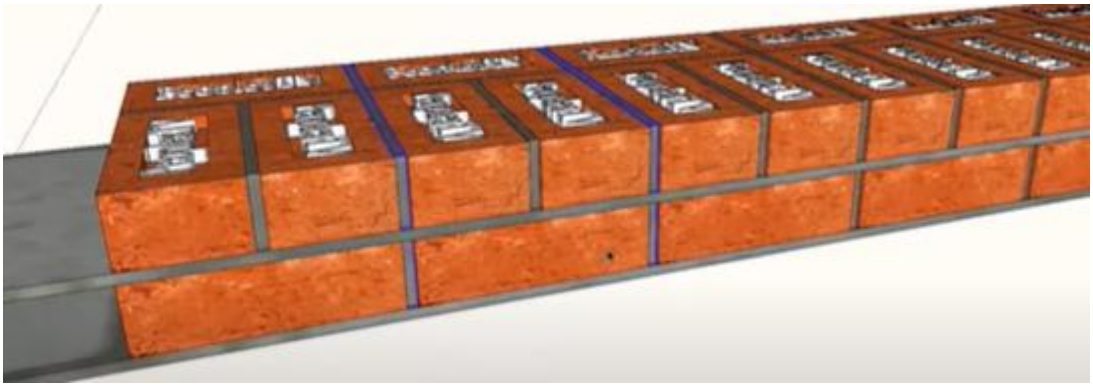
- English bond has alternate courses of headers and stretchers.
- It is necessary to place queen closers after the first header in the heading course for breaking the joints vertically.
- English bond construction requires the following points to be kept in view:
  - A queen closer must be provided after the quoin header. A header course should never start with a queen closer.
  - Each alternate header should be centrally placed over a stretcher.
  - Continuous vertical joints should not be allowed except at stopped end.
  - In case of the wall thickness equivalent to an even number of half bricks, the wall shall present the similar appearance on both the faces.
  - In case of the wall thickness equivalent to an odd number of half bricks, the same course shall have stretcher on one face and header on the other.
  - Only headers should be used for the hearting of the thicker walls.

PROCEDURE: -

- In course-1 of one and a half thick brick wall stretchers are placed in the front of wall and the headers are placed at the back to complete the one and a half brick thickness, this is the reason we see the stretchers in the front in course-1 and headers in the back in the same course.

- now in course-2 we do just opposite of the course-1 by placing headers in the front and the stretchers at the back.

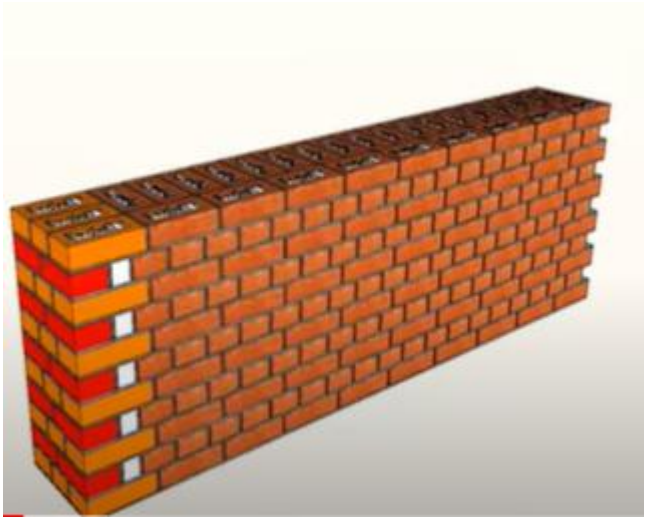
- By doing this we avoid continuous vertical joints but still there are some vertical joints remained as we can see if we place the course-2 above course-1 as it is.



- So, to avoid the vertical joints completely from the face of the wall both front and back we have to simply follow the typical English bond rule in which the headers centered over the mid point of the stretchers.
- So, when we shift the whole course-2 to the mid point of the stretcher in course-1 we will see that our vertical joints are totally removed from the front and the back.

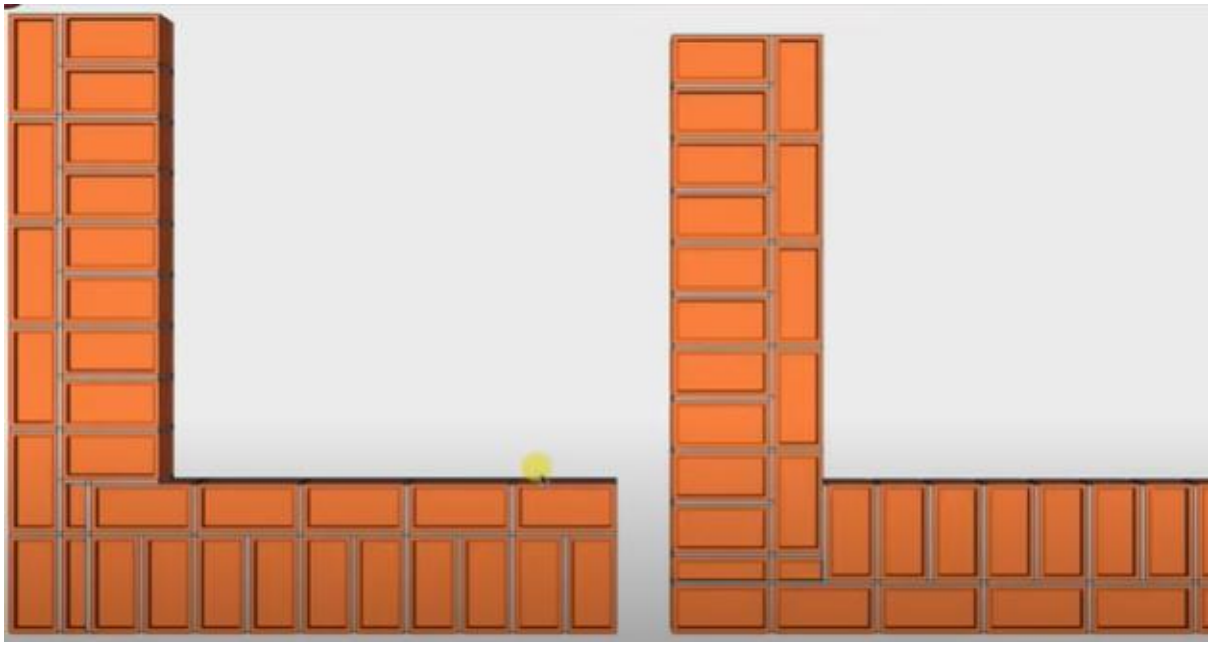
- But still the wall is not complete, because the starting is not resolved yet.as we know in course-1 we have stretchers in the front so we don't want to change that pattern that's why we will start from the three stretchers in course-1 and in course-2 we have to place two ¾ bat in the start and that two ¾ queen closer after that, and then we can continue our wall further.

- So, this is how we start an English bond wall of one and a half brick thickness that is in course-1 ,we start the wall with placing three stretchers than in course-2 we start with placing two ¾ bat following with two ¾ queen closers.



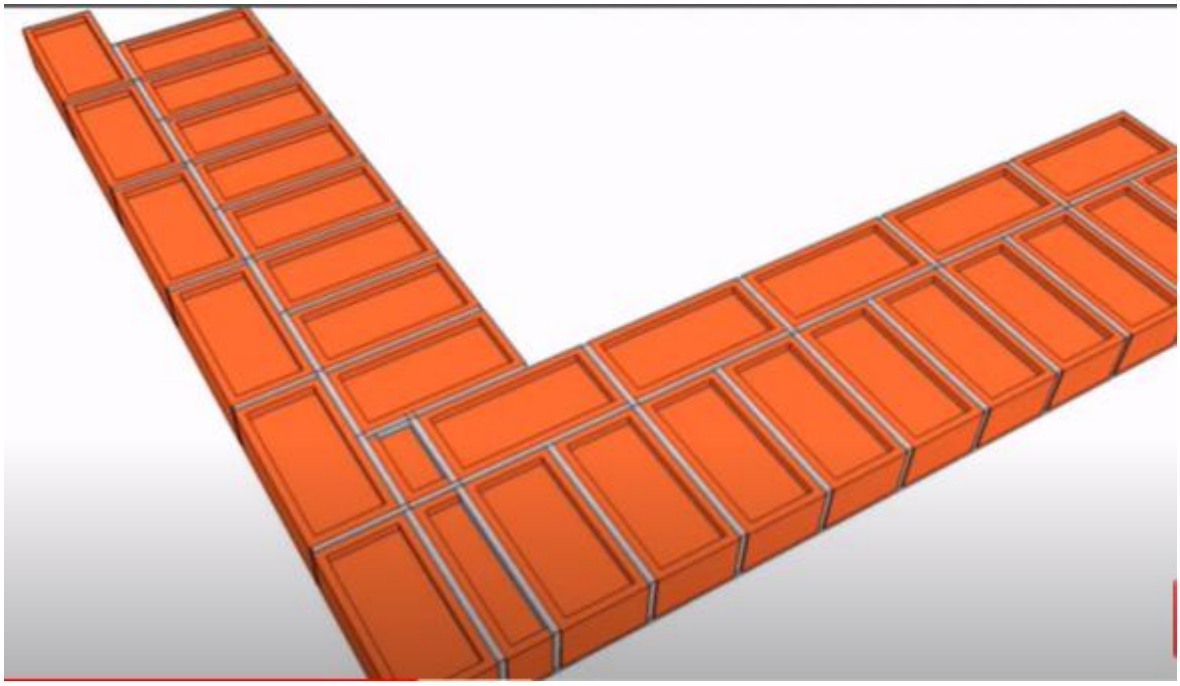
- Now let's get to know the stopped end of the wall. If we want to end the wall then we have to close the toothing in the wall.so to close that we have to place end bricks in the wall taking care of vertical joints.
- So, in course-1, we place the mirror of the arrangement of bricks by which we started our course-2 that is two ¾ queen closer and two ¾ bat at the end.

- And in course-2 we use the same as we use in starting of the course-1 that is three stretchers. After this arrangement our one and a half brick thick wall is complete.
- Now when we join the two walls of 1 ½ brick thickness here is the plan of two courses of 1 ½ brick thick wall. Left is course-1 and right are course-2.

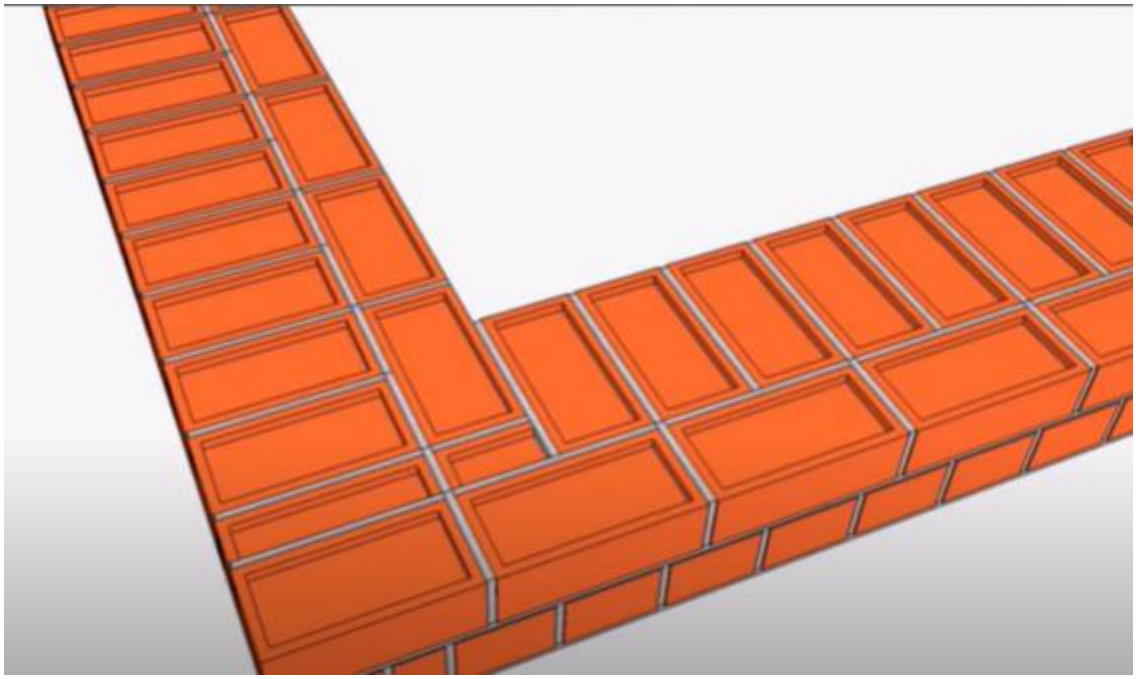


Course-1 course-2

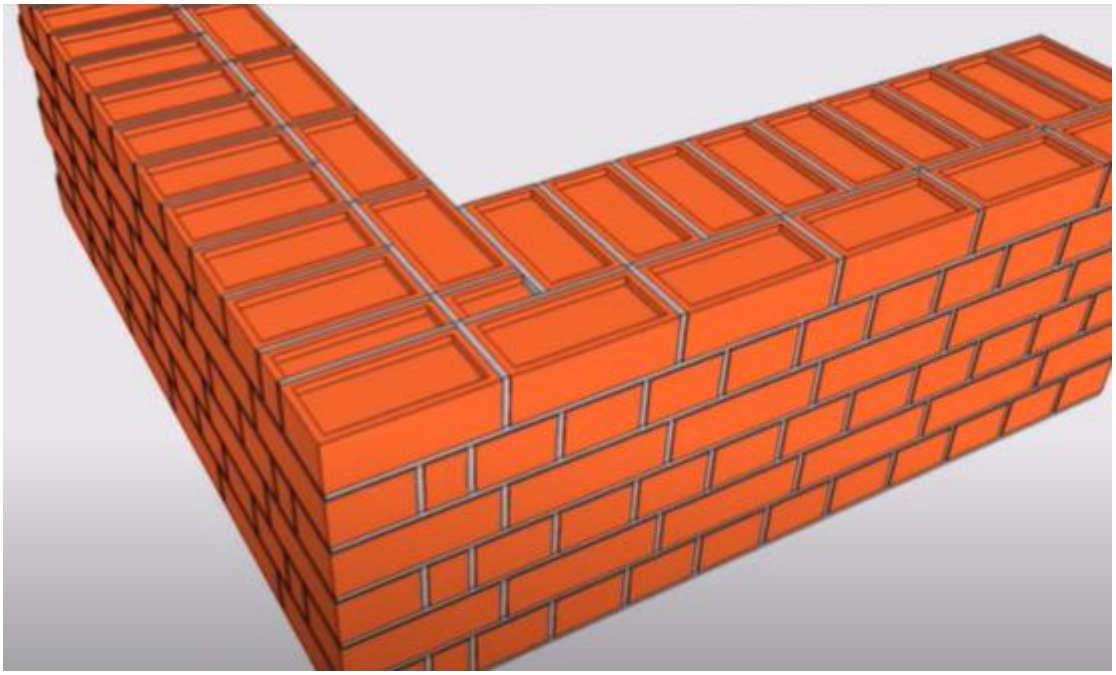
- Walls which have thickness equal to odd number of half brick like 1 ½ thick,2 ½ brick thick and so on, Let's start with course-1 of 1 ½ brick thick wall.
- In English bond arrangement in any thickness of walls the courses never started with a queen closer as it is liable to get displaced in this position.
- After every first header or stretcher in a course the queen closer is placed as we can see in the below figure. The side of the wall where headers placed outside, stretchers are placed inside and on the other side of wall where stretchers are placed outside and headers inside.



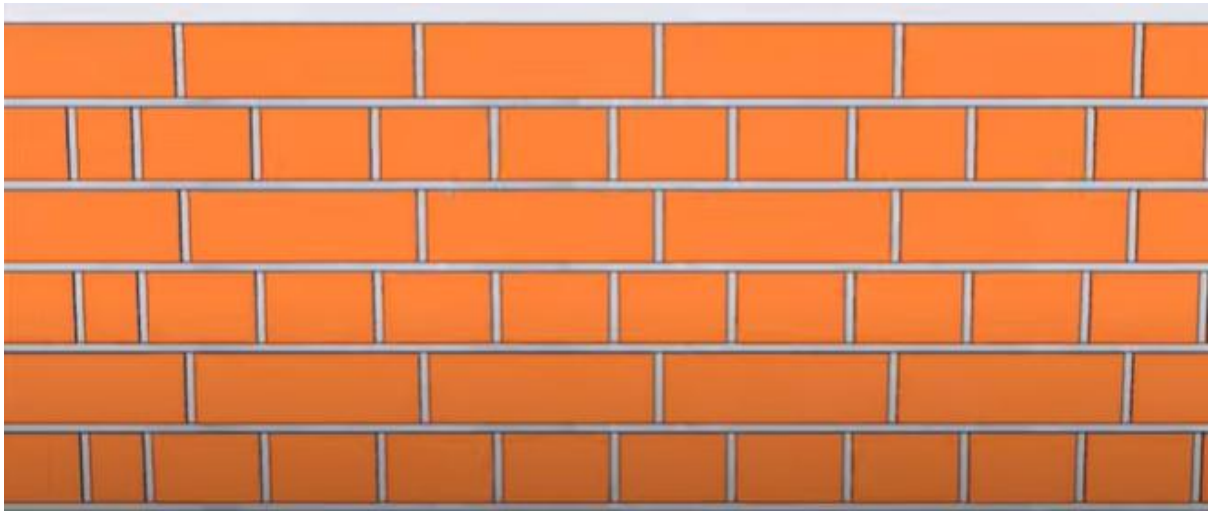
- When we start laying course-2, to avoid vertical joints between course-1 & 2 the headers are placed above the stretchers and the stretchers are placed above headers as shown in below figures. In this way the stretcher come outside and the header inside which is the mirror of course-1 of the same side of the wall.



- Similarly, all other courses are laid one by one. Every alternate course is the same.



- The below figure shows the elevation of 1 ½ thick brick wall.



CONCLUSION: -

From the above experiment we have learnt about construction of a 1 &1 ½ Brick thick walls in English Bond.

Experiment No-04

AIM OF THE EXPERIMENT: - To construct a 1 &1 ½ Brick thick pillar using mud mortar.

APPARATUS REQUIRED: -

1. Mason's square
2. Plumb bob.
3. Spirit level
4. Trowel string
5. Straight edge,etc.

MATERIALS REQUIRED: -

1. Brick
2. Cement
3. Sand
4. Water

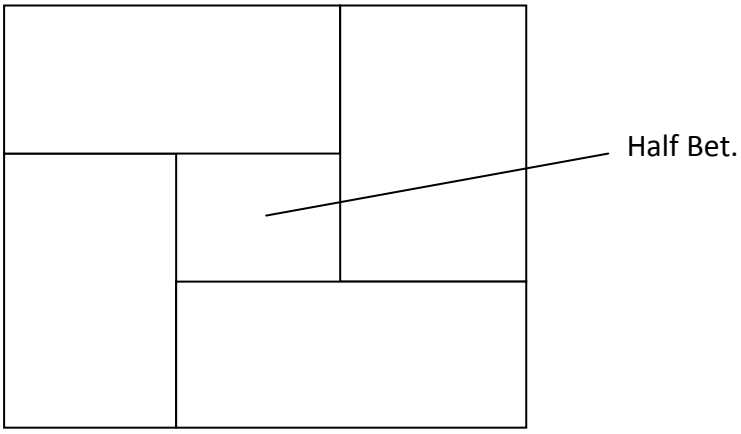
Principle: -

- In Flemish bond the headers and stretchers are placed alternately in each course.
- A pattern figure is adopted to avoid continuous vertical joints.

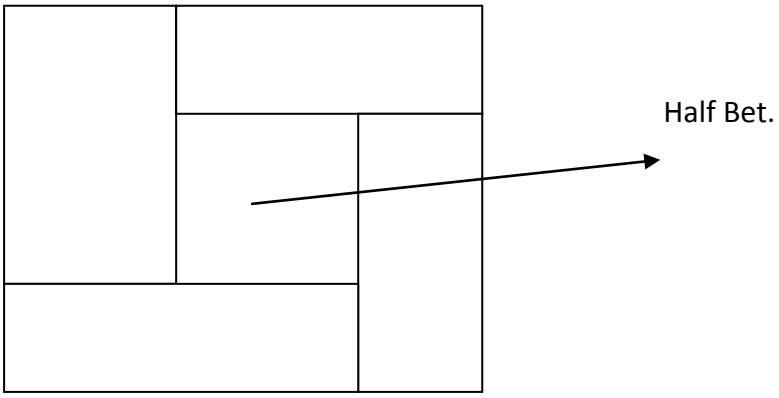
PROCEDURE: -

- Layout or demarcation of the pillar is made on the ground where it is to be constructed.
- Excavation of earth is made for the foundation in the ground at the marked layout.
- Lay the mud mortar in the foundation.
- Brick work in foundation is done with the first class bricks and mud mortar to transfer the load of super structure to the ground. The brick work in foundation is done into various steps of brick works in foundation below plinth level and these all steps should be accommodate in to the ground.
- ½ bet is also used in between the layers.
- Lay the horizontal dam-proof course on the pillar.
- Care should be taken that brick work should be done in plumb and line according to specification.
    - Proper curing for at least 10 days should be done.

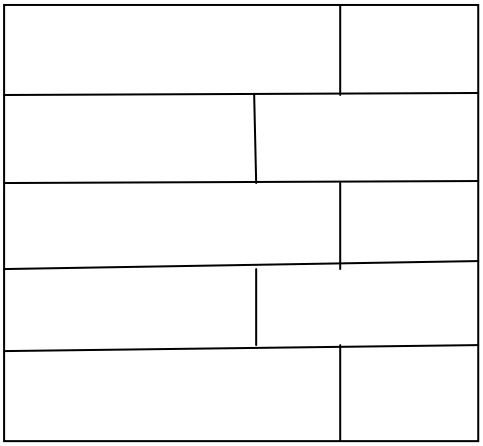
- After completion of work painting should be done.



< Even Course>



< ODD Course>



ELEVATION

CONCLUSION: -

From the above experiment we have learnt about construction of a 1 &1 ½ Brick thick pillar.

Experiment No-05

AIM OF THE EXPERIMENT: - Bar bending and fabrication of reinforcements for a beam

APPARATUS REQUIRED: -

1. Bar bending bench
2. Bar bending machine

MATERIALS REQUIRED: -

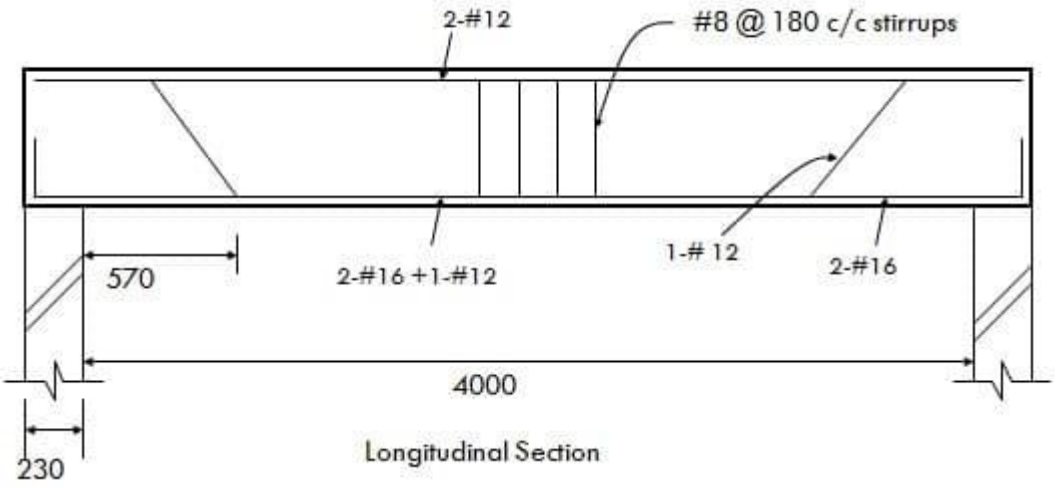
1. Mild/Tor steel
2. Binding Wires

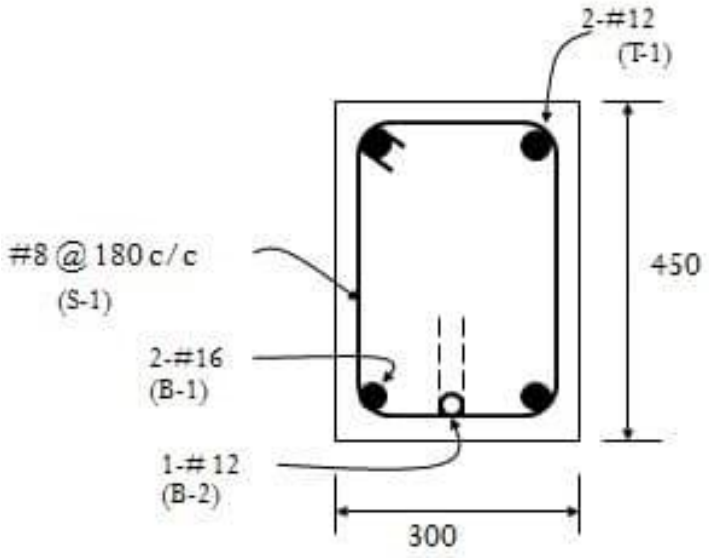
THEORY: -

- Bar Bending Schedule is the process of cutting & bending of Reinforcement bars into required shape, which gives the complete information about reinforcement steel bars like Location and marking of bars, types of bars, size of bar, cutting length of bar, bending details of bar, number of bars, Shapes of Bars and total quantity of steel.
- As we know that all the site workers are non-technical and they have lack of knowledge about steel. So, it is the responsibility of a site supervisor to give them details of cutting, bending of steel. So, A bar bending schedule is the data which help the supervisor for this process.

PROCEDURE: -

- Consider a beam of clear length of 4m, 300mm wide by 450mm depth.
- It consists of 2-12 mm diameter bars at top, and 2-16 mm diameter and 1 - 12 mm diameter bars at the bottom.
- Diameter of stirrup is 8mm spaced at 180mm centre to centre. Clear cover to reinforcement provided is 40mm



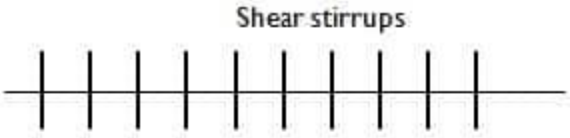


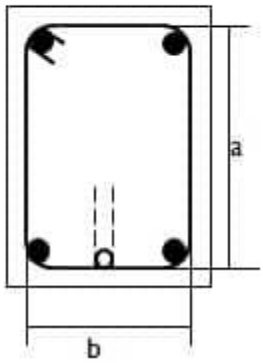
C/S of beam

- Now we will calculate the length of reinforcement for reinforced concrete beam in above example.
- We will start with bottom reinforcement B1 & B2. Bar shape of B1 is as shown below:

- **Length of B1** = clear distance between walls + 2 x width of walls - 2 x bar cover + 2 x bend length
- **Bend Length**= 6 x 16 = 96 ≅ 100mm
  (Bend length is calculated as 6 x diameter of bar for reinforcement conforming to IS: 1786-1961)
- **Length of B1** = 4000 + 2 x 230 - 2 x 40 + 2 x100 = 4580 mm
- **Length of bar B2** is calculated based on shape of this bar. This bar bends up near the support as shown below

- **Length of bar B2** = A + B + C
  = 4000 + 2 x 230 - 2 x 40 + (1.414xH - H)
  ∴ H = 450 - 2 x 40 - 2 x 12 - 2 x 12/2 = 334mm
- **Length of bar B2** = 4000 + 2 x 230 - 2 x 40 + (1.414x334 - 334)
  = 4518.3 = 4520 mm
- Now we will calculate top reinforcement T1**.**
- **Length of Bar T1** = 4000 + 2 x 230 -2 x 40 = 4380 mm
- **Length of Stirrups S1:**



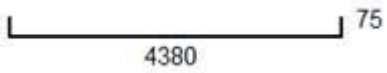
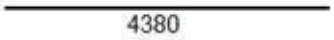
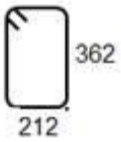


- Stirrups are spaced at 180mm centre to centre.
- Stirrups are provided between walls or support for a beam.
- No. of stirrups required for given beam = $\frac{4000}{180}+1=24$

- Length a = 450 - 2 x40 - 8 = 362mm
- Length b = 300 - 2 x 40 - 8 = 212mm
- Therefore, **length of 1 stirrup S1** = 2 x (212 + 362 + 90) = 1328 mm Where 90mm is the minimum hook length as per IS 2502 - Table - II.

TABULATION: -

BAR BENDING SCHEDULE OF THE BEAM

Sl No.	Bar Mark	Bar dia (mm)	No. of bars	Length (mm)	Bar Shape
1	B1	16	2	4580	
2	B2	12	1	4520	
3	T1	12	2	4380	
4	S1	8	24	1328	

CONCLUSION: -

From the above experiment we have done bar bending of reinforcement for beam.

Experiment No-06

AIM OF THE EXPERIMENT: -Bar bending and fabrication of reinforcements for a slab.

APPARATUS REQUIRED: -

1. Bar bending bench
2. Bar bending machine

MATERIALS REQUIRED: -

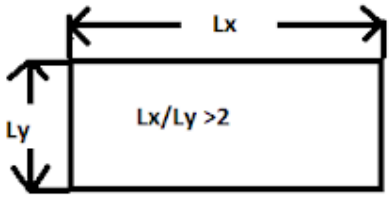
1. Mild/Tor steel
2. Binding Wires

THEORY: -

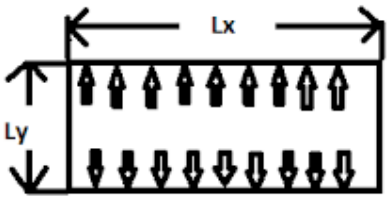
1) Bar Bending Schedule avoids wastage of steel reinforcement and thus save project cost.
2) It provides better estimation of reinforcement steel required for each and every structure member.
3) It enables easy or fast preparation of bill of construction work for clients and contractors.

SLAB: -

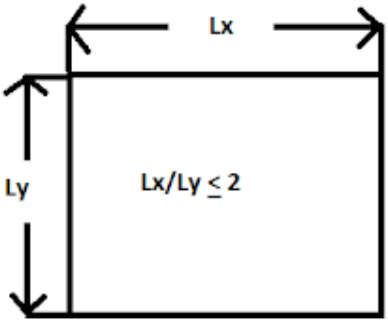
- A flat, monolithic piece of stone or concrete used for a floor or roof is known as slab.
- There are various forms of reinforced-concrete slabs
  - ✓ One-way slab -One way slab is a slab which is supported by beams on the two opposite sides to carry the load along **one direction**. The ratio of longer span (l) to shorter span (b) is equal or greater than 2, considered as **One way slab** because this **slab** will bend in **one direction** i.e in the **direction** along its shorter span.



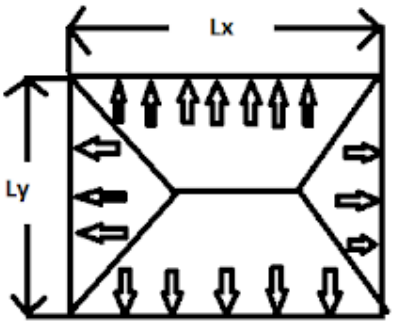
One-way Slab



Load Transfer - One-way Slab



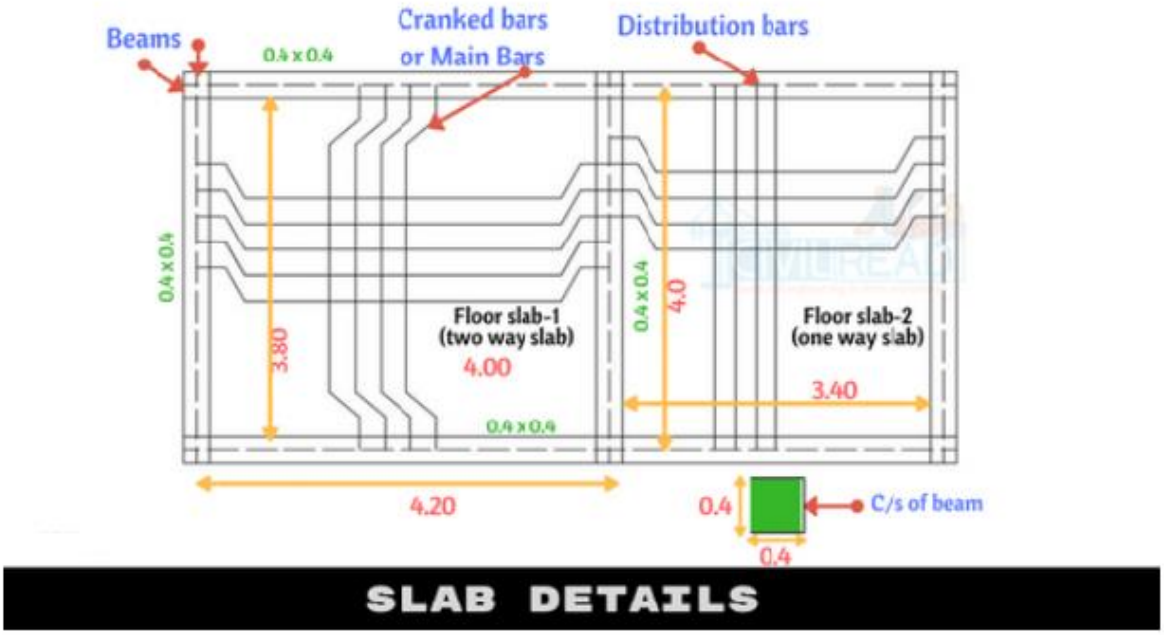
Two-way Slab

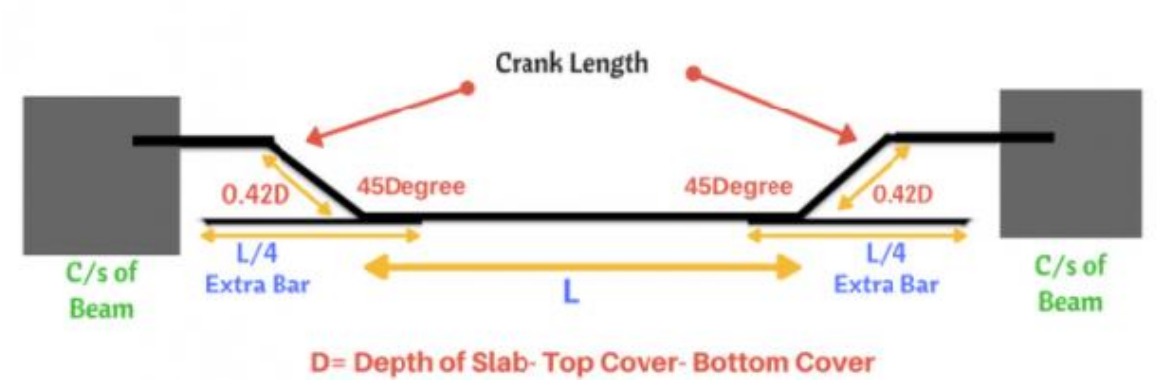


Load Transfer - Two-way Slab

- ✓ Two-way slab –The slab which is supported by beams on all the four sides and the loads are carried by the supports along with both directions, is known as two way slab. In two way slab, the ratio of longer span (l) to shorter span (b) smaller than 2, considered as two way slab because in two way slabs, the load will be carried in both the directions. So, the main reinforcement is provided in both directions for two way slabs.

PROCEDURE: -





Dia of bars = 10mm, Spacing between bars = 0.10m, Depth of Slab = 0.15m

Floor Slab-1 (Two-Way Slab)

<u>Bars along X Axis:</u>

1. Deduction of cover- For this divides the beam into two parts with axis line. From the Figure width and depth of beam is 0.4 x 0. 4

2. Length of Distribution bar

=Bar length C/C-Deduction of cover (both sides) +0.42 D x 2

=4.2-0.025-0.025+0.42D X 2

D = Depth of slab-Top Cover-Bottom cover

Depth of Slab= 0.15m

As per condition for 0.15m cover of 0.025m is provided from top and bottom

Therefore, D = 0.15-0.025-0.025
=0.1m

Length of distribution bar = 4.2-0.025-0.025+0.42x0.1x2
=4.234m

3. No. of Bars =Opp length/ Spacing +1
=3.8/ 0.1 + 1 = 39 bars

4. Extra Bar length = L/4 = 4.15/4
= 1.0375m

5. For Each bar 2 extra bars are provided
Therefore, length of extra bar for 1 bar = 1.0375 x 2 =2.075

6. Total Length of Distribution Bars = 39 x 4.234+ Length of extra bar
= 165.126m + 39 bars x 2.075
= 246.051

Bars along Y Axis:

1. Deduction of cover-For this divides the beam into two parts with axis line. From the Figure width and depth of beam is 0.4x0.4.

2. Length of Distribution bar=Bar length C/C-Deduction of cover (both sides)+0.42D x 2
=4.2-0.025 -0.025+ 0.42D X 2

D=Depth of slab-Top cover-Bottom cover
Depth of Slab = 0.15m

As per condition for 0.15m cover of 0.025m is provided from top and bottom
Therefore, D = 0.15-0.025-0.025
=0. 1m
Length of distribution bar =4.0-0.025-0.025+0.42x0.1x2
= 4.034m

3. No. of Bars =Opposite length/ Spacing +1
=4.0/0.1 +1=41 bars

4. Extra Bar length= L/4=3.95/4=0.9875m

5. For Each bar 2 extra bars are provided
Therefore length of extra bar for 1 bar = 0.9875x 2 =1.975m

6. Total Length of Distribution Bars = 41 x 4.034+ Length of extra bar
=165.394m +41 bars x 1.975m
= 246.369

CONCLUSION: -

From the above experiment we have done bar bending of reinforcement for slab.

Experiment No-07

AIM OF THE EXPERIMENT: - To prepare Bar bending and fabrication of reinforcements for a lintel with chajja.

APPARATUS REQUIRED: -

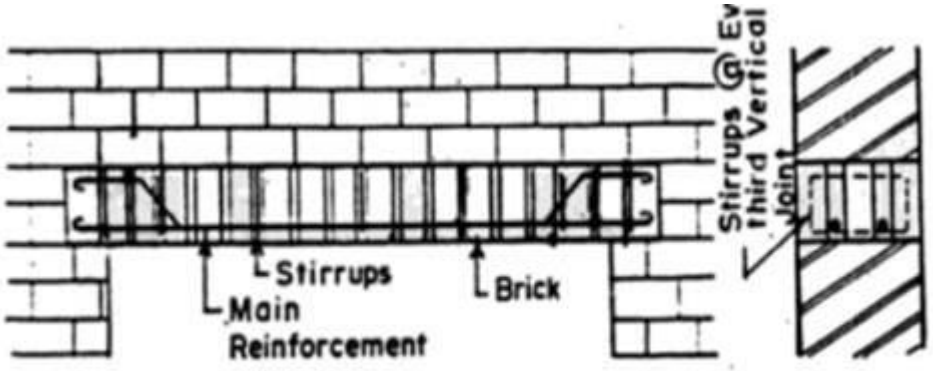
1. Hammer
2. Chisel or power cutting tools.
3. Binding hook
4. Bar bending level
5. Measuring tape-3 mtr.
6. Three pin plate, chalk box.

MATERIALS REQUIRED: -

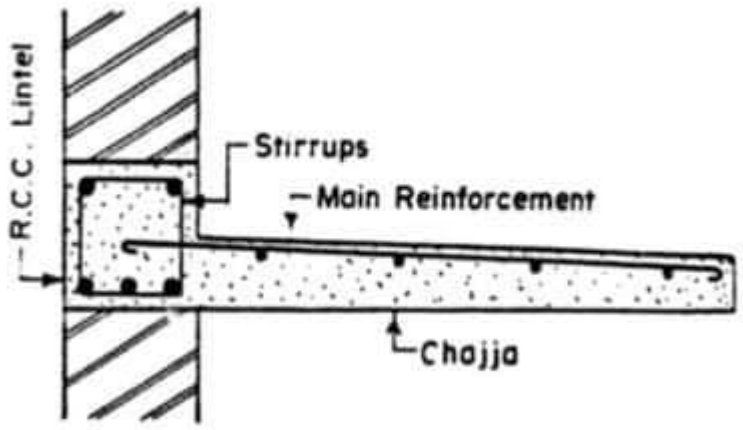
1. Binding wire (18 gauge)
2. Steel rods.
3. Safety helmets.
4. Safety shoes and goggles.

THEORY: -

Lintel is defined as horizontal structural member which is placed across the opening.
The lintel is designed as beam to take load coming on it.
Chajja or sunshade is projecting from lintel and it is designed as cantilever slab.



(a) LONGITUDINAL SECTION (b) CROSS SECTION



Exercise: -

Prepare bar bending schedule of a lintel with chajja from the given details.

- Size of opening 1 mtr.
- Bearing on either side is 150 mm.
- Cross section of the lintel is 230 * 150 mm
- Projection of chajja from the wall is 450 mm
- Thickness varies from 75 mm to 100 mm.
- Lintel reinforcement consist of 4 bar of 10 mm ø i.e. 2 bars at top and 2 bars at bottom. 2l stirrups 6 mm @ 150mm c/c.
- Chajja main reinforcement consist of 8 mm ø @ 150 mm c/c and distribution steel consist of 6 mm ø @ 100 mm c/c . Clear cover to reinforcement provided is 25 mm for lintel and 15 mm for chajja.

PROCEDURE: -

- Prepare the structural drawing with all reinforcement detail.
- Read the drawing, identify the type of bar, grade of reinforce to be used.
- Calculate the cutting length of the bar from the structural drawing.
- Prepare the bar bending schedule and calculate the total of steel required as given in table.
- Mark the appropriate cutting length on the straighten bars.
- Cut and bend the bar to the required length as per shape in schedule.
- Place the cover blocks at the bottom for ensuring clear cover and check the position of the main reinforcement and stirrups and rectify the defects if arises.

CALCULATIONS: -

1. Hanger bar straight Top 10 mm – 2 bars

Length of One bar = Clear span + 2(bearing)-2 (cover) +2 (Hooks:10 ø)
= 1000+2*150-(2*25)+(2*10*10)
= 1.45 mtr.

2. Tension bar straight bottom 10 mm-2 bars

Length of One bar = Clear span + 2(bearing)-2 (cover) +2 (Hooks:10 ø)
= 1000+2*150-(2*25)+(2*10*10)
= 1.45 mtr.

3. Vertical Stirrups: 2 l-6 mm diameter at 150 mm c/c

Length of bar = 2(A+E) +24 ø
A= 150-2(25) = 100 mm
E = 230-2(25) = 180mm

Length of one stirrups= 2A+2E+24 ø
= 2(100)+2(180)+24(6)
= 0.704 mtr.

Number of Strriups ={(Clear span + 2(bearing)-2 (cover))÷spacing} +1
= {(1000+2*150-2*25)/150}+1
= 9 nos.

4. Chajja Reinforcement:-

Length of each bar = Chajja projection length + wall thickness - 2 (cover) +Ld (16 ø) 2+ 1Hook (10ø)
= 450+230-(2*25)+(16*8)+(10*8)
= 838 mm.= 0.838 mtr.

Number of chajja bars={(Clear span + 2(bearing)-2 (cover))÷spacing} +1
= {(1000+2*150-2*25)/150}+1
= 9 nos.

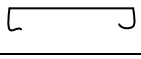
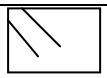
5. Distribution bar :6 mm diameter @ 100 mm c/c:-

Length of One bar = Clear span + 2(bearing)-2 (cover)
= 1000 +2*150-2*25
= 1.25 mtr.

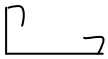
No of stirrups= (chajja projection / spacing) +1
= (450/100)+1
= 6 nos.

Bar Bending Schedule: -

For Lintel

Mark	Bar design	No of bar	Dia of bar	Length per piece.	6 mm	8 mm	10mm	Remarks
Top straight		2	10 mm	1.45 mtr.			2.90	
Bottom Straight		2	10 mm	1.45 mtr.			2.90	
Ring		9	6 mm	0.704 mtr.	6.336			

For Chajja

Mark	Bar design	No of bar	Dia of bar	Length per piece.	6 mm	8 mm	10mm	Remarks
Main bar		1	8 mm	0.838 mtr.		7.542		
Distribution bar		6	6 mm	1.25 mtr.	7.500			

Total length in meter =	13.836	7.542	5.80
Weight per meter length =	0.22	0.39	0.62
Total weight in kg =	3.043	2.941	3.596

CONCLUSION: -

From the above experiment we have done bar bending of reinforcement for lintel with chajja.

Experiment No-08

AIM OF THE EXPERIMENT: - Bar bending and fabrication of reinforcements for a Column.

APPARATUS REQUIRED: -

1. Bar bending bench
2. Bar bending machine

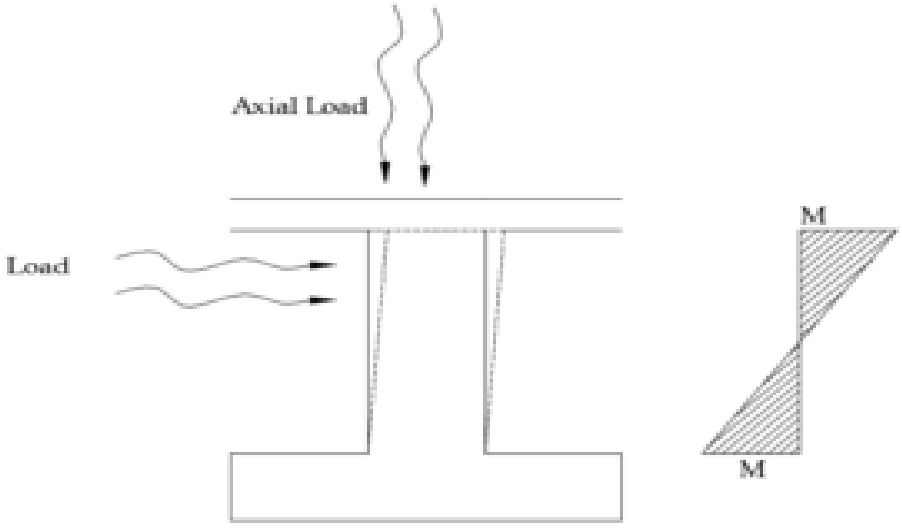
MATERIALS REQUIRED: -

1. Mild/Tor steel
2. Binding Wires

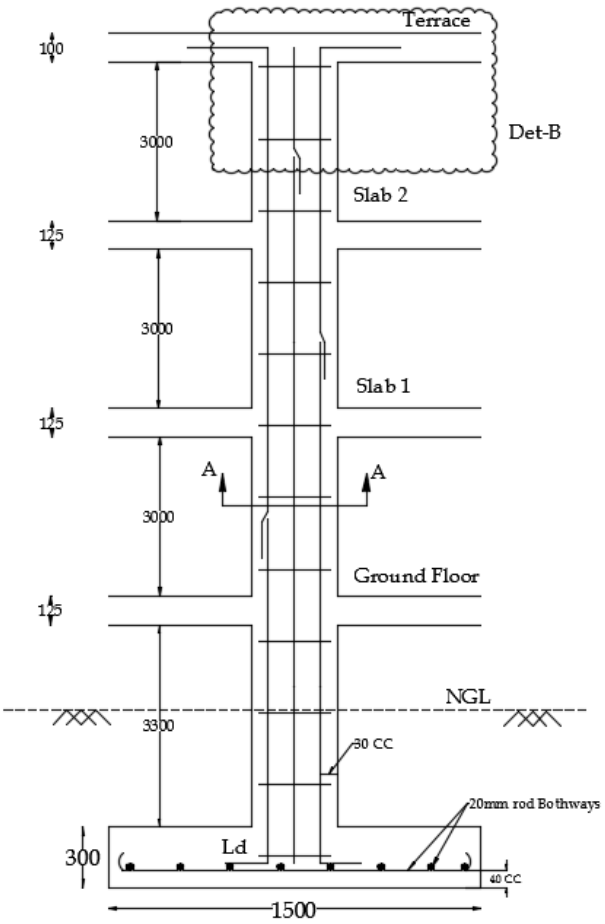
THEORY: -

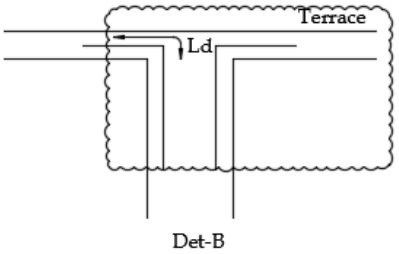
We hope that you know the typical load action on a column if you see the internal forces and moment diagram, the column has maximum moments at top and bottom and less at centre.
Never tie a column at top and bottom where the critical moments is high, always tie the column at centre.

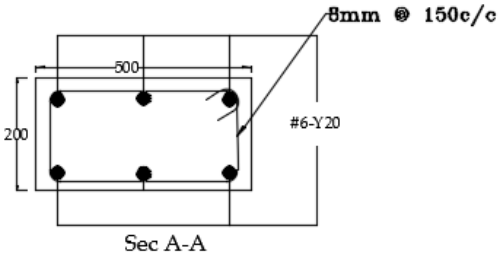
PROCEDURE: -



Column Internal Force & Moment Diagram







From the diagram,

- Slab Thickness – 125 mm & 100 mm
- Floor height – 3000 mm or 3 m
- Ground Floor Level – 3300 mm
- Footing Height – 300 mm
- Development Length – 50d
- Column has 6 numbers of 20 mm dia bars
- 8mm stirrups @ 150 mm C/C
- Footing Clear Cover – 40 mm
- Slab Clear Cover – 25 mm

Step 1 – Find the length of Vertical Bar

Length of Vertical bar = Development length (Ld) + Height of Ground Level + Floor Heights (1,2,3)+ Slab Thicknesses + Overlap Length (Det.B)

= (50×20)+3300+ (3×3000)+(3×125)+100 +(50×20)

= 14775 mm or 14.78 m

Now we know the length of one vertical bar. Normally column reinforcement drawings won't come with lapping details.

Step 2 – Find out lapping

As we know that lapping length required is 50d = 50 * Diameter of the bar = 50×20 = 1000 mm.
We know that each bar is 12.25 m or 40 feet length (approx).

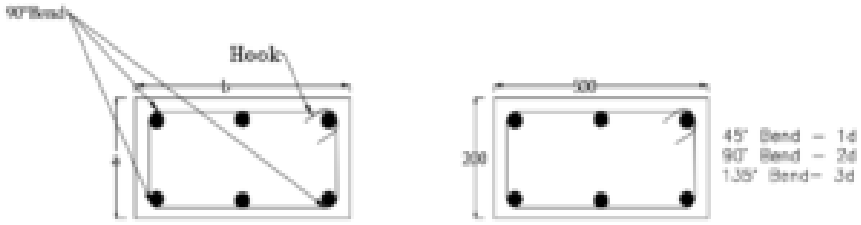
Total Length of Vertical Bar = 14.2 m which is more than 12.25 m so each rod will be lapped at least once to attain the required length.

So we have added the lapping length with the total length = 14775+1000 = 15775 mm or 15.78m

As we mentioned earlier in this post, consider the points while lapping the bar. There is no one correct method we can use. Just remember the lines.

- Never tie a column at top & bottom
- Always lap at alternate bars
- Always overlap top bars with bottom bars

Step 3 – Cutting Length of Stirrups



Length of One Hook = 9d
Cutting length of Stirrup = Perimeter of stirrup + Number of Bends + Number of Hooks
= 2(a+b) + 3 numbers of 90 degree bends + 2 numbers of hooks
= 2(500+200)+(3 x2d)+(2x9d)= 2×700+3x2x20+2x9x20

Cutting length of Stirrup = 1880 mm

Step 4 – Number of Stirrups

Number of stirrups required = (Total length of Column/spacing of stirrups)+1
= (3300+125+3000+125+3000+125+3000+100)/150 + 1

Number of stirrups = 85 no.s

Step 5 – Bar Bending Schedule

	Diameter of Bar	Numbers	Cutting Length	Total Length

Vertical bar	20 mm	6	14.2 m	85.2 m
Stirrups Bar	8 mm	85	1.88 m	159.8 m

CONCLUSION: -

From the above experiment we have done bar bending of reinforcement for column.

Experiment No-09

AIM OF THE EXPERIMENT: - To conduct a Non destructive compressive strength test on concrete beam using rebound Hammer.

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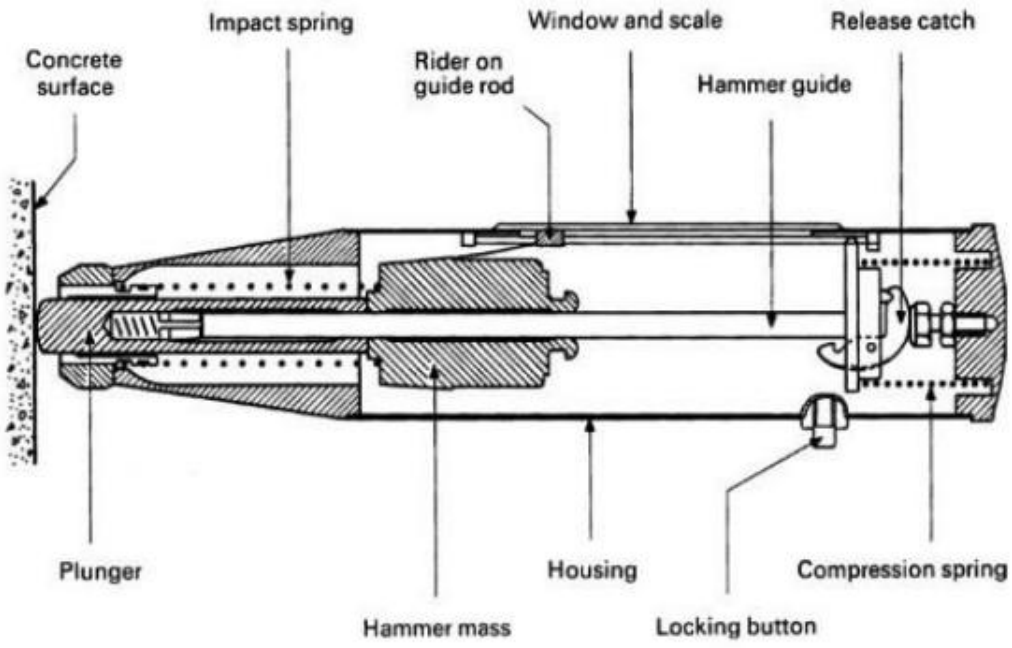
APPARATUS REQUIRED: -

Rebound Schmidt Hammer (Manual)

THEORY: -

1) The rebound hammer test is the most popular method to measure the surface hardness of a concrete mass. The Swiss engineer Ernst Schmidt first developed a practicable rebound test hammer.

   The basic features of this equipment are shown in Figure – 1 below.



The hammer is very simple, not heavy (about 2 Kg), and has an impact energy of about 2.2 Nm. It can be operated on vertical, horizontal and inclined surfaces, upwards and downwards, but it has to be at right angles to the measured surface as indicated in the Figure – 2 below.

Figure – 2: Rebound hammer in use

Procedure: -

The reading is very sensitive due to local variation in the concrete, especially to aggregate particles near to the surface. It is better to take numerous readings at each test location, and then find their mean. Standards vary in their precise requirements, according to ASTM C805 ten reading should be taken. To take reading the following step should be considered.

Step 1: Make sure the hammer is calibrated.

Step 2: The surface must be smooth, clean and dry, and should be preferably formed, but if trowelled surfaces are unavoidable, use a grinding stone to smoothen the test surface.

Step 3: The plunger is released before use; then it should be pressed strongly and vertically to the concrete surface and locked in its position.

Step 4: Take the scale reading on the side window of the hammer, this reading is known as the rebound number.

Step 5: Repeat the test at all points and record the rebound numbers, find the mean and check that each reading didn't exceed 6 units difference from the mean reading.

Step 6: Each rebound number will produce a compressive strength from the relationship between the rebound number and compressive strength on the side of the hammer.

Step 7: Compressive strength can then be found using a calibration graph of Compressive strength v/s Rebound (Rebound Hammer conversion chart)

Step 8: Calculate Mean, standard deviation and coefficient of variation.

Observation :-

SL No.	Rebound No.	Compressive strength (N/mm2)	Mean	Stad. Deviation	Coefficient of variance.
1	205	32	33	2.449	0.0742
2	152	33			
3	140	35			
4	130	29			
5	174	36			

CONCLUSION: -

From the above experiment we have done bar bending of reinforcement for slab.

Experiment No-10

AIM OF THE EXPERIMENT: - To study pipe joints and plumbing fixture.

THEORY: -

Pipe fittings are an important component of the plumbing system. In plumbing, many types of fixtures are joined with the help of various types of material as per the requirement. Fittings are fixed in the plumbing system to join straight pipes or any section of tubes. We can say that the water-supply fittings like elbow, tee, socket, reducer, etc., are fitted to change the direction of flow, distribute the water supply from the main pipe to other pipes of equal size or lower size, etc.

Types of Fitting:-

1. Collar
2. Elbow
3. Gasket
4. Union
5. Reducer
6. Tee
7. Nipple
8. Trap.

Collar

While joining two pipes in the same length, collar is used . Collar is fitted in the end of pipe.

Elbow

It is installed at the time of joining two pipes. With the help of an elbow, the direction of liquid is changed. Normally a 45° or 90° elbow is used. When the two sides of pipes differ in size, an elbow of reducing size is used. This is called reducing type elbow or reducer type elbow.

Long Radius (LR) Elbows

Here, the radius is 1.5 times the diameter of pipe.

Short Radius (LR) Elbows

In this, the radius is 1.0 times the diameter of pipe.

90° Elbow

This is used when the change in direction required is 90°

45° Elbow

This is used when the change in direction required is 45°

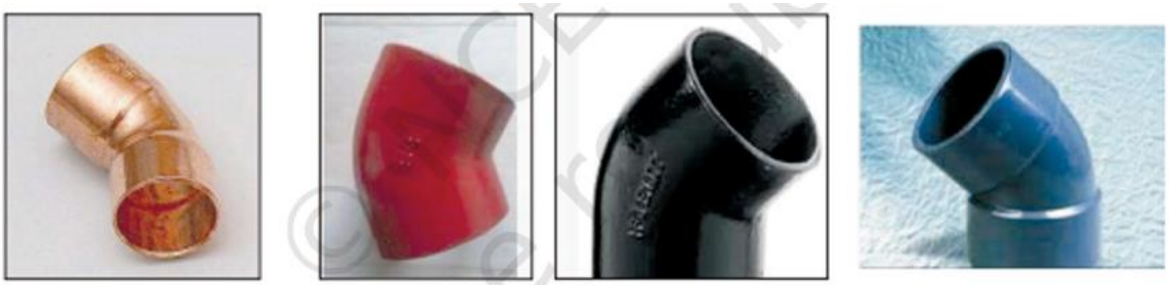
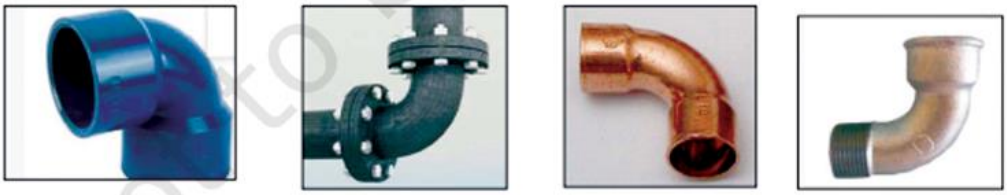


Fig. 5.4: Bend 45°



Gasket

They are mechanical seals, generally ring-shaped type and fitted for sealing flange joints. A flange joint is a plate or ring to form a rim at the end of a pipe when fastened to the pipe. Gaskets are made as per by construction, materials and features.

Union

When two ends of pipes are joined, the pipe fitting used is called union. A union is made of three parts namely a nut, a male end and a female end. The male and female ends are assembled with the support of the nuts, and necessary pressure is made to connect the joint.

Reducer

It is used to connect pipes of different diameters. A reducer may be of various types like reducer tee, reducer elbow and reducer socket.

Tee

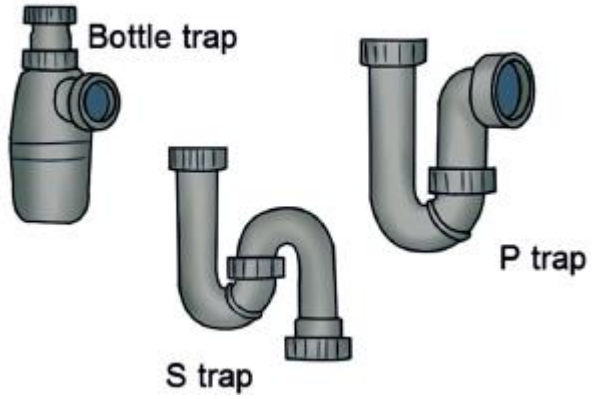
It is an important fitting with a side outlet at 90_0 to the run of the pipe. Tees connect pipes of various diameters and help in changing the direction of water or material in a pipe.
Tees are made in various sizes like equal or unequal.

Nipple

It is a piece of pipe having thread at both sides, and could be used for short extension of plumbing lines.

Trap

It is a fitting in a P, U, S or J-shaped type. Traps are fitted near a plumbing fixture. The trap bend is fitted to prevent sewer gases from entering the building. If the gases are inserted back into home, then it could lead to people inhaling foul smell.



Cross

When four pipes are joined,a cross is formed. It is also called a cross branch line or a four-way fitting. This fitting has three outlets and one inlet.

Offset

When an assembly of fittings on a pipeline makes one section of pipe out of line and parallel to a second section, then it is known as an offset.

Pipe Joints

Pipes are connected with the help of joints. A variety of joints are used in an assembly of pipes. Connecting two or more pipes together is called a fitting. Various types of joints could be used in a

pipe as per the requirement. Joints are also used for multiple pipe connections, and are an important component of the plumbing system.

Types of pipe joints

Various types of pipe joints are as follows.

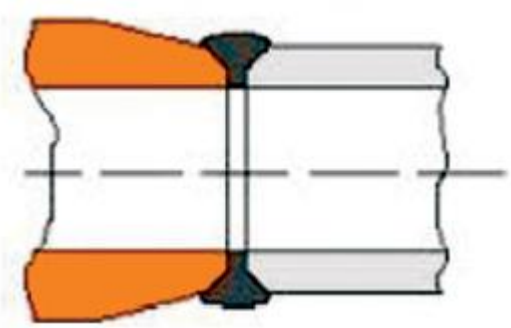
1. Threaded joint
2. Welded joint (butt welded, socket welded)
3. Brazed joint
4. Soldered joint
5. Grooved joint
6. Flanged joint
7. Compression joint

Threaded joint

When pipes are joined by screwing in threads which are provided in the pipe, it is called a threaded joint. In this joint, one of the pipes has internal threads whereas the other pipe has threads externally. The threads are also made in various pipes like PVC, CI pipes, copper pipes and GI pipes, etc.

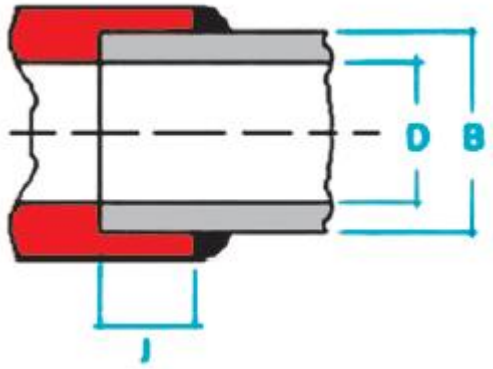
Welded joints (Butt-welded joints)

It is one of the most common methods of joining pipes used in large infrastructure like commercial, institutional and industrial systems. Cost of material are low, but the labour costs are more due to the non-availability of trained welders and fitters.



Socket-welded joints

These are used when there is a high chance of leakage in the joints. Pipes are joined as putting one into other and welded around the joint.



Brazed joints

When pipes are joined with the help of molten filler material at above 840°C, it is called brazing. Brazing is done for connecting copper pipes or copper alloy pipes. It is important to note that the melting point of the parent material (pipe material) should be higher than the filler material.

Soldered joints

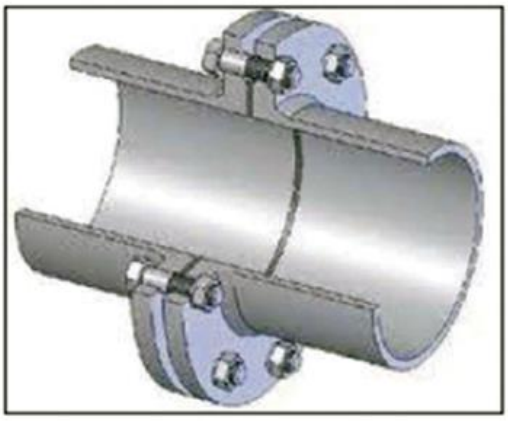
Soldering and brazing are similar activities. In soldering, the filler material melts below 840$_{o}$C. With the help of soldering, copper and copper alloy pipes are joined. During soldering, flux or metal joining material is used to prevent oxidation due to the flame.

Grooved joints

When two pipes are joined together by making grooves (narrow cuts or depression) at the end of pipes with the help of sockets or couplings, such joints are called grooved joints. Due to the ease of assembly of the grooved joints, the labour cost is less.

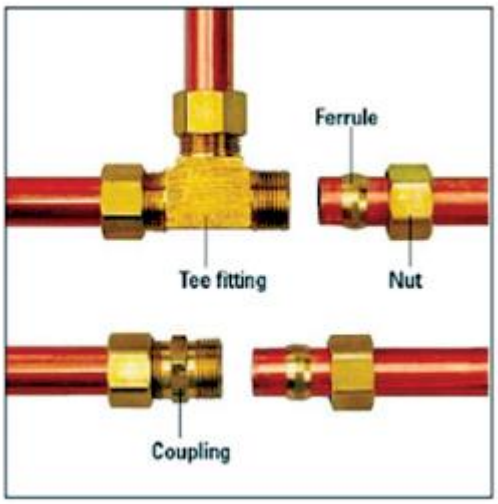
Flanged joints

This joint is commonly used for joining pipes in pumping stations, filter plants, hydraulic laboratories and boiler houses, etc. These joints are preferred due to easy process of assembly and disassembly, however these connections are costly. These joints can be disassembled and re-assembled when required.



Compression joints

These are applied to join the pipe without any preparations. The cost of installation of these joints is very economical. The pipes having plain ends are joined by fixing fittings at their ends, and such a joint is called a compression joint.



CONCLUSION: -

From the above experiment we have known various types of fitting and joints of pipes.