CONSTRUCTION WORKS PRACTICE & MS PROJECT LAB MANUAL

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CONTENT

EXPERIMENT-1

AIM OF THE EXPERIMENT

STUDY OF VARIOUS TOOLS REQUIRED FOR CONSTRUCTION OF MASONRY.

THEORY:

Masonry is the proper assemblage of masonry units bonded together with mortar. At the construction site numerous construction tools can be seen, each having specific purpose. We use various tools in the construction process to complete the particular work.

Masonry work requires tools for various purposes, i.e. for handling of mortar, for the dressing of stone, for cutting of bricks to get required shape etc. As it goes with traditions in existence since the days of the Ancient Indian and Egypt, masonry deals with some common elements as crushed stones from the earth and simple metal tools.

The tools are also known by their regional names depending upon local customs of the region for example, spades are known as “phavadas”, mortar pan is known as “ghamela” and so on.

APPARATUS REQUIRED:

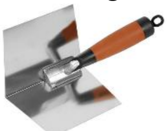
Common Masonry Tools used in Masonry Construction are as follows:

1. 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.

2. 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.

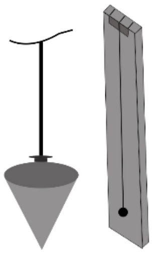
2A. Outside Corner Trowel: There are different designs of outside corner trowel but the one shown at left side with shorter flanges is the most common. These outside corner trowel can have a sharp 90-degree angle or a bull nose (rounded) edge.

2B. 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.



3. 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.

4. 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.

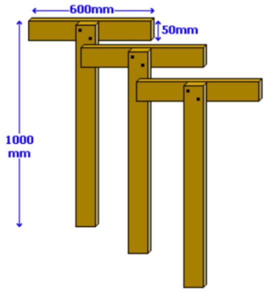


5. Spirit Level: It is used to check the horizontality and verticality of the surfaces. Spirit level is made of hard plastic or wood with bubble tube in the middle. The bubble tube is partially filled with alcohol in such a way that, an air bubble is formed in it. The spirit level is placed on surface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

6. 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.

7. 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 will be at the same level whether you're holding them together or spreading them a hundred feet apart.

8. 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.



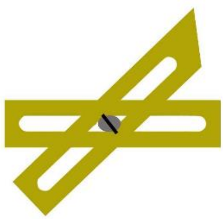
9. Spades (Phavadas): They are used to mix mortar and also used to place cement, mortar, concrete in head pan. Spade is also used to dig the soil for foundation trenches etc. It consists of metal plate at the end of long wooden handle.

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.

Masonry Tools for Stone Masonry

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.

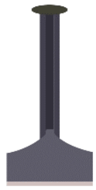
15A. Wood Handled Chisel: It is used to dress soft stones. A chisel is a tool with a characteristically shaped cutting edge of blade on its end, for carving or cutting stone by hand. Its handle is made from wood or plastic.

15B. 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.

15C. 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.

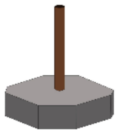
16. Boaster: It is also used to cut soft stones. It is a broad-faced or wide-edged masonry chisel. Boasted finish is done by boaster. This type of finish includes intermittent parallel

lines which are horizontal or vertical or inclined. Boaster has an edge of width about 60 mm.

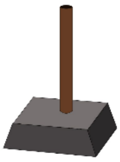


17. Hammer: Following are seven types of hammers that are specifically used for stone masonry.

17A. 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.

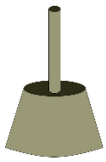


17B. Mash Hammer: A mash hammer is also known as a stone mason's hammer. It is used to hit and drive chisel for rough dressing of stone. It is double-sided with two striking faces, most often used in stone masonry work. It should only be used to strike stones, but can also be used for such tasks as chipping away mortar in stone masonry. This hammer consists of a wooden handle to which is attached a heavy head, usually made of metal.

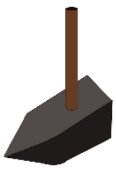


17C. Mallet (Wooden Hammer): It is a basic tool used for shaping of stone. It is a wooden hammer used for driving wooden headed chisels. It usually has a large head.

17D. 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.

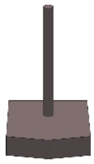


17E. Scabbling Hammer: Scabbling also called scappling is the process of reducing stone while dressing of stone. In scabbling dressing, only irregular angels are taken off with a scabbling hammer. Hence scabbling hammer is a tool used to break small projections of stones or removing irregular bushings from the face of stone. It has a large head made of iron and wooden handle.



17F. Waller's Hammer: It is used for removing spalls in stone masonry work. It also consists of iron head and wooden handle.

17G. 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.



18. 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.

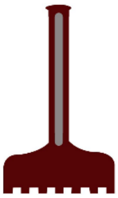
19. Gauge: It is employed to dress stones for spring, course, cornice, coping etc. It is made of metal.

20. 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.

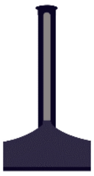
21. Point: It is employed for roughly dressing the hard and tough stones. Point is also used for roughing out areas and knocking off high spots in stones. Point tool is used after any initial work with the pitching tool. Both point and punch are used to rough-out the form but the latter tapers to a small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

22. 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

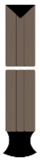
ensure all of the chisel's teeth are in contact with the stone, in order to prevent breakage.



23. 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.

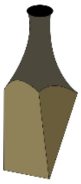


24. Jumper: It is a long drilling tool consisting of an iron bar with a chisel-edged steel tip at one or both ends, operated by striking it against the rock, turning it a little with each blow. They are used to bore holes for blasting purposes in a quarry by quarry workers and masons.

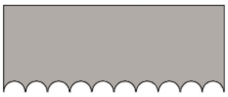


25. Wedge and Feathers: It is an oldest yet, one of the best tools to split the stone. It is a three-piece set tool. Each set of tool consists of a metal wedge (also called plug), and two shims (also called feathers). The feathers are tapered and curved at the top and wide at the bottom. When the two 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 jumper.

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

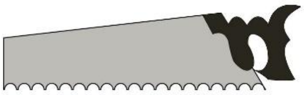


27. Drag: It is employed to level a stone surface. It consists of blades set at alternating angles, between 15 and 30 degrees, over the length of a block of wood. The blades are toothed to provide even removal of surface material. Some drags can be fitted with specially shaped blades to follow convex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



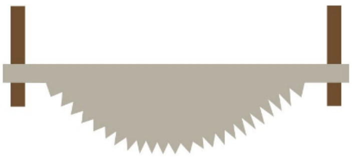
28. Saw: Following are four types of saw that are commonly used for stone masonry.

28A. 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. It is used by one hand.

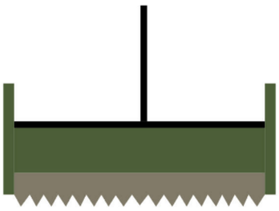


28B. Circular Saw: A circular saw is either hand held or affixed to a substrate. It runs on electricity and is provided with a toothed or abrasive blade/disc which has the ability to cut different materials including wood, stone, brick, metals, plastic by using a rotary motion that spins around an arbor.

28C. 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.



28D. 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.



Masonry Tools for Brick Masonry

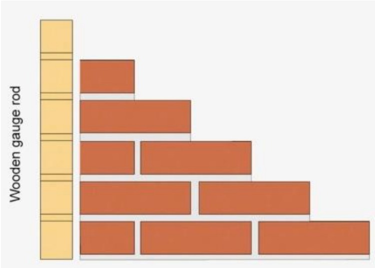
29. Brick Hammer: It is used for rough cutting of bricks in different shapes and sizes. One end of the hammer is square and another end is sharp-edged. It has one flat traditional face and a short or long chisel shaped blade. It is also used to push the bricks if they come out from the course line.

30. 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.

31. 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.

32. 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.

33. 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.



34. 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.

CONCLUSION:

From the above study we have learnt the above tools which are used in brick and stone masonry construction.

EXPERIMENT-2

AIM OF THE EXPERIMENT

Setting out of foundation plan of building

THEORY

Building Construction is a core subject in Civil Engineering, which deals with the construction processes of sub structure, super structure, building finishes and maintenance of buildings. A diploma civil engineer is required to have the competency of laying down the centre line and mark the foundation plan on the ground before the excavation of foundation trenches. It also requires to maintain the perpendicular at the corners particularly and to verify the same by measuring the diagonals from opposite corners using the Pythagoras principle (i.e.3, 4, 5 method). This practical will develop the aforesaid competency in the students.

APPARATUS REQUIRED

Sr. No.	Particulars	Specification	Quantity
1	Foundation plan	Drawn on A 4 size sheet with the scale 1: 50 .	1 No
2	Measuring Tape	30 meter Steel Tape	2 NO
3	Wooden pegs	25mm X 25 mm X 300 mm wooden peg with pointed at one end	10 No
4	Line dori(string)	White line dori	2 bundles
5	Hammer	Hammer of standard size	1 No
6	Lime powder		Approx. 5 kg

PROCEDURE

1 Prepare the foundation plan and section of wall for the given drawing of the building on the paper to the scale 1:50.
2 Mark the positions of the centre lines on foundation plan with reference to a point
3 Mark the centre line of the longest outer wall of the building on the ground by stretching a string between wooden pegs driven at its ends. This serves as the reference line for marking the centre line of all the walls of the building.
4 The center line of the wall which is perpendicular to this wall is marked by setting up right angle.
5 Right angle is set up by forming a triangle with sides 3,4 and 5, units long
6 Mark the center line dimension of perpendicular wall on this line.
7 Similarly mark the dimensions of all other walls.
8 Check the diagonals of all rooms.
9 Mark half width of the foundation on both sides of the center line for each wall as per the drawing using lime powder.
10 Center lines are then permanently marked by driving the pegs at a distance of at least one meter from external face of excavation.
11 After marking the complete layout the position of all the foundation trenches is verified and permission is granted for excavation.
12 Thedolite /Total station can be used to verify the layout marked.

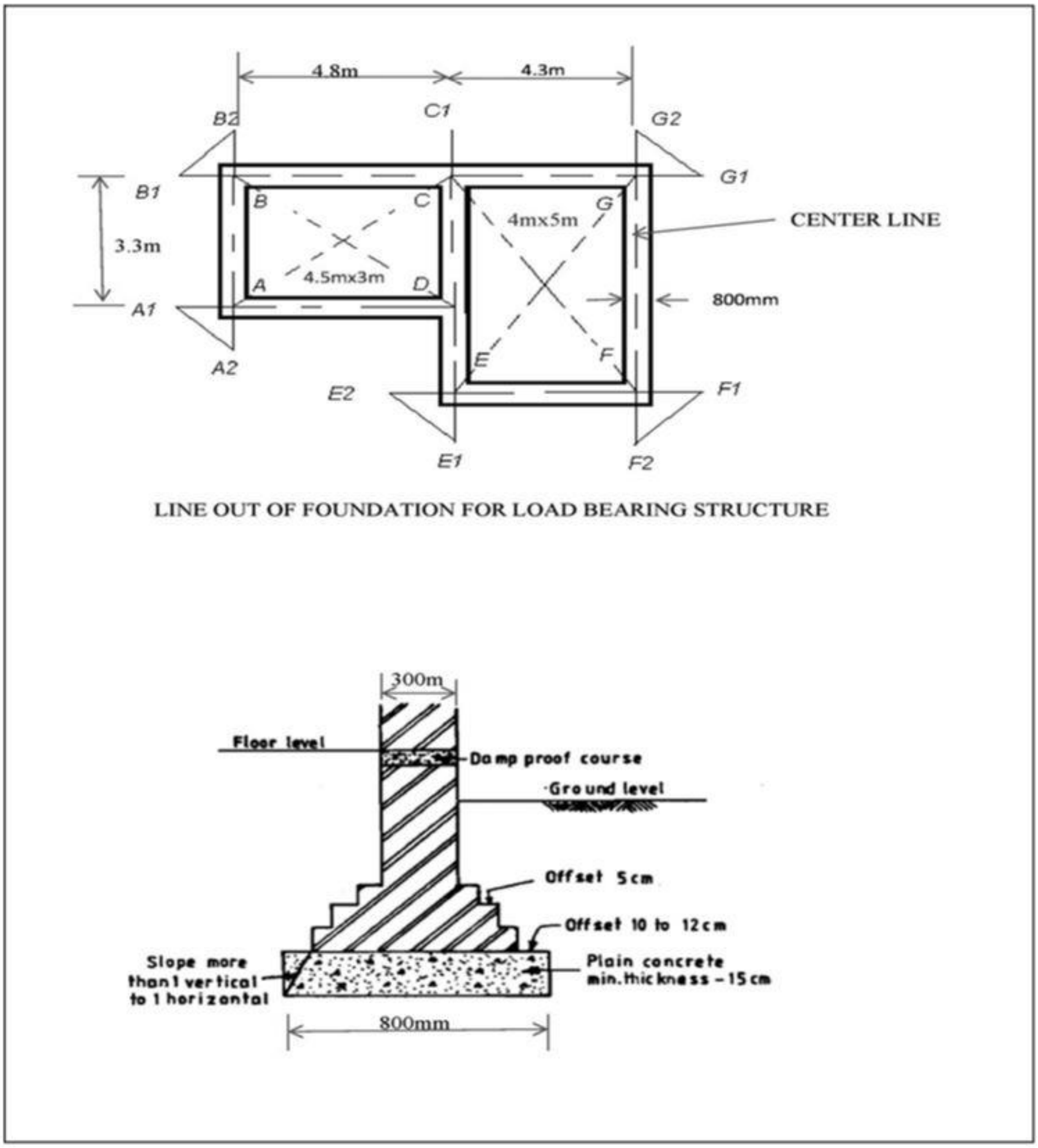


Figure 2: Foundation plan and section

CONCLUSION

From the above experiment we have learnt to determine the layout plan of a two room building.

Precautions to be followed

1. Correct transformation of the distances on ground from plan.
2. Perpendicular should be carefully ensured at corners in particular.

EXPERIMENT-3

AIM OF THE EXPERIMENT

Construction of one & one half brick thick walls in English bond in mud mortar including a corner.

THEORY

Brick masonry is a process of arranging bricks in courses in order to develop longitudinal and transverse interlocking for individual bricks. The purpose of bonding is to achieve united mass as strong as practicable to suit the length height and thickness of brickwork. The bonds ensure that the vertical joints do not come one over the other. The brick wall having continuous vertical joint will not act as complete unit but will consists of small portion which act as a column. However if a wall is built so that there are no continuous vertical joints the load will get distributed. The various types of bonds generally used in brickwork are header, stretcher, English and Flemish bond.

It is required to know importance of selection and soaking of bricks. It is required to make use of line string, plumb-bob and spirit level to maintain verticality and horizontality in the construction of brick wall in English bond.

English bond is produced by laying alternate courses of headers and stretchers. For breaking joints vertically it is essential to place queen closer after the header quoin in the heading course.

APPARATUS REQUIRED

Sr. No.	Particulars	Specification	Quantity	Remark
1	Trowel (Thapi)	Medium type 15 cm long	10	
2	Line string/dori	1 to 2 mm diameter	50m	
3	Plumb-bob	Mild steel	2 no.	
4	Water tube level	5mm diameter plastic tube	10m	
5	Mason spirit level	30 cm long with vertical and horizontal bubble	5 no.	
6	Mason square	60cm long leg &20cm short leg	5 no.	
7	Measuring tape	Metallic tape 30m &steel tape 30m	5no.	
8	Spade	20 cm wide MS blade	5 no.	
9	Mortar pan	Plastic or iron	10 no.	
10	Bricks	IS or local bricks of size 19x9x9cm	1000 no	

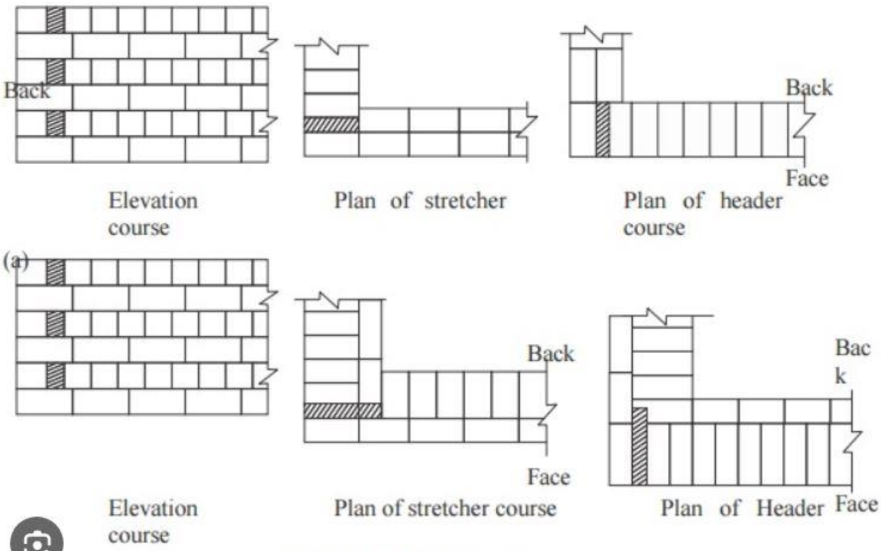


Fig. 2.6.3 English bond

PROCEDURE

1. All the bricks to be used are thoroughly soaked in water so that they do not absorb water from mortar
2. Prepare mud mortar mixing water with soil.
3. Spread the mortar over the area to be covered with the thickness of 15mm.
4. First construct the corner of the wall. Lay one brick at the corner and press it with hands so that the thickness of the bed joint remains only about 10mm.
5. The first queen closure is also fixed as corner brick. Check the level and alignment. Lay other bricks to form thickness of one and half brick thick wall .
6. After laying first course spread the mortar over entire course and arrange the bricks to get bond.
7. Similarly lay down the corner at another end of wall .The corner construction will guide for filling between bricks of various courses
8. Stretch the line string along top of the first course laid at each corner of wall .The course is then raised. The line string is then shifted up and second course is constructed .This process is repeated for consecutive courses
9. The verticality and horizontality is checked by plumb bob and spirit level for every course.
10. The joints should be cleaned after everyday's work.

CONCLUSION

From the above procedure we have learnt and constructed one & one half brick thick walls in English bond in mud mortar including a corner

PRECAUTIONS TO BE FOLLOWED

1. Never start header course with queen closer.
2. Every alternate header comes centrally over the joint between the two stretcher in the course below giving a lap of one-fourth brick .
3. Check the verticality of a wall with plumb bob after every course.

EXPERIMENT-4

AIM OF THE EXPERIMENT

To construct a one & one half brick thick pillar by using mud mortar.

APPARATUS REQUIRED

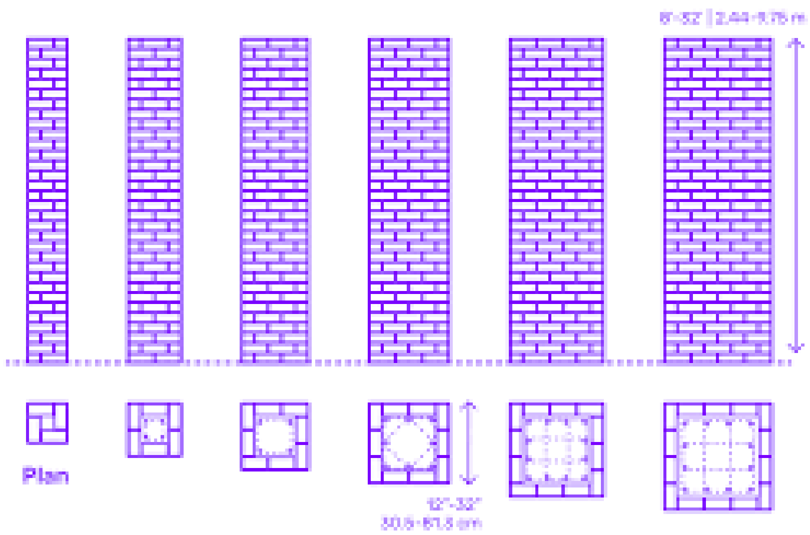
1. Plumb bob
2. Tray, trowel, bucket

MATERIAL REQUIRED

1. No. of bricks
2. Mud
3. Sand
4. Water

PROCEDURE

1. At first mud mortar is prepared by mixing mud, sand and required quantity of water by using tray and trowel.
2. Two numbers of brick are placed in stretcher length at a suitable place where the pillar is to be constructed.
3. Mortar should be applied in between two consecutive bricks to make a joint in between them.
4. After applying the mortar all over the bricks, another two no.s of brick placed above the stretcher length brick in header position to give a certain size of the pillar.
5. Again, the mortar is placed in between the joints as well as the surface of the brick.
6. This process is repeated to a certain height and the plumb bob is used to check the verticality of the work.
7. Thus the process is done for both 1 & 1.5 thick brick pillar to a certain height to construct a brick pillar.



CONCLUSION

By doing this experiment, I constructed 1 & 1.5 brick thick pillar by using mud mortar.

EXPERIMENT-5

AIM OF THE EXPERIMENT

Bar bending and fabrication of reinforcement for a beam.

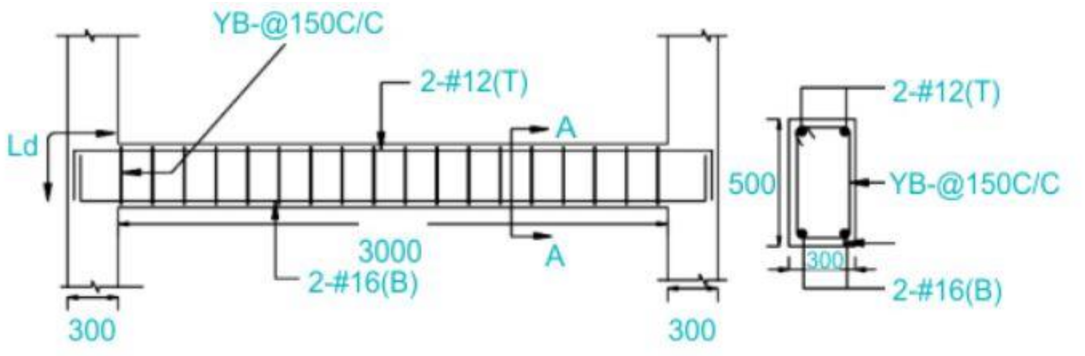
APPARATUS REQUIRED

For 3m clear span

1. 16 mm dia. Bar
2. 12 mm dia. Bar
3. 8mm dia. bar for stirrups
4. Wooden block for fabrication / wooden ply & battens.

THEORY

Bar bending schedule for a simple beam that the clear span of the beam is 3m consisting of 2 numbers of 16mm diameter bars at the bottom and 2 numbers of 12mm diameter bars at the top with 8mm diameter stirrups having a clear cover of 150mm. Let us assume a clear cover of 25mm at both sides and ends of the given beam.



PROCEDURE

The observations that can be drawn from the above figure are-

- Clear span of the beam= 3000mm
- Development length \Ld= 50d (assume)
- Clear cover= 25mm at any ends.
- Bottom- 2 numbers @ 16φ
- Top- 2 numbers @ 12φ
- Stirrups- 8phi$h$ @ 150mm clear cover.

Step 1- Cutting Length of the top bar

Cutting Length of top bar= Clear span of beam + development length (Ld) on 2 sides - clear cover on 2 ends

= 3000+(2× 50d)- (2× 25)

= 3000 + (2×50×12) - 50

= 4150mm

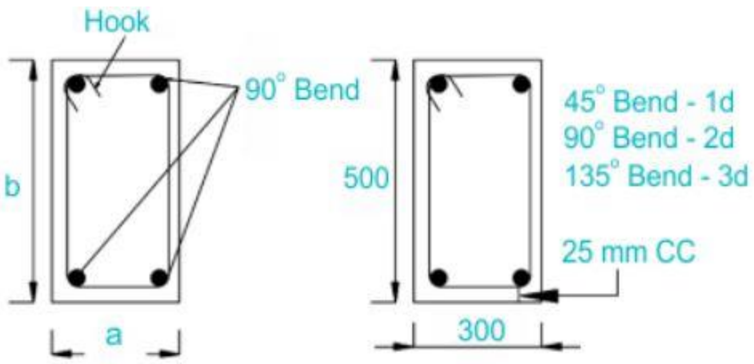
Step 2- Cutting Length of Bottom Bar

Cutting Length of bottom bar= Clear span of beam + development length (Ld) on 2 sides - clear cover on 2 ends

= 3000 + (2× 50d) - (2× 25)

= 3000 + (2×50×16) - 50

= 4550mm



Step 3- The number of stirrups

Number of stirrups required = (Clear Span of Beam/Spacing of Stirrups) + 1

= (3000/150) + 1= 21 numbers.

Step 4- Cutting Length of each stirrup

Let us split the sides as 'a' and 'b' to make the calculation easier.

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(300+500) + (3×2d) + (2×9d)

= 1600 + (3×2×8) + (2×9×8)1600 + (3×2×8) + (2×9×8)

= 1792mm

Step 5- Weight of Stirrups

Total number of stirrups = 21

Total length of stirrups = 21×1.792 = 37.632m21×1.792 = 37.632m

Weight of stirrups = $\frac{d^2L}{162} = \frac{8^2 \times 37.632}{162}$ = 14.86 kg

Diameter of Bars (mm)	Numbers	Cutting Length (mm)	Total Length (mm)	
Top bars	12	2	4150	8300
Bottom bars	16	2	4550	9100
Stirrups	8	21	1792	37632

CONCLUSION

From the above procedure I can construct bar bending and fabrication of reinforcement of a beam.

EXPERIMENT-6

AIM OF THE EXPERIMENT

Bar bending and fabrication of reinforcement for a slab.

APPARATUS REQUIRED

1. Required dia. of bars
2. Required dia. of stirrup
3. Instrument required for bar bending/rebar
4. Wooden or steel fabrication

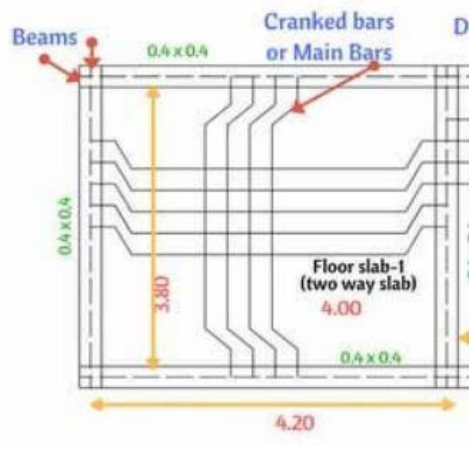
THEORY

- In one way slab main reinforcement is parallel to shorter direction and the reinforcement parallel to longer direction is called distribution steel.
- In two way slab main reinforcement is provided along both direction.
- minimum reinforcement is 0.12% for HYSD bars and 0.15% for mild steel bars.

PROCEDURE

1. Conventional concrete slabs are square in shape and have a length of 4m.
2. Reinforcement is provided in conventional slab and the bars which are set in horizontal are called main reinforcement bars and bars which are set vertical are called distribution bars.
3. Before provision of bars for slab centering is done.
4. Centering is the formwork usually made from wood, that is used to support the masonry, before masonry is placed and before it has gained sufficient strength to support its own weight.
5. Now reinforcement should be placed low enough so saw cutting doesn't cut the reinforcement.
6. For welded wire reinforcement, the wire reinforcement institute recommends steel placement 2 inches below the surface or within the upper third of the slab thickness, whichever is closed to the surface.
7. The bars are setup accordingly and bent up bars also provided in the required section to create a reinforcement of a slab.

CALCULATION



Consider,

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

Floor Slab – 1 (Two-Way Slab)

Bars along X-Axis

1. Deduction of cover:- For this divide the beam into two parts with axis line. From the Figure breadth and depth of beam is 0.4 x 0.4. .
2. Length of Distribution bar = Bar length C/C- Deduction of cover(both sides) +0.42D 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=4.2-0.025-0.025+0.42x0.1x2

   = 4.234m

3. No. of Bars $= \frac{\text{Opp length}}{\text{Spacing}} + 1$

   $= \frac{3.8}{0.1} + 1 = 39$ bars

4. Extra Bar length $= \frac{L}{4} = \frac{4.15}{4} = 1.0375$m
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

7. Weight of Steel bar in $= \frac{D^2}{162}$ Kgs/m

   (For 10 mm) $= \frac{10^2}{162} = 0.61$kgs/m

Total weight of steel = 0.61×246.051 = 150.091 kgs

Bars along Y-Axis

1. Deduction of cover:- For this divide the beam into two parts with axis line. From the Figure breadth and depth of beam is 0.4 x 0.4. .
2. Length of Distribution bar = Bar length C/C- Deduction of cover(both sides) +0.42D 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 = $\frac{\text{Opp length}}{\text{Spacing}} + 1$

   = $\frac{4.0}{0.1} + 1$ = 41 bars

4. Extra Bar length = $\frac{L}{4} = \frac{3.95}{4}$ = 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

7. Weight of Steel bar in = $\frac{D^2}{162}$ Kgs/m

   (For 10 mm) = $\frac{10^2}{162}$ = 0.61kgs/m

Total weight of steel = 0.61×246.369 = 150.285 kgs

Total weight of bars = 150.091 + 150.285 = 300.376 kgs

CONCLUSION

From the above procedure I learn to construct the bar bending & fabrication of reinforcement for a slab.

EXPERIMENT-7

AIM OF THE EXPERIMENT

Bar bending and fabrication of reinforcement for a lintel with chajja.

APPARATUS REQUIRED

1. Required dia. of main bar

2. Steels for main bar

3. No. of stirrups

4. Wooden or steel fabrication

THEORY

- The minimum bearing for lintels onto brickwork shall be 150 mm.
- The minimum bearing for lintels onto blockwork shall be 300 mm.
- Lintels shall bear on whole not cut blocks.
- Lintels are to be bedded in mortar similar to that used for laying the units.

PROCEDURE

Bar Bending Schedule of Lintel Beam:

1. For the bar bending of lintels first calculate length of one main bar.

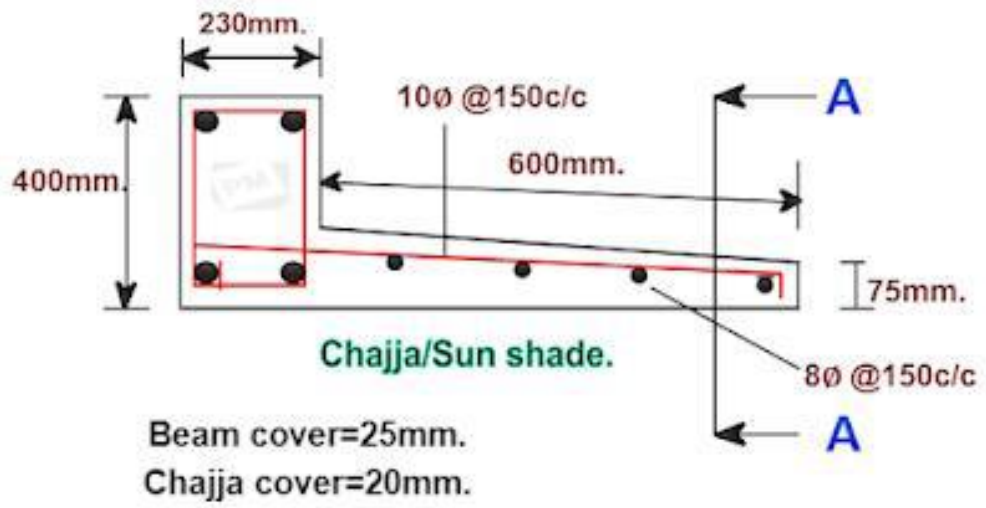
   Length of one bar = Length of lintel – clear cover for both sides

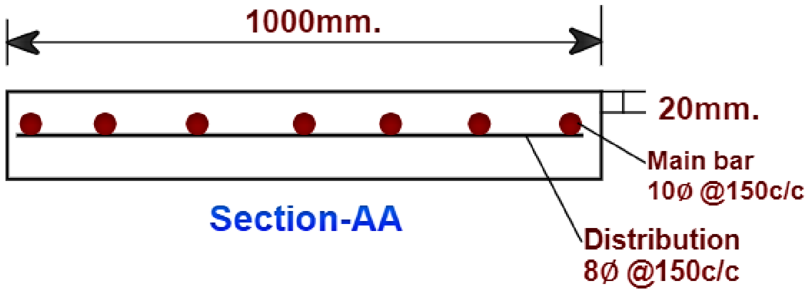
2. Then calculate the total length of main bars i.e. No. of bars × Its length.
3. Calculate weight of steel for main bars i.e.

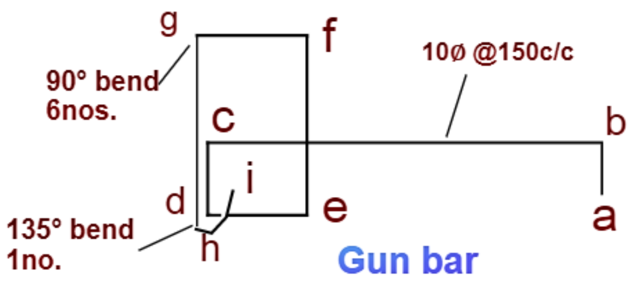
   $Weight\ of\ steel\ for$ Lintel beam of D mm bar = D^2 L/162

Bar bending schedule (BBS) of chajja :

1. Calculate Cutting length of the main bar (gun bar).
   Cutting length of the gun bar = [(ab + bc + cd + de + ef + fg +gh + hi) - (6nos. × 90° bend. + 1no. × 135° bend.)]
2. Calculate cutting length of distribution bar.
   Cutting length of distribution bar = [chajja length - (2nos.× sunshade cover)]
3. Calculate No. of main bars.
   No. of main bars/gun bars = [{chajja length - (2nos. × cover)} ÷ c/c distance] +1
4. Calculate No. of distribution bars.
   No. of distribution bars = [{chajja width - cover - main bar dia} ÷ c/c distance] +1
5. Calculate the total $weight\ of\ steel\ for$ Chajja.







CALCULATION

Bar bending and fabrication of reinforcement for the given lintel with chajja as follows:

Length of Lintel/chajja = 1000mm.
Width of chajja = 600mm.
Chajja thickness (front) = 75mm.
Lintel beam width = 230mm.
Lintel beam depth = 400mm.
Main bar (gun bar) = 10Ø @ 150c/c.
Distribution bar = 8Ø @ 150 c/c.
Clear cover of chajja =20mm.
Lintel beam cover = 25mm.

Bar Bending Schedule Of Lintel Beam:

1. Length of one bar = Length of lintel – clear cover for both sides

= 1000 – (2×25)

= 950mm

2. Total length of main bars = No. of bars × Its length

   = 4 × 950 = 3800mm = **3.8m**

3. **$Weight\ of\ steel\ for$ 10 $mm\ bar$ = D^2 L/162 = 10^2 × 3.8 / 162 = 2.34 kg**

Bar bending schedule (BBS) of chajja :

Cutting length of the main bar (gun bar) = = [(ab + bc + cd + de + ef + fg +gh + hi) - (6nos. × 90° bend. + 1no. × 135° bend.)]

Where,
ab = [chajja thickness - (2nos. × cover)]
= [75mm. - (2nos. × 20mm.)]
= **35mm.**

bc = [(chajja width - chajja cover) + (beam width - beam cover)]
= [(600mm. - 20mm.) + (230mm. - 25mm.)]
= [580mm. + 205mm.]
= **785mm.**

cd = [chajja thickness - chajja cover - beam cover]
= [75mm. -20mm. - 25mm.]
= 30mm.
de = [beam width - (2nos.× cover)]
= [230mm. - (2nos.× 25mm.)]
= 180mm.
ef = [beam depth - (2nos.× cover)]
= [400mm. - (2nos.× 25mm.)]
= 350mm.
fg = de = 180mm.
gh = ef = 350mm.
hi = hook length
= 12d = [12 × 10mm.]
= 120mm.
Now, the cutting length of the gun bar
= [(35mm. + 785mm. + 30mm. + 180mm. +350mm. + 180mm. + 350mm. + 120mm.) - (6nos. × 2 × 10mm. + 1no. ×3 × 10mm.)]
= [2030mm.- 150mm.]
= 1880mm.
= 1.88m.

2. Cutting length of distribution bar
= [chajja length - (2nos.× sunshade cover)]
= [1000mm. - (2nos. × 20mm.)]
= 960mm.
= 0.96m.

1. No. of main bars/gun bars.

= [{chajja length - (2nos. × cover)} ÷ c/c distance] +1

= [{1000mm. - (2nos. × 20mm.)} ÷ 150mm.] +1

= [{960mm.} ÷ 150mm.] +1

= 6.4 +1

= 7.4

By rounding off = 8 nos.

2. No. of distribution bars

= [{chajja width - cover - main bar dia} ÷ c/c distance] +1

= [{600mm. - 20mm. - 10mm} ÷ 150mm.] +1

= [{570mm.} ÷ 150mm.] +1

= 3.8 +1

= 4.8

By rounding off = 5nos.

Sl. No.	Type of Bar	Dia. in mm.	Nos.	Length in m.	Total length in m.	Weight in Kg/m.	Total bar wt. in kg.
1.	Main bar.	10	8	1.88	15.04	0.612	9.20
2.	Distribution bar.	8	5	0.96	4.80	0.395	1.90
3.	Total weight of steel bars =						11.10
4.	Add 3% wastage =						0.33
5.	**The grand total wt. of rebar's in chajja =**						**11.43**

CONCLUSION

By following the above procedure, we can able to construct a lintel with chajja.

EXPERIMENT-8

AIM OF THE EXPERIMENT

Bar bending and fabrication of reinforcement for column.

APPARATUS REQUIRED

1. 6 no. s of 20 mm dia. bar

2. 8 mm stirrup

3. Instrument required for bar bending

4. Wooden or steel fabrication

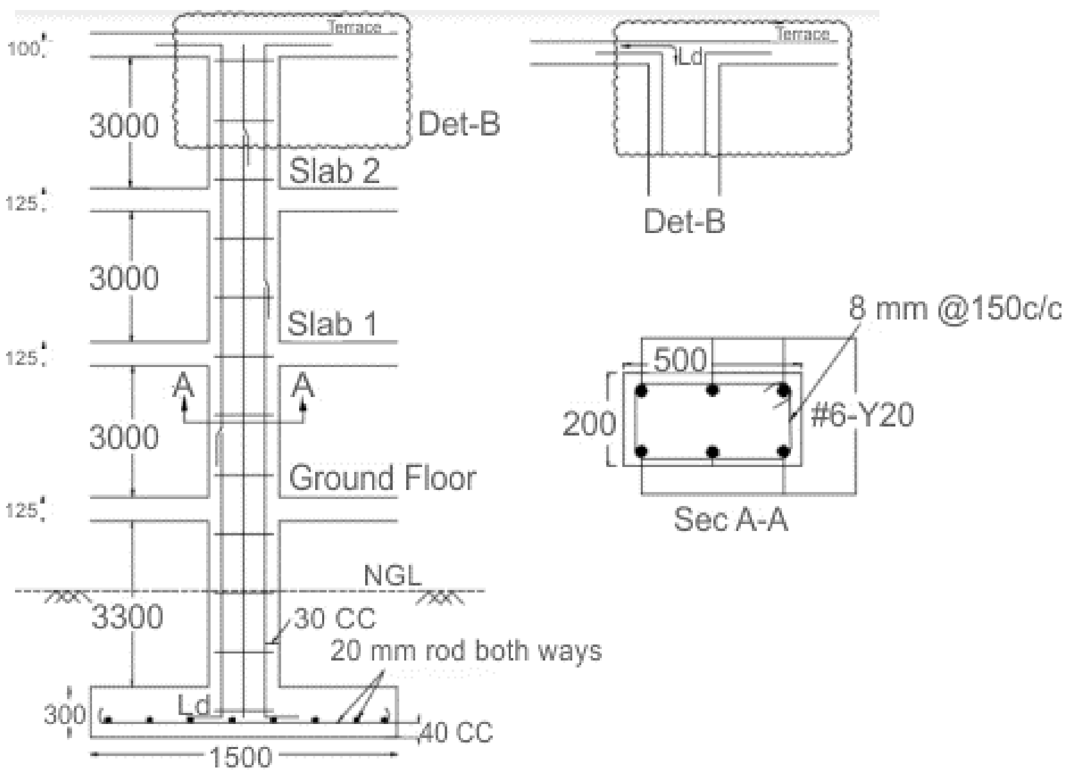
THEORY

Calculation of the total quantity of bars required for completing a construction project or a part of the construction project is called Bar Bending Schedule. It becomes very important in estimating the cost of the project as the cost of reinforcement in a construction project has a major part in determining the total cost.

In architecture and structural engineering, a column or pillar is a structural member that transmits the weight of the structure above to other structural elements below by compression. A column, in other terms, is a compression member.

The bar bending schedule calculation for columns refers to the calculation of the amount of reinforcement required for the construction of columns in a structure.

For construction of column following data are needed.



- Slab thickness – 125 mm & 100 mm
- Floor height – 3000 mm or 3 m
- Ground floor level – 3300 mm
- Footing height – 300 mm
- Development length – 50 d
- Column has 6 no. of 20 mm dia. Bars
- 8 mm stirrup @ 150 mm c/c
- Footing clear cover – 40 mm
- Slab clear cover – 25 mm

PROCEDURE

Following steps are involved in column construction

Step 1 - Find the length of vertical bar.

Length of vertical bar = Development length (L_d)+Height of ground level +Floor height (1,2,3) + slab thickness + Overlap length

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

= 14775mm or **14.78 m**

Now we know the length of one vertical bar.

Step 2 - Find out lapping

As we know that lapping length required is 50 d

= 50 ×dia. of bar =50×20=1000mm

We know that each bar is 12.25m or 40 ft. length.

Total length of vertical bar = 14.78m is more than 12.25m, 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 i.e. 14.78+1=**15.78m**

Step 3 - Cutting length of stirrups

Length of one hook=9d

Cutting length of stirrups=Perimeter of stirrups + no. of bends +no. of hooks

=2(a+b)+3 no.s of 900 bends+2 no.sof hooks

=2(500+200)+(3×2d)+(2×9d)

=2×700+3×2×20+2×9×20 = 1880 mm

Cutting length of stirrups = **1880 mm**

Step 4 - Number of stirrups

N$o.\ of\ stirrups$=($total\ length\ of\ linteldistance\ between\ stirrups$)+1

= (3000/150) + 1= 21 numbers.

=(3300+125+3000+125+3000+125+3000+100150)+1

Number of Stirrups = 85 numbers

Step 5 - Bar bending schedule

Type of Bar	Dia. of bar	No. of bars	Cutting length	Total length
Vertical bar	20 mm	6	14.7 m	85.2 m
Stirrups bar	8 mm	85	1.88 m	159.8 m

CONCLUSION

From the above experiment we learn the bar bending schedule for reinforcement of column.

EXPERIMENT-9

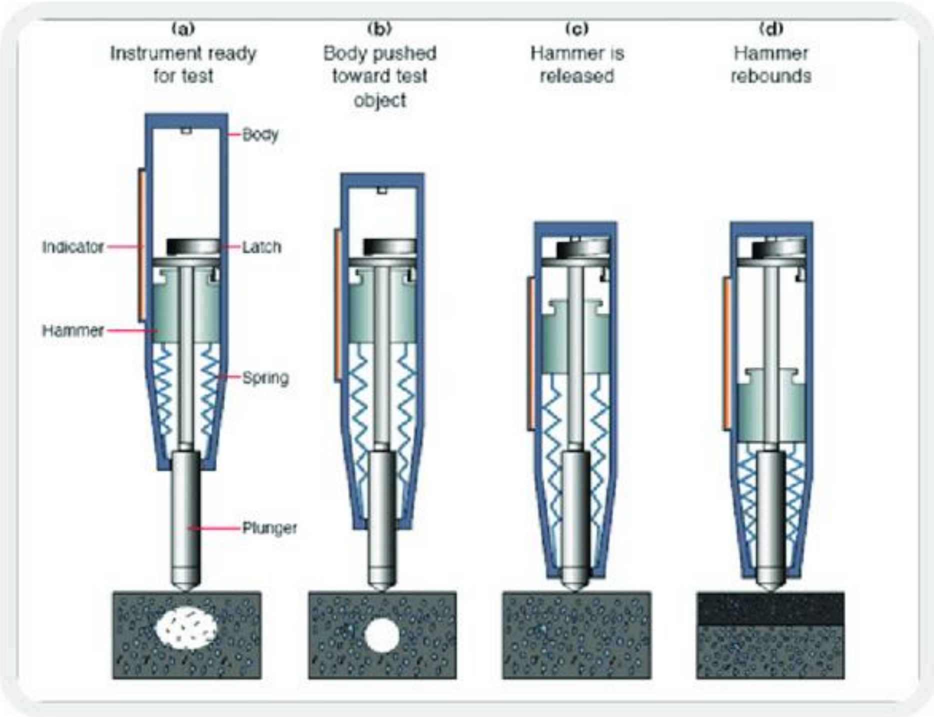
AIM OF THE EXPERIMENT
Conducting a non destructive compressive strength test on concrete beam using rebound hammer.

APPARATUS REQUIRED
1. Rebound hammer
2. Plunger
3. Ingredient for concrete

THEORY

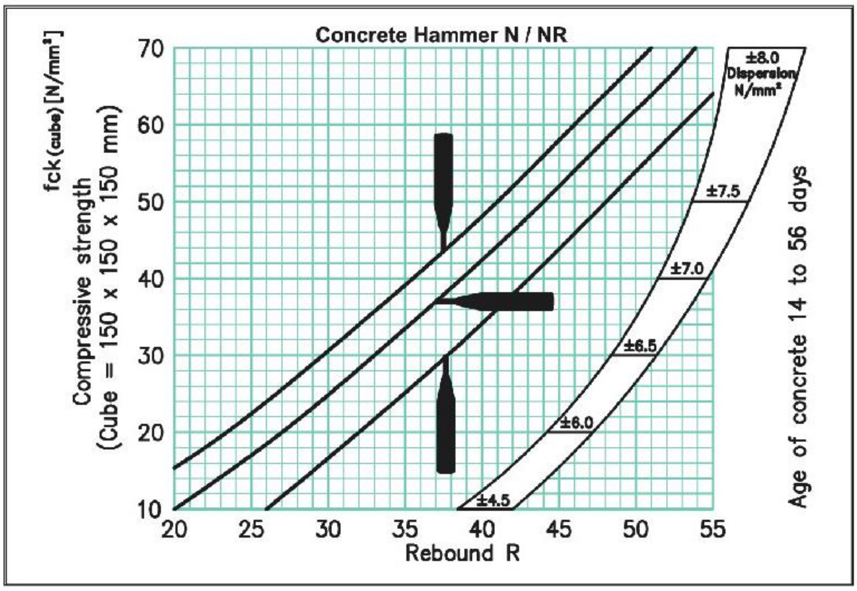
Rebound hammer test is a non-destructive testing method of concrete which provided a convenient and rapid indication of the compressive strength of the concrete. When the plunger of rebound hammer is pressed against the surface of concrete a spring controlled mass with a constant energy is made to hit concrete surface to rebound back.

The extent of rebound, which is a measure of surface hardness is measured on a graduated scale. This measured value is designated as rebound number. A concrete with low strength and low stiffness will absorb more energy to yield in a lower rebound value.



PROCEDURE
- For rebound hammer test on concrete structure starts with calibration of the rebound hammer.
- For this the rebound hammer is tested against the test made of steel having Brinell hardness number of about 5000 N/MM2
- After rebound test is done the rebound hammer is held at right angles to the surface of the concrete structure for taking the reading.

- The test thus can be conducted horizontally on vertical surface and vertically upward or downward in horizontally surface.
- If the rebound hammer is held at intermediate angle, the rebound number will be different for the same concrete.
- The impact energy required for the rebound hammer is different for different application.



Impact energy for rebound hammer for different application.

Sl. No.	Application	Approximate impact energy In mm
1	For normal weight Concrete for light weight concrete	2.25
2	Small and impact resistive concrete parts for mass concrete testing	0.75
3	In roads, hydraulic structures and pavements	30.00

CONCLUSION

From the above experiment I learned to conducting a non-destructive compressive strength test on concrete beam.

EXPERIMENT-10

AIM OF THE EXPERIMENT

Study of pipe joints and plumbing fixtures.

THEORY

PLUMBING 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. Joints are also used for multiple pipe connecting and are an important component of plumbing system.

PIPE JOINTS

Pipes are connected with the help of joints. A variety of joints are used in an assembly of pipes.

Various types of joints could be used for multiple pipe connection. The pipe joint fitted can easily sustain the pressure created in the pipe.

TYPES OF PIPE JOINT

Various types of pipe joints are as follows

1. Threaded joint
2. Welded joint
3. Brazed joint
4. Soldered joint
5. Grooved joint
6. Flanged joint
7. Compression joint

1. THREADED JOINT

When pipes are joined by screwing in threads which are provided in the pipe, it is called a threaded joint. Threaded joints are used from 6 mm dia. to 300 mm dia. pipes. Threads are also made in various pipes like PVC, CI pipes, Copper pipes and GI pipes etc.

2. WELDED JOINT

It is one of the most common methods of joining pipes used in large infrastructure like Commercial, Institutional and Industrial systems.

3. BRAZED JOINT

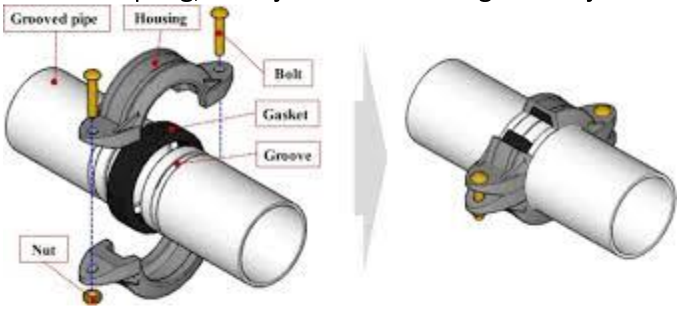
When pipes are joined with the help of molten filler material at above 840^0 C, it is called brazing. Brazing is done for connecting copper pipes or copper alloy pipes.

4. SOLDERED JOINT

Soldering and Brazing are similar activities. In soldering the filler material melts below 840o . During soldering flux or metal joining material is used to prevent oxidation due to flame.

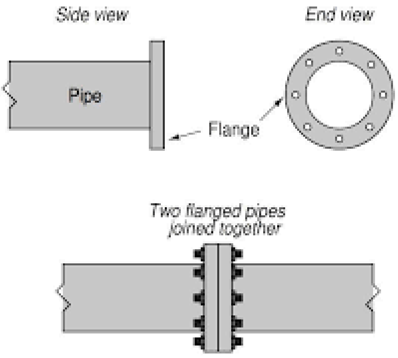
5. GROOVED JOINT

When two pipes are joined together by making grooves at the end of pipes with the help of sockets or coupling, Such joints are called grooved joints.



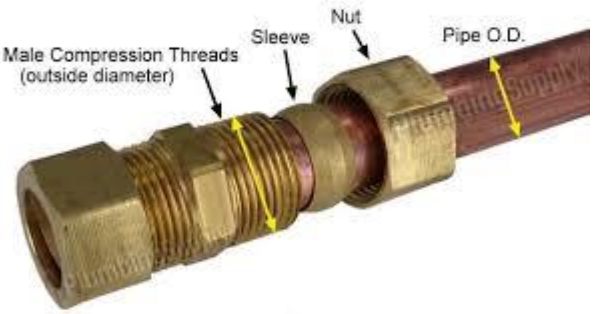
6. FLANGED JOINT

This joint is commonly used for joining pipes in plumbing stations . Filter plants, hydraulic laboratories and boiler houses. These joints are preferred due to easy process of assembly and disassembly.



7. COMPRESSION JOINT

These are applied to join the pipe without any preparation. 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 joints are called compression joint.



8. VALVES

For proper functioning of the pipe line valves made of iron or brass are used in the water supply mains. Valves stop or control the flow of fluid like liquid, gas, condensate etc. These are classified according to their usage like isolation, throttling and non-return corrector.

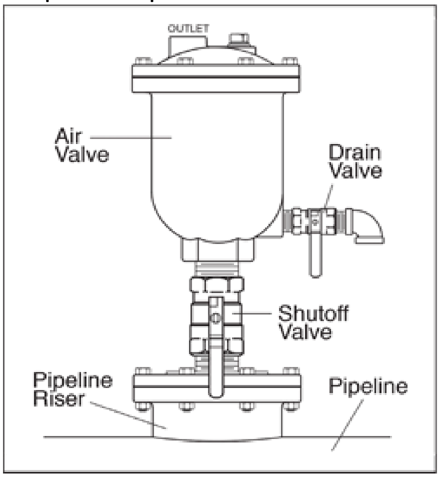
DIFFERENT TYPES OF VALVES ARE

a. Air valve
b. Scour valve

c. Reflux valve or, Check valve
d. Gate valve or, Sluice valve
e. Relief valve
f. Angle valve
g. Stop Cock
h. Ferrule
i. Bib cock
j. Ball Valve
k. Watermeter

a. Air valve

Air valves are hydromechanical devices with an internal float mechanism designed to release trapped air and wastewater gases during filling and operation of a piping system. They also ensure air intake during draining to maintain a positive pressure.

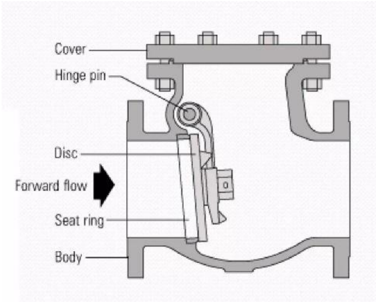


b. Scour valve

Scour valves are located at low points or between valved sections of the pipeline. Their function is to allow periodic flushing of the lines to remove sediment and to allow the line to be drained for maintenance and repair work.

c. Reflux valve

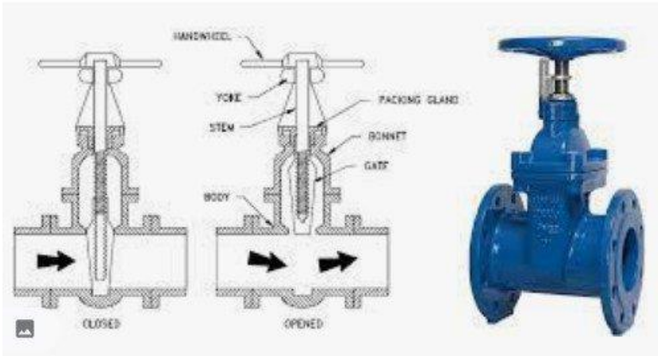
A reflux valve is designed to prevent the water and sewerage from flowing back into the private property drain when the sewer main or on-site treatment plant becomes inundated during a flood event.



SECTION OF CHECK VALVES

d. Gate valve or, Sluice valve

A gate valve, also known as a sluice valve, is a valve that opens by lifting a barrier (gate) out of the path of the fluid. Gate valves require very little space along the pipe axis and hardly restrict the flow of fluid when the gate is fully opened.



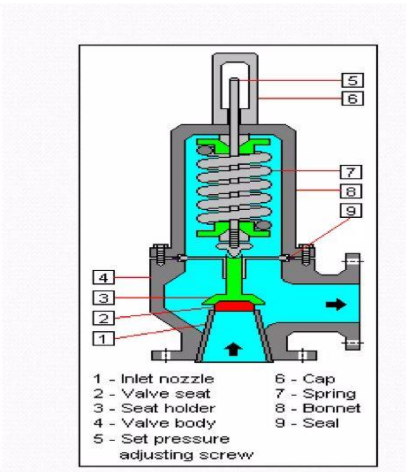
e. Relief valve

Relief valves are designed to open at a preset pressure (or temperature) level and relieve the system when it has exceeded the desired level. The valve's relief of elevated liquid, gas, or steam pressures prevents damage to the system.

These are also known as the automatic cut-off valves or, safety valves. The load on the spring is adjusted to the maximum pressure.

When pressure of water exceeds a predetermined limit, the valve operates automatically and it will save a particular section of water pipe before bursting of pipe takes place.

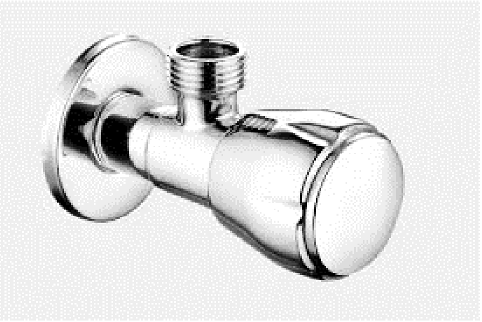
RELIEF VALVES



SECTION OF RELIEF VALVES

f. Angle valve

An angle valve is a device used to regulate the flow of fluids or gas in a piping system. Angle valves are typically used in residential and commercial plumbing applications to regulate water flow in a piping system. Angle valves are also used in industrial applications, such as chemical processing plants.




g. Stop Cock

A stopcock looks like a tap, but without an outlet spout. It will be between two lengths of pipe, acting as a connector. This allows the stopcock to block the flow of water when it's closed off.


h. Ferrule

A plumbing ferrule is a tool inside of a pipe known to connect two plumbing pipes. It is inside a ferrule nut, which exerts pressure and compresses the line to enable water pressure to be consistent. A plumbing ferrule is common in pipes that don't have gravity working on their side.

i. Bib cock

Bibcock is a tap used to control the water flow of a water supply pipe or drain. A bibcock is a wall-mounted water tap with a downward-bent nozzle that allows people to turn the water supply on and off. It is commonly used in outdoor areas, gardens, toilets, bathrooms, and sometimes basins.

At its core, the bibcock valve, commonly known as "bibcock," is a faucet or tap that provides controlled access to water or other fluids. While it might appear as just another tap to many, its specific design and mechanism suit it for certain applications.

j. Ball Valve

A ball valve is a shut-off valve that allows, obstructs, and controls the flow of liquids, gases, and vapors in a piping system by rotating the ball having a bore inside the valve. The ball is mounted against two seats and has a shaft that connects it to the operating and control mechanism that rotates the ball.

k. Watermeter

A water meter is measures the quantity (volume) of water that passes through a pipe or other outlet. Typically, meters use a standard unit of measure for volume, such as cubic feet or gallons. Your meter works like a car odometer, recording the cumulative amount of water that has passed through the meter.

CONCLUSION

From the above description I learned about various types of pipe joints and plumbing fixtures.