Department of Civil Engineering

Civil Engineering Workshop

Laboratory Manual

Progress through education

Mission

To seek, to strive and to achieve greater heights in Engineering, Technological and Managerial and not yield on quality of education

Department of Civil Engineering

Vision

Progress through quality education by keeping pace with new challenges in the field of Civil Engineering

Mission

To create competent Civil Engineering professionals, applying their technical and managerial skills thereby finding real time solutions to regional and global problems and accept new challenges in various Civil Engineering projects

Program Educational Objectives (PEOs)

PEO I: Our graduates will apply fundamental technical knowledge and skills to find creative solutions to technological challenges and problems in various areas of basic sciences and civil engineering and contribute to society and nation when solving engineering problems and producing reliable solutions.

PEO II: Our graduates will contribute to the professional practice of their chosen field through effective communication, leadership, team work and service while exhibiting high ethical and professional standards in fulfilling their responsibilities to both employers and society.

PEO III: Our graduates will continue lifelong learning through professional activities and training and take up higher education, engage in research and development in civil engineering and allied areas of science and technology.

Programme Outcomes (Pos)

a. Ability to understand and apply the basic mathematical and scientific concepts for the solution of complex problems in Civil Engineering.
b. Ability to design and conduct experiments, collect data, analyze and interpret experimental /acquired data and use them in a realistic scenario.
c. Ability to achieve competency to design a system/component or a process to meet the desired needs within the realistic constraints of socioeconomic, enviro nmental, political, ethical, safety and sustainability requirements.
d. Ability to function on multidisciplinary teams during execution of projects requiring inter disciplinary inter phases.
e. Ability for analytical thinking, logical reasoning and problem solving skills and being familiar with contemporary civil engineering soft wares.
f. Ability to understand Professional and Ethical responsibilities to be nurtured in graduates.
g. Ability to communicate effectively and to produce engineering reports of professiona l quality.

h. Ability to appreciate the scope, complexity and significance of Civil Engineering field and its impact on society.

i. Ability to develop skills and motivation for continuous learning process and professional growth after graduation.

j. Ability to understand the importance of continuous improvement and being familiar with recent Civil Engineering issues.

k. Ability to utilize the techniques, skills and modern engineering tools required for successfully taking up Civil Engineering as a profession.

l. Ability to achieve proficiency in core principles of Civil Engineering as they have a clear exposure to the various sub divisions like Construction Engineering and Management, Environmental Engineering, Geotechnical Engineering, Structural Engineering, Surveying ,Transportation Engineering, Water Resources Engineering, etc.

FOREWORD

This laboratory manual on CIVIL ENGINEERING WORKSHOP covers mainly such experiments, which are included in the syllabus for undergraduate students in Civil Engineering of Kerala Technological University.

CONTENTS

I . SETTING OUT

INTRODUCTION

A definition of setting out, often used, is that it is the reverse of surveying. Whereas surveying is a process for forming maps and plans of a particular site or area, setting out begins with plans and ends with the various elements of a particular plan correctly positioned on site

The International Organisation for Standardisation (ISO) define setting out as: Setting out is the establishment of the marks and lines to define the position and level of the elements for the construction work so that works may proceed with reference to them. This process may be contrasted with the purpose of surveying which is to determine by measurement the position of existing features

AIMS OF SETTING OUT

There are two main aims when undertaking setting out operations: -

1. The various elements of the scheme must be correct in all three dimensions both relatively and absolutely, that is each must be its correct size, in its correct plan position and correct reduced level

2. Once setting out begins it must proceed quickly with little or no delay in order that the works can proceed smoothly and the cost can be minimized.

PRINCIPLES OF SETTING OUT

Horizontal control techniques

In order that the design of the scheme can be correctly fixed in position, it is necessary to establish points on the site which the E, N coordinates are known.

These are horizontal control points and, once they have been located they can be used with a positioning technique to set out E, N coordinates of the design points.

Two factors need to be taken into account when establishing horizontal control points.

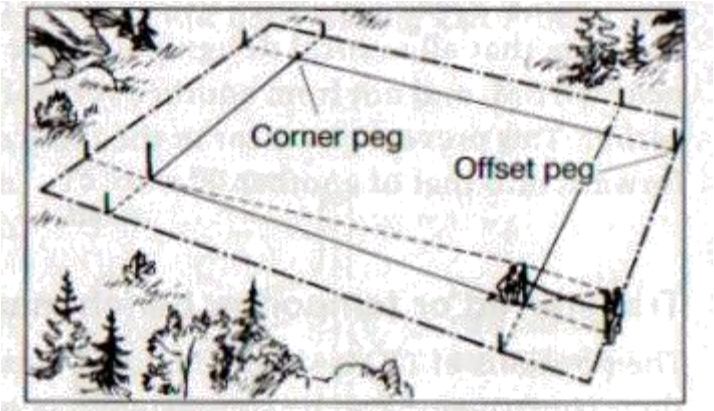


Figure 11.8 Use of offset pegs.

1. The control points should be located throughout the site in order that all the design points can be fixed from at least two or three of them so that the work can be independently checked.

2. The design points must be set out to the accuracy stated in the specifications.

Baselines

A baseline is a line running between two points of a known position. Where a baseline is specified to run between two points then once the points have been established on site, the design points can be set out from the baseline by offsetting using tapes.

Reference grids

Reference grids are used for accurate setting out of works of large magnitude.

Offset pegs

Once excavations for foundations begin, the corner pegs will be lost. To avoid these extra pegs called offset pegs are used.

CONCLUSION

The difference between surveying and setting out is specified and the the aims and principles of setting out is explained.

EXPERIMENT 1 **DATE**

SETTING OUT OF A BUILDING USING TAPE ONLY

AIM

To set out the foundation trenches of a room of size 3 x 4m

TOOLS REQUIRED:

Peg, hammer, tape, string

PRINCIPLE

The setting out or ground tracing is the process of laying down the excavation lines and centre lines etc, on the ground, before excavation is started.

PROCEDURE

1. For setting out the foundations of small buildings, the centre line of the longest outer wall of the building is first marked on the ground by stretching a string between wooden or mild steel pegs drive n at the ends. This line serves as the reference line
2. Two pegs one on either side of the central pegs are driven at each end of the line. Each peg is equidistant from the central peg and the distance between the outer pegs corresponds to the width of the foundation trench to be excavated
3. Each peg may project about 25 to 50 mm above the ground level and may be driven at a distance of about 2m from the edge of excavation so that they are not disturbed
4. When the string is stretched joining the corresponding pegs at the extremities of the line, the boundary of the trench to be excavated can be marked on the ground with dry lime powder
5. The centre line of the other walls which are perpendicular to the long wall are then marked by setting out right angles
6. A right angle can be set out by forming a triangle with 3,4 and 5 units long sides. These dimensions should be measured with the help o f a steel tape.
7. Similarly other lines of foundation trench of each cross walls can be set out

RESULT

Setting out was done

EXPERIMENT 2 DATE

SETTING OUT OF A BUILDING USING CROSS STAFF

AIM

To set out a single room building of size 3m x 4m using cross staff

TOOLS REQUIRED

Ranging rods and Cross staff

PRINCIPLE

The setting out or ground tracing is the process of laying down the excavation lines and centre lines etc, on the ground, before excavation is started.

PROCEDURE

1. For setting out the foundations of small buildings, the centre line of the longest outer wall of the building is first marked on the ground by stretching a string between wooden or mild steel pegs drive n at the ends. This line serves as the reference line
2. Two pegs one on either side of the central pegs are driven at each end of the line. Each peg is equidistant from the central peg and the distance between the outer pegs corresponds to the width of the foundation trench to be excavated
3. Each peg may project about 25 to 50 mm above the ground level and may be driven at a distance of about 2m from the edge of excavation so that they are not disturbed
4. When the string is stretched joining the corresponding pegs at the extremities o f the line, the boundary of the trench to be excavated can be marked on the ground with dry lime powder
5. The centre line of the other walls which are perpendicular to the long wall are then marked by setting out right angles
6. Select two points on a chain line say A and B. fix the ranging rod at A.
7. The cross staff is set up at a point ‘R’ on the line from which the which the perpendicular has to be created.

8. Adjust the cross staff at ‘R’ such that the line of sight passes through ranging rod A.
9. Now the point fixed by viewing through the other pair of vertical slits will be line at right angle to survey line AB.
10. Thus the point ‘P’ is fixed.
11. Join ‘PR’ which is the required perpendicular to the line AB
12. Once the corner point is fixed, the remaining points of the room is marked and the final building is set out in the field

RESULT

The building was set out.

II. BUILDING AREA COMPUTATION

INTRODUCTION

‘Building' means any structure for whatsoever purpose and of whatsoever material constructed and every part thereof whether used for human habitation or not and includes foundations, plinth, walls, floors, roofs, chimneys, plumbing and building services, verandah, balcony, cornice or projections, part of a building or anything affixed thereto or any wall enclosing or intended to enclose any land or space and signs and outdoor display structures

ESTIMATION

Estimation of any construction work may be defined as the process of calculating the quantities and costs of various items required in connection with the work. It is prepared by calculating the quantities from the dimensions on the drawings for the various items required to complete the project and multiplied by unit cost of the item concerned. To prepare an estimate, drawings consisting of the plan, the elevation and the sections through important points, along with a detailed specification giving specific description of all workmanship, properties and proportion of materials are required.

CONCLUSION

A brief introduction to what is a building and what is estimation and what are the materials required for estimating is specified.

EXPERIMENT 3 **DATE**

COMPUTATION OF THE AREA/ VOLUME OF VARIOUS FEATURES OF THE BUILDING

AIM

To compute the area and /or volume of various features of a building such as door and window size, number of bricks required to construct a wall of a building, diameter of bars used in windows, etc.

APPARATUS

Tape, Vernier calipers

PRINCIPLE

Estimation of any construction work may be defined as the process of calculating the quantities and costs of various items required in connection with the work.

PROCEDURE

1. Using a tape measure the dimensions of the given wall, size of door openings and windows.
2. To find the volume of brick work deduct the door openings and window openings.
3. Find the diameter of bars used in window using vernier caliper.
4. Express the various items measured in their standard units.

RESULT

The area and /or volume of various features of a building such as door and window size, number of bricks required to construct a wall of a building, diameter of bars used in windows etc are computed.

Standards of measurement

Description of ite m	Unit of measure ment
Brickwork	Cum
Door and window shutters of different types	Sq m
Woodwork in door and window frames	Cum
Steel doors and windows	Sqm
Plastering	Sqm
Door handle	Number
Bricks	Number
Bars used in window	Number

Observation

Sl no	Main scale reading (in cm)	Vernier scale reading		Total reading = Main Scale Reading + Vernier scale reading
		Coinciding division of vernier scale	Vernier scale reading = coinciding division of vernier x least count (in cm)	
1				
2				
3				

Mean diameter =

Sl no	Describtion of item	No:	Length	Breadth	Height	Quantity	Explanatory notes

III. COMPUTATION OF CENTRE OF GRAVITY AND MOMENT OF INERTIA

INTRODUCTION

When a body is acted upon by the force of gravity, all of the mass particles of which the body is composed, experience a force of attraction directed towards the earth center. The resultant force of all these small attractive forces is the body's weight & the location at which the resultant force is assumed to act is the centre of gravity (CG) of the body. Inertness of a body to change its state of being in rotation is called Moment of Inertia (MI)

CENTRE OF GRAVITY

Every object consists of a large number of particles which get attracted towards the centre of the earth. For a small object compared with the earth, gravitational forces on all the particles of the object can, for practical purposes, be regarded as being parallel with one another. These parallel forces can be replaced by a resultant force equal to the weight of the body & having its line of action passing through a point termed as centre of gravity of the body. Location of the CG is independent of the position of the body.

MOMENT OF INERTIA

According to newton's first law of motion the body continues to stay in the state of rest or in the state of motion. This property of inertia possessed by all the matter is the measures of mass in translatory motion. Similarly when a body is rotating or fixed about an axis. Any change in its state of rest or motion can be brought about by a couple or Torque the greater the opposition to change greater is the inertia. It is this rotational inertia of the body is called its moment of inertia about its axis of rotation.

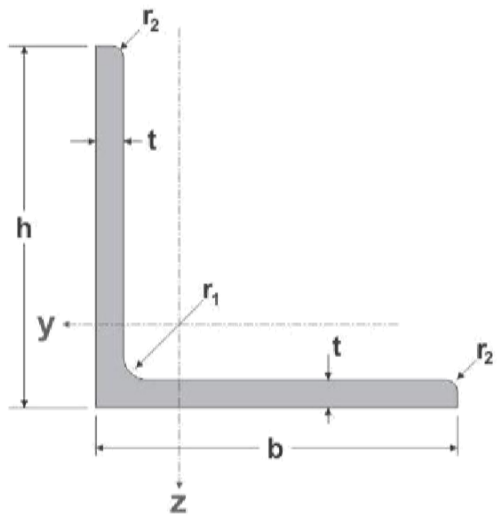
The moment of inertia of an object about a given axis describes the inertness of a body to change its angular motion about that axis. MI therefore encompasses the mass as well as distribution of mass about the axis. The farther from the axis the object mass is, the more rotation inertia the body has and the more torque is required to change its rotation rate. In one sentence, it could be

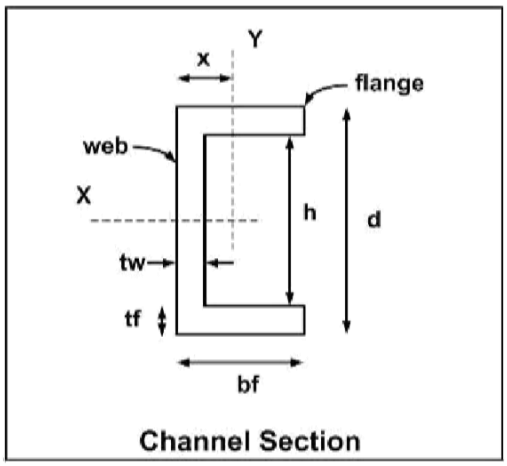
said that; ‘moment of inertia is a measure of an object’s resistance to change in its state of being in rotation.

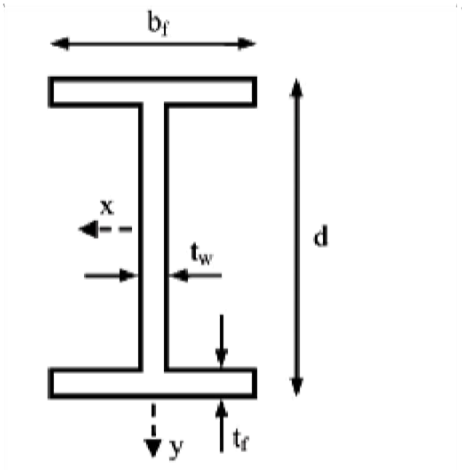
CONCLUSION

A brief about centre of gravity and moment of inertia is specified.

DIFFERENT STEEL TYPES OF STEEL SECTIONS USED IN CONSTRUCTION







EXPERIMENT 4 **DATE**

COMPUTATION OF CENTRE OF GRAVITY AND MOMENT OF INERTIA OF A GIVEN ROLLED STEEL SECTION

AIM

To compute Centre of gravity and Moment of Inertia of the given rolled steel section

INSTRUMENTS USED

Screw gauge, Ruler

PRINCIPLE

I. The location of centre of gravity of the section from the reference axes can be found out using the formula:-

$$\bar{x} = \frac{\sum a_i x_i}{\sum a_i} \text{ and } \bar{y} = \frac{\sum a_i y_i}{\sum a_i}$$

II. The moment of inertia can be found about its own centroidal axes and applying parallel axis theorem

a. $I_{XX} = I_{G_{xx_i}} + a_i h_{i_y}^2$

b. $I_{YY} = I_{G_{yy_i}} + a_i h_{i_x}^2$

PROCEDURE

1. Identify the rolled steel section given
2. Measure the dimensions of the given section
3. Draw a neat sketch of the given section
4. Identify the reference axes say OA and OB
5. Divide the figure into simple components
6. Find out the location of centre of gravity of the section from the reference axes using the following formulae

$$\bar{x} = \frac{\sum a_i x_i}{\sum a_i} \text{ and } \bar{y} = \frac{\sum a_i y_i}{\sum a_i}$$

7. Find out the moment of inertia of each component about its own centroidal axes
8. Calculate the moment of inertia of the given section by using parallel axis theorem

   a. $I_{XX} = I_{G_{xx_i}} + a_i h_{i_y}^2$

   b. $I_{YY} = I_{G_{yy_i}} + a_i h_{i_x}^2$

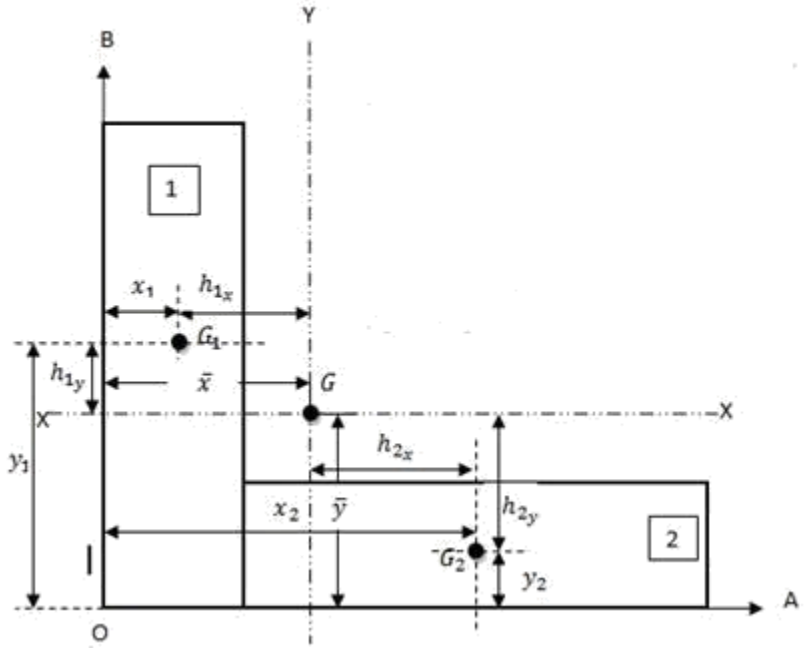
RESULTS

Location of Centre of Gravity of the given section is $(\bar{x}, \bar{y})$ =

Moment of Inertia of the given section of rolled steel about XX axis, I_{XX}=

Moment of Inertia of the given section of rolled steel about YY axis, I_{YY}=

For channel section



- G_1 and G_2 are the centre of gravities of component 1 and 2 respectively.
- G is the centre of gravity of the composite section.
- (x_1,y_1) is the position of centre of gravity of component 1
- (x_2,y_2) is the position of centre of gravity of component 2
- $(\bar{x},\bar{y})$ is the position of centre of gravity of the composite section.
- XX and YY are the axes passing through the centre of gravity of composite section.
- h_{1x} and h_{1y} are the distances between
- h_{2x} and h_{2y} are the distances between

Calculations

1. Determination of Centre of Gravity

ComponentArea,					

2. Determination of Moment of

Inertia Component Area,							

Moment of Inertia of the given section about XX axis,

Moment of Inertia of the given section about YY axis,

IV BRICK MASONRY

INTRODUCTION

Brick masonry is the arrangement of bricks in different ways, so as to form load bearing or non load bearing building components. In brick masonry, the brick units are bonded together with mortar. In place where stones are not easily available, bricks are used in the construction. Bricks can be easily arranged into various patterns so as to satisfy the needs. These are preferred because of its durability, strength, reliability, low cost.

BRICKS

A brick is an artificial kind of stone. Bricks are obtained by moulding clay in rectangular blocks, and then by drying and burning them. It is one of the best walling materials. The standard modular brick size is 19cm x 9cm x 9cm.

The quality of bricks depends upon-

1. The chemical properties of earth
2. The preparation of earth
3. The degree of burning of baking.

TERMS USED IN BRICK MASONRY

STRETCHER

A brick laid with its length parallel to the face of the wall is known as stretcher.

HEADER

A brick laid with its length perpendicular to the face of the wall is known as header.

BRICK BAT

It is a piece of brick designated according to its length . Thus a half brick is called a half bat. A three quarter (3/4) bat is one whose length is ¾ of a brick.

COURSE

Each row of brick is called a course.

BED

Bed of a brick is its bottom surface. Bed joint is the mortar joint parallel to the beds of the brick.

QUOIN

In brick wall a corner brick is called a Quoin.

CLOSER

It is the piece of brick used to create bond in brick work.

TYPES OF CLOSERS

1. KING CLOSER

It is obtained by cutting a corner of the brick joining half the header and half the stretcher. King closers are used for the construction of splayed door and window jambs.

2. QUEEN CLOSER

It is a piece of brick obtained by cutting a brick longitudinally into equa l parts. It is placed next to the quoin header course.

3. BEVELLED CLOSER

It is obtained by cutting a triangular portion of the brick joining half the header and full stretcher. It is used for splayed brick work like jambs of doors and windows.

4. MITRED CLOSER

It is obtained by cutting a triangular portion of the brick through its width at an angle of 45^0 or 60^0 with the length of the brick.

MORTAR

Mortar is a homogeneous mixture , produced by uniform mixing of a binder with an inert material and water to make paste of requird consistency and is used to bind a masonry unit.

Mortar acts as cementing materials and unites individual bricks together to act as homogeneous mass.

TYPES OF MORTARS

1. Cement mortar
2. Lime mortar
3. Cement lime mortar
4. Lime sunk mortar
5. Mud mortar

Mud mortar is used for unimportant low rise building which carry light load.

Cement mortars are used for high rise building where strength is of prime importance.

TOOLS USED IN BRICK MASONRY

TROWEL

It is available in various sizes ranging from 5cm to 30cm in length. Trowels are used for lifting and spending mortar, cutting of bricks and construction of joints.

PLUMB RULE

It is a smooth wooden piece of 2cm length, 10 cm width and 7 cm thickness. The longer edges are parallel. A plumb bob hangs from the top of the wooden piece . This is employed to check the vertically of the wall constructed.

BUBBLE TUBE

This helps in checking the horizontally of the floor, roofs etc.

LINE AND PINS

A 10m (or more) long cord connects two metallic pins. This is stretched between two quoins of the wall to maintain the correct alignment of the courses.

SQUARE

This is a right angle piece made of wooden section. This is employed for checking perpendicularity.

BRICK HAMMER

One end of the hammer is a square and the other end is sharp edged. It is employed to cutting bricks to different shapes and sizes.

SCUTCH

It is used for cutting soft bricks.

FOUR FOLD RULE

It is a measuring scale which can be folded four times.

BONDS

Bond is the interlocking arrangement of bricks or stones in a wall or other structures so as to avoid the occurrence of continuous vertical joints. By adopting bond different portion of a wall or structure are tied together and weight is distributed more easily.

TYPES OF BONDS

1. Header Bond
2. Stretcher Bond
3. English Bond
4. Flemish Bond
5. Raking Bond

HEADER BOND

Header bond is the one in which all the bricks are laid as headers on the faces of the walls. The width of the brick are thus along the direction of the wall. The pattern is used, when the thickness

of the wall is equal to one brick. The bond is suitable for curved wall and foundation for better load distribution.

STRETCHER BOND

Stretcher bond is one in which all the bricks are laid as stretchers on the faces of the wall. The length of the bricks are thus along the direction of the wall . This pattern is used only for those walls which have thickness of half brick.

ENGLISH BOND

The English bond consists of headers and stretchers in alternate courses. In every header course, a queen closer is placed next to the quoin header to create the bond. Continuous vertical joints are avoided in this bond. A course consisting of stretchers on the joint elevation will show stretchers an the rear elevation. For the walls having thickness of two bricks or more the hearting or interior should be filled with headers only.

FLEMISH BOND

Flemish Bond consists of alternate headers and stretchers in every course. Every alternate course is commenced with a header at this course. A queen closer is placed next to the quoin header in every alternate course to create a bond. A stretcher is placed next to this queen closer who is then followed by a header and stretcher alternatively. A header in every course is at the centers of a stretcher in the course below it.

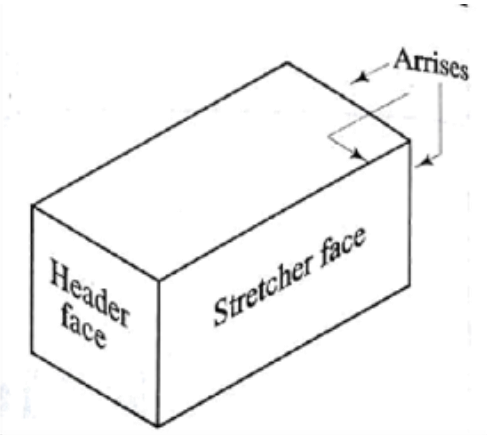
RAKING BOND

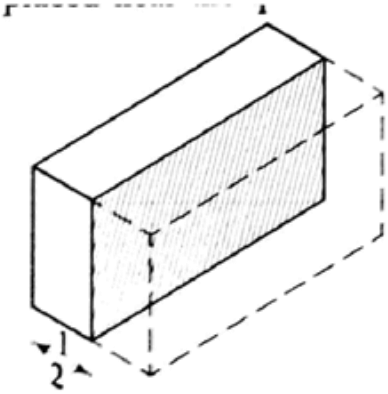
In this bond alternate course are placed in different directions to get maximum strength in the wall. The raking bond can be of the following two types.

1. Diagonal Bond
2. Zig Zag Bond

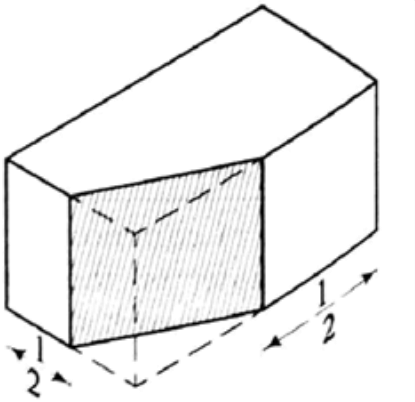
CONCLUSION

The various terms used in Brick Masonry, types of mortar and the tools used in brick masonry are discussed.



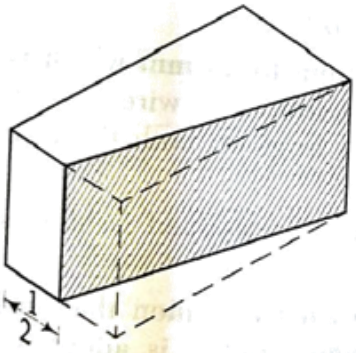


Queen closer

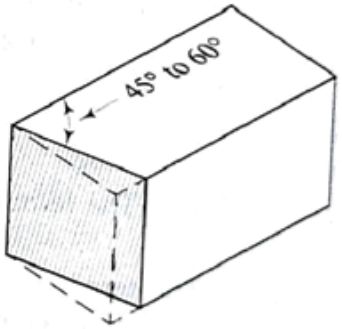


King closer

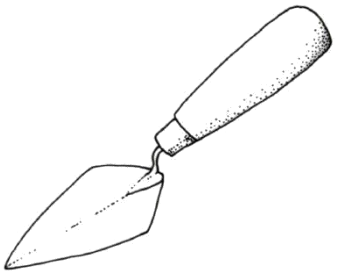
...is used for the splayed brickwo...



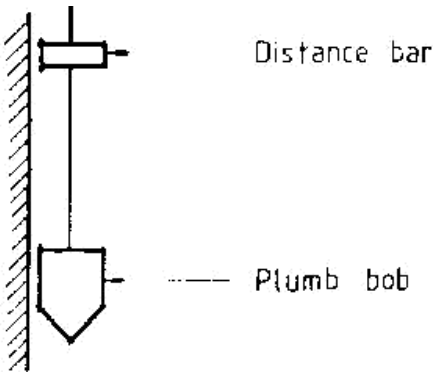
Bevelled closer



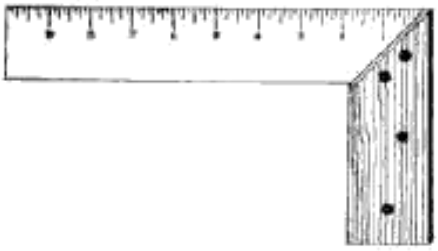
Mitred closer



TROWEL



PLUMB RULE



SQUARE

BRICK HAMMER

EXPERIMENT 5 **DATE**

BRICK MASONRY(1½ BRICK THICK WALL)

AIM

Construct a wall of height 50 cm and wall thickness 1½ bricks using English bond (Corner portion)

MATERIALS REQUIRED

Brick, cement, sand and water.

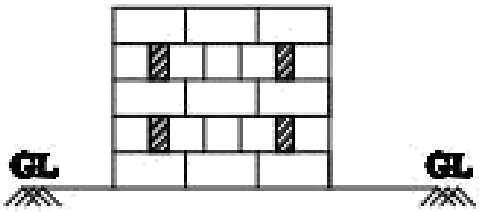
PROCEDURE

1. Snap chalk lines on both sides, then check to make sure that they are perfectly square using a carpenter's square or the 3-4-5 method.
2. Make a dry run to make the position of the brick. Then place the first brick exactly at the corner, being careful to line it up with a chalk lines
3. Lay the remaining bricks in the first course of the lead. With the level and/or carpenter's square, check the alignment and make sure that the bricks are level and plumb
4. Lay the back-up
5. Arrange the second layer of bricks over the odd course as in the plan of even course. Check the vertical and horizontal lines using plumb bob and straight edge
6. Repeat the procedure above by placing odd and even course alternatively up to the required height and length

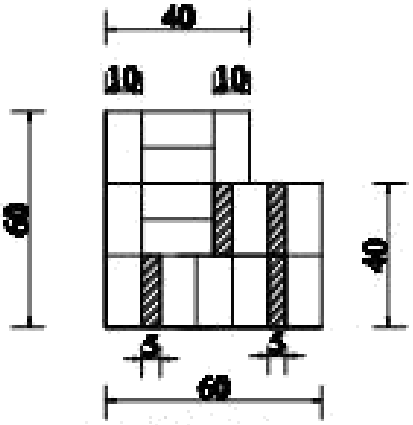
RESULT

Wall of height 50 cm and wall thickness 1½ bricks using English bond is constructed

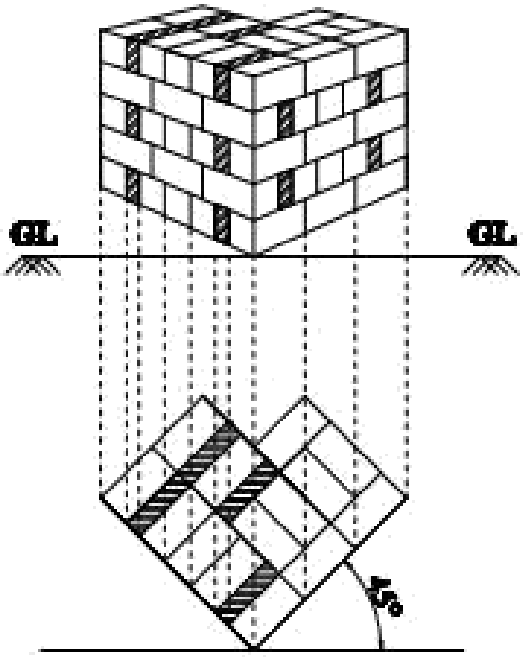
TWO BRICK THICK WALL IN ENGLISH BOND



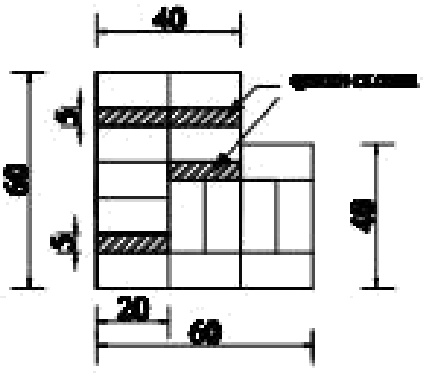
ELEVATION



EVEN COURSE



PERSPECTIVE



ODD COURSE

PLAN

ALL DIMENSIONS ARE IN Cm
SCALE: 1:100

EXPERIMENT 6 **DATE**

BRICK MASONRY (2 BRICK THICK WALL)

AIM

Construct a wall of height 50 cm and wall thickness 2 bricks using English bond (Corner portion)

MATERIALS REQUIRED

Brick, cement, sand and water.

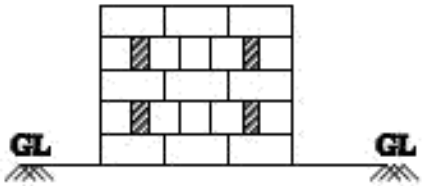
PROCEDURE

1. Snap chalk lines on both sides, then check to make sure that they are perfectly square using a carpenter's square or the 3-4-5 method.
2. Make a dry run to make the position of the brick. Then place the first brick exactly at the corner, being careful to line it up with a chalk lines
3. Lay the remaining bricks in the first course of the lead. With the level and/or carpenter's square, check the alignment and make sure that the bricks are level and plumb
4. Lay the back-up
5. Arrange the second layer of bricks over the odd course as in the plan of even course. Check the vertical and horizontal lines using plumb bob and straight edge
6. Repeat the procedure above by placing odd and even course alternatively up to the required height and length

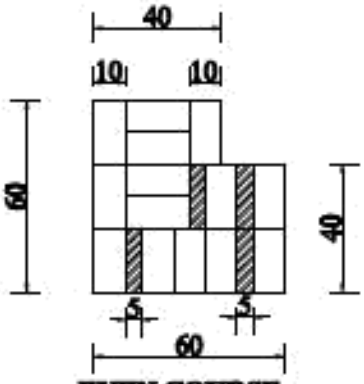
RESULT

Wall of height 50 cm and wall thickness 2 bricks using English bond is constructed

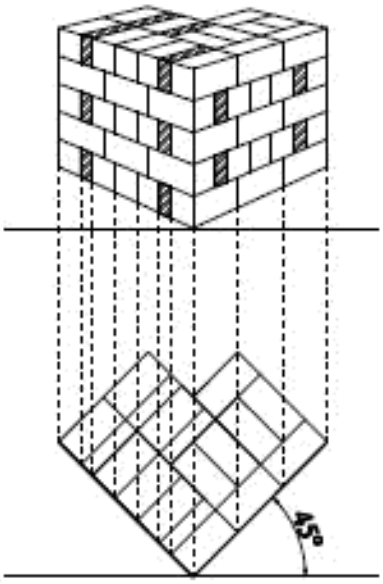
TWO BRICK THICK WALL IN ENGLISH BOND



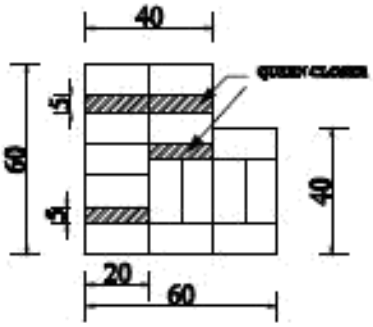
ELEVATION



EVEN COURSE



PERSPECTIVE



ODD COURSE

PLAN

ALL DIMENSIONS ARE IN CM
SCALE: 1:100

V. PLUMBING

INTRODUCTION

Plumbing is the process of installing and repairing of pipe lines including pipe specials (like Elbows, 'T' s , Reducers) and pipe fitting (like different type of valves) for supply, drain of water/ gas and sanitation work. Plumbing works include cutting of pipe to required length , drilling of holes threading and making leak proof joints using sealants like shellac, solvent cement, Teflon tape etc.

TOOLS USED IN PLUMBING

PIPE VICE

Pipe vice is a device used to hold a pipe firmly while cutting and threading pipes, fixing specials / fittings etc. It has two 'V' shaped jaws, one fixed and the other movable to grip various sizes of circular pipes.

PIPE WRENCH

Pipe wrenches are used for gripping circular pipes of various sizes between two jaws with the help of a knurled nut. Pipe wrenches come in various sizes from 6 inches (150mm) to 24 inches (600mm).

CHAIN WRENCH

A chain wrench is used for gripping circular pipes like a pipe wrench but of larger diameters . An adjustable chain wound around the pipe grips the pipe to the body of the wrench.

STEEL RULE

Steel rules are used to take linear measurements up to an accuracy of 0.5mm . They are generally made of stainless steel and are available in sizes 150mm, 300mm, 600mm, and 1000mm.

HACK SAW

It is a cutting tool with a blade made of high carbon or high speed steel held tightly in mild steel frame (adjustable or fixed).

SCREW DRIVER

Screw drivers are used for tightening or loosening screws with slotted heads. It has a steel rod with a chisel shaped end and a wooden/ plastic handle. The chisel edge is hardened and tempered. These tempered edges should not be ground to suite different screw heads.

DIE SET (DIE AND DIE STOCK)

Dies are used to cut external threads on round pipes. A common type Die is the two piece rectangular Die made with hardent steel, containing threads and flutes which forms the cutting edges. The tool for holding and turning the Die is called Die-stock. When the die is assembled in the Die- stock using an adjustable screw is called Die set.

SPIRIT LEVEL

A spirit level is used to check the level of a horizontal surface. Levels fitted with a second bubble tube can also check the vertically of a surface.

ADJUSTABLE SPANNER

It is general purpose spanner which can be adjusted to suite different s izes of nuts.

COUPLING

It is short pipe sleeve with internal threads at both ends . it is used to connect pipes of equal diameter in axial alignment.

REDUCER COUPLING

It is similar to a regular coupling , but has ends of different diameters . It is used to couple pipes of different diameters in axial alignment.

ELBOW

Elbow is similar to similar to a coupling but the axis at the ends are at an angle usually 90. It has internal threads at both ends.

REDUCER ELBOW.

It is similar to a regular elbow but has different diameters at the ends to connect pipes of different sizes meeting at right angle.

BEND

Bends have a larger radius of curvature compared to elbows. They offer less resistance to fluid flow and save pumping energy. Bends have external threads at both ends.

EQUAL TEE

An equal Tee is a pipe special used to take a branch connection of same size as the main line at right angle. It has internal threads at all the 3 ends.

REDUCER TEE

It is similar to an equal Tee, but has branch connection of smaller diameter compared to the main line.

HOSE NIPPLE

It is use to take a hose connection from a pipe fitting like valve. It has one end externally threaded to suite the pipe fitting and the other end a stepped tapper to suite the hose.

SHORT NIPPLE

It is a short pipe sleeve both ends externally threaded with a short unthreaded middle portion for gripping.

MALE PLUG

It is similar to a male plug but has internal threads at one end and a square shape at the other end.

SCREWED UNION

It is used to connect pipes, which need to be dismantled with out disturbing the entire pipe line. It has 3 parts . The 2 end pieces are internally threaded. These pieces are screwed on to the pipe ends. The central piece which has a hexagonal shape . draws the end s together and presses a soft packing inside to get a leak proof joint.

PIPE FITTINGS

INTRODUCTION

Pipe fittings are devices used to control/ measure fluid flow through a pipe line. They are valves of different construction flow meters etc. they can be made of different materials like brass, cast iron, cast steel, forged steel or plastic. The end connection of a pipe fitting can be of threaded, flanged or welded construction.

WATER COCK

It is simple form of valve which has a conical plug with a rectangular hole in it. It fits in to a similar conical opening in the valve body. When the rectangular opening is in line with the pipe direction the valve is open. When the plug is turned 90 with a handle , the solid portion of the plug comes in font of the opening and blocks the passage.

GLOBE VALVE

It is used for opening or closing the fluid flow in a pipe line. It can also be used in a partly open condition . Due to the change in flow direction, there is a head loss even in fully opened condition. A valve element can be moved up or down with the help of a handle . Small valves have soft seat (rubber, synthetic material etc.) to ensure tight shut of f. A globe valve is to be fitted in a pipe line as per the direction arrow marked on the body.

GATE VALVE

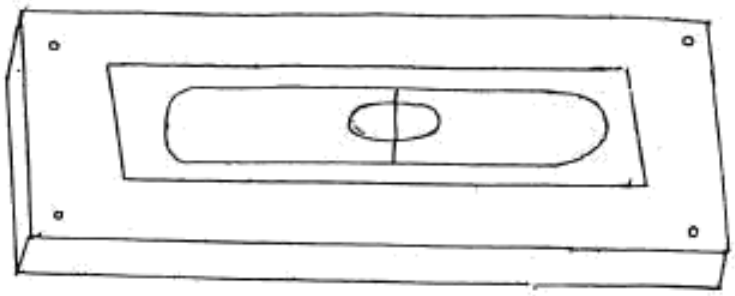
It is essentially an on- off type of valve which offers a good amount of resistance in partly open condition but offers practically no resistance in fully open condition as the full passage is available for fluid flow. This valve has two disks or gates work ing inside a wedge shaped opening. A spindle with a handle can move the discs up or down there by opening or closing the valve. A gate valve can be fitted in either direction.

WATER TAP

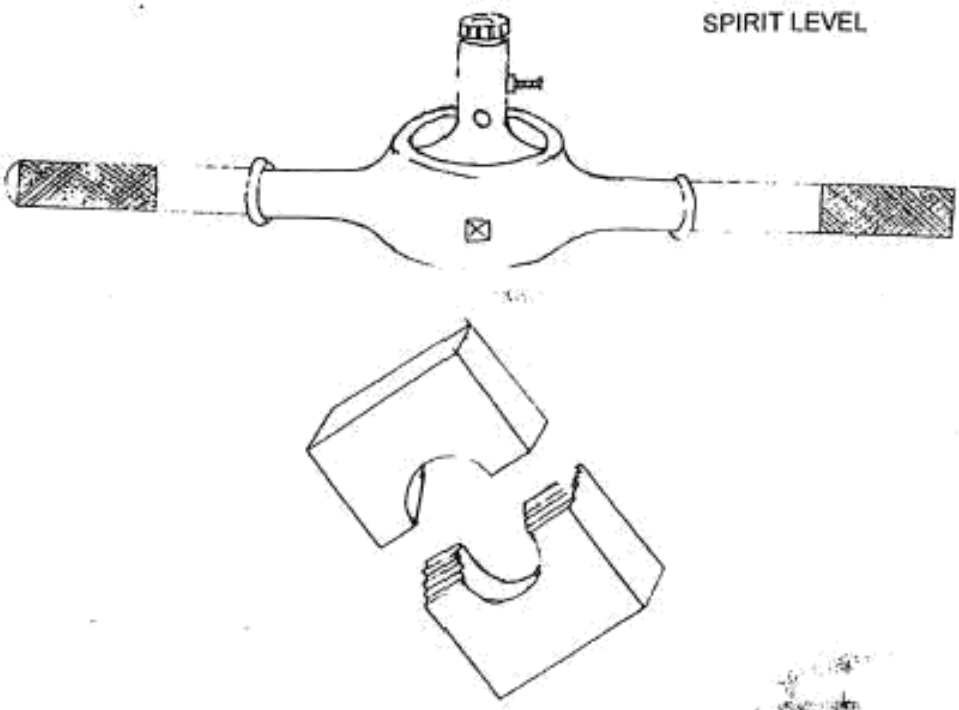
It is a simple modified globe valve with the outlet bent downwards for easy collection of water.

FOOT VALVE

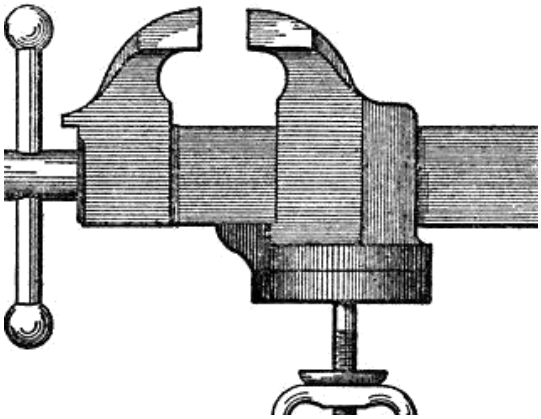
It is a one way or non return valve fitted at the suction point of a pump. A flap loaded with a weight or spring closes the valve when water tends to flow in the opposite direction. This ensures that suction pipe and pump body is fitted with water and pump does not need priming.



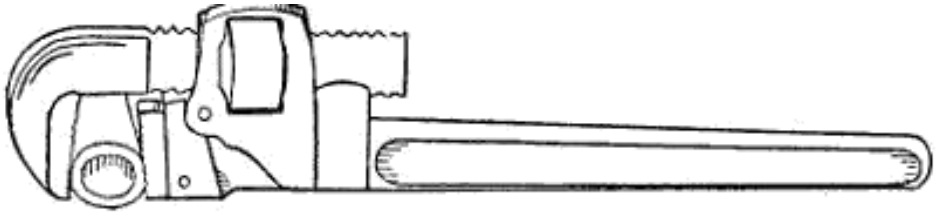
SPIRIT LEVEL



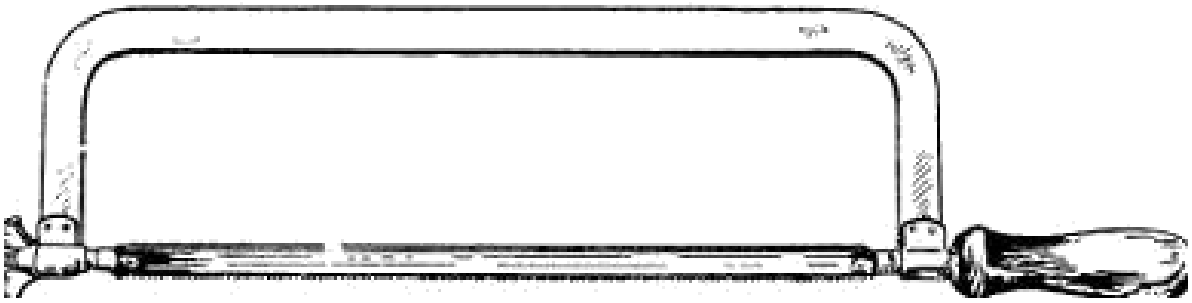
STOCK & DIE SET



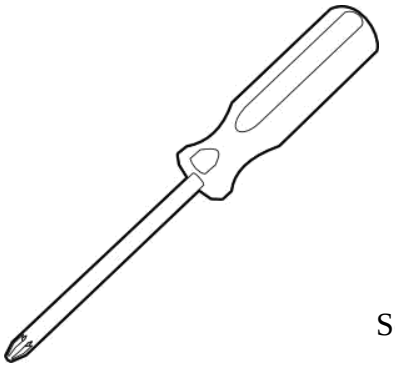
Pipe vice



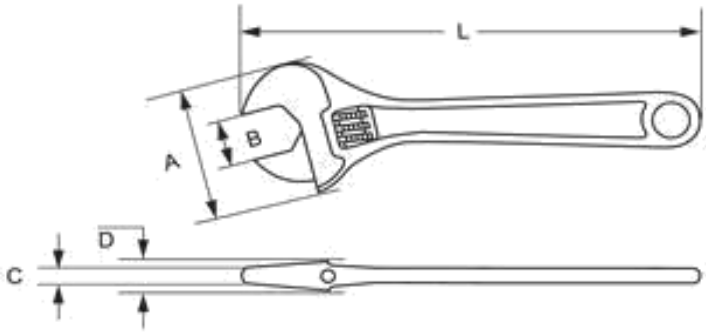
Pipe wrench



Hack saw

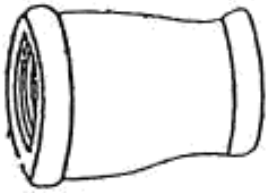


Screw driver

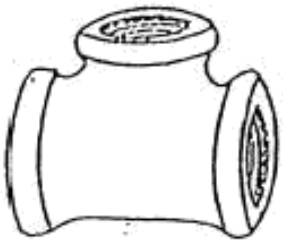


Adjustable spanner

a - Elbow

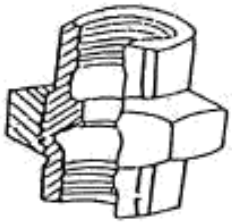


b - Reducer Coupling

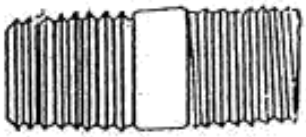


c - Tee

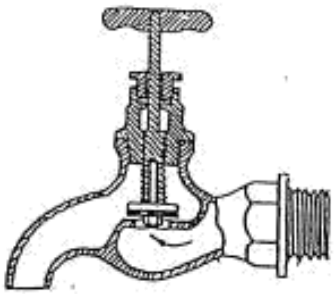
d - coupling



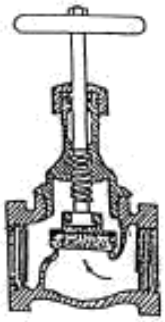
e-Union



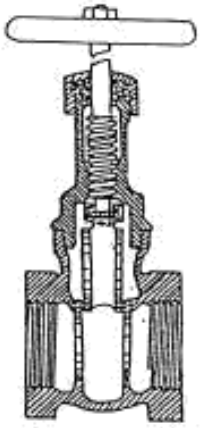
F - Nipple



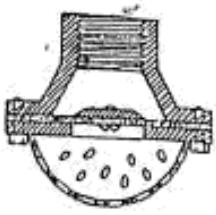
SDB TAP



GLOBE VALVE



GATE VALVE



FOOT VALVE

EXPERIMENT NO. 7 **DATE**

PIPE LAYING PRACTICE

AIM

To lay a pipe line with required specials and fittings.

MATERIALS REQUIRED

PVC pipe, specials like Tee, reducer coupling and fittings like Gate valve, Globe valve, Tap etc.

TOOLS REQUIRED

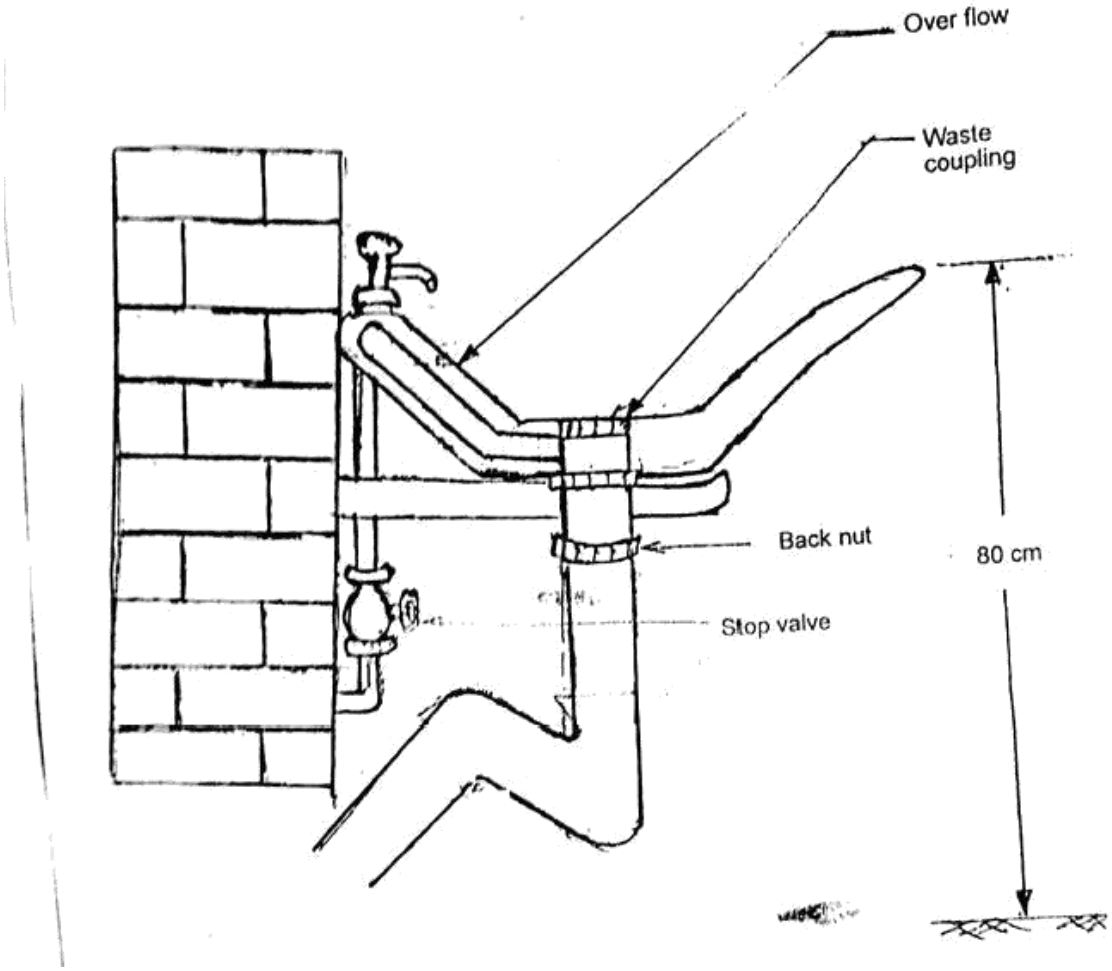
Pipe wrench, die set, hack saw, portable drilling machine , screw driver, adjustable spanner.

PROCEDURE

1. Collect the required materials from the store.
2. Cut the PVC Pipe to required length and thread both the ends using a die set, pipe vice and pipe wrench
3. Apply a coat of shellac and jute on the outside of pipe thread and the inside of fitting/ specials
4. Tighten the fitting/specials using a pipe wrench holding the pipe in a pipe vice
5. Similarly connect all pipes, fittings and special
6. Fix the layout on the wall using pipe clamps and complete the pipe lay out a s shown in the figure.

RESULT

The required pipe lay out was completed



EXPERIMENT NO. 2

EXPERIMENT 8 **DATE**

FITTING OF WASH BASIN

AIM

To practice fixing of wash basin.

TOOLS REQUIRED

Steel tape, screw driver, pipe wrench, adjustable spanner.

MATERIALS REQUIRED

Wash basin, pillar cock, flexible connector, brackets, wooden plug, shellac, pvc pipe.

OPERATION TO BE CARRIED OUT

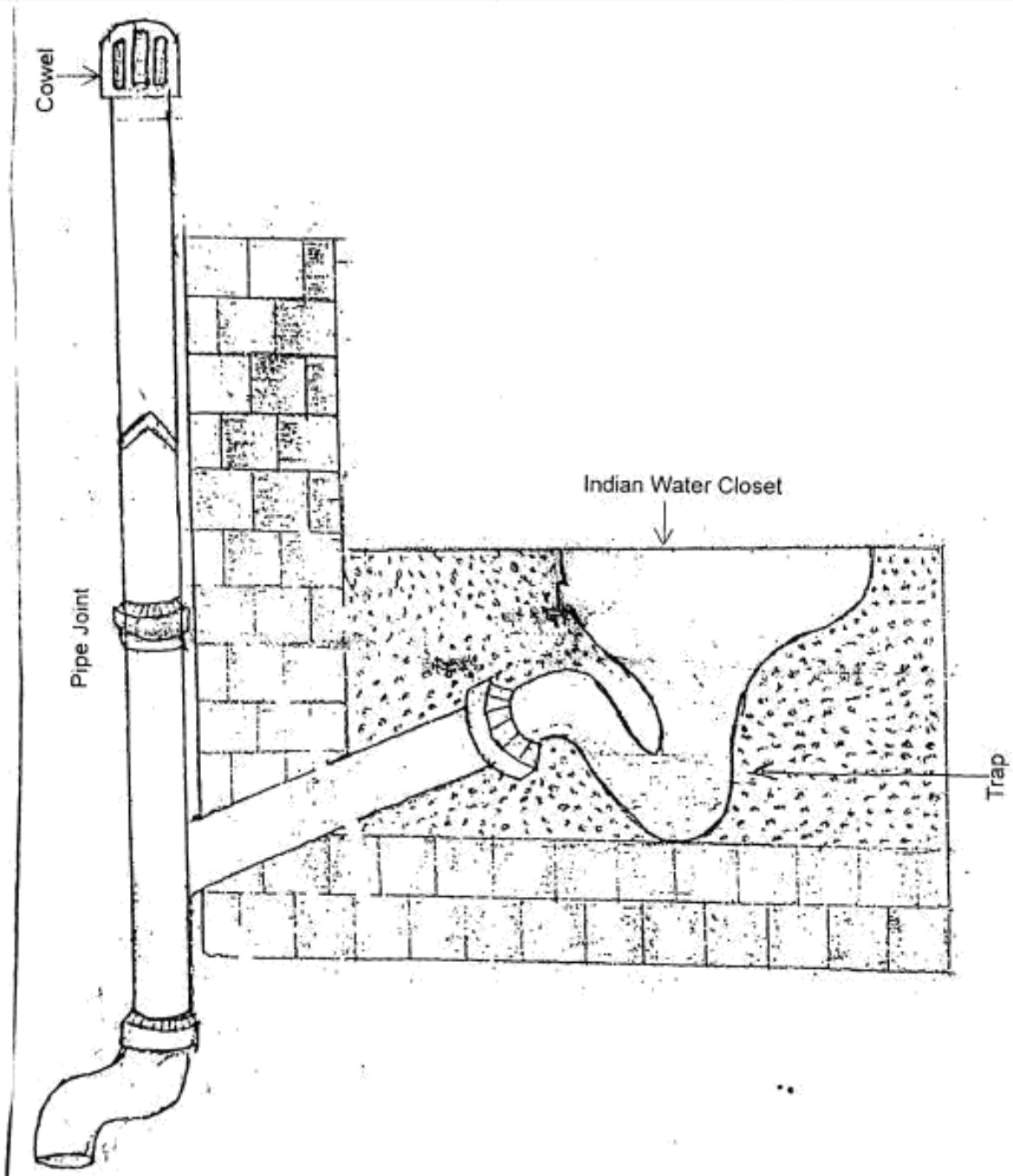
Measuring , marking, fixing and joining.

PROCEDURE

1. Mark a point on the wall where the wash basin is to be fixed (approximately 80 to 85cm ab9ove floor).
2. Bore holes at that point and fix the brackets or raw bolts.
3. Fix the basin on the bracket and check the level.
4. Fix the Piller cock, flexible connector and outlet waste pipe under the wash basin and connect it to the service channels properly.

RESULT

The wash basin is fitted.



INDIAN WATER CLOSET

EXPERIMENT 9 **DATE**

FITTING OF INDIAN WATER CLOSET

AIM

To practice fitting f Indian type water closet.

TOOLS REQUIRED

Steel tape, spirit level, showel, mortar pan, trowel.

MATERIALS REQUIRED

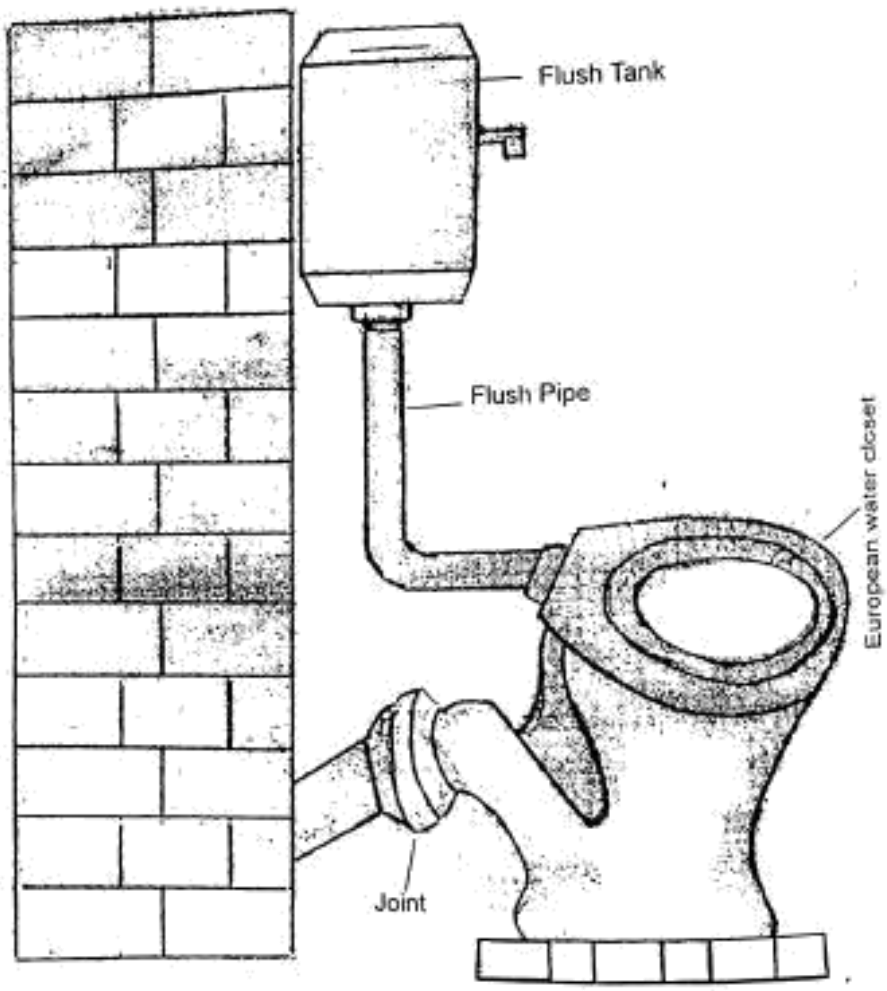
Indian water closet with foot rest, trap.

PROCEDURE

1. Make excavation of 50cm depth to fix the trap and closet
2. Place the trap in proper position and fix water closet over it
3. Level it using a spirit level and fix with cement mortar
4. Then conveniently fix the foot rest at the both sides of the closet

RESULT

The Indian water closet was fitted.



EUROPEAN WATER CLOSET

EXPERIMENT 10 **DATE**

FITTING OF EUROPEAN WATER CLOSET

AIM

To practice fitting of European type water closet.

TOOLS REQUIRED

Steel tape, Screw driver, spirit level, pipe wrench, adjustable spanner

MATERIALS REQUIRED

European water closet, flush pipe, flush tank, pipe.

PROCEDURE

1. Clean the floor.
2. Place the European type water closet in position on the floor.
3. Level it using a spirit level and fix with screws.
4. Fix a low level flush tank on the wall over the closet.
5. Fix the flush pipe from flush tank to the closet.
6. Connect the pipe and trap to the service lines.

RESULT

European water closet is fitted.

VI. BUILDING MATERIALS

INTRODUCTION

Wide varieties of materials are used for making engineering structures and buildings. It is necessary for an engineer to have a basic knowledge of these materials which are available either from natural resources or manufactured. Commonly used building materials are stones, bricks, cement, steel and wood

STONES

Stones are used in Civil engineering constructions in different forms. Stone blocks irregular in size called rubbles are used for building walls. These rubbles are cut forming cubical blocks of size 200mm – 230mm side, and they for the basic material for masonry wall construction. Smaller irregular stones of size 100mm-150mm are used for constructing the base of floors and roads. Stones broken into smaller pieces of 75mm size and less are called aggregates. Larger size aggregates are used for making roads. Smaller aggregates of 40mm and below are used for making concrete

BRICKS

A brick is a block or a single unit of a kneaded clay-bearing soil, sand and lime, or concrete material, fire-hardened or air-dried, used inmasonry construction. Lightweight bricks (also called "lightweight blocks") are made from expanded clay aggregate. Fired bricks are the most numerous type and are laid in courses and numerous patterns known as bonds, collectively known as brickwork, and may be laid in various kinds of mortar to hold the bricks together to make a durable structure.[1] Bricks are produced in numerous classes, types, materials, and sizes which vary with region and time period, and are produced in bulk quantities. The standard size of bricks are 19cm x 9cm x 9cm

CEMENT

A cement is a binder, a substance that sets and hardens and can bind other materials together. The various types of cements are Rapid Hardening Cement, Quick setting cement, Low Heat Cement, Sulphates resisting cement, Blast Furnace Slag Cement, High Alumina

Cement, White Cement, Coloured cement, Pozzolanic Cement, Air Entraining Cement, Hydrographic cement

CONCRETE

When stone or gravel, sand, cement and water are mixed together, they form an easily workable plastic mixture which can be moulded and cast into desired shapes or structures. This cement and water in the plastic mixture undergoes a chemical combination in a few hours after mixing results in a solidification and gradual hardening. This mixture is called concrete

TIMBER

It is the wood suitable for building or engineering purposes and it is applied to trees measuring not less than 0.6m in girth

CONCLUSION

The various building materials used for making engineering structures and buildings are discussed.

EXPERIMENT 11 **DATE**

TESTING OF BUILDING MATERIALS

AIM:-

To do the compression testing of the given three construction materials and compare the strength

APPARATUS

Compression Testing Machine

PRINCIPLE

In the study of strength of materials, the compressive strength is the capacity of a material or structure to withstand loads tending to reduce size. It can be measured by plotting applied force against deformation in a testing machine. Some materials fracture at their compressive strength limit; others deform irreversibly, so a given amount of deformation may be considered as the limit for compressive load. Compressive strength is a key value for design of structures. Compressive strength is often measured on a universal testing machine.

PROCEDURE

1. Remove the unevenness of the specimen and find the cross sectional area
2. Place the specimen between plates of the testing machine
3. Apply load axially at a uniform rate of 14 N/mm^2 per minute till failure occurs and note maximum load at failure
4. The load at failure is the maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine. Note down the reading
5. Calculate the compressive strength

RESULT

The compressive strength of the given specimens were determined and the comparison was done

CALCULATION

$$Compressive\ Strength = \frac{Maximum\ load\ at\ failure\ (N)}{Average\ Area\ (mm^2)}$$

Sample no:	Specimen	Cross sectional area(mm^2)	Maximum load at failure (N)	Compressive strength(N/mm^2)
1				
2				
3				

HOME ASSIGNMENTS

1. Preparation of a building model - The students in batches should prepare and submit a building model for a given plinth area in a given site plan constrained by a boundary wall. The minimum requirements of a residential building viz., drawing cum dining room, one bed room and a kitchen should be included. The concept of an energy efficient building should also be included in the model.

2. Report preparation - The student should collect the construction details of an industrial building related to their branch of study, prepare and submit a detailed report with neat illustrations. Home assignment

3. Report preparation - The students should collect samples of building materials, prepare and submit a detailed report about their market rates.