1

NOMENCLATURES AND THEIR MEANINGS

Introduction: Building is defined as that construction which has walls, columns, floor, ceiling, doors, windows, ventilators, stair case, lift and other related components. One of the main jobs of civil engineer is to construct building. For this it is very essential to have good knowledge of different parts of building and their construction related information and practices.

Role and Responsibilities of Construction Supervisor

The construction supervisor posted at job site should have the capability to understand fully and clearly the instructions given by higher authorities. He is responsible for getting the job done accordingly, by the skilled, semi-skilled and unskilled labourers / He should understand the abbreviations which are given below:

TABLE : 1.1

Abbreviation	Meaning	Abbreviation	Meaning	Abbreviation	Meaning
A.C.	Air Conditioner	A.C.B.	Air Circuit Breaker	A.C. Sheet	Asbestos Cement Sheet
B.C.	Bearing Capacity	B.M.	Bench Mark	B.O.C.	Bottom of Concrete
C.A.	Coarse Aggregate	C.B.	Circuit Breaker	C.C.	Cement Concrete
C.G.I.S.	Corrugated Galvanized Iron Sheets	C.I.	Cast Iron	C.J.	Construction Joint

C.L.	Center Line	C.M.	Cement Mortar	C.P.	Chromium Plated
C.S. Area	Cross Sectional Area	D.B.	Distribution Board	D.C.	Direct Current
F.A.	Fine Aggregate	F.M.	Fineness Modulus	F.T.	Floor Trap
G.F.L.	Ground Floor Level	G.I.	Galvanized Iron	G.L.	Ground Level
G.T.	Gully Trap	H.P.	Horse Power	H.T. Cable	High Tension Cable
I.C.	Inspection Chamber	ISMB	Internal Standard Medium Beam	I.S.M.C.	Indian Standard Medium Channel
I.W.C.	Indian Water Closet	L.D. Cover	Light Duty Cover	L. L.	Live Load
L.T. Cable	Low Tension Cable	M.B.	Measurement Book	M.C.	Moisture Content
M.C.B.	Miniature Circuit Breaker	M.R.P.	Maximum Retail Price	M.S.	Mild Steel
M.S.L.	Mean Sea Level	N.A.	Not Applicable	NRV	Non Return Valve
O.B.D.	Oil Bound Distemper	O.C.B.	Oil Circuit Breaker	O.H.T.	Over Head Tank
O.P.C.	Ordinary Portland Cement	O.W.C.	Orissa Water Closet	P.B.	Plinth Beam
P.C. C.	Plain Cement Concrete	R.B.C.	Reinforced Brick Concrete	R.C.C.	Reinforced Cement Concrete
R.L.	Reduced Level	R.M.C.	Ready Mixed Concrete	R.R. Masonary	Random Rubble Masonary
R.S.	Rolled Steel	R.W.P.	Rain Water Pipe	S.C.	Stop Cock
S.C.I.	Sand Cast Iron	S.F.	Shear force	S.S. Pipe	Stainless Steel Pipe
S.W.G.	Standard Wire Gauge	S.W. Pipe	Stone Ware Pipe	T&P	Tools & Plant
T.W.	Teak Wood	W.B.	Wash Basin	W.B.D.	Water Bound Distemper
W.B.M.	Water Bound Macadam (Road)	W.C.	Water Closet	W.L.	Water Level
W.O.	Work Order	W.P.	Waste Pipe	W.T.	Water Table

TABLE : 1.2

Units of Measurement

General Construction Material	Unit of Measurement
Cement	Bag, Metric Ton
Sand	Cubic metre or Cubic ft
Aggregates	Cubic metre or Cubic ft
Earth Work	Cubic metre or Cubic ft
Timber	Cubic metre or Cubic ft
Board, Ply	Square metre or Square ft
Brick	1000 Nos.
Reinforcement Steel	Kilogram, Metric Ton
Steel (Angle, Channel, Beams)	Kilogram or Metric Ton
Steel Plates or Sheets	Square metre or Square feet
M.S., G.I., C.I., or S.W. Pipe	R.M. (Running Metre)
Stone	Number
Liquid Paint	Ltr.
Powder Paint, Cement Paint, dry distemper	Kg.
Cement Water Proofing Compound	Kg.
Wax Polish	Kg.

TABLE : 1.3

Plumbing and Sanitary Fitting

General Construction Material	Unit of Measurement
Water Supply / Sewer Pipe	Metre
Water Supply specials (Bend, Elbow, etc.)	Nos. (dia /Nos.)
Fitting	Nos.

TABLE : 1.4

Unit of Measurement for different types of Construction Works

Name of the Work	Unit	Work	Unit
Earth Work (Filling & Cutting)	Cubic Metre	Concrete Work	Cubic. Metre.
Skirting, Water line, Sewer line, Draining Pile, Railing	Running Metre	Reinforcement	Kg.
Brick Work (one brick or more)	Cub. Metre	Plastering & Painting (Doors & Windows)	Sq. metre
Brick Work (less than one brick thick)	Square metre	Flooring & Pointing	Square metre
Structural steel works	Kg	Grills	Square metre or Kg

TABLE : 1.5

Definition of the different parts of building

Name of the part of Building	Definition
Balcony	The extended portion of the slab of any floor excluding Ground Floor.
Barsati	A Room on the Top Floor (with or without toilet).
Basement	Space below the Ground level, may be open or closed, used for store or parking.
Canopy	The portion above the main door of the building extending out side.
Carpet Area	The total constructed area of the building which may be 50 to 57% of total floor area.
Circulatory Area	Area of the building which is used for movement within the building.
Court Yard	Part of the building which is open to sky.

Jhajja or Sunshade	The extended portion of lintel above the door or window.
Floor Area Ratio (FAR)	Ratio of floor area to plot area
Garrage	Part of the building at Ground level where vehicle is parked.
Tand (Wall shelf)	Shelf supported on the wall extending 90 cm and at a height of 2.2 m above the floor surface.

Living Area: Living area is generally found for determining the fees / rent of the Government buildings.

The method of finding living area is as follows:

1. 100% of the area of Rooms, Kitchen, Bathrooms, Latrines, Store, Verandah (closed)
2. 25% of the area of open verandah, Corridor and Barsati.
3. 12 ½ % of the area of the Porch floor.
4. 5% of the area of Pucca Court Yard.

TABLE : 1.6

Lobby	It is that area of the house which is not used as room, but it is used for going from one room to the another.
Loft	Space at the top or bottom between the ceiling or floor extending from the wall at lintel level as slab, and it is used for keeping the things.
Stair case	Room used to cover steps / stairs, which saves the stairs from rains.
Mezzanine Floor	A small floor constructed between two floors, whose area is not more than 1/3rd area of the bottom floor and height of the floor is not more than 2.2 m.
Open Area	Open Area is equal to plot area minus ground area.
Out house	A house outside the main house
Parapet	It is a 90 cm high wall or railing arrow the top open terrace.
Platform	A raised Area, constructed in front or back of the house.

Plinth Area or Covered Area: Area enclosed by the house:

Areas not included in the plinth area are raised platform out of house, stair case area, sun shades, compound wall of gardens, Tank, Pavement, Parking Area, Common Entrance, Pump House, Servant Room, etc..

Following areas are included in plinth area

- stairs if in the room.
- Half the area of balcony if the width is more than 3.0 ft.
- Full area of the covered balcony.

Main points in Plinth Area Calculation

1. The wall thickness area are included.
2. The areas of Canopy, covered balcony, Parapet and Railings.
3. 50% Area of open balcony enclosed by Railing or parapet.
4. Any platform constructed in open sky is not included in plinth area.
5. If the verandah is covered its total area is included in the plinth area.
6. 50% of area of such raised platform which is enclosed with walls from three sides.

TABLE : 1.7

Plinth height	Height of floor level from G.L.
Plinth Security	One metre width projecting outside the plinth constructed for saving the plinth.
Plot Area	Total area of the plot.
Porch	Covered area, which is constructed in front of the main door of the building, where vehicles come and stop.
Roof	Topmost slab covering the building.
Set back	The open space from the boundary of the plot facing road side .
No. of Storey	No. of floors - 1

Terrace	Open space in front of a room at the roof level.
Verandah	It is a covered space enclosed on three sides and open on one side.

TABLE : 1.8

Formulae for determining the Areas

Shape	**Area**	**Perimeter**
Rectangle	Length × Breadth	2 (Length + Breadth)
Parallelogram	Base × Height	2 (Length + Breadth)
Triangle	½ × Base × Height	Sum of all the three sides
Trapezoid	½ (Length 1 + Length 2) × Height	Sum of all the four sides
Circle	$\pi \times (\text{radius})^2$	$2 \times \pi \times$ radius

Formulae for determining the Volume

Shape	**Area of shape**	**Volume**
Cube	6 x $(\text{side})^2$	Length × Breadth × Height
Cone	$\pi \times (\text{radius})^2 + \pi \times$ radius × diagonal height)	1/3 $\pi \times (\text{radius})^2 \times$ height
Rectangular prism	(Sum of all the three sides) × length + Base × Height	½ (Base × Height) × Length
Cylinder	$2 \times \pi \times$ radius × height	π x $(\text{radius})^2 \times$ height
Pyramid	(2 × Base × Height) + $(\text{Side})^2$	1/3 × Area of Base × Height
Sphere	$4 \times \pi \times (\text{radius})^2$	(4/3) x π x $(\text{radius})^2$

Diagonal height = Square root of $(\text{Radius}^{2)} + (\text{Height})^2$

Value of π = 22/7 = 3.1416

2

INTRODUCTION TO DRAWING

2.1 INTRODUCTION

When we speak something it is expected that the other person who is listening understands the same and it is called the language. When we write something which is expected that the other person who is reading understands the same, this is called script e.g. Devnagri Lipi or Persian Lipi. In the same way an engineer communicates his idea through drawings, which is his script.

2.2 OBJECTIVES

After going through this lesson you will be able to:

- explain the meaning of building drawing;
- define the need for scale of the map;
- describe the type of drawing.

2.3 IMPORTANCE OF PLAN/MAP

First of all a plan/map is made before starting the construction project. As a matter of fact this determines as to at what place what will be constructed. e.g. Bed room, Kitchen, Drawing room, Bathroom Verandah, etc. After this, the front elevation and side elevation of the proposed building is prepared. All these maps show as to how the building will look when we see it from the top, front and side.

Long time back the units for measuring length, weight and time were inch,/ feet,/yard, ounce,/pound,/ton and second / minute/hour. The area of any place was measured in sq. inch, sq. ft, and sq. yd units.

Now, the units to measure these are Metre, Kilogram, and Seconds/1 m = 100 cm = 1000 mm. 1 km = 1000 meter.

Similarly 1 kg = 1000 gm, 1 Ton = 1000 kg = 10 quintal.

Let us suppose that it is proposed to construct a room where clear dimensions area 3.5 x 3.0 m and the thickness of the wall is 25 cm. If you see its plan you will get a rectangle.

2.4 NATURE OF THE DRAWING

For knowing the location of the site, you should know the site plan. In the site plan important buildings and places are shown. These are called land marks and they help in reaching the site. You might have seen these land marks in road directions given often in invitation letter. They help in reaching the place where the function is to be held.

After locating the site with the help of road map the size of the plot is to be measured for which layout plan and site plans are required. This is usually given in the same map. Sometimes it is on a separate sheet as well. In this plan the details such as adjoining the plot other houses, roads, etc. are shown. All these things help in correctly locating the plot. Pegs are placed at located site.

Boundaries of Actual Construction:

With the help of site plan the locations of all the walls are drawn on the actual land. This is called layout plan of the building.

2.5 IMPORTANT PARTS OF THE BUILDING DRAWING

2.5.1 Direction Symbol (North line)

This is an important part of any drawing. Whenever any information about the site is required, we can use this direction symbol. A typical direction symbol is shown in Fig. 2.1.

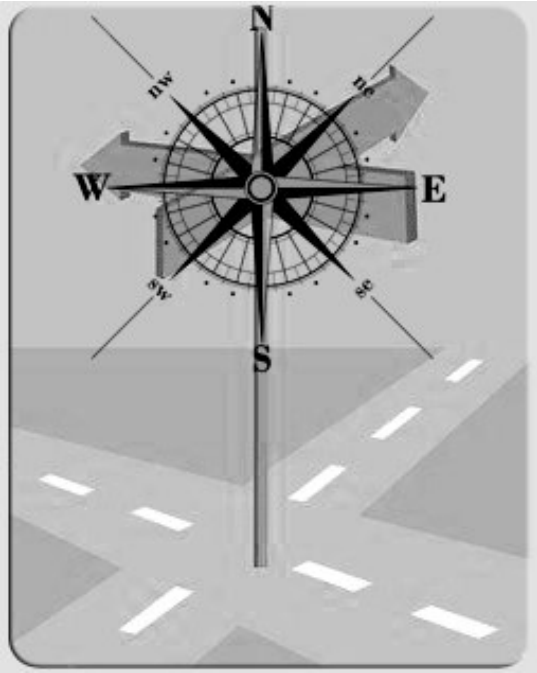


Fig. 2.1

2.5.2 Detailed Plans

In this plan a detailed drawing is prepared on a suitable scale of all the parts of the building with dimensions written on each part in most of the cases (Fig. 2.2). In case no dimension is written on one or two parts it can be measured and converted to the actual size by using the scale.

The section of the building cut at the sill level of window and are drawn to a scale as seen for the top is called sectional plan. The window level is called sill level of the building (Ref. Fig. 2.3). In this plan we can measure only length and breadth of any item of the building.

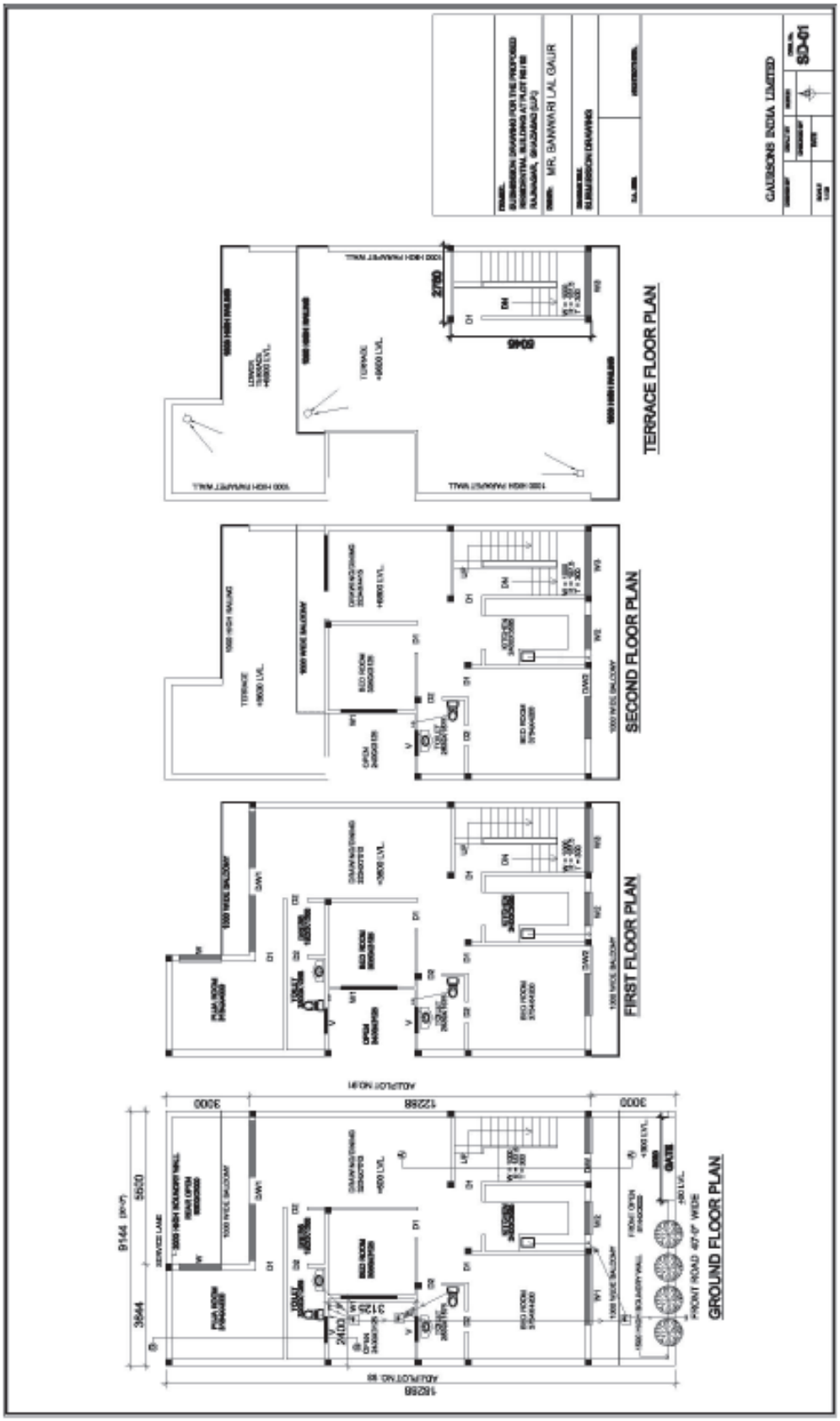

GAURSONS INDIA LIMITED
SD-01
MR. GANWARI LAL GAUR
TERRACE FLOOR PLAN
SECOND FLOOR PLAN
FIRST FLOOR PLAN
GROUND FLOOR PLAN
FRONT ROAD 40'-0" WIDE
SERVICE LANE
3000
12288
9144
3644

Fig. 2.2

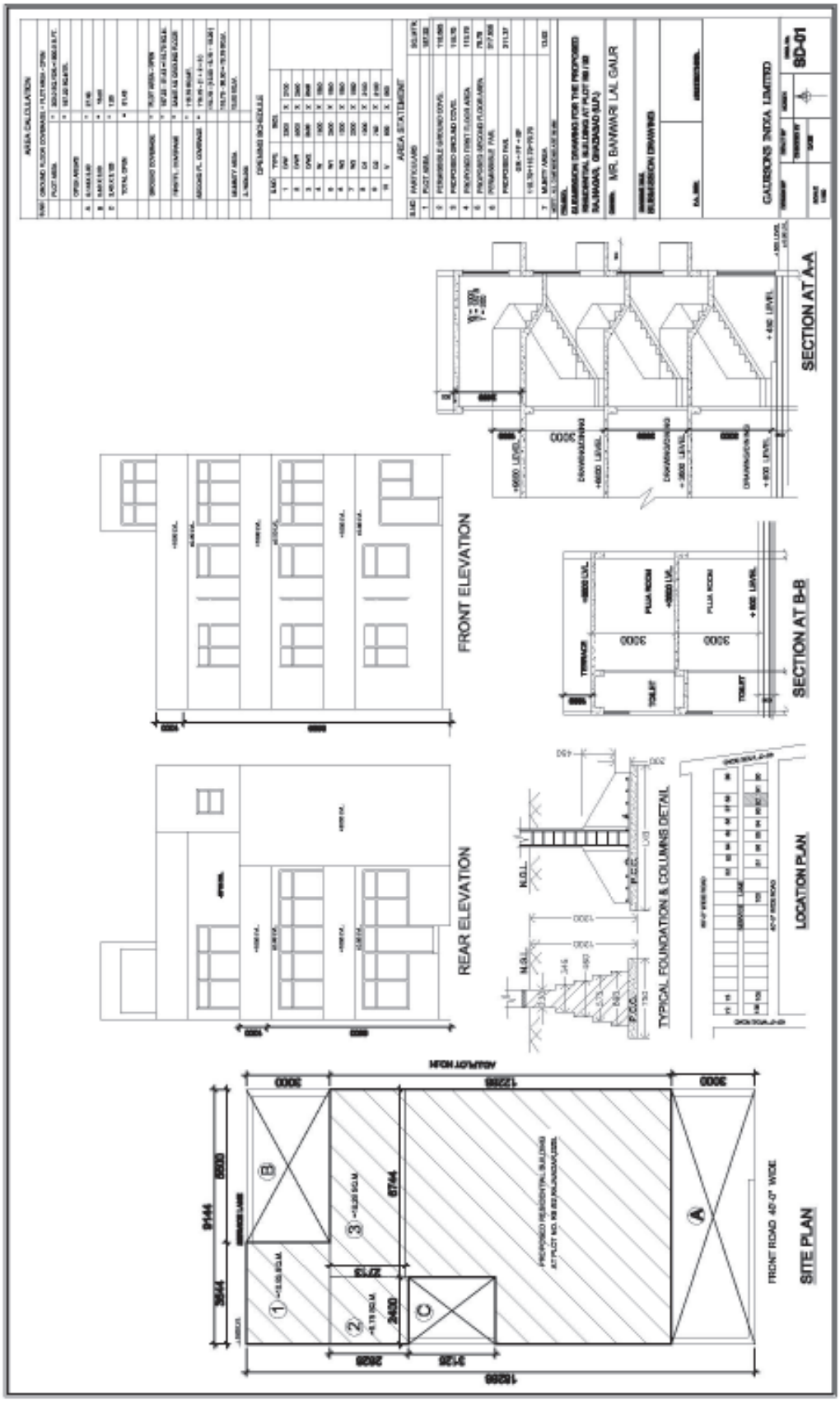

SECTION AT A-A
FRONT ELEVATION
SECTION AT B-B
REAR ELEVATION
TYPICAL FOUNDATION & COLUMNS DETAIL
LOCATION PLAN
SITE PLAN
GAURSONS INDIA LIMITED
SD-01
M/S. BANWARI LAL GAUR

Fig. 2.3

Fig. 2.4 Three dimensional view of building

2.5.3 Views

Any building can have following views (Figure 2.3 and 2.4)

Front elevation: It is the view of the building when observed from the front. In this view length / breadth and height are shown.

Side elevation: It is the view of the building when seen from the side.

Real view/three dimensional view: It is the view of the building when seen through an angle of 30^0 or 60^0 from the front.

2.6 PLANS FOR SERVICES

Along with the map of the proposed building such as site plan, lay out plan, sectional plan, front elevation, side elevation, sectional elevation other related drawings of the building are also prepared. These are as follows:

1. Sanitary and water supply lines
2. Electrical fittings lines
3. Timber works drawing
4. Reinforcement details / plans (Ref. Fig. 2.5)

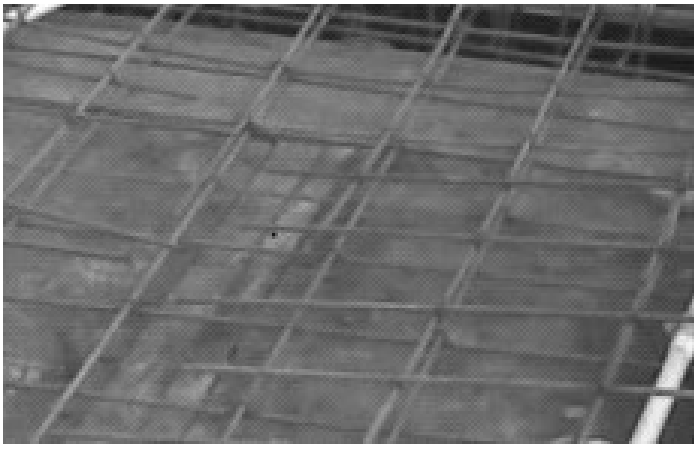


Fig. 2.5

2.7 SCALE OF THE DRAWING

The scale of any drawing shows the ratio of distance on the land to that of the distance shown on the plan/map for the same object. For example if two

points at a distance of 10 m are required to be shown on the map, it can be shown by 1.0 cm distance on it. This is called the scale of the map.

If expressed in the same unit then it is called R.F. (Representative Fraction), which will become 1000 in the above case. It may also be termed as scale ratio.

This ratio can be increased or decreased as per need.

Table No. 2.1

Length in the map			Scale (Ratio)	Original Length of land/object	
in mm	in cm	in m		in cm	in m
1	2	3	4	5	6
	Column 1 /10	Column 2 /100		Column 2 /scale ratio	Column 5 /100
3000	300	3	1:100 or 1/100	30000	300
3000	300	3	1:50 or 1/50	15000	150
3750	375	3.75	1:100 or 1/100	37500	375
3750	375	3.75	1:50 or 1/50	18750	187.5

2.8 WHAT HAVE YOU LEARNT

- Map shows the plan of construction i.e. what will be constructed and where.
- Site plan is prepared accordingly.
- There is a special technique to measure distances through maps using scale of the map.

2.9 TERMINAL QUESTIONS

1. What do you understand by the term “Map”?
2. How many types of maps are there?
3. What is the necessity of scale in the map?
4. Differentiate between plan and elevation.
5. What are the things required to be present in the site map for site identification?
6. What is the difference between front elevation and side elevation?
7. What do you understand by the term “detailed map”? Describe in brief.
8. Why direction/road map plan is made?

3

SURVEYING

3.1 INTRODUCTION

The art of measuring the distances and angles on ground in such a way that it becomes reproducible on a map which is drawn to scale later on, is called surveying.

Surveying is a science as well as an art, by which studies are made of the objects present on the ground and below the ground at different points. Although the earth is spherical but during survey of small areas, we consider it flat. If large areas are to be surveyed, it is considered spherical, while making maps of the different countries. In that case it is called Geodetic survey.

3.2 OBJECTIVES

After reading this lesson you will be able to:

- define surveying;
- describe the aims of surveying;
- explain the utility of the apparatus used in surveying and their proper use;
- prepare the maps of the land pieces and calculate the area of the land;
- establish the relative position of every point on the land and their levels;
- explain layout the building plan on the land;
- calculate the area of land.

3.3 WHAT IS SURVEYING

Knowing about the relative position of various objects, determination of distances between them, measurement of angles, measurement of height, determination of boundaries and relative heights of various points come under the purview of surveying.

It is very essential to mark the various points on the land, boundary lines of the proposed construction sites and levels (heights) of the various locations before starting the construction of building, bridge, embankment, railway line etc.

After performing the measurements of the shape, size and location of objects on ground, the details are plotted on paper (drawing sheet). After the completion of drawing which may be one or more than one, describing the details, the construction process is started. After determining the details of the soil strata below ground and bearing capacity of soil which is called Geotechnical survey, the depth of earth work is decided by the engineer. All these things are inter-related and forms the part of the total survey work.

At first sight the job of survey looks very simple but it actually requires special knowledge about it and the understanding of the job. The students who have studied or who have the knowledge of Mathematics and Physics can acquire the knowledge about survey in a nice manner. The pace of development which is going on in India and through out the world has increased the importance of survey, related works.

Measurement of Length

Appropriate measuring tape (Fiber, steel, etc.) or chain (Fig. 3.1) is used. The metallic end of the tape is also taken into account while measuring the length. The distances are written on the tape in m, cm, etc.

3.4 TYPES OF SURVEYING

The types of surveying which are extensively being conducted are many e.g. Contour survey, Land survey, city survey, topographical survey, route survey, Mines survey, engineering survey, satellite survey, geological survey, Construction survey etc. However we, will discuss only construction related surveys here.

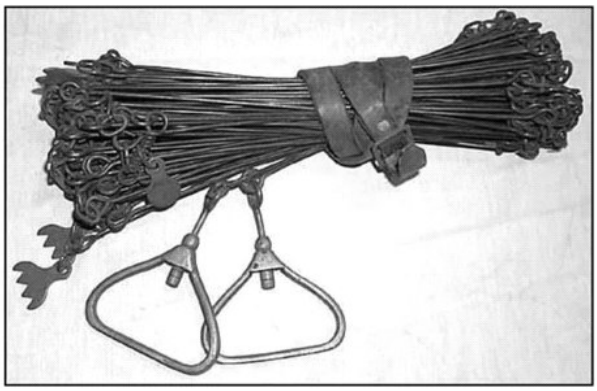


Fig. 3.1

3.4.1 Classificatoin of Survey

a) **Compass Survey:** In this survey either trough compass (Fig. 3.2) or prismatic compass (Fig. 3.3) are used. The angles are measured as internal angles using those apparatuses and the lengths between various points are measured by using measuring tapes.

Fig. 3.2: Trough Compass

Fig. 3.3: Prismatic Compass

Fig. 3.4: Prismatic compass

b) **Levelling:** Relative heights of different points situated on the ground is measured by this apparatus. This helps to know as to by how much amount a point is either higher or lower with respect to each other and standard bench mark.

c) **Plane Table Survey:** This type of survey is conducted by using a drawing board mounted on a Tripod stand, Control over the point situated on the ground which is called station. An alidade is used to draw line parallel to the line between the two existing stations A and B. The alidade has a slit on the observation side and a thread (vertical) on the object side. Only one side of the alidade is used (usually right hand side). The lines are drawn to the selected scale on the drawing paper pasted on the drawing board of the plane Table. This type of survey is called Plane Table Survey (Refer Fig. 3.5)

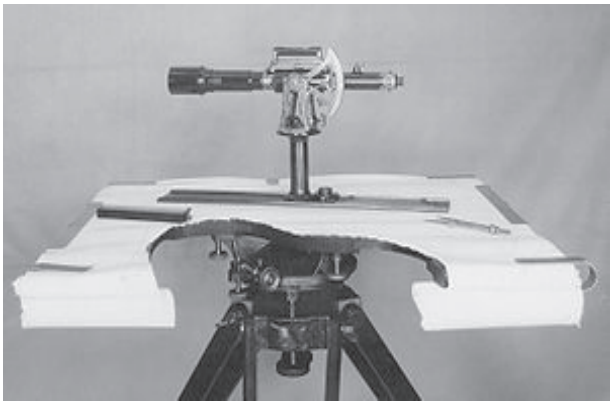


Fig. 3.5

3.5 ANGLES

If a circle is drawn using drawing compass, its total angle is 360^{o} (degree). Every degree is divided into 60 minutes and then every minute is divided into 60 seconds e.g.

1 degree = 60 minute

1 minute = 60 seconds

3.6 LEVELLING

Leveling (survey) is conducted either by a conventional apparatus called "Dumpy

level" or by a modern apparatus called "Total station" (Automatic modern levelling apparatus). In both the machines a telescope is horizontally mounted on a tripod stand. This telescope is free to move in 360° rotation in the horizontal plan. The viewing glass near the eye is called eye piece, and the viewing glass facing the object is called object piece. The line (imaginary) which joins the centres of the eye piece and object lens, is called the line of collimation.

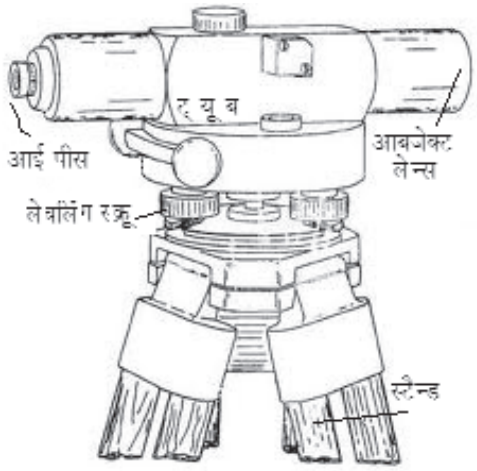


Fig. 3.6: Dumpy level

Fig. 3.7: Modern Automatic lavelling M/c

In the Dumpy level the line of collimation is made horizontal by using the bubble of the sprit level which comes into middle when the horizontality is achieved. This is done by using leveling screens. In automatic leveling machine a rough horizontality is achieved by using spirit level and finally fine tuning is done in an automatic manner. After achieving, the horizontality of line of collimation The instrument is turned by 360°. The imaginary plane formed by the rotation of

line of collmation by 360^{o} is called the plane of collimation. All the readings of level are taken at this plane of collimation by rotating the equipment horizontally.

In automatic machine (total station) it is possible to record the distance and height electronically without actually measuring the distances on the ground.

(Ref Fig 3.6 for Dumpy level and Fig 3.7 for modern automatic leveling machine)

3.6.1 Words used in leveling survey works

1. Station: It is a point on the ground where the leveling staff is kept (erect position) for measuring the height of line of collimation.
2. Leveling staff: It is a collapsible 4" (five inch wide) wooden staff on which m, cm & mm are marked.
3. Height of instrument: The height of line of collimation with respect to reference bench mark is called height of instrument.
4. Back sight: When the leveling staff is kept erect at a point on the ground whose level is already known by previous measurement whether done much earlier or during the present survey after changing the instrument station, is called the Back sight reading.
5. Fore sight: It is the last reading taken on the leveling staff during level survey.
6. Intermediate sights (reading): Reading taken on the leveling staff on any point on the ground which is in between back site reading and fore sight reading.

3.7 FIELD BOOK (LEVEL SURVEY)

There are two methods by which the levels of different points situated on ground is calculated after completing the field work. These are :

1. Height of Instrument method
2. Rise and fall method

Table 3.1: Height of Instrument Method

Station (1)	B.S. (Back Sight) (2)	I.S. (Intermediate Sight) (3)	F.S. (Fore Sight) (40	H.I. (Height of Instrument Method) (5)	R.L. Reduced Level (6)	Remarks (7)
A	1.310	2.10		101.310	100.00 99.210	BM
B	1.420		2.245	100.485	99.065 98.865	TP
C		1.620	2.150		98.335	
Sum	2.730	3.720	4.395			

According to the above table three stations viz., A, B and C have been chosen. The R.L. at station A which is called Bench Mark (B.M.) is known/assumed to be equal to 100.00. The instrument has been shifted to 'B' and back sight at 'A' is taken an intermediate site is also taken and these after Final reading at station 'C' which is called fore sight is also taken. All the readings are shown in Table 3.1.

For checking the work following formula is used:

(Sum of all Back Sight – sum of all Fore Sight) = First reading – last reading

(2.730 – 4.395) = (98.335 – 100)

Or 1.665 = – 1.665

It means that our calculation is correct.

3.8 WHAT HAVE YOU LEARNT

- Main information related to surveying.
- Classification of surveying
- Apparatus/Equipment used in surveying

- Importance of measurement of angle and levels.
- Words used in survey works.

3.9 TERMINAL QUESTIONS

1. Define surveying and give its classifications.
2. Give the different classifications of surveying based on the type of equipment used.
3. What is leveling?
4. Prepare a chart for finding the levels of different points situated on a piece of land.
5. Define the following words:
   a) Intermediate Readings
   b) Back sight
6. What is Plane Table Survey and how it is conducted? Describe in brief.

4

INTRODUCTION TO CONSTRUCTION WORK

4.1 INTRODUCTION

The structure of the building is divided into two parts. The sub-structure and the super structure. The lower portion of the building which transmits the load of the super structure to the foundation soil is called sub-structure and the portion of the building which is above the substructure is called super structure. The weight of superstructure is borne by the foundation hence the foundation should be strong enough to carry the load of the super structure.

4.2 OBJECTIVES

After going through this lesson you will be able to:

- describe the working of various equipments used in construction work;
- explain the importance of foundation;
- explain about the super structure and its importance;
- enumerate the type of construction;
- describe the method of laying out the proposed construction plan.

4.3 REQUIREMENTS OF FOUNDATION

1. The foundation of sub-structure distributes the load of the building evenly

on the soil in such a way that at not below the foundation the soil pressure exceeds the maximum allowable bearing capacity of soil.

2. It helps in strengthening the building against the lateral forces caused due to tornado, earthquake, etc.
3. It provides strong surface for the construction of proposed structure.
4. To provide safety to the structure from flow of water and seepage.

4.4 AIM OF SUPERSTRUCTURE

The aim of providing super-structure is to provide support in the construction of building as per designed plan and various members of super-structure such as columns and beams are designed to provide strength for carrying the dead load and live load expected to come on the various parts of the structure in a safe and well distributed manner.

4.5 TYPES OF CONSTRUCTION

Construction can be of following types:

1. Building development/construction
2. Road construction
3. Electricity distribution
4. Water supply structure
5. Sewerage construction
6. Drains etc.

4.6 AIM OF SITE INSPECTION

Aims of site inspectoin are:

1. Inspection of site for foundation.
2. Behaviour of soil near proposed wall and thickness of layers of soil deposits.
3. Changes in soil behaviour and in depth of water Table.
4. Direction of flow of water and its drainage
5. Movement in earth layer due to any reason if any.

4.7 SITE CLEARANCE

Before starting any construction work it becomes necessary to clear the place from the unwanted grass, jungles, trees and plants etc. In case of any hill like appearance on the ground, that too needs to be cleared of the excess earth and if there is a pit, it is required to be filled up. This total job is called site clearance. Only after the site clearance lay out of the structure at site can be planned. At the time of clearing of the site it should be remembered that any plant whose girth is more than 30 cm above the ground is designated as tree, and no tree can be removed without taking permission from the appropriate authority.

In this way clearance of site of the unwanted jungles, shrubs, trees etc. and keeping of felled trees at a distance away upto 10 m or more forms the part of the agreement of the contractor for which payment are required to be made and all these things are written in the agreement paper, which is required for explaining the terms and conditions.

4.8 LAYING OUT THE BUILDING PLAN AT SITE FOR FOUNDATION

The total load of all the wall etc. including that of the beams and columns final come on the ground which is called foundation soil. Engineers at site and design office decide the size of foundation for their foundation i.e. depth, length and breadth etc. and type of foundation.

4.8.1 Work Methodology

1. In the layout plan you will observe the size of construction in the plot and also the distances which should be left out of construction from the boundaries. This is called set back distance from the boundary wall. This is clearly shown in the layout plan.
2. It is required to draw line on the ground of the proposed construction. It is done by putting lime powder along a string stretched along the proposed line of construction. These lines extend at least one meter away from the actual end lines and they are called reference lines. They remain even after the earth digging or cutting is over for foundation work.

3. A bench Mark pillar is also constructed at site which gives the level of plinth and foundation etc. permanently. Water level marks are used for this purpose. This bench mark is required to be secured till the end of the construction.

4. The map will be kept in proper orientation with respect to the site. Generally the longest wall of the building is considered as base line. Refer Plate No. 3, Plate No. 4, Plate No. 5.

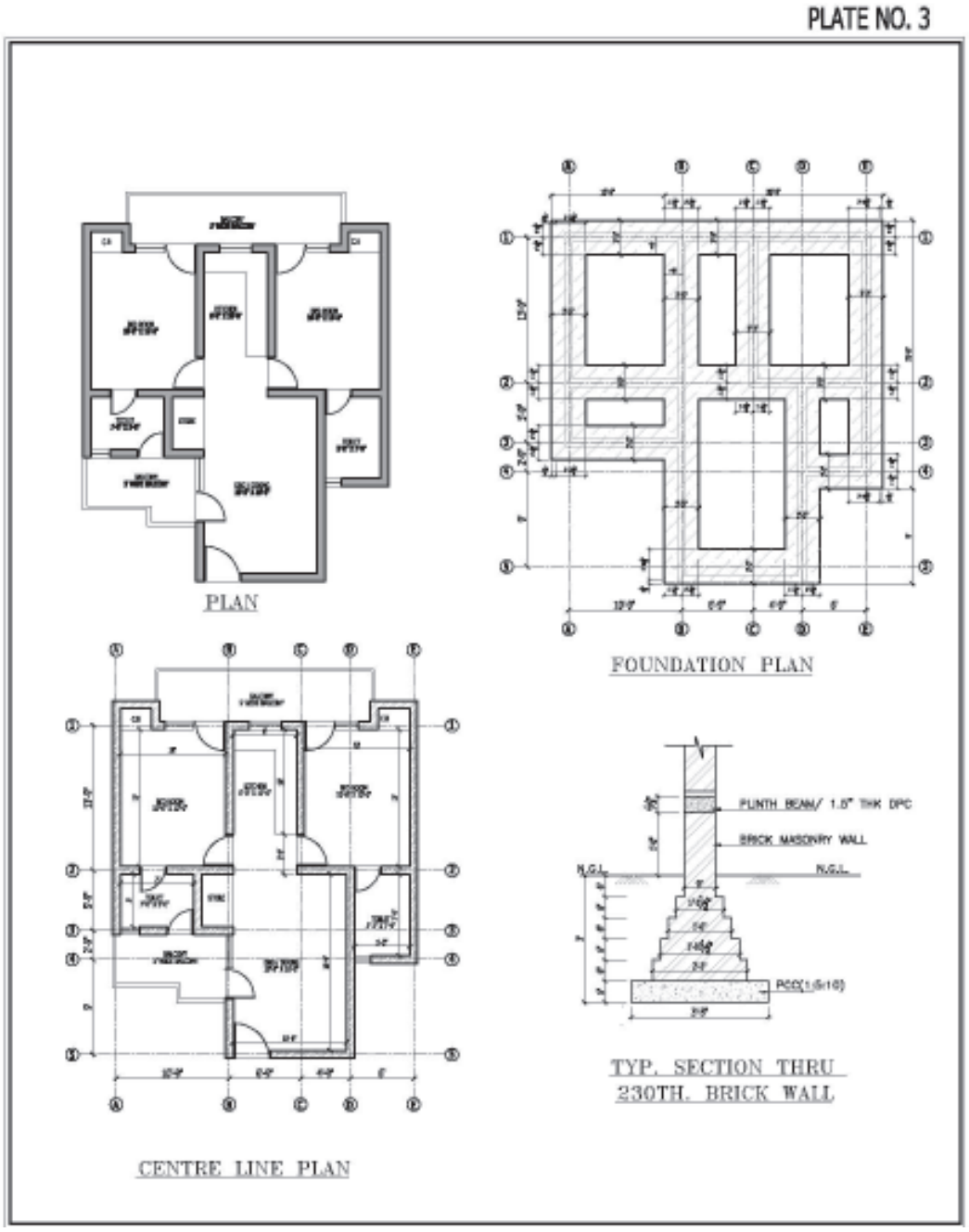


Fig. 4.1

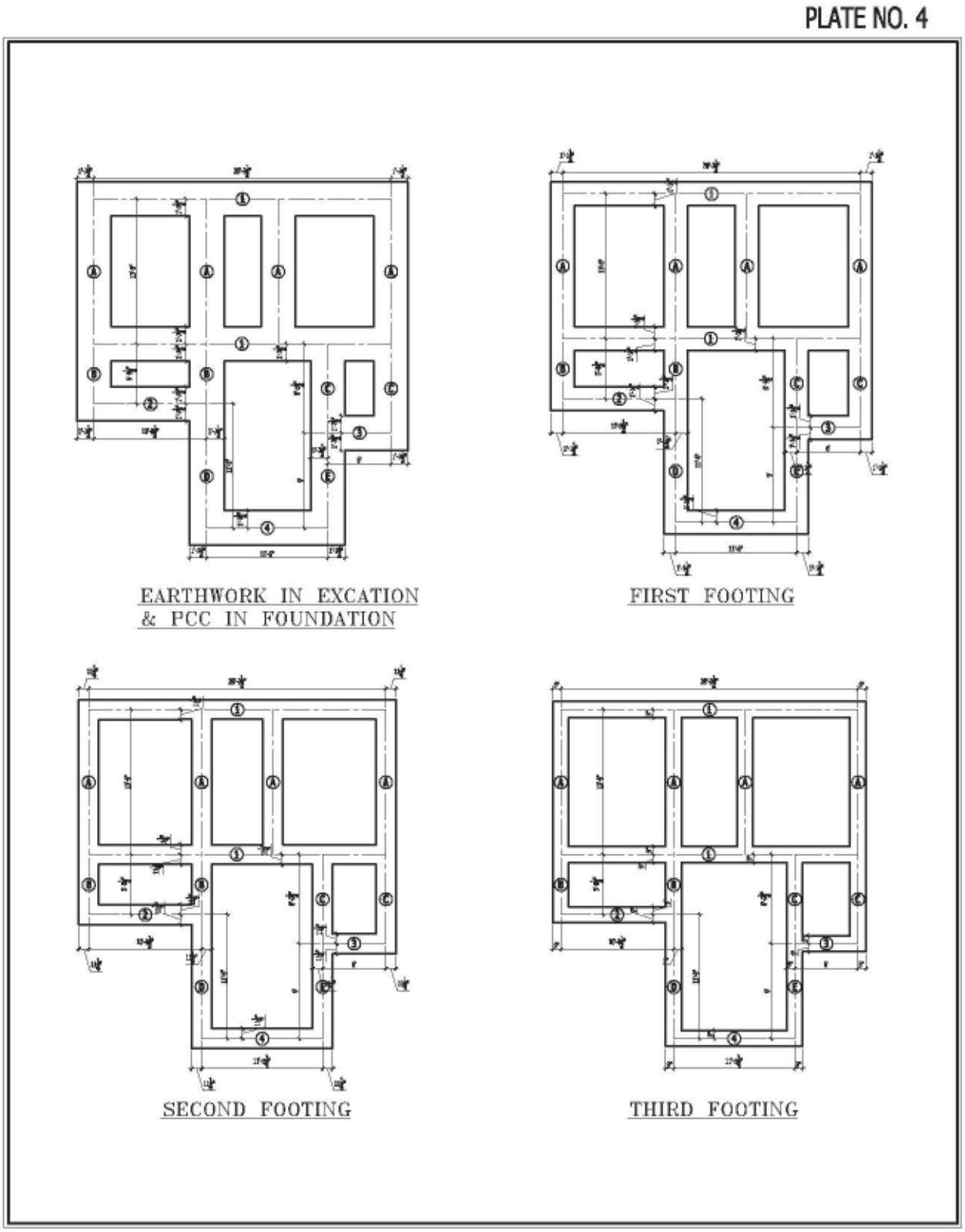
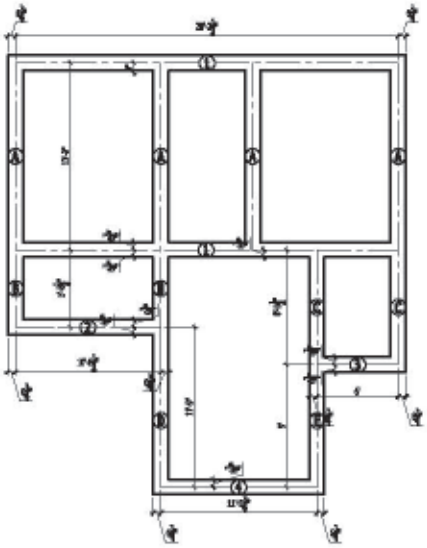


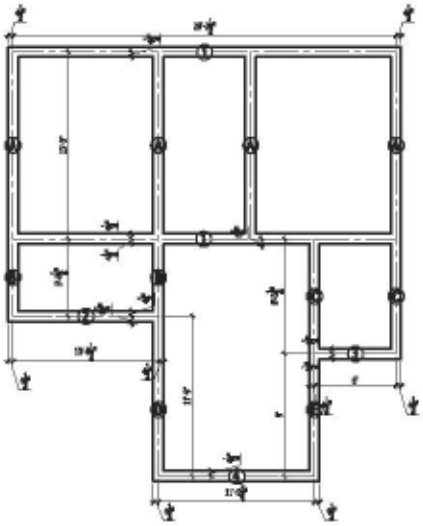
PLATE NO. 4
EARTHWORK IN EXCATION
& PCC IN FOUNDATION
FIRST FOOTING
SECOND FOOTING
THIRD FOOTING

Fig. 4.2

PLATE NO. 5



FORTH FOOTING



PLINTH WALL ABOVE FOOTING
& DAMP PROOF COURSE

Fig. 4.3

5. Now after leaving the set back distance from the first wall limit from the boundary, the line parallel to wall will be plated on the ground depending upon the set back distance. In this fashion all the four sides of the building will be laid on the ground.
6. After plotting the first corner other remaining corners are also plotted on the ground.
7. For plotting the 90^{o} angle on the ground either cross staff is used or Pythagoras Theorem is used (3, 4 & 5).
8. After this all the centre line will be extended up to 1.0 to 2.0 m as per the direction of the Engineer and guide pillars are required to be constructed.

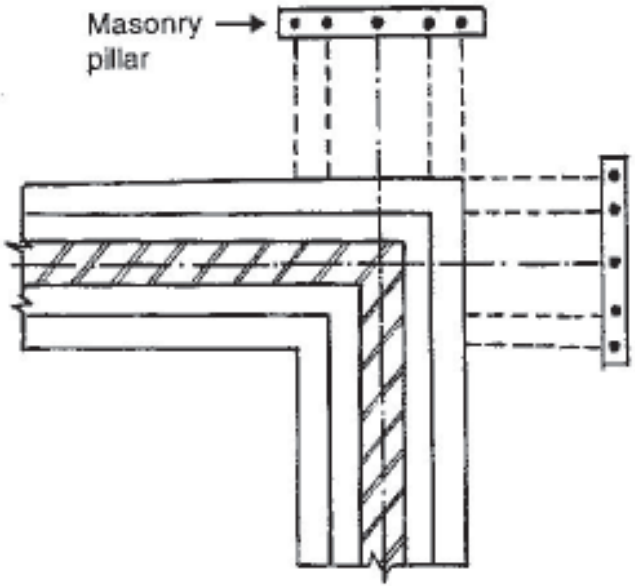


Fig. 4.4: Use of Masonry pillars

The height of the masonry pillars will be equal to the height of the plinth. The level of the floor is called plinth level.

9. All the lengths and distances are measured with the help of standard chain or tape (steel)

4.9 WHAT HAVE YOU LEARNT

- Requirement of foundation is extremely important and its use and construction should be according to design.

- Similarly the use of super-structure above G.L. is also very important.
- Methods of laying out the foundation plan of building are many.
- Guide pillars are very important for laying the building plan at the site.

4.10 TERMINAL QUESTIONS

1. What is the use of any structure in the foundation?
2. What do you understand by the Plinth level?
3. Why General Tape or string is not used for measurement?
4. What do you understand by guide pillars?

5

EARTH WORK (CUTTING & FILLING)

5.1 INTRODUCTION

Construction of building foundation, Road construction, and construction of sewer lines, water supply lines involve the job of cutting and filling of earth. This job is called in general language "Earth-Work".

5.2 OBJECTIVES

After going through this lesson you will be able to:

- explain shoring and timbering;
- describe the method of control of ground level for development work;
- explain different types of precautions needed for completion of earth work.

5.3 SHORING AND TIMBERING

The length, breadth and depth of trench should be as per the drawing and design given in the map. Where the soil is wet or cohesion less the side slopes are supported by the use of cross bars and side shutters (planks) in order to prevent the collapse of the trench. This is called shoring and timbering. The details of shoring and timbering are give in Figs. 5.1 and 5.2.

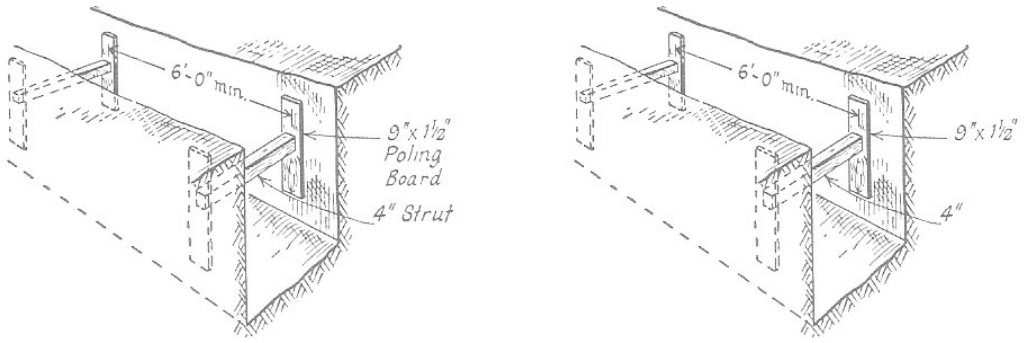


Fig. 5.1: Loose timbering

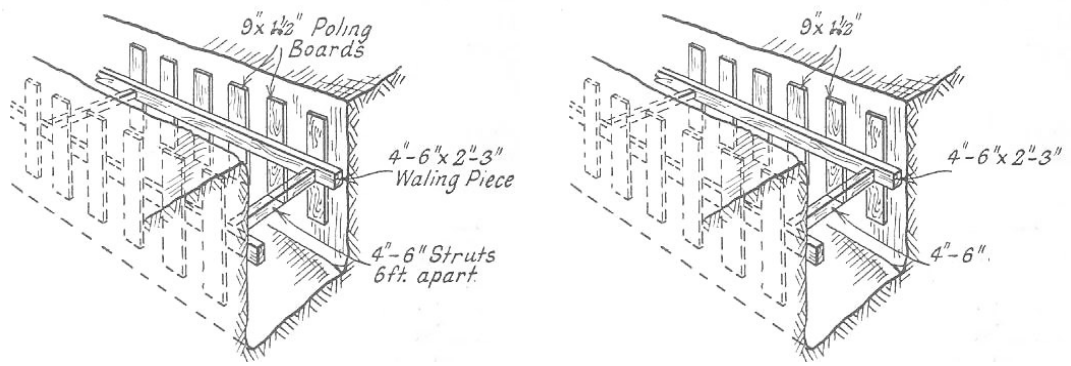


Fig. 5.2: Close timbering

Unit of measurement of earth-work

The unit of measurement of earth work is cubic meter (meter^3). If the length of trench = 1 m, breadth 1 m and depth 1 m then the total earthwork is 1 m × 1 m × 1 m = 1 cub m. (length × breadth × depth)

If the shape of the trench is trapezoidal

$$\text{Vol. of earth work} = \frac{B_1 + B_2}{2} \times \text{height} \times \text{Length}$$

Base of the Trench

The base of the trench should be made flat and all loose soil should be removed from it.

If by mistake the depth of the trench becomes more than the required depth, it should not be filled by loose soil rather it should be filled with lean concrete 1 : 4 : 8 or 1 : 5: 10 and made flat under the guidance of the site engineer.

If it is required to construct a soil embankment, at least 10% more soil should be added i.e. if the designed height of the embankment is 6.0 m, the embankment of 6.6 m height should be constructed initially to allow for the settlement of soil at a later stage.

In case of deep cutting or filling a side slope of 1 : 1 or 2 : 1 (i.e. 2 horizontal and 1 vertical) is usually maintained.

If it is required to put new soil over old soil, Benching is required to be done so that a perfect bonding between old and new soil is achieved. Benching means construction of steps.

Grass should be planted on the slope to check the soil erosion; in order to protect the slope of the embankment.

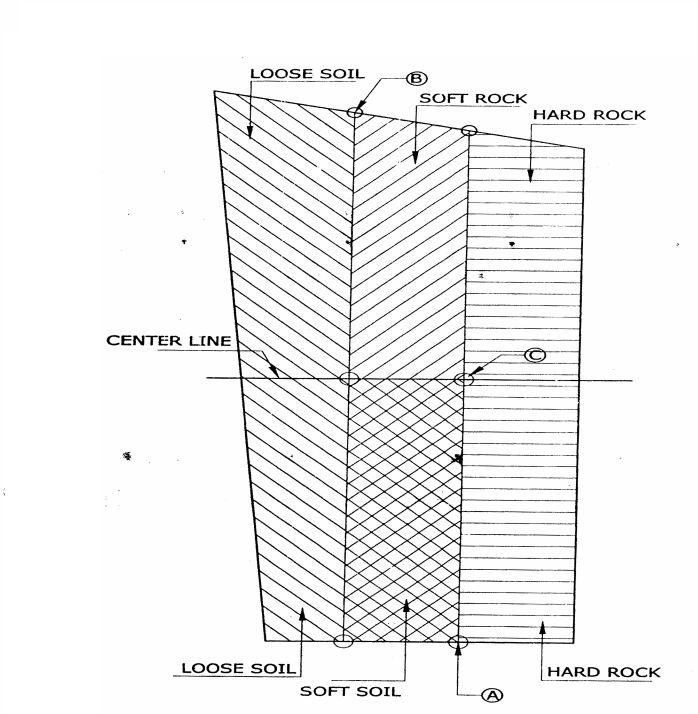


Fig. 5.3

Apart from the above earthwork is required to be carried out in the construction of roads. During construction of roads two types of situation can arise i.e. it may require either cutting or filling. During excavation we may get different types of soil layers. For this a reformed line is required to be made for controlling

the width and direction of the road/embankment. This helps in determining whether the cutting or filling has been done as per the drawing or not. Catch water drains are made on the sides of the cutting which takes out the water from the trench.

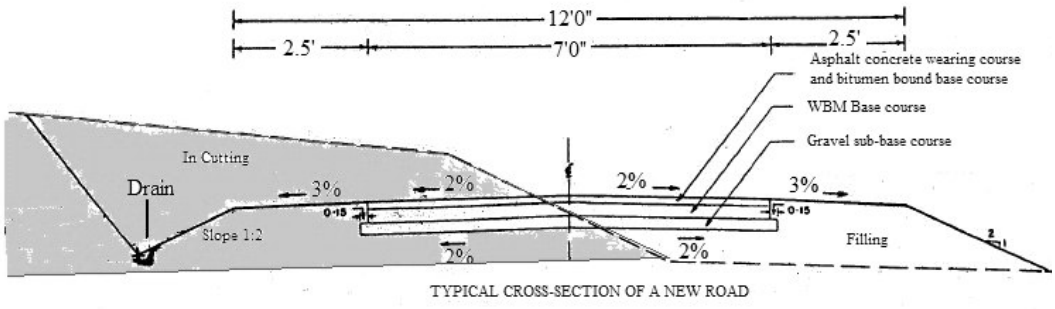


Fig. 5.4: Cross section of a road

Payment

The rate of payment for cutting/filling of earth is made by cubic m of the earth work and the lead distance for carriage of earth away from the site or to the site is also taken into account.

5.4 WHAT HAVE YOU LEARNT

- Precautions needed to check the collapse of the sides of the trench while cutting the soil for foundation etc.
- Shoring and timbering process
- Measures to be taken if the soil being cut for digging is wet

5.5 TERMINAL QUESTIONS

1. What do you understand by loose timbering?
2. Where and why "Benching" is done?
3. How the volume of cutting is measured?
4. What is the importance of filling of earth for the construction of embankment?
5. What is soil embankment?

6

PREVENTION OF BUILDING FROM TERMITE AND DAMPNESS

6.1 INTRODUCTION

Prevention of building from the attack of termite and dampness is one of the very essential measures which is adopted in all construction works. Damp Proof Course (D.P.C.) is provided in all the building to prevent the rise of water from the ground which causes dampness. The dampness caused due to seepage from roof into the wall is prevented by water proofing of roof.

6.2 OBJECTIVES

After going through this lesson you will be able to:

- explain the measures taken for prevention of building from the attack of termites;
- describe termite treatment before construction;
- enumerate the measures taken to prevent the rise of water above the plinth level which causes dampness.

6.3 METHOD OF PREVENTION FROM THE ATTACK OF TERMITE

The method of prevention from the attack of termite can be divided into two parts:

1. Measures taken before construction (Pre-construction technique)

2. Measures taken after completion of construction (Post construction technique)

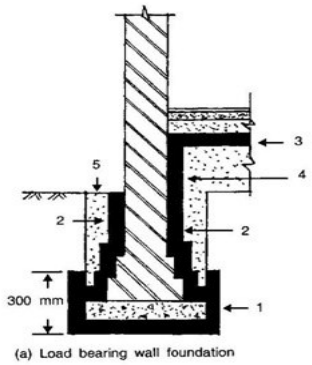
The termites which are seen in the building generally lives under the ground and breeds before the commencement of rainy season.

Apart from this, it is also found to be present in the timber, rubber, etc. Some times before in the past, Aldrine, or DDT were being used for prevention purposes, but with the observance of bad effect of these two medicines on human being, the use of Aldrine and DDT have been stopped. Accordingly now a day following medicines are used:

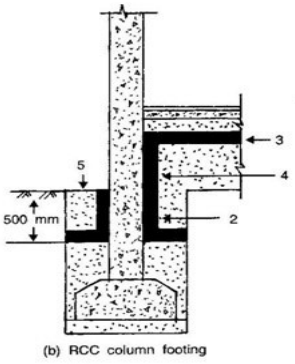
1. Chloropyriphosh, which is available as Dermit/Dustbin in the market 1% solution of chlorophos is sprayed in the soil/water. This is very poisonous substance, hence hand should be properly washed withsoap each time after use.
2. Apart from dirmat or Dustbun, TC Hepafloor (5% solution) can also be used.
3. The solution of Chlorden (1% solution) can also be used.

6.4 TERMITE TREATMENT BEFORE CONSTRUCTION

Before starting the concreting work in the foundation Dermit solution is sprayed by hand pump in the foundation soil. This job should not be carried out during rainy season or when water is present in the foundation trench. This process is carried out before pouring concrete mix in the foundation trench, in an orderly fashion in stops.



(a) Load bearing wall foundation



(b) RCC column footing

Fig 6.1 (a) **Fig. 6.1 (b)**

Foundation of load bearing wall **Column and Footling**

Step 1

The Dermit solution of appropriate strength should be spread up to 30 cm from the foundation level to the wall, so that the termite is completely killed. It should be used at the rate of (@) 5.0 ltr. per sq. m of the area covered.

Fig. 6.1 (a) depicts that foundation on which the load of the load bearing wall will act. The Fig 6.1 (b) depicts the R.C.C. foundation.

Step 2

If the soil from outside source is brought to fill the foundation space, the soil should be properly pulverized and mixed with 3 to 5 ltr. of Dermit solution and it should spread up to 30 cm from the determined area outwardly.

Step 3

Starting from the foundation level and up to plinth level, holes @ 15 cm are made in the soil extending up to 5 to 7.5 cm. deep. After that @ 5 ltr. per square meter chemical solution of Dermit of appropriate strength is filled in the holes.

Step 4

Treatment at the joint of wall and floor:- At the joint of wall and floor, Dermit solution of appropriate strength is applied @ 15 ltr. per. sq. m.

Step 5

Treatment of soil which touches the building from outside:- After completion of the construction work of the building, holes 30 cm deep are made at every 15 cm along the length and the Dermit solution is filled @ 5 ltr. per m. length.

Step 6

Treatment at other places:- Termite prevention treatment should also be carried out at places where the timber work in the building touches the soil or the conduit pipe is put in the floor and in the same way where construction joints occur. It is provided @ 3 ltr. per m. length.

In the same way the termite prevention treatment should be carried out in walls above the plinth level.

Above the plinth, at 45° angle holes should be made at every 30 cm on both sides of the wall and the chemical should be pumped in the holes till the chemical starts coming out. After this the holes should be filled with cement mortar (1 : 2)

6.5 ANTI TERMITE TREATMENT OF BUILDING POST CONSTRUCTION

At places whenever the timber work touches the wall, holes are made and the Dermit solution made in Kerosene oil is pumped into the 6.0 mm diameter holes. Hand pump should be used to push the chemical in the holes.

6.6 WORKS RELATED TO PREVENTION FROM DAMPNESS (DAMP PROOF COURSE)

Damp proofing course is laid above the ground level adjoining plinth level of the building in the entire width of the wall. However it is kept below the floor level. The thickness of the DPC (Damp Proof Course) varies between 12 mm to 20 mm. At certain places it may be 40 mm thick also. It is also provided below the sill level of the doors.

Method of laying Damp Proof Course

When the brick work reaches plinth level a special type of mix known as Damp proofing compound is mixed with cement and sand (1 : 2) with adequate amount of water and is laid in the full width of the brick work below it. The thickness of this layer is usually kept at 2.5 cm unless and until specified otherwise. This layer prevents the dampness to rise above.

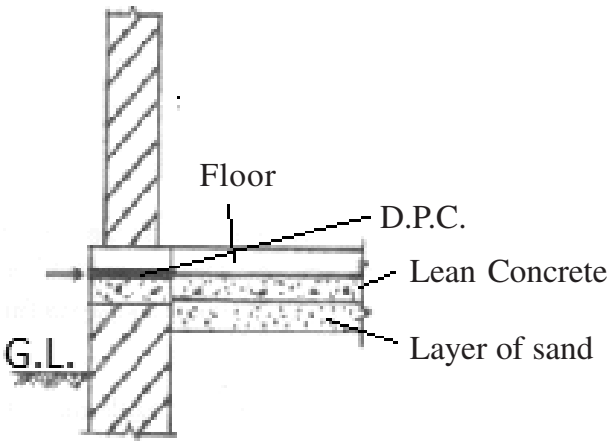
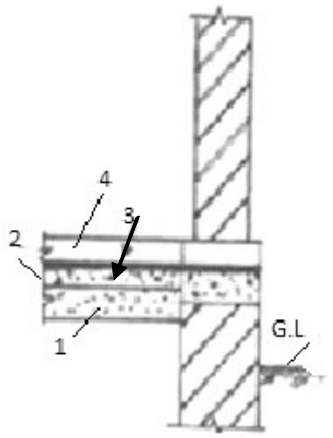


Fig. 6.2: Application of DPC in Cohesionless soil



1. Layer of sand
2. Lean concrete
3. D.P.C.
4. Floor

Fig. 6.3: Application of DPC in Cohesive soil

D.P.C. is sometimes made of Cement concrete also. In this the ratio of cement: sand: stone chips is 1 : 2: 4 to which Damp Proofing Compound is also added.

D.P.C. is kept wet (cured) for 7 days.

After drying D.P.C. layer is coated with coal-tar.

6.7 WATER PROOFING AT THE JUNCTION OF PARAPET AND ROOF

The method of water proofing at the junction of Parapet and proof is shown in Figs. 6.4(a), (b) and (c).

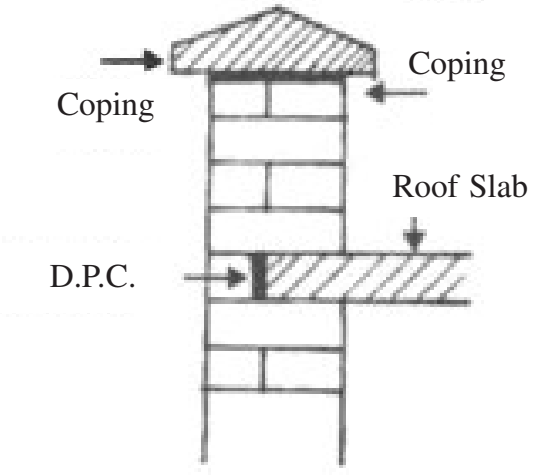


Fig. 6.4(a)

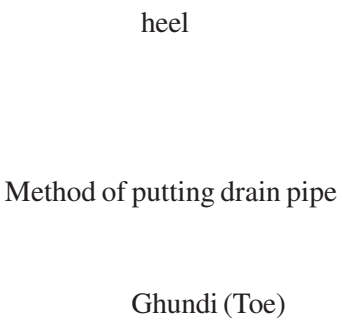


Fig. 6.4(b) **Fig. 6.4(c)**

(Fig.6.4: Prevention of seepage from Roof through water proofing methods)

6.8 WHAT HAVE YOU LEARNT

- When the chances of attack of Termites are more pronounced?
- Treatment for prevention of attack of termites-How it should be done?
- What are the differences between the treatment applied before construction and post construction for prevention of attack by termites in buildings?
- How many types of damp proofing course are there?
- What is the necessity of providing DPC?
- How the dampness in building can be prevented?

6.9 TERMINAL QUESTIONS

1. Why attack of termites are not treated now with Aldrine or D.D.T.?
2. How the attack of termites on timber can be prevented after construction?
3. What is the amount of chemical solution which is required to be applied at place where the timber touches the solid?
4. What are the differences in treatment of walls and timber for prevention against attack of termites?
5. What do you understand by D.P.C.?
6. At which level the D.P.C. is laid?
7. Which substance is mixed with cement at the time of laying D.P.C.?

7

SECURITY ARRANGEMENTS

7.1 INTRODUCTION

The precautions taken to prevent the possibility of accidents is called "Security Arrangements". In this lesson you will know about the arrangements which are made at the construction site for various types of security. The aim of this lesson is not only to let you know as to what measures should be taken to prevent the accidents at work site such as what to do and what not to do, rather it is also to let you know as to how such good habits can be inculcated among all the workers starting right from top officers to ordinary workers, which minimizes the chance of accidents, that may cause loss of life/ any of the body parts and also creates hindrances in the construction work.

7.2 OBJECTIVES

After going through this lesson you will be able to:

- explain the necessity of security at work site;
- describe the details of security measures which are required to be taken for the security at work-site.

7.3 PLAN ABOUT THE SECURITY PROGRAM

At the time of first appointment each employee will be got acquainted with the basic principles of security fully. In this program following things will be explained in detail:

1. Who should comply with the security requirements.
2. Role and responsibilities of security supervisor.
3. General requirement of security during work.
4. Symbols of different types of security alerts and their observance.
5. Self Protection Equipment and their use.
6. Security Boards for machines, wire mesh, guard etc. their importance and use.
7. Special security zones.

7.4 WHO SHOULD OBSERVE THE SECURITY INSTRUCTION AND GUIDELINES

Security instruction and guidelines should be observed by each and every person religiously in full manner as non-observance of statutory orders of security by any person causes accidents and accidents do not differentiate between the level of the person, i.e. whether he is a worker or a top officer.

7.5 ROLE AND RESPONSIBILITY OF SECURITY SUPERVISOR

Security officer is required to be alert at all the times during working hour and also after the working hour and see that no lapses occur in the security system at the construction site. If required the employee, who is lax and unaware of the security requirement should be alerted by him and any ignorance on the part of the employee about the security requirement should be removed at once. It is the responsibility of the security supervisor to train the worker about security directives and about the Personal Protective Equipment.

He has the further responsibility to:

- Impart training at the work site about the security requirements.
- Procure all types of general and personal security devices for each and every employee.
- Untrained and unauthorized person should not be allowed to run any equipment or machinery.

7.6 GENERAL PROVISIONS OF SECURITY DURING WORK

- No security equipments should be removed or disabled.
- The security boards, wire mesh and guard etc. of the running machine should always be kept at proper place and should not be removed.
- At the time of necessity the personal security equipment must be used.
- Compulsory observance of security warning symbols must be observed.
- Prohibited drugs and alcohol must not be brought at work site.
- Arms, ammunitions and explosives should not be brought at work site.
- Smoking, alcohols drinking and fighting etc. is strictly prohibited at work site.
- During work don't do anything which is harmful or dangerous.
- If the work appears to be dangerous security supervisor or safety supervisor should be informed at once. They will explain the method of performing the job safely.
- Don't adopt any short cuts, it may be dangerous. Ramps, stair case or regularly provided steps should be used for movements.
- Do not remove or tamper with any security symbol or instruction.
- Any security system should not be tampered irrespective of any fact, whether it is being used by any staff or yourself.
- Do not forget to wear Helmet, Safety belt, and safety shoes at work site (Ref. Fig. 7.1)
- The safety should be maintained by the contractor by giving information regarding safety precautions. Any lapse in this will make the contractor responsible for payment of compensation etc.
- Highly visible paint should be used for writing instructions on warning boards.
  - Red flat or Red light
  - Intermittent lights for use in night
  - Arrangements as per the instructions of traffic police

- Providing barriers around the trenches

- Proper barricading of open spaces in Roofs, shafts, left for different purposes such as lift, pipes etc. In the same way Balcony, stair cares etc should also be barricaded.
- Scaffolding made for doing the construction works should also be strong enough. They should not bend or sag.
- 6.0 m strong mesh should be tied around all the four sides of the building so that no article and person should fall all of a sudden.
- Movement spaces should be kept free of debris and any thing kept randomly.
- The rope used for lifting of materials should be strong enough so as not to cause breakage of the rope.
- Children should not be allowed at the work place.
- Other temporary arrangements should be made for the safety of workers as required.

7.7 SECURITY WARNING SIGNS AND THEIR OBSERVANCE

Security symbols are installed for safety against accidents in special circumstances such as: Warning Boards, Red Flag, Red light etc.

7.8 SELF SECURITY EQUIPMENT AND THEIR USES

* These are: helmets, safety belt, and safety shoes

Fig. 7.1: Personal safety Equipment

7.9 PERSONALIZED SAFETY EQUIPMENT

- For protection of different parts of the body:
  - Helmet for protection of head,
  - Specticals/glass for protection of eyes,
  - Special shoes for protection of legs
  - Ear plug for protection or ear drums
  - Mouth mask for protection of lungs
  - Rope for safety against surprise faults
  - Glazed Jackets
  - Almirah for keeping the safety equipment and devices, Medicines
- Special Protection devices
  - Eyes shields to be used during gas welding
  - Rubber gloves
  - Apron
- Personal security devices have been developed on the basis of large experiences. However they can be developed fresh for future needs. Keeping in view the requirement of the technology.

7.10 IMPORTANCE OF SECURITY BOARDS, WIRE MESH & GUARD ETC

Security Boards, Wire Mesh and Guard should always be present on running machines, carelessness in these matters may lead to body harm, or harm to the machinery.

7.11 AREAS REQUIRING SPECIAL ATTENTION

- No spark should be allowed in the vicinity of inflammable material
- The hose or string attached to a machinery should not pulled using the same.

7.12 ELECTRICAL WORKS

- Single worker should not be allowed to work on a running line.
- The voltage should always be checked when working on running line.
- On running line the electrical work should be carried out in adequate light.
- No electrical repair/new work should be carried on running line in open when it is raining.
- The wet cloth and tools should not be used while working or running line.

7.13 WHAT HAVE YOU LEARNT

- Types of dangers which can exist at work site.
- Types of injuries which can occur on different parts of body during work at work site.
- How to prevent the accidents.

7.14 TERMINAL QUESTIONS

1. What type of preventions can be achieved by using Helmet, special shoes, special specs?
2. What types of security arrangements are needed?
3. Why security mesh are provided in machines?
4. What type of security arrangement should be provided on roofs and balcony?

8

BUILDING MATERIALS

8.1 INTRODUCTION

During construction of the building generally cement, sand, stone chips, steel, tiles etc are used as materials of construction. Apart form this electric wires for wiring, pipes for water line, tanks for storage of water, bathroom, kitchen, sewers for sewer lines are also used as materials during construction of the building.

8.2 OBJECTIVES

After going through this lesson you will be able to:

- describe the materials used in construction of building;
- explain the property of materials and their utility;
- describe the procedure for storage of cement.

8.3 CEMENT

8.3.1 Cement

Cement is a very important material. Therefore it is necessary to know about it in some details. In general cement has been classified by different groups depending upon its strength e.g. grade 43, grade 44 etc. Depending upon the requirement of strength in the structure the Engineer I/C decides as to which cement is to be used where.

8.3.2 Storage

Storage of the cement is done in a very specialized manner. First of all the place of storage should be selected in such a way that there is less circulation of air, because the air contains moisture and cement sets due to it very soon.

Cement should not be kept in open too. The floor and roof should be damp proof. The cement bags should be stalked in such a way that it facilitates inspection from all the four sides. In one stalk not more than 10 bags should be loaded in vertical space. In general wooden sleepers should be used in the bottom, which should be at least 20 cm for the floor and it should also be at least 30 cm away from the wall of the stalk room.

At the time of using cement, it should be ensured that the cement bags which had arrived first are put to use first. If the cement is more than 6 months old, it should be used only after performing the strength test of cement.

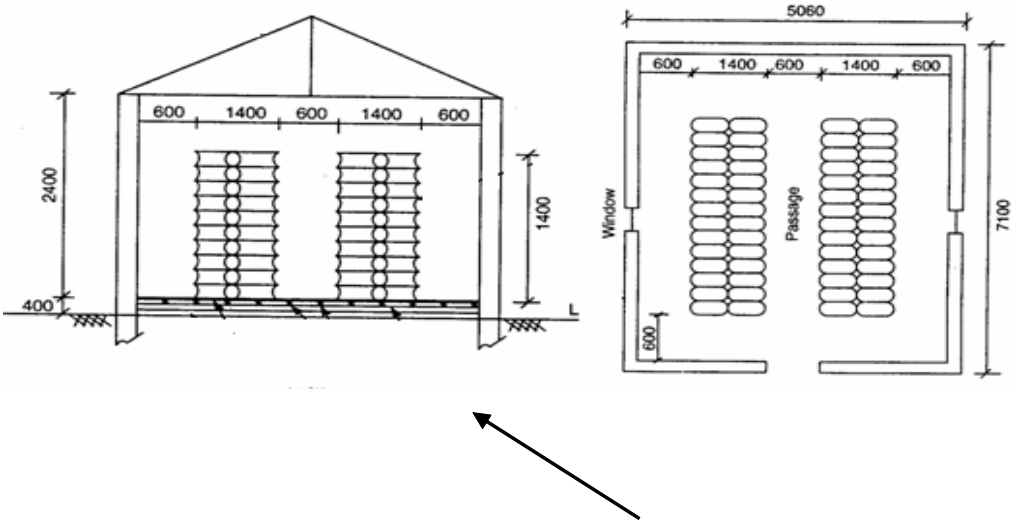


Fig. 8.1: A sketch of cement godown for stalking 500 bags of cement.

Table 8.1: Strength depletion of cement with time with respect to the strength of fresh cement

Time elapsed in months	% Reduction in strength	Remaining strength
3 months	20%	80%
6 months	30%	70%
12 months	40%	60%
24 months	50%	50%

Table 8.2: Specification for stalking of Cement

a)	Distance of wall from the edge of the stalk	30 cm
b)	Ht. of planks form the floor	15-23 cm
c)	Ht. of stalk	10-20 bags
d)	Rows of cement bags	15
e)	Air & light	No outside air is allowed only light is allowed

8.4 FINE SAND

In general sand is mined from rivers and canals. The coarser the particles of sand, the better it is. For this purpose I.S. Sieves are available. Sieving through them gives the required size of sand particles. It should be ensured that there is no soil particles mixed with sand. Sand is used in plastering, brick work and in concrete work.

8.4.1 Bulking of sand

When water is added into sand, initially the volume of sand increases. This phenomenon is known as bulking of sand. But when water is added in large amount

into the sand its volume again reduces to that of the original one of dry state. The bulking by volume may vary between 15% to 30%.

To check the presence of clay in sand, silt content test is conducted. A glass of water (preferably half full) is taken and it is filled with the sand. It is then stirred with a stirrer so that the clay (silt) gets dissolved in it. Then keep the glass on the table. One layer of silt (clay) will settle at the top. Take the measurement of this layer of silt with a measuring tape. The ratio of the height of this layer of soil to that of the height of water in the glass gives the percentage of clay present as an idea.

The sand which contains greater than 18% of clay in the sand is to be rejected.

- The sand should be chemically un-reactive.
- The crystalline sand should be clean, hard, and it should be free of domestic waste, carbonic matters, and vegetable ingredients.
- When the sand is kept in water for 24 hrs., not more than 10% of water should be absorbed into it.

8.5 COARSE SAND

The fineness modulus of coarse sand should be less than 2.5. It should be tested as per I.S.I. (B.I.S.) manual.

Fig. 8.2: Different types of sieves in a set

8.6 STONE BALLAST (STONE CHIPS)

In general stones having sizes 25 to 50 mm and greater then 50 mm are called stone ballast. It is used in road construction. The length of the stone ballast is called gauge of the ballast. On sieving the ballast 90-100% of Ballast of particular size/gauge should pass the specified sieves for that gauge e.g. for 50 mm gauge, 90-100% stone Ballast should pass through the 50 mm size sieve.

The stone Ballast are stalked in 60 cm heights of specified area at a time.

8.6.1 Fine stone chips

The stone chips of size 25 mm to 50 mm is used in concrete work and they are categorized as fine stone chips. Generally soft foundations are cast using chips of this size.

8.6.2 Coarse Stone Chips

The stone chips of size 40 to 60 mm are generally used in road construction in the base and sub-base. It should neither be too soft nor too hard. It should be slightly porous also, so that a compact base can be prepared with the addition of Murrum etc.

8.7 BRICKS

The quality of brick is evaluated on the basis of its shape, water absorbing capacity, and load carrying capacity. The edges of the bricks should be straight. The brick should be properly burnt, water absorption should be minimum (usually less than $1/5^{th}$ of its weight). It should not break if dropped by hand. The bricks which are under burnt will break if dropped by hand and its color will also be not Cherry red. Over burnt bricks are usually black in color and its edges are curved (not straight). Bad quality brick should not be used for brick work.

The soil used for making brick should neither be excessively cohesive (clay) nor it should be excessively cohesion less (sandy). A well burnt brick should have cherry red color.

The general dimensions of the standard brick are as follows:

Length — 9 inches (22.9 cm)

Breadth — 4.5 inches (11.2 cm)

Height — 3.0 inches (7.0 cm)

The size includes the ¼ inch (6.0mm) the thickness of cement mortar in the joints. In case of IS Bricks the corresponding sizes are 20 cm x 10 cm x 10 cm. This also includes the thickness of the mortar.

Frog: The depression in the middle of the flat side of the brick is called frog. During brick work this depression is filled by the cement mortar at the time of brick work.

8.7.1 Types of Bricks

Well Burnt (Properly Burnt) Bricks: These types of bricks have cherry red color. When kept in water for 24 hrs, it should not absorb more the 20% water by weight.

Jhama Bricks (Over Burnt Bricks): Over burnt bricks, become black and its edges also become curved. This type of brick is not used in brick work of building.

Yellow Bricks (Under burnt Bricks): These types of bricks are under burnt. Their load carrying capacity is also very low. They break easily. Therefore they are not suitable for use in construction work.

8.8 WHAT HAVE YOU LEARNT

- Proper method of cement stalking
- Sand and their varieties.
- Stones and their types.
- Bricks and its properties.

8.9 TERMINAL QUESTIONS

1. What is the proper method of stalking of cement?
2. How many types of sand can be used in building construction?
3. What types of stone chips are suitable for building construction?
4. What are the general shape and size of standard brick and what are the suitable properties of brick for use in building works?

9

BRICK WORK

9.1 INTRODUCTION

The walls of a building are generally constructed by bricks and the method of joining bricks in different fashions is called brick work.

9.2 OBJECTIVES

After going through this chapter you will be able to:

- describe the importance of brickwork in building construction;
- explain the method of performing of brickwork;
- explain the different types of bonds used in brick work;
- enumerate precautions which are required to be observed during brickwork.

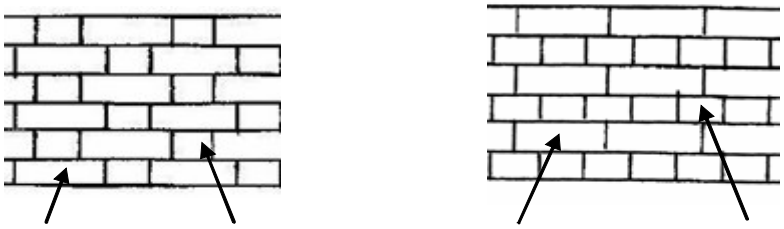
9.3 BRICKWORK IN BUILDING WORKS

1. **Brickwork in Clay:** In this, wet clay is used for joining the bricks. The clay should be cohesive with permissible amount of sand. The thickness of clay/earth mortar is 12 mm and the maximum height of building constructed with clay is restricted to 2.5 m.
2. **Brick work in Cement or Lime Mortar:** In this type of Brick work cement or lime mortar is used. Cement mortar consists of Cement and sand with water in appropriate proportions and the lime mortar consist of lime and Surkhi with water in appropriate proportions. The thickness of the joint in this type of work is kept not more than 10.0 mm. Other materials such as

stones and cement blocks are also used in brick work. Sometimes corners are made of bricks where it is required to keep the brick open (without plaster). This type of brick work is called "facing brickwork".

The end view of the brick facing long side is called "stretcher" and the end view of the brickwork which faces breadth of the brick is called "header". It means that when we view the brick work from the front and see the face 9″ × 3″ it is stretcher and when we see the face 4.5″ × 3″ it is header.

Queen Closer: A brick cut lengthwise in 9″x2¼″, is called a queen closer and is placed next to the header course to break the joints.



Flemish Bond English bond

Fig. 9.1

The Bricks should be fully soaked in water before starting the brick work. If the bricks get dried during transportation from the wetting site to the place where brickworks is going to be carried out, then again it should be made fully wet before putting it for use in brickwork. In any case very wet or dried bricks should not be used in brick work. Table 9.1, 9.2 and 9.3 give information about the consumption of cement in different modes of brick work.

Table 9.1: Consumption of Cement in one Cubic meter of Cement Mortar

Mix Ratio (Cement : sand)	No. of bags of cement required per cubic meter of Mix	Mix ration (Cement : Sand)	No. of bags of cement per cubic meter of Mix
1 : 1	20.4	1 : 2	13.60
1 : 3	10.20	1 : 4	7.60
1 : 5	6.20	1 : 6	5.00

Table 9.2: Consumption of Cement and Sand per Cubic meter of Brick work

Mix Ratio (Cement : Sand)	No. of bags of cement required per cubic meter of Mix	Mix ratio (Cement : Sand)	No. of bags of cement per cubic meter of Mix
1 : 6	1.30	1 : 5	1.60
1 : 4	1.90	1 : 3	2.60

Table 9.3: Consumption of Cement in 115 mm thick Brick Work (BW) per sq. m.

Mix Ratio (Cement : Sand)	No. of bags of cement required per cubic meter of Mix	Mix ratio (Cement : Sand)	No. of bags of cement per cubic meter of Mix
1 : 3	0.30	1 : 4	0.22

9.4 METHOD OF MAKING MORTAR FOR BRICKWORK (B/W)

For example, to make a mortar of ratio 1 : 4 take 4 volumes of sand on a flat space. Then lay 1 volume of cement over it and continue to mix it thoroughly with shovel till uniform color is obtained. After this, pour water over it only to the extent that it becomes workable but water does not flow out of it.

Fig. 9.2: Pan Mixer

The mortar must be consumed in Brick work within 30 minutes of pouring water otherwise it starts setting.

Petty or Boxes are used for measuring sand. The size of the box is generally 30 cm × 30 cm × 38 cm deep. For different ratios of mix, boxes of special sizes can also be made as per the direction of the Engineer.

Table 9.4: Amount of Cement and Sand per cub. m. of mortar

Mix Ratio	Cement in Bags	Sand Cub.m.	Mix Ratio	Cement in Bags	Sand Cub.m.
1 : 1	20.40	0.71	1 : 2	13.60	0.95
1 : 3	10.20	1.05	1 : 4	7.60	1.05
1 : 5	6.20	1.05	1 : 6	5.00	1.05
1 : 7	4.20	1.05	1 : 8	4.00	1.05

Table 9.5: Consumption of materials per cubic m. of Brick work

Mix Ratio (Cement : Sand)	Cement Bags (Nos.)	Sand in cubic m.	Bricks (No.)	Mix Ratio (Cement : Sand)	Cement Bags (Nos.)	Sand in cubic m.	Bricks (No.)
1 : 3	2.6	0.275	500	1 : 4	1.9	0.275	500
1 : 5	1.6	0.275		1 : 6	1.3	0.275	
1 : 7	1.1	0.275		1 : 8	0.95	0.275	

At a time not more than 1.0 m height of Brickwork should be carried out. Spirit level should be used at the time of Brick work. Pipe or water level should not be used. The excess mortar should be removed from the joints before setting of the Cement. After finishing the days work, the date of work should be written with chalk etc on the Brickwork portion itself. This is necessary because the date up to which the brickwork is to be kept wet is decided on the basis of that date, the putting up the date facilitates the inspection work later on regarding wetting period etc. The brickwork is cured for a minimum period of 7 days. In

case of ½ brick thick walls, 6.0 mm dia steel reinforcement is placed after every four layers. The length of this steel rod is kept at 2 ft nearly. These reinforcements are used to connect the pillars, which are provided at every ft or less. All the ½ bricks should not be placed at one place during the brickwork.

To start the brickwork at any place first of all the corners of the wall are fixed and centre lines of both the walls are demarcated. The cotton thread is stretched on the corners of both the walls by wrapping it around the brick and kept attached to the outer face of the wall, so that the outer face remains in line and at the same time it remains horizontal too. As per the requirement of the bond, Queen closers are provided and at a time four layers of bricks are constructed. It's total height should be measured to the accuracy up to 1.0 mm. The requirement of layers to be laid should be in whole numbers. If required the thickness of mortar between the bricks can be adjusted as per requirement. A big stick should be used as gauge and marking should be done on it. In this manner more no. of stick gauges can be made. At least two gauges should be available at a time of constructing a wall. At the time of construction of wall these gauges are required to be kept erect on both the sides of the wall and every time the cotton thread should be raised for keeping the height of brick layer same throughout its length. At some places it is required to leave holes of the size of header for holding bamboo scaffolding or platforms for brickwork at higher levels from the ground. Sometime for decorative purposes also holes are left. In that case, this type of brickwork is called "honeycomb brickwork". In general the thickness of this type of brickwork is kept as 11.5 cm. The brick should overlap by 2 cm on each side. (Refer Fig. 9.3)

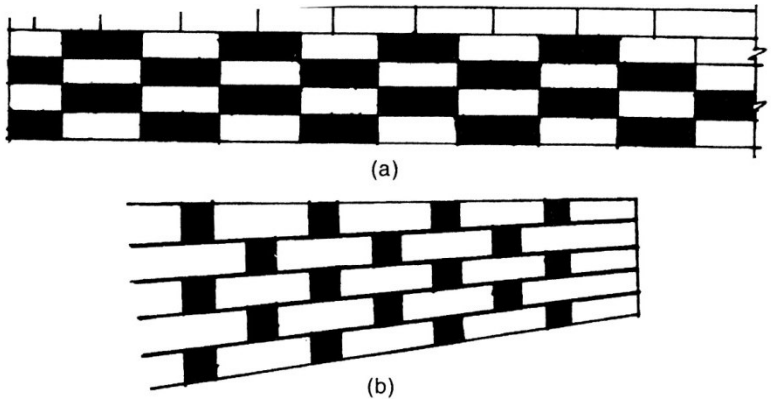


Fig. 9.3: Honey Comb Brickwork

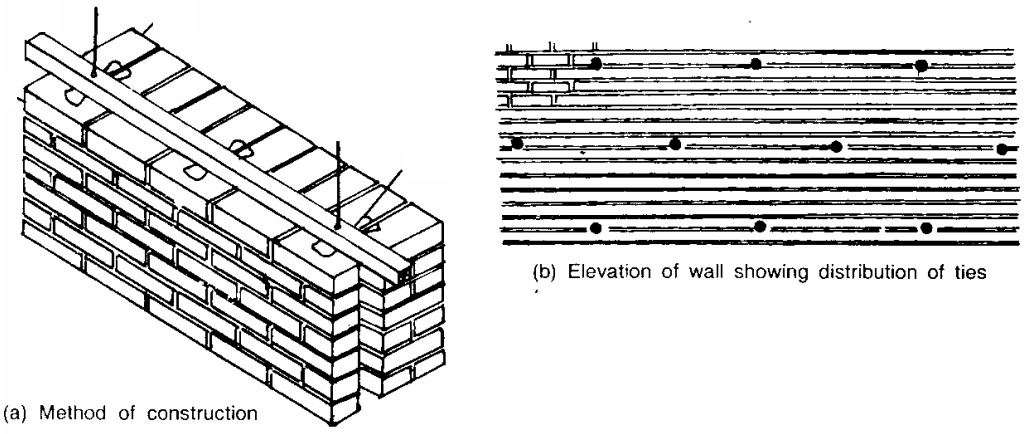


Fig. 9.4: Cavity wall BW

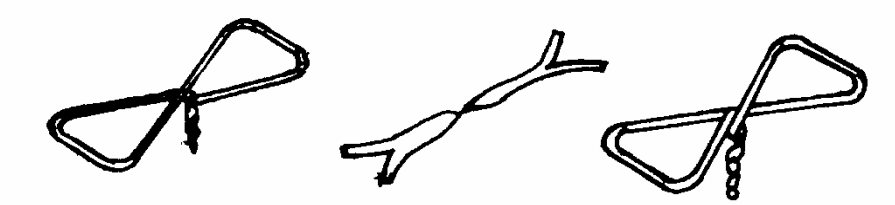
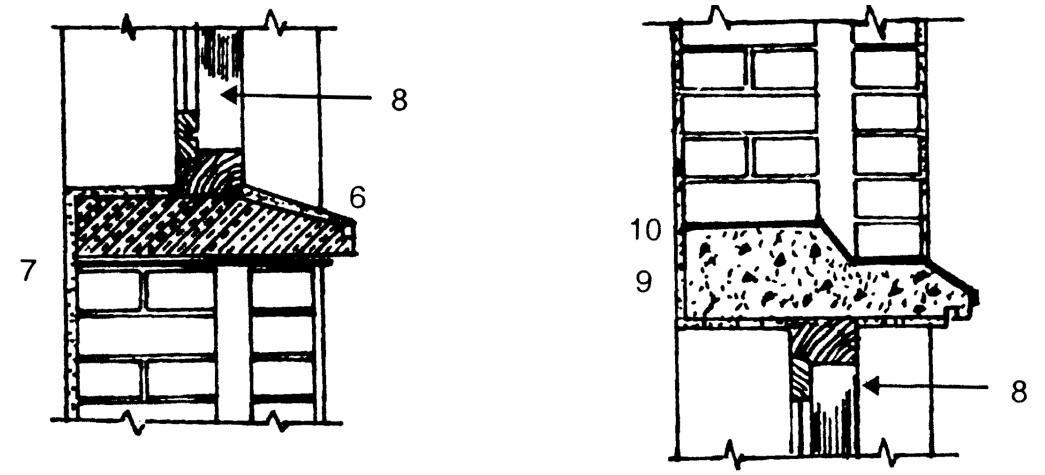


Fig. 9.5: Cavity wall clamps or wall ties



1. Inner wall 2. Outer wall

Fig. 9.6: Cavity wall

In order to hold the doors and windows fast with the wall either of the two methods are adopted. A hold fast of the shape of Z is jammed with concrete put in the hole of the wall made for this purpose, when the frame is being put at the time of construction. And if the frame is to be put later on then fastners are used.

Bond

In general Brickwork is done in English Bond, however different types of bonds can also be used if asked for e.g. Flemish Bond, American Bond, Garden Wall Bond, and English Bond. Some of the useful Bonds are shown in the Fig. 9.7 – 9.13 below.

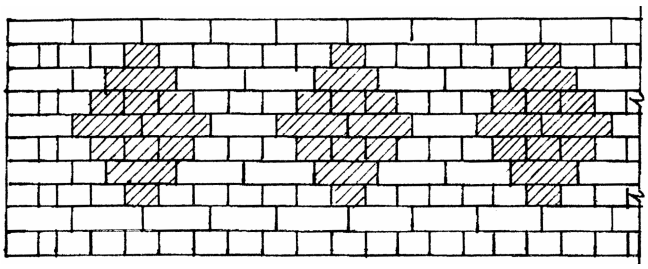


Fig. 9.7: English Cross Bond

(For creating pattern Bricks in English Bond or painted)

English Garden Bond

In English Garden Bond 3 stretcher course is followed by one Header Bond

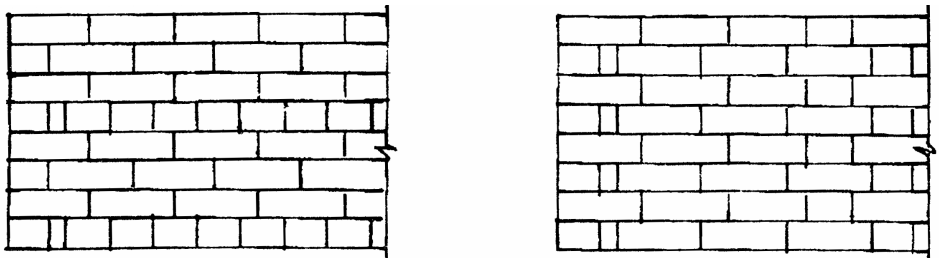
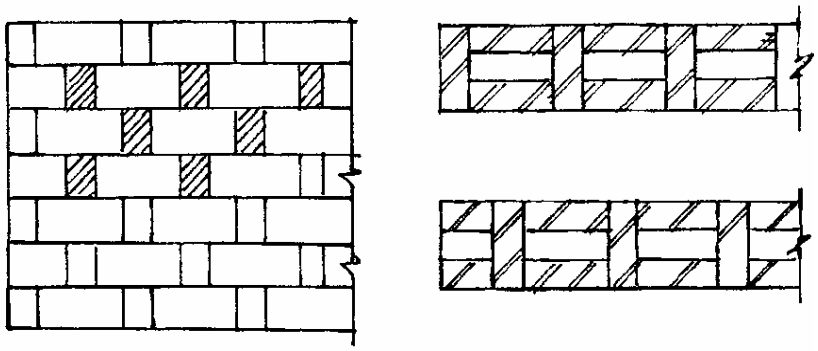


Fig. 9.8

Flemish Garden Bond

In Flemish Garden Bond also one Header course is provided after three stretcher course

Fig. 9.9



Elevation Plan

Fig. 9.10: Rap Trap Bond using brick on Edge

Sometimes two types are used simultaneously. This is called Mixed Bond. This is done when two walls meet or when wall and Pillars meet.

Fig. 9.11: Mixed Bond

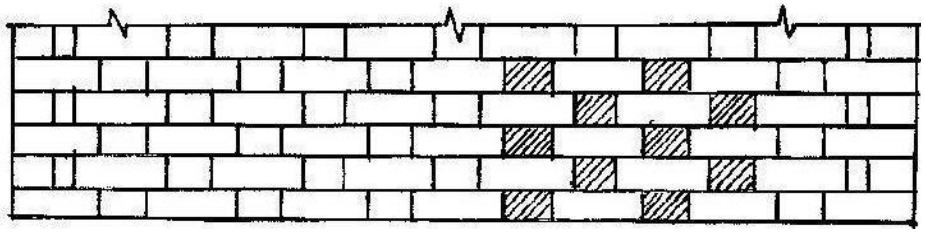


Fig. 9.12: Flemish Bond

The specialty of Flemish Bond is that in every course one brick is kept in Header Position and the next brick is kept in Stretcher position.

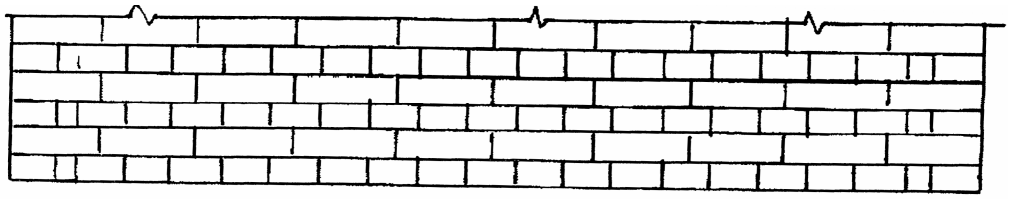


Fig. 9.13: English Bond

In English Bond one course is laid as stretcher layer and the next course is laid as Header layer.

In both the types of bond closers (King closer and Queen closers) are used in the full thickness of the wall.

In American Bond after every four or five courses one stretcher course is layed.

During brickwork construction it should be kept in mind that the joint of first course and second course should not fall in one line. This is kept like this with the aim that the loads are distributed diagonally up to the foundation. The combined thickness of one course including that of the mortar should not exceed 7.6 cm in any layer/course.

The brickwork for all is always started from both the ends. In general walls are constructed as ½ brick thick, 1½ bricks thick, 2 bricks thick, 2½ brick thick and 3 brick thick which we see in our daily life. However, in Boundary walls one brick thick wall are also constructed. In English Bond the lay outs of 1st layer,

3rd layer and 5th layer etc are same they are called odd layers and the layouts of all even layers (course) are similarly same. The joints are not actually cut but they are made to overlap.

Any wall which is more than 23 cm in thickness Plumb bob and vertical gauge is put on both the sides of the wall and the cotton string is also stretched on both the faces of the wall. If the wall is being constructed on all the four sides, all the walls should be raised up to the same height and left at 45° for next day's work, so that good bond can be made.

Joints: All joints should be cut up to 12 mm deep, so that at the time of plastering good bond is made between the brick and the plaster. It acts like a key.

Curing: In general brickworks are cured at least for 7 days.

Measurement: Measurements for the purpose of payment will be done considering the thickness of wall in the multiple of 11.5 cm i.e. 11.5, 23.0 cm etc.

Arch construction (DOT): At certain places in the openings of doors and windows of building Arches are constructed. Arches are classified as segmental, Gothic etc. The lower portion of the arch is generally a part of the circle. (Fig. 9.14)

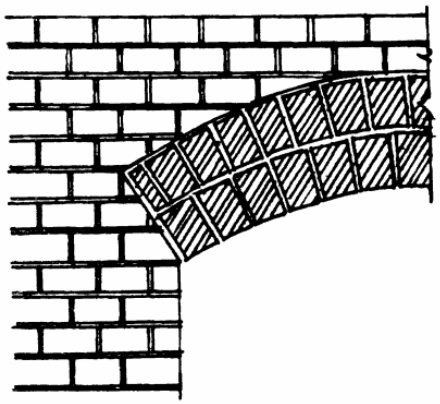


Fig. 9.14: Arch

(In this arch the thickness of the mortar between the brick is varied to make the Arch)

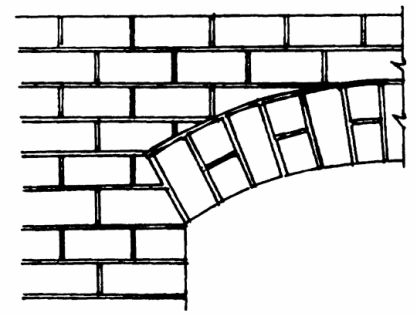


Fig. 9.15

(In this type of arch the glazed bricks are rubbed and cut to make the arch)

Temporary support (shuttering) is required to be constructed at the time of construction for supporting the arch under construction. Centre is required to be marked. The starting point of the arch is called "Spring" and the line joining two springs is called spring line. This operation is called centring and shuttering.

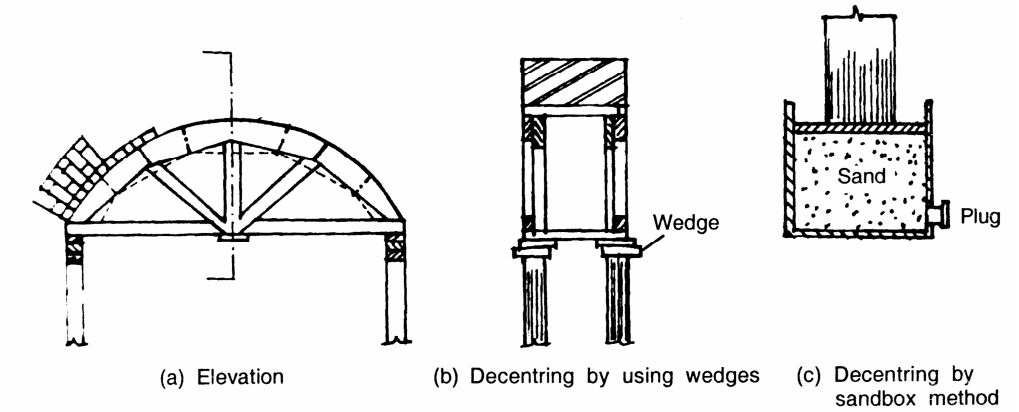


Fig. 9.16: Various stages of Arch Construction

9.5 POINTS TO BE NOTED AT THE TIME OF BRICKWORK CONSTRUCTION

- It should be ensured that the brick being used is as per requirement.
- The brick should be wet for atleast two hours before starting the construction for which a water tank is needed at the work site.
- The brick should be properly placed on the even surface and the mortar should fully cover the brick surface before laying the other course.

- The brick work should be raised in layers in an uniform manner and it due to any reason it is not possible stepping should be made in brick wall under construction for future work.
- Vertical layer and horizontal layer both should be controlled while constructing a brick wall.

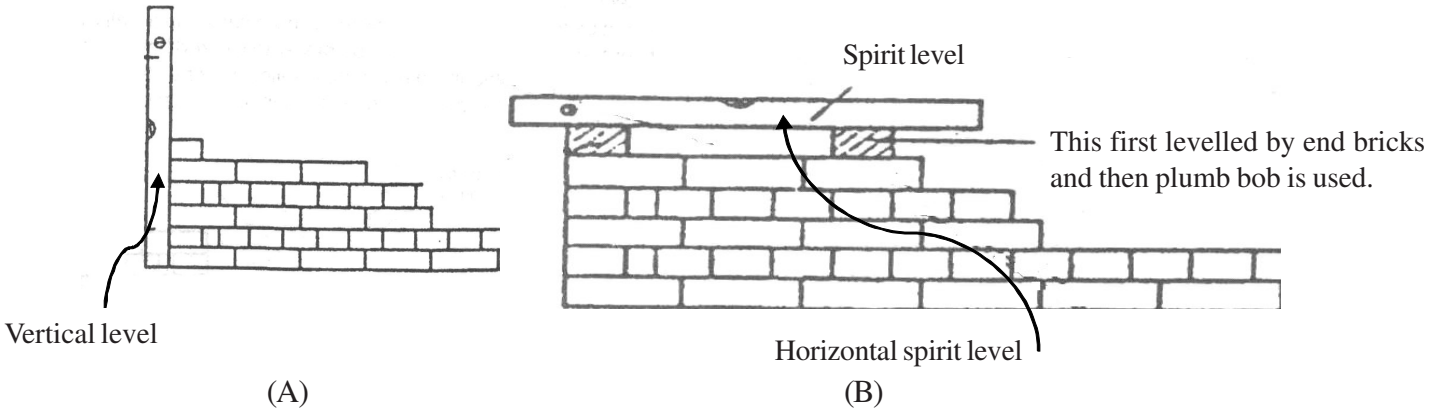


Fig. 9.17: Process to be observed before laying a fresh course of B/W

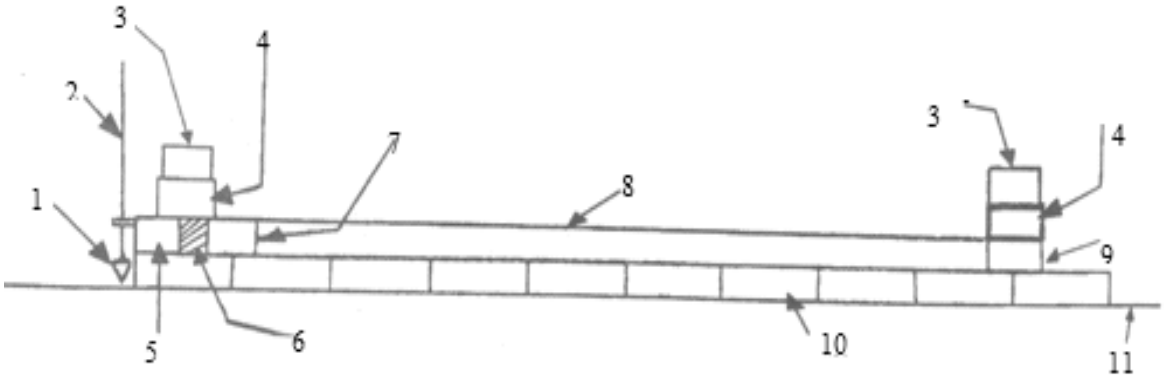


Fig. 9.18: Process of starting the second course of brick work by using plumb bob

1. Plumb bob, 2. String of plumb-bob, 3. Dry brick for increasing the weight, 4. Dry brick for wrapping of cotton string, 5. The corner of the header of the second course, which is set in the corner of the stretcher coinciding with the string of the plumb -bob, 6. Closer -brick, 7. The brick set for second course of B.W., 8. Cotton- string, 9. The brick level fixed for the second layer, 10. First layer of B.W., 11. Base Concrete.

- Approved cement mortar should only be used for B/W
- It is not permissible to use small brick bats or ½ bricks in the B/W

- The B/W should be carried out maintaining the vertical and horizontal level.
- The brick work should be cured for atleast 2-3 weeks with water if it is in cement mortar and for 1 to 2 weeks if it is in lime mortar.

The defect in B/W may be of the following nature: defect in joints, loose particles in brick, improper drying or efflorescence.

9.6 PLINTH BEAM

It has become very necessary these days to cast a beam at the plinth level. It joins all the walls from each side. Its thickness and width is kept as per design. It keeps the total building bounded together and helps in the providing safety to the building during earthquake etc.

In the same way at plinth level also ring beam is provided which joins all the walls.

9.7 WHAT HAVE YOU LEARNT

- Brickwork and its type
- Bonds and its types used in Brickwork.
- Points which should be kept in mind at the time of Brickwork.
- Plinth beam

9.8 TERMINAL QUESTIONS

1. What is the importance of Brickwork in building construction?
2. How many types of bonds are used in Brickwork?
3. What points should be kept in mind during Brick work?
4. What do you know about the Plinth Beam?

10

ORDINARY CEMENT CONCRETE

10.1 INTRODUCTION

The homogenous mixture of Cement, Sand and stone chips when casted by mixing it with adequate amount of water is called concrete. The process of preparing the mix is called concrete mix.

10.2 OBJECTIVES

After going through this chapter you will be able to:

- describe about the appropriate Mix ratio of Cement concrete;
- explain the method of mixing of concrete;
- describe the precautions which are required to be taken at the time of casting of concrete;
- describe the process and period of curing of concrete.

10.3 PREPARATION OF CONCRETE

As mentioned in the drawing, the raw materials for the proposed concrete mix should be available in the required proportion. After this the mixing of concrete is carried out. It is of two types:

Mixing by Hand

For mixing by hand, the material should be kept in a water proof tank. Before

adding water, the material should be properly/thoroughly mixed till the color of the mix becomes uniform in dry state and only after that the suitable amount of water should be added to make the mix workable one.

Mixing by Machine

All the raw materials of concrete such as cement, sand and stone chips are collected in the required proportion and then put into the rotating drum and is rotated firstly in dry state and then water is added in the amount sufficient to make a workable concrete. These machines are of both the types i.e. tilting and non-tilting. Mostly they are electrically operated. For small works using Cement up to one bag only, we have smaller mixing machines also. All these machines are available at job sites.

For big works such as Roads, Airport, and Embankments construction special types of mixers are also used. For still bigger works off site or distant Mixing Plants are also used. This is called Ready Made Concrete or Ready Mixed Concrete (RMC).

Fig. 10.1: Mobile Mixing Plant

Fig. 10.2: Concrete Mixer for use at site

Fig. 10.3: Truck Mixer (T.M.)

- Water should be added in the mixer only after pouring dry materials in it.
- After using the concrete mixer, it should be washed properly. Otherwise small bubbles will get enjoined into it due to presence of cement.
- Inspection of the mixer should be done at regular intervals and any broken part should be replaced.
- The duration of mixing and its speed depends upon the specification of the concrete.
- Concrete should be taken out of the mixer after the specified time.
- Fresh concrete takes its place easily.

Table 10.1: Ratios of Cement, Sand and aggregate for different works

Foundation base for temporary construction of general nature	1: 5: 10 or 1:6: 12
Foundation base for good building etc.	1:4:8 or 1:5:10
R.C.C. Bridge	1:2:4
Important Construction	1:1½ : 3

Table 10.2: Acquired strength of PCC with time

Time Elapsed	Acquired strength in % of F. Strength
After 3 days	40%
After 7 days	65% - 67%
After 28 days	100%
After 03 months	115% - 122%
After 06 months	120% - 146%
After 12 months (1 year)	130% - 155%

(Note: Strength acquired after the elapse of 28 days is considered full strength)

Fig. 10.4: Pouring of RMC

Concrete should be poured at the designated place and then tampered properly, so that it becomes dense and compact. This may be done by either of the two methods- 1. Tampering rod of steel 2. Machine called vibrator (electrically operated)

Fig. 10.5: Vibrator

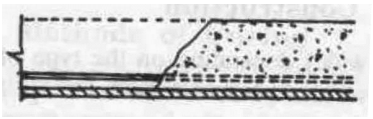
Table 10.3: Requirement of material for preparing 1 Cub. M. of concrete

Concrete Mix (old system)	Water Cement ratio	Requirement of materials			
		Water in ltr.	Cement No. of bags	Sand Cub.m.	Stone chips (cub.m.)
1:1:2	0.54	27	12.2	0.45	0.90
1:1.5:3	0.60	30	8.0	0.44	0.882
1:1:4	0.64	32	6.4	0.47	0.94
1:3:6	0.74	37	4.4	0.485	0.969
1:4:8	0.90	45	3.4	0.50	0.963
1:5:10	1.20	60	2.6	0.475	0.921

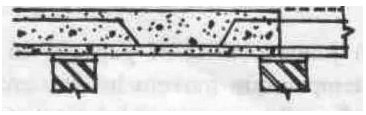
10.4 CONSTRUCTION JOINT

All the concrete work should be carried out as a one single operation, this is most desirable. However, if due to any reason it becomes necessary to stop the

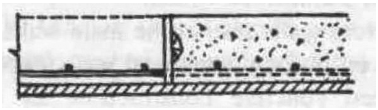
work, then construction joints are required to be provided. Various types of construction joints have been shown in Fig. 10.6 below.



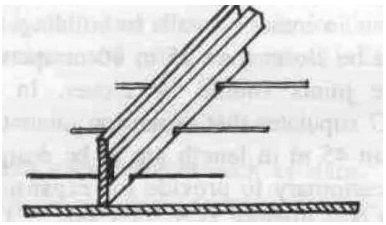
Not correct



Recommended for support beam and slabs.



Recommended in slabs with stop board



Details of stop board

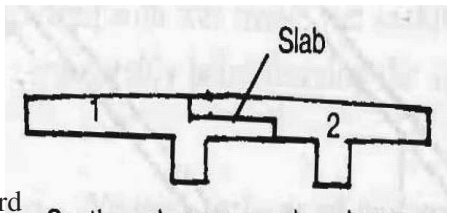


Fig. 10.6: Construction Joints

10.5 CURING

Initial setting of concrete though starts after 30 minutes of pouring, but it starts hardening after 2 hours.

After the elapse of 24 hrs after pouring of concrete, it is required to be kept wet (fully) for 14 days in continuation. This process is called curing. Any brickwork over the concrete can be started only after 48 hrs, but the curing should simultaneously continue for atleast 14 days.

Curing is an important thing in any concrete work. If not properly cured, the concrete loses strength and becomes easily breakable which is dangerous.

Measurement of concrete work

The thickness of the concrete work is measured to the accuracy of 0.5 cm. The length and breadth is measured in such a way so as to include the slope also and this is measured upto the accuracy of 1.0 cm.

Table 10.4: Consumption cement per Cub. M. of concrete Mix.

Mix/grade	Amount of cement in bags	Mix/grade	Amount of Cement in bags
1:5:10 (M5)	2.6	1:4:8 (M 7.5)	3.40
1:3:6 (M10)	4.40	1:2:4 (M 15)	6.40
1: 1½ : 3 (M 20)	7.20	1:1:2 (M25)	7.80
M30 (Design mix)	8.80	M 35 (design mix)	9.80

10.6 CONSISTENCY (CONCRETE WORK)

Consistency means the ease of flow of concrete. It depends on the amount of water used. The less the amount of water used the spreading of concrete becomes difficult but it gives higher strength, and if more water is used the spreading of the concrete becomes easier, but the strength reduces. Therefore, it always becomes necessary to use appropriate amount of water in the concrete work and this is controlled by specifying and determining the consistency of concrete. The measurement of consistency of cement (work ability) is done by a test which is called "Slump Test". The procedure of conducting slump test is given below:

10.6.1 Slump Test

To determine the appropriate workability of concrete slump test is performed. The workability is controlled by controlling the amount of water in the concrete.

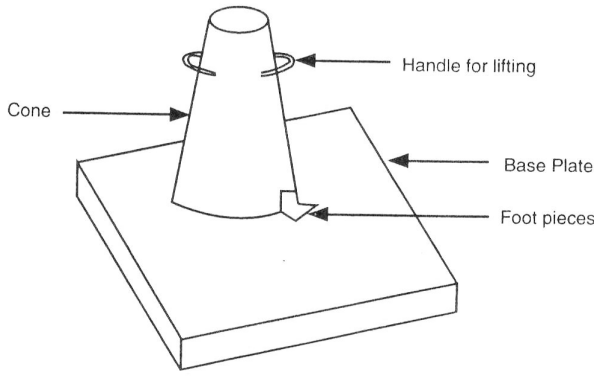


Fig. 10.7: Slump test (Step-1)

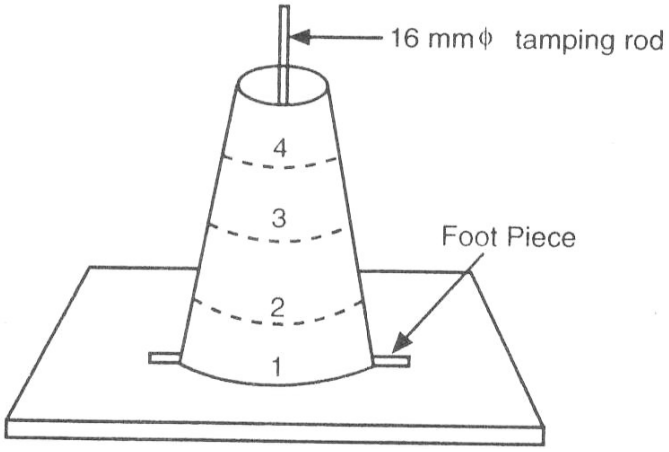


Fig. 10.7: Slump test (step 2)

The method of conducting this test is as follows:

- The slump cone and associated equipment should be cleaned such that no concrete particles are adhering to the walls.
- The concrete to be tested is mixed thoroughly so as to give a homogenous mix.
- The slump cone is so placed on the base plate that the wider face is at the base and the smaller face is on the top.
- The concrete sample is then poured into the cone in four layers and each layer should be tampered by tampering rod (16 mm and 600 mm length) 25 times. During tampering the rod should not penetrate into the lower layer.
- The concrete should be leveled at the top. Excess concrete should be removed.
- The cone should be cleaned both from inside and outside along with the plate. Thereafter, the cone is slowly lifted. When fully lifted the concrete will slump slightly. This slump in height is to be noted.
- Higher the slump value higher is the workability.

The table below gives the values of maximum value of permissible slump for different types of works.

Table 10.5: Permissible values of slump for different works

S.No.	Work	Amount of slump in cm	
		Compaction by using vibrator	**Manual compaction**
1.	Bulk concrete (R.C.C. foundation, footings and Retaining walls)	1.0 to 2.5 cm	5.0 to 7.5 cm
2.	General Reinforced slab, beam and columns	2.5 to 4.0 cm	10.0 to 12.5 cm
3.	Slender RCC sections/dense reinforcement section	4.0 to 5.0 cm	12.5 to 15.0 cm
	RMC (Ready made concrete from mixing plant)	As per Site engineer's direction	As per Site engineer's direction

10.7 POURING OF CONCRETE

Concrete will be poured slowly in Roof slab, columns or Beams, it is not to be thrown forcefully. If the place where the concrete is to be poured is below the pouring level, sheet of steel or chute will be used. So that it reaches the spot smoothly.

It is better to pour 1.0 m of concrete height only at a time in case of column construction.

10.8 BEAM

If it becomes necessary to give construction joint in beam it should be given in the middle away from the end locations.

10.9 EXPANSION JOINTS

If the R.C.C. work is more than 45 m in length, one or two expansion joints should be given.

10.10 WHAT HAVE YOU LEARNT

- What is concrete?
- What is the correct method of mixing of concrete?
- Points to be observed during pouring of concrete?
- Curing of concrete.

10.11 TERMINAL QUESTIONS

1. Describe the different methods of mixing of concrete.
2. What is the time limit within which the concrete mix must be used after adding water to it?
3. What is the aim of tampering/vibrating of concrete?
4. What is the method of measurement of constituents of concrete in the directed proportions?
5. Why slump test is performed?
6. Why different slump values have been recommended for the same work for vibrator compacted concrete and manually compacted concrete?

11

REINFORCED CEMENT CONCRETE

11.1 INTRODUCTION

The concrete of the mixture of cement, sand, water and aggregate in a certain proportion with steel bars by a known method is termed as Reinforcement Cement Concrete.

11.2 OBJECTIVES

After reading this lesson you will be able to:

- explain Reinforcement Cement Concrete;
- explain why, reinforced cement concrete cover is provided and where it is;
- describe the behaviour of RMC in concrete used in large scale;
- take precautionary measures in placing reinforced cement concrete;
- describe preparation of form work for construction of reinforced cement concrete structure;
- explain the points to be remembered in removing of form work used in reinforced cement concrete structure.

11.3 STEPS FOR PLACING RCC

11.3.1 Form work, shuttering, centering

For casting of slab or column, there is a requirement of form work, which should

be covered from four sides to retain the concrete. For casting of slab, shuttering is also required. Form work and shuttering are done by plywood or steel plates (panels) where an arch is provided in wall. Form work is done according to the curve of the arch, which is known as centering.

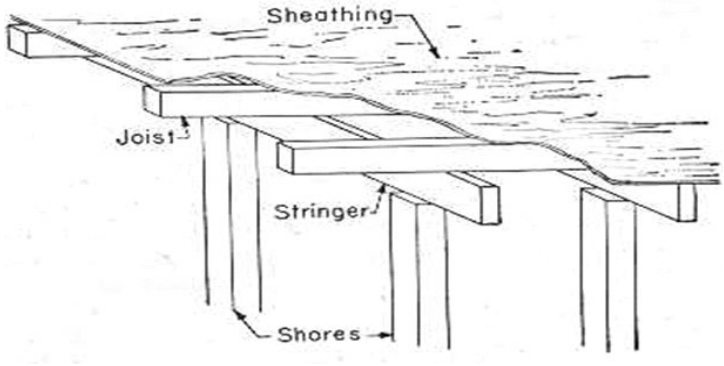


Fig. 11.1: Shuttering for slab

Fig. 11.2: Form work for column

The wooden planks or steel panels used as mould, in which concrete is poured and the stand of ballies (Bamboos) or steel posts is known as shuttering. It is provided till concrete get hardened to bear loads. The diameter of ballies should not be less than 100 mm and at extreme 80 mm. Ballies should be provided at the distance of the column and should be placed straight. Wooden planks of size 40 × 40 cm. are provided at the bottom of ballies.

Fig. 11.3: Ballies below wood planks

Shuttering should be kept at the middle (4 mm in a meter span) to hold concrete not below the horizontal level when settled with their own weight.

Fig. 11.4: Horizontal shuttering

When shuttering is provided at projected portion (known as cantilever), it is kept little up at projected portion (1 in 50) so that after removing the shuttering, hardened concrete becomes horizontal.

Wooden planks used for shuttering should not be made of too dry or green wood because it will absorb water from concrete leaving the slab base uneven and disfigured. Provision are given for lights and fans in the form of small steel box.

12

ROOF

12.1 INTRODUCTION

The structure provided to cover the house surface (floor) is known as roof. For different situation and requirement, it is made of different materials and methods such as RCC roof, Tiles roof, factory roof etc.

12.2 OBJECTIVES

After reading this lesson you will be able to:

- describe the importance of roof in a house;
- explain the various types of roof;
- explain the precautions to be taken in construction of roof;
- describe the construction activities in different types of roof.

12.3 IMPORTANCE OF ROOF

Predominantly, walls are used in the house for providing safety from different weather conditions. Roof made on the walls provides a cover from rain. The safety of a house is related to the strength of a roof.

12.4 TYPES OF ROOF IN A HOUSE

There are three important types of roofs such as:

1. Jack arch roofs
2. Sloppy roofs
3. Flat roofs

Besides above, another types of roofs are Tin, Cement sheets, T-iron, Stone slab, R.B.C and RCC slab.

12.4.1 Jack arch roofs

In Jack arch roofs, Joist of appropriate size are kept parallel at interval of 1 mm (approx) so as to complete span of a room is divided into one meter span. Arches are made on a pair of two girder. Dot of bricks are constructed at the lower flange by temporarily centering.

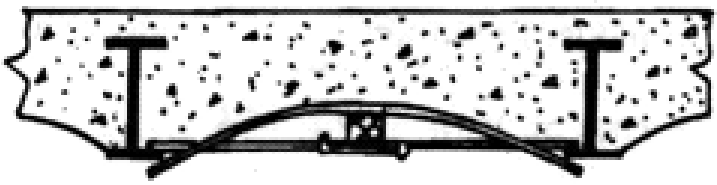


Fig. 12.1: Method of Jack Arch roofs construction

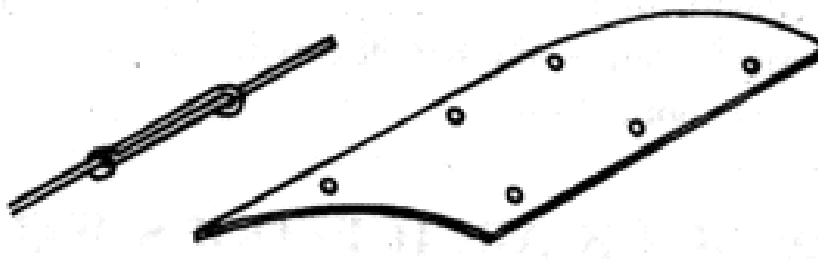


Fig. 12.2: Centering (Mould of Jack Arch roofs)

After 4-5 days of construction of dot at all span, centering is removed after hardening of mix and can be reused.

Although construction of this roof is easy and moulding is easy but upper surface is circular curve. Upper surface is made flat by filling concrete.

Steel bars with plate and bold are provided at one meter interval in construction of last spans dot.

The use of concrete for upper surface and necessarily of girder makes these roofs redundant.

12.4.2 Sloppy (Inclined) Roofs

Sloppy roofs are used in those places where upper surface of roofs is not in use, span is large and aesthetic view is not required in inner surface. In hilly areas due to the possibility of snowfall, the top floor, roofs are made sloppy. The shade of workshops are also made sloppy. A sufficient capacity frame is provided to support the surface load of sloppy roofs. There are two types of sloppy roofs:

1.One sided slope 2. Two sided slope

For small span (2.5 to 3 m) one sided sloppy roofs are provided viz. verandah.

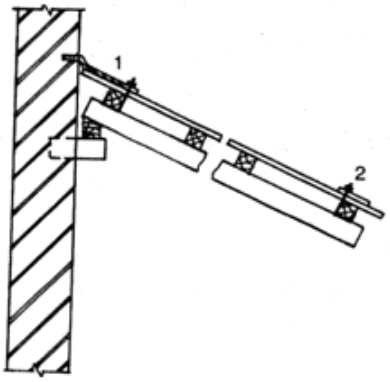


Fig. 12.3: One sided slope

Various materials are used to cover sloppy roofs.

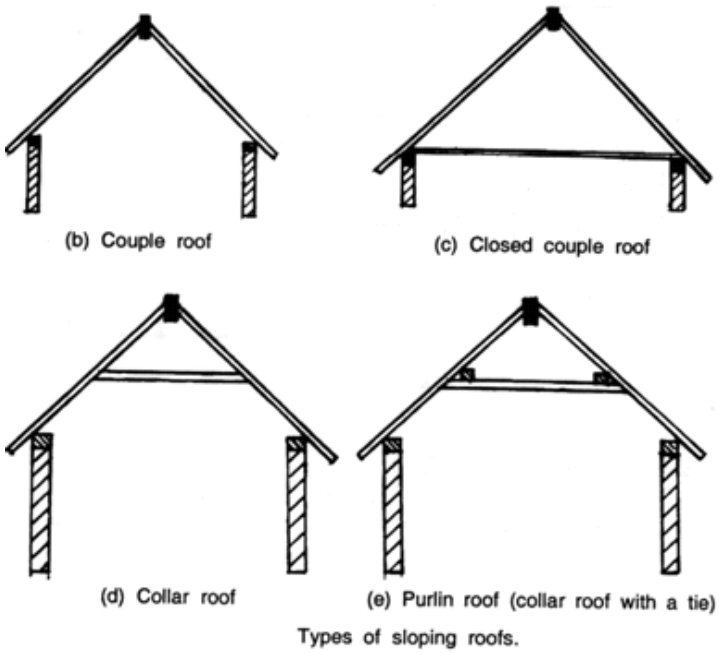


Fig. 12.4: Both sided sloppy roofs

Normally two sided sloppy roofs are couple roofs, attached at base level are closed. Couple, attached at mid level are collar roof and purlin with collar are known purlin roof.

Rain water falls from both side of roof for which gutters are provided at lower side. Both sloppy sides are met at ridge and gap is covered with special size ridge sheets.

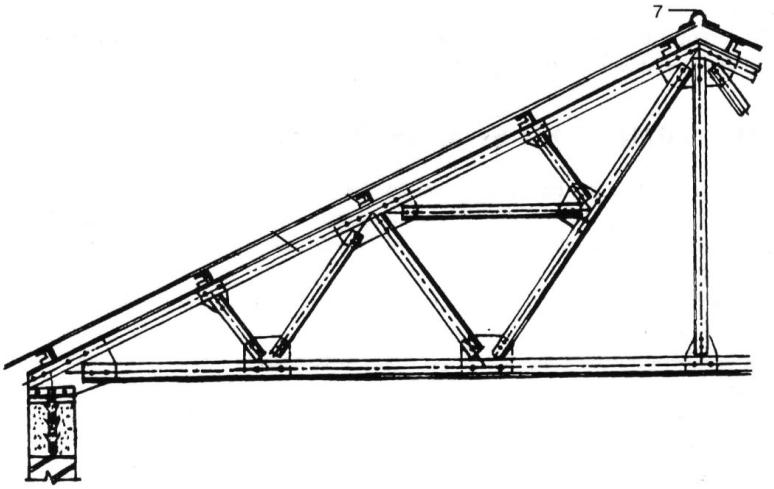


Fig. 12.5: Roof truss

These are two types. Grooved (width 1 mm after fixing) and Traffered. In grooved sheets, six grooves are provided as shown in fig. 12.6.

1.Grooved Sheets

Sheets are made of zinc coated thin steel sheets, asbestos sheets, aluminum sheets. The fabrication procedure of these sheets are same.

Lower section is made of wood (sequence sect.) iron pipe or iron angle section.

All sloppy roofs are started from bottom and end to top. Sheets are attached to lower frame with the help of clamps or nut-bolts.

When span is large, both sided sloppy roofs are used. The frame work required to support these roofs is known as truss. Truss is made of angles, revetted or welded plates. These trusses can be seen as a roof support trusses at railway station platform.

Fig. 12.6: Traffered and plane corrugated sheet.

Plane sheets are without any grooves.

Method of laying AC sheet

(see fig. 12.7 and 12.8)

1. Before laying the sheets, it is required to check the distance of both purlin and length of sheet so as minimum overlapping of 150 mm in sheet length, maximum, projection at caves, 300 mm and overlapping of 75 mm is available at ridge.
2. The rough surface should be inner side.

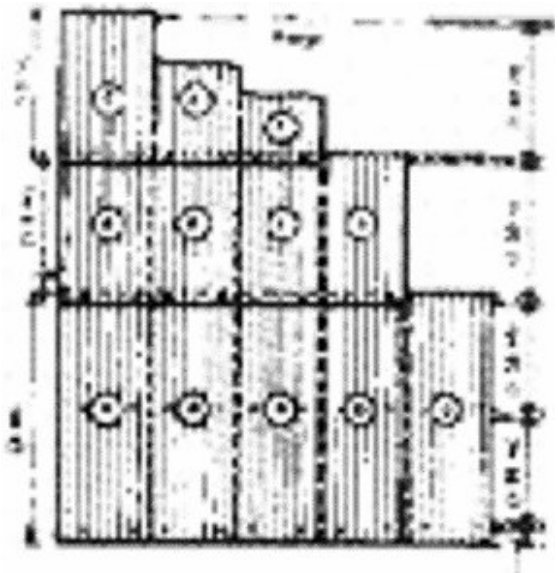


Fig. 12.7: Method of laying AC sheets.

3. To adjust next sheet on previous one, the lower groove should be at left and upper groove should be at right on previous one by moving, left to right from the eaves. (In fig. A, B, C D). In this manner, first line has been laid. All sheets should be mitred at upper left except 1st sheet of left corner.

4. Now the lower right corner of first sheet of 2nd line should be mitred, other sheets (except the last one) are nitred at two corner (upper left and lower right). Last sheet is mitred at upper left corner.

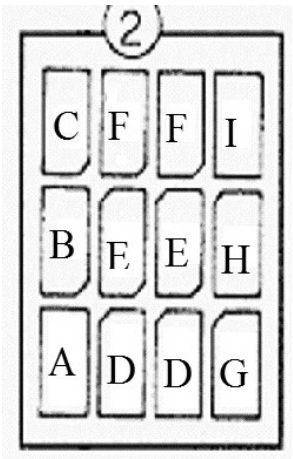


Fig. 12.8: Method of laying AC sheets

12.4.4 Asbestos Cement Roof

All sheets are laid according drawing. Purlins (pipe etc.) should be horizontal. Smooth surface should be outer side. Sheets are laid from left to right. Side lap should be half groove and lower side lap should not be more than 30 cm, out the wall.

At joints J or L shape look bolts are used. Size of bolt should be 8 mm. At the time of bolting, a bitumen washer is used below a tin washer to check the water from bolt gap.

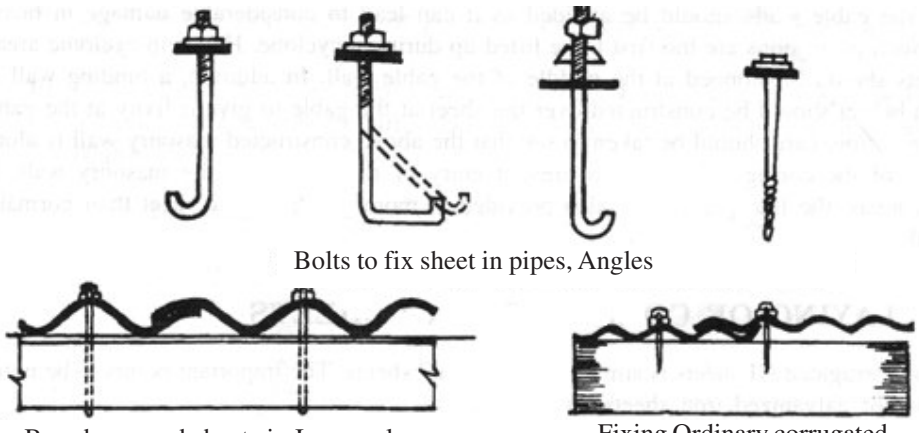


Fig. 12.9: Method of laying asbestos cement roof

In laying GIC, lap are provided at width and length, 2.5 times of groove size and 15 mm respectively. The shape of AC sheet is such that the side lap of half groove.

In sloppy roof (couple roof), on upper function viz. ridge, in A.C. sheet both sided A.C. ridge is provided to close completely ridge function and in GIC sheeting; plain GIC sheet flasig is used.

To tie the sheets in high pressure of wind, in lower purlin position, a flat iron strip is provided covering all sheets. This is known as wind tie.

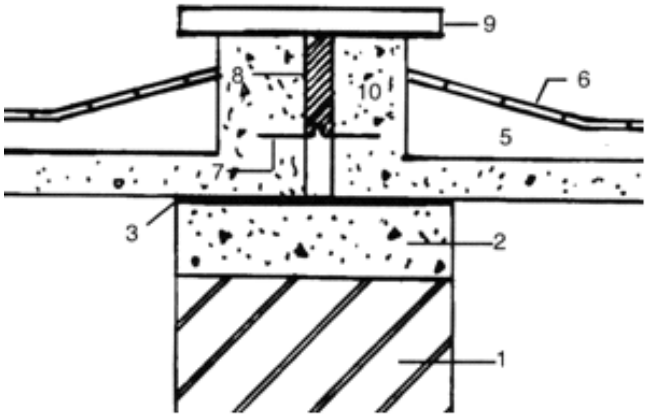
The edge of roof is known as cave.

For rain water, gutter is provided at appropriate slope. A rain water pipe is provided at the end with special size gutter end.

12.4.5 Flats roofs

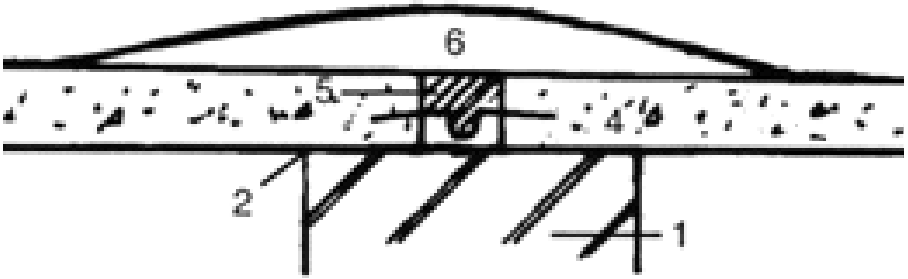
These are following types:

1. **Kachi roof:** They are made of wood planks on ballies.
2. **Stone slabs:** Square shape stone slab are kept on Angle or T iron. These are permanent and are in use now days due to simple construction.
3. **Prefabricated roofs:** They are used at important places where prefabrication facilities are available.
4. **RCC roof:** Wood planks, plywood or iron plates are used as shuttering. Reinforcements are placed according to the drawing. Generally cement, sand and aggregates are mixed in 1:2:4 ratio. Vibrators are used in casting of roof. After 24 hrs. curing starts which remains till next 14 days. After 14 days shuttering is removed.
5. **Expansion joints:** Following two figures show the expansion joints. This joint is provided at adjacent roofs and structured in such a way that rain water can not enter.



(a) Expansion joint at both side of beam

1.Brick wall work 2. Concrete brick, 3. Craft paper 4. Slab 5. Brick Jale concrete 6. Membrane water proofing 7. Wafers 8. Joint filler 9. Two layer of concrete 10. Beam.



(b) Expansion joint in slab on walls at both side

1. Brick wall work 2. Craft paper 3. Slab 4. Water slope 5. Joint filler 6. Water proofing.

Fig. 12.10: Expansion joint

6. **Mud Phuska :** If bitumen paint is provided at the RCC roof, the following method should be followed:

The RCC slab is cleared off dust and loose materials.

Normally 80/100 bitumen is used. After boiling it is spread over so as white spot do not remain. It is painted upto 6" height pharaphet wall.

Immediately after painting, a layer of coarse sand is spread over the coat of bitumen at the rate of 0.6 m^3 of sand per 100 m^3 of roof surface.

Mud phuska is prepared from pudded clay mixed phuska at the ratio of about 8 kg of bhusa/m^3 of clay. From mud phuska 5 cm slope is provided at roof. After 24 hrs. brick tiles are laid, with 1 cm gap. After this the joints are filled with 1:3 cement mortar. After drying flush pointing is done.

This is for one floor house. But nowadays homes are multistoried, in which top roof is covered with glazed tiles to reflect the sun rays. This reduces heat in roof.

12.5 DRAINING OF WATER FROM ROOF

Pipes are used to drain rain water from roof. These are known as rain water pipes. Earlier CI and cement pipe were used. But now plastics pipes are used. The diameter, bends, sockets etc. are shown in detail drawing of a house.

12.6 WHAT HAVE YOU LEARNT

- Roof construction in a house
- Types of roofs
- Methods of water drain from roofs

12.7 TERMINAL QUESTIONS

1. How many types of method are used for constructing roofs in a house?
2. How many types of sheets are available to construct the roofs in a house?
3. What precautions should be taken in construction of roofs?

13

PLASTERING, PAINTING AND POLISHING

13.1 INTRODUCTION

After the completion and making the building infrastructure strong in order to save it and its fittings from the effect of weather, and to give it an attractive look, the plaster, painting and polishing work is to be done.

13.2 OBJECTIVES

After going through this lesson, you will be able to:

- explain what is the necessity of plaster in inside and outside the buildings and the rooms;
- describe the types of plaster;
- describe the precautions to be taken while covering the infrastructure through these processes;
- describe the process and varieties of covering and making a building attractive.

13.3 CEMENT PLASTER

Cement plaster is generally used with 13 mm thickness and some times it can be of 19 mm thickness also. 19 mm plaster is done in two parts. First layer is of 13 mm and 2nd is of 6 mm thickness.

After the 1st layer is set, the slurry of cement of the 2nd layer is applied.

Besides the walls, plaster has to be done on the ceiling (lower part of the roof) also sometimes when the shuttering is opened, many holes are found at various places in the ceiling and at some places it is not found to be smooth, then a 6 mm plaster is done in the ratio of 1:3 of cement and sand, respectively. Its curing is done in the same manner as normal cement plaster.

Table 13.1: Consumption of Cement in the Cement Plaster

Thickness of Plaster	**Consumption of cement (Sack)**
20 mm thick (1:4) single coat	0.18 per square metre
20 mm thick (1:5) single coat	0.14 per square metre
20 mm thick (1:3) single coat	0.25 per square metre
20 mm thick (1:6) single coat	0.133 per square metre
12 mm thick (1:4) single coat	0.11 per square metre
12 mm thick (1:5) single coat	0.10 per square metre
12 mm thick (1:3) single coat	0.15 per square metre
12 mm thick (1:6) single coat	0.103 per square metre
6 mm thick (1:3) single coat	0.081 per square metre
6 mm thick (1:4) single coat	0.055 per square metre
20 mm thick (1:4) double coat (15 mm + 5 mm)	0.19 per square metre

Table 13.2: Required amount of material for plaster of each per 100 sq meter

Thickness (mm)	Mix 1:2		Mix 1:3		Mix 1:4		Mix 1:5		Mix 1:6	
	Sack of cement (Number)	Sand (cubic metre)	Sack of cement (Number)	Sand (cubic metre)	Sack of cement (Number)	Sand (cubic metre)	Sack of cement (Number)	Sand (cubic metre)	Sack of cement (Number)	Sand (cubic metre)
10	14-0	0-88	9-7	1-0	7-5	1-035	6-45	0-974	5-4	1-09
12	19-6	1-37	14-7	1-54	10-95	1-53	8-92	1-51	7-2	1-51
15	23-4	1-64	17-55	1-84	13-0	1-83	10-7	1-81	8-6	1-81
18	26-9	1-80	19-3	2-01	15-06	2-10	12-9	2-18	10-76	2-25
20	30-5	2-13	22-85	2-40	17-0	2-38	13-9	2-36	11-20	2-35

13.4 PAINTING THROUGH LIME

Lime, which comes in the form of blocks, is converted in to powder form by spraying it on a solid (pucca) floor and spraying water on it. This process is called slaking or extinguishing. Later on more water is mixed into it so that it becomes ready in the form of a slurry, which can be painted on walls through brushes. In order to make its grasping strong, 5 kg of adhesive is added in 4 cubic meter of lime. Walls are cleared completely and then painted with brush. Generally three coats are done.

For payment, it is calculated on the basis of area which is equal to length × width. It is up to two decimal points only.

13.5 COLOUR WASHING

For colour wash, the first coat, which is called priming coat is of lime. Then the required colour is mixed with lime for doing the second coat.

13.6 DRY DISTEMPER

One kg distemper of any good brand and 0.6 litre of water is mixed in ratio for about 3 minutes. It will be better if this solution is kept overnight and then is taken for use. In order to maintain the same colour throughout the wall, it is necessary that every time you should shake the solution before dipping the brush. Thus its consistency as well as the colour can be maintained.

Only that quantity of distemper should be mixed with water, which is likely to be consumed in day.

13.6.1 Making the surface ready

The surface on which distemper is to be done, is first cleaned with sand paper and made smooth as far as possible.

After the plaster gets dried up on the wall for minimum 60 days, only then distemper is to be done. First coat of lime is done on the plastered surface and after that 2 coats of distemper is applied.

For doing the distemper on old surfaces, first the surface is cleaned thoroughly and small pits are filled with plaster of paris mixed with the distemper. Once the wall is made smooth with sand paper then only the distemper is applied.

13.7 OIL BOUND DISTEMPER

Cement Primer coat is applied before doing oil bound distemper and all the process of smoothening of the surface is to be done in the same way as dry distemper.

Cement Paint: Cement paint is done only on the outer walls and not on the walls which are already painted.

13.8 MATERIALS

All materials used for paint should be of standard companies.

Painting Brush

Different size of brushes are used for different applications. For example 7.5 to 10 cm brushes for doors, windows etc. 5 cm brushes for grills and railings and 10 to 15 cm brushes are used for walls.

Maintenance of Brushes

After using brushes these are to be washed thoroughly in Terpentine oil and then kept aside. if the brushes are kept without washing, then they can not be used again.

Before using new brushes, they should be washed first in soap water and then in clean water and then dried. Before starting the painting work, rest of the jobs should be finished. Rooms are cleaned completely and then painting work should start. Painting work should not be done in the rainy season or in extreme humidity. The best season for painting is summer season.

Making the surface ready

Before painting, the surface should be cleaned thoroughly, so that any type of dust or any other material or loose particles are not deposited on the surface which is to be painted. Sand paper is used for cleaning purpose. Paint is poured from big drums to small containers. Every time paint is stirred well before

taking the paint through brush so that the texture of the paint remains the same.

While painting, brush is moved from top to bottom and then from right to left and in the end the brush is slowly moved after bringing it from right to left or from left to right giving light pressure on it.

The process so adopted is called one coat and when it gets dried, the same process is repeated which is called second coat. All the work is to be inspected at the site by the site engineer from time to time.

Painting is also done through spray machines. In that case the paint is made thin by mixing thinner into it. The surface should be dried before spray.

The putti which is applied on the doors and windows in order to give support to the glasses, is also painted with this paint colour. But remember that the stains of paint should not be seen on the glass.

Generally one coat is done on old works and two coats are done on new works.

13.9 PRECAUTIONS

The paint labourers should be warned that they should keep a net on the face while painting and wear rubber gloves in their hands so that they can save themselves from becoming ill.

13.10 MEASUREMENT OF PAINT

Measurement of paint is done in square meter upto two decimal points. Straight measurements are multiplied with their multipliers according to those given in the table below, and then the area for payment is calculated. (See table 13.3). While taking measurement only length and width are measured and not the curves. Measurement of collapsible gate is done by taking the length and width of that place where the gate is fixed, without opening it fully, other measurements are done in the same manner.

Parts of doors and windows are measured in straight and not in curve and these are measured along with the frame.

For collapsible gate, it is opened fully and measured from outside. No measurement is taken separately for any channel etc. similarly if there is any hood or cover is fitted on the top then separate measurement is taken for that.

For the doors or roofs (cement or iron) made of piped sheets, measurement is taken in straight line and not in circular curve.

Moulding or hand railing is measured in curve.

In the case of Truss, girders etc, measurement is made in terms of length × breadth which will be in square metre. No payment is made for any extra things.

Painting of Rain water pipes or any other such type of pipes is done in running metres. Clamps are included in this.

Painting of wall are done with exact measurements.

Chimneys or scaffoldings are measured separately. All measurements are done upto one centimeter.

In order to calculate the area painted or different surfaces, the following table should be consulted. Complete area is calculated after multiplying it with the multiplier given on the right side of the table.

Table 13.3: Multiplier for the paint measurements

Sl. No.	Description	Multiplier
1.	Doors and windows made of frames or bracings or panels	1.125 (for each surface)
2.	Battoned Doors windows	1.125 (for each surface)
3.	Flush doors (Flat doors)	1 (for each surface)
4.	Doors/windows of panels and glass	1 (for each surface)
5.	Doors/windows of glass or net	0.5 (for each surface)
Doors and windows made of iron		
6.	Doors and windows made of plain sheet	1.125 (for each side)
7.	All the glasses or doors/windows of net	0.5 (for each side)
8.	Some portion panelled and some portion of glass	1 (for each side)
9.	Doors or windows made of piped sheet	1.25 (for each side)
10.	Collapsible doors	1.50 (for each side)
11.	Rolling shutters	1.25 (for each side)
12.	Fencing or doors – wooden/iron	1 (for entire painting)
13.	For roof made of piped sheet	1.14 (for each side)
14.	Roof made of cemented piped sheets	1.20 (for each side)
15.	Net doors – for painting including the net	(for each side)

13.11 PAINTING WORK ON WOOD

A painting coat is applied first on the wooden surface. Now a days it comes ready made, otherwise it can also be made at the site. For this red lead, white lead and double boiled linseed oil is mixed in the ratio of 0.70 Kg per liter. New or old sand paper is used for rubbing the wooden surface, cleaning the dust with a clean cloth and then the primer is applied. After this the paint to be used should be of standard company and of I.S.I. marked. Second coat is applied only after the first coat becomes dry. Now a days quality enamel paint is made thin by mixing thinner into it and then it is applied through spray gun, like it is done on the cars and other vehicles.

13.12 PAINTING ON IRON STEEL

Just like the wooden work, a primer coat is initially applied on the iron/steel surface. Normally it comes ready made from the market. It is also made by mixing red lead and raw linseed oil in the ratio of 2.80 kg/litre with the terpentine oil and is made ready at the site with thin consistency. After primer coat, any type of paint, can be applied but it should be of good company. While painting the iron/steel surface, it should be kept in mind that before starting the painting, the surface which is already cleaned, it cleaned again with waste cotton or clothes, before being painted because there is oxygen in the air which reacts with iron and an iron oxide layer gets deposited on the iron surface in a very short time, which is known as rust as the time passes.

13.13 PAINTING ON THE PLASTERED SURFACE

Now a days plastic or oil bound distemper is done on the plastered walls, therefore it is necessary that the surface should be clean and clear, smooth, straight and plain. For this plaster of paris is done on the walls, so that the ups and downs on the surface can be removed or hidden. Then following process is adopted after the last coat of paint.

Plaster of paris surface is rubbed with sand paper and then a primer coat made of cement is applied. Then a putti made of mixing local enamel and chalk powder is applied and made smooth by a thin iron plate, and then the surface is cleared

by rubbing and after this distemper or plastic paint is applied on the surface which is made ready.

13.14 POLISH ON WOOD

The surface is first cleaned with thin and then with thick sand paper and then a coat is applied by mixing chalk powder and colur. After filling putti and then again sand paper is used. This sequence is repeated for 2-3 times. When the surface becomes smooth completely, a pad is made by folding a very thin cotton cloth and then first coat is applied by dipping the pad in the polish solution.

After drying, fine sand paper is used and then again the layer of polish is applied with the help of the pad. In the second and third phase, final coat of polish is applied and left for drying. It should be remembered while applying the coats of paint or polish that dust should not come on the surface from the surrounding area. Otherwise, dust particles will be deposited on the surface along with the drying of the polish and the labour along with the material will be wasted and this will cause monitory loss. If walls are to be painted with plastic paint, then remember that putti made of oil should never be applied on the surface below that.

13.15 VARNISHING

The wooden surface is first cleaned and if there are any holes, then a thin layer of gum is applied on these and wooden dust is applied over this to fill these holes. When this becomes dry, thin sand paper is used for rubbing this and then the first layer of varnish is applied. When first layer becomes dry then second layer of varnish is applied.

13.16 SPIRIT POLISH

Clean and clear sealing wax (Lac) particles which are available in light yellow and orange colour, are mixed with spirit. The ratio of mixing these two is 140 gram sealing wax (Lac) particles is to one litre spirit.

The process of applying

Wooden surface is first painted with a putti made by mixing chalk powder and spirit or the ready made putti is also used. Then the surface is smoothened by rubbing it through sand paper. After this, as told earlier, a pad is made of cotton cloth and polish is applied on the wooden surface through this pad. After 2-3 coats, the pad is dipped in only spirit and then last finishing touch is applied with loose hands.

For removing old paint, ready made paint removers are available in the market.

Caustic soda is also used for removing paint. It is mixed with water in the ratio of 1 : 48. While using caustic soda, it must be remembered that it should not touch human body otherwise it may burn the body and becomes very painful.

The process of measurement of painted and polished surface is already given.

13.17 WHAT HAVE YOU LEARNT

- What is the normal thickness of plaster?
- What precautions must be taken while doing the plaster?
- What is to be done for making thick plaster?
- What is the process of painting on wood/iron?
- What are the main features for different types of distempering inside and outside the building?

13.18 TERMINAL QUESTIONS

1. What arrangement is made during brickwork which is helpful for doing plaster?
2. What do you understand by the term single coat in painting or distempering?
3. What is the difference between the process of measurement of the finishing jobs done on the walls and openings (Doors/windows)?
4. What is the process of removing old paint?

14

FLOORING

14.1 INTRODUCTION

The job of protecting slabs of roofs on the different floors in building and providing suitable finish of floor surfaces is known as flooring. There are many types of floors according to their uses, economy and required level of finishing.

14.2 OBJECTIVES

After reading this lesson you will be able to:

- explain types of flooring;
- differentiate among different process of flooring;
- describe reasons for laying panels on ordinary floors of cement;
- provide explanations for grinding of special types of floors.

14.3 PRECAUTION BEFORE FLOORING

Before constructing the flooring, levelling should be done and marking should be done on wall at 30 cm above from required level. For this purpose spirit level or mercury level should be used. For better accuracy, water level used by mason (mistry), should not be used. Due to more length of pipe and friction inside the pipe, results are not accurate. One should use long wooden patty while making floors so that floor surface can be flat.

14.4 LAYING OF SUBGRADE

In some places concrete is used before flooring. This concrete is known as subgrade. The places where flooring is done directly on soil, surface should be rammed with the help of wooden hammer, so that the surface should not be settled down. If concrete is used after 24 hours, cement slurry (2 kg cement per square meter) should be laid and then flooring is done. If this concreting is done on ground it is known as base concrete. If it is done on RCC slab, it is known as kusson of size 100 mm and 40 mm respectively.

14.5 TYPES OF FLOOR

1. Bricks or interlocking tiles flooring
2. Cement concrete floor
3. Marble chips or crazy marble flooring
4. Ready made marble tiles flooring
5. Glazed tiles flooring
6. Kota stone, Agra stones etc stone flooring
7. Wooden flooring

14.5.1 Bricks or interlocking of tiles flooring

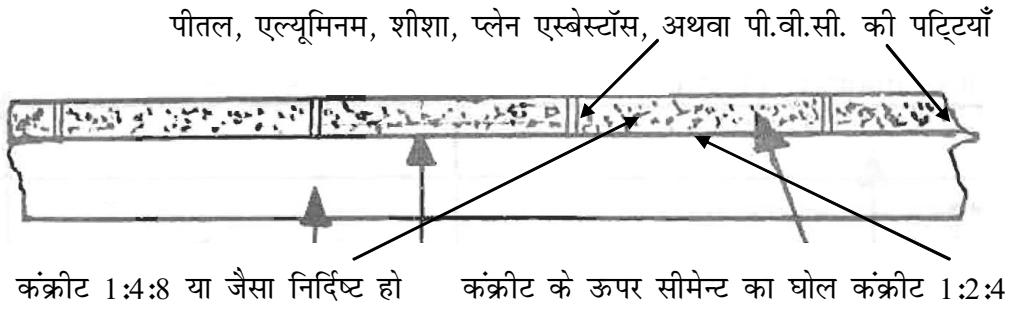
High quality materials should be used. If mortar is not used or even subgrade in lower surface, thick layer of sand is spread, and joints with space 6 mm wide are filled with sand.

Normally brick flooring is done as harry bonding in which joints are not continuous.

14.5.2 Cement concrete flooring

Monolithical cement concrete flooring

Due to technical reason any flooring of cement concrete should not be laid together. In this type of flooring, the surface is divided into rectangular panels. Alternate panels are laid first. Before concreting in panels, cement slurry is used.



Process of C.C. flooring in panels with use of strip

Fig. 14.1: Cement Concrete floors

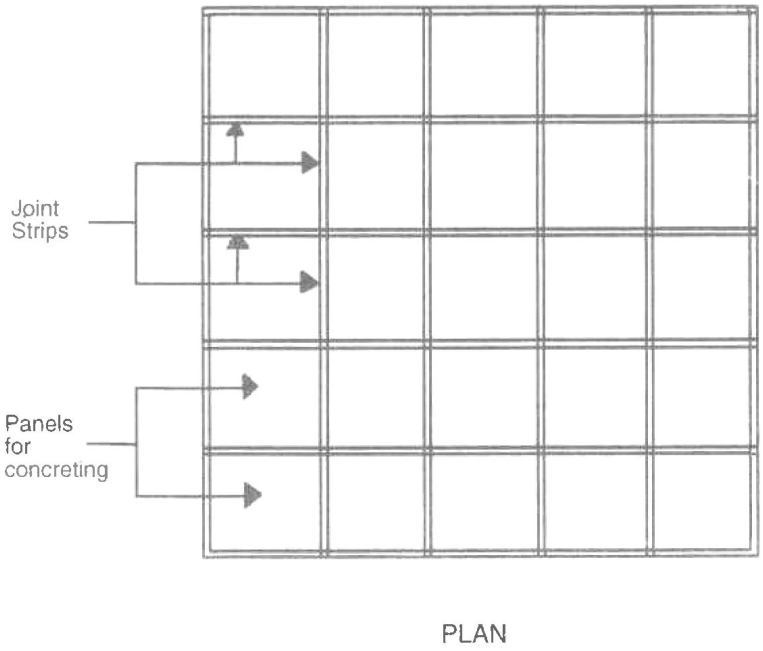


Fig. 14.2: Planning of flooring

Where this type of flooring is laid, first surface is compacted with wooden hammer and then 10 cm thick sand layers is spread. Then after watering and compaction, cement flooring laid.

Flooring is laid in two parts, upper portion of size 10 mm is known as topping made of cement and sand. After levelling with the help of a straight edge steel trowel is used for smoothening and finishing its top surface. Dry cement or mortar should not be used if some water comes at surface. Because this layer may be stripped out. The surface is then properly cured for a period of 14 days.

Non monolithic flooring in two layers:- In this method lower concrete layer of **1: 2:4** and upper layer of **1:2 ratio** of cement and sand mortar of 5 mm to 10 mm is made. In this polish can be done later.

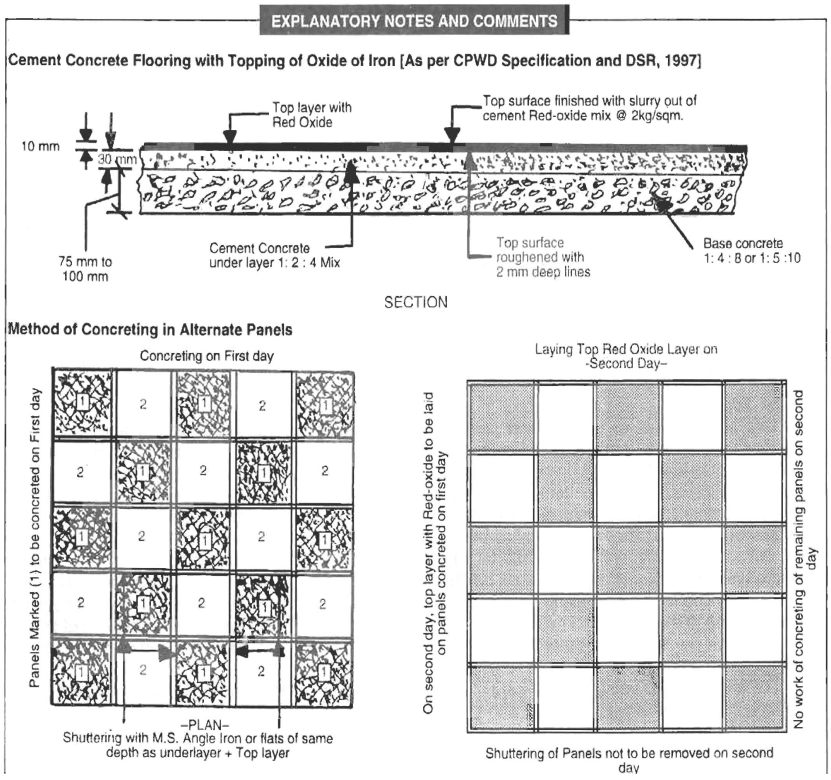


Fig. 14.3

Heavy duty concrete flooring: This type of flooring is made for railway platform or where heavy machines are used. **In this, flooring base is 50 mm and total thickness is 125-150 mm.**

14.5.3 Marble chips or crazy marble flooring

There are three parts of flooring: Base concrete, under layer and topping. This types of flooring is just like the cement concrete, except that toping layer is made of marble chips and cement of ratio 1: 1 ½ or 1: 2. To avoid cracks, partitions are made of not more than 25 gm size. Lower layer made of 30 to 40 mm size aggregate of 1: 2: 4 cement sand and aggregate. Glass or aluminium stripes are used for partition from lower layer to upper top layer.

The thickness of top layer is 10 mm and it is made of marble powder and cement in 1: 3 ratio and then powder and marble chip in 1: 2 ratio.

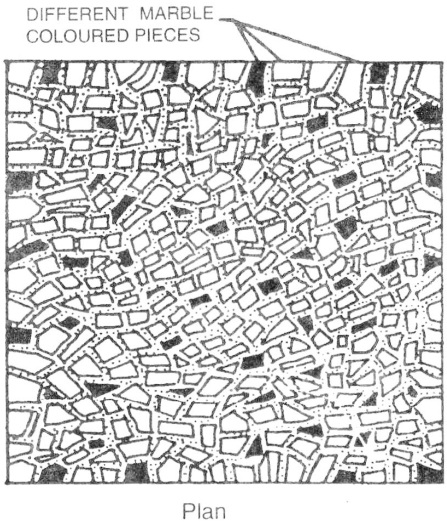


Fig 14.4: Crazy marble flooring

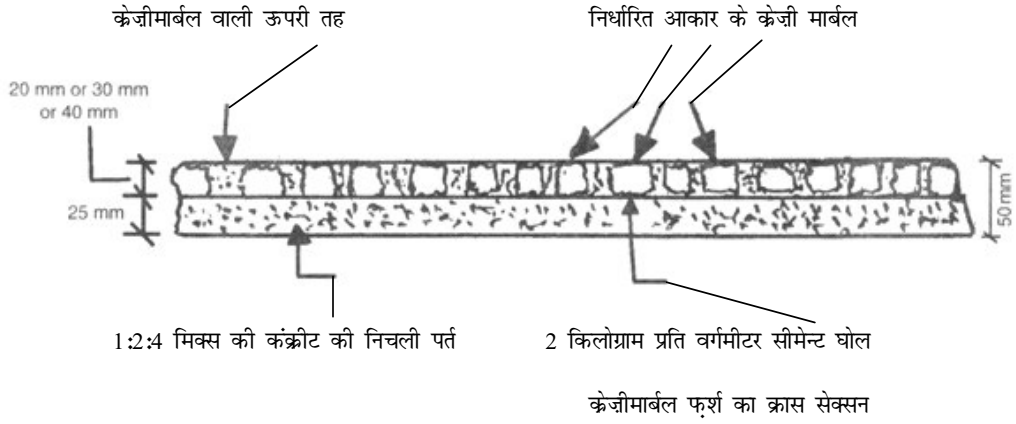


Fig. 14.5: Method of crazy marble flooring

Curing: Floor is left in atmosphere for 12 to 18 hrs, and cured for more than 4 days by water filled in small partitions.

Grinding and Polishing: After seven days of flooring is laid, grinding is done. Grinding stones are available in different grade. At the end polishing is done.

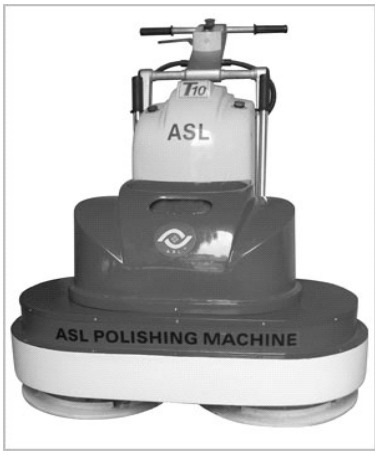


Fig. 14.6: grinding machine

14.5.4 Readymade marble tile flooring

Readymade marble tiles are available in market. For this flooring, firstly subgrade is prepared and

then on the mortar, tiles are laid. Mortar surface is prepared with 1:6 ratio of cement and sand. The thickness of mortar is 20 mm.

Laying of marble tiles: Before laying the tiles thin paste of cement slurry (4.5 kg/m^2) is spread and tiles are lid flat over it by gently pressing them into the bedding mortar with the help of wooden mallet till leveled surface is obtained. The flooring is then cured for seven days, then grinding and polishing is done in the same manner. These days glazed tiles are commonly used in houses.

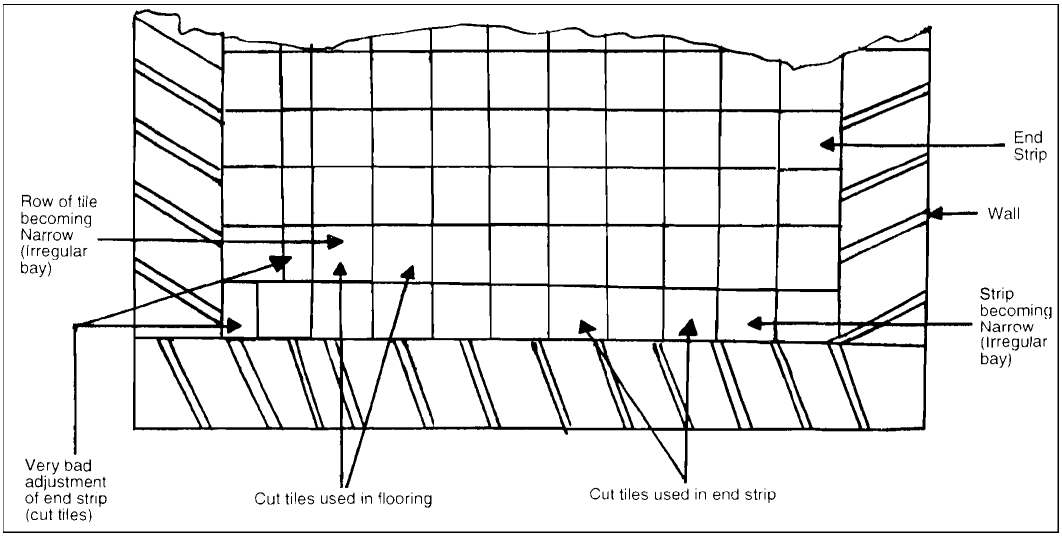


Fig 14.7: Laying of marble tiles

14.5.5 Glazed tiles flooring, skirting and dedo

Glazed tiles, skirting and dedo are made on sub grade with thickness 13 mm by cement and sand in the ratio of 1: 3. These are following types of glazed tile, vitrified, semi vitrified, or normal glazed tiles.

Vitrified tiles are of 10-12 mm thick in which upper layer is of 3-4 mm having long durability and shining whereas semivitrified are of medium quality.

Laying of tiles: After laying mortar, tiles are laid and pressed by wooden mallet as in marble tile flooring.

Before using, tiles should be clean and dried.

Skirting and dedo are laid in same manner. In the end all joints are filled with white cement pigment of tile colour.

14.5.6 Kota Stone Flooring

This is available in size of 600 × 600 mm which after dressing becomes of size 500 × 500 mm and thickness 25-40 mm.

Flooring is done in same manner as in tiles flooring except bed is made in 1: 4 ratio and bed thickness of 40 mm.

Table 14.1: Requirement of cement for flooring work

Types of flooring	**Cement requirement/bag**
IPS 1:2:4 (40 mm thick)	0.34
IPS 1:2:4 (25 mm thick)	0.25
IPS 1:2:4 (50 mm thick)	0.40
Kota stone (25-30 mm)	0.14
White glazed tile	$0.18/m^2$ + $0.05/m^2$ (for white cement paste)
Relaying of marble/Mosaic/moargar tile 1: 3 (thickness 13 mm)	0.176
Relaying of marble/mosaic 1:3 (13 mm)	0.28
Kota Stone 1: 4 (20 mm)	0.3
Tarozo 1 : 3 (19 mm)	0.38
Mosaic 1: 6 (20 mm)	0.26
IPS 1: 4 (20 mm)	0.28

14.6 WHAT HAVE YOU LEARNT

- Types of floors
- Methods of laying different types of floors
- Reasons of position in normal cement flooring.

- Importance of grinding in flooring.

14.7 TERMINAL QUESTIONS

1. How many types of flooring are generally used?
2. Describe various methods of flooring.
3. Why grinding is required in flooring?

15

WOODEN AND FABRICATION WORK

15.1 INTRODUCTION

In the construction work of building, after making the structure work, doors/windows are used for controlling air, light and security and to make it ready for living. Doors/windows are made of wood, iron, plastic or glass according to the need and the design.

15.2 OBJECTIVES

After going through this lesson you will be able to:

- describe the process of fitting shutters for convenient use of door/windows in building;
- familiarize yourself with different types of shutters;
- explain the process of making joints in the shutters;
- explain the importance of other security measures for doors/windows in the building; and
- familiarize yourself with joining the shutter of doors/windows with the building structure (walls and columns).

15.3 TYPES OF SHUTTER, FOR DOORS/WINDOWS

Generally the shutters are made of wood but due to the cost, choice etc, these are also made of iron, plastic and glass. Generally, woods used for shuttering work, are Teak, Deodar or Sal. In other ordinary buildings, wood from mango and neem etc. are used.

Shutters can have following differences:

1. Materials of frame for fixing them in the walls/structure
2. Fixing arrangement.

Among wooden shutters, Battoned/Braced and Battoned, Panelled, glazed, Panelled-cum-glazed, and flush doors are of the main types. Louvered shutters are also used at some places. Now a days, Battoned/Braced and battoned doors are rarely used except in cheap/temporary houses.

The wooden frames are used for wooden doors. Initially they were having four legs, but generally, they are having three legs. Stone frames are used in those places where natural stone is available in plenty. Now a days frames are made of iron sheets or fabricated from angle iron and concrete are also used. Generally doors are fixed in walls/structures through iron hinges.

The wood used for wooden frames or doors must have some special characteristics.

1. The wood should be saved in the direction of its fibres.
2. There should not be any lose knot.
3. The wood from the middle of the trunk of the tree should only be used.
4. It is sawed according to the requirement, and then kept for 15 to 20 days in stalk, so that it can be seasoned naturally, i.e. the moisture which lies inside the wood is dried completely

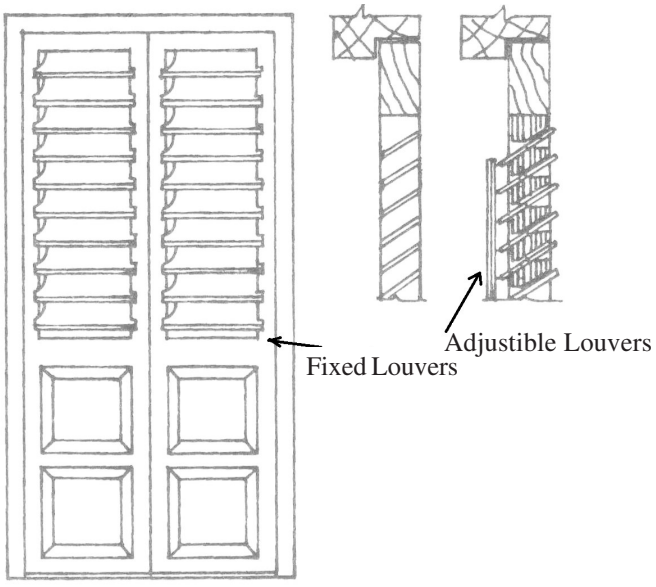


Fig. 15.1: Louvered shutters

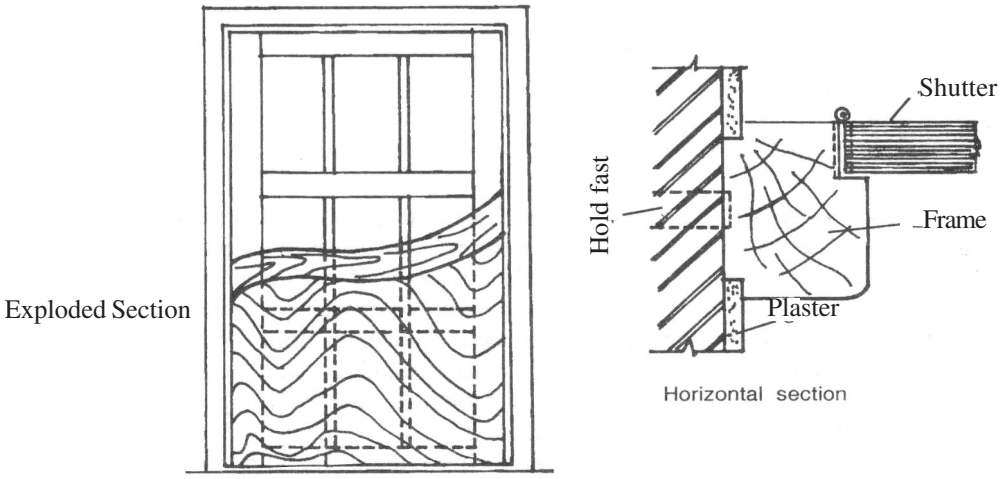


Fig. 15.2: Flush doors

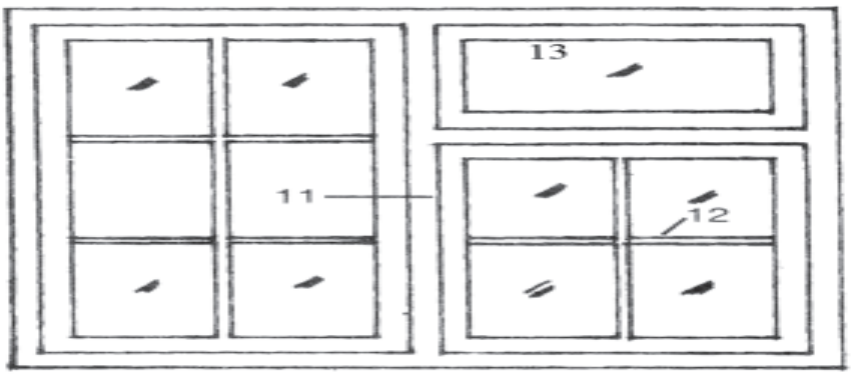


Fig 15.3: Hinged window

1. Hinge 2. Hold fast 3. Bamboo nails or Gujje of frame 4. Patama 5. Frame 6. Style 7. Top rail 8. Lock rail 9. Bottom rail 10. Glass 11. Frame for small window 12. Beading for holding the glass 13. glass.

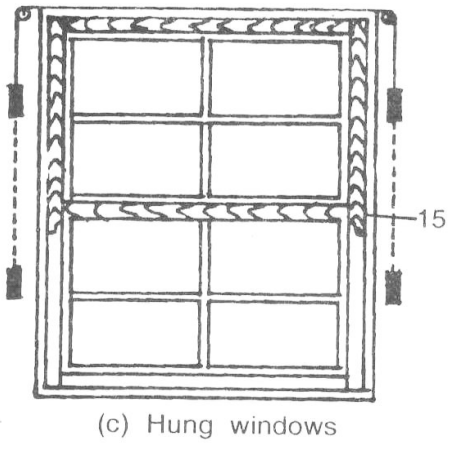


Fig 15.4: Window shutter for the up-down sliding window

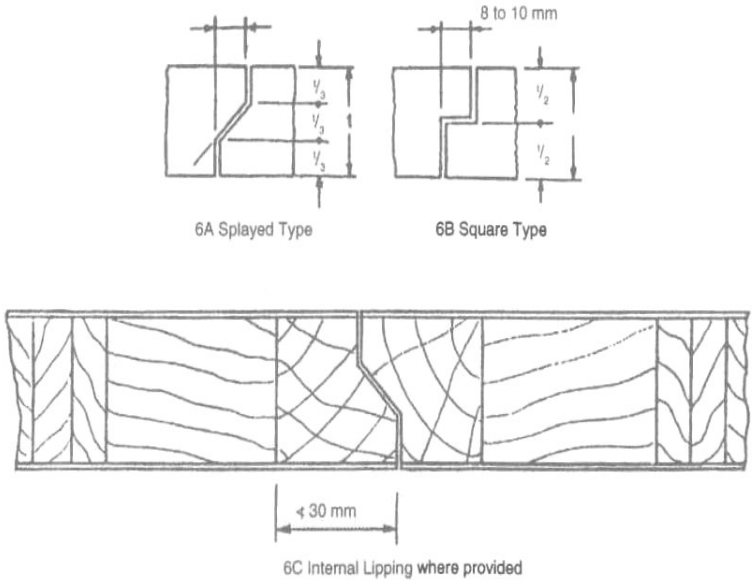


Fig. 15.5: Shape of windows for Inclined roofs

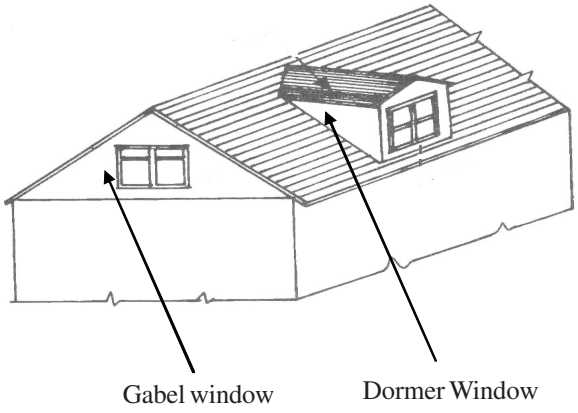
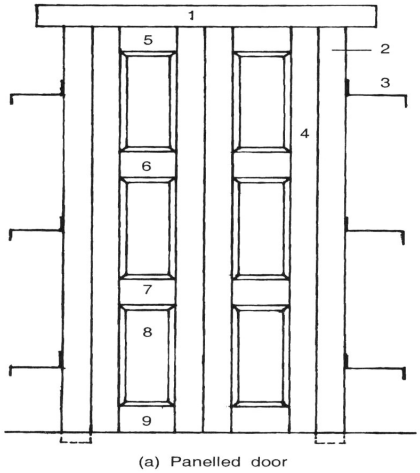


Fig. 15.6: Windows of sliding roofs



1. Top rail
2. Stile
3. Steel Joists

Fig. 15.7: Panelled doors

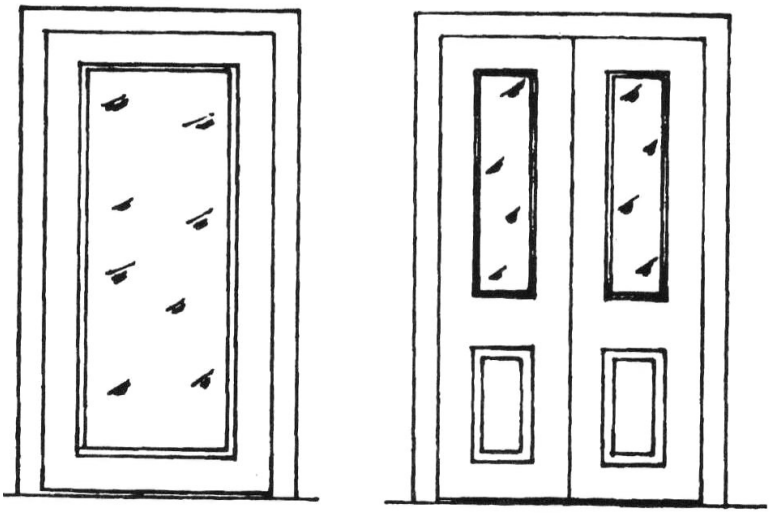


Fig. 15.8: Complete glass window

Process of making joint in the frame: While joining the frame, mortis and tennon joint are used and bamboo nails are used for joining. Before doing this, favicol is used on the mortis and Tennon joint so that is does not get loose.

Joints should be straight and flat. The other part is joined with the first part in such a way that one part gets flushed with the other part of completely if required chieselling can be done. This joint is called Mortis and Tennon joint. Before joining, favicol is applied into it and after that bamboo nails which are also called Gujja are used for joining it. Some more joints are shown in the figures given below.

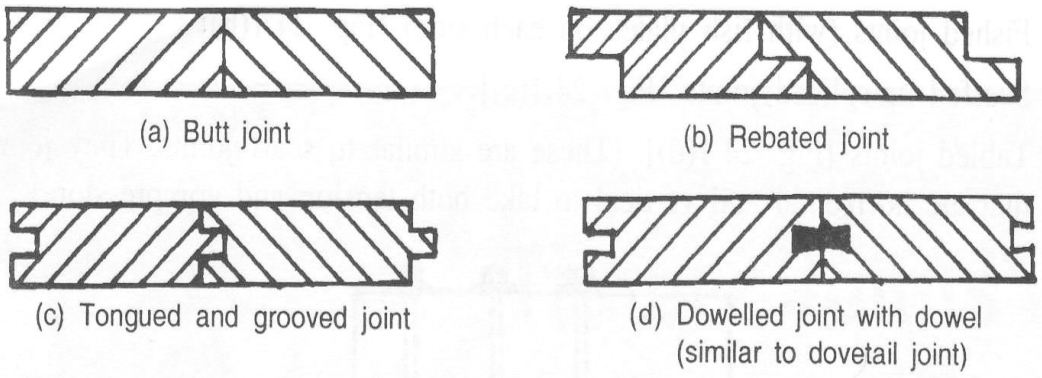


Fig 15.9: Joints in the wood.

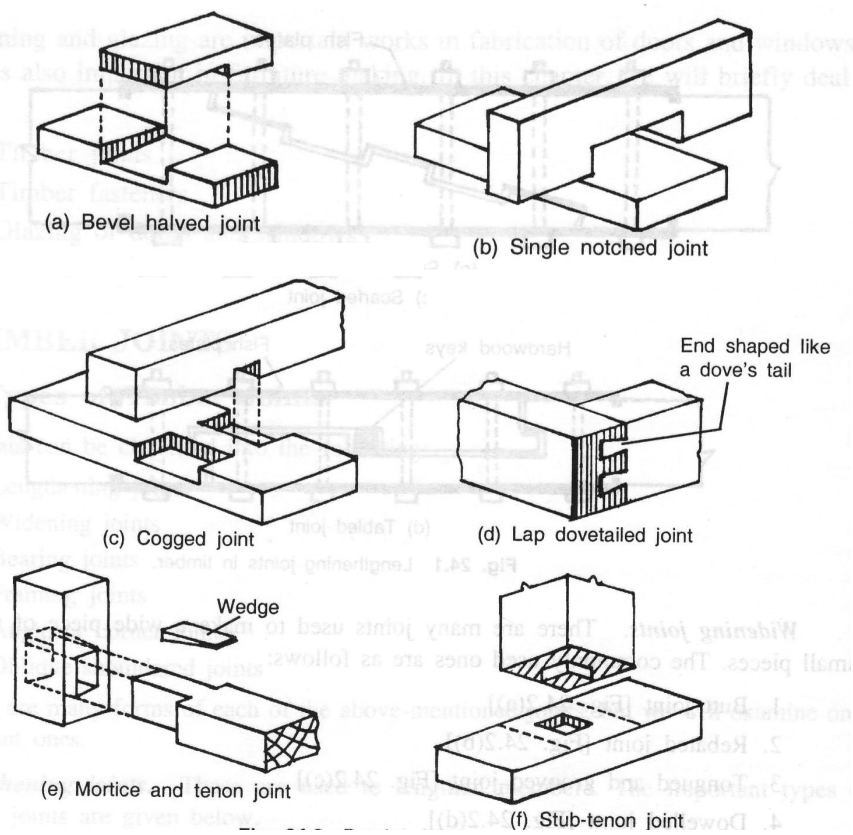


Fig. 15.10: Joints used in the wooden works.

Process of protection from termite: Various types of chemicals are used to protect the wood from termite and wood boarers (an insect)

Fittings of doors and windows: These fittings are made of aluminium, iron or brass as shown in the map. All types of fittings, hinges, locks, stoppers, drawers, etc should be approved by Indian standards Institute, otherwise they must be of that particular company whose name is mentioned on the drawing.

Rules for fittings:

1. The door which is fitted in the courtyard, corridor or lobby, is called outside door.
2. Four hinges are required wherever the height of door is more than 2.15 metre. Three hinges are used if the height is less than this.
3. One extra hinge is used where the width of one panel of the door is more than 80 cm.

4. If the height of the window is more than 1.20 metre, than one extra which means 3 hinge need to be fitted.
5. Places where wooden cleats are fitted in order to give support to the panels of the doors, then these should be fitted with 50 mm hinges.

Glazing (Glass) work: The width of glass in the doors, windows and ventilators depends upon their span (width)

For example:

1. If the size of glass is upto 900 square cm, then the thickness of the glass should be 2 mm.
2. From 900 to 3700 square cm, the width of glass will be 2.5 mm.
3. From 3700 to 5500 square cm, the width of glass will be 3 mm.
4. From 5500 to 8400 square cm, the width of glass will be 4 mm.
5. If the size is more then 8400 square cm, then the glass whose thickness is 6 mm will be used.

Glass is prepared by reducing the size by 1.5 mm from the actual size so that it does not get broken while fitting. Later on it is tightened by fixing the glass putti. In those places where **frasted** glass is to be fitted, **frasted** surface is kept inside.

Flush door shutters (panels)

These are of three types:- 1. Solid core 2. Hollow core 3. Particle board

Solid core

Good quality strips in which there is no gap are fitted inside solid core. These are prepared with the help of big machines. These are complete solids. These can be used just like the wooden battens.

Hollow core:

Hollow core is prepared by making a wooden frame having the four sides and by fitting a ply from the top of it, where the lock is to be put. A wide strip is fitted in the middle at that place.

Normally solid core panels should be used which are approved by any good government organization such as ISI etc.

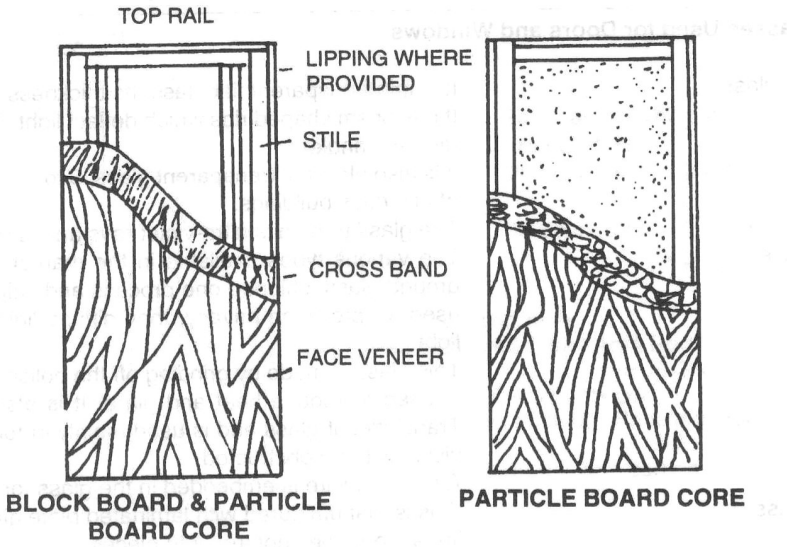


Fig. 15.11: Particle Board

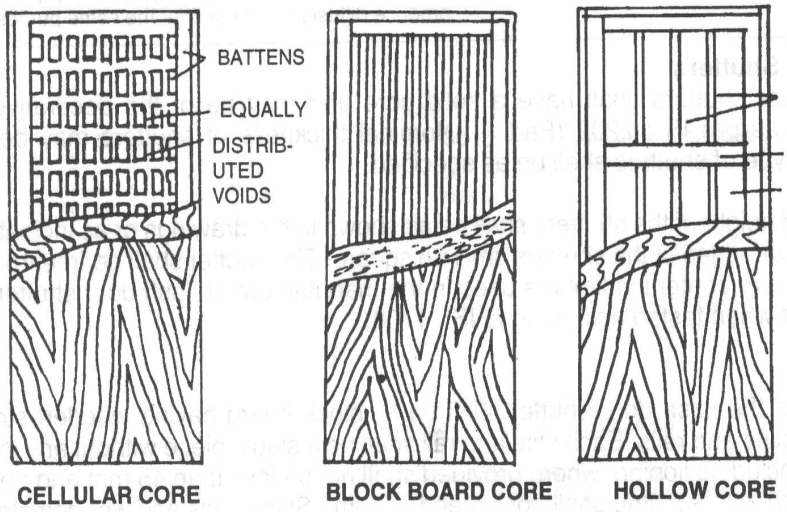


Fig 15.12: Various types of core

15.4 STEEL WORK OR IRON WORK

In building construction work, besides the iron rods, iron is used at various places in various other forms also.

In very normal works frames, grills and windows frames are made of angle iron. Doors are also made by making a frame out of this and then welding a steel

sheet on the top of it. Similarly steel girders, channel T etc. are used where ever they are required. Remember that after finishing all iron jobs and fitting them, they should be primered so that they should not get rusted because as the termite eats up wood, rust eats up iron.

15.5 USES OF GLASS

Glasses are fitted in the windows and ventilators made of steel, which is called glazing. Normally 3 mm thick glass is used for small squares and 5 mm thick glass is used for big squares.

Putti: Putti is used in order to keep the glass safe in the place where it has been fitted. Putti is made by mixing one part of Safeda with 3 part of powdered chalk. Then it is mixed with hot linseed oil and made into a flour like dough and if this putti is to be used on the iron frame, then 5.6 litre varnish is mixed with 100 kg of putti.

15.6 ROLLING SHUTTERS

Rolling shutters are normally made from wide strips whose thickness is 1.25 mm. These can be closed by dragging with hands in an open area upto 11.20 square metre, and can be again taken back to the top. But if the area of doors is more than 11.20 square metre, then they can be opened and closed with a light small machine.

Fig. 15.13: Rolling shutters

Similarly fitting hinges in iron frames, fitting net in the windows, iron girders, fitting channels, making main gate, making railings for stairs and balcony and fitting grills on other places, all these work come under steel work, which are used as per the measurements shown on the maps.

15.7 WELDING WORK

Normally two types of welding are used, such as electric welding and gas welding. Gas welding used for joining brass or thin sheets. Electric arc welding is used for heavy works.

It should be remembered in both types of welding works that the joint should become so hot that it is about to melt. If the rod is melted and the Tanka is done then there is a possibility of breaking down.

15.8 WHAT HAVE YOU LEARNT

- How the shutters are fitted in doors/windows?
- Which material is used for making shutters?
- How the shutters are joined in the walls or structure?
- How joints are made in the wooden panels?
- What are the things to be remembered in iron welding?
- What is the process of fitting glass in wooden panels?

15.9 TERMINAL QUESTIONS

1. How many types of shutters are used in doors/windows?
2. What is the process of fitting frame in the walls or columns of doors/ windows?
3. What fittings are generally used for doors/windows?
4. What type of wood should be used in doors/windows?
5. Many types of joints are used in the wooden panels. Write the names of any three types of joints and show them by drawing picture.

16

CONSTRUCTION OF DRAINS/ SEWERS

16.1 INTRODUCTION

Drains are made to allow the exit for rain water. These are of two types:- 1. open and 2. covered. For the out let of house hold water, an open drain is constructed in front of the house, which takes away the house hold water away to a long distance.

16.2 OBJECTIVES

After going through this lesson you will be able to:

- explain the reason for drain construction;
- differentiate between drain and sewer;
- describe the process of giving specific slope, while constructing drains and sewer and digging of the trench;
- describe various parts of pipe;
- explain about manholes and its applications;
- explain sanitary fittings used in the buildings.

16.3 DRAINS

For the outlet of house hold water, an open drain is constructed in front of the house which takes away the water to a long distance. Since there is a possibility of getting water deposited in the open drains and also there is a possibility of breeding

mosquitoes therefore as far as possible, covered drains should be made. In the colonies of the city, underground sewer lines are layed besides constructing the rain drains and bigger drains. These are normally made of R.C.C. pipes.

16.4 THE PROCESS OF GIVING SPECIFIC SLOPE WHILE DIGGING THE TRENCH DURING THE CONSTRUCTION OF DRAIN OR SEWERS

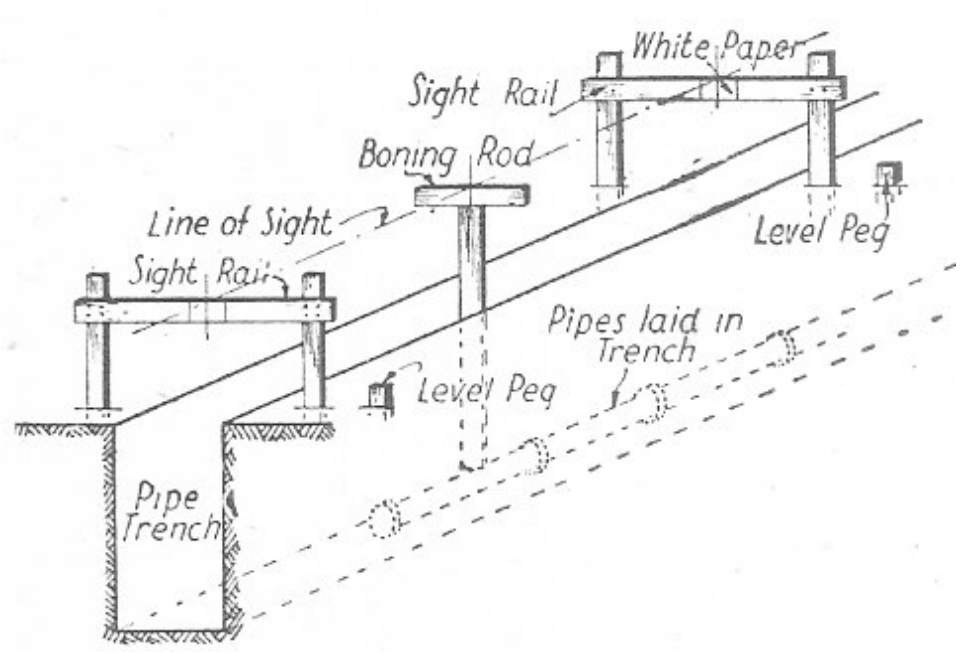


Fig 16.1: The process of examining the digging of trench

Trench: The earthen drain which is dug for putting pipe is called trench. This should be much more than the thickness of the pipe so that work can be done easily. Pipes should be put in a straight line and in the same grade as shown in the map.

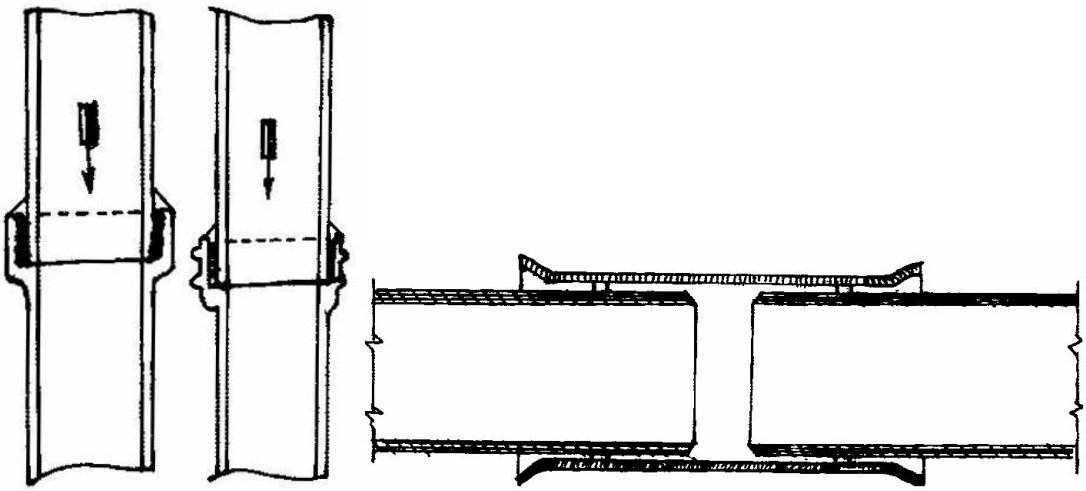
Drains are open and sewers are covered. Sewers are generally made by joining pipes. Since the drains are not covered, cleaning can be done easily and manholes are constructed for the same in the sewers. Design of slope of the bottom of the trench which is to be dug for sewers and open drains, should be in exact proportion. In case of faults, flow of water is obstructed and there is no other way out but to construct the faulty portion once again. Therefore at a specific height A from the bottom (which can be more or less according to the depth of trench), strong woods are fitted on both sides of the trench and then site rails

are fitted over and across the trench at a distance of about 20 metres each (see Fig. 16.1).

For examining the level of the bottom, boring rods are fitted controlling the alignment from over the side rails. The level below this are marked by putting level pegs.

16.5 DESIGN OF PIPE

There is a socket on the front end of the pipe and the rear end is called spigot. The spigot of the next pipe is fixed in the socket of the previous pipe. In this sequence pipe line is laid and later on the empty space left between each socket and fixed pipe is fitted with cement mixture, which is made in 1: 2 ratio. The mixture should be fitted tightly. After the entire pipe is laid down, trench is filled compactly with the soil.



1. Porcelene pipe to porcelene pipe 2. Iron pipe to iron pipe 3. P.V.C. pipe to P.V.C. pipe

Fig. 16.2: Design of pipe and joint

16.6 MANHOLES

A manhole is constructed at the point where the grade, direction or size of the pipe changes. The distance between each manhole varies from 60 to 150 metres and it depends on the pipe line/sewer line grade (slope).

Generally manholes are of three types. Manholes are used for cleaning the sewers

and connecting small sewer/house sewers to the bigger sewers. (see fig 16.3)

The chambers which are of size 90 cm × 80 cm, are corvered with a lid of cast iron of the size 455 × 610 mm. similarly 120 cm × 90 cm manholes are covered with round iron lid of 500 mm diameter.

House connecting chambers of 90 cm × 80 cm are build inside the houses. Manholes appear in the middle of the rods. Foot rest are put inside these holes in order to get down into it. These are put at the intervals of 30 cm and are not in a straight line but are put side by side.

Similarly if a deep drain comes in the middle of the road, then rod gali traps are build at that point.

Special precautions must be taken while installing sanitary fittings inside the houses and putting joints in the sewer lines, so that when used, there should be no leakage.

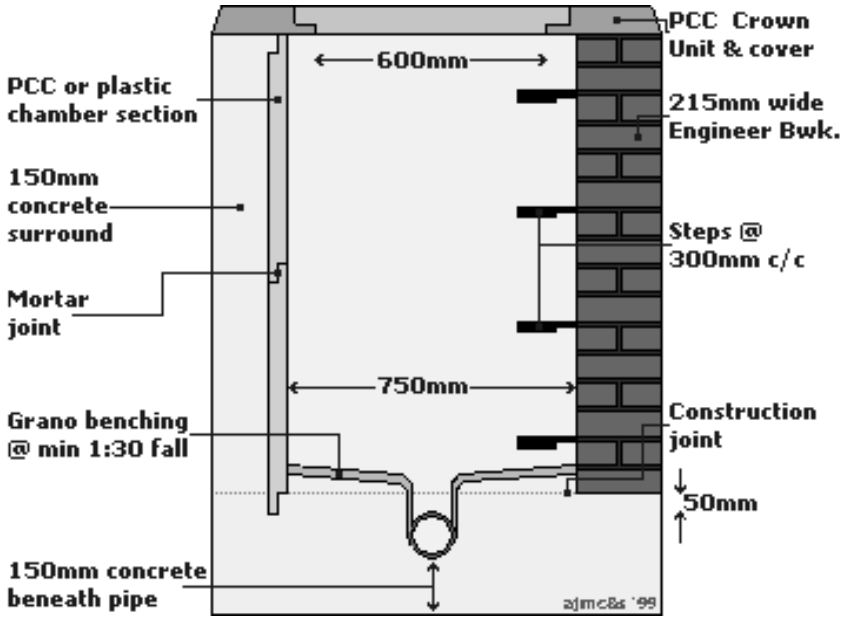


Fig. 16.3: Manhole

16.7 VENT SHAFT

The point where the sewer line starts, a chamber is constructed and a pipe is erected there. Similarly at those points from where there is a slope or height

starts in the sewer line, a pipe is erected. Its major advantage is that sewer gases are released through this.

Fig. 16.4: Vent Shaft

16.8 SANITARY INSTALLATIONS

Sanitary installation work include fittings of Indian or English pots, wash basins, urine pots, wooden sheets (over the pots), water sistern, brackets etc. All these things should be used according to the standards set by I.S.I.

Indian W.C.: It is made of glazed porcelene and its size varies from 21 to 23 inches. There is a P or S type of band lies at its lower end and below this there is a 5 cm vent arm. It is set by making a concrete base and it is joined with cement, sand (1: 10 mixture with trap.

(a) Orissa pattern W.C.

(ii) Indian W.C.

Fig. 16.5

Flushing Cistern: In order to clean the pot with water, a small tank, which is of the shape of a basket, is used. There is a push button attached on its top and on pressing this button, water comes out of the tank and takes away the human waste along with it. This is called flushing Cistern. Plastic Cisterns are also used these days.

Fig. 16.6: Flushing Cistern

European type W.C.: This is also made of porcelene and it is very smooth. Water cistern is attached with this in the backside wall. A P or S type band is attached at the lower end of this.

Fig. 16.7: European W.C.

Wash Basin: It is a pot made of glazed earth which is used for washing hands.

Fig. 16.8: Wash basin

Sink: Pot used for washing utensils.

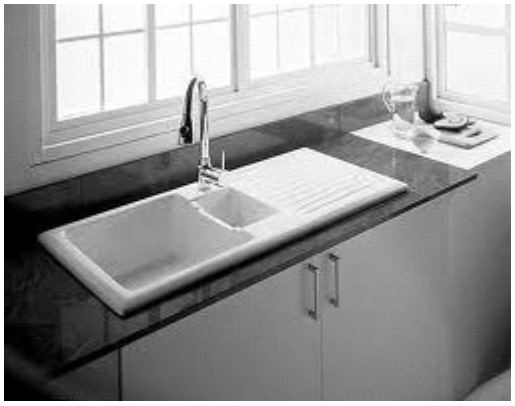


Fig. 16.9: Sink

16.9 WHAT HAVE YOU LEARNT

- How many types of drains are there and where are they used?
- What is the process of giving specific slope while making drains and sewers?
- What is the purpose of making manhole and where are they constructed?
- What is the material of the pipe which is used in sewer lines?

16.10 TERMINAL QUESTIONS

1. With the help of a diagram, explain the use and objective of boning rod and site rail.
2. What precaution must be taken while joining the sewerage connection of the house to the manhole?
3. Why are the main holes built?
4. Explain the objective of the vent pipe with the help of a diagram.

17

ROAD WORK

17.1 INTRODUCTION

In order to connect one place to another, the entire width of the land is made pucca or solid. This is called road. The management of its construction is called road work. It is classified according to the density and design of the traffic, such as National highways, state highways, district roads, village roads, etc.

17.2 OBJECTIVES

After going through this lesson you will be able to:

- describe various types of roads;
- explain the process of preparing premix in the bitumen roads;
- describe the special precautions to be taken while constructing the roads made of cement concrete.

17.3 WIDTH OF ROADS

Engineers generally decide the thickness of various layers and materials used for the roads, after deep studies. Its classification such as national/state roads etc should also be in accordance with the standards as set by the organization which are installed by central government.

17.4 FORMATION LEVEL OF THE ROADS

Before making Pucca roads, roads are made in level throughout its width and

reached upto that level on which the pucca road is to be built. This level is called formation level. The processes upto to this level of work are the same as already described in the lesson named as Earthwork Cutting and Filling (Chapter 5).

The time taken for building the upper layer should be minimum one year and the land is prepared before hand so that the layer becomes hard completely. This is the case if machines are not used for filling the soil and specified compaction tests are not performed.

Main parts of the roads

1. **Sub Base:** After the formation level of the road the first layer is called sub base. Its main objective is to protect the sub grade from the possibilities of getting damaged during construction work. Its materials is slightly of different quality than the base material.
2. **Base:** It transfers the traffic load uniformly on the soil. It is made through the process of making the soil strong. This soil may be stone dust or soil made by other processes.
3. **Upper layer:** This is called surfacing, which is made by bitumen concrete or stone chips which are compacted by water. This gets eroded or broken while the traffic moves and it can be easily repaired without removing the lower layers.

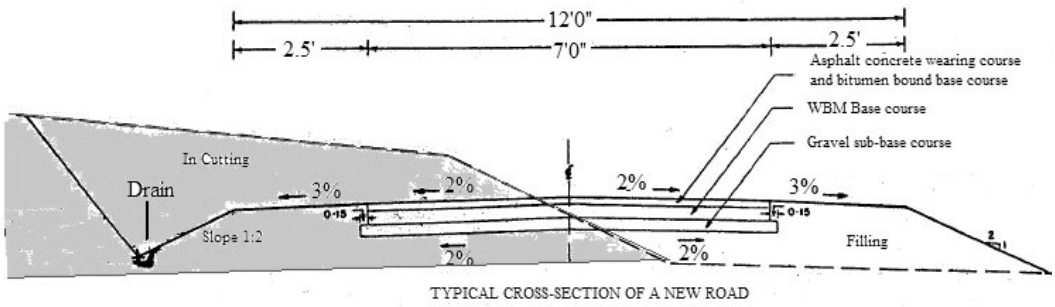


Fig. 17.1: A typical cross section of the road

17.5 PREPARATION FOR SUB GRADE

In order to make the surface, embankment is leveled up to the specified level which is equal to the width of the soling. This level has been finalized for the formation level of the road and it is equal to the total depth of sub base (if it

exists), soling and wearing coat. All the foreign particles must be removed from this. The weak points should be repaired which arise due to unorganized water outlet, traffic or any other reasons.

Compaction: Compaction of subgrade should be done by the road roller. Water should be sprayed uniformly on the subgrade one day before the rolling. During the rolling, if any part goes down, then it is filled with soil and roller is moved again over that place. According to the instructions given by the engineer, all the soft, unwanted and extra soil should be removed and the place is repaired after removal.

If the CBR (California Bearing Ratio) value of soil below the sub grade is less than 11.0 tonne per square metre, then at that place, deep, uneven material should be made available for the sub base. For this *Murram, Bajri, Shingal* and other materials are used. The thickness of subbase should be according to the Engineer's orders. In any case it should not be less than 15 cm. Sub base should be prepared on the entire width. The width of sub base should be 60 cm more than the width of the subgrade.

When the subgrade is made of black cotton soil due to capillary rise of water extra precautions are required to be taken. In that case thin sub base should be made below the base, out of *Murram* or coarse sand. This sub base will be of stone or boulder soling and roller should be moved over this after spraying water.

Fig. 17.2: Road Roller

Normally soling coat is always laid but only those places are left where the road is on the hard soil surface or big stones.

Soling should be made of those boulder or stones which are fitted on the road sides. Grading stone, Ballast, hard stone, hard laterite stone, first class bricks

(pucca bricks), over burned bricks (jhama bricks) or any other such type of material is also used to make the soling according to the instruction given by the Engineer.

Width of Soling coat: If the Engineer has not given any orders then it should be 30 cm i.e. 15 cm on each sides more than the wearing coat.

Material: The materials which are used for water bound macadam roads are road stone, screening, binding material such as *Murram* or soil and sand for finishing.

Screening: These are the smallest stones (6-12 mm) and these are pieces of wearing stone. The main job of these stone is to fill the gaps completely. Its quantity varies from 9.5 m cube to 13.5 m cube per 1000 square metre.

Boulder: In any measurement these are not less than 15 cm and not more than 22.5 cm. The bigger size than this specified size is rejected. This is a common rule made for the labourers and contractors.

Stone Ballast: This will be same as wearing coat and if convenient, it may be of bigger size.

Compaction of layer: Soaling stone is fitted on the sides and it is hand packed. It is kept over the subgrade. The widest part of the stone is set towards the lower side and pairs are matched, the inter spaces between the stone are filled with small stones so that empty spaces are fitted completely. This is done at the same time as keeping the soaling stone not before or later.

After packing, the surface is tested according to the approved design. Small or big empty spaces are again filled through packing. After this soaling is dry rolled starting from corner towards the centre. Rolling is continued till strong surface is reached i.e. the wheel impression stop appearing on the road after rolling. Surface is tested again by the template and its compaction is corrected by small stones or grids.

In case of boulders, soaling is repaired by hands and all the empty spaces are filled with small stones and packed tightly. After this dry rolling is done by the road roller on the soaling. The surface is made strong by putting shingal or Bajri

on the surface. Slope is made towards both sides starting from the middle. Empty spaces are never filled with soil.

If brick ballasts are used, then building layer like wearing coat and compaction work should be done.

Cushion: On the top of the soaling, 25 mm thick murram layer (or a layer of small stones or laterite stones) is built but those places are left where the soaling is made of laterite, stone or hard murram. In those places water is sprayed and for brick soaling, it is rolled lightly for laying the wearing coat and cushion surface is rolled with the hand roller.

17.6 TYPES OF ROADS

17.6.1 Water Bound Macadam Wearing Course

Normally the wearing surface itself takes the load of the wheels and then the load is transferred on the lower surfaces. Therefore this should be sufficiently strong so that it can bear the traffic load without getting damaged.

After rolling the thickness of wearing coat should be 11.5 cm. For the first time this thickness should be from 7.5 cm to 11.5 cm or according to the drawing details.

Camber

Camber is the slope which is given from the middle of the road towards both sides. This is done in the ratio of 1: 48 or as ordered by the Engineer.

The slope height gets bigger towards the middle from both ends of the roads across the entire width of the road. This is called camber. According to this the water falling on the roads flows away towards the sides (See fig. 17.3)

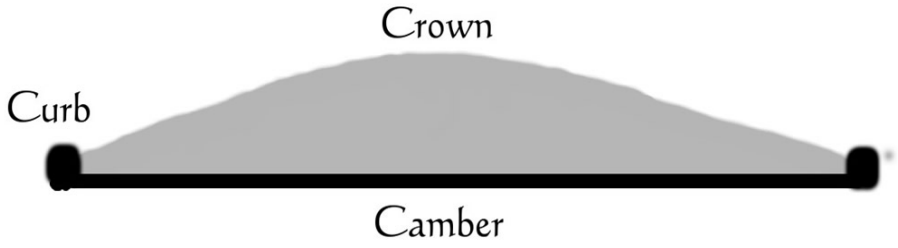


Fig. 17.3: Camber of the road

If the old water bound macadam road is to be converted into metalled road, then first the road surface is completely cleaned with wire brushes and then two walls of soil are made on both sides of the road which are 15 cm high (no extra payment is made for this). In between these two walls, metal (rodi) filled in baskets are sprayed by moving in circles. Two wooden dyes are made to measure its thickness in which camber is also provided and metal is sprayed is the panels of 15 × 15 metres.

For compaction, first dry rolling is done in which the roller moves from two sides towards the centre. In order to see that the rolling is complete or not, it must be seen that on the solid surface, wheel impression or road roller impressions should not appear and if a 25 mm piece of Gitti is kept infront of the roller then it should be broken into powder. If it gets inserted into the road, then the rolling is not complete. Camber should also be checked side by side.

After spraying metal which is of size 50 to 75 mm, screening with size 6 to 12 mm is also sprayed over this. Spraying of screening and rolling by the roller should go side by side till the mixing of incrasing and metal stops.

Rolling with water: Roller is moved on the road after spraying water along with some binding material which may be soil or murram and it is put in 6 to 12 mm thickness. After the movement of roller for some time a slurry is prepared which fills the small spaces on the surface with the roller. After this extra slurry is removed. After drying, the surface is cleaned with broom. At the time of rolling, it is necessary that half of the width is rolled at a time and then the other half is taken. Thus water bound macadam road is prepared.

17.6.2 Application of one coat of bitumen on the surface of water bound macadam Road

Binder: Approved bitumen is called binder which binds. Generally two types of binders are used. People usually call all black binding material as coaltar but coaltar is obtained by factional distillation of the coal extracted from the mines where as asphalt is obtained by refining crude oil. Both are called Bitumin in local language.

Blindage: 12 mm stone grit which is spread on the road after painting by bitumen, is known as blindage. Before using, it is put in blocks on the roads sides after measuing through boxes.

Preparing the surface: If there are pits on the road (water bound) then they are cleaned and made into a square, then bitumen is spread, 40 mm ballast is filled and it is tampered by an iron rod to make the surface smooth. Payment for this is made separately.

The surface of water bound macadam road is first cleaned by iron brushes, then bitumen which is heated upto 170 cg temperature, is sprayed through pressurized sprinklers. After this ballasting is done i.e. 12 mm grit is filled in the basket and it is sprayed on the bitumen by throwing. Remember that ballasting should be done immediately after the hot bitumen spray. When ballasting is completed in a specific area, then it is pressed by power road roller. After 24 hours, the road prepared in this way is opened for traffic.

17.6.3 Premix Carpet with hot Bitumin

An approved quality of bitumen which means binder along with 10-12 mm grade of boulders is found in this. Grit or boulder blocks are put at some distance from the road where bitumen is mixed with it and brought on the road surface. All the processes which are told earlier will be used here, such as cleaning the surface of water bound macadam road, filling the bits by 25 mm size of boulders and making it into a leveled surface separately.

Tack coat: After cleaning the surface, Bitumin is put on the surface through sprinkler. It is put on the basis of 7.5 to 10 kg square metre on a new surface and 5 to 7.5 kg per 10 square metre on the prepared surface. This is called Tack coat. Premix carpet is put over this.

Preparing the mix: Grit is put into drum mixers after filling it in to wooden or iron boxes. After this bitumen is boiled upto the specified temperature. Then boiling bitumen is put in the mixer drum and the mix is prepared. Remember that no pieces of stone chips should remain lose without bitumen. Mix so prepared is brought to the working surface through small hand driven carts and sprayed on it. It is put on the surface upto a thickness which is more than the carpet, so that after the movement of the roller, the required thickness of carpet can be obtained. These days, this job is done by Paver machines, in which even if the thickness of carpet varies at various places, the upper layer is absolutely plain.

Fig. 17.4: Paver machine

Consolidation: Consolidation is the process of pressing the spread boulders with roller. When Bitumin grit is spread on a good amount of area for premix carpeting, then compacting is done by rolling through the roller of 6 to 8 tonne weight. During the movement of the roller, its wheels are kept wet through wet sacks otherwise hot boulders stick to the wheels again and again.

Opening the road for traffic: 24 hours after the completion of rolling the road is opened for traffic.

17.6.6 Spreading Premix carpet on the road with cold bitumen

For this the coaltar which is used does not require any heating. All the processes in this case are same as were done in the case of hot bitumen mixing, and almost all the works are also same. The road is opened for traffic after 48 hours in this process.

Seal coat: The surface of premix carpet is cleaned is such a way that there should not remain any dampness or soil on it and no stone chips should come out of its surface. After this tack coat is put by hot bitumen through sprinkler. Above this just like premix, only bitumen and coarse sand or jeera rodi mix is spread as a layer of 6 mm thick and it is then rolled, so that the surface becomes smooth and water can not pass upto the lower layers. In this case the clearing and roller movement is done just like the earlier case. Seal coat is done with cold bitumen also, but the time gap in this case for opening the road for traffic must be minimum 48 hours.

17.7 BUILDING THE ROAD FROM CEMENT CONCRETE

The road which is constructed by laying cement concrete slabs is called cement concrete road. Up to 7.5 cm, it is called thin slab and above this it is called thick slab. These are layed by preparing a sub grade below this.

Materials: in the concrete road, cement, water, coarse aggregate i.e. coarse sand and stone chips are used in the same way as was explained in the concrete lesson.

Sub grade: A soaling or foundation is laid which should be of minimum 15 cm or as per the specified thickness. First the above sub grade is compacted by the road roller and then only the concrete slabs are laid down. Sub grade is completely made wet through water before 36 hours so that when putting the concrete, subgrade should not absorb its water. For constructing concrete rod, first iron channels are put on both sides of the road in the length and then concrete is poured. If the concrete slab is more than 10 mm thickness, then it is put in two layers. In order to press the concrete spread on the raod (for compacting) wooden rods are used which are 5 metre long and 20 cm thick. Similarly for testing the road camber, a wooden template is built.

Steel dyes should not be removed before 24 hours specially the side ones.

Mix: Unless it is strictly specified, the ratio for cement mix would be 1: 2: 4 by volume and not by weight, but cement is put measuring by sacks not by the peti or box.

Laying of concrete: As told earlier, concrete is laid in the iron dyes and in one day alternate dyes are kept empty, then after 5 days these empty dyes are filled with concrete.

Expansion joints are constructed at every 15 metre distance on the concrete roads. These are plain but joints made of 10 mm thick bitumen strips.

Curing: Big strips of jute or hasian cloth are stitched at both ends with bamboo and kept for 2 hours on the surface after making them wet. After this the wet clothes are spread on the surface. The surface is not allowed to get dry in any situation. Next day wet clothes are removed and soil bed are made on the road

with 15 cm thick soil which are of the size 15 m × 15 m and water is filled in these for 28 days. After this the soil is removed and the road is opened for traffic. Expansion joints are filled with tarfelt or as told by the Engineer, and on both sides of the road an edging is put which is about 2 feet wide. The purpose of this is to save the road edges from breaking. Stone strips are used in those places where they are available and they are replaced for bricks.

17.8 WHAT HAVE YOU LEARNT

- How many types of road are there?
- How classification of roads is done?
- How is a water bound Macadam Rod constructed?
- What is the process of doing premix carpet?
- What is the complete process of making cement concrete roads?

17.9 TERMINAL QUESTIONS

1. Explain the process of camber in the construction of water bound macadam roads.
2. What is difference between premix carpet and the work done manually?
3. Why are the dies used for making cement concrete roads?
4. Explain the complete process of putting tack coat. Also tell where they are used?

APPENDIX - A

LIST OF EQUIPMENTS

Following are equipments required at Study Centre:

(a) Survey Equipments

i. Compass

ii. Chain, 30 m

iii. Arrow

iv. Ranging rod

v. Flag Staff

vi. Optical square

vii. Offset rod

viii. Plane Table

ix. Alidade

x. Plumb bob

xi. Dumpy Level

xii. Levelling Staff

xiii. Theodolite

xiv. Total Station

(b) Construction Equipments

i. Trowel

ii. Chiesel hammer

iii. Planer

iv. Kadhai

v. Bucket

vi. Mug

vii. Poker Rod

viii. Chiesel

ix. Rod Bending Platform

x. Safety helmet

xi. Screen

xii. Sievers of different sizes

xiii. Kudal

xiv. Gainta

xv. Measuring box

xvi. Liner/fiber tape

xvii. Steel tape

xviii. M.S. scaffolding models or photos

xix. Models of different types of construction such as ceiling, Arches etc.

(c) Videos of Modern Construction Machines

i. Earth mover

ii. Escalators/lift for high rise building construction

iii. Struts for the safety of trenches during the cutting of soil

iv. Spray equipment for protection against termites attack

(d) Materials for painting and polishing

i. All types of Brushes

ii. Scratching plate

iii. Steel Brush

iv. Spray machine

(e) Equipment for floor construction

i. Grinding machine

ii. Tenon saw

iii. Chiesel

iv. Steel hacksaw

(f) Iron fabrication

i. Cutting machine

ii. Welding machine

iii. Drill machine

(g) Equipment for construction of drains and sewers

i. Thread cutting tool

ii. Sockets

iii. Bends of different types

iv. T-joint

v. Water sealing devices

(h) Videos of Road construction related equipments

i. Bitumen sprayer

ii. Bitumen mixer

iii. Camber checking templates

iv. Compaction Testing M/C and core cutters

v. Oven

APPENDIX - B

List of Class Room Requirements

		Size (Minimum)	No
1.	Director's Room (including toilet)	8.0 ft × 8.0 ft	1
2.	Directors Office	10.0 ft × 20.0 ft	1
3.	Reception room	10.0 ft × 5.0 ft	1
4.	Account section	20.0 ft × 20.0 ft	1
5.	Class rooms including white board, chairs and tables		2
6.	Practical room		1 (2, if possible)
7.	Library		1
8.	Computers (with internet facility Printer (multi tasking)		5 1
9.	Over head projector		2
10.	Common Toilets for		1
	(a) Students		1
	(b) Staff		1
11.	Control room for examination controller		1
12.	Strong room related to exam		1
13.	Store		1
14.	Canteen		1

APPENDIX - C

Faculty and supporting staff

Faculty and supporting staff	Academic/professional Qualifications	Experience	No.
Teaching staff	Degree/Diploma in civil Engineering in the related field	3 years for Diploma holders	1 for 20 students (2 faculty 1 full time 1 parttime)
Instructor for Lab	ITI	1 year	Batch size 20- 25
Attendant to assist the lab instructor for the maintenance of the lab			2

Batch Size

- There can be maximum 2 batches in the study centre and there should be 20 students in each batch.
- Study centre should take theory as well as practical classes for minimum 4 hours per day basis
- Each student should have a work book, which is signed by the trainer daily. Students will write their experience related to construction work.
- Students are evaluated annually on the basis of their written and oral exams

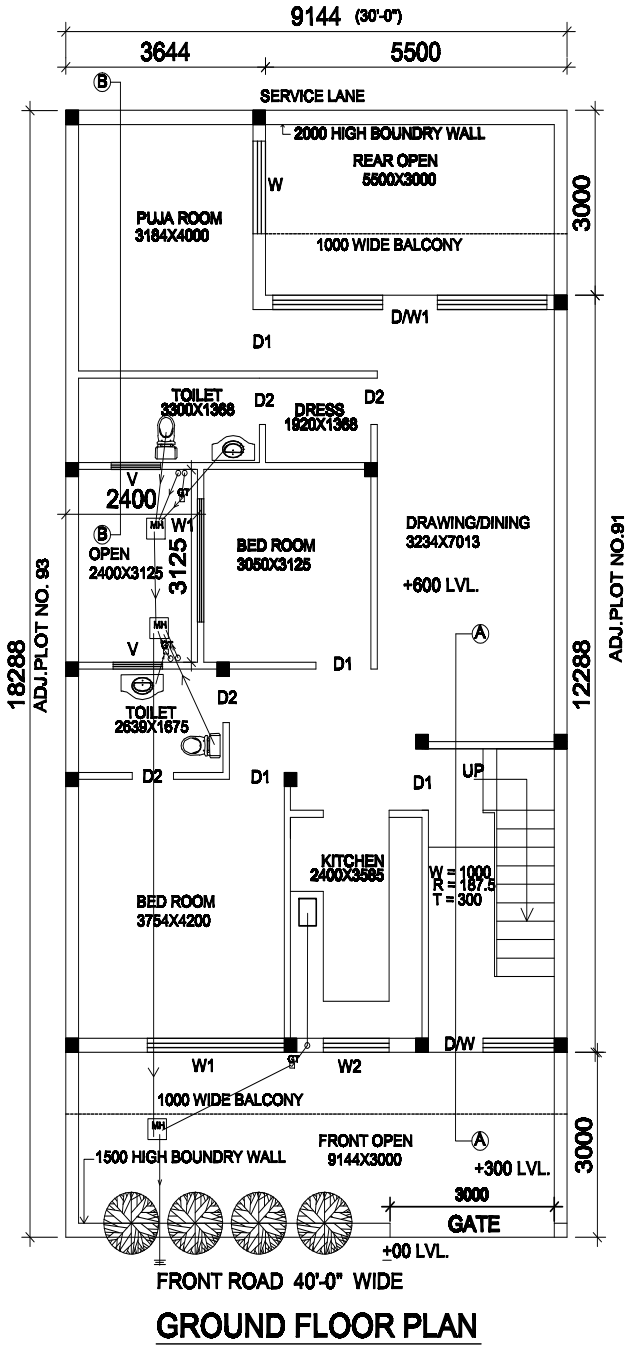


Fig. 2.2 (a). GROUND FLOOR PLAN

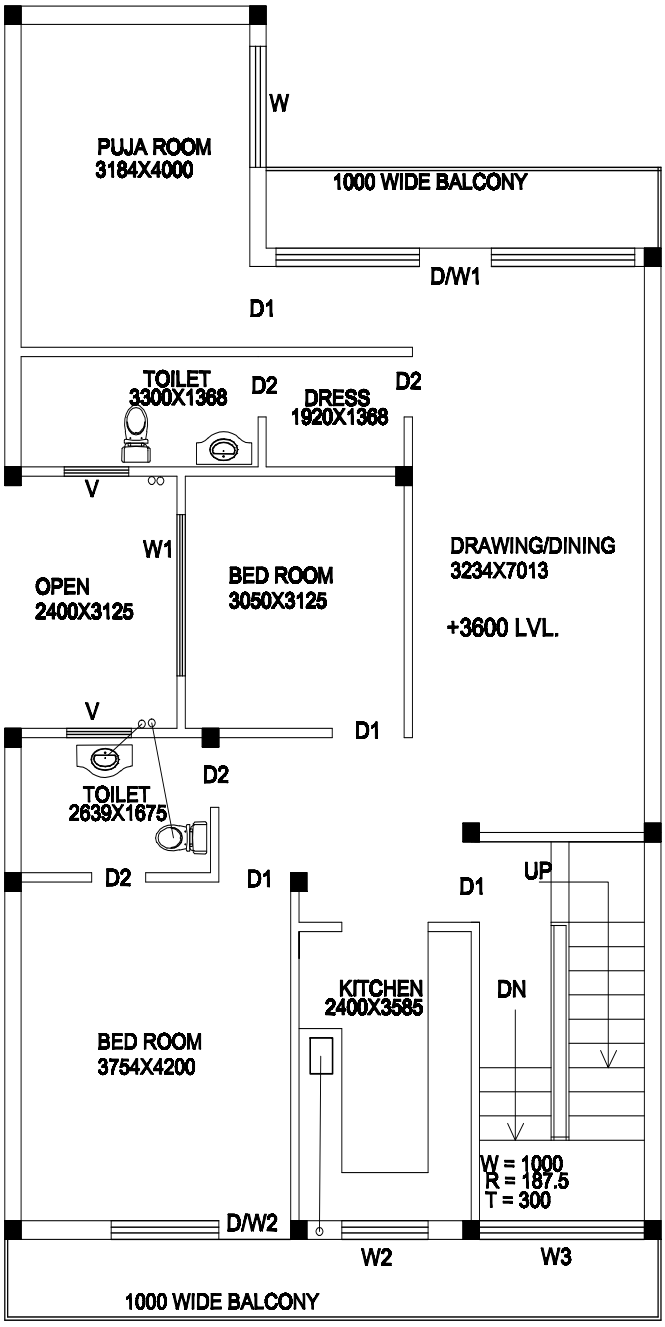


Fig. 2.2 (b). FIRST FLOOR PLAN

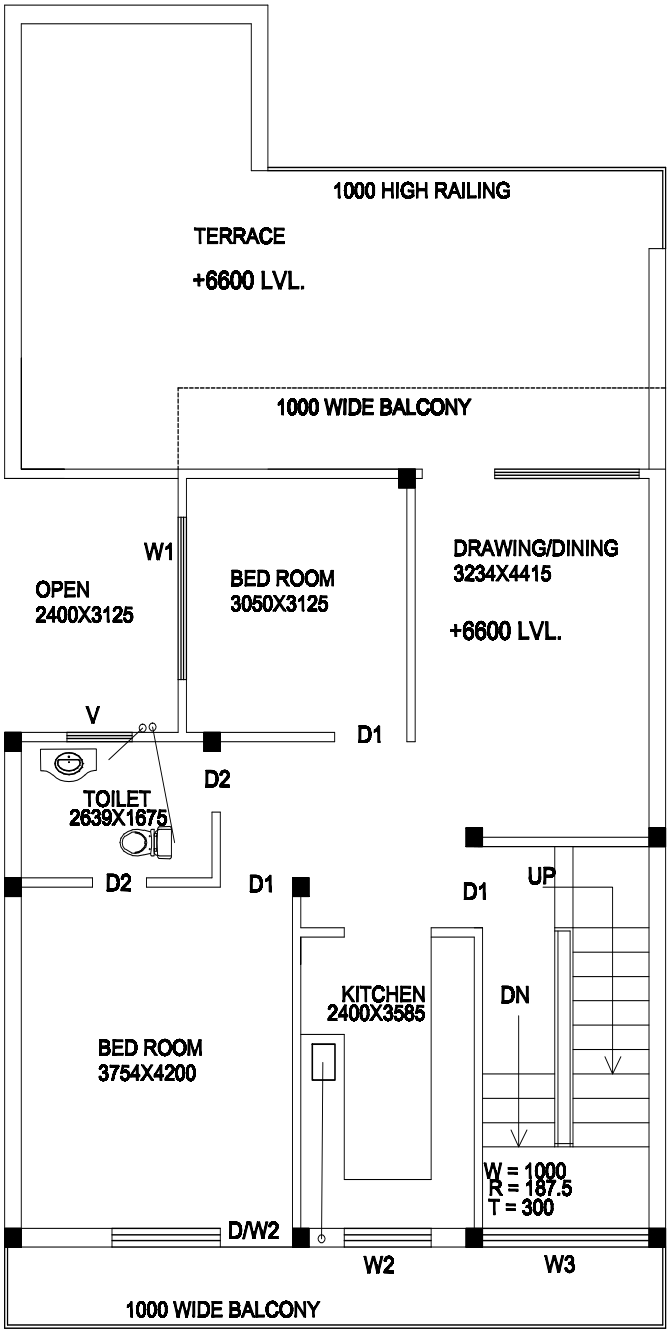


Fig. 2.2 (c). SECOND FLOOR PLAN

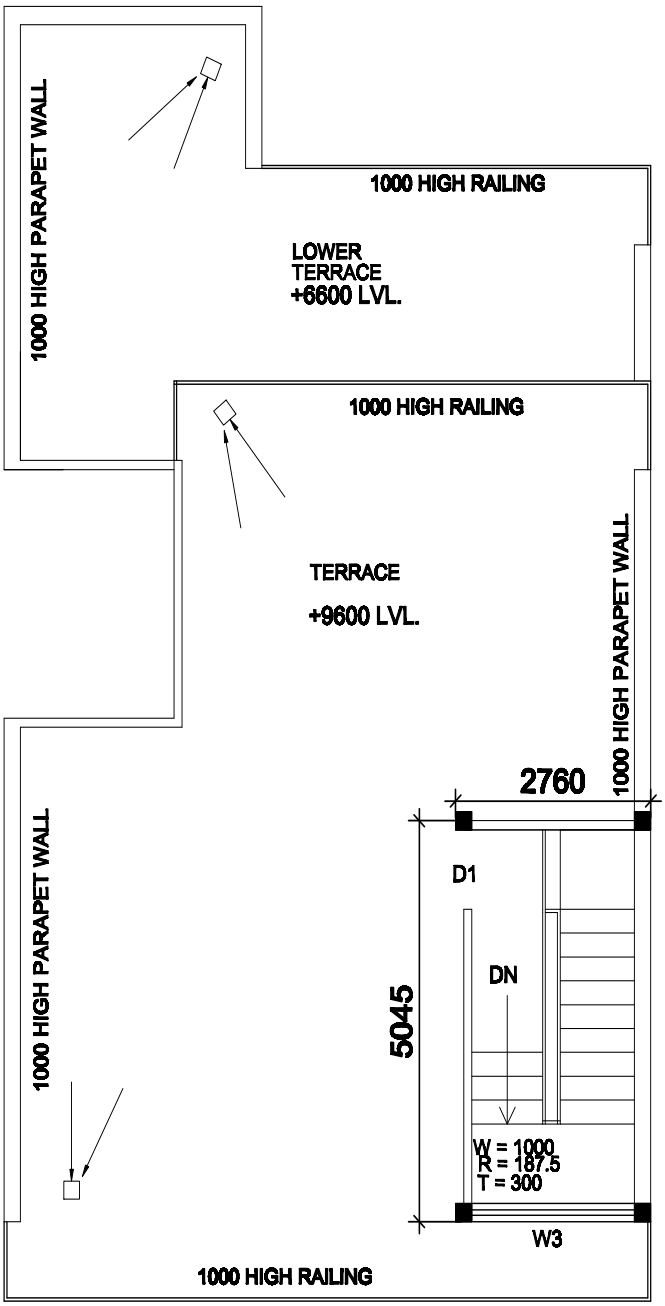


Fig. 2.2 (d). TERRACE FLOOR PLAN

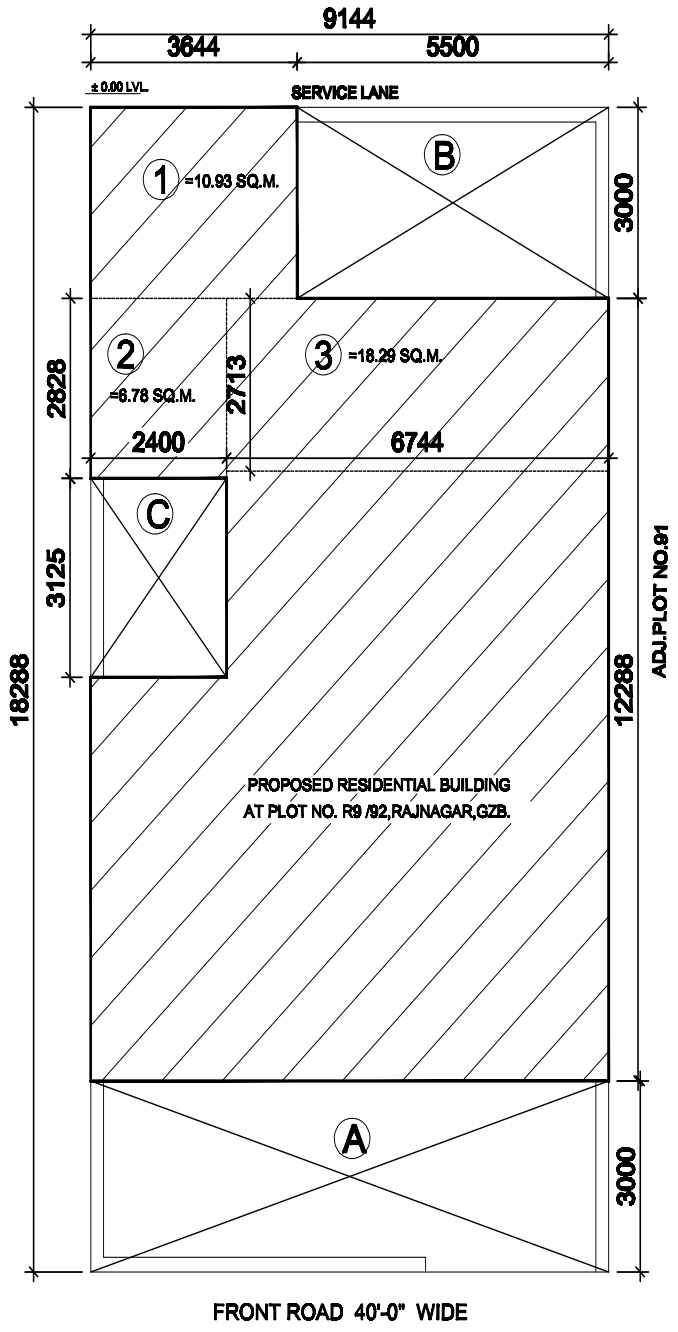


Fig. 2.3 (a). SITE PLAN

Fig. 2.3 (b). REAR ELEVATION

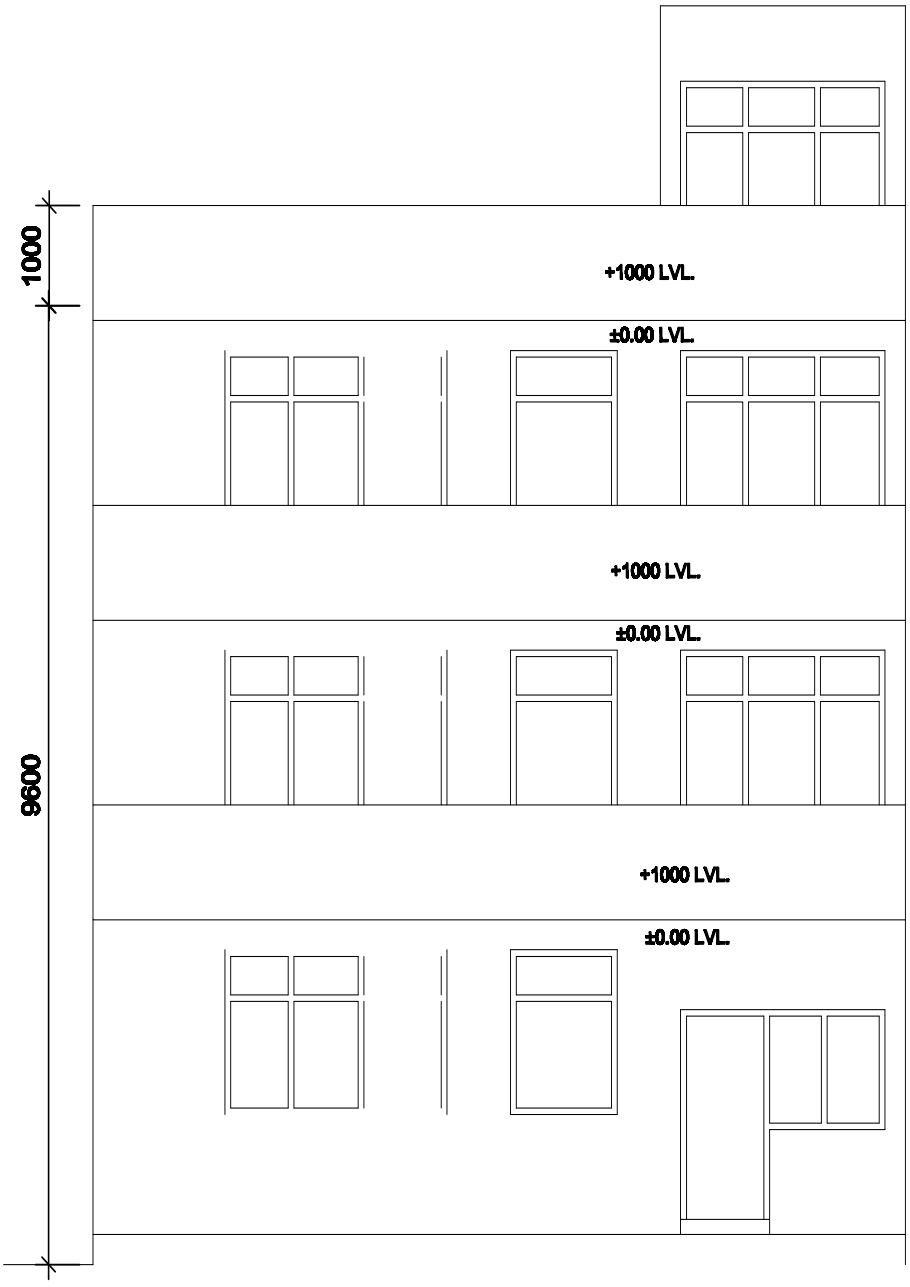


Fig. 2.3 (c). FRONT ELEVATION

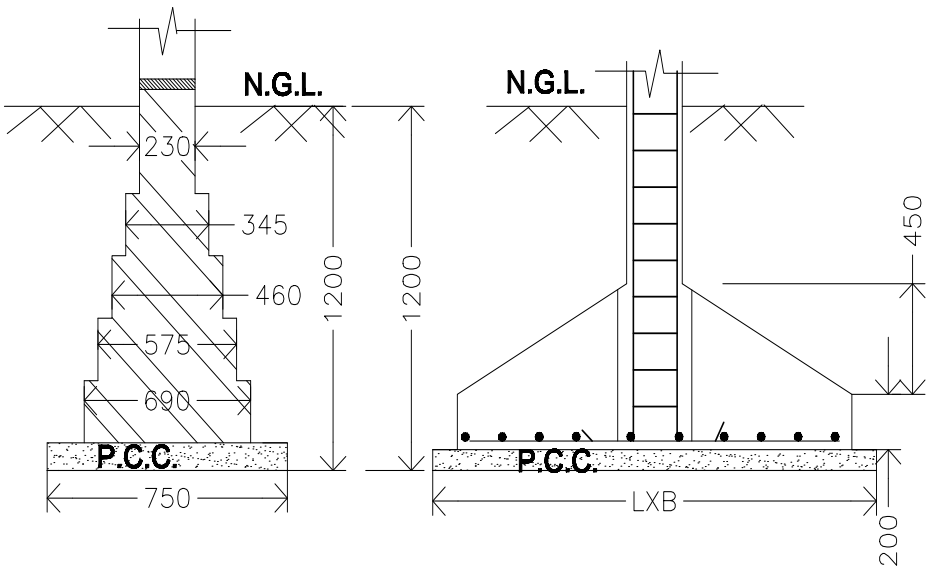


Fig. 2.3 (d). TYPICAL FOUNDATION & COLUMNS DETAIL

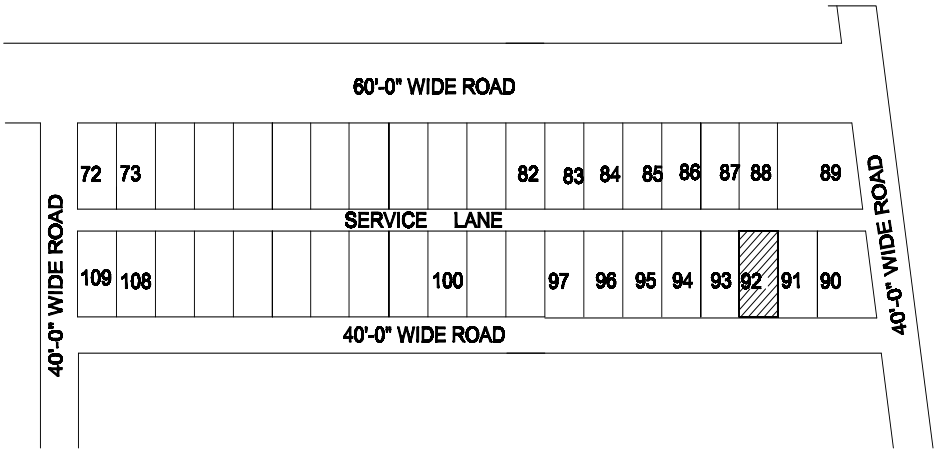


Fig. 2.3 (e). LOCATION PLAN

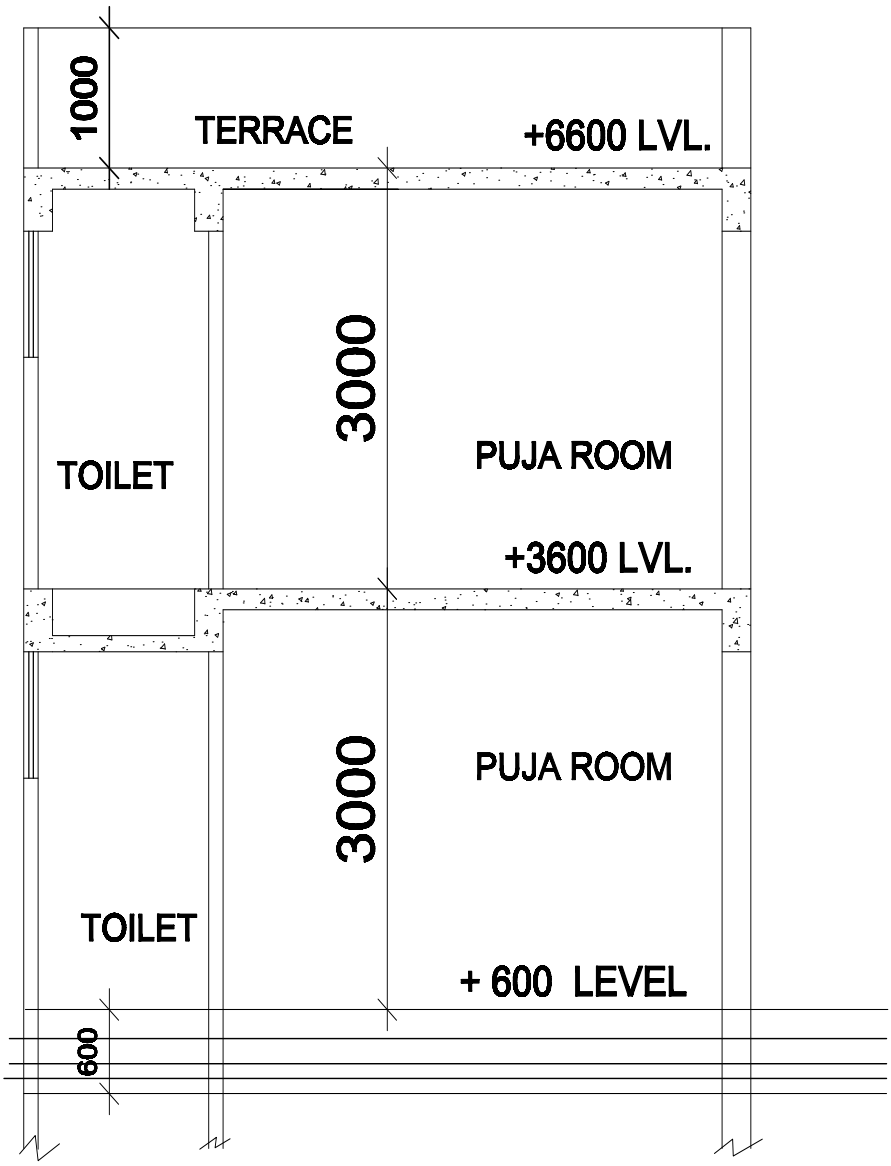


Fig. 2.3 (f). SECTION AT B-B

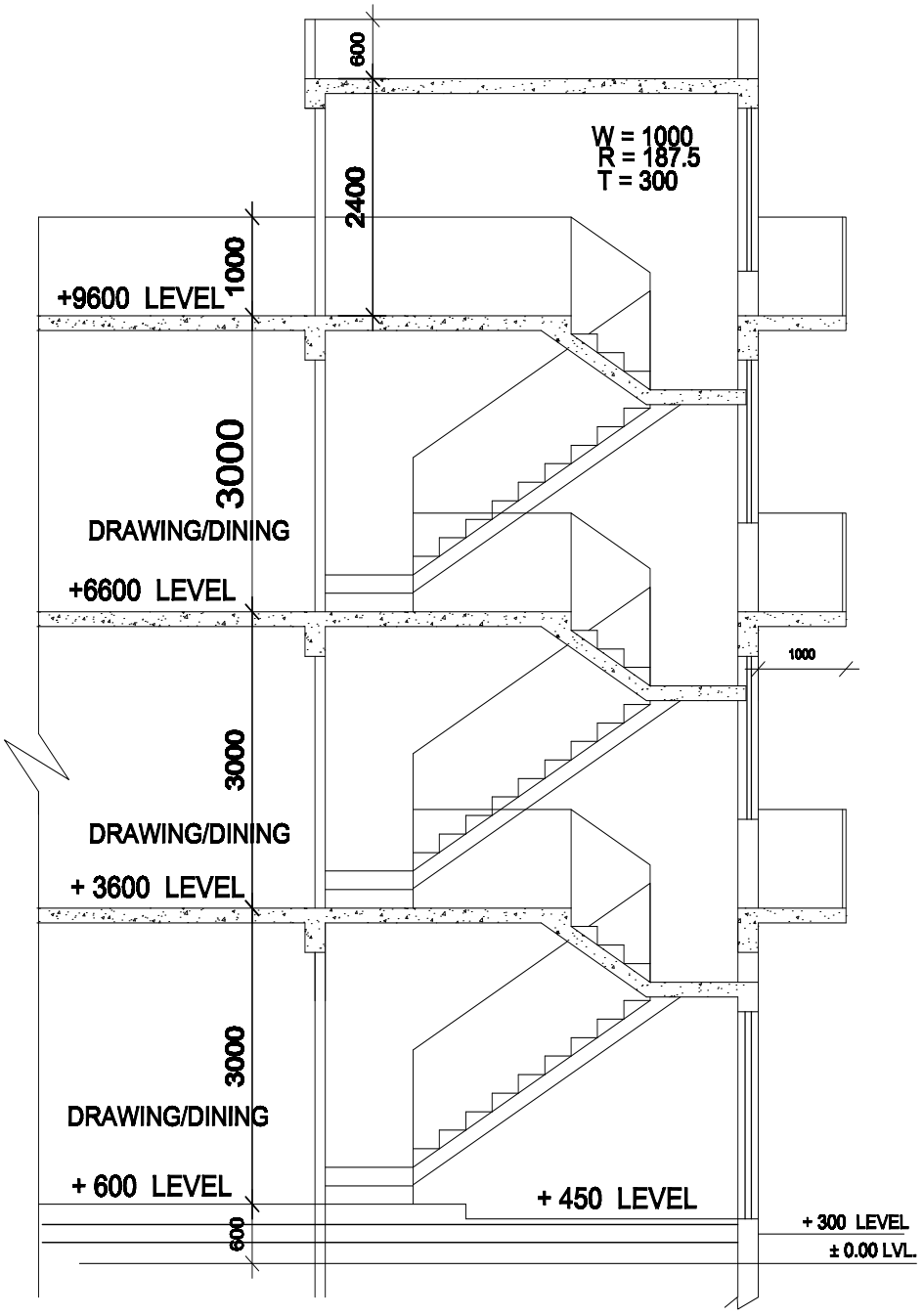


Fig. 2.3 (g). SECTION AT A-A

AREA CALCULATION

S.NO	GROUND FLOOR COVERAGE = PLOT AREA - OPEN		
	PLOT AREA	=	200.0 SQ.YDS.=1600.0 S.FT.
		=	167.22 SQ.MTR.
	OPEN AREA'S		
A	9.144X 3.00	=	27.43
B	5.50 X 3.00	=	16.50
C	2.40 X 3.125	=	7.50
	TOTAL OPEN	=	51.43
	GROUND COVERAGE	=	PLOT AREA - OPEN
		=	167.22 - 51.43 =115.79 SQ.M.
	FIRSTFL. COVERAGE	=	SAME AS GROUND FLOOR
		=	115.79 SQ.MT.
	SECOND FL. COVERAGE	=	115.79 - (1 + 2 + 3)
			115.79 - (10.93 +6.78 + 18.29)
			115.79 - 36.00 = 79.79 SQ.M.
	MUMMTY AREA		13.92 SQ.M.
	2.76X5.045		

OPENING SCHEDULE

S.NO	TYPE	SIZE		
1	D/W	2300	X	2100
2	D/W1	5000	X	2550
3	D/W2	2600	X	2550
4	W	1500	X	1650
5	W1	2500	X	1650
6	W2	1200	X	1650
7	W3	2300	X	1650
8	D1	1000	X	2100
9	D2	750	X	2100
10	V	900	X	900

AREA STATEMENT

S.NO	PARTICULARS	SQ.MTR.
1	PLOT AREA	167.22
2	PERMISSIBLE GROUND COVG.	118.693
3	PROPOSED GROUND COVG.	115.79
4	PROPOSED FIRST FLOOR AREA	115.79
5	PROPOSED SECOND FLOOR AREA	79.79
6	PERMISSIBLE FAR.	317.635
	PROPOSED FAR.	311.37
	GR + FF + SF	
	115.79+115.79+79.79	
7	MUMTY AREA	13.92

NOTE : ALL DIMENSIONS ARE IN MM

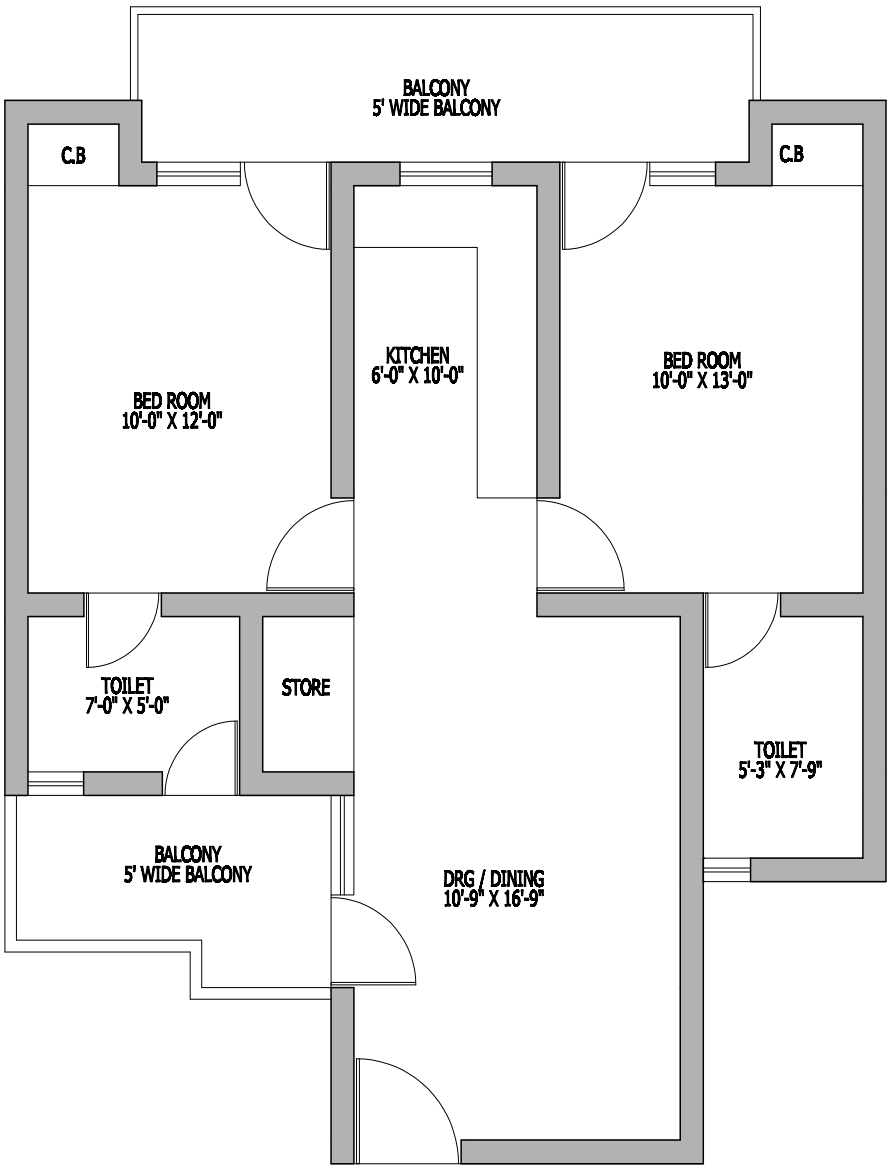

BALCONY
5' WIDE BALCONY
C.B
C.B
BED ROOM
10'-0" X 12'-0"
KITCHEN
6'-0" X 10'-0"
BED ROOM
10'-0" X 13'-0"
TOILET
7'-0" X 5'-0"
STORE
TOILET
5'-3" X 7'-9"
BALCONY
5' WIDE BALCONY
DRG / DINING
10'-9" X 16'-9"

Fig. 4.1 (a). PLAN

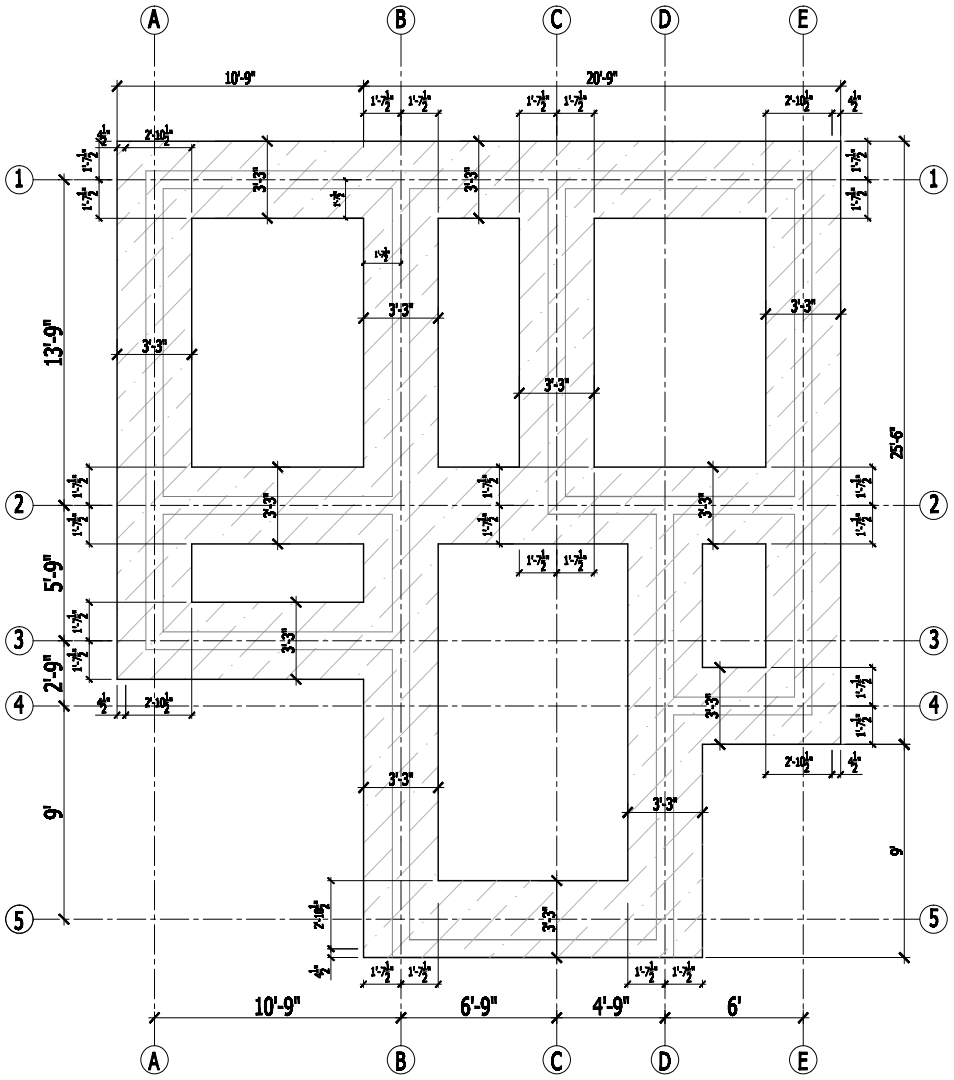


Fig. 4.1 (b). FOUNDATION PLAN

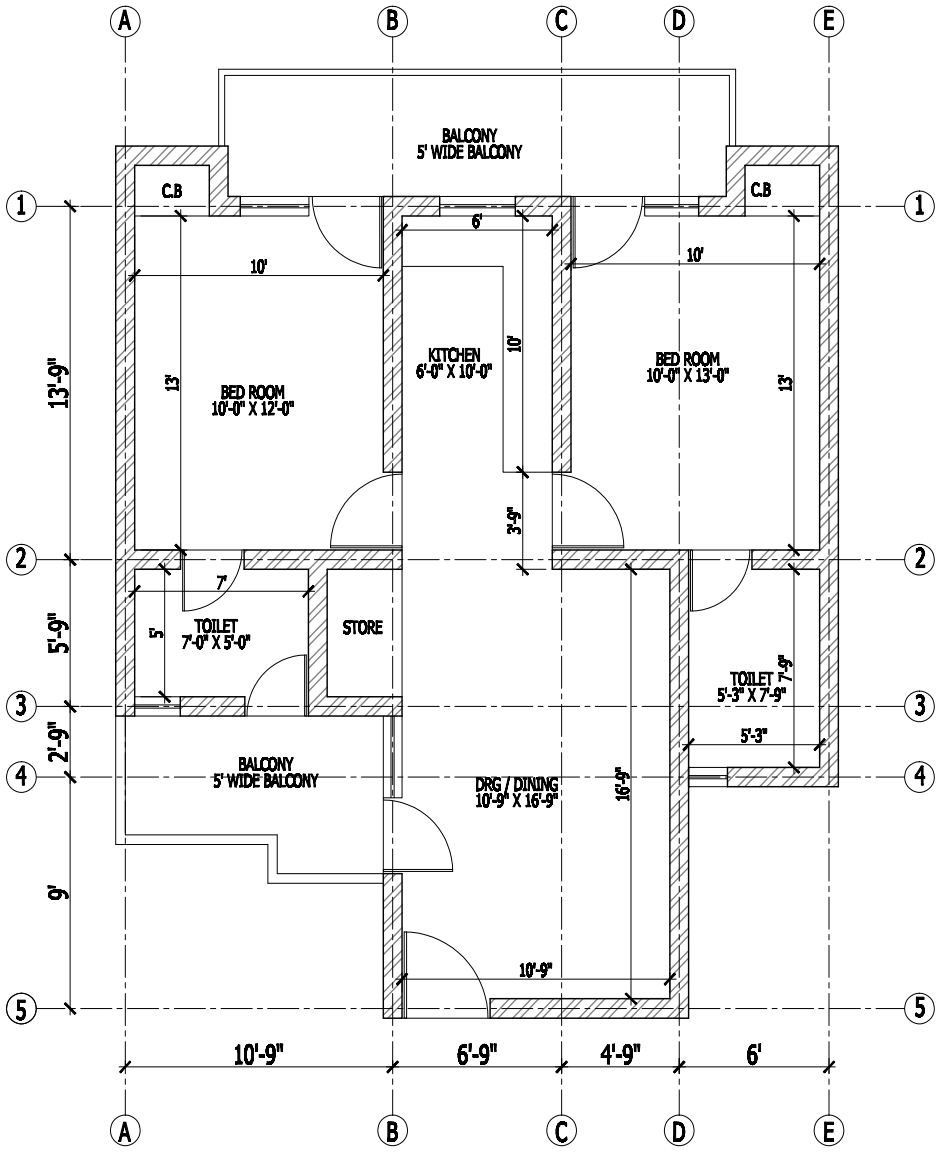

A
B
C
D
E
1
2
3
4
5
BALCONY
5' WIDE BALCONY
C.B
C.B
6'
10'
10'
13'-9"
13'
BED ROOM
10'-0" X 12'-0"
KITCHEN
6'-0" X 10'-0"
10'
BED ROOM
10'-0" X 13'-0"
13'
3'-9"
7'
5'-9"
5'
TOILET
7'-0" X 5'-0"
STORE
TOILET 7'-9"
5'-3" X 7'-9"
5'-3"
2'-9"
BALCONY
5' WIDE BALCONY
DRG / DINING
10'-9" X 16'-9"
16'-9"
9'
10'-9"
10'-9"
6'-9"
4'-9"
6'

Fig. 4.1 (c). PLAN

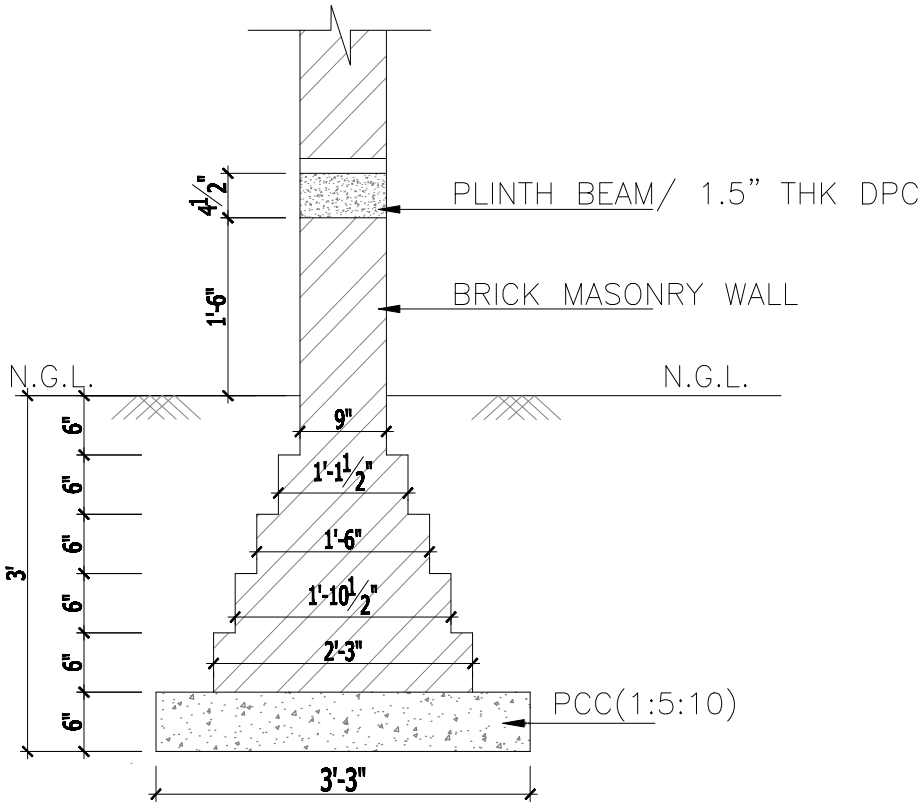


Fig. 4.1 (d). TYP. SECTION THRU 230TH. BRICK WALL

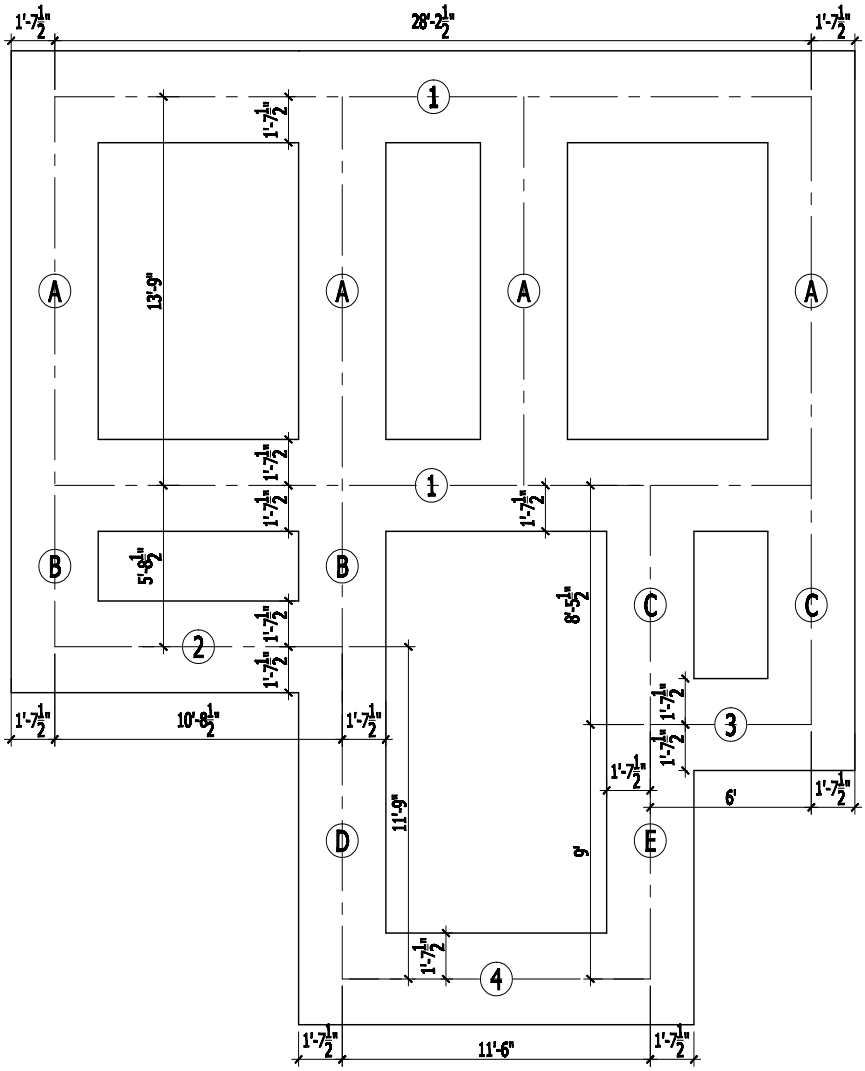


Fig. 4.2 (a). EARTHWORK IN EXCATION & PCC IN FOUNDATION

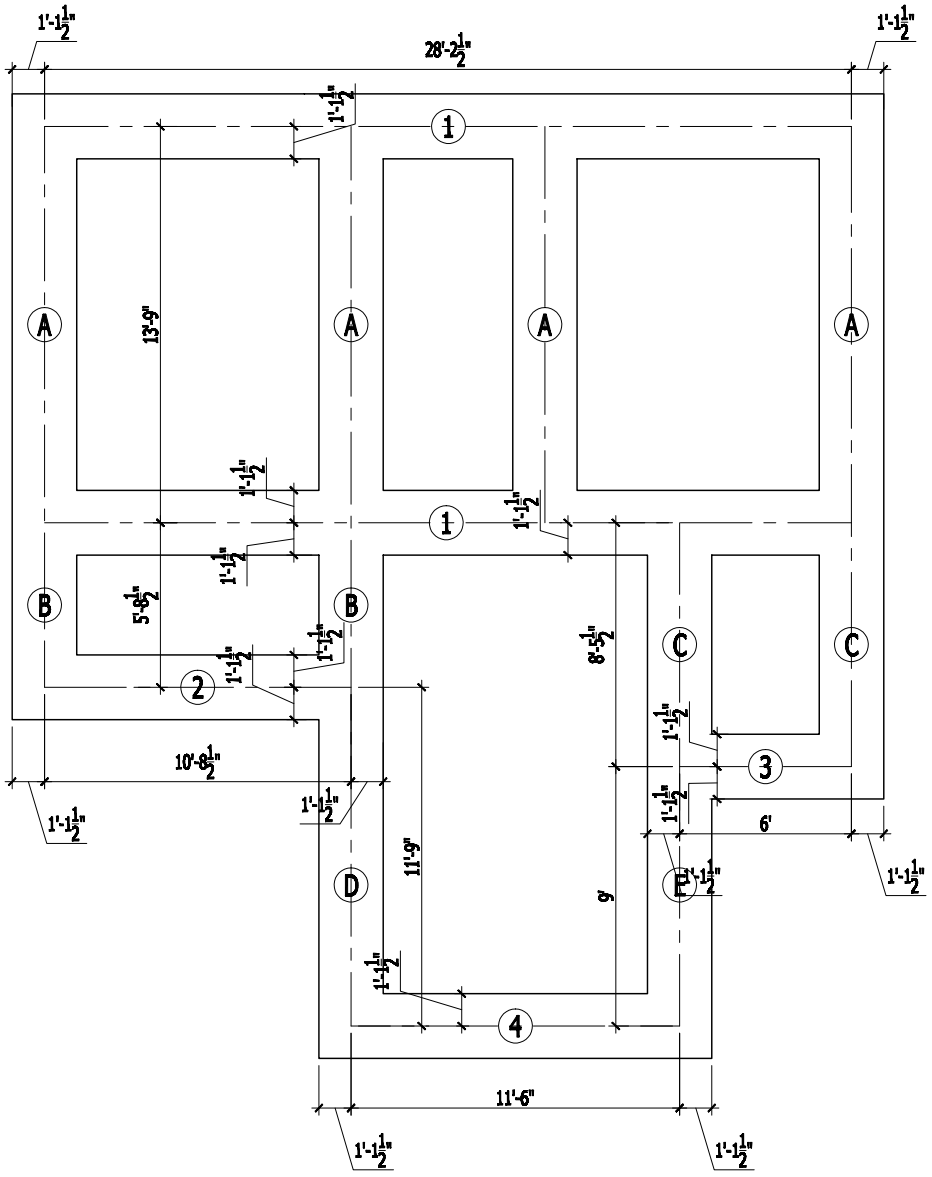


Fig. 4.2 (b). FIRST FLOOR

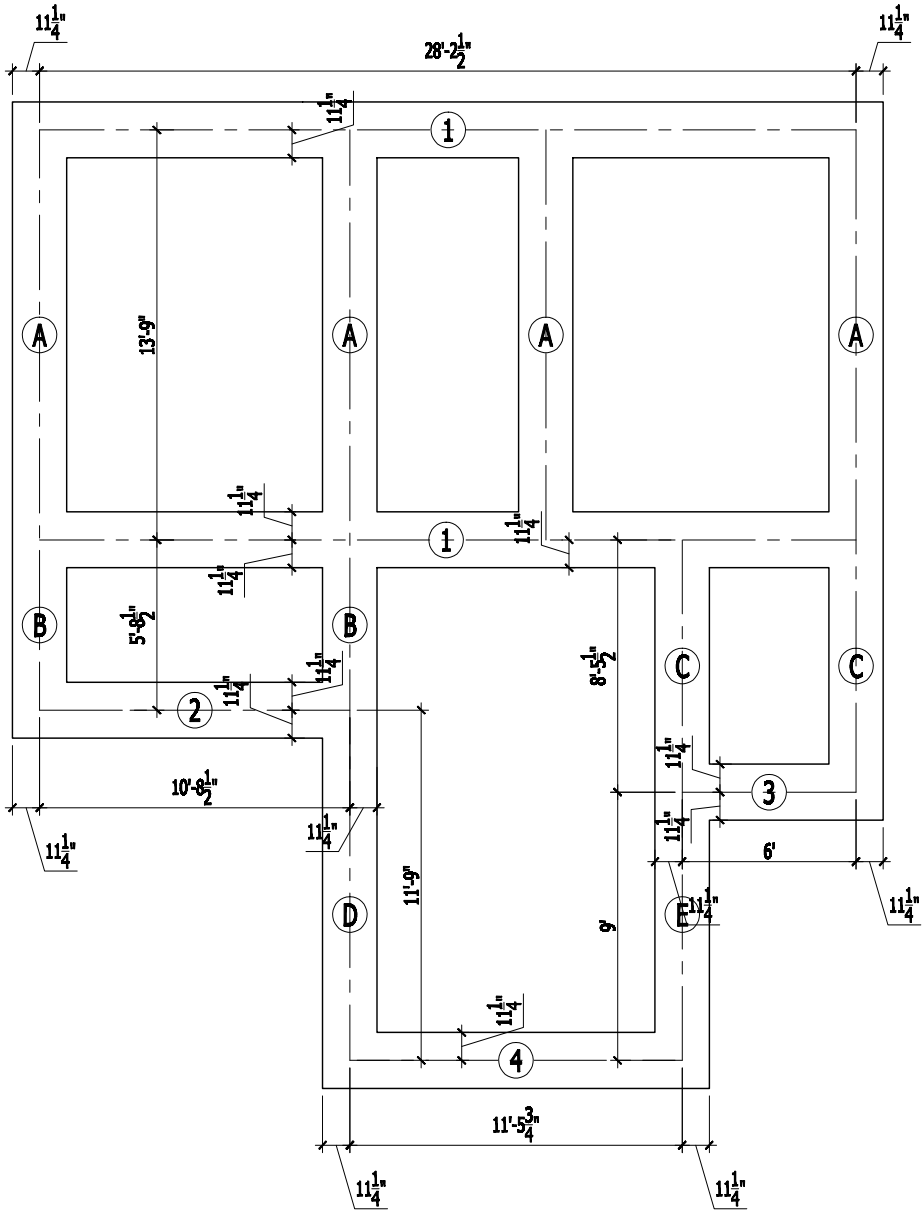


Fig. 4.2 (c). SECOND FLOOR

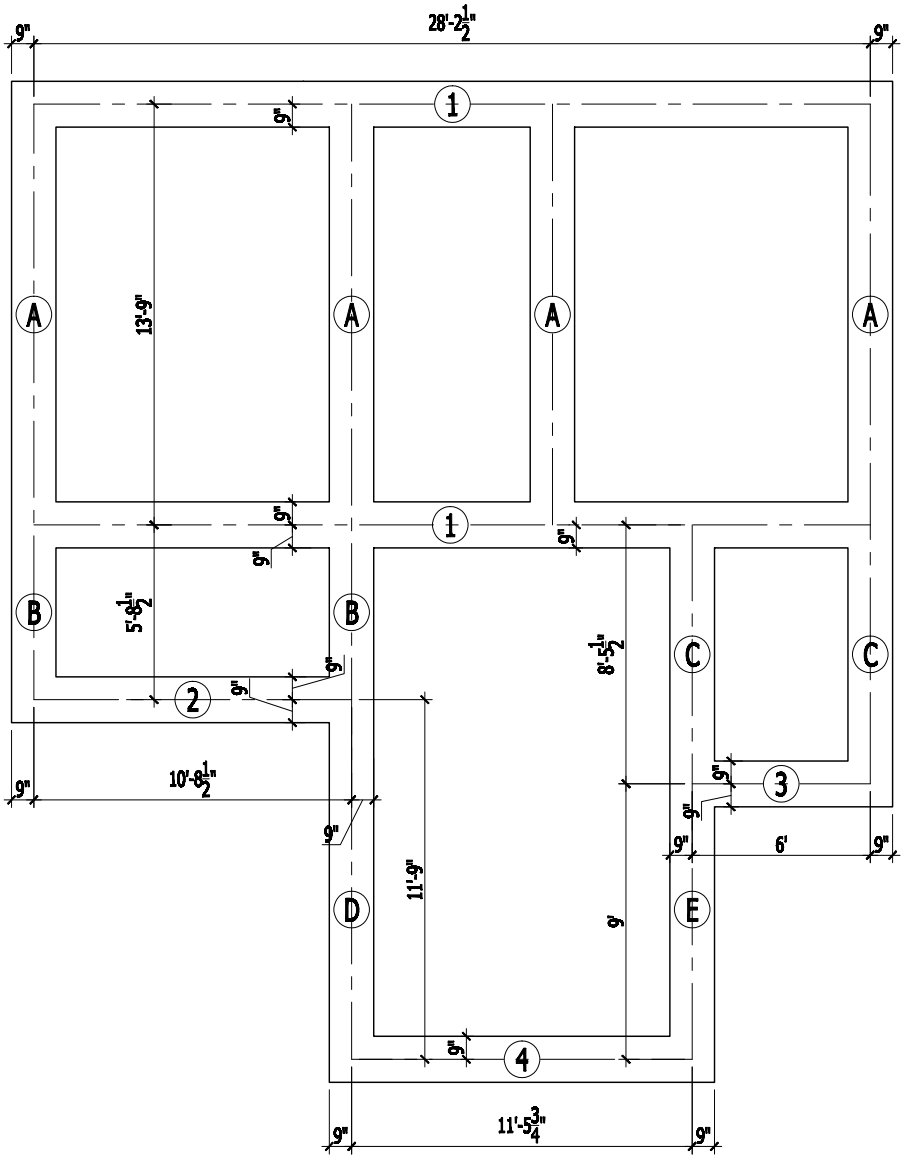


Fig. 4.2 (d). THIRD FLOOR

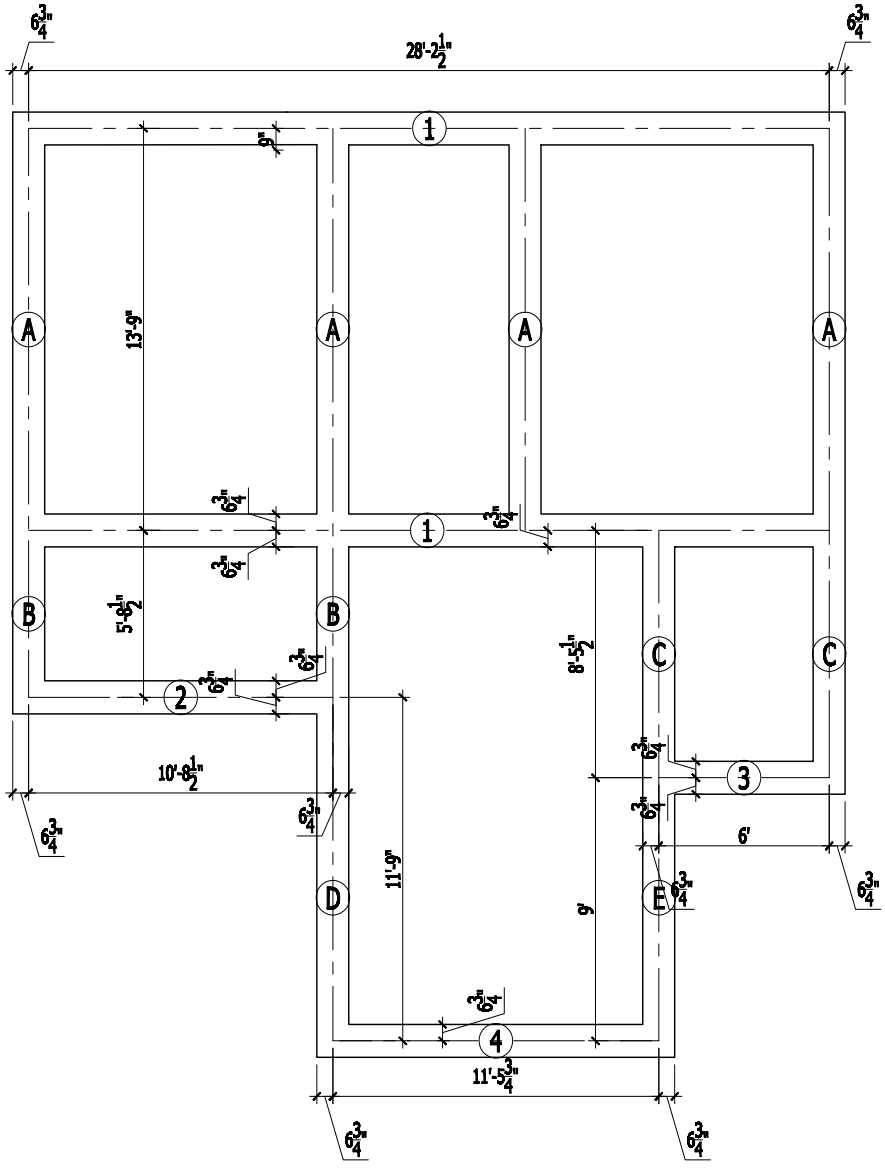


Fig. 4.3 (a). FORTH FLOOR

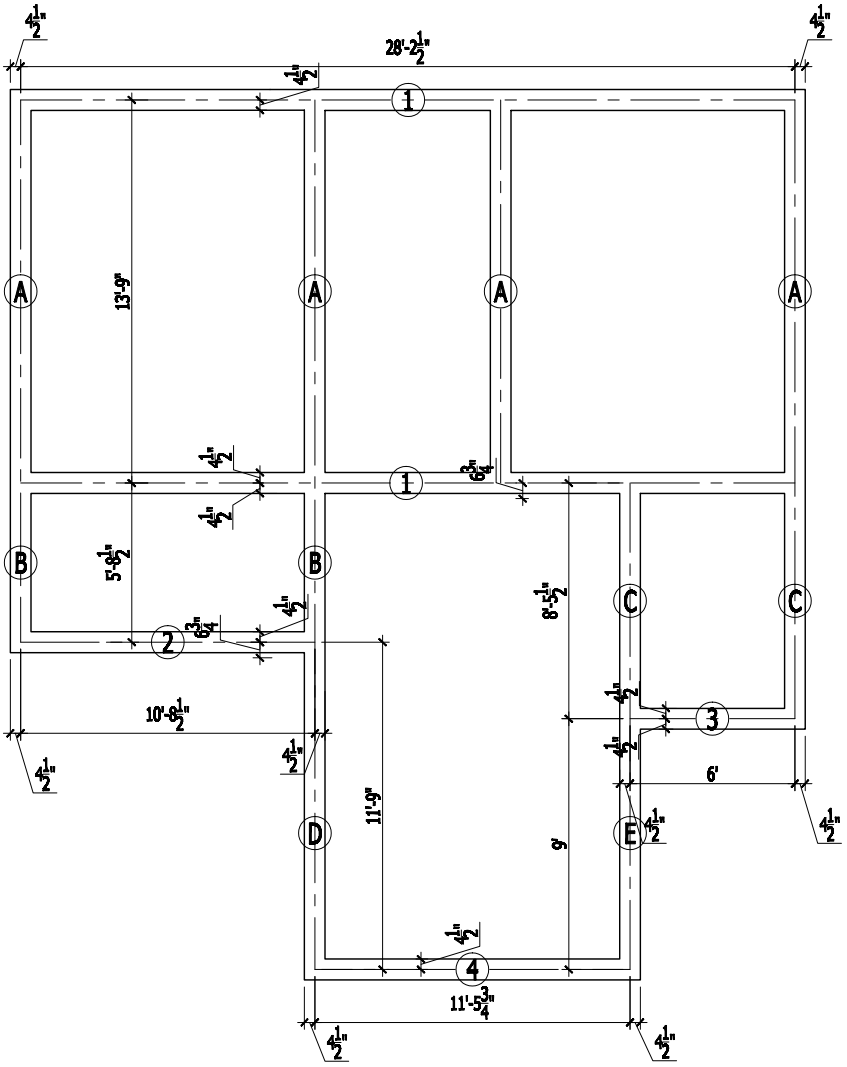


Fig. 4.3 (b). PLINTH WALL ABOVE FOOTING & DAMP PROOF COURSE

Syllabus

1. Introduction to Drawing and Surveying

- Importance of Drawings
- Types of Drawing
- Scales of drawing
- Types of Surveying
- Leveling

2. Construction Work

- Need of foundation
- Site Inspection and Marking
- Digging and Filling (Earthwork)
- Loose and close Timbering
- Prevention from timbering and Seepage
- Methods of security check
- Introduction to Building Material

3. Brick Work

- Brick Work
- Method of Preparation of Mortar
- Different types of Bond
- Different types of Arch
- Plinth Beam

4. Concrete Work

- Preparation of Concrete
- Construction joint
- Curing
- Expansion Joints
- Reinforced cement concrete
- Shuttering

5. Roof Work

- Types of Roof
- Drainage from roofs

6. Finishing and Polishing

- Cement Plaster
- Dry Distemper
- Material used in Paints
- Measurement of Paints
- Painting and Polishing on wood
- Painting on Iron

7. Flooring

- Types of Flooring
- Watering, Grinding and Polishing
- Tile work
- Kota stone flooring

8. Wood and Iron Work

- Shutters of Doors/ Windows
- Joint in Frame
- Fitting of Doors/ Windows
- Glass Work
- Iron Work

9. Drainage and Sewer Construction

- Types of Drainage
- Method of Drainage Construction
- Shape of Pipes
- Manholes and Sanitary Installation

10. Road Work

- Formation level of roads
- Main part of the roads
- Sub grade and compaction
- Types of roads
- Construction of cement concrete road.