BUILDING DRAWING AND DRAFTING LABORATORY

LAB MANUAL

SUBJECT : BUILDING DRAWING AND DRAFTING LAB

CODE : ES 354 CE

CLASS : B.E III SEM AICTE

MUFFAKHAM JAH COLLEGE OF ENGINEERING AND TECHNOLOGY
AFFILIATED TO OSMANIA UNIVERSITY, ACCREDITED BY NAAC APPROVED BY AICTE ROAD NO.3, BANJARA HILLS, HYDERABAD

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1	INTRODUCTION TO COMPUTER AIDED DRAFTING
2	BRICK MASONRY BONDS
3	DOORS AND WINDOWS
4	STAIR AND STAIR CASE
5	FOUNDATIONS
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7	PLANNING OF BUILDINGS
8	PLAN, SECTION & ELEVATION OF RESIDENTIAL BUILDINGS
9	PLAN, SECTION & ELEVATION OF RESIDENTIAL BUILDINGS
10	PLAN OF RURAL HOSPITAL
11	PLAN OF SCHOOL BUILDING

EXPERIMENT 1

INTRODUCTION TO COMPUTER AIDED DRAFTING

Aim: To learn basic AUTOCAD Commands

Software Used: AUTOCAD

AUTOCAD COMMANDS

UNITS

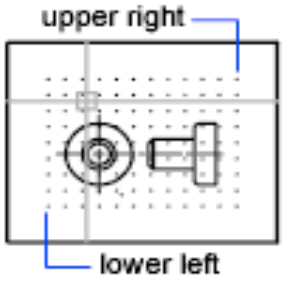
Controls the precision and display formats for coordinates, distances, and angles.

The format, precision, and other settings used to display coordinates, distances, and angles are set through this dialog box, and are saved in the current drawing. It is recommended that you save these settings to your drawing template files to reduce your setup time when you start a new drawing.

LIMITS

Sets an invisible rectangular boundary in the drawing area that can limit the grid display and limit clicking or entering point locations.

The following prompts are displayed.



Lower-Left Corner
Specifies the lower-left corner for the drawing limits.

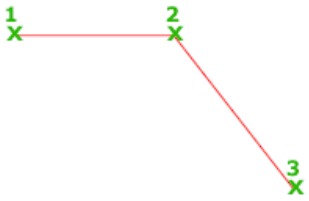
Upper right corner
Specifies a point in the drawing area that represents the opposite corner of the rectangular limits boundary.

DIMSTYLE

It creates and modifies dimension styles

LINE

Create a series of contiguous line segments. Each segment is a line object that can be edited separately.The following prompts are displayed.
Specify first point: Sets the starting point for the line.
Click a point location.
Specify next point: Specifies the endpoint of the line segment.
You can also use polar and object snap tracking together



with
direct distance entry.

LINETYPE

Creates, loads, and sets linetypes

MLINE

Creates multiple parallel lines

COPY

Copies objects a specified distance in a specified direction. The following prompts are displayed.
Select objects: Use an object selection method and press Enter when you finish
Specify base point or [Displacement/mOde/Multiple] <Displacement>: Specify a base point or enter an option
Specify second point or [Array] <use first point as displacement>: Specify a second point or enter an option

MOVE

Moves objects a specified distance in a specified direction.Use coordinates, grid snaps, object snaps, and other tools to move objects with precision. The following prompts are displayed.
Select objects: Specifies which objects to move.
Base point: Specifies the start point for the move.
Second point: In combination with the first point, specifies a vector that indicates how far, and in what direction, the selected objects are moved.

TRIM

Trims objects to meet the edges of other objects. There are two modes that you can use to trim objects, Quick mode and Standard mode.

ERASE

Removes objects from a drawing. To erase selected objects from the drawing. This method does not move objects to the Clipboard, where they can then be pasted to another location.

EXTEND

Extends objects to meet the edges of other objects. To extend objects, first select the boundaries. Then press Enter and select the objects that you want to extend.

LENGTHEN

Changes the length of objects and the included angle of arcs. To specify changes as a percentage, an increment, or as a final length or angle. LENGTHEN is an alternative to using TRIM or EXTEND.

XLINE

Creates a construction line of infinite length. Xlines are useful for creating construction and reference lines, and for trimming boundaries.

TEXT

Creates a single-line text object. One can use single-line text to create one or more lines of text, where each text line is an independent object that you can move, format, or otherwise modify.

MTEXT

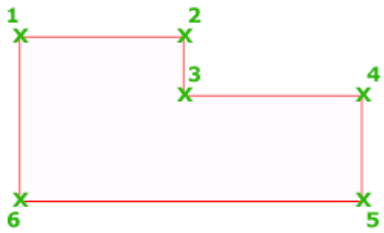
Creates a multiline text object. One can create several paragraphs of text as a single multiline text (mtext) object. With the built-in editor, you can format the text appearance, columns, and boundaries.

PLINE

Creates a 2D polyline, a single object that is composed of line and arc segments. The following prompts are displayed.

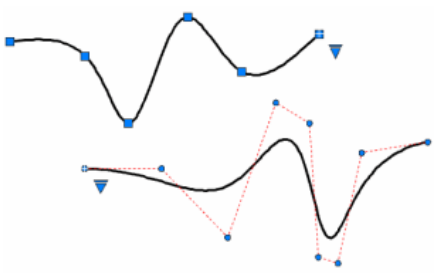
Specify start point

Specify next point



SPLINE

Creates a smooth curve that passes through or near a set of fit points, or that is defined by the vertices in a control frame. Splines are defined either with fit points, or with control vertices. By default, fit points coincide with the spline, while control vertices define a control frame. Control frames provide a convenient method to shape the spline. Each method has its advantages.



EXPLODE

Breaks a compound object into its component objects. Explodes a compound object when you want to modify its components separately. Objects that can be exploded include blocks, polylines, and regions, among others.

BLOCK

Creates a block definition from selected objects. The Block Definition dialog box is displayed. Enter -BLOCK at the Command prompt, options are displayed. Create a block definition by selecting objects, specifying an insertion point, and giving it a name.

EXPERIMENT 2

TYPES OF BRICK BONDS

Aim: To draw plan, elevation and isometric view of Flemish and English bond.

Software Used: AUTOCAD

Theory:

BRICK MASONRY

A **brick** is a type of block used to build walls, pavements and other elements in masonry construction. Properly, the term brick denotes a block composed of dried.

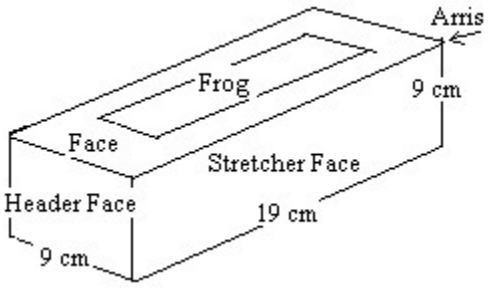
Sun-dried bricks. Also known as unburnt bricks, these types of bricks are mostly used for decorative purposes because they are the weakest.

Burnt bricks. These bricks are divided into four categories

- Concrete bricks
- Lime bricks
- Engineering bricks
- Fly ash bricks

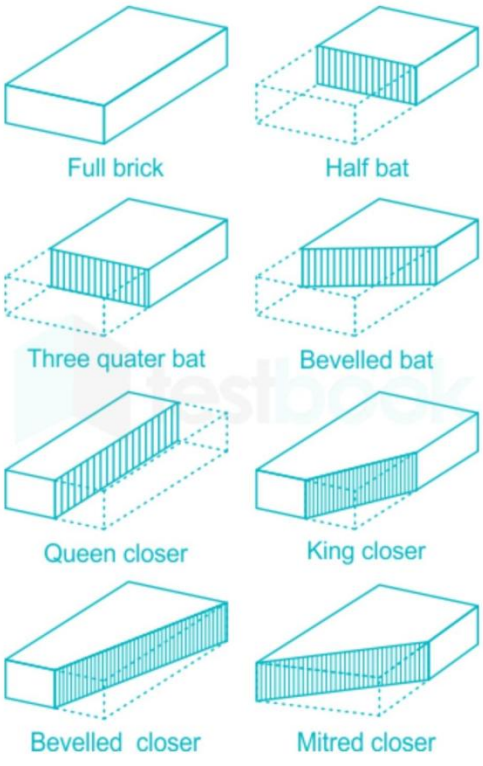
Depending on strength

- First Class Bricks - Water absorption should be 12-15%. The crushing strength of the brick should not be less than 10 N/mm^2.
- Second Class bricks - Water absorption should be 16-20%. The crushing strength of the brick should not be less than 7 N/mm^2.
- Third Class bricks - Water absorption is about 25 per cent of dry weight. The crushing strength of the brick should not be less than 3.5N/mm^2



BRICK BAT

Brick bat is defined as a cut portion of brick, generally the brick is cut along the width and the length of brick piece is smaller than the original.



Types of brick bats

- Half brick bat
- Three-quarter brick bat
- King closer
- Queen closer
- Mitred closer
- Bevelled closer

TYPES OF BONDS

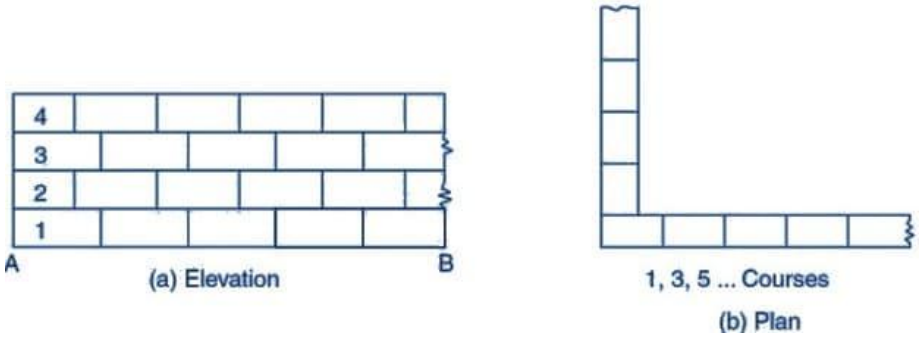
Types of bonds in brick masonry wall construction are classified based on laying and bonding style of bricks in walls. The bonds in brick masonry are developed by the mortar filling between layers of bricks and in grooves when bricks are laid adjacent to each other and in layers in walls. Mostly used material for bonds in brick masonry is cement mortar. Lime mortar and mud mortar are also used.

The most commonly used types of bonds in brick masonry are:

1. Stretcher bond
2. Header bond
3. English bond and
4. Flemish bond

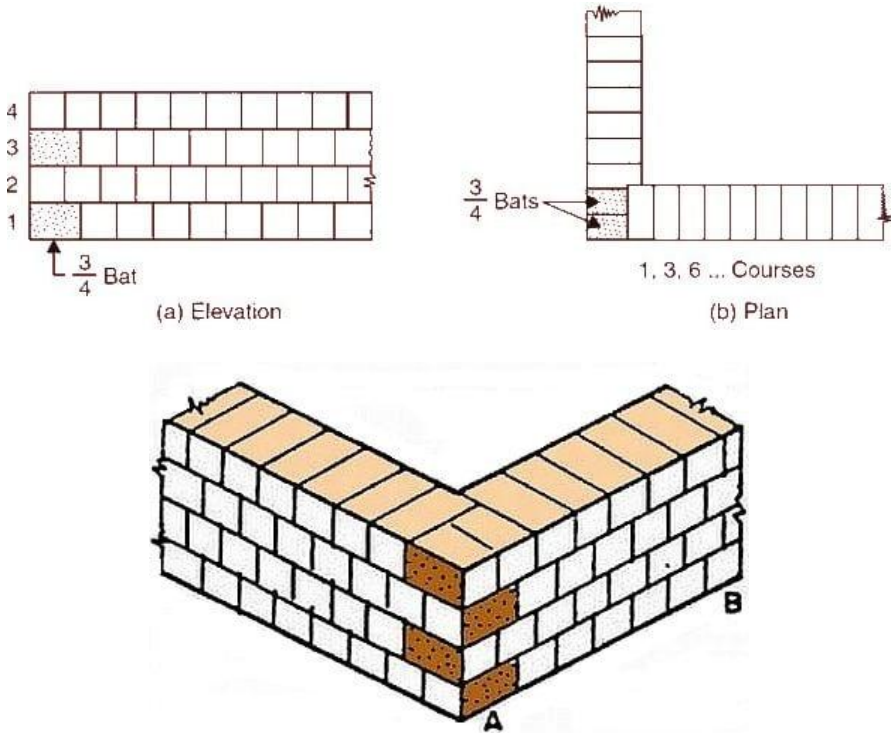
Stretcher bond

Longer narrow face of the brick is called as stretcher as shown in the elevation of figure below. Stretcher bond, also called as running bond, is created when bricks are laid with only their stretchers showing, overlapping midway with the courses of bricks below and above.



Header bond

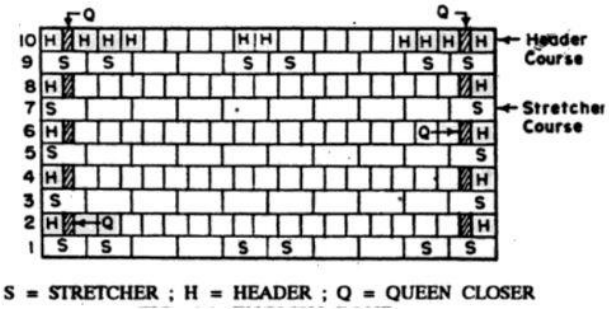
Header is the shorter square face of the brick which measures 9cm x 9cm. Header bond is also known as heading bond. In header bonds, all bricks in each course are placed as headers on the faces of the walls.

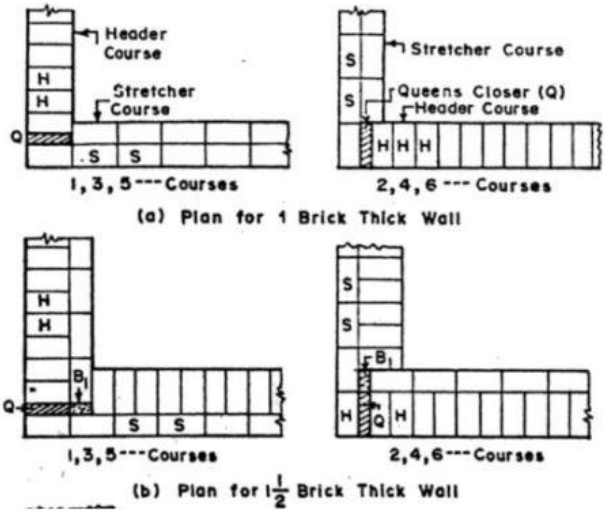


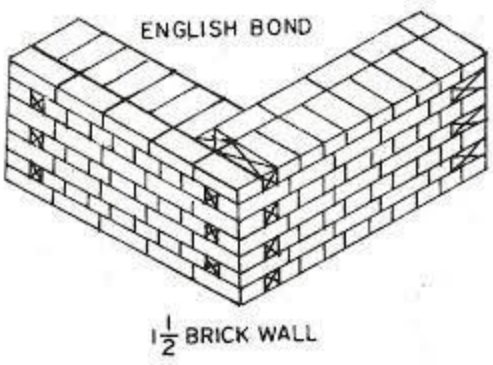
Isometric View of Header Bond

English Bond

English bond in brick masonry has one course of stretcher only and a course of header above it, i.e. it has two alternating courses of stretchers and headers. Headers are laid centered on the stretchers in course below and each alternate row is vertically aligned. To break the continuity of vertical joints, quoin closer is used in the beginning and end of a wall after first header. A quoin close is a brick cut lengthwise into two
halves and used at corners in brick walls.





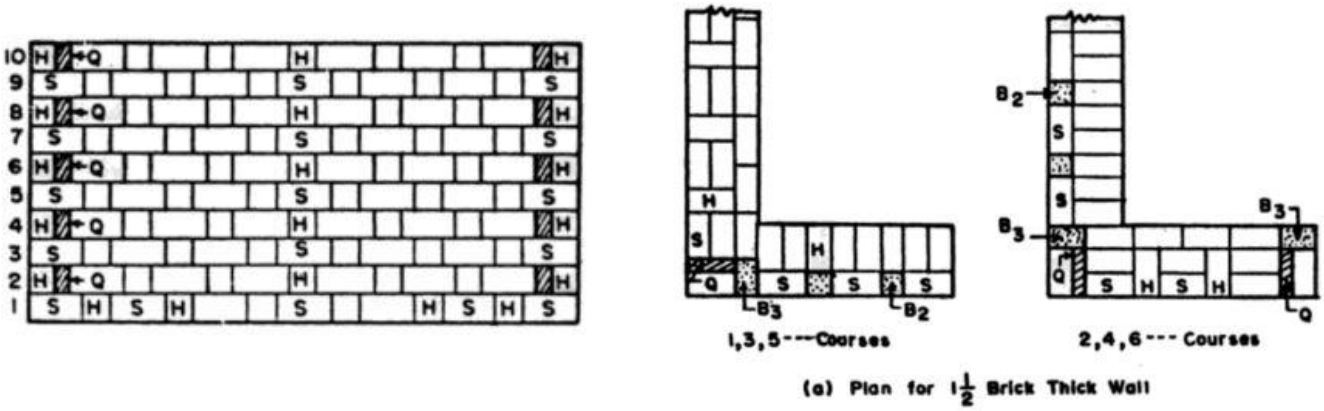


Flemish Bond

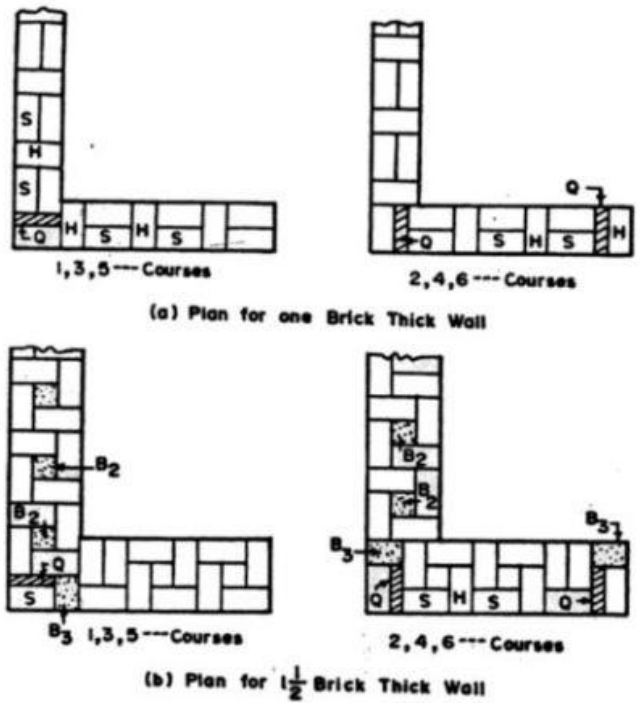
A Flemish bond pattern consists of each course of alternate headers and stretchers. Every alternate course starts with a quoin header at the corner. To the next of quoin header, quoin closer is placed in alternate courses to develop face lap. The patterns arrange such that every header is centrally supported over the stretcher below it.

Flemish bonds can be either:

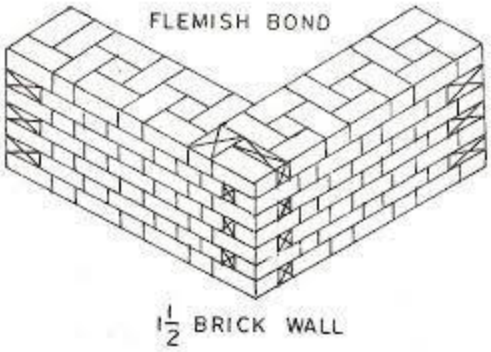
1. Double Flemish Bond
2. Single Flemish Bond



Flemish Bond



Single Flemish Bond



Double Flemish Bond

EXPERIMENT 3

DOORS AND WINDOWS

Aim: To draw plan, section and elevation of fully paneled door and window, fully glazed window.

Software Used: AUTOCAD

Theory:

DOORS AND WINDOWS

Doors are the means to provide access to the rooms of a building. A door consists of a frame and one or two shutters or leaves. Accordingly, they are called as single shuttered or double shuttered doors.

Door Frame:

A door frame consists of two vertical members called styles and two horizontal members' one at top called top rail and one bottom rail or sill or threshold. Now-a-days the bottom rail is omitted and made to flush with floor level.

M.S Clamps of flat iron about 300mm x 50mm x 6mm are fixed to the vertical styles on the outer side known as "Hold Fast" in Z shape

When bottom members (sill) are not provided, the vertical members (styles) should be inserted in the floor finish by about 40mm or 50mm.

Shutter:

Shutter for the door frame may be fully paneled or partly paneled or partly glazed and partly paneled with one or two leaves or shutters. In fully paneled shutter, the number of shutters may be 3, 4 or 6 as per design.

In case of door shutters, the horizontal members are called as rails (top, bottom, lock and frieze). All other rails fixed between the lock rail and top rail are called as frieze rails. The continuous vertical members are called as styles or stiles.

The joints between panel and frame shall be tongued and grooved joints. Grooves are formed along the inner edges of the stiles and rails to receive the panels.

Designation and sizes of Doors & Windows:

As per APDSS (Andhra Pradesh Detailed Standard & Specifications) 1002.3.2. Following notations shall be used.

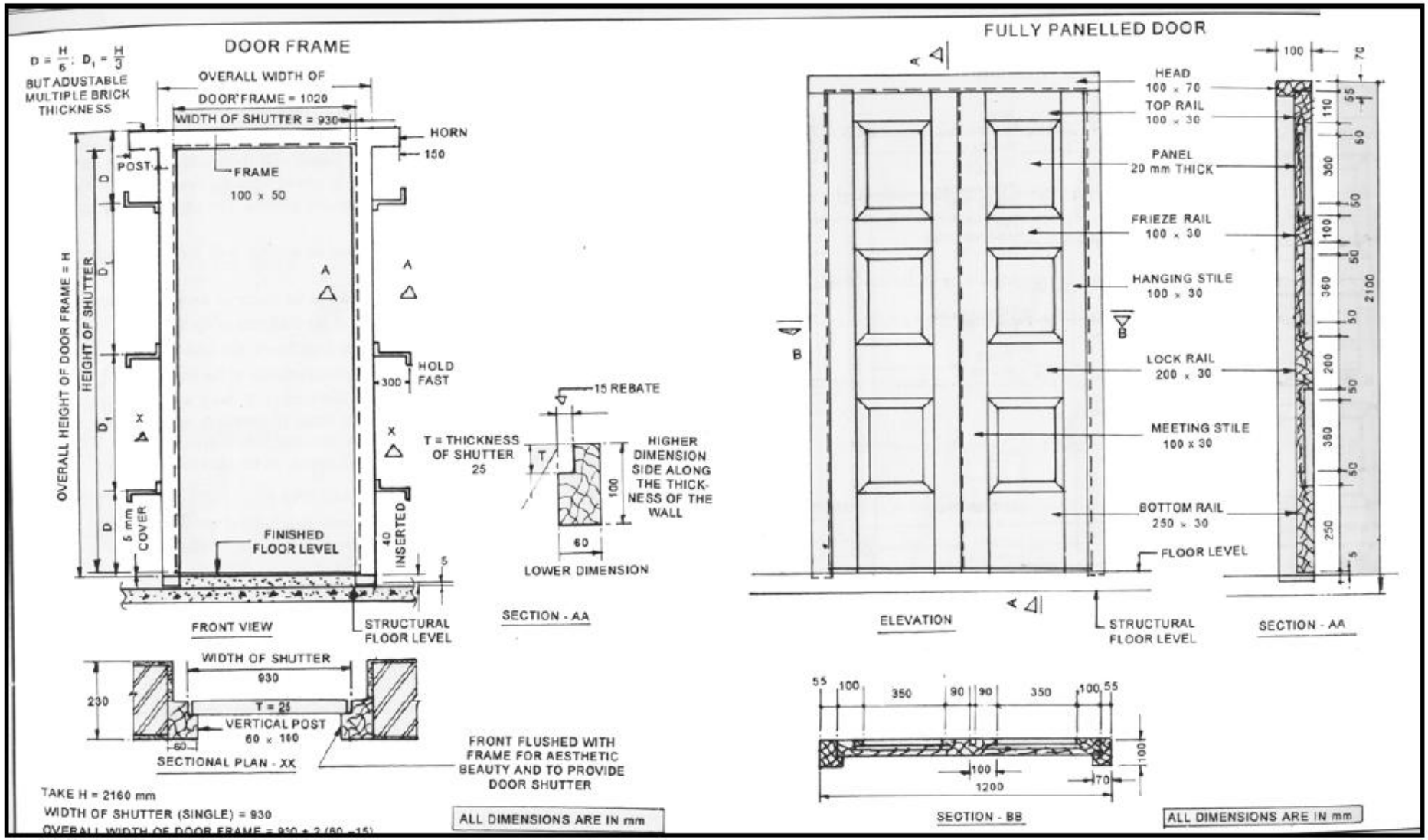
D - Door
W – Windows
V – Ventilator
S- Single Shutter
T – Double Shutter
P – Two Panels
R – Three Panels
Q – Four Panels

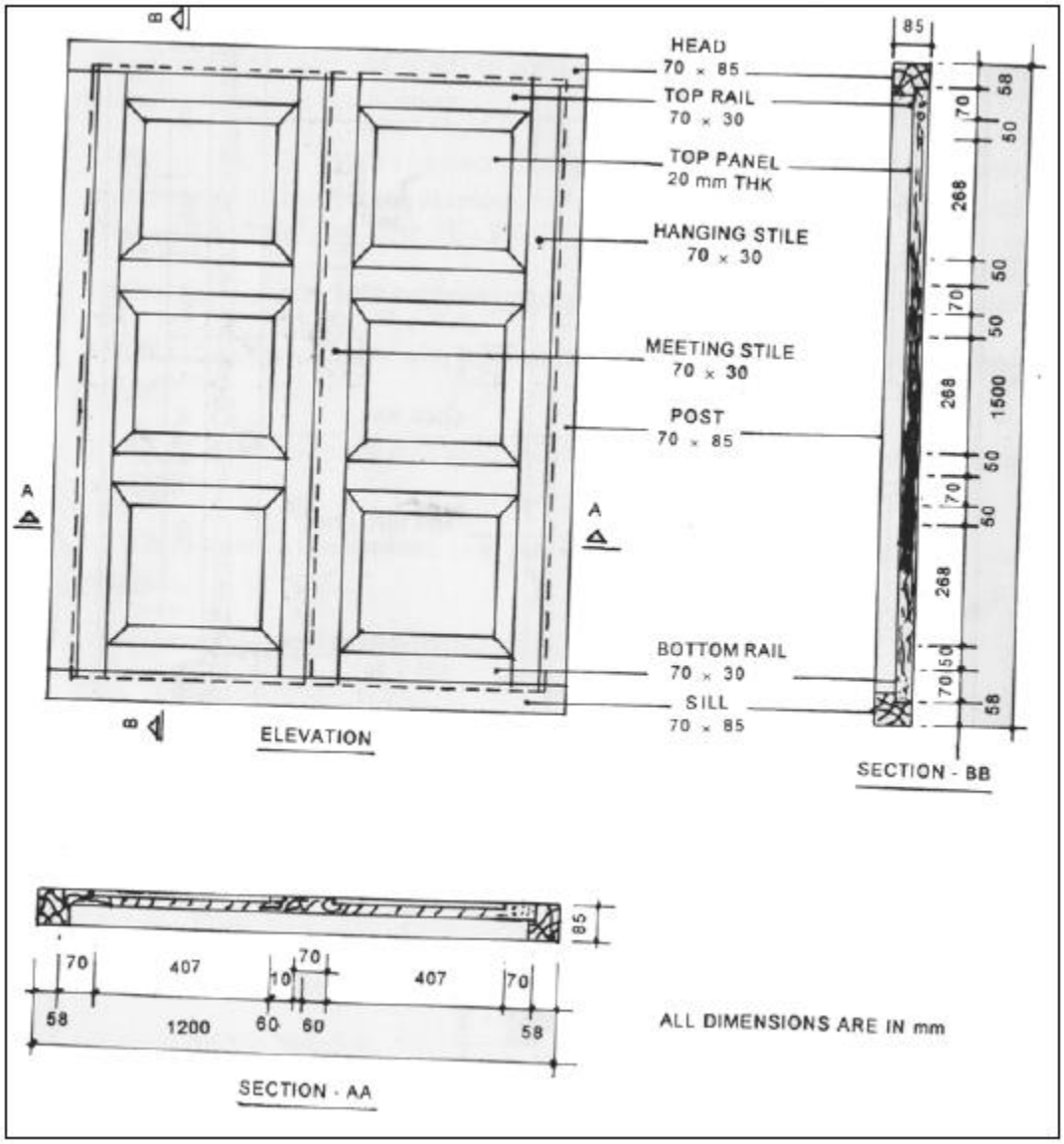
Width and depth are indicated by number of modules

1 Module = 100mm

Examples:

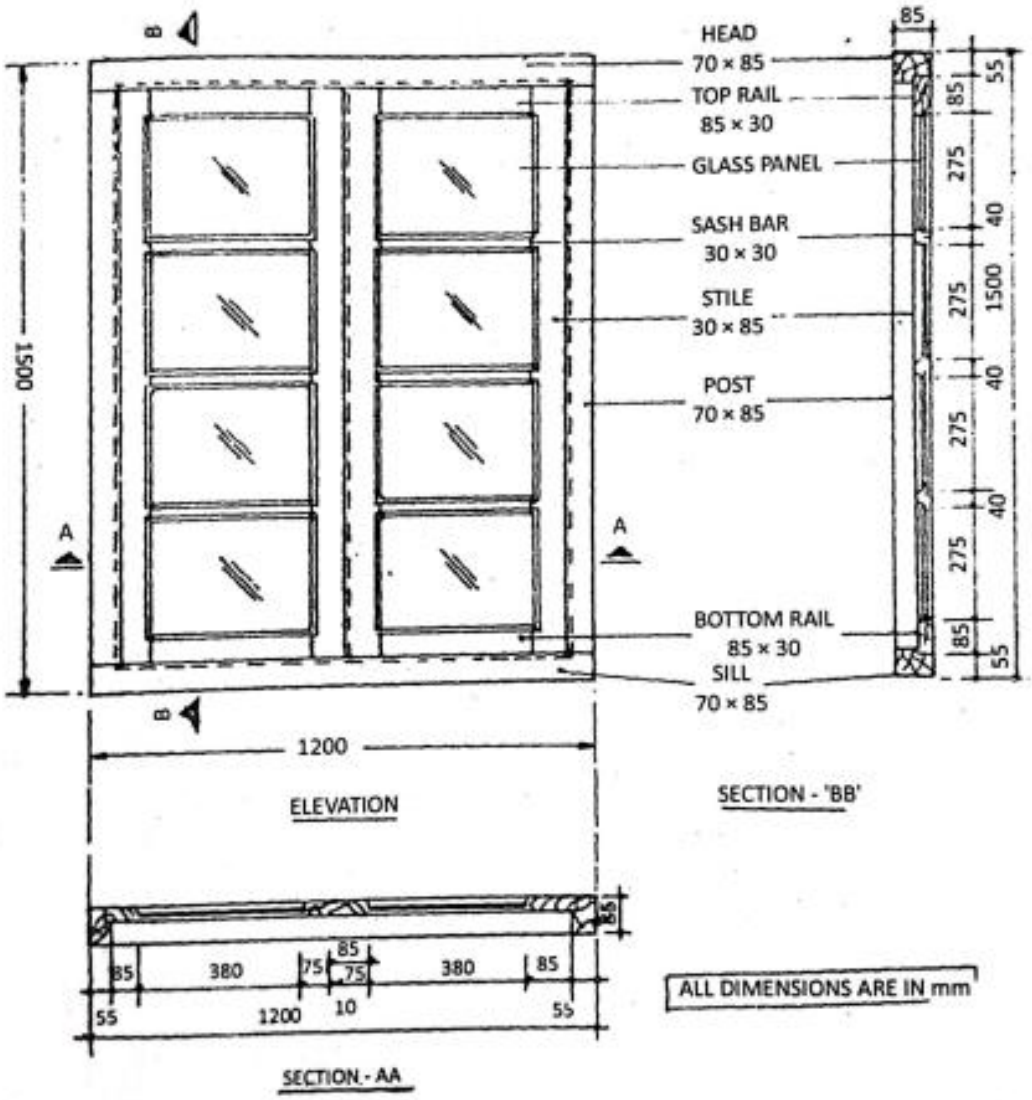
- 11 DT 20 shall mean a frame of a double shutter door with a width of 11 modules and depth of 20 modules.
- 10 DS 20 means a Door with single shutter with width as 10 modules and 20 modules height.
- 15 WQ 12 mean a window with four panels having 15 modules as width and 12 modules as height.
- 10 WT 12 means a window with double shutters having 10 modules as width as 12 modules as height
- 11 WR 15 means a window with three panels having 11 modules as width and 15 modules as height
- 10 V 6 means a ventilator having 10 modules as width and 6 modules as height


DOOR FRAME
$D = \frac{H}{6}$; $D_1 = \frac{H}{3}$
BUT ADUSTABLE MULTIPLE BRICK THICKNESS
OVERALL WIDTH OF DOOR FRAME = 1020
WIDTH OF SHUTTER = 930
HORN
150
POST
FRAME
100 x 50
OVERALL HEIGHT OF DOOR FRAME = H
HEIGHT OF SHUTTER
D
D1
D1
D
5 mm COVER
HOLD FAST
300
FINISHED FLOOR LEVEL
40
INSERTED
5
STRUCTURAL FLOOR LEVEL
FRONT VIEW
15 REBATE
T = THICKNESS OF SHUTTER 25
T
HIGHER DIMENSION SIDE ALONG THE THICK-NESS OF THE WALL
100
60
LOWER DIMENSION
SECTION - AA
WIDTH OF SHUTTER
930
230
T = 25
VERTICAL POST
60 x 100
60
SECTIONAL PLAN - XX
FRONT FLUSHED WITH FRAME FOR AESTHETIC BEAUTY AND TO PROVIDE DOOR SHUTTER
TAKE H = 2160 mm
WIDTH OF SHUTTER (SINGLE) = 930
OVERALL WIDTH OF DOOR FRAME = 930 + 2 (60 +15)
ALL DIMENSIONS ARE IN mm
FULLY PANELLED DOOR
HEAD
100 x 70
TOP RAIL
100 x 30
PANEL
20 mm THICK
FRIEZE RAIL
100 x 30
HANGING STILE
100 x 30
LOCK RAIL
200 x 30
MEETING STILE
100 x 30
BOTTOM RAIL
250 x 30
FLOOR LEVEL
ELEVATION
STRUCTURAL FLOOR LEVEL
100
70
55
110
50
300
50
100
50
360
50
2100
200
50
360
50
250
5
SECTION - AA
55
100
350
90
90
350
100
55
100
100
1200
70
SECTION - BB
ALL DIMENSIONS ARE IN mm



FULLY PANELLED WINDOW

FULLY GLAZED WINDOW SHUTTER



EXPERIMENT 4

STAIRS AND STAIRCASES

Aim: To draw plan, elevation of open well and dog legged stair case.

Software Used: AUTOCAD

Theory:

STAIRS AND STAIRCASES

The stairs are a series of steps properly arranged to connect different floors in a building. The hall or room in which the stars are located is called a stair case

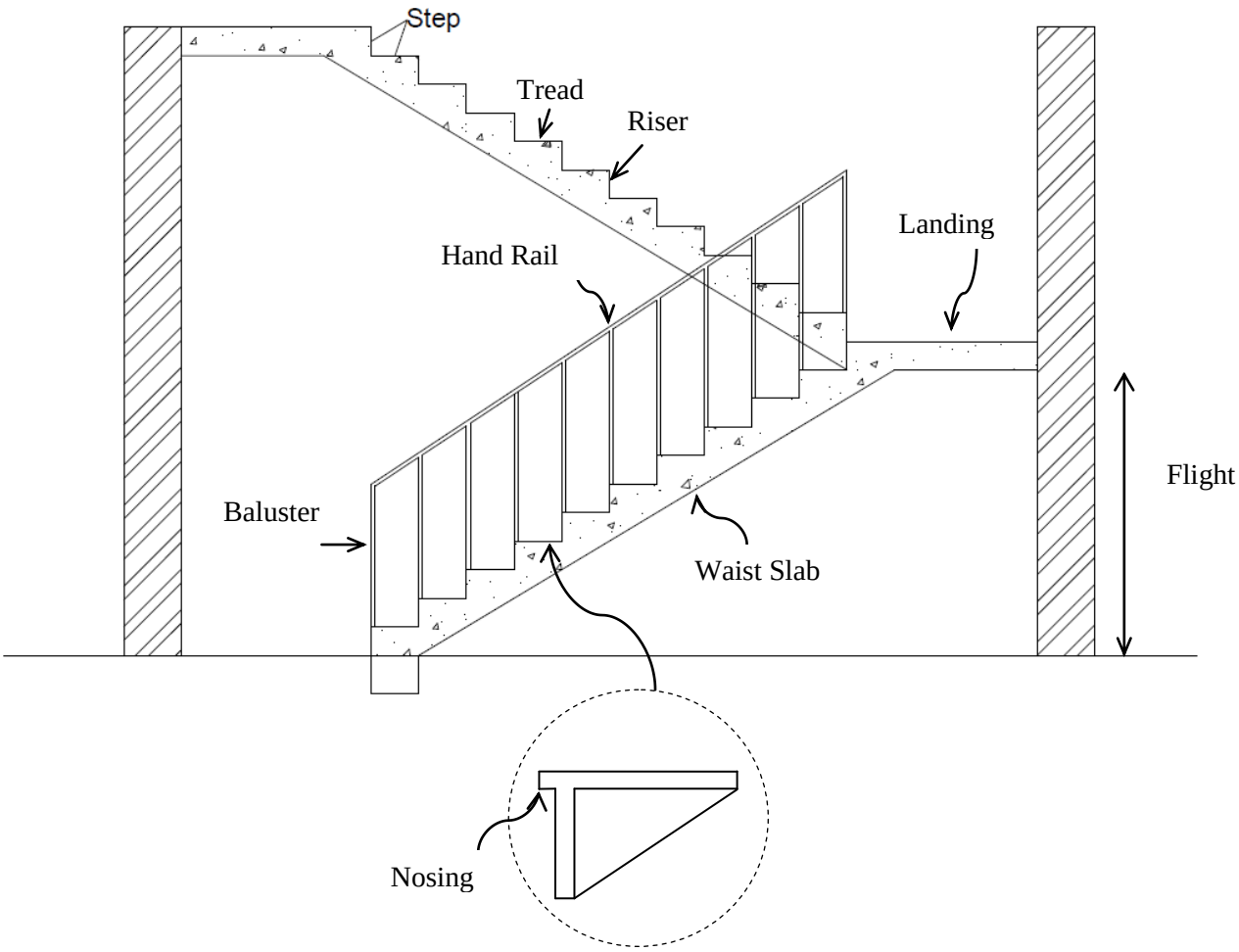
- **Step:** A part of stairs consisting of a tread and riser which is used to ascent or descent from one floor to another.
- **Tread:** The horizontal upper part of a step which is used to rest the foot while ascending or descending the stairs.
- **Riser:** The vertical member between two treads is known as riser.
- **Rise:** It is the vertical distance between surfaces of two consecutive steps
- **Flight:** A series of continuous steps without any break or horizontal platform is known as flight.
- **Landing:** A horizontal platform between two flights of stair is called landing. When landing extends to full width it is half space landing and when it extends to only for half of staircase it is quarter space landing.
- **Hand Rail:** Wooden or metallic rail which is generally provided on the sides of stairs at about 750mm for hand hold and safety of users is termed as hand rail. Height of the hand rail should not b e more than 850mm and not less than 750mm.
- **Waist:** The thickness of RCC slab over which steps are constructed is known as waist or waist slab.
- **Head Room:** It is vertical distance between the tread of a step and bottom of the flight or landing immediately above.
- **Baluster:** It is vertical member placed between hand rail and edges of the treads to support the hand rail.
- **Balustrade:** The combined frame work of hand rail and baluster is called balustrade.
- **Winders:** They are angular or radiating steps and are provided to change the direction of a flight without introducing and landing.
- **Nosing:** A small outer projection of a tread beyond the riser is known as nosing.

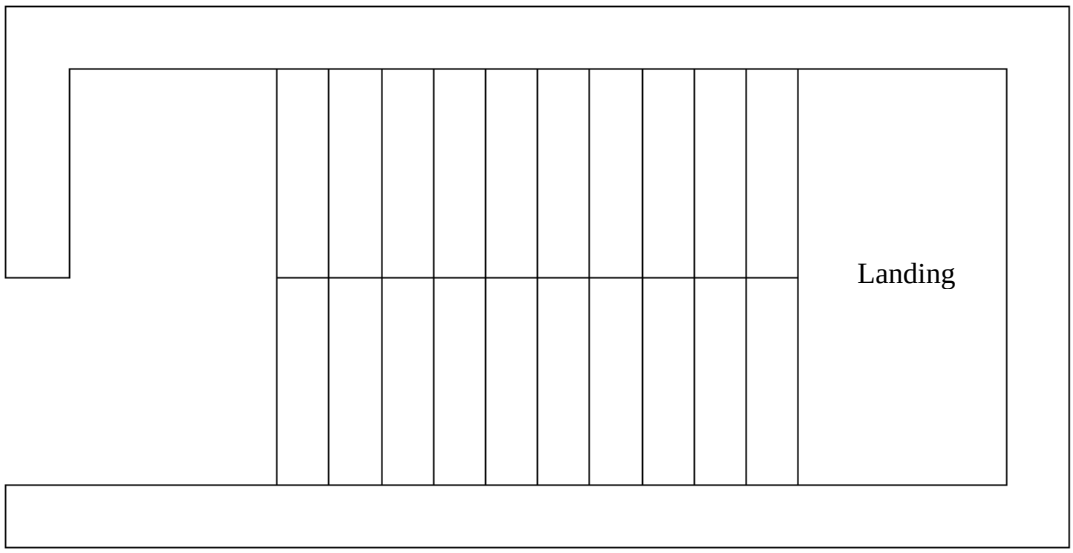
NOTE:

As per building bye laws the maximum riser and minimum width of tread are as follows :

Type of Building	Maximum Riser	Minimum Tread without nosing
Public Building	150mm	300mm
Domestic Building	190mm	250mm

- Minimum width of stair case (width of flight)
- Residential building – 1.0 m
- Public Building – 1.5m
- Minimum Head room – 2.2m
- Width of the landing in no case should be less than width of the stair case or flight width.





Dog Legged Stair Case

TYPES OF STAIRS:

- Stairs
  - **Straight Flight Stair:** All steps will be in one flight without or with one or two intermediate landings.
  - **Quarter turn stair:** Steps are arranged in two flights making an angle of 90^0 separated by landing.
  - **Half turn stair:** The two flights will be separated by a landing so that change in the direction is 180^0.
    - Dog legged stair
    - Open well stair either with half or quarter
    - Bifurcated stair
    - Circular stair or Spiral stair
    - Geometrical stair
    - Semi Elliptical stair

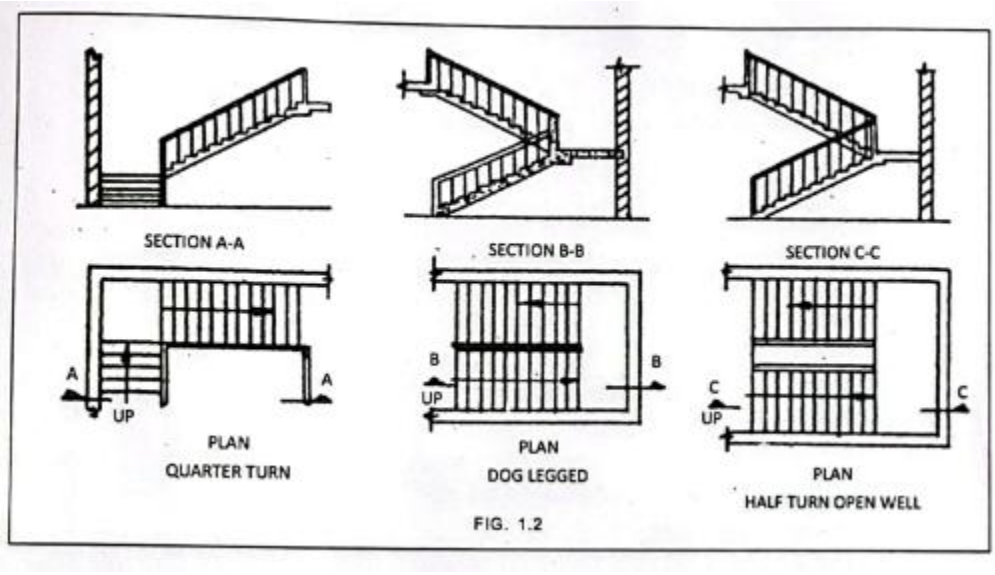
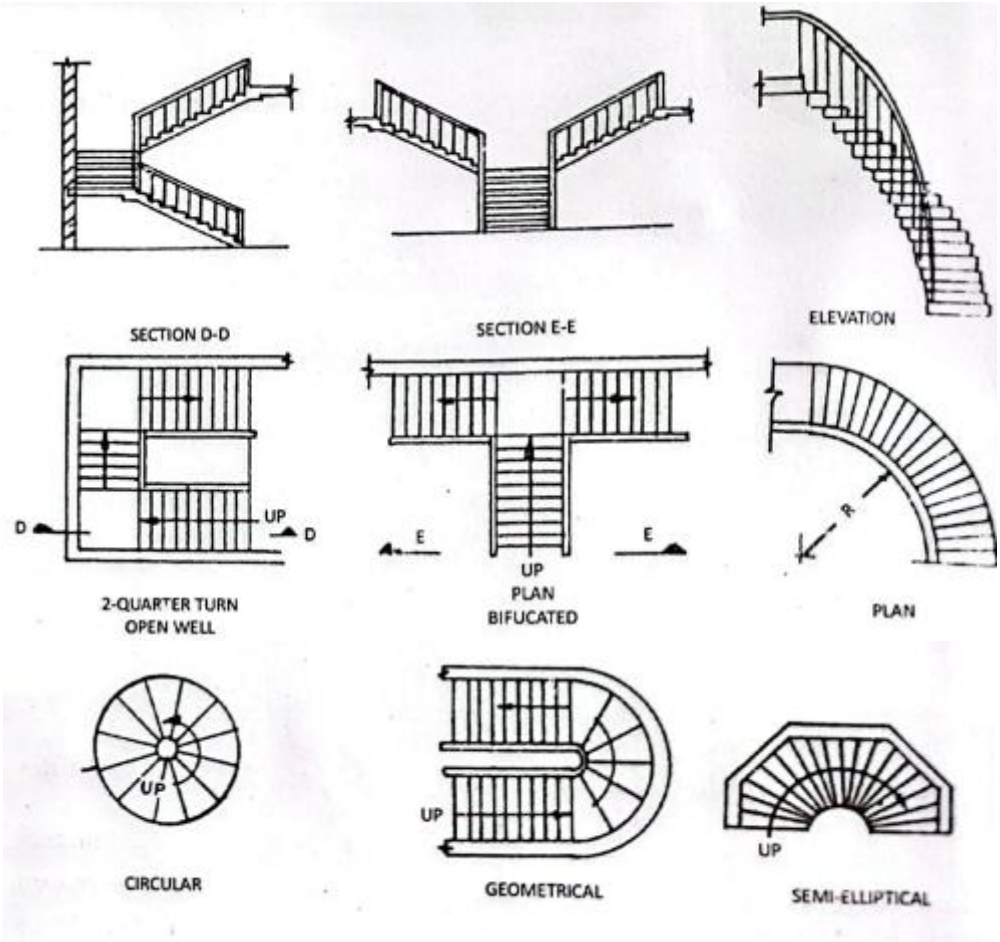


FIG. 1.2

Most commonly used stairs are

- Dog legged stair
- Open well stair

In most of residential building dog legged stairs are used and in public buildings open well stairs may be preferred.



EXERCISE - 3

1. Draw the plan and sectional elevation on C-D (as indicated in the plan) to a scale of 1 : 20 with the following details : (Refer plate 9-1).

Type of stair = Dog-legged half turn

No. of flights = 2

No. of steps in each flight = 10

Tread of each step = 250 mm

Rise of each step = 150 mm

Width of flight = 1000 mm

Height of each flight = 1650 mm

Height between floors = 3300 mm

Any other data required may be suitably assumed.

Calculations to draw the above views.

Inside dimensions of the stair case room

Width = Length of landing = 2 × width of flights

= 2 × 1000 = 2000 mm

Length = Total goings in one flight + 2 (width of landings)

= (10 x 250) + 2 (1000) = 4500 mm

2. Draw to a scale 1 : 20, the plan and sectional elevation along A-B of a openwell stair with a rectangular well for an office building with the following data (Refer plate no. 9-2).

Inside dimensions of staircase = 6m x 4.5 m

Height between the floors = 3.60 m

Thickness of floor slab = 150 mm

Width of flight = 1500 mm

Calculations :

$$\text{Number of steps required (selecting rise as 150 mm)} = \frac{\text{Height between floors}}{\text{Rise of each step}}$$

$$= \frac{3600}{150} = 24$$

Arranging in two flights, No. of rises in each flat = $\frac{24}{2} = 12$

∴ No. of treads required in each flight = 12 – 1 = 11

∴ Provide 11 No. of treads in each flight; width of open well = width of room – 2 (width of flight)

= 4500 – 2 (1500) = 1500 mm

Providing landings width = width of flight

Length available for all 11 goings in each flight

= 6000 – 2 (1500) = 3000 mm

Now tread of each step = $\frac{3000}{11} = 272.2$ mm

Providing tread of each step equal to 270 mm

Total length of goings = 270 x 11 = 2970 mm

Remaining length = 3000 – 2970 = 30 mm

This 30 mm space is provided at the beginning of first landing.

Data available from the above calculation :

No. of flight = 2

Width of each flight = 1500 mm

Width of top landing = 1530 mm

Width of intermediate landing between two flights = 1500 mm

Width of open well = 1500 mm

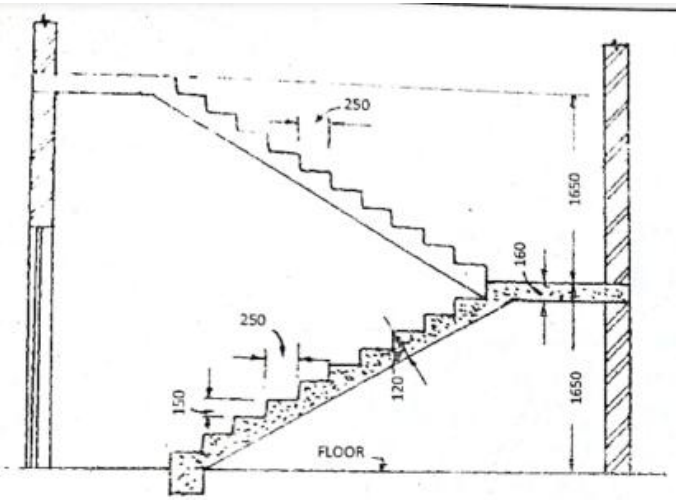
Length of open well = 2970 mm

No. of treads in each flight = 11

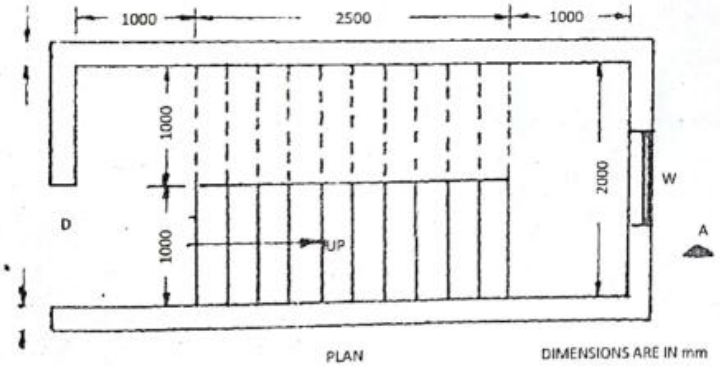
No. of rises in each flight = 12

Tread = 270 mm; Rise = 150 mm

PLATE : 4



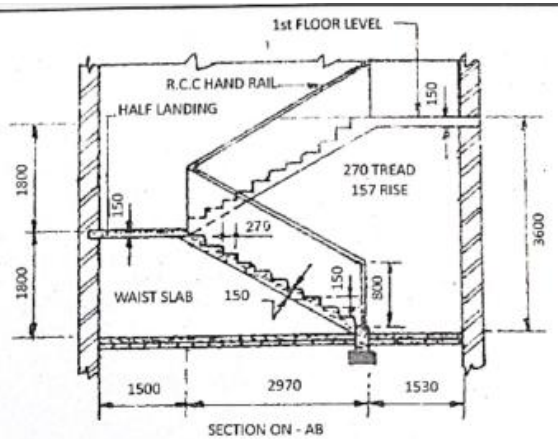
ELEVATION ON SECTION - AA



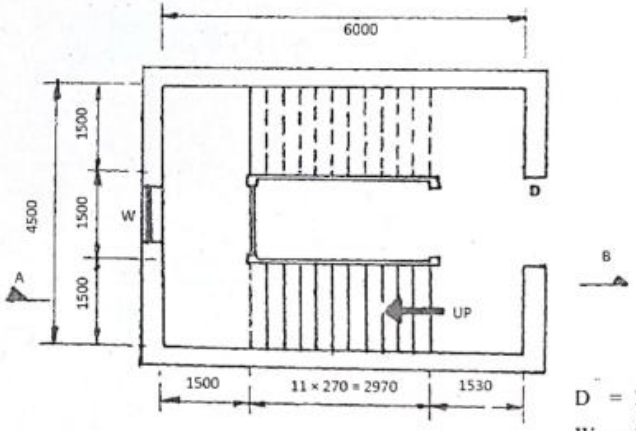
PLAN

DIMENSIONS ARE IN mm
D = 1000 × 2100 mm
W = 1200 × 1200 mm

DOG LEGGED STAIR



SECTION ON - AB



PLAN OF R.C.C. STAIR

D = 1000 × 2100 mm

W = 1200 × 1200 mm

Note : All dimensions are in mm

OPEN WELL STAI

EXPERIMENT 5

FOUNDATION

Aim: To draw plan, Section of Isolated footing (RCC) and Load bearing wall.

Software Used: AUTOCAD

Theory:

FOUNDATIONS

Buildings may be constructed with load bearing walls namely load bearing walled structure or with a number of isolated RCC columns connected laterally by beams. Most of the residential building of one or two storeys is generally constructed with load bearing walls.

Load bearing walls receive all dead loads which finally transmits to the sub soil.

Foundation:

The portion of the building constructed below the ground level in order to distribute the structural load is known as foundation or sub- structure.

Footings:

The width of the load bearing wall is increased in steps. These steps are known as footings. Depth of the foundation is vertical distance below ground level to the bottom of the concrete bed.

Plinth:

The portion of the structure between the surrounding ground level and the surface of the floor level immediately above the ground level is termed as plinth. Also the level is called as plinth level which shall not be less than 450mm.

Depth of foundation:

Depth of foundation is vertical distance measured from G.L to the bottom of CC bed over which masonry footing are constructed.

As per NBC foundation depth depends on

- Bearing Capacity of soil
- Shrinkage and swelling properties of soil
- Depth of ground water table
- Depth of frost penetration

Thickness of concrete bed in foundation:

The thickness of cement concrete bed below the masonry wall in spread footing depends on

- Type of concrete used
- Upward pressure of the soil below CC bed
- As a thumb rule d = (5/6)T, T= thickness of wall in super structure.

Super structure:

The portion of the building constructed above ground level is called super structure. It includes Masonry walls, columns, steps, doors, windows ventilators, lintels, sunshades, stair case roof, weather proof course, parapet wall etc.

Lintels:

Lintels are small beams which are of RCC provided over small opening like door, windows , almirahs etc. which is of 150mm thickness.

Sun-shade:

Sun shade is sloping or horizontal RCC cantilever slab provided over openings on external walls to provide protection from sun and rain.

Porch:

Porch or Portico or Canopy is covered surface supported on columns or otherwise for the purpose of pedestrian or vehicular approach to the building , height of porch should be generally 2.1m.

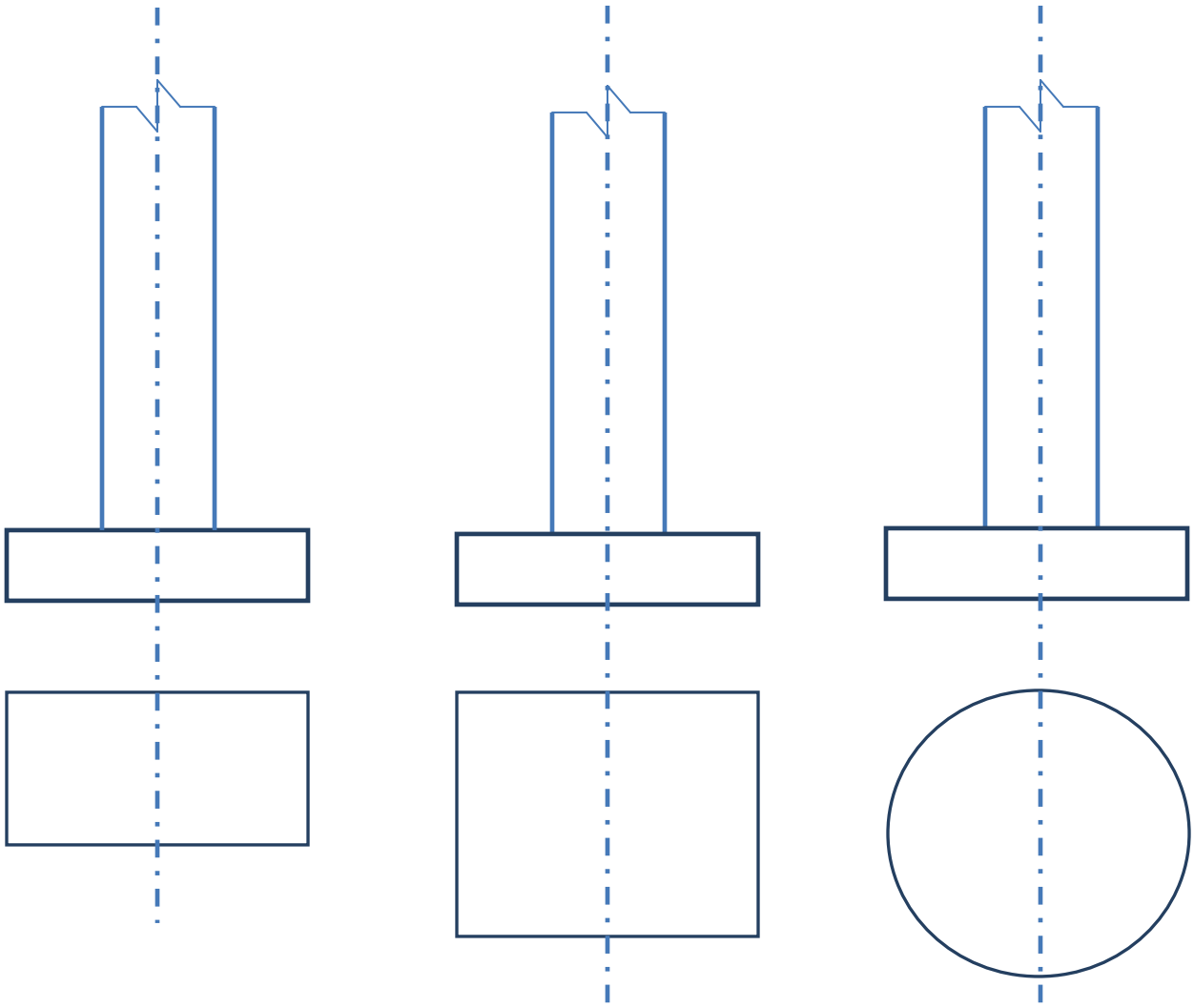
Types of footings:

Based on geometry

- Rectangular footing
- Square footing
- Circular footing
- Sloped footing

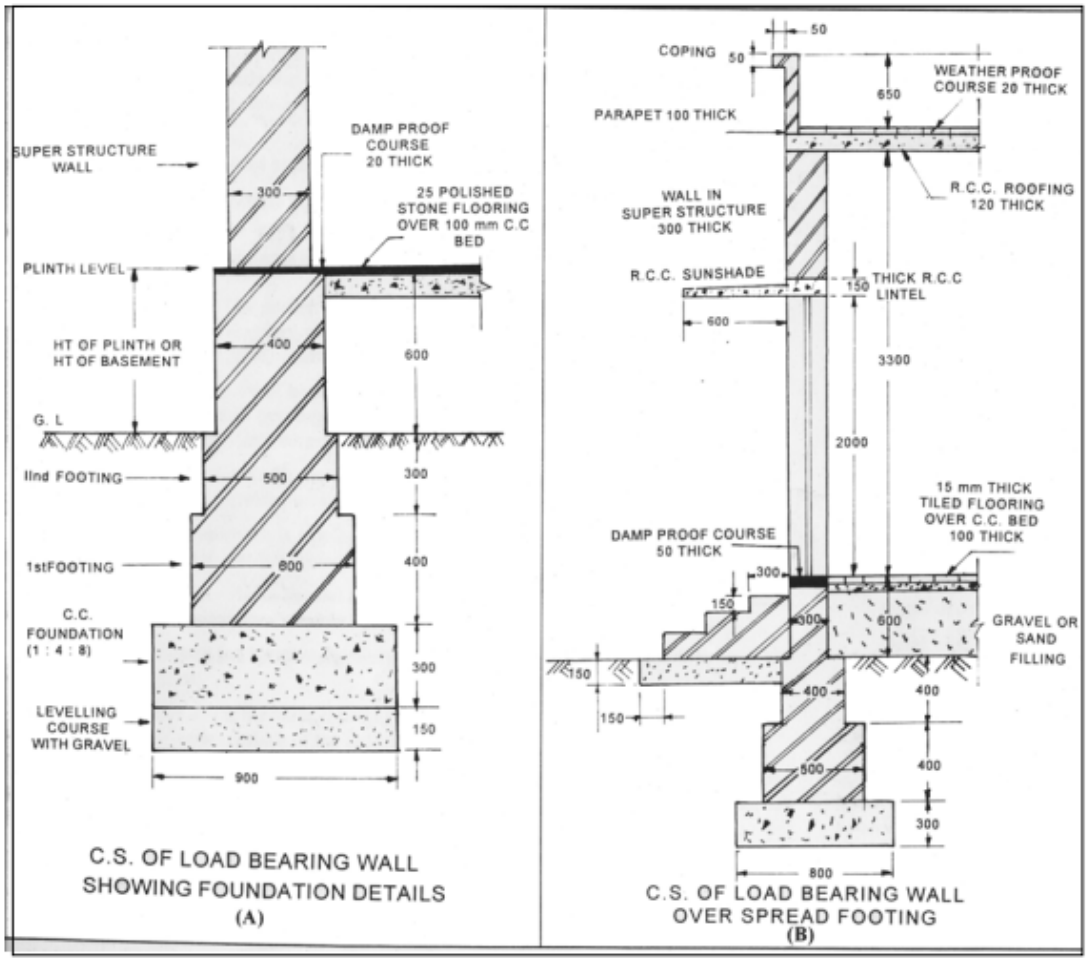
Based on material

- Cement Concrete footing
- Reinforced Concrete footing

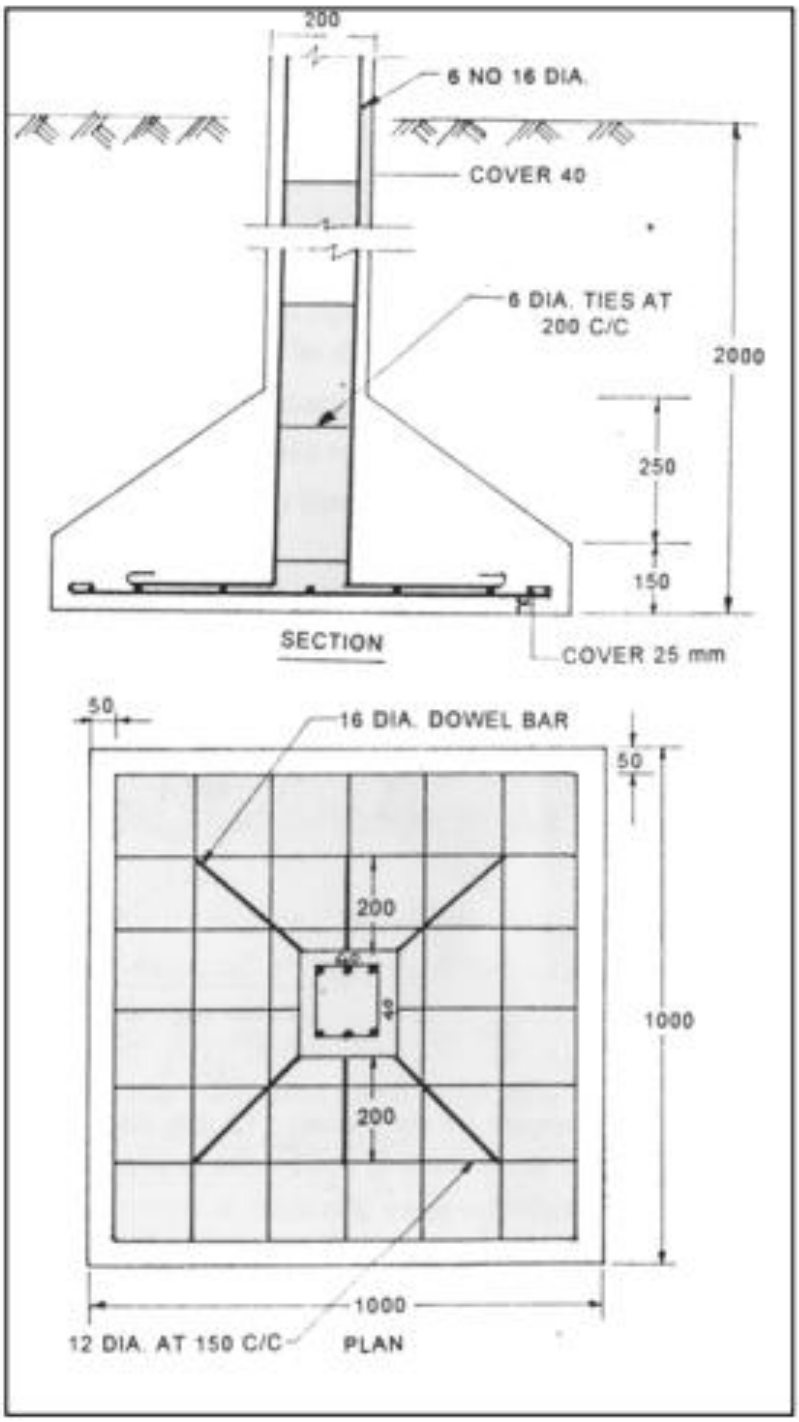


(a) Rectangular footing **(b) Square Footing** **(c) Circular Footing**

Types of Isolated Footing



PRACTICAL 7 - cross section of load bearing wall



PRACTICAL 6 –Isolated R.C.C. Square Footing

EXPERIMENT 6

TRUSSES

Aim: To draw elevation of king post truss.

Software Used: AUTOCAD

Theory:

TRUSSES

A truss is formed by joining various members to form a system of triangles. King post truss is a timber truss and used for pitched roofs. These are placed in parallel rows on walls at certain intervals depending on the span.

These trusses are connected at op by a wooden member known as ridge piece. Similarly on two sloping sides another wooden member will be joined namely purlin. In king post truss one purlin shall be provided on each side.

Thus the truss is made to have a means of fitting the common rafters and reapers on which the roofing material like tiles or AC sheets can be arranged.

PRINCIPLE OF CONSTUCTION

The centre line of the tie beam and centre line of the principal rafter meet at a point, and this point shall pass through the centre line of the supporting wall at both he ends of a truss as shown in the figure. From the front view of a roof truss, the depth of the member can be seen.

All the members in a roof truss will carry either direct (axial) compression or tension.

Tension members: Tie beam and King post

Compression members: Principal rafter and strut

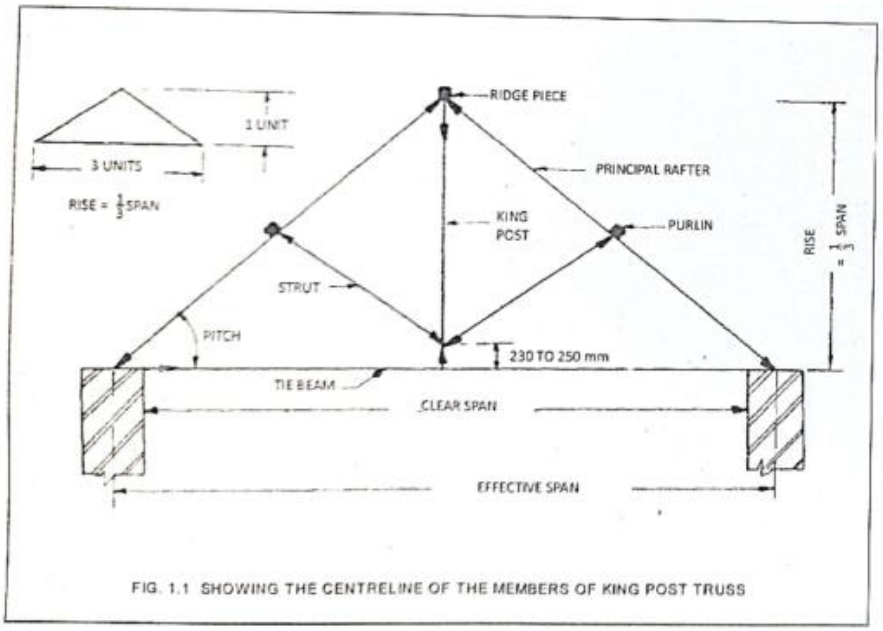
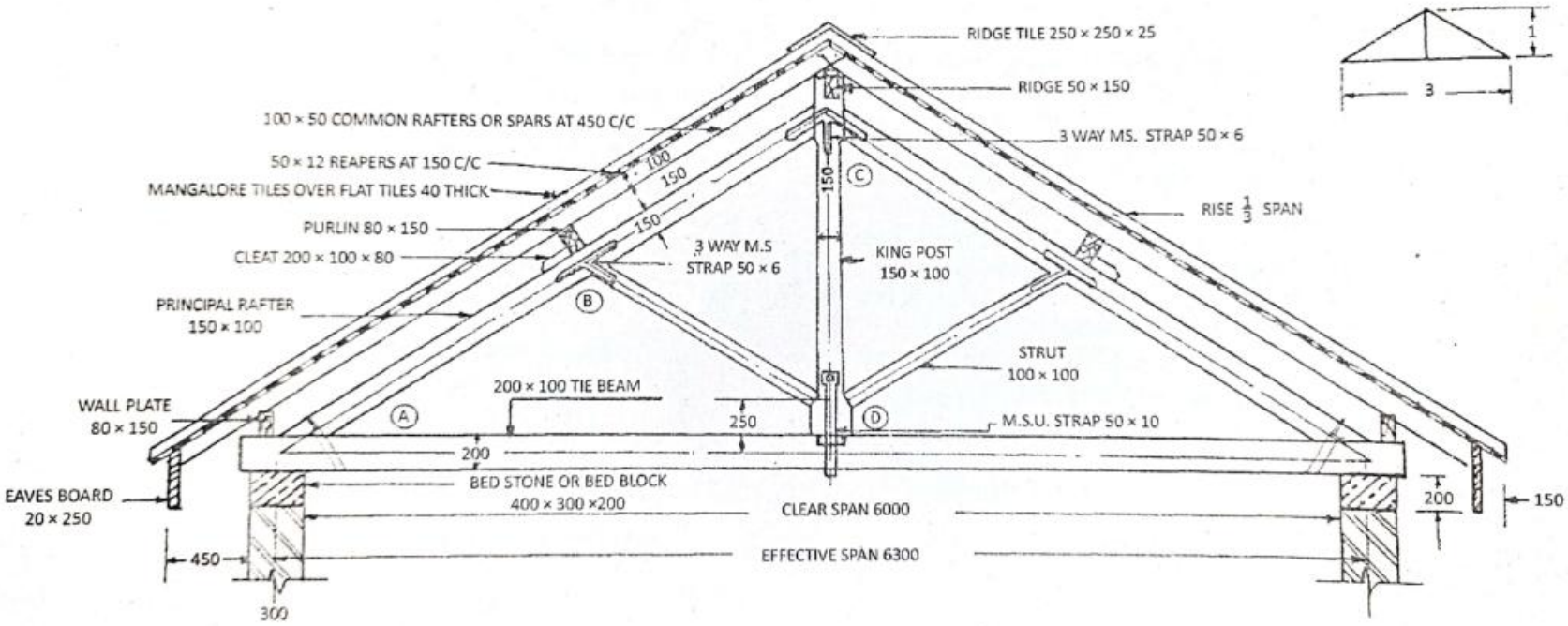


FIG. 1.1 SHOWING THE CENTRELINE OF THE MEMBERS OF KING POST TRUSS


RIDGE TILE 250 × 250 × 25
RIDGE 50 × 150
100 × 50 COMMON RAFTERS OR SPARS AT 450 C/C
3 WAY MS. STRAP 50 × 6
50 × 12 REAPERS AT 150 C/C
MANGALORE TILES OVER FLAT TILES 40 THICK
PURLIN 80 × 150
CLEAT 200 × 100 × 80
RISE 1/3 SPAN
3 WAY M.S STRAP 50 × 6
KING POST 150 × 100
PRINCIPAL RAFTER 150 × 100
STRUT 100 × 100
200 × 100 TIE BEAM
WALL PLATE 80 × 150
M.S.U. STRAP 50 × 10
BED STONE OR BED BLOCK 400 × 300 ×200
EAVES BOARD 20 × 250
CLEAR SPAN 6000
EFFECTIVE SPAN 6300
100
150
150
150
250
200
200
150
450
300
A
B
C
D
1
3

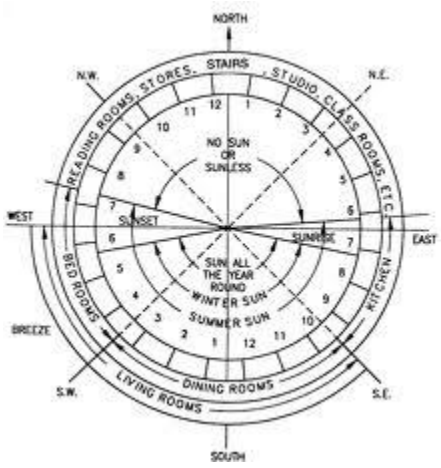
EXPERIMENT 7

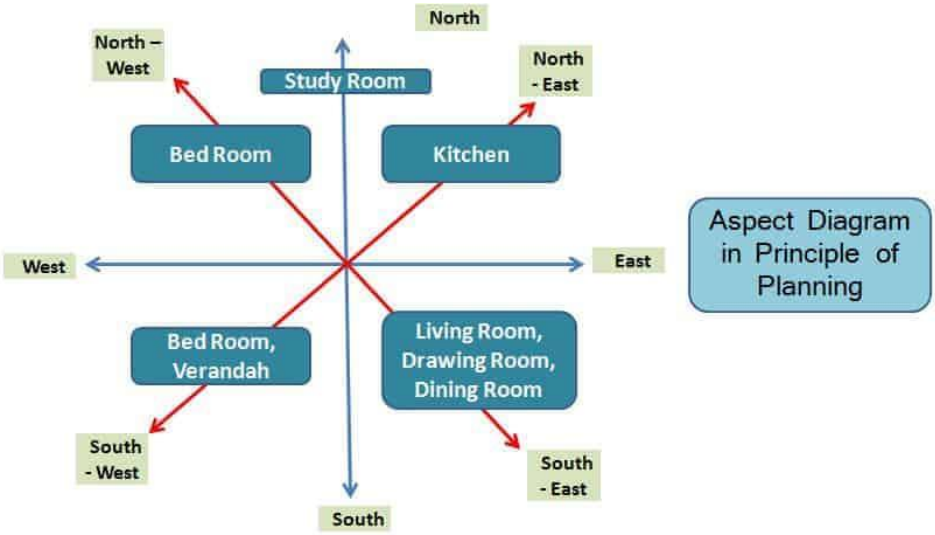
BUILDING PLANNING

Aim: To understand about principles of building planning and building bye laws

Theory:

ASPECTS AND SUN DIAGRAM





Purely technical, ancient Indian Vaastu was confined to architects (Sthapathis) and handed over by word of mouth or through hand-written monographs. It was treated as the science for the construction of temples and royal palaces. The principles of construction, architecture and sculpture have been incorporated in the science.

According to the science behind this, the basic objective of planning of buildings is to arrange all the units of a building on all floors and at level according to their functional requirements making best use of the space available for a building. The shape of such a plan is governed by several factors such as climatic conditions, site location, accommodation requirements, local bye-laws, surrounding environment, etc.

In spite of the certain principles or factors, which govern the theory of planning, are common to all buildings of all classes intended to be used for residential purposes. These principles, enunciated below, are not rigid but just factors to be considered in planning:

1. Aspect
2. Prospect
3. Privacy
4. Grouping
5. Roominess
6. Furniture Requirement
7. Sanitation
8. Flexibility
9. Circulation
10. Elegance
11. Economy
12. Practical Considerations

1. **Aspect:** 'Aspect' means peculiarity of the arrangement of doors and windows in the external walls of a building which allows the occupants to enjoy the natural gifts such as sunshine, breeze, scenery etc. aspect is a very important consideration in planning as it provides not only comfort and good environment to live in but from hygienic point of view also. A room which receives light and air from a particular side is said to have aspect of that direction and all such rooms making a dwelling need particular aspect. From this angle, the following aspects for different rooms are preferred (Fig. 3.4):

a) For kitchen – E – aspect.
b) For dining room- S-aspect.
c) For drawing and living room – S-aspect or S-E- aspect
d) For bed rooms- S-W -aspect or W-aspect.
e) For verandahs – S-W-aspect or W-aspect
f) For reading rooms, stores, class rooms, studios, stairs, etc – N-aspect.

From the above sun diagram it is clear that the kitchen should be on E – aspect, so that the morning sun would refresh and purify the air and keep the kitchen cool during the remaining period of the day. The dining, drawing and living room should have a S- aspect or S-E – aspect. The sun is towards the south during winter and more deviated towards the north during summer. Similarly, the bedrooms should have W-aspect or S-W- aspect, since the breeze required in the summers will be available from west side only. But a verandah, a gallery or some such sun-shading device, must be provided on one side (i.e., W or S-W side) so as to protect the structure the structure from the hot afternoon sun. as there will be no direct sun from the north and only diffused light will be available, hence reading room, stores, stairs, studios, classrooms, etc. are placed towards the north.

2. **Prospect:** 'Prospect' in its proper sense, is the impression that house is likely to make on person who looks at it from outside. Therefore, it includes the attainment of pleasing appearance by the use of natural beauties, disposition of doors and windows, and concealment of some undesirable views in a given outlook.

'Prospect' and 'Aspect' both demand disposition of doors and windows. For sake of either seeing or hiding certain views, window sites play a vital role.

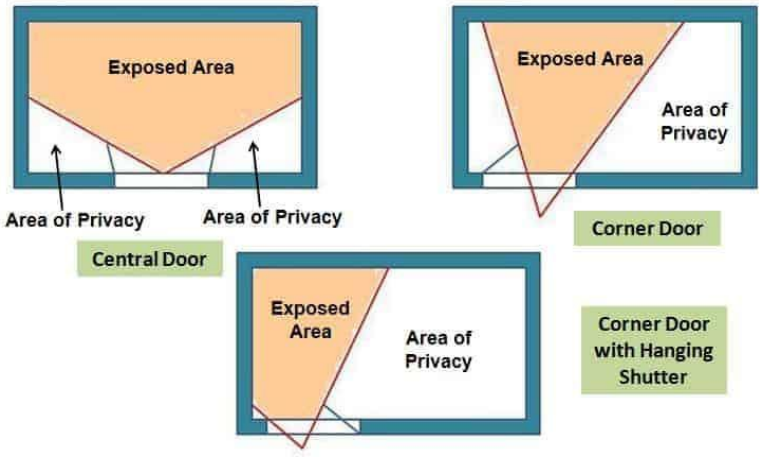
3. **Privacy:** Privacy is one of the most important principles in the planning of buildings of all types in general and residential buildings in particulars.

Privacy requires consideration in two ways:

i. Privacy of one room from another.
ii. Privacy of all parts of a building from the neighboring buildings, public streets and by-ways.

Privacy of the former type is attained by careful planning the building with respect to grouping, disposition of doors, mode of hanging doors, provision of small corridor or lobby etc. this can be also be achieved by planning screens and curtains.

Privacy of the latter type is easily secured by carefully planning the entrance and steering it with tree or creepers trained on a trellis. However, the extent of privacy depends mainly upon the function. Sometimes, privacy of a part only is desired from exteriors, but the building as a whole is required to attract the attention of all. Privacy is of supreme importance in bedrooms, water closets, urinals, bathrooms, etc. the kitchen apartment should be kept out of view of the passersby.



4. **Grouping**: grouping means the disposition of various in the layout in a typical fashion so that all the rooms are placed in proper correlation of there function and in proximity with each other. Every apartment of a building has a definite function or functions and there is also some sort of sequence in between them. The objective of grouping of apartments is to maintain the sequence of their functions with least interference. For example, in a residential building, dining room must be close to the kitchen, at the same time the kitchen should be away from the drawing room

or main living room otherwise kitchen smells and smoke would be distracting. Services must be nearer to and independently accessible from every bedroom. The water closets, urinals, etc must be far away from the kitchen, dining room and so on.

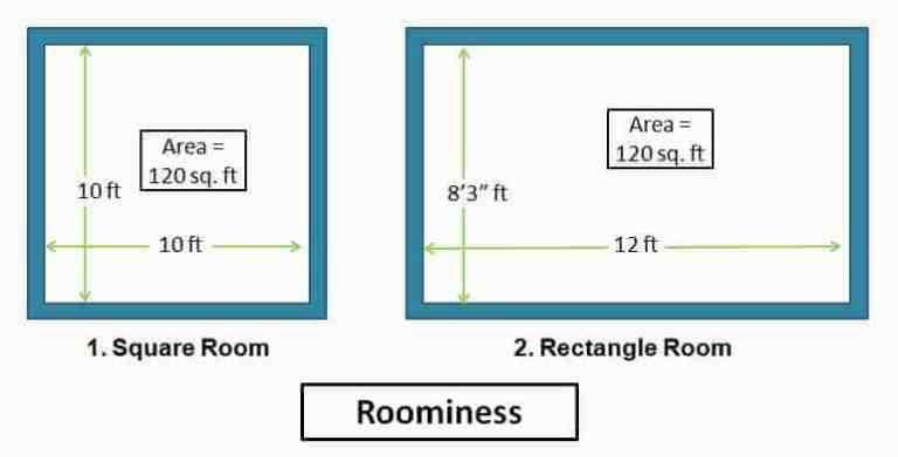
In case hospitals, office buildings, etc. the administrative department should best be placed centrally for convenience of economy of service. In case of factories while manufacturing certain articles which are composed of some parts, the departments processing or fabricating such parts, should be arranged in proper correlation with each other so that the finished article is ready in last department for packing and dispatching.

It should be noted while grouping, a residential building provides efficiency, comfort and health to the occupants whereas the buildings other than residential type provide facility of economical service, efficiency and proper correlation

5. **Roominess**: 'Roominess' refers to the effect produced by deriving the maximum benefit from the minimum dimensions of a room. In other words, it is the accomplishment of economy of space at the same time avoiding cramping of the plan. It is essential particularly in case of residential buildings where large storage spaces is required, to make maximum use of every nook and corner of the built-up area of the building before making an addition to the plinth area.

It looks so simple task at first sight, but is really so difficult an art that it usually taxes the brains of the planners. For giving better impression of roominess, the following points should be kept in view:

i. A great skill should be exercised in making suitable arrangements of the rooms, doors and passages for accommodation in such away that the utility, liability, privacy and extension appearance are not adversely affected.
ii. A square room appears relatively smaller in size and utility than the rectangular room of the same area. For a rectangular room the better proportion is to adopt length as 1.2 to 1.5 times of breadth.
iii. A small room within ordinately high walls appear relatively smaller than its actual size.
iv. The disposition of doors, windows and cupboards, such that they don't cross-cut this room area and obstruct the placing of furniture and adds to roominess.
v. The design of elements such as floor, walls, ceilings, lifts etc. should be such as to create the sense of space beyond its actual dimensions.



6. **Furniture Requirements**: The functional requirement of a room or an apartment governs the furniture requirement of a room. This is an important consideration in planning of buildings other than residential in particular and residential in general. In case of buildings other than residential, they are generally planned, with due thought to the furniture, equipment and other fixtures, to meet the needs of particular function required to be performed. This can be done by assuming the sufficient sizes of furniture pieces and then studying the circulation and space requirements round them.

In case of residential buildings, a room whether intended for a bedroom or drawing room or kitchen, the architect should take into account the furniture positions of all types likely to be accommodated, so that the doors, windows and circulation space do not prevent from placing of sufficient number of pieces.

7. **Sanitation**: Sanitation consists of providing ample light, ventilation, facilities for cleaning and sanitary conveniences in the following manner:
i) Light: Light has two fold significance, firstly its illuminates and secondly from hygienic point of view. Light in interior buildings may be provided by natural or artificial lighting. Glare in lights distracts the vision and hence the source of glare may be avoided.

Uniform distribution of light is necessary particularly in schools, workplaces etc. a room should get sunlight as long as and as much as possible. Vertical windows are, therefore better than horizontal ones.

Generally, the minimum window area for proper lighting should not be less than 1/10th of floor area; however this may be increased to 1/5th for buildings like schools, workshops, factories, chawls, dormitories, etc.

Good lighting is necessary for all buildings. This has three primary aims. The first is to promote the work or other activities carried on within the building; the second is to promote the safety of people in the building; and the third is to create, in conjunction with the structure and decoration, a pleasing environment conducive to interest and a sense of well being.

ii) **Ventilation**: it is the supply of the outside air either positive ventilation or by infiltration into the building. Good ventilation is an important factor conducive to comfort in building. Poor ventilation or lack of fresh air in the building, always produces headaches, sleepiness, inability to fix attention, etc. ventilation may be natural or mechanical. In natural ventilation, the air is supplied to the building through windows, ventilators, or other openings due to wind outside and convection effect arising from temperature or vapour outside the building. In mechanical ventilation the outside air is supplies either by mechanical device such as fan or by infiltration by reduction of pressure inside due to exhaust of air, or by a combination of positive ventilation and exhaust of air. Good ventilation is generally achieves by placing the windows, doors and ventilators such that they may catch as much breeze as possible.

iii) **Cleanliness and sanitary conveniences**: though the general cleaning and up keeping of the building is the responsibility of the occupants but even then the some provision to facilitate cleaning and prevention of dust are necessary in planning. The floors as far as possible should be of non absorbent surface, smooth and proper slope should be given to facilitate washing with

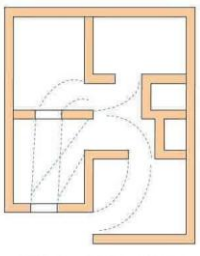
suitable outlets in the walls. Prevention of dust accumulation is essential. Dust helps the growth of bacteria and spread of disease.

Sanitary conveniences include the provision of bathrooms, water closets, lavatories, latrines, urinals, etc. in a building. Provision of such conveniences is not an optional matter but is an absolute requirement.

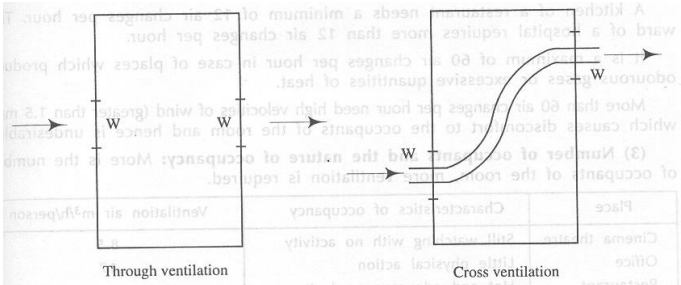
8. **Flexibility**: Flexibility means planning room or rooms in such away which, though originally designed for a specific purpose, may be used to serve other overlapping purposes also, as and when desired. This is particularly important for designing the houses for the middle class families or other buildings where economy is a major consideration. A house planned on the scientific principles, within a small space, must provide other similar activities such as listening to radio, child homework, entertaining guest and festive occasions such as holiday dinners, birthday parties, and wedding banquets and so on. These are two ways to meet the demands of festive occasions and religious social gatherings \(or congregations) one is to combine the drawing room and dining room by a removable partition or a screen between them, and the other way is to dine in open air. For the latter, a convenient access should be provided from the kitchen to the yard or garden and the space should be screened from public gaze.

9. **Circulation**: Circulation means 'internal thoroughfares' or the movement space provided on the same floor either between the rooms or within the rooms called 'horizontal circulation' and between the different floors through stairs or lifts called 'vertical circulation'. Passages, corridors, halls and lobbies serve the purpose of horizontal circulation whereas for vertical circulation normally stair or stair-case, electric lifts, ramps, etc. are the means of access to different floors. In fact, for better circulation, the following points should be considered in the planning of a building:

i. The links between entrances, passages and stair-cases should be planned in a proper relation.
ii. All passages in a building should be straight, short, sufficiently lighted and well ventilated to achieve efficiency, comfort and convenience.
iii. All the sanitary\y services and stair-case must have an independent access from every room through a lobby, to increase the usefulness of the building.
iv. All stairs or stair-cases should the minimum requirements regarding tread, rise, width, landings, light and ventilation.
v. Stairs should have strong balustrades or parapets and hand, rail on both sides and should also be accessible from entrance as well rooms on floors being linked.



Easy Circulation in House



Through ventilation Cross ventilation

10. **Elegance**: 'Elegance' is the effect produced by the elevation and general layout of the plan. The elevation, therefore, should speak out the internal g\facts and be indicative of characters.

Elevation should be impressive and should be developed together with the plan simultaneously. With the economy limitations, elevation should be aesthetically good and attractive.

11. **Economy**: The economy may not be a principle of planning but a factor that certainly affects planning. The economy may restrict the liberties of the architect and may also require certain alterations and omissions in the original plan. The economy should not have any had affect on grouping or aspect, however the prospect at the most to some extent can be sacrificed if need be. Economy should not have nay adverse effect on the utilities and safety of structure. A structure designed for a good strength and solid character may be costly in its initial cost but may prove cheaper in main run as it saves maintenance costs. No general rules however are framed to attain economy, as the ways and the means to achieve it in different situations are different.

12. **Practical Considerations**: The following practical points should be given due consideration in the planning of building:

i. Strength and stability of structure, coupled with convenience and comfort, should occupy the first place of importance in planning.
ii. Simplicity and effect of strength lend a lasting beauty and mobility to a building.
iii. It should be remembered that a building or a house is immovable property and is built to last for several generations. One has, therefore, no right to practice false economy by erecting a weak structure.
iv. While planning, it is necessary to keep provisions for either adding a wing or extending some part of some house without dismantling.

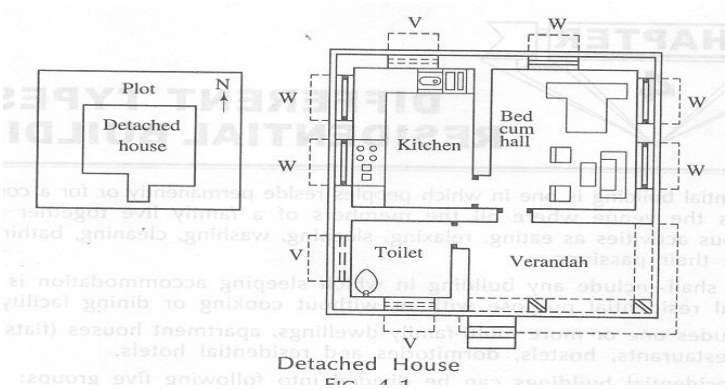
Building bye laws:

Building is defined as any structure for whatsoever purpose and of whatsoever materials constructed and every part thereof whether used as human habitation or not and includes foundation, plinth, walls, floors, chimneys, plumbing and building services, fixed platforms, verandah, balcony, cornice (or projection), and signs and outdoor display structures,.

- Building consists of three parts, viz.,
- Foundation
- Plinth and
- Superstructure

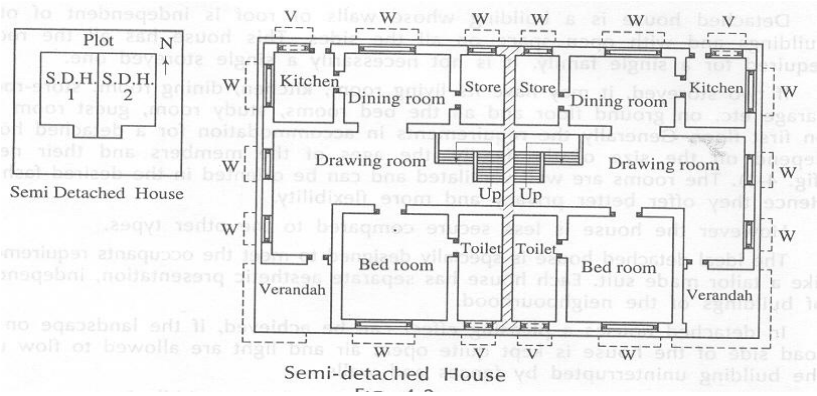
Detached Building

Whose walls and roofs are independent of any other building with open spaces on all sides



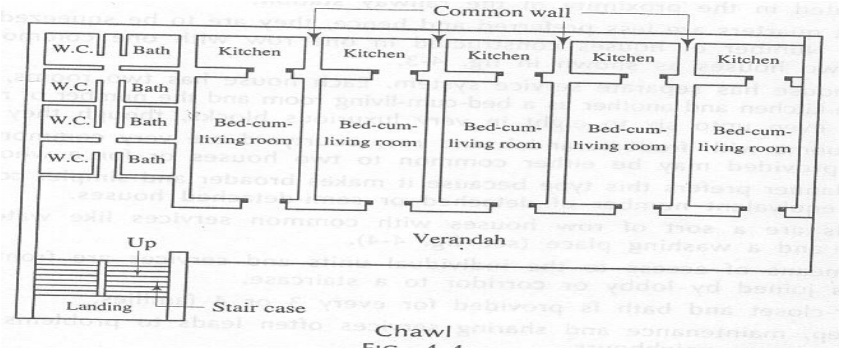
Semi-Detached Building

Whose **THREE** sides are detached with open spaces

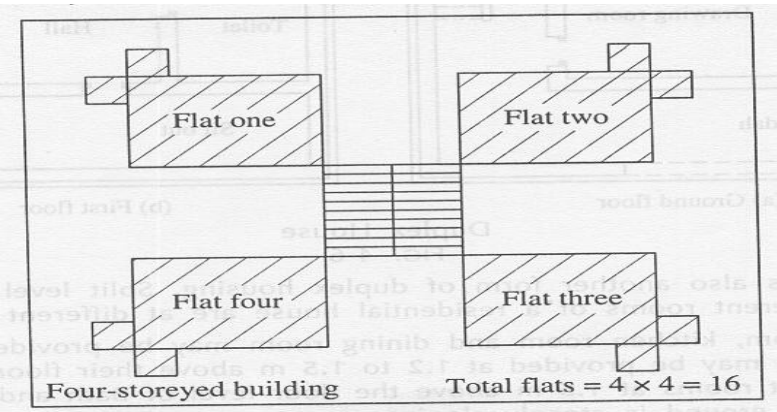


Row Houses or Chawls

In which open spaces are provided on the front, rear and in the interior

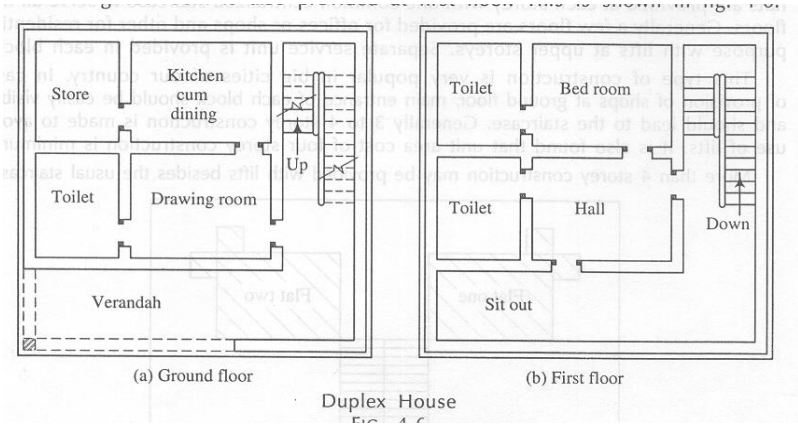


Block of Flats or Terrace Houses



Blocks of Flats

Duplex Type House



(a) Ground floor (b) First floor

Duplex House

BUILDING BYE LAWS

NATIONAL BUILDING CODE OF INDIA

- Group A : Residential Buildings
- Group B : Educational Buildings
- Group C : Institutional Buildings
- Group D : Assembly Buildings
- Group E : Business Buildings
- Group F : Mercantile Buildings
- Group G : Industrial Buildings
- Group H : Storage Buildings
- Group I : Hazardous Buildings

CLASSIFICATIONS OF MULTI STOREY BUILDINGS:

Depending on the height, need and various other factors, multi storey buildings are classified into following.

1. Low Rise building: A low rise multi storey building has few storeys (typically less than four), with the usage of elevators and stairs for vertical circulation.

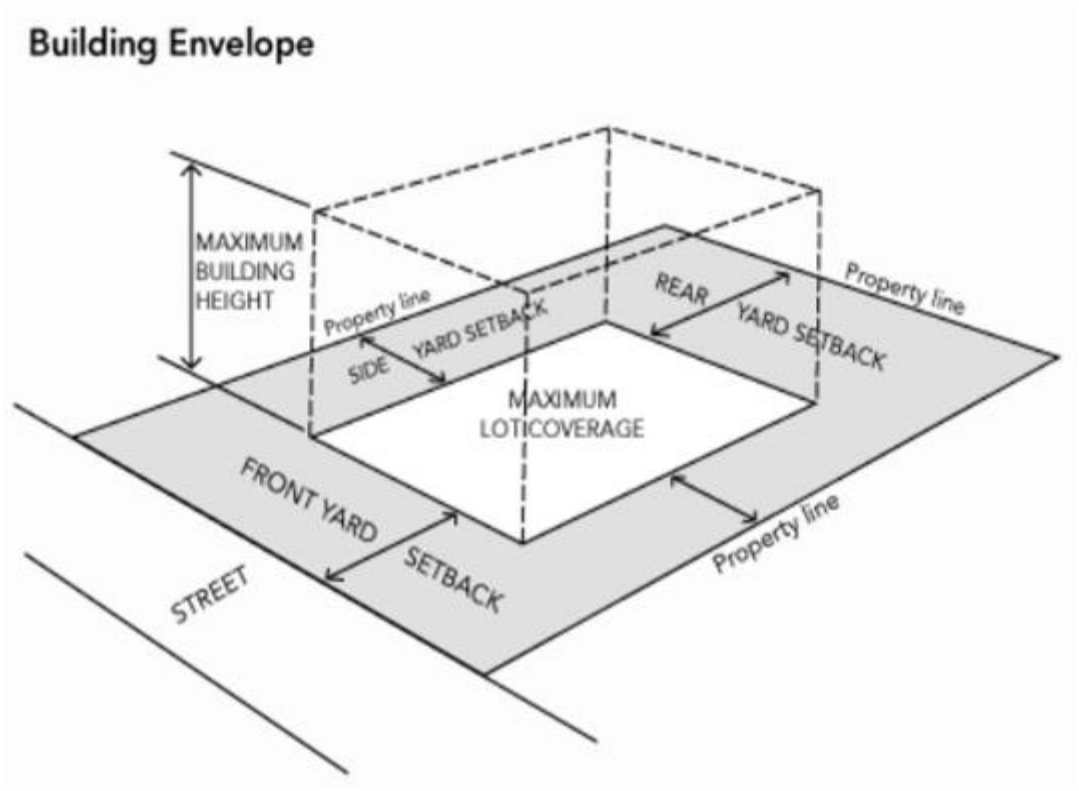
2. Mid Rise building: A Mid Rise building has number of storeys ranging from 4 to 12.

3. High Rise building: A High Rise building has number of storeys ranging from 12 to 40, with usage of lifts and stairs.

4. Skyscraper building: A tall and habitable steel building having storeys more than 40 but height less than 300m is considered as Sky Scrapper Multi storey building.

5. Super tall building: Super tall building is the steel building with its height exceeding 300m are Super tall Multi storey building.

6. Mega tall building: Super tall building is the steel building with its height exceeding 600m are Super tall Multi storey building.



Minimum Plot Size and Building Frontage

Different types of residential Building, plot size and their frontages		
Types of Residential Building	**Plot size in m^2**	**Frontage in m**
Detached Building	Above 250	Above 12
Semi Detached Building	125-250	8-12
Row type Building	50-125	4.5-8

Note: Minimum frontage on any street 6m, for row housing it may be 5.5m

Minimum Front open space to be provided

Width of street in front of plot in m	Front open space minimum in m
Up to 7.5m	1.5
7.5 to 18	3.0
18 to 30	4.5
Above 30	6.0

Permissible Plinth Area (Covered area) in Residential Plots

Area of Plot	Max. Permissible covered area
< 200 m^2	66.66% of plot area
201 to 500 m^2	50% of the plot area
501 to 1000 m^2	40% of the plot area
> 1000 m^2	33.33% of the plot area

Minimum Rear open space to be provided (upto 10m height): Average width = 3m but not less than 1.8m

Minimum side open space to be provided (upto 10m height)

- Detached building: 3m on both sides
- Semi detached building: 3m on one side only

Floor Area Ratio:

- Floor area ratio (FAR) = Total covered area of all floors / plot area
- FAR : 1 to 2 depending on type of construction
- Maximum building height = (1.5 x width of abuting road) + front open space

EXPERIMENT 8

PLAN AND ELEVATION OF BUILDING

Aim: To draw plan, section and elevation of building line diagram.

Software Used: AUTOCAD

Theory:

BUILDING DRAWING

A building may be residential or public building. The plan, section along given vertical plane and elevation gives the details of building.

Plan:

Plan of building represents a horizontal section of building at given height seen from top. It is a general conventional to imagine that the building has been cut down by a horizontal plane at the sill level of the window and is seen from the top after removal of so cutpart.

The plan shows the arrangement of rooms, varandah or corrider, position of door, and window and other openings along with their respective sizes. The dimension of the room indicated as Breath x Length In the case of Varandah's, the given dimension upto the end of Varandah retaining wall and the position of beams, sunshades, portico, ventilators which are above sill level of window are shown with dotted or broken lines.

Line diagram is the sketch generally not drawn to particular scale also known as line sketch. The relative positions of all elements like rooms, doors, windows are clearly shown inside to inside. From the given specifications, the thickness of wall in super structure shall be taken to draw the fully dimensioned plan to a convenient scale.

Section :

Section is also known as vertical section and sectional elevation or cross section. It is imagined that a finished buildings is cut vertically along a line so that the building is separated into two portions along the imagined vertical plane right from top of the building to the lowest part of foundation. The view that can be seen while travelling along this imaginary vertical plane when looking towards left is drawn to the same scale as that adopted for the plan.

The line, which is drawn on the plan to indicate the section, is called sectional line and represented by A-B or X-X. The arrow heads shall be marked to indicate the way in which the sectional view is to be drawn. In some cases offset is given to indicate the necessary details, but the offset is only to shift the vertical plane from one position to another position as shown below. The necessity of the section is to indicate all the vertical dimensions like, foundation details, basement, details of flooring, height of super structure, sizes of doors, windows, almairahs, cupboards, other openings, thickness of roofing, width and depth of parapet wall, lintels,

sunshades, portico and other details. All these details are required to calculate the quantities of items of work and to execute the process of construction.

ELEVATION:

Elevation or front view is the outward view of a completed building along any side of the building. When a building is seen by standing in front of it, the view that can be viewed is known as front elevation. Similarly backside view is called rear elevation or from any side of it which is known as side elevation.

Development of plan:

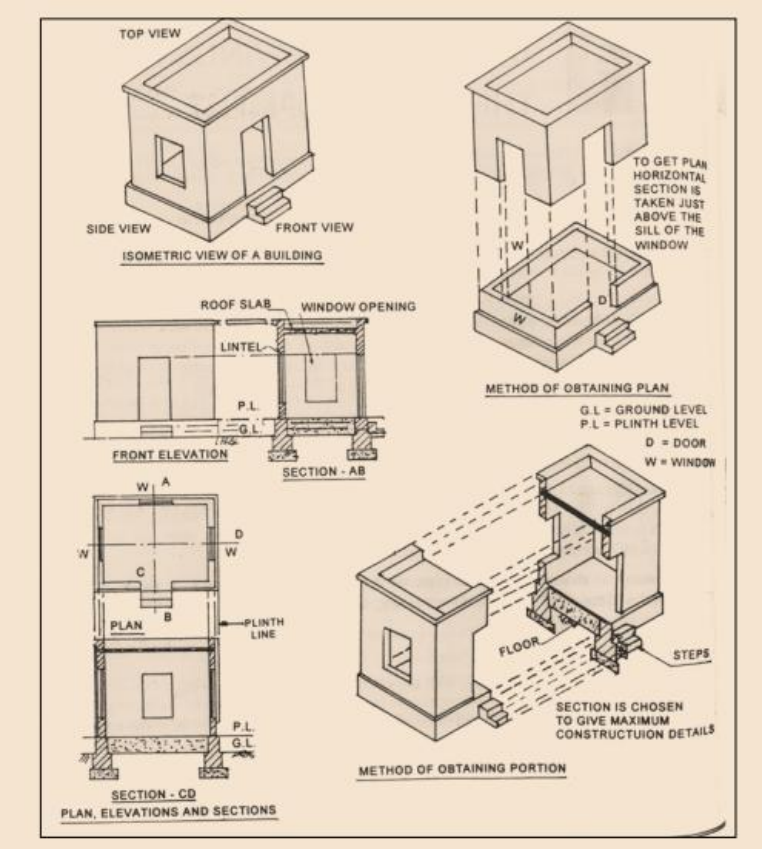
The plan should be drawn at the bottom portion on left side of drawing sheet. To start with, extreme left hand corner of the building should be taken and thickness of walls, length of walls along length wise (vertical lines) and breadth wise (horizontal lines) shall be drawn with a light pencil in order to complete in all respects by drawing cross-walls to show the position of doors, windows etc. Dimensions are shown in each room, width of wall etc and plan can obtained by accurate with sharp pencil lines.

Development of section:

The sectional view is drawn on the top right side of drawing sheet. The view shall be started from starting point of the section line and the horizontal dimensions along the section are represented in sequence in developing the sectional elevation The section of walls from bottom to top, position of doors, windows that are viewed shall be drawn. From the given specifications, the foundation details, flooring details, roofing details are neatly drawn and such information is to be mentioned in the section. But the different materials used in the construction shall be indicated by drawing the respective conventional signs.

Development of Elevation:

The elevation is obtained by projecting the details from the plan vertically upwards and projecting details from the section horizontally towards left side. The intersection of these projections from plan and section help to draw the elevation. Hence the elevation shall be exactly above the top of the plan and is accomated in the top left side of the drawing sheet. The first projection line shall be from plinth offset. The projections from sunshades, super structure walls and to end points for doors, windows shall be made both from plan and section to show the detailed drawing.



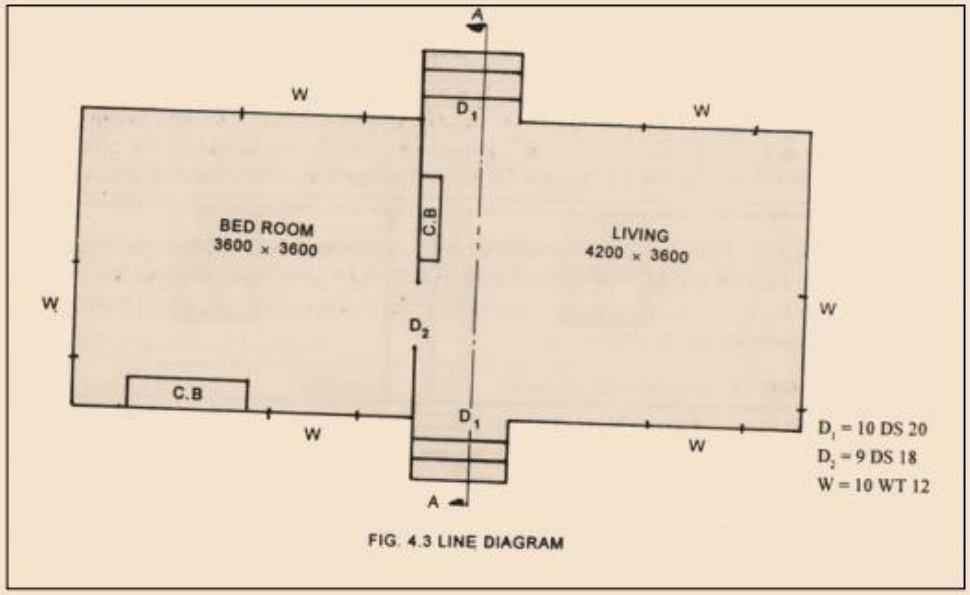
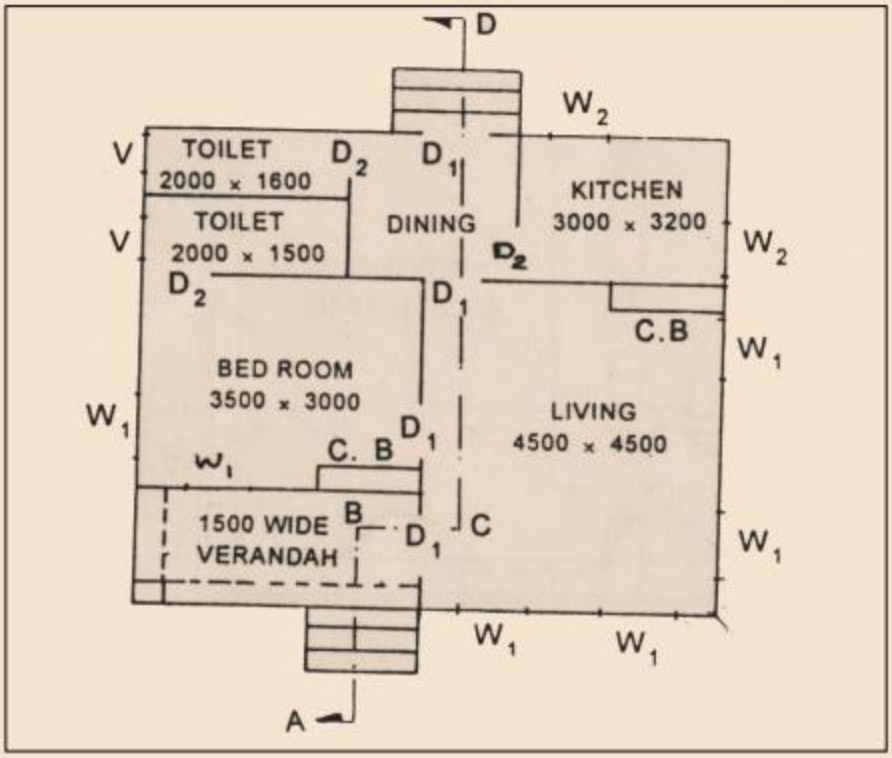


FIG. 4.3 LINE DIAGRAM

PRACTICAL 9

LINE DIAGRAM OF THE TWO ROOM BUILDING.



LINE DIAGRAM OF

RESIDENTIAL BUILDING

EXPERIMENT 9

PLAN AND ELEVATION OF BUILDING

Aim: To draw plan, section and elevation of building line diagram.

Software Used: AUTOCAD

Theory:

BUILDING DRAWING

A building may be residential or public building. The plan, section along given vertical plane and elevation gives the details of building.

Plan:

Plan of building represents a horizontal section of building at given height seen from top. It is a general conventional to imagine that the building has been cut down by a horizontal plane at the sill level of the window and is seen from the top after removal of so cutpart.

The plan shows the arrangement of rooms, varandah or corrider, position of door, and window and other openings along with their respective sizes. The dimension of the room indicated as Breath x Length In the case of Varandah's, the given dimension upto the end of Varandah retaining wall and the position of beams, sunshades, portico, ventilators which are above sill level of window are shown with dotted or broken lines.

Line diagram is the sketch generally not drawn to particular scale also known as line sketch. The relative positions of all elements like rooms, doors, windows are clearly shown inside to inside. From the given specifications, the thickness of wall in super structure shall be taken to draw the fully dimensioned plan to a convenient scale.

Section :

Section is also known as vertical section and sectional elevation or cross section. It is imagined that a finished buildings is cut vertically along a line so that the building is separated into two portions along the imagined vertical plane right from top of the building to the lowest part of foundation. The view that can be seen while travelling along this imaginary vertical plane when looking towards left is drawn to the same scale as that adopted for the plan.

The line, which is drawn on the plan to indicate the section, is called sectional line and represented by A-B or X-X. The arrow heads shall be marked to indicate the way in which the sectional view is to be drawn. In some cases offset is given to indicate the necessary details, but the offset is only to shift the vertical plane from one position to another position as shown below. The necessity of the section is to indicate all the vertical dimensions like, foundation details, basement, details of flooring, height of super structure, sizes of doors, windows, almairahs, cupboards, other openings, thickness of roofing, width and depth of parapet wall, lintels,

sunshades, portico and other details. All these details are required to calculate the quantities of items of work and to execute the process of construction.

ELEVATION:

Elevation or front view is the outward view of a completed building along any side of the building. When a building is seen by standing in front of it, the view that can be viewed is known as front elevation. Similarly backside view is called rear elevation or from any side of it which is known as side elevation.

Development of plan:

The plan should be drawn at the bottom portion on left side of drawing sheet. To start with, extreme left hand corner of the building should be taken and thickness of walls, length of walls along length wise (vertical lines) and breadth wise (horizontal lines) shall be drawn with a light pencil in order to complete in all respects by drawing cross-walls to show the position of doors, windows etc. Dimensions are shown in each room, width of wall etc and plan can obtained by accurate with sharp pencil lines.

Development of section:

The sectional view is drawn on the top right side of drawing sheet. The view shall be started from starting point of the section line and the horizontal dimensions along the section are represented in sequence in developing the sectional elevation The section of walls from bottom to top, position of doors, windows that are viewed shall be drawn. From the given specifications, the foundation details, flooring details, roofing details are neatly drawn and such information is to be mentioned in the section. But the different materials used in the construction shall be indicated by drawing the respective conventional signs.

Development of Elevation:

The elevation is obtained by projecting the details from the plan vertically upwards and projecting details from the section horizontally towards left side. The intersection of these projections from plan and section help to draw the elevation. Hence the elevation shall be exactly above the top of the plan and is accomated in the top left side of the drawing sheet. The first projection line shall be from plinth offset. The projections from sunshades, super structure walls and to end points for doors, windows shall be made both from plan and section to show the detailed drawing.

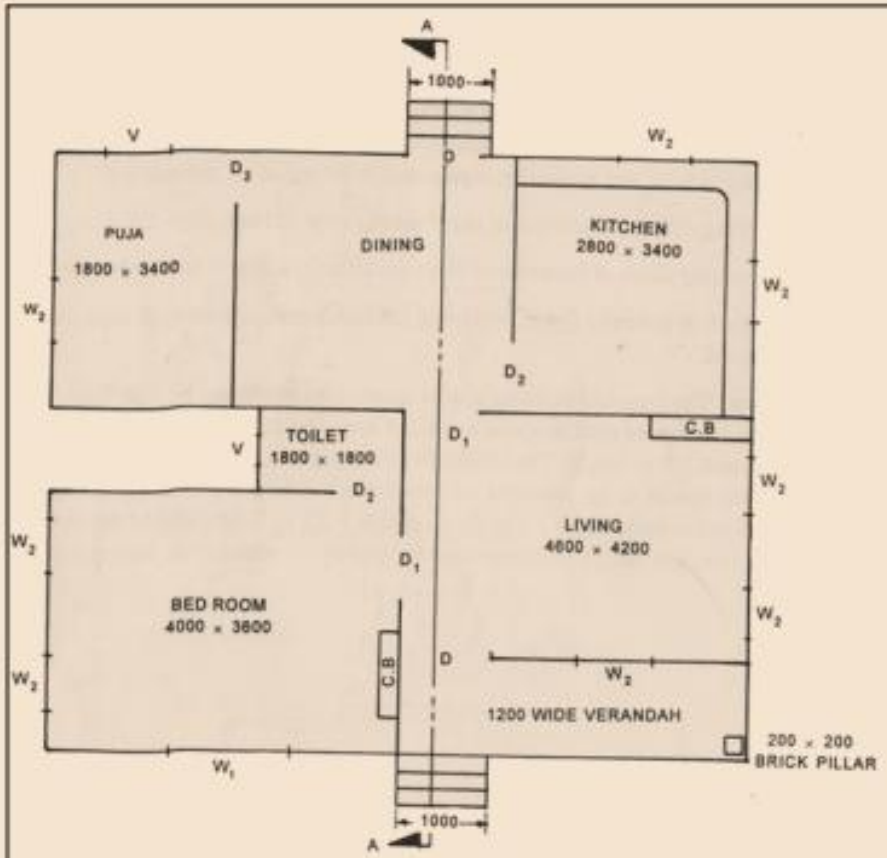


FIG. LINE DIAGRAM

SCHEDULE OF DOORS, WINDOWS, VENTILATORS AND CUP BOARDS.

Designation	Numbering	Modular size in mm	Specifications
10 DT 21	D = 2 No	1000 × 2100	Fully panelled
10 DS 21	D_1 = 2 No	1000 × 2100	Flushed door
9 DS 18	D_2 = 3 No	900 × 1800	Flushed door
15 WQ 12	W_1 = 1 No	1500 × 1200	Glazed window
10 WT 12	W_2 = 7 No	1000 × 1200	Glazed window
15 CBT 18	C.B = 2 No	1500 × 1800	Flushed shutters
10 V 6	V = 3 No	1000 × 600	Glazed ventilator.

EXPERIMENT 10

PLAN AND ELEVATION OF RURAL HOSPITAL

Aim: To draw plan, section and elevation of building line diagram.

Software Used: AUTOCAD

Theory:

A building may be residential or public building. The plan, section along given vertical plane and elevation gives the details of building.

Plan:

Plan of building represents a horizontal section of building at given height seen from top. It is a general conventional to imagine that the building has been cut down by a horizontal plane at the sill level of the window and is seen from the top after removal of so cutpart.

The plan shows the arrangement of rooms, varandah or corrider, position of door, and window and other openings along with their respective sizes. The dimension of the room indicated as Breath x Length In the case of Varandah's, the given dimension upto the end of Varandah retaining wall and the position of beams, sunshades, portico, ventilators which are above sill level of window are shown with dotted or broken lines.

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The line, which is drawn on the plan to indicate the section, is called sectional line and represented by A-B or X-X. The arrow heads shall be marked to indicate the way in which the sectional view is to be drawn. In some cases offset is given to indicate the necessary details, but the offset is only to shift the vertical plane from one position to another position as shown below. The necessity of the section is to indicate all the vertical dimensions like, foundation details, basement, details of flooring, height of super structure, sizes of doors, windows, almairahs, cupboards, other openings, thickness of roofing, width and depth of parapet wall, lintels,

sunshades, portico and other details. All these details are required to calculate the quantities of items of work and to execute the process of construction.

ELEVATION:

Elevation or front view is the outward view of a completed building along any side of the building. When a building is seen by standing in front of it, the view that can be viewed is known as front elevation. Similarly backside view is called rear elevation or from any side of it which is known as side elevation.

Development of plan:

The plan should be drawn at the bottom portion on left side of drawing sheet. To start with, extreme left hand corner of the building should be taken and thickness of walls, length of walls along length wise (vertical lines) and breadth wise (horizontal lines) shall be drawn with a light pencil in order to complete in all respects by drawing cross-walls to show the position of doors, windows etc. Dimensions are shown in each room, width of wall etc and plan can obtained by accurate with sharp pencil lines.

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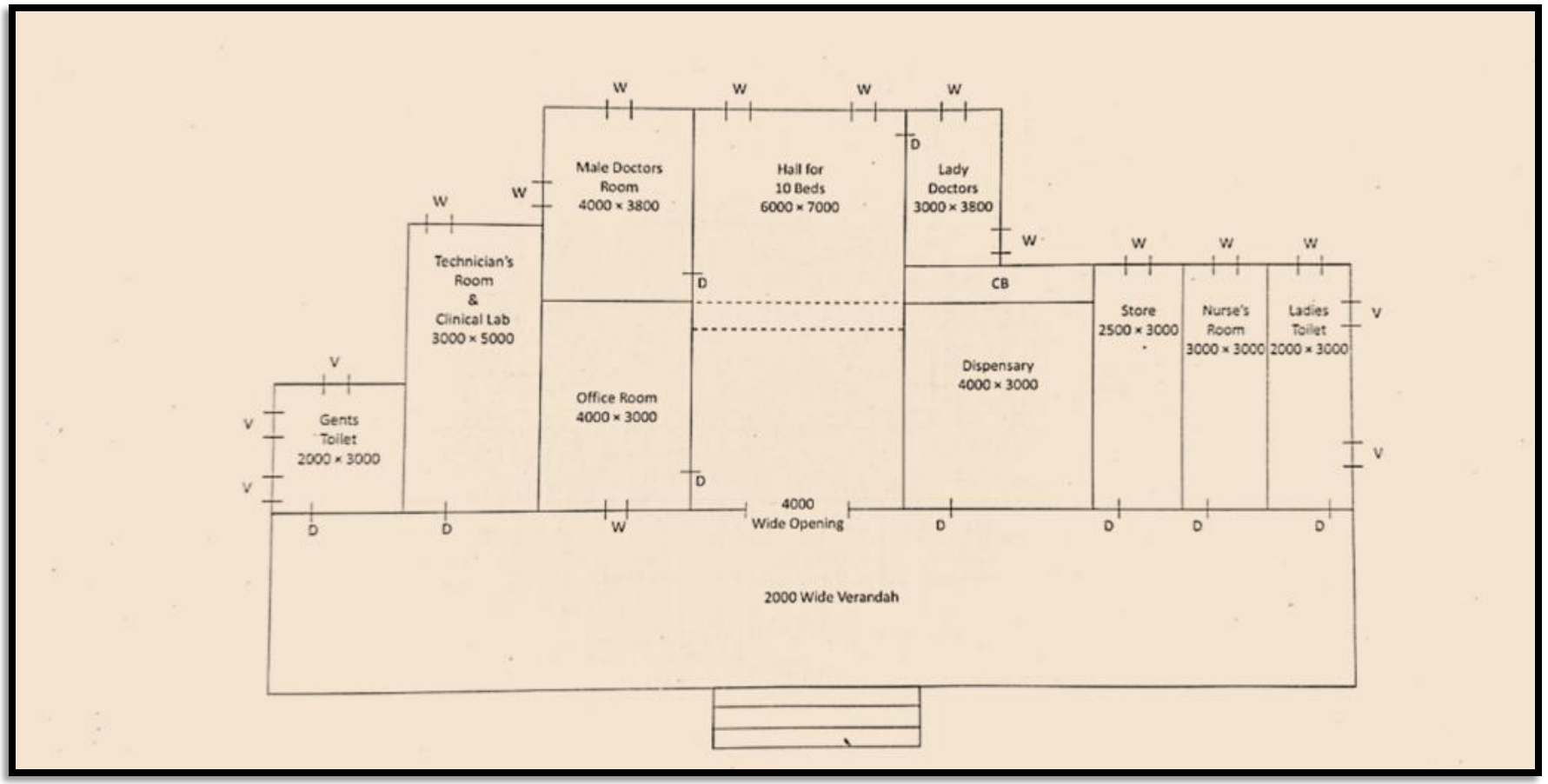
Male Doctors Room 4000 × 3800
Hall for 10 Beds 6000 × 7000
Lady Doctors 3000 × 3800
Technician's Room & Clinical Lab 3000 × 5000
CB
Store 2500 × 3000
Nurse's Room 3000 × 3000
Ladies Toilet 2000 × 3000
Gents Toilet 2000 × 3000
Office Room 4000 × 3000
Dispensary 4000 × 3000
4000 Wide Opening
2000 Wide Verandah
W
D
V

EXPERIMENT 11

PLAN AND ELEVATION OF SCHOOL BUILDING

Aim: To draw plan, section and elevation of building line diagram.

Software Used: AUTOCAD

Theory:

A building may be residential or public building. The plan, section along given vertical plane and elevation gives the details of building.

Plan:

Plan of building represents a horizontal section of building at given height seen from top. It is a general conventional to imagine that the building has been cut down by a horizontal plane at the sill level of the window and is seen from the top after removal of so cutpart.

The plan shows the arrangement of rooms, varandah or corrider, position of door, and window and other openings along with their respective sizes. The dimension of the room indicated as Breath x Length In the case of Varandah's, the given dimension upto the end of Varandah retaining wall and the position of beams, sunshades, portico, ventilators which are above sill level of window are shown with dotted or broken lines.

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sunshades, portico and other details. All these details are required to calculate the quantities of items of work and to execute the process of construction.

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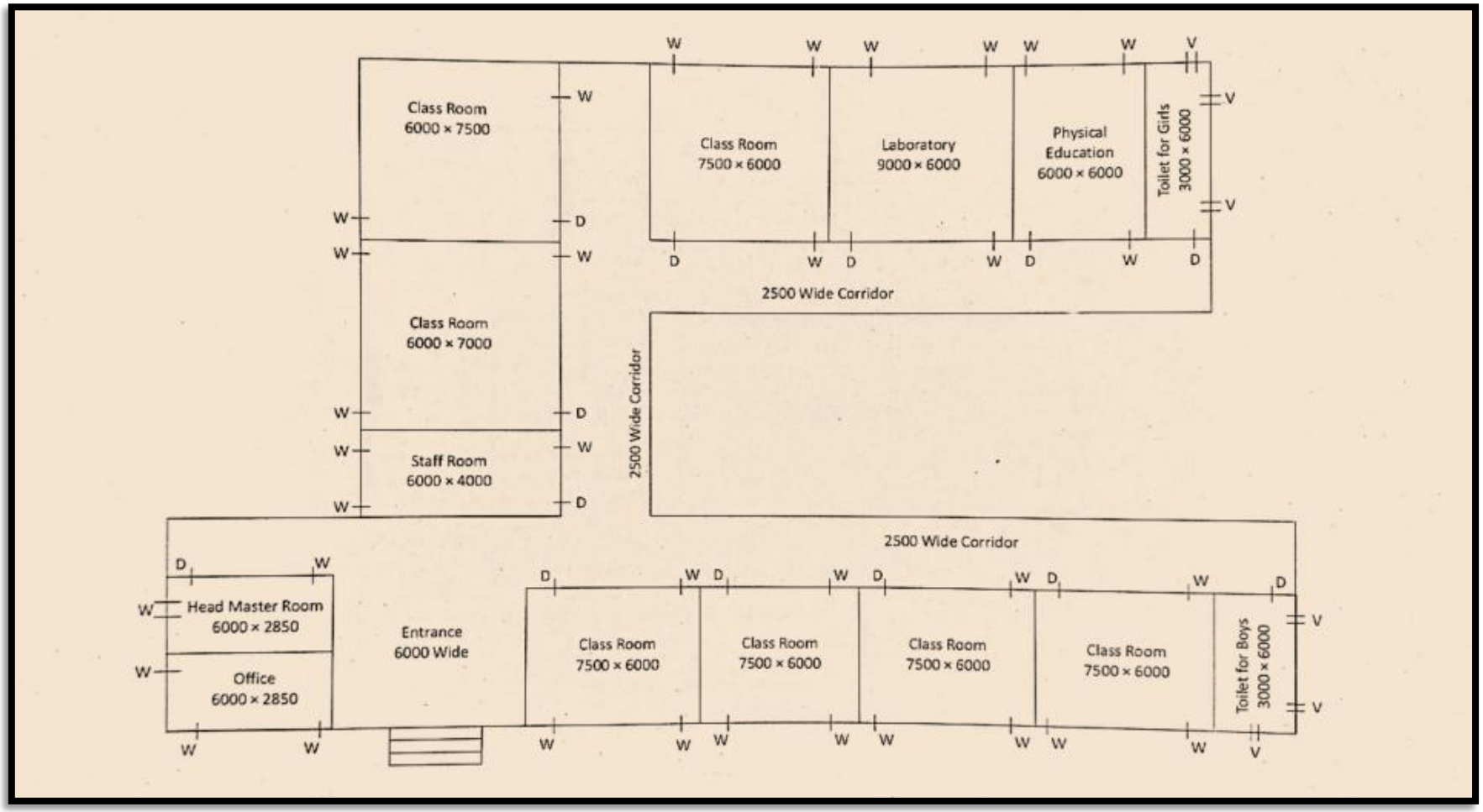
Class Room
6000 × 7500
Class Room
7500 × 6000
Laboratory
9000 × 6000
Physical
Education
6000 × 6000
Toilet for Girls
3000 × 6000
2500 Wide Corridor
Class Room
6000 × 7000
Staff Room
6000 × 4000
2500 Wide Corridor
2500 Wide Corridor
Head Master Room
6000 × 2850
Office
6000 × 2850
Entrance
6000 Wide
Class Room
7500 × 6000
Class Room
7500 × 6000
Class Room
7500 × 6000
Class Room
7500 × 6000
Toilet for Boys
3000 × 6000