



## **Course Title: Civil Engineering Drawing Lab-I**

### **Covered Course: Civil Engineering Drawing-I Sessional**

**COURSE CODE: CE 0731-1100**

**CREDIT: 01**

**CIE MARKS: 30**

**SEE MARKS: 20**

**CLO 01 Understand** basics of drawing.

**CLO 02 Construct** drawing lines and perspective projections.

**CLO 03 Create** plan, elevation and sections of a building.

**CLO 04 Develop** beam, footing, slab and stair's views and details.

**Prepared By- Md. Rejoan Chowdhury, Lecturer, CE, UGV**

Sl.	Course Contents	Hours	CLOs
1	Traditional Drawing Tools, Standard Engineering Lettering.	15	CLO 1
2	Different Geometric Constructions (Points, lines, angles, triangles, quadrilateral, polygon, Types of Lines (Visible, header, extension, hidden, center), arrowhead, break-line, phantom line.	15	CLO 2
3	Perspective Projections, Orthographic Projections and Isometric Drawing.	15	CLO 3
4	Structural drawing–Plan view, Elevation view and Cross-sectional view.	10	CLO 3
5	Structural drawing–Isolated footing and beam longitudinal and cross-sectional views.	10	CLO 4
6	Structural drawing–Slab and Stair reinforcement detailing.	5	CLO 4

**Reference Book-** How to Build a Nice Home- Md. Ibrahim

<b>Week</b>	<b>Topic</b>	<b>Teaching Learning Strategy</b>	<b>Assessment Strategy</b>	<b>CLOs</b>	<b>Page</b>
1	Traditional Drawing Tools.	Lecture, Discussion	Lab report, Quiz	CLO 1	1-3
2-3	Standard Engineering Lettering.	Lecture, Discussion	Lab report, Quiz	CLO 1	4-11
4	Different Geometric Constructions.	Lecture, Discussion	Lab report, Quiz	CLO 1	12-18
5-6	Types of Lines.	Lecture, Discussion	Lab report, Quiz	CLO 2	19-29
7-8	Perspective Projections	Lecture, Discussion	Lab report, Quiz	CLO 2	30-38
9	Orthographic Projections and Isometric Drawing	Lecture, Discussion	Lab report, Quiz	CLO 2	39-51
10-11	Structural drawing – Plan view, Elevation view and Cross-sectional view	Lecture, Discussion	Lab report, Quiz	CLO 3	52-57
12-13	Structural drawing –Isolated footing and beam longitudinal and cross-sectional views	Lecture, Discussion	Lab report, Quiz	CLO 4	58-60
14	Structural drawing – Slab and Stair reinforcement detailing	Lecture, Discussion	Lab report, Quiz	CLO 4	61-63
15	Lab assessment	Demonstration	Lab report, Quiz	CLO 1- 4	N/A

# Assessment Strategy

**CIE- Continuous Internal Evaluation (60 Marks) (Should be converted in 30 marks)**

<b>Bloom's Category Marks (out of 60)</b>	<b>Lab Final (30)</b>	<b>Lab Report (10)</b>	<b>Continuous lab performance (10)</b>	<b>Presentation &amp; Viva (10)</b>	<b>External Participation in Curricular/Co-Curricular Activities (10)</b>
Remember	05			02	Attendance 10
Understand	05	05	02	03	
Apply	05		02		
Analyze	05		02		
Evaluate	05	05	02		
Create	05		02	05	

**SEE- Semester End Examination (40 Marks) (Should be converted in 20 marks)**

<b>Bloom's Category</b>	<b>Tests</b>
Remember	05
Understand	05
Apply	10
Analyze	05
Evaluate	05
Create	10



## (Week 1) Traditional Drawing Tools



## Drawing

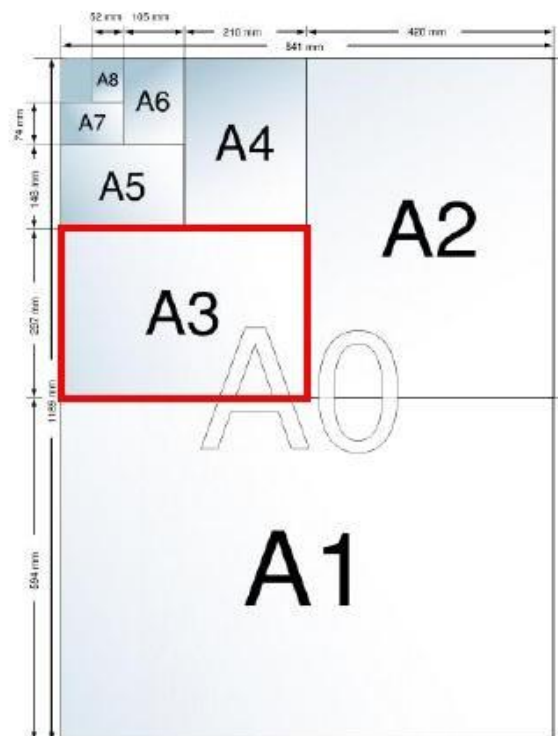
A drawing is a graphic representation of an object, or a part of it, and is the result of creative thought by an engineer or technician. When one person sketches a rough map in giving direction to another, this is graphic communication. Graphic communication involves using visual materials to relate ideas. Drawings, photographs, slides, transparencies, and sketches are all forms of graphic communication. Any medium that uses a graphic image to aid in conveying a message, instructions, or an idea is involved in graphic communication.

### Engineering drawing:

The engineering drawing, on the other hand, is not subtle, or abstract. It does not require an understanding of its creator, only an understanding of engineering drawings. An engineering drawing is a means of clearly and concisely communicating all of the information necessary to transform an idea or a concept into reality. Therefore, an engineering drawing often contains more than just a graphic representation of its subject. It also contains dimensions, notes and specifications.

## Drawing Sheets

<b>A Series Formats (mm)</b>	
<b>A0</b>	841 × 1189
<b>A1</b>	594 × 841
<b>A2</b>	420 × 594
<b>A3</b>	297 × 420
<b>A4</b>	210 × 297
<b>A5</b>	148 × 210
<b>A6</b>	105 × 148
<b>A7</b>	74 × 105



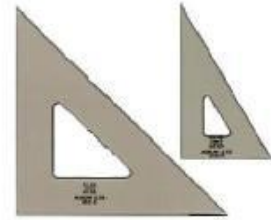
DRAWING TOOLS



DRAWING TOOLS



1. T-Square



2. Triangles

DRAWING TOOLS



3. Adhesive Tape



4. Pencils

DRAWING TOOLS



5. Sandpaper



6. Compass

DRAWING TOOLS



7. Pencil Eraser



8. Erasing Shield

DRAWING TOOLS



9. Circle Template



10. Tissue paper

DRAWING TOOLS



11. Sharpener

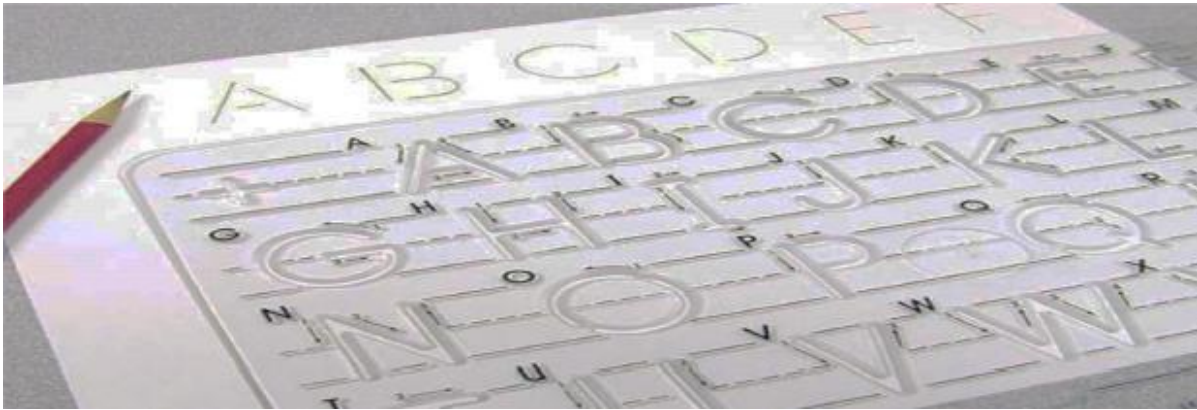


12. Clean paper



# (Week 2-3)

## Standard Engineering Lettering



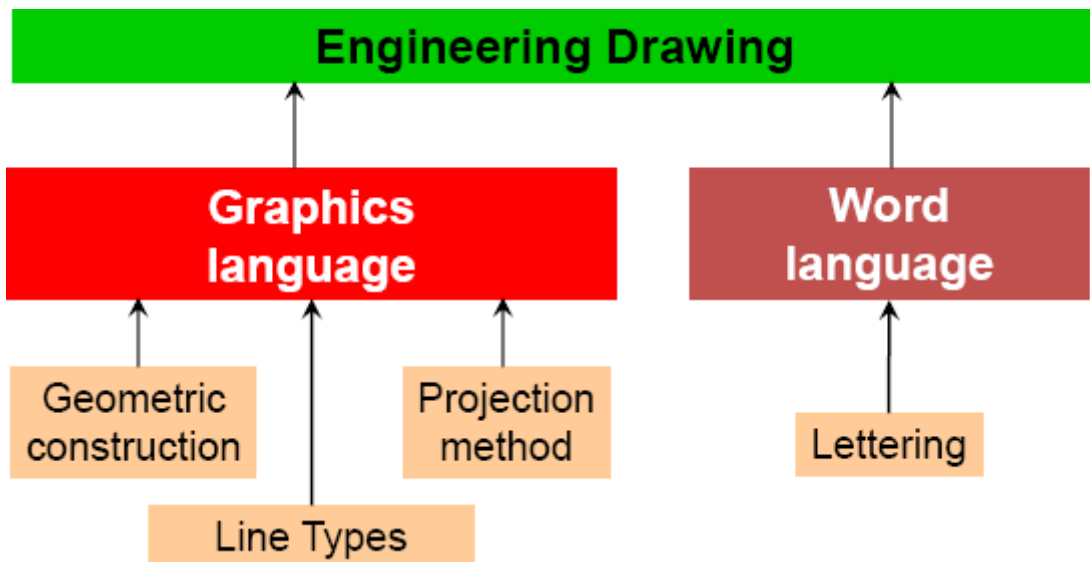
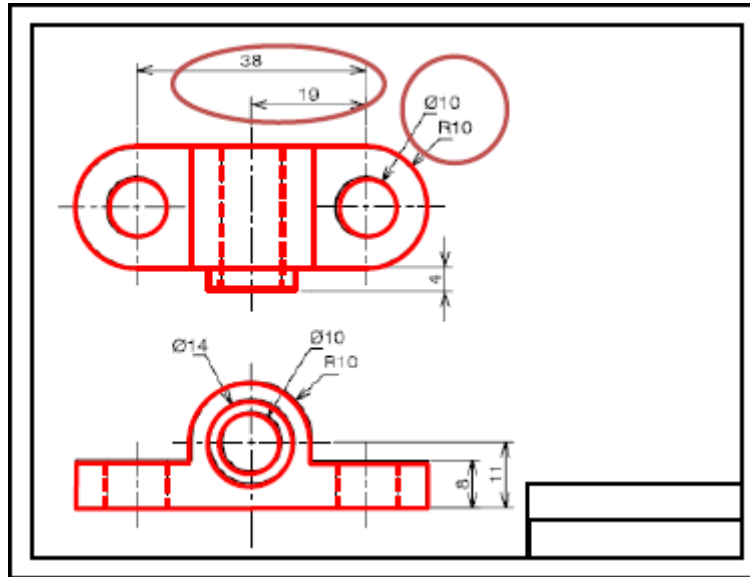


## Elements of Engineering Drawing

Engineering drawing are made up of *graphics language* and *word language*.

**Graphics language:** Describe a shape (mainly).

**Word language:** Describe an exact size, location and specification of the object.



## Lettering in Engineering Drawing

Lettering is used to provide easy to read and understand information to supplement a drawing in the form of notes and annotations. Lettering is an essential element in both traditional drawing and Computer Aided Design (CAD) drawing. Thus, it must be written with:

**Legibility** – shape & space between letters and words.

**Uniformity** – size & line thickness.

## Types of Lettering

The two types of lettering are:

1. Double Stroke Lettering: In Double Stroke Lettering the line width is greater than that of Single Stroke Lettering.

Double Stroke Lettering is further divided into:

a) *Double Stroke Vertical Gothic Lettering.*

b) *Double Stroke Inclined Gothic Lettering.*

A stencil is mostly used when hand drawing double stroked letters.

2. Single Stroke Lettering: Thickness in single stroke lettering is obtained by a single stroke of pencil or ink pen. It is further divided into:

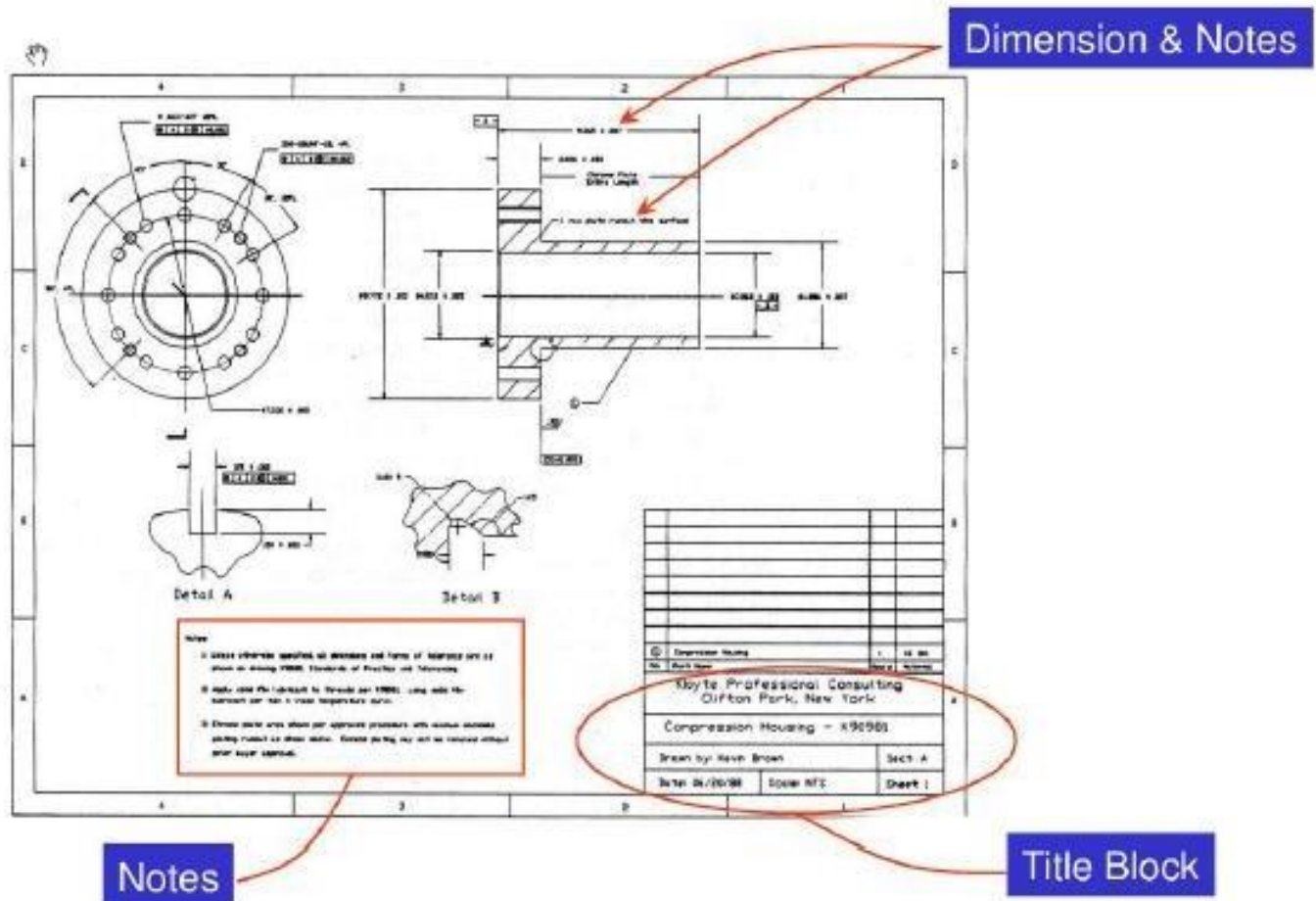
(a) *Single Stroke Vertical Gothic Lettering.*

(b) *Single Stroke Inclined Gothic Lettering.*

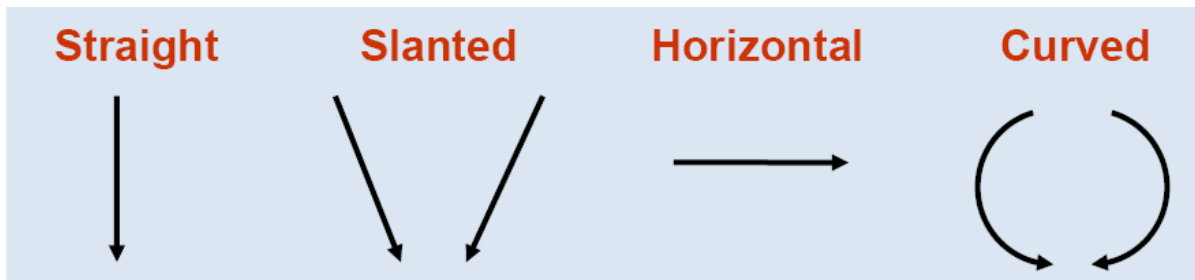
## Conventions for Lettering

- Use all **CAPITAL LETTERS**.
- Use ***even pressure*** to draw **precise, clean lines**.
- Use ***one stroke*** per line.
- **Horizontal Strokes** are drawn ***left to right***.
- **Vertical Strokes** are drawn ***downward***.
- **Curved strokes** are drawn ***top to bottom*** in one continuous stroke on each side.
- Use The ***Single-stroke, Gothic Style of Lettering***.
- Always ***Skip A Space*** Between **Rows Of Letters**.
- Always Use ***Very Light Guide Lines***.
- **Fractions** Are Lettered ***Twice the Height Of Normal Letters***.
- **Fraction Bars** Are Always ***Drawn Horizontal***.
- Use a ***Medium Lead*** For ***Normal Lettering***.
- Use a ***Hard Lead*** For Drawing ***Guide Lines***.

# Placement of Text on Engineering Drawings



## Basics of Single Stroking

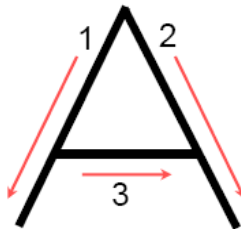


### Examples

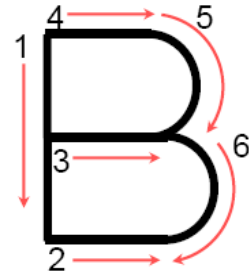
“I” letter



“A” letter



“B” letter



## Spacing

Uniformity in spacing of letters is a matter of equalizing spaces by eye.

- The background area between letters, not the distance between them, should be approximately equal.
- Words are spaced well apart, but letters within words should be spaced closely.



- For either upper case or lower-case lettering, make the spaces between words approximately equal to a capital O.

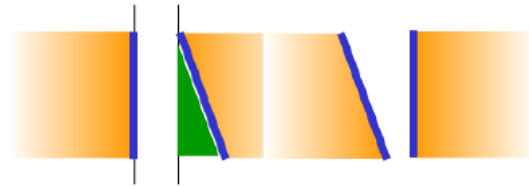


## Space between letters

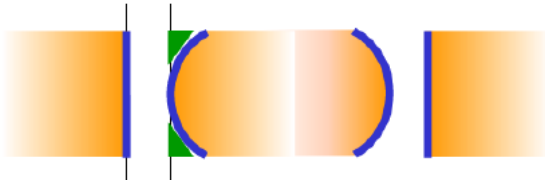
1. Straight - Straight



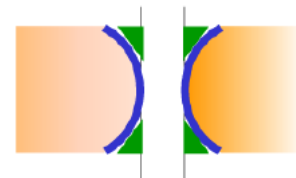
3. Straight - Slant



2. Straight - Curve



4. Curve - Curve



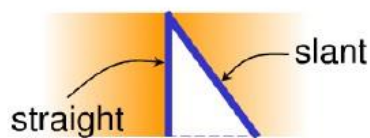
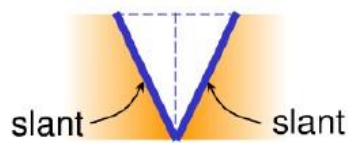
5. Curve - Slant



6. Slant - Slant



7. The letter "L" and "T"



## Drawing scales

Scale is the ratio of the linear dimension of an element of an object shown in the drawing to the real linear dimension of the same element of the object.

Designation of a scale consists of the word “SCALE” followed by the indication of its ratio, as follows:

SCALE 1:1 for full size

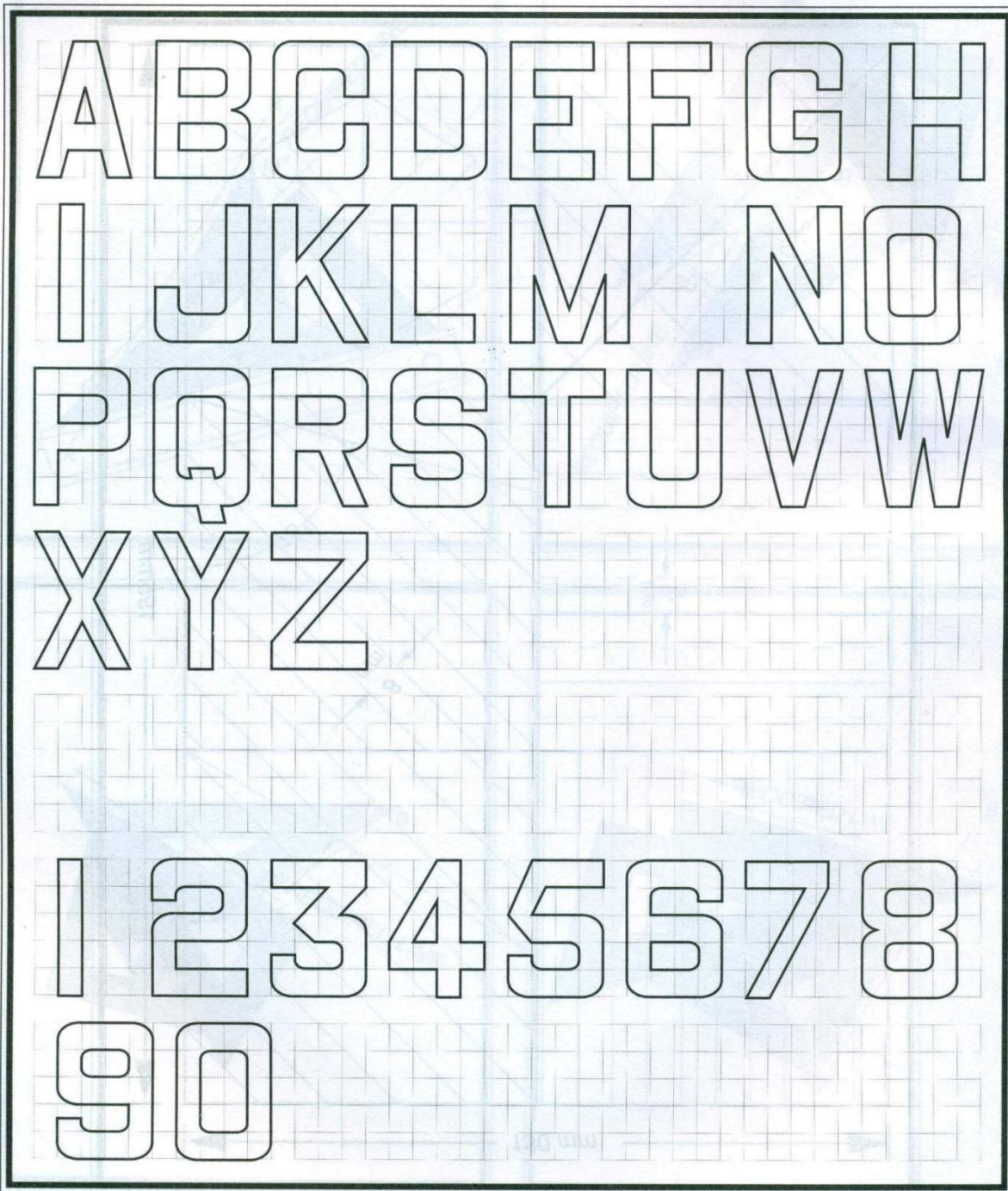
SCALE **X**:1 for *enlargement* scales ( $X > 1$ )

SCALE 1:**X** for *reduction* scales ( $X > 1$ )

Dimension numbers shown in the drawing correspond to “true size” of the object and they are independent of the scale used in creating that drawing.

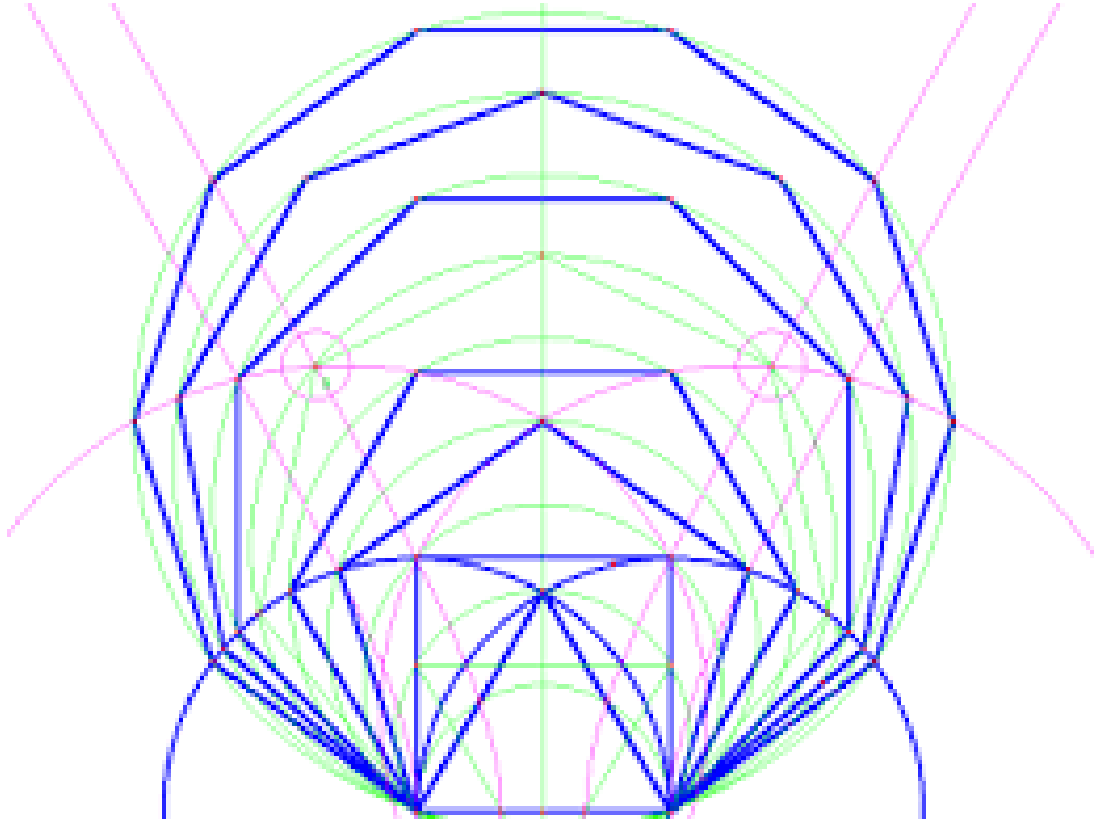


Try with one-fourth (0.25) inches distance between the lines, in both the directions (X and Y axes)





## (Week 4) Different Geometric Constructions





## **Objectives:**

At the end of this chapter students should be able to:

- Define geometric nomenclatures like angles, lines etc
- Discuss the steps to construct different geometric figures like lines, arcs, polygon, ellipse etc.

## **Introduction :**

Strict interpretation of geometric construction allows use of only the compass and an instrument for drawing straight lines, and with these, the geometer, following mathematical theory, accomplishes his solutions. In technical drawing, the principles of geometry are employed constantly, but instruments are not limited to the basic two as T-squares, triangles, scales, curves etc. are used to make constructions with speed and accuracy. Since there is continual application of geometric principles, the methods given in this chapter should be mastered thoroughly.

## **GEOMETRIC NOMENICLATURE**

### **A. POINTS IN SPACE**

A point is an exact location in space or on a drawing surface. A point is actually represented on the drawing by a crisscross at its exact location. The exact point in space is where the two lines of the crisscross intersect. When a point is located on an existing line, a light, short dashed line or cross bar is placed on the line at the location of the exact point. Never represent a Point on a drawing by a dot; except for sketching locations.

### **B. LINE**

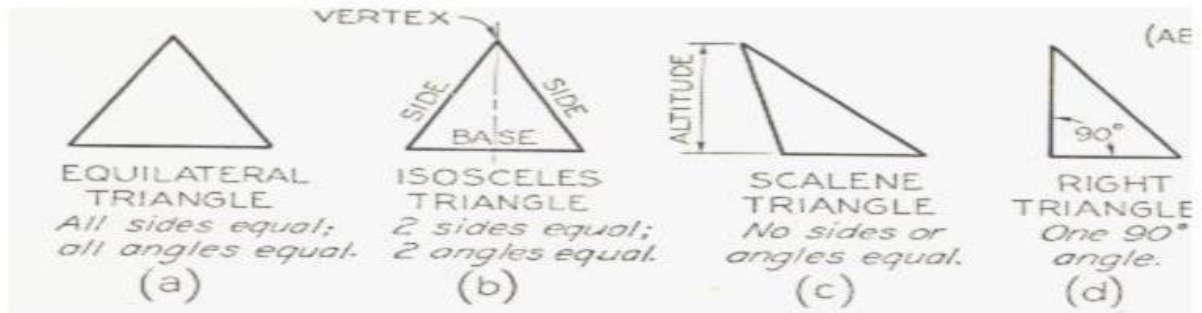
Lines are straight elements that have no width, but are infinite in length (magnitude), and they can be located by two points which are not on the same spot but fall along the line. Lines may be straight lines or curved lines. A straight line is the shortest distance between two points. It can be drawn in any direction. If a line is indefinite, and the ends are not fixed in length, the actual length is a matter of convenience. If the end points of a line are important, they must be marked by means of small, mechanically drawn crossbars, as described by a pint in space. Straight lines and curved lines are considered parallel if the shortest distance between them remains constant. The symbol used for parallel line is // . Lines, which are tangent and at 90 degree are considered perpendicular. The symbol for perpendicular line is  $\perp$ .

### **C. ANGLES**

An angle is formed by the intersection of two lines. There are three major kinds of angles: right angles, acute angles and obtuse angles. The right angle is an angle of 90°, an acute angle is an angle less than 90°, and an obtuse angle is an angle more than 90°. A straight line is 180°. The symbol for an angle is  $\angle$  (singular) and  $\angle$ 's (Plural). To draw an angle, use the drafting machine, a triangle, or a protractor.

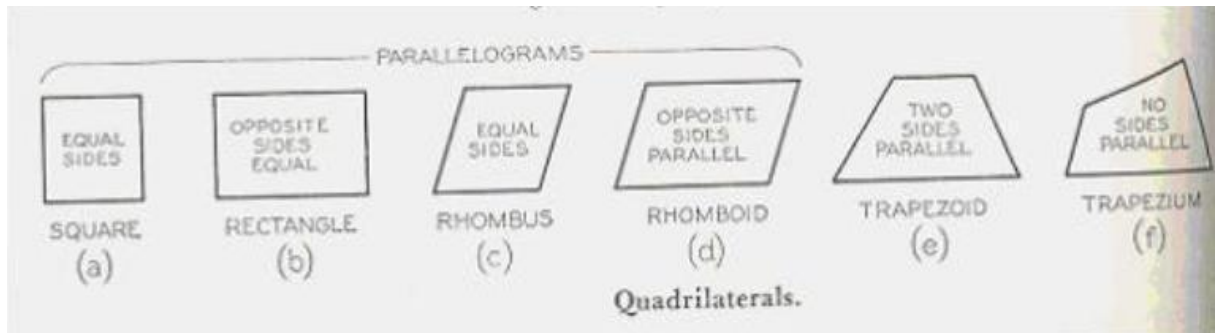
### D. TRIANGLES

A triangle is a closed plane figure with three straight sides and their interior angles sum up exactly 1800. The various kinds of triangles: a right triangle, an equilateral triangle, an isosceles triangle, and an obtuse angled triangle.



### E. QUADRILATERAL

It is a plane figure bounded by four straight sides. When opposite sides are parallel, the quadrilateral is also considered to be a parallelogram.

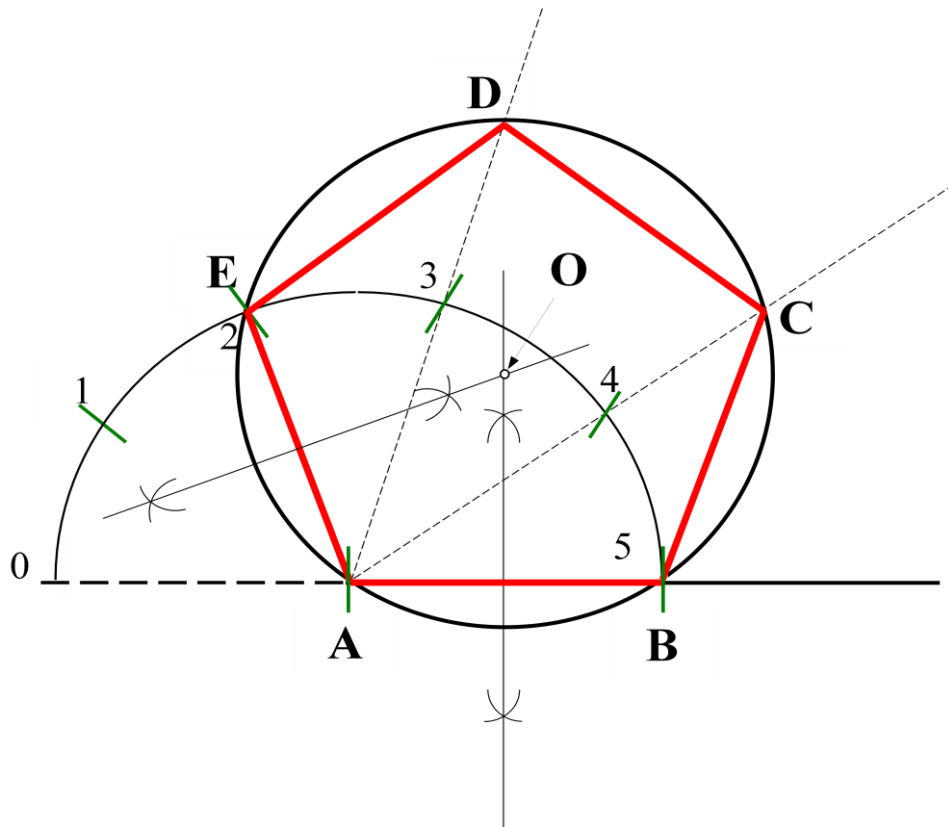


### F. POLYGON

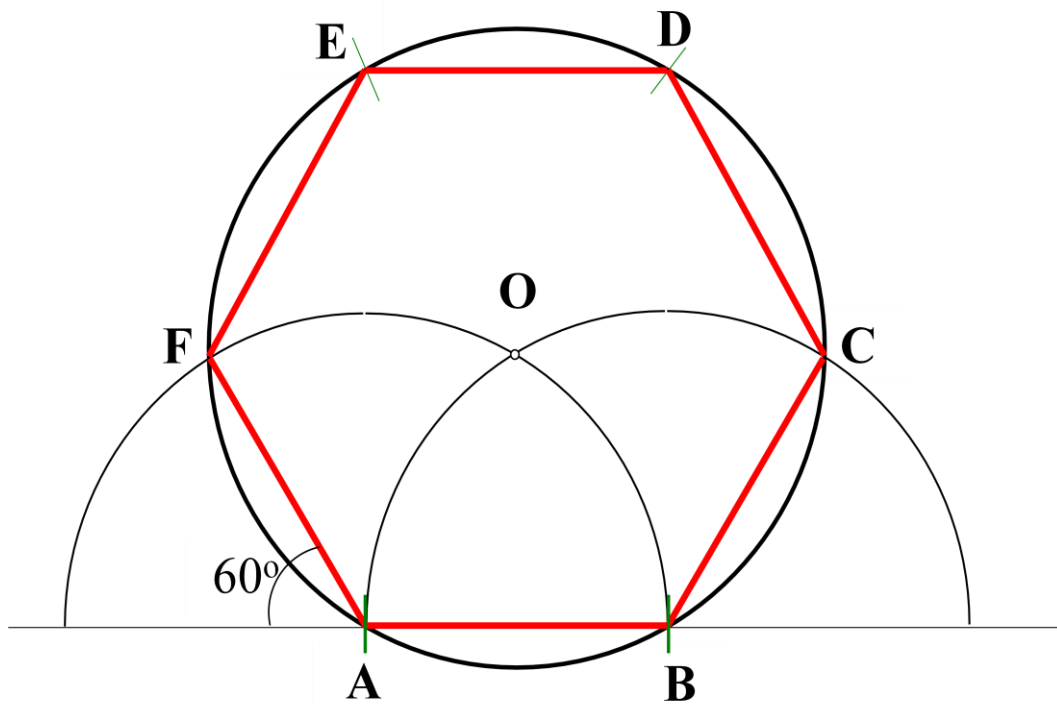
A polygon is a closed plane figure with three or more straight sides. The most important of these polygons as they relate to drafting are probably the triangle with three sides, square with four sides, the hexagon with six sides, and the octagon with eight sides.



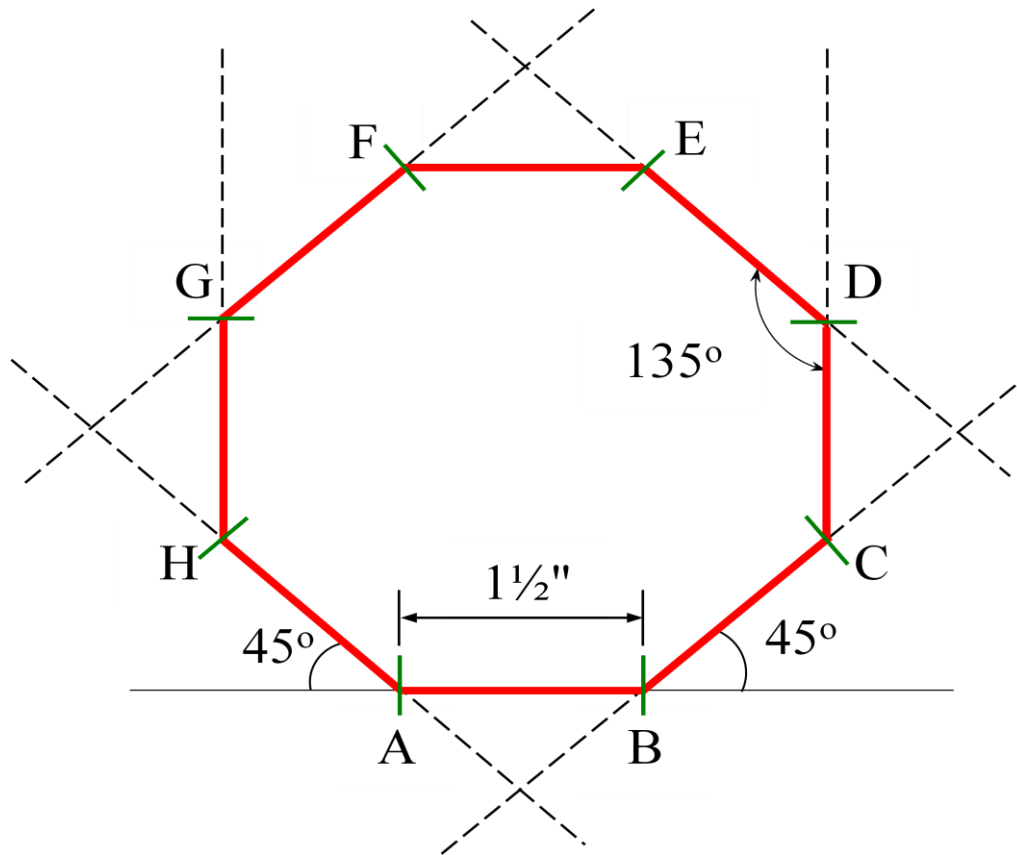
**F1. Regular Pentagon**



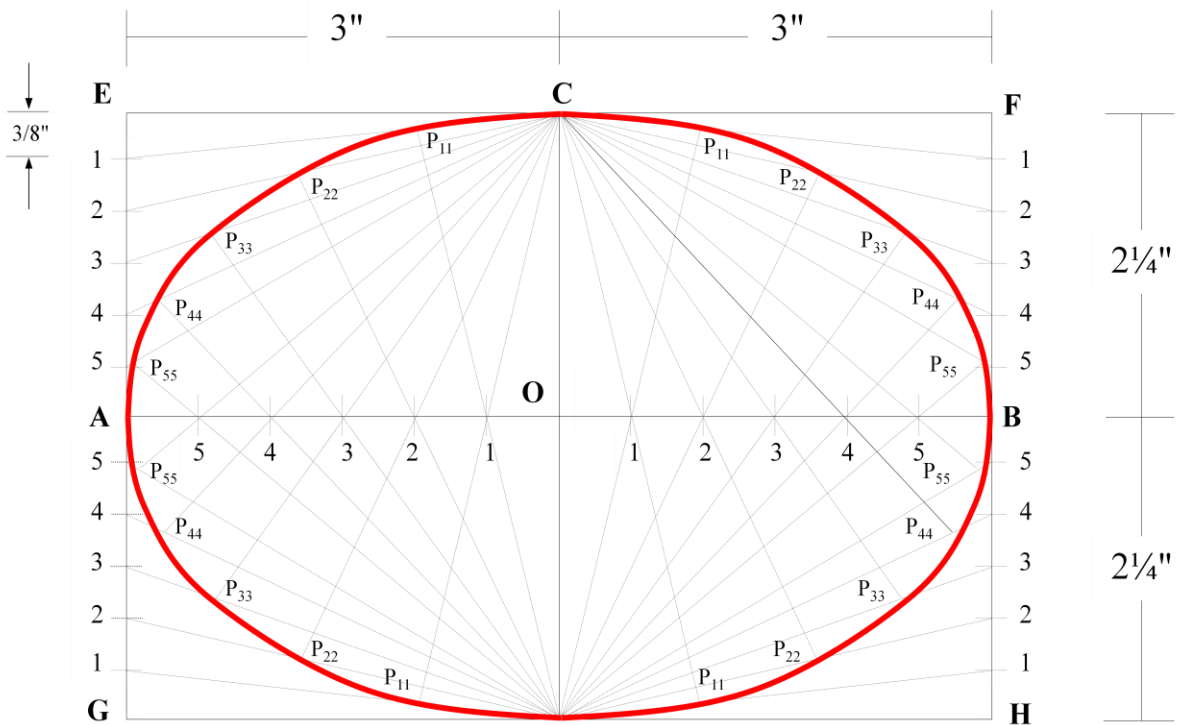
**F2. Regular Hexagon**



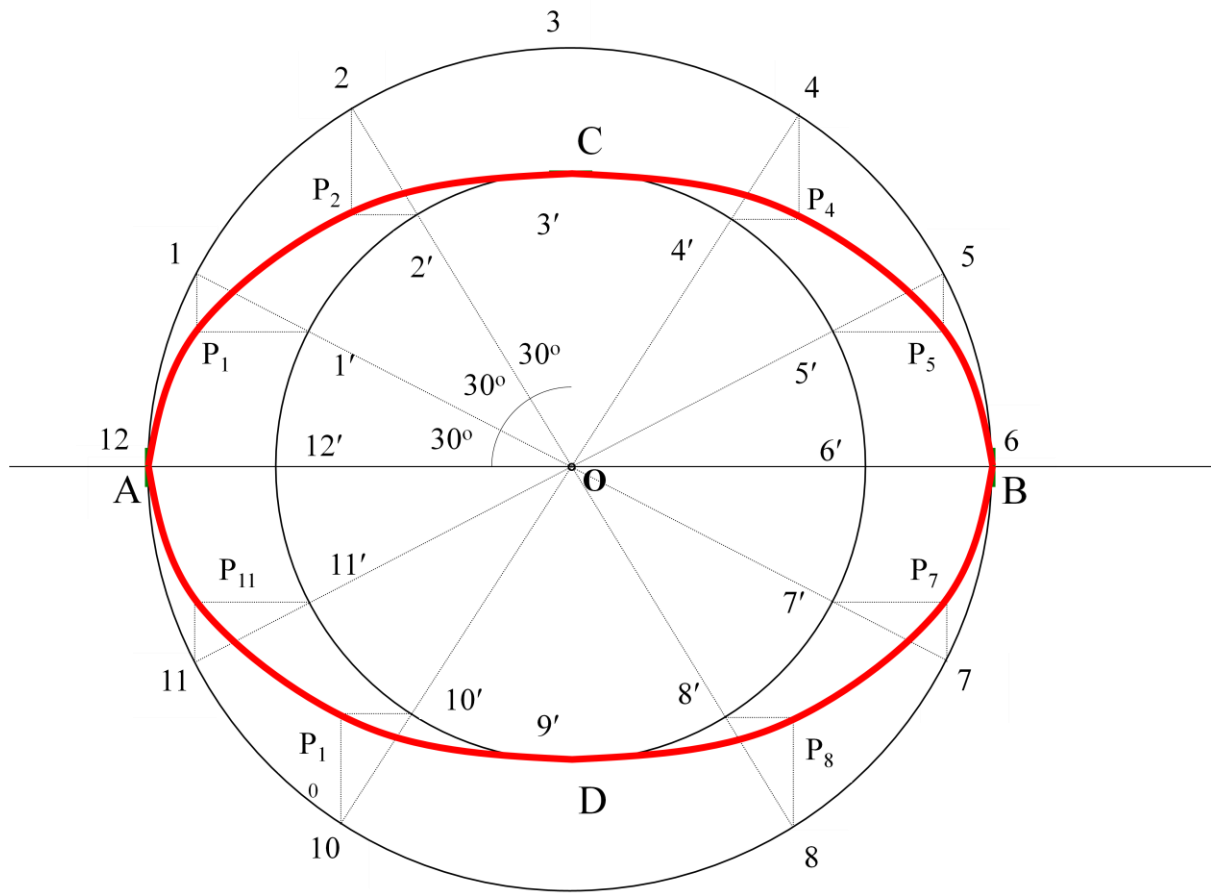
**F3. Regular Octagon**



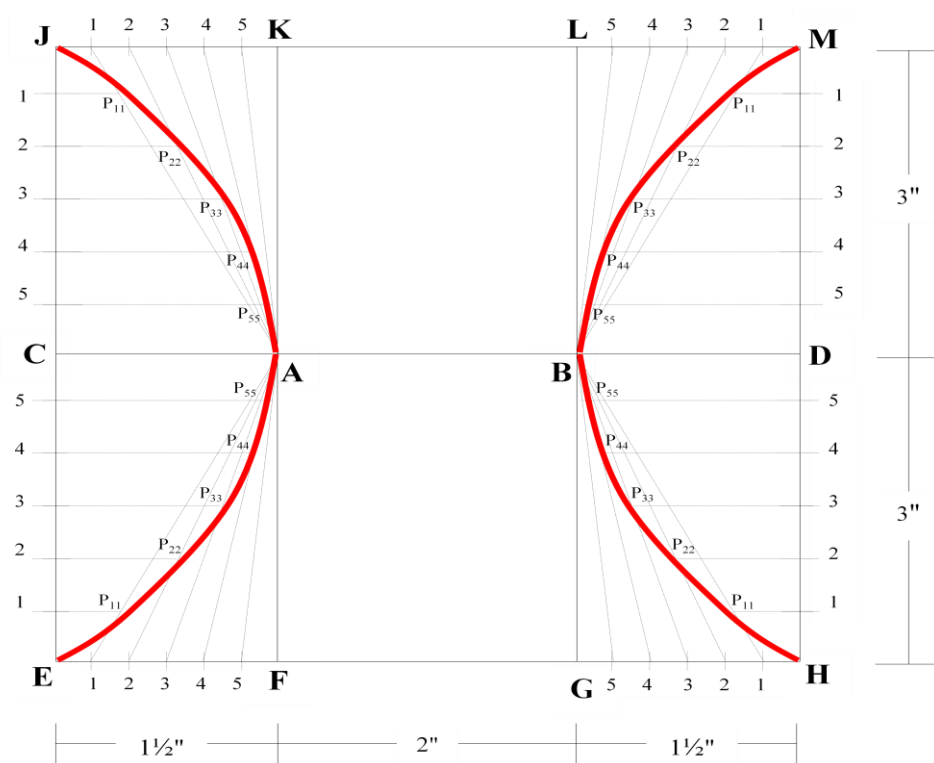
**G1. Ellipse (Parallelogram Method)**



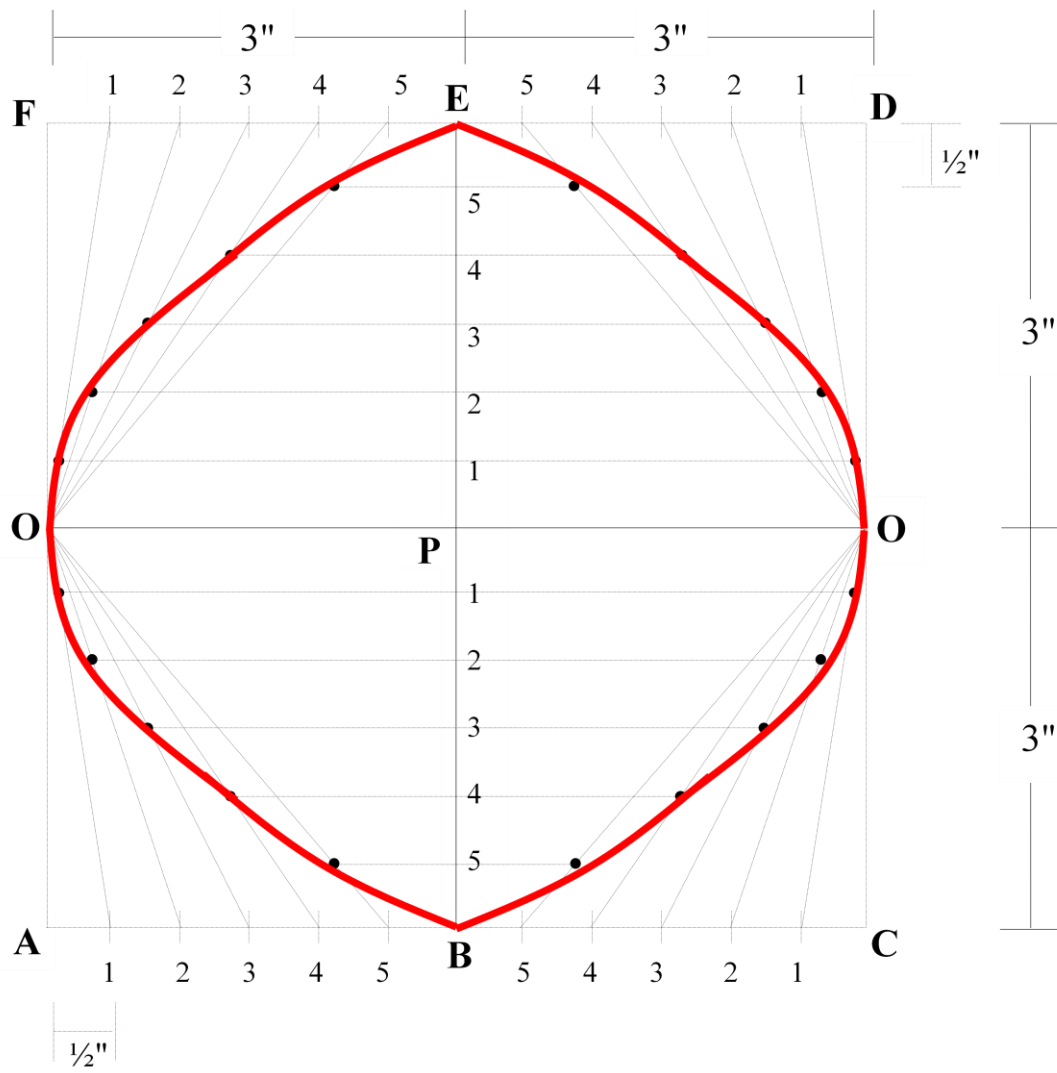
**G2. Ellipse Concentric Circles Method**



**H. Hyperbola**

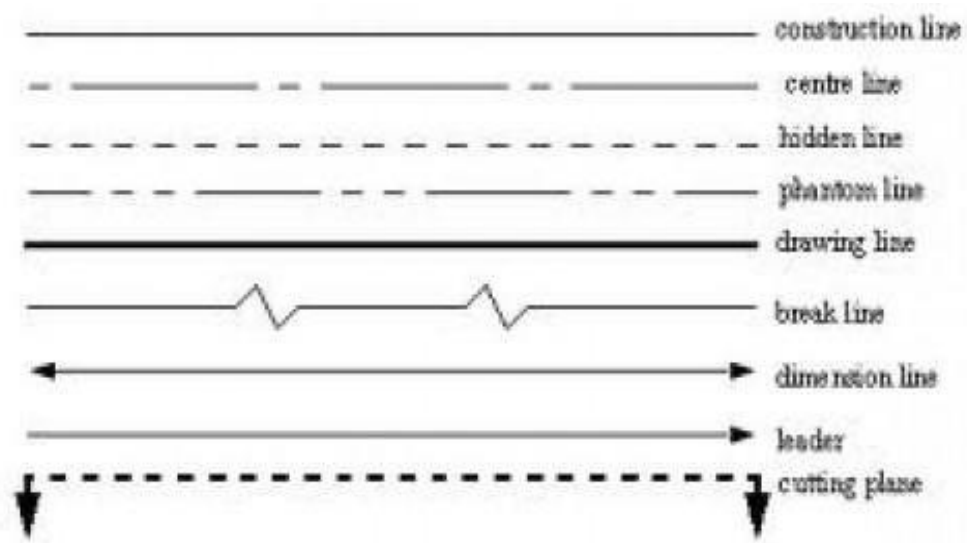


**I. PARABOLA**




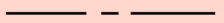




## (Week 5-6) Types of Lines

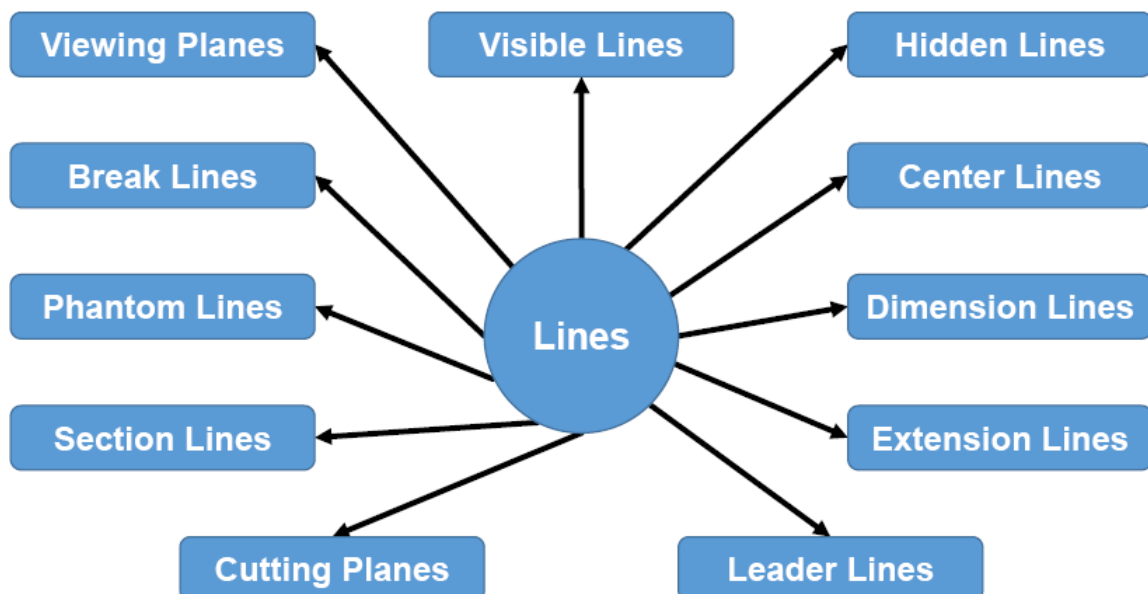


## Introduction to Types of Lines

Thickness	Thick	Thin	
Style	Visible line		1. Dimension line 2. Extension line 3. Leader line
Continuous			Hidden line
Dash			
Chain			Center line

1. **Visible line** represent features that can be seen in the current view.
2. **Dimension line**  
**Extension line**  
**Leader line** indicate the sizes and location of features.
3. **Hidden line** represent features that cannot be seen in the current view.
4. **Center line** represents symmetry, path of motion, centers of circles, axis of axisymmetrical parts.

## Main Line Types

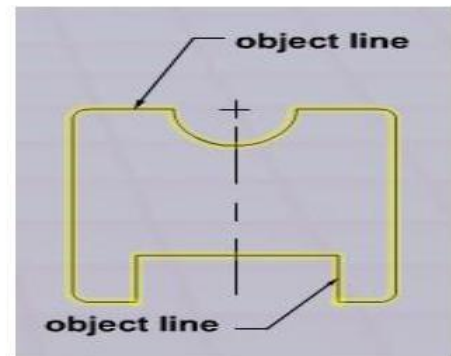
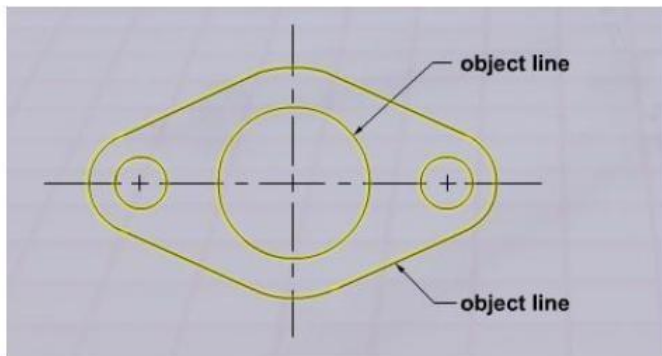




## Visible/Object Lines

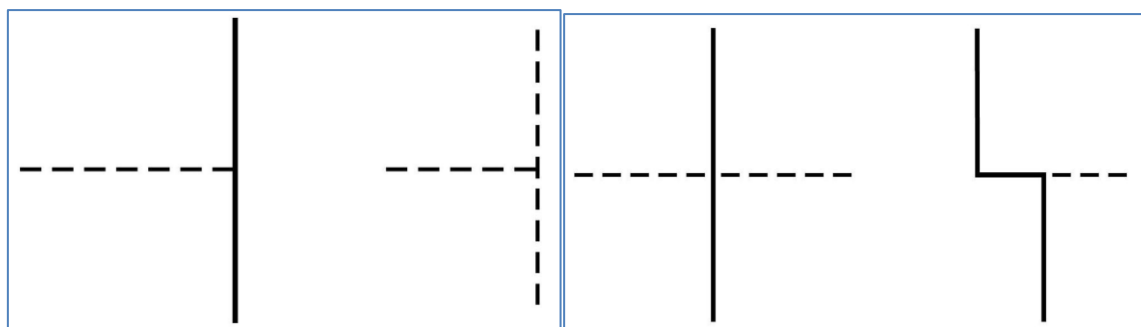
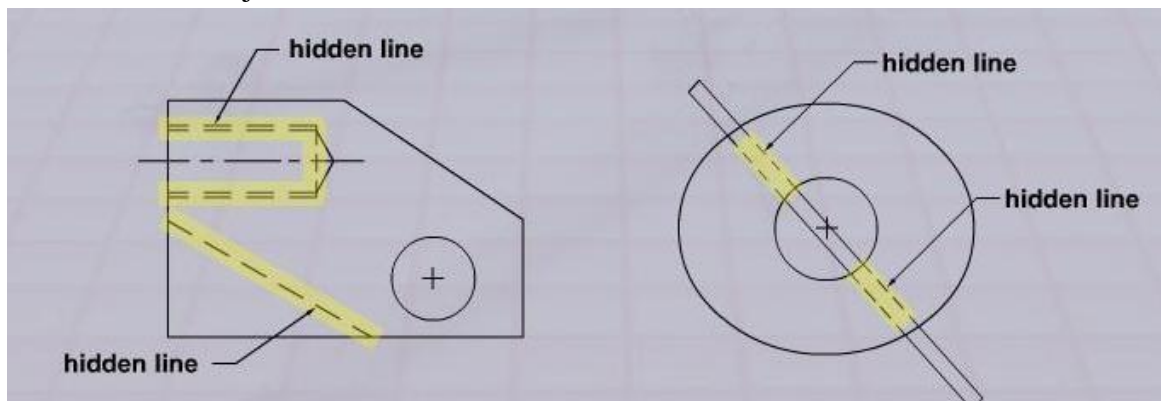
- Dark, heavy lines.
- Used to represent the outline or contour of the object being drawn.
- Define features you can see in a particular view.

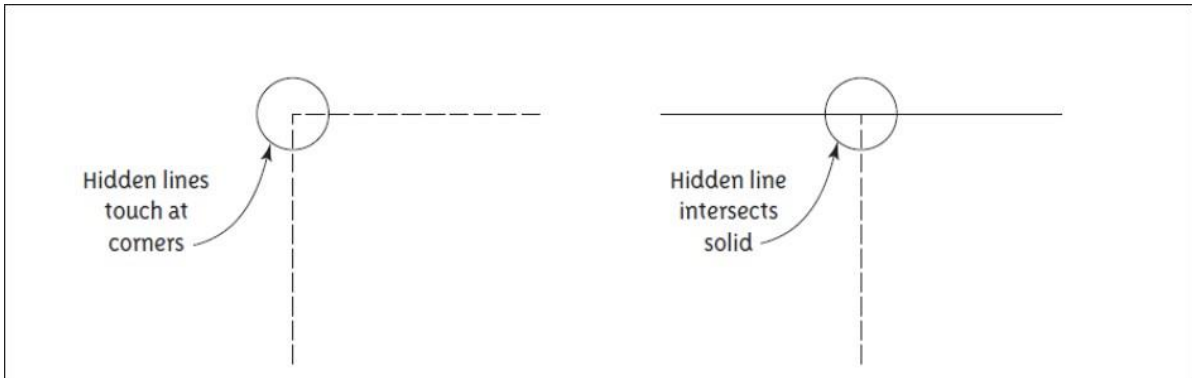
THICK



## Hidden Lines

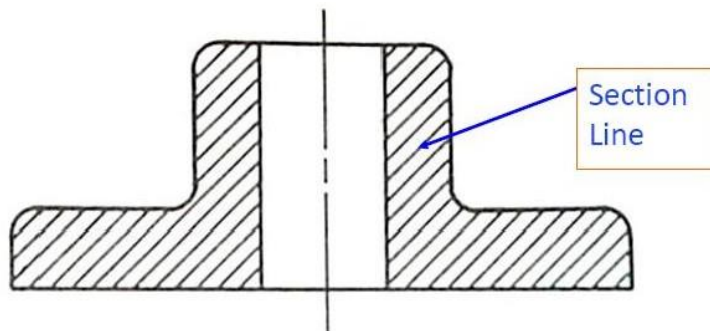
- Light, narrow, short, dashed lines.
- Shows the outline of a feature that cannot be seen in a particular view.
- Used to help clarify a feature, but can be omitted if they clutter a drawing.
- Hidden lines should always begin and end with a dash. Exception: When the hidden line begins or ends at a parallel visible or hidden line.
- Dashes should join at corners.





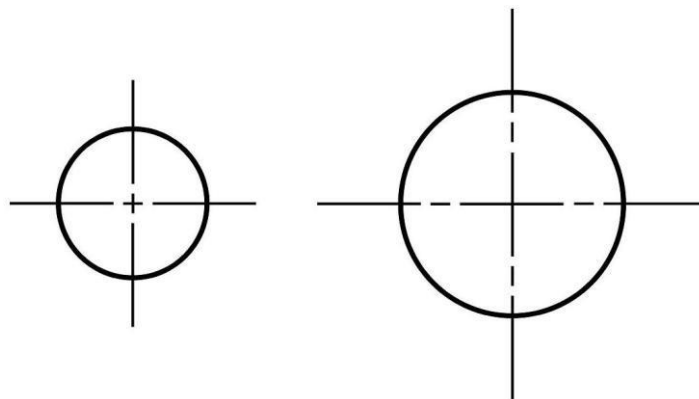
## Section Lines

- Thin line usually drawn at a 45 degree angle.
- Indicates the material that has been cut through in a sectional view.

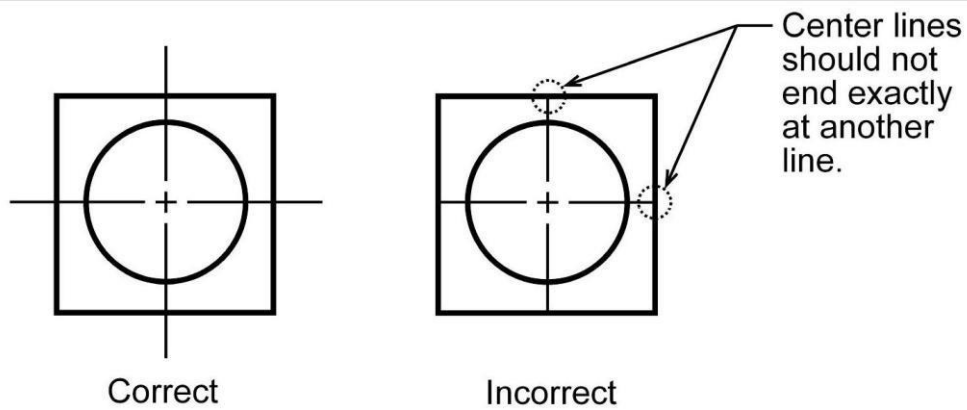


## Center Lines

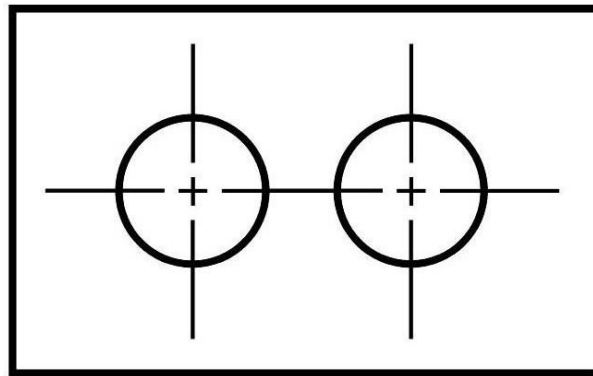
- Thin line consisting of alternating long and short dashes.
- Used to represent the center of round or cylindrical features, or the symmetry of a feature.
- Center lines should start and end with long dashes.



- Center lines should intersect by crossing either the long dashes or the short dashes.
- Center lines should extend a short distance beyond the object or feature.

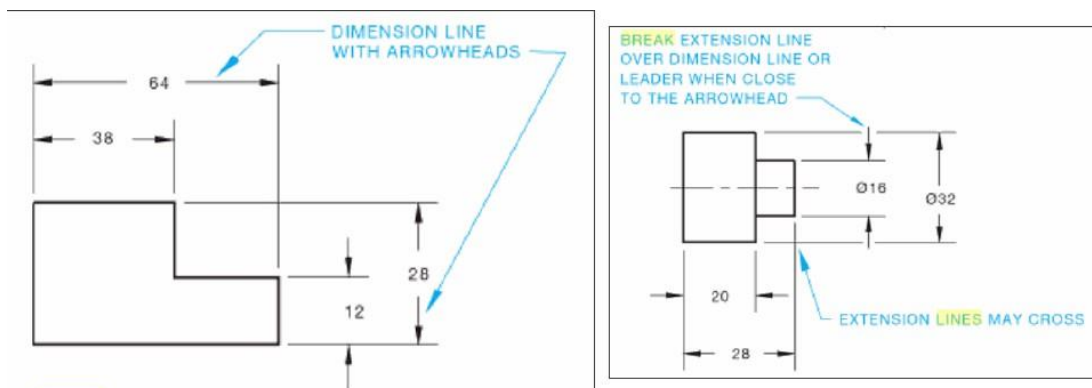


- Center lines may be connected **within a single view** to show that two or more features lie in the same plane. Center lines should not extend through the space between views.



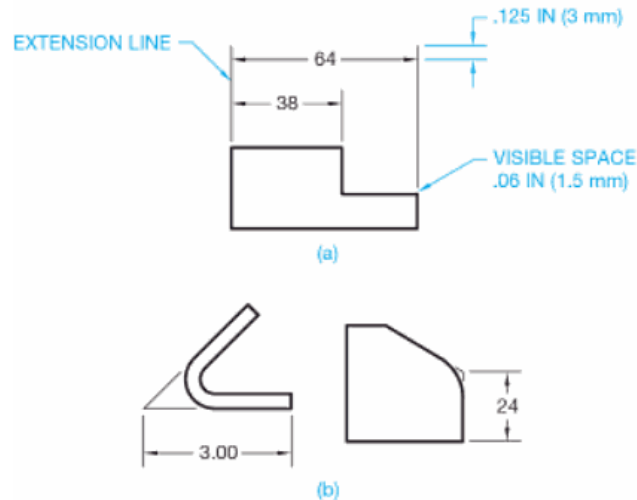
## Dimension Lines

- Thin lines capped on the ends with arrowheads and broken along their length to provide a space for the dimension numeral.
- They indicate length.



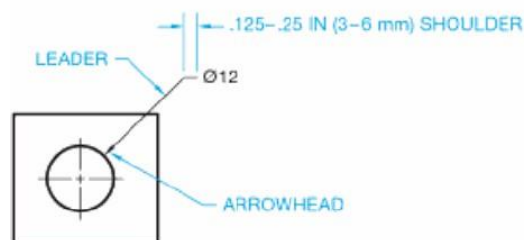
## Extension Lines

Thin lines used to establish the extent of a dimension. Can also be used to show extension of a surface to a theoretical intersection as shown in (b). Begin 1.5mm from the object and extend to 3mm beyond the last dimension. They should not cross dimension lines.



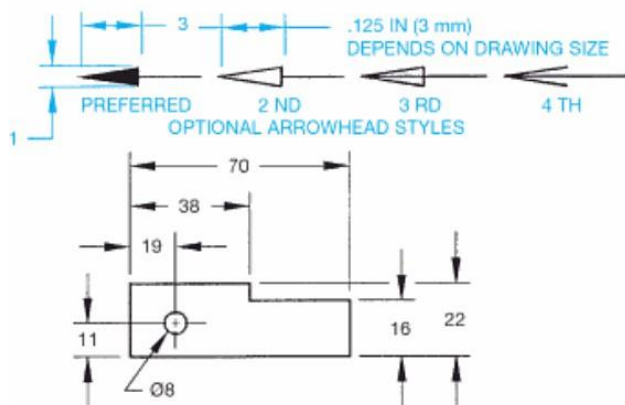
## Leader Lines

- Thin lines used to connect a specific note to a feature.
- Also used to direct dimensions, symbols, item number and part numbers on a drawing.
- Commonly drawn at **45**, **30** and **60** degrees.
- Has a **short shoulder** (3-6mm) at one end beginning at the center of the vertical height of text, and a **standard dimension arrowhead** at the other end touching the feature.
- Leader lines should not cross each other.
- Leader lines should not be excessively long.
- Leader lines should not be vertical or horizontal.
- Leader lines should not be parallel to dimension lines, extension lines or section lines.



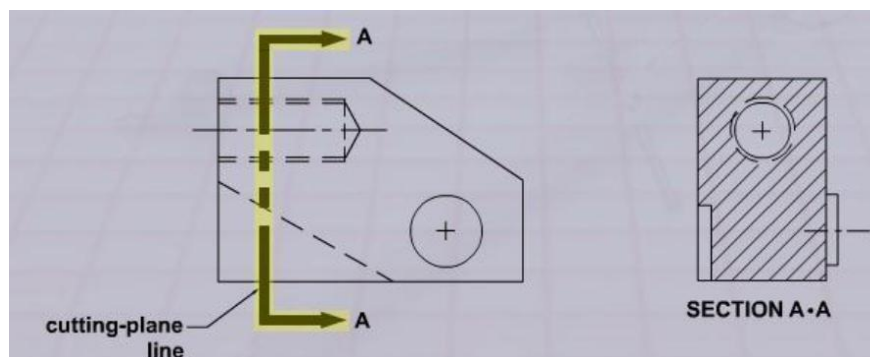
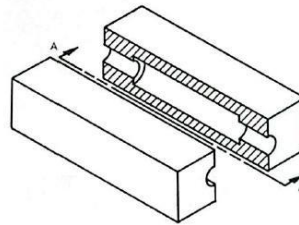
## Arrowheads

- Used to terminate dimension lines and leader lines and on cutting-plane lines and viewing plane lines.
- They should be three times as long as they are wide.
- They should be the same size throughout the drawing.
- The filled arrowhead is generally preferred because of its clarity.



## Cutting Plane Lines

- Thick broken line that is terminated with short **90 degree arrowheads**.
- Shows where a part is mentally cut in half to better see the interior detail.

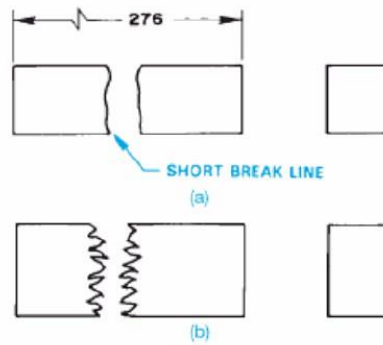


## Break Lines

Break Lines are used to break out sections for clarity or for shortening a part. Three types of break lines with different line weights:

### a) Short Break Lines.

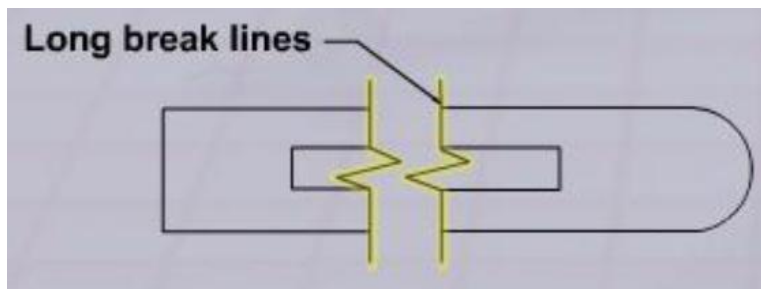
- Thick wavy line.
- Used to break the edge or surface of a part for clarity of a hidden surface.



(a) Short break line on metal shape;  
 (b) Short Break Line on wood shape.

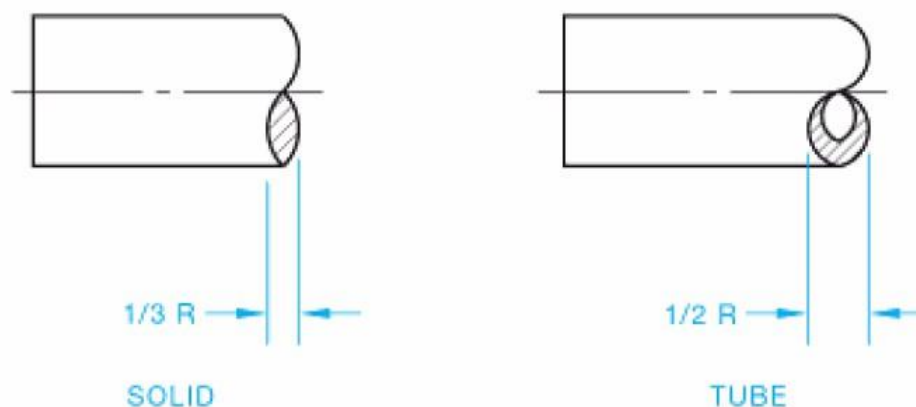
**b) Long Break Lines**

- Long, thin lines.
- Used to show that the middle section of an object has been removed so it can be drawn on a smaller piece of paper.



**c) Cylindrical Break Lines.**

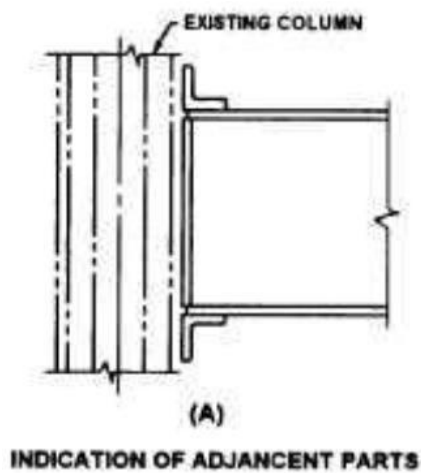
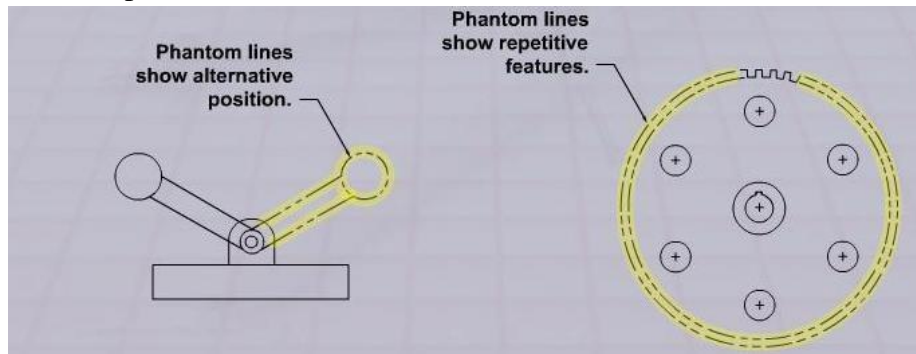
- Thin lines.
- Used to show round parts that are broken in half to better clarify the print or to reduce the length of the object.



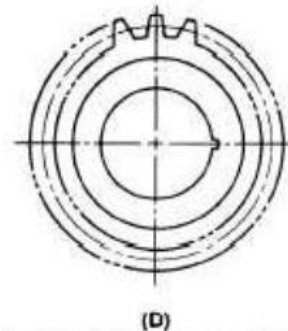
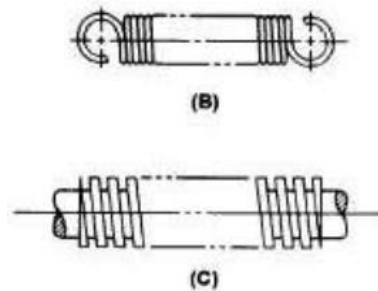
Cylindrical conventional breaks for a solid and tube;  
 where R = Radius

## Phantom Lines

- Thin lines made up of long dashes alternating with pairs of short dashes.
- Three purposes in drawings:
  - To show the alternate position of moving parts.
  - To show the relationship of parts that fit together.
  - To show repeated detail.



INDICATION OF ADJACENT PARTS



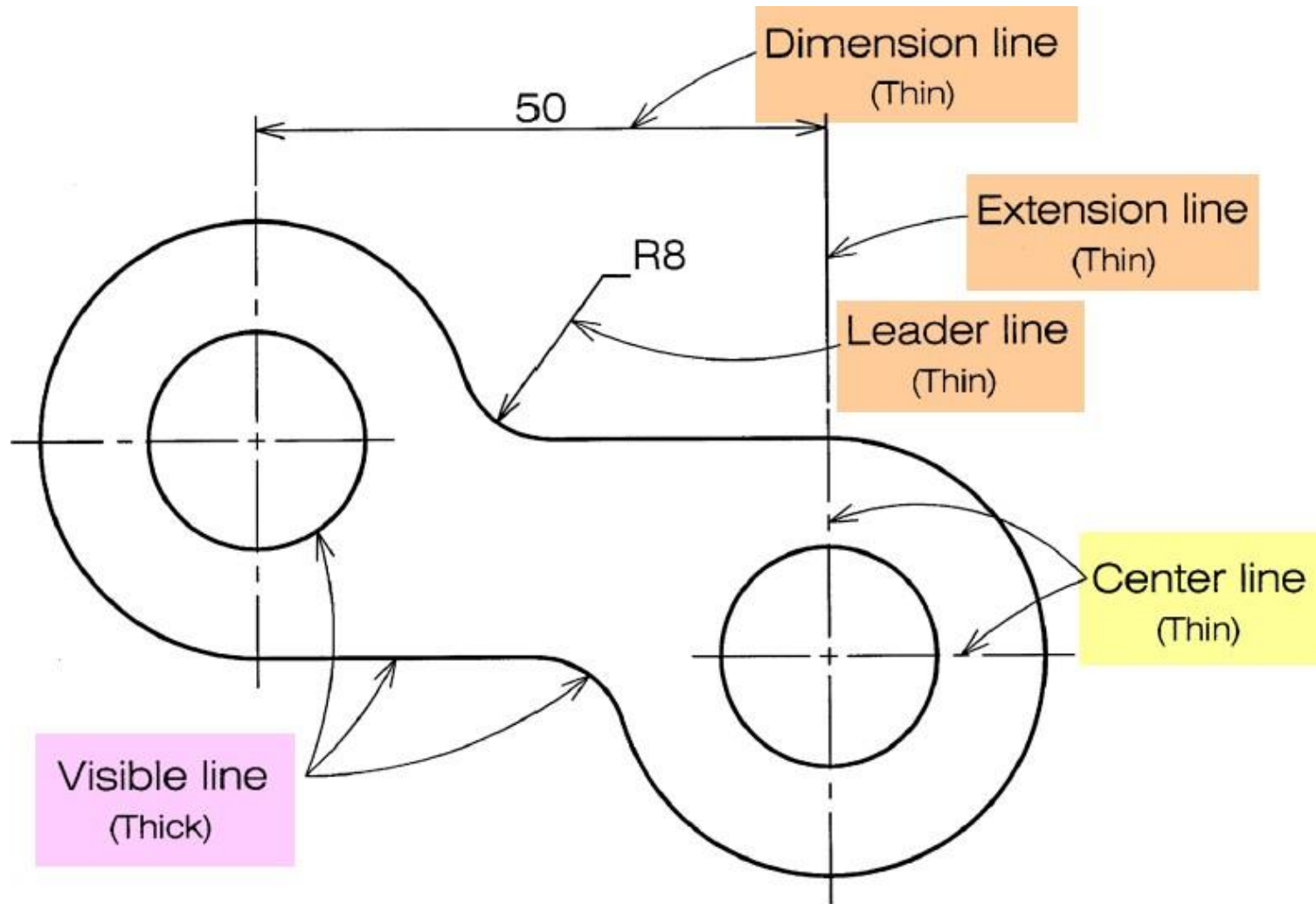
INDICATION OF REPEATED DETAIL

## Line Precedence

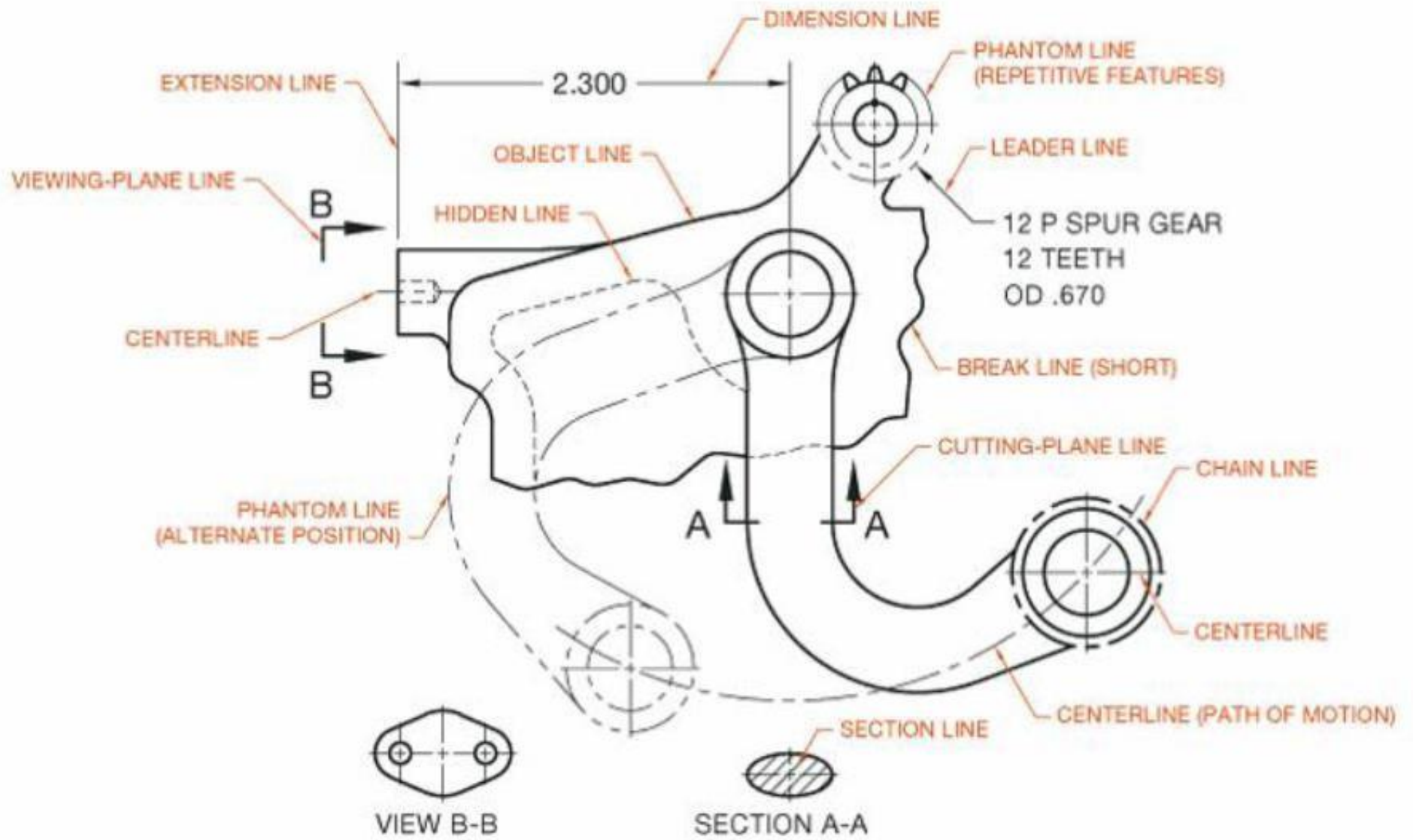
If two lines occur in the same place, the line that is considered to be the least important is omitted. Lines in order of precedence/importance are as follows:

- Cutting plane line
- Visible line
- Hidden line
- Centerline

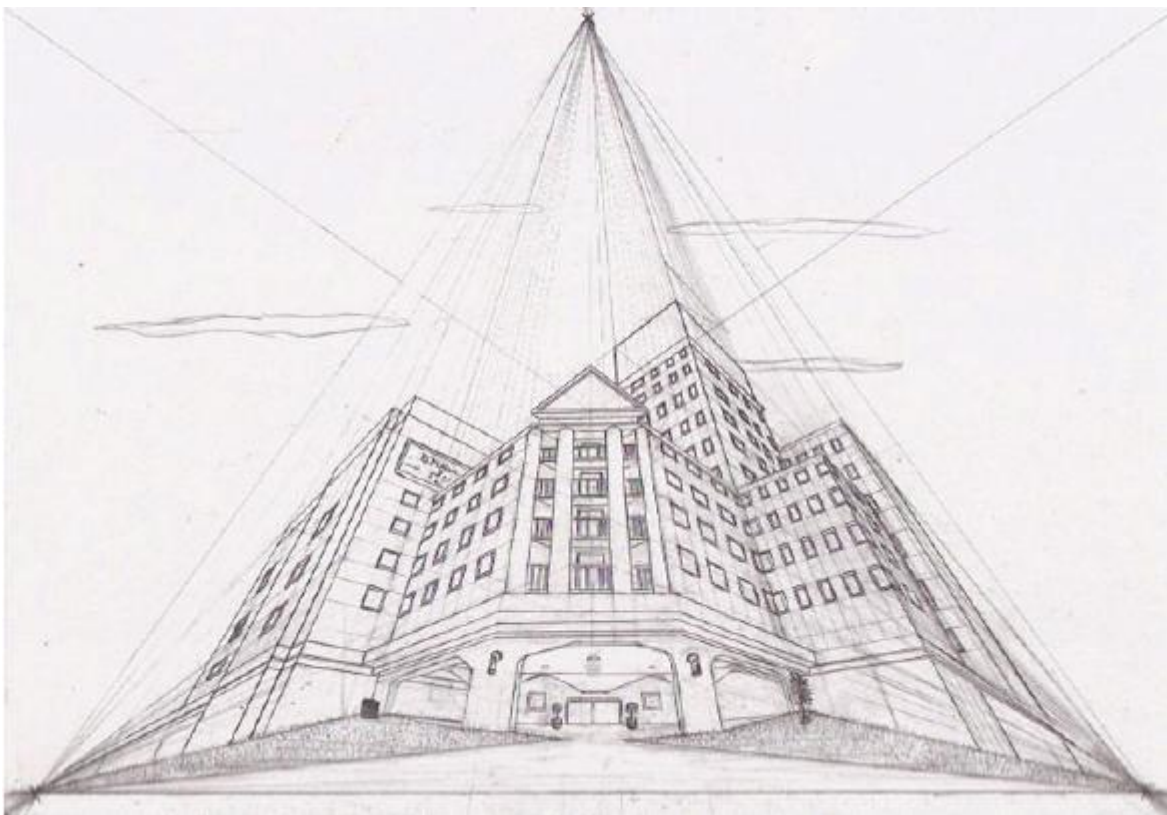
Example





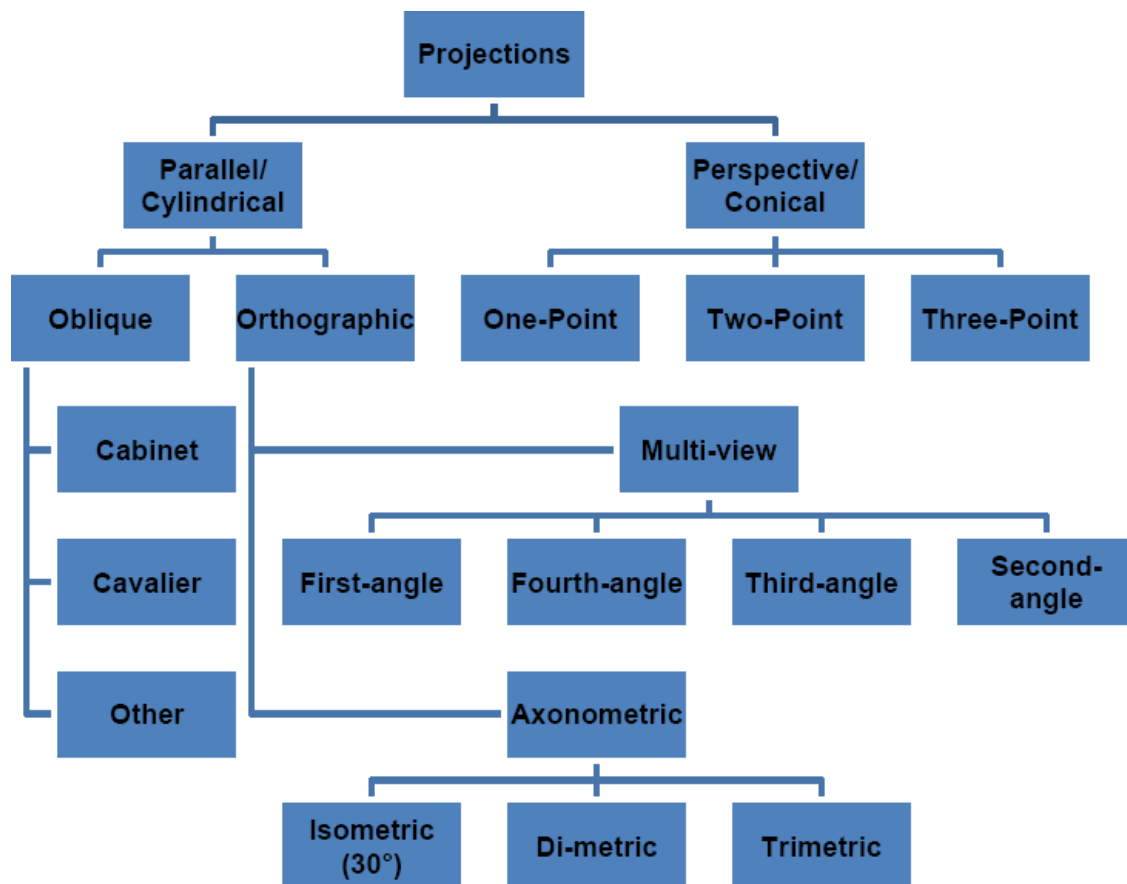


## (Week 7-8) Perspective Projections

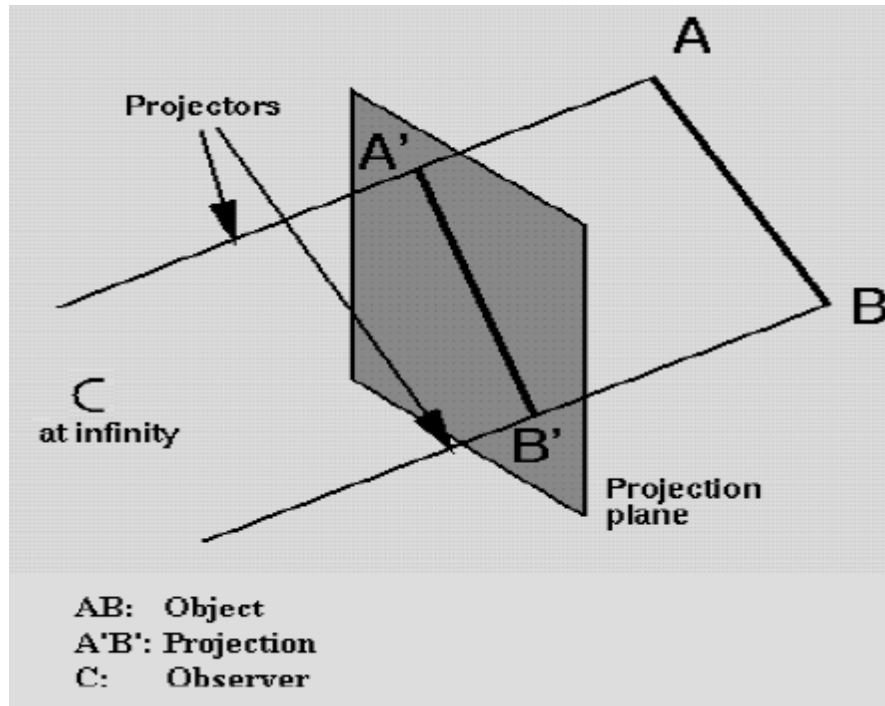


## Projection

- Projections transform points from  $n$  (here,  $n = 3$ ) dimensional space into a space of dimension less than  $n$  (here,  $n = 2$ )
- Points to be considered,
  - Location of object
  - Location of observer
  - Plane of projection
  - Projectors/lines of projection



## Parallel Projections

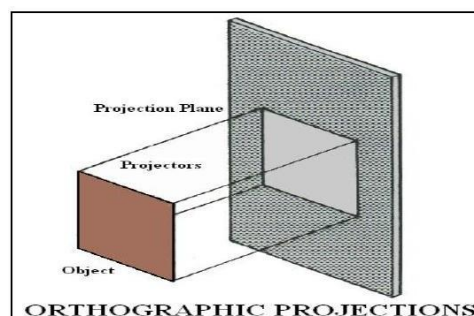


Parallel Projection is a type of projection where the line of sight or projectors are parallel and are perpendicular to the picture planes. It is subdivided into the following three categories: Orthographic, Oblique and Axonometric Projections.

- Orthographic projections: are drawn as multi view drawings, which show flat representations of principal views of the subject.
- Oblique Projections: actually show the full size of one view.
- Axonometric Projections: are three-dimensional drawings, and are of three different varieties:  
Isometric, Dimetric and Trimetric.

## Orthographic Projections

- Orthographic projections are drawings where the projectors, the observer or station point remain parallel to each other and perpendicular to the plane of projection.
- Orthographic projections are further subdivided into axonometric projections and multi-view projections.
- Effective in technical representation of objects.



## Oblique Projections

- *Projectors* are parallel to each other but not perpendicular to *projection plane*.
- An oblique projection shows front and top surfaces that include the three dimensions of height, width, and depth.
- The front or principal surface of an object (the surface toward the plane of projection) is parallel to the plane of projection.
- Effective in pictorially representing objects.

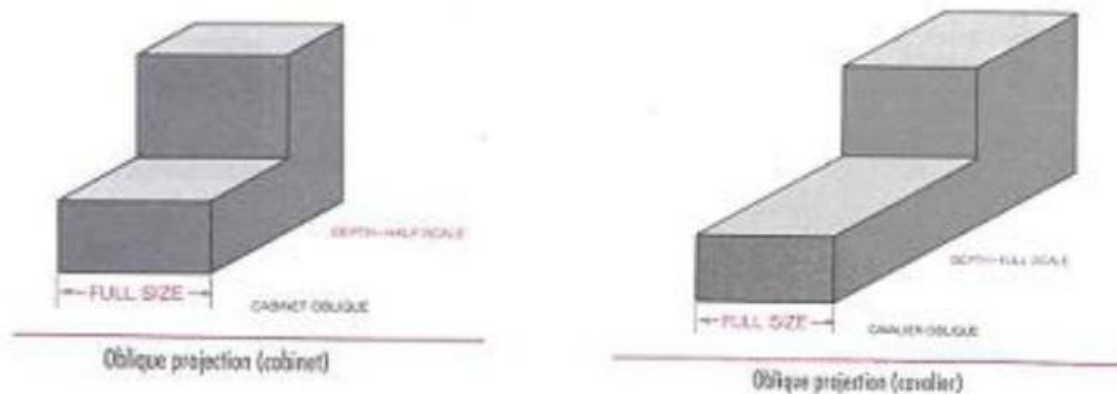
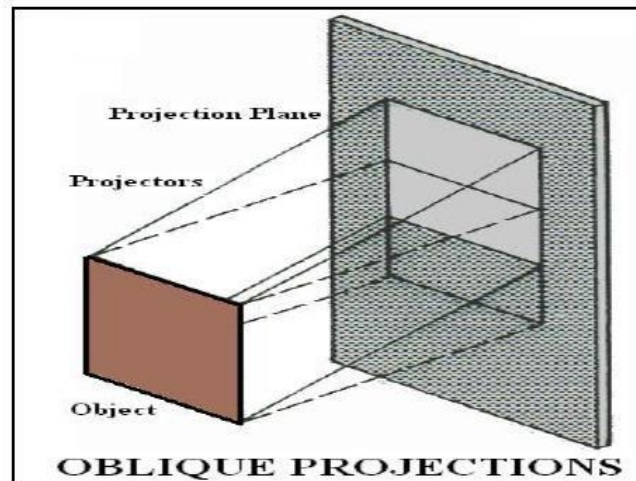
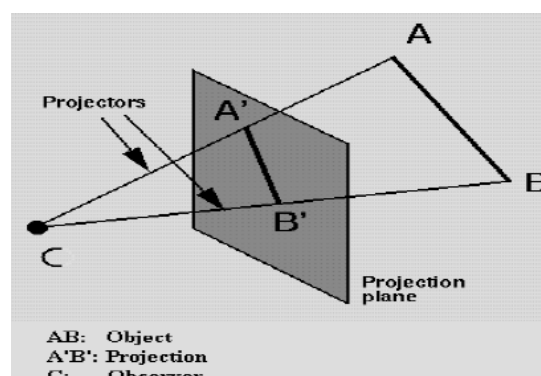


Figure: Oblique drawing

## Perspective Projections





Perspective projections are drawings which attempt to replicate what the human eye actually sees when it views an object. There are three types of perspective projections: One-point, Two-point and Three-point Projections.

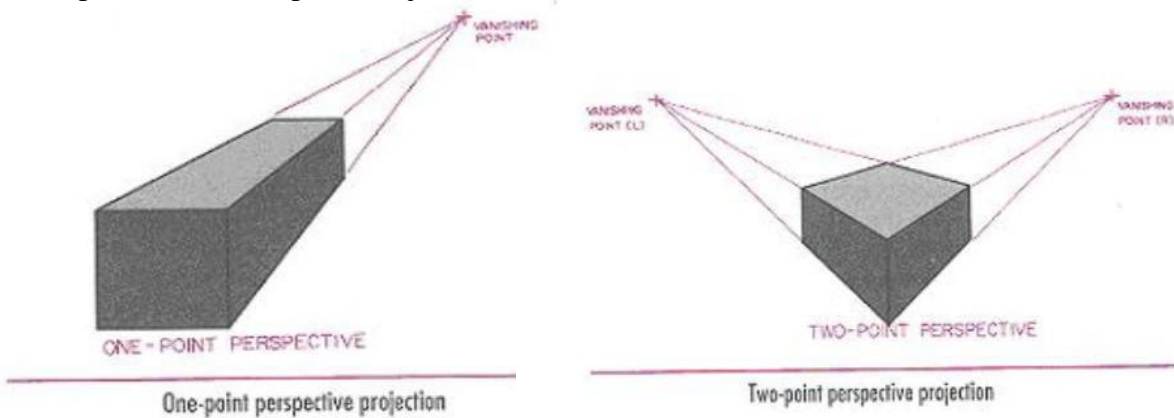
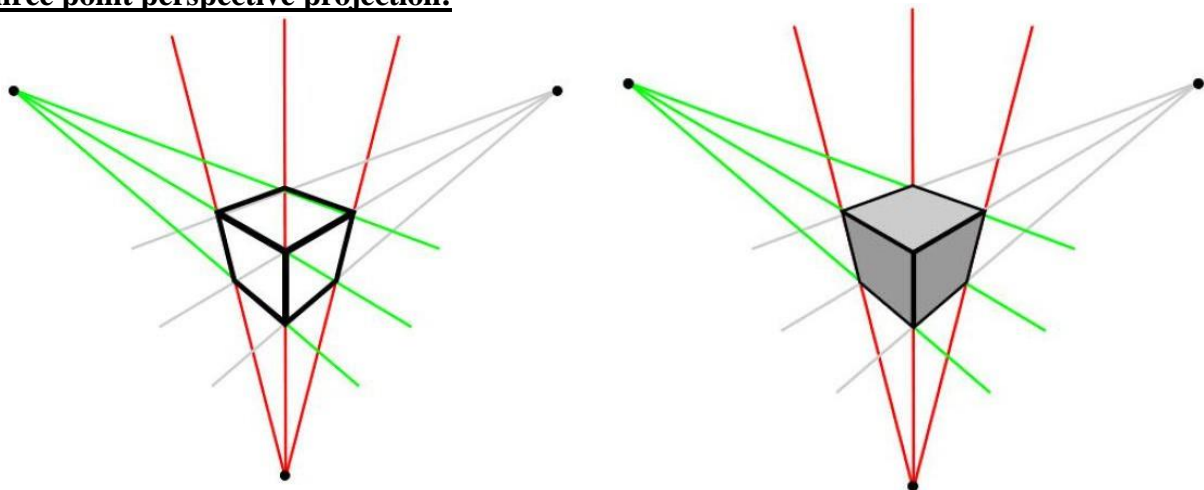


Figure: Perspective projection

**Three point perspective projection:**



Some real world examples of one 1 point, 2 point and 3 point Perspective projection:

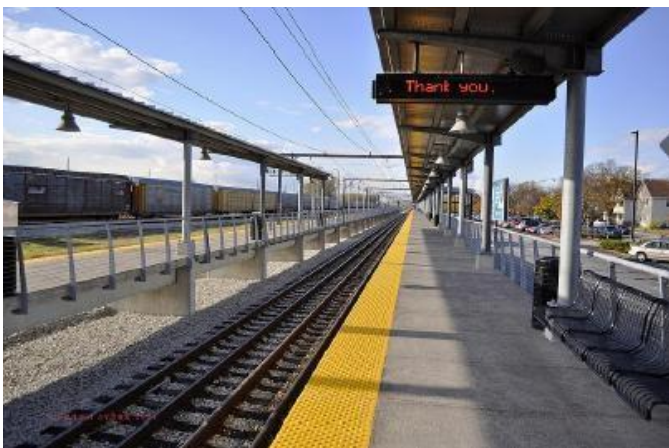




Figure: One Point Perspective Projections

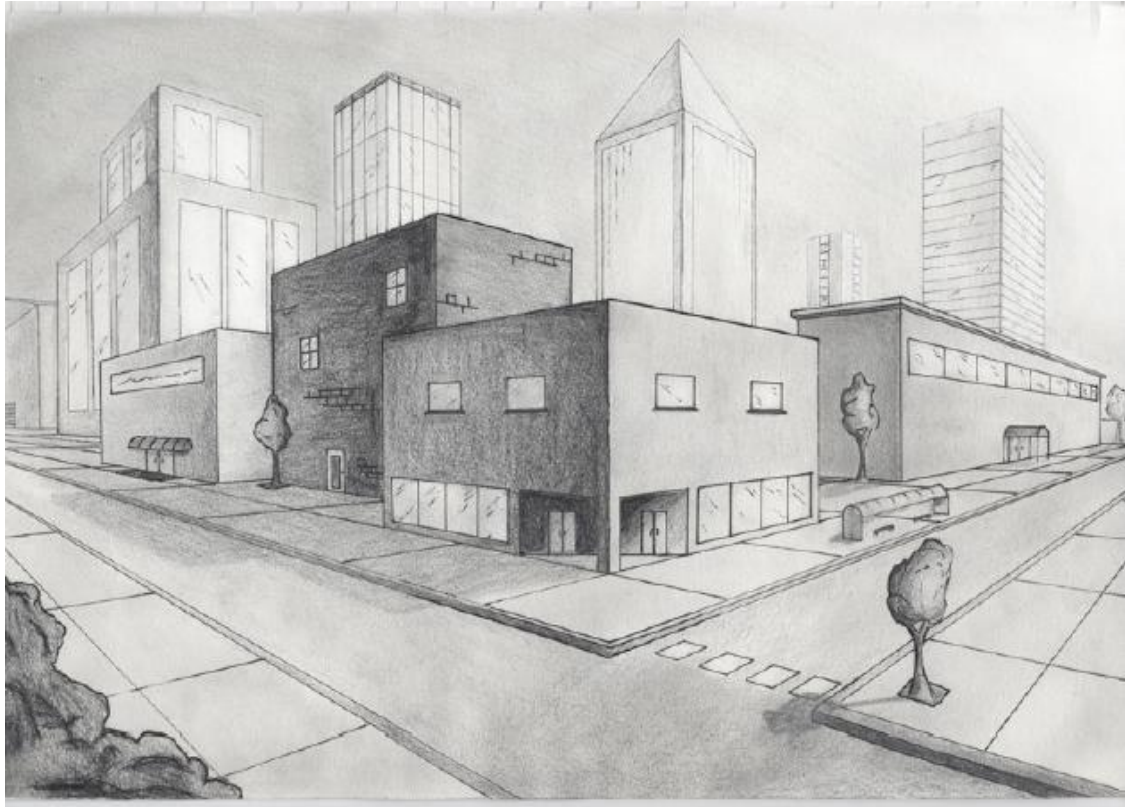


Figure: Two Point Perspective Projections



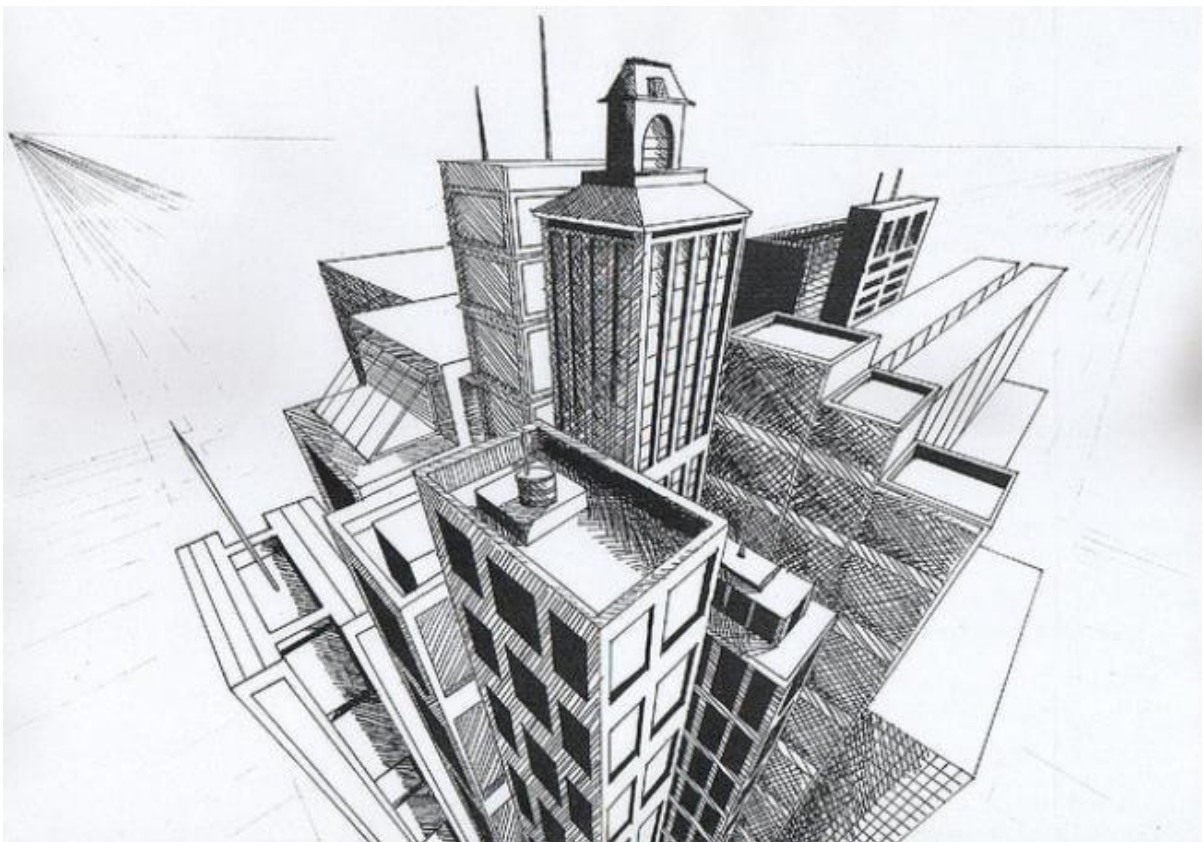
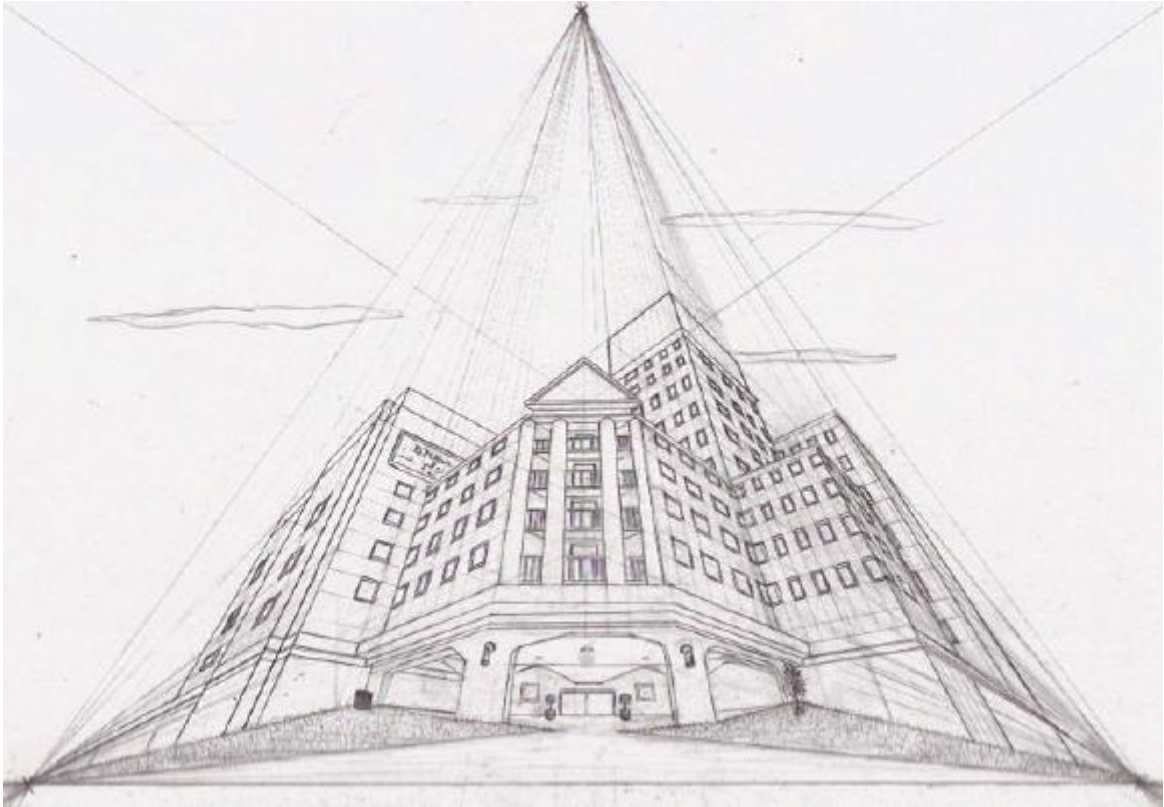
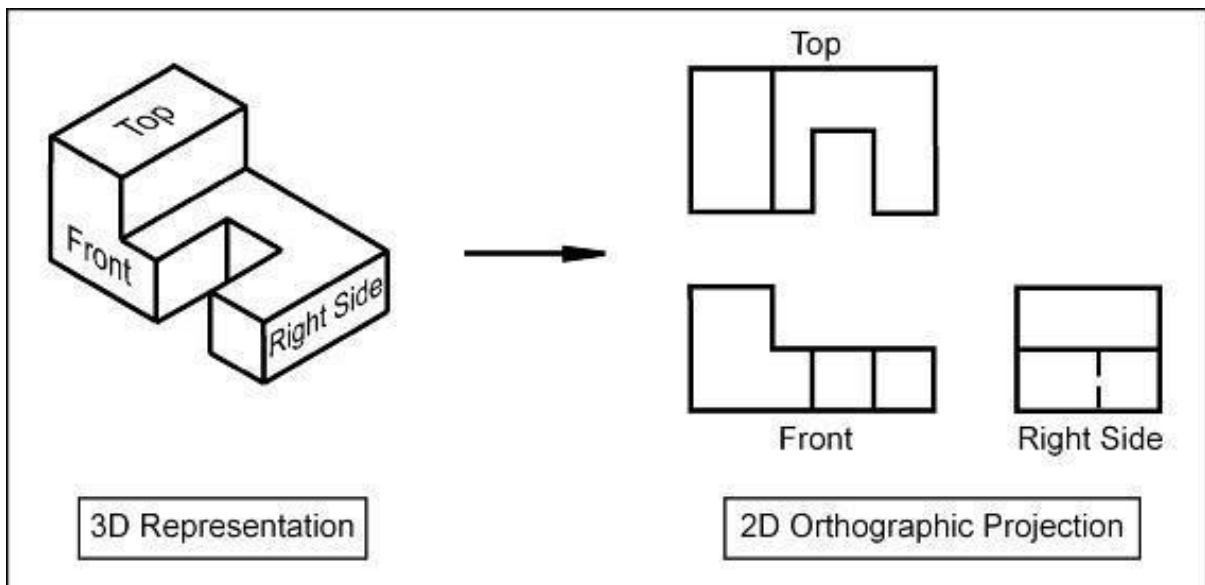




Figure: Three Point Perspective Projections

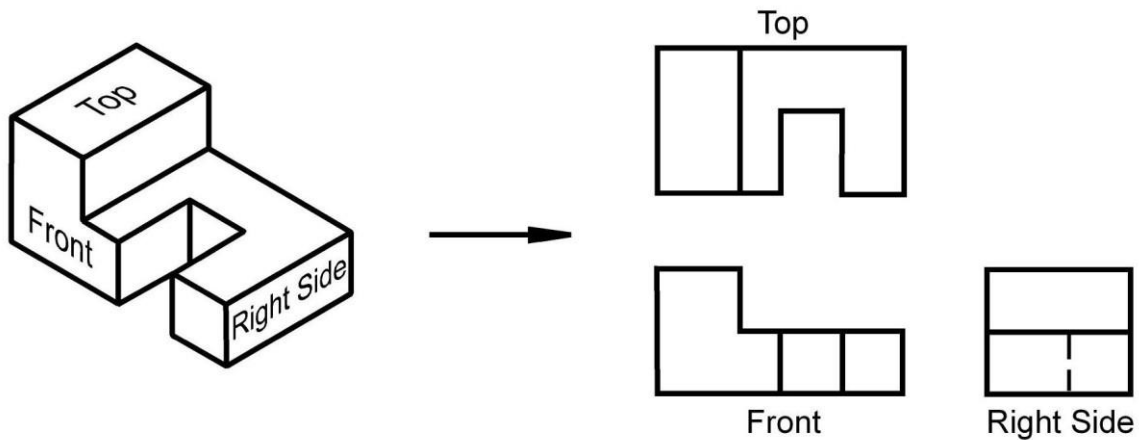
# (Week 9)

## Orthographic Projections and Isometric Drawing



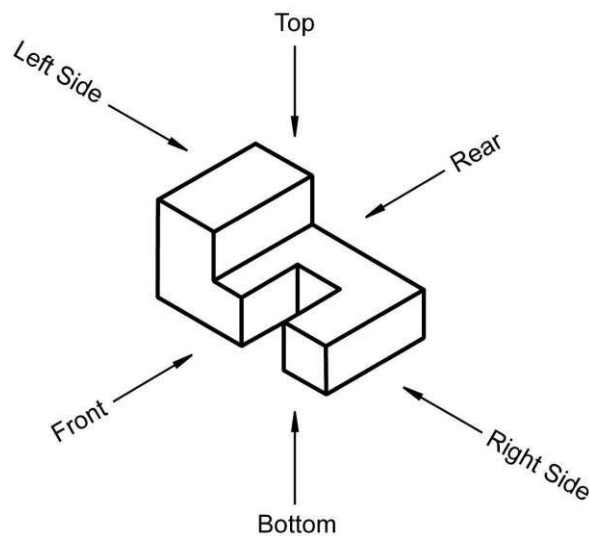
## Introduction

Orthographic projection = 2-D representation of a 3-D object.



## The Six Principal Views

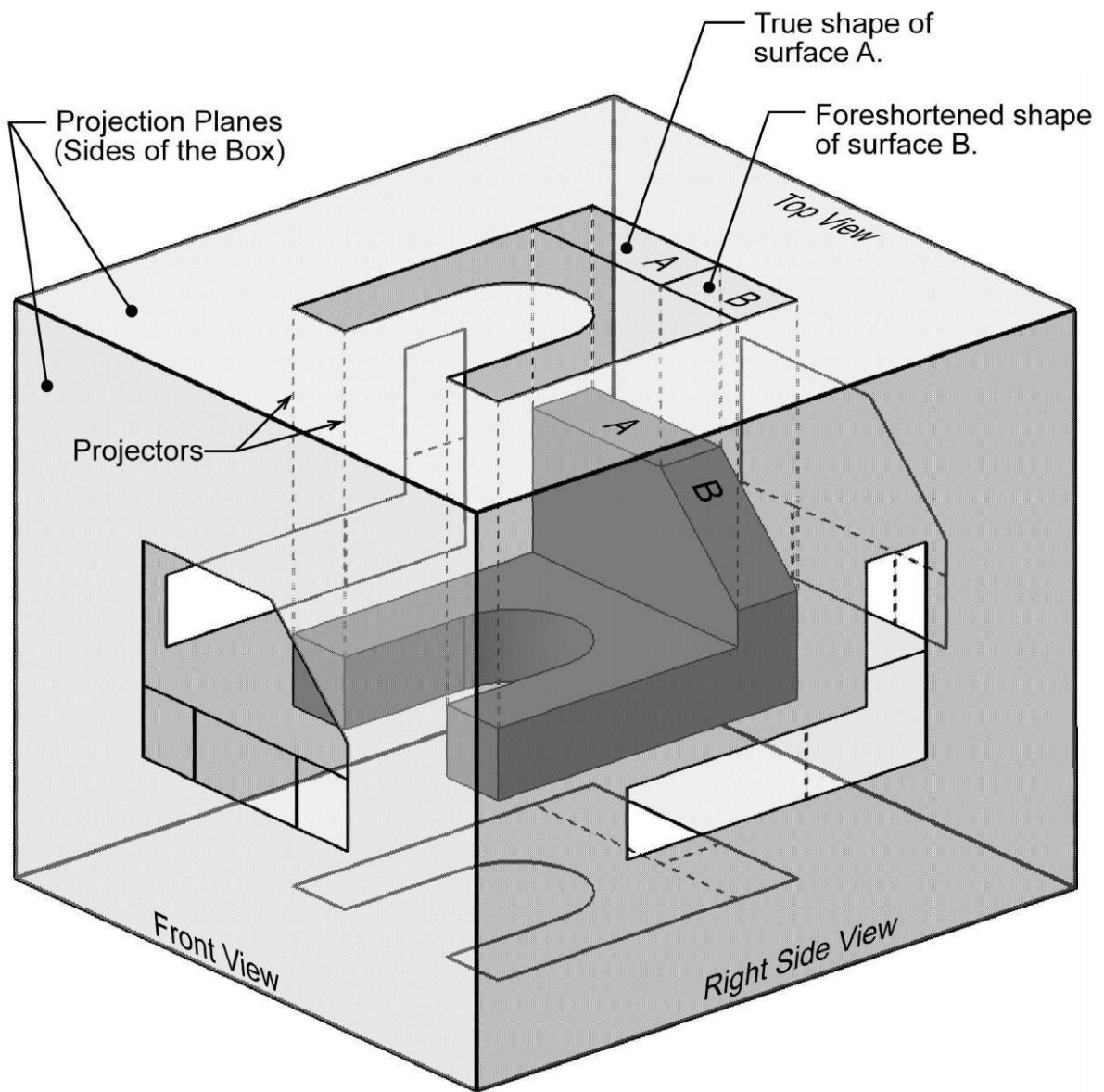
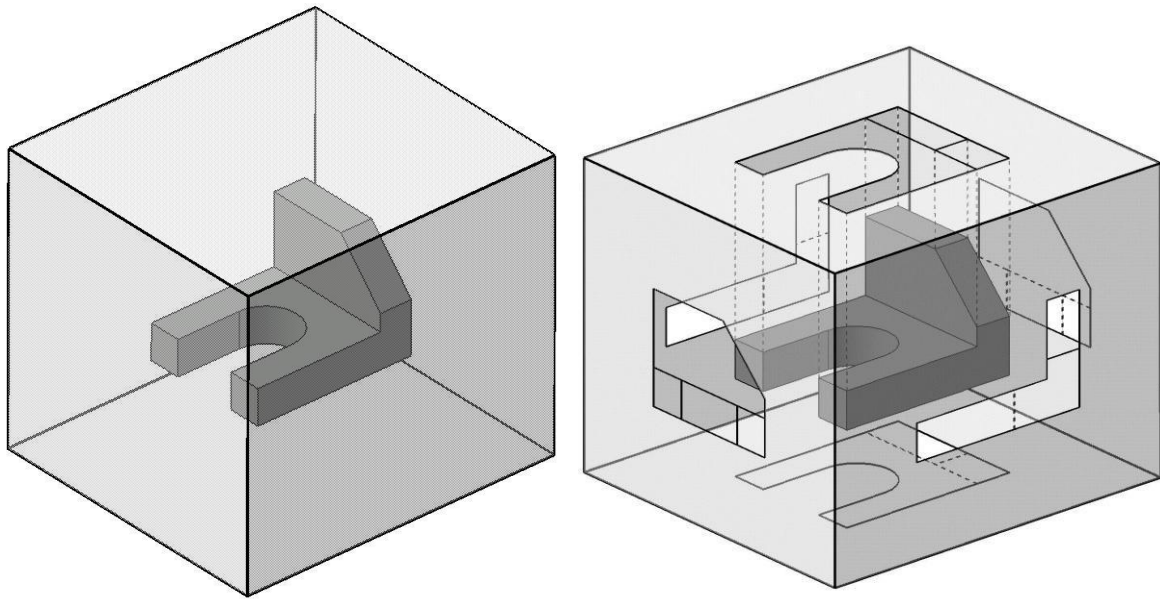
The 6 principal views are created by looking at the object, straight on, in the directions indicated.

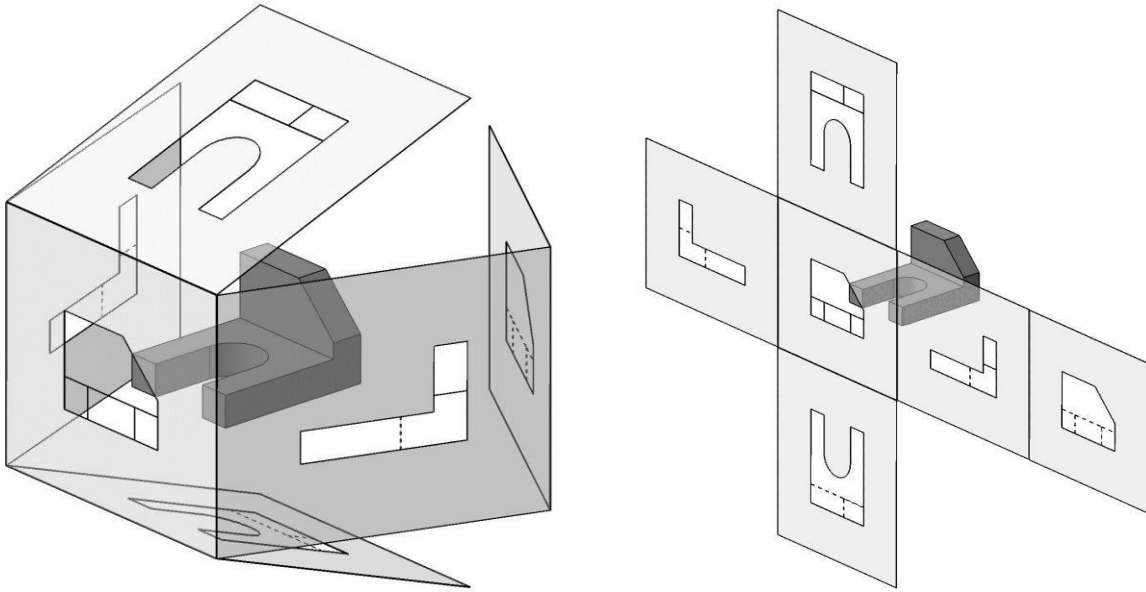


## The Glass Box Method

- The object is placed in a glass box.
- The sides of the box represent the 6 principal planes.
- The image of the object is projected on the sides of the box.
- Things to notice:
  - The projection planes.
  - The projectors.
  - How surfaces A and B are projected.
- The box is unfolded creating the 6 principal views.







### **Standard Views**

When constructing an orthographic projection, we need to include enough views to completely describe the true shape of the part.

- Complex part = more views
- Simple part = less views

### **Front View**

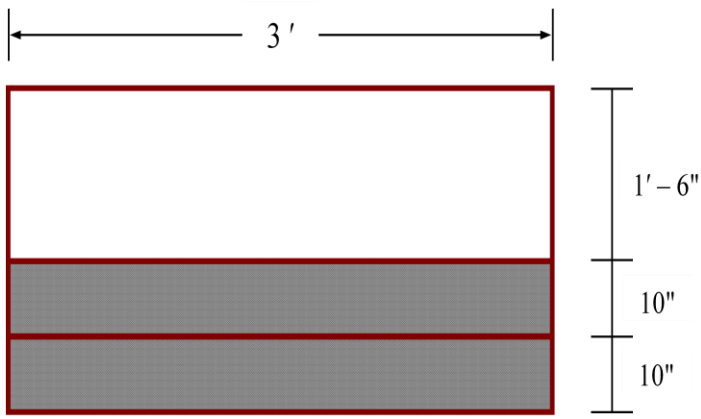
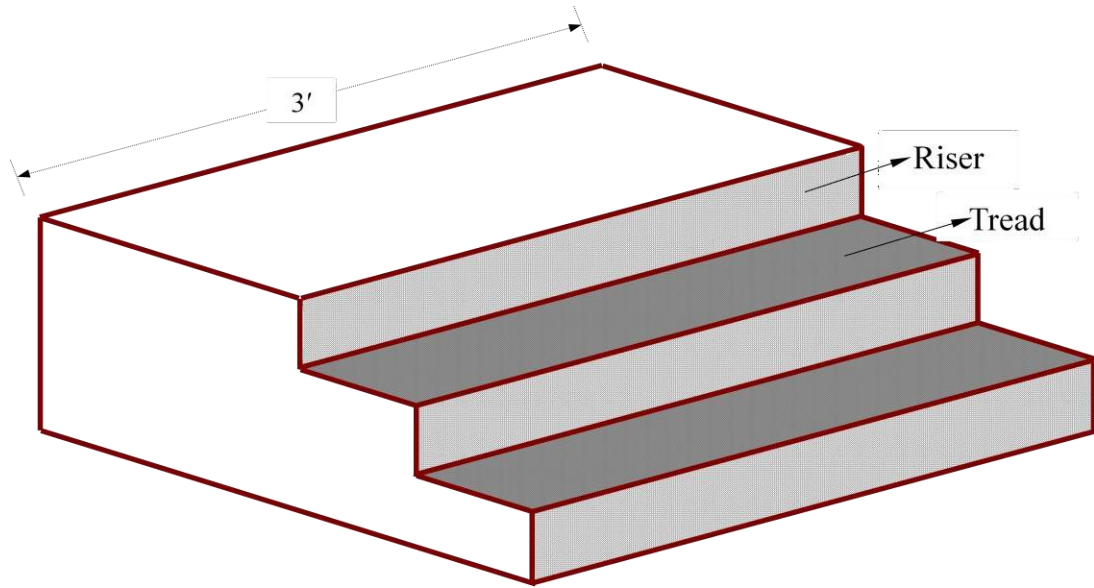
The front view shows the most features or characteristics of the object.

- It usually contains the least amount of hidden lines.
- The front view is chosen first and the other views are based on the orientation of the front view.

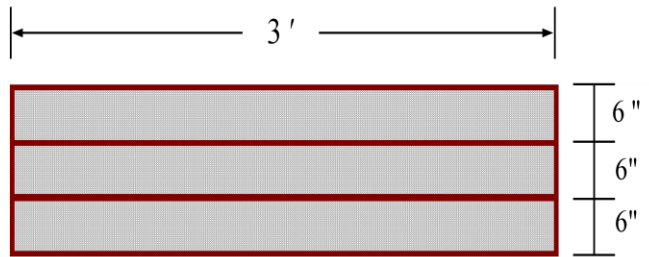
### **View Alignment**

- The top and front views are aligned vertically and share the same width dimension.
- The front and right side views are aligned horizontally and share the same height dimension.

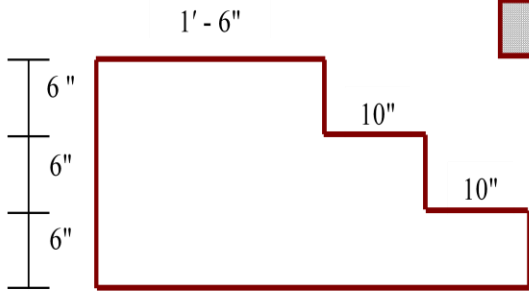
1.



TOP VIEW

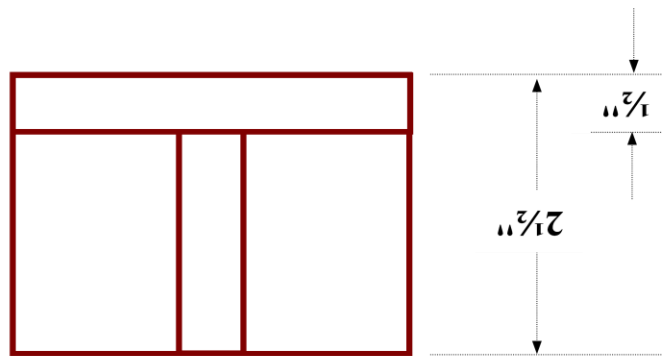
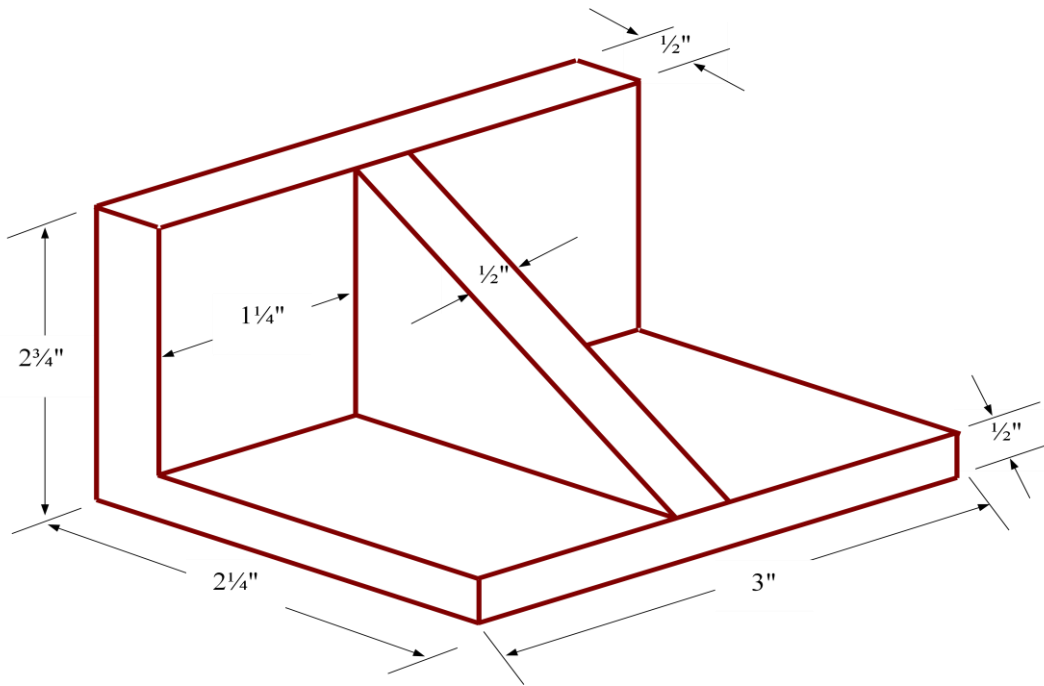


FRONT VIEW

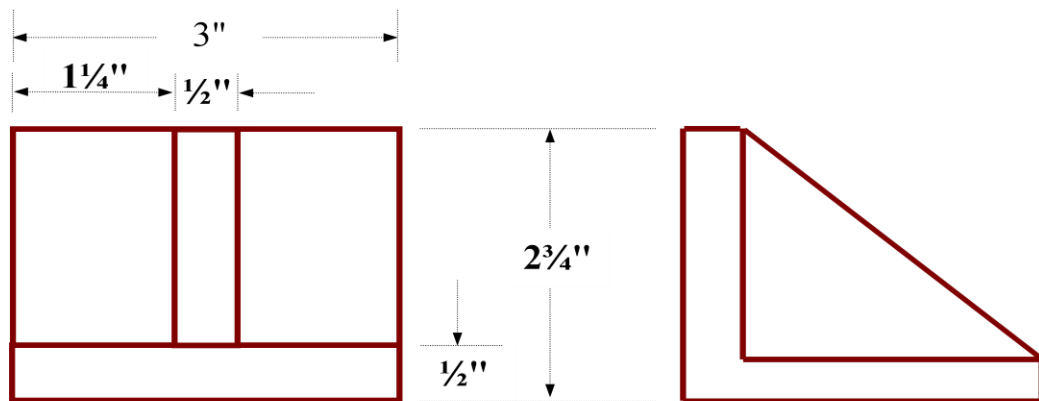


LEFT VIEW

2.



**TOP VIEW**

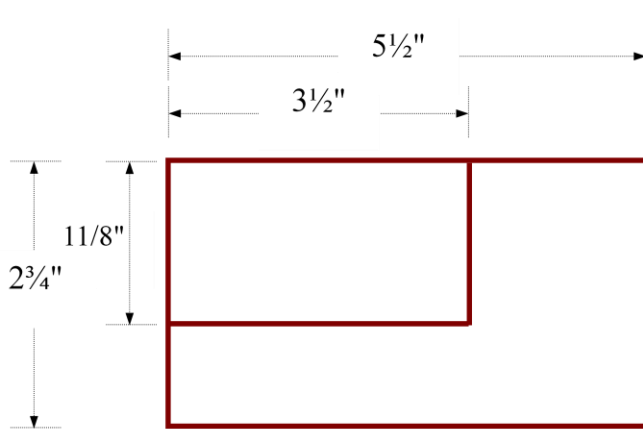
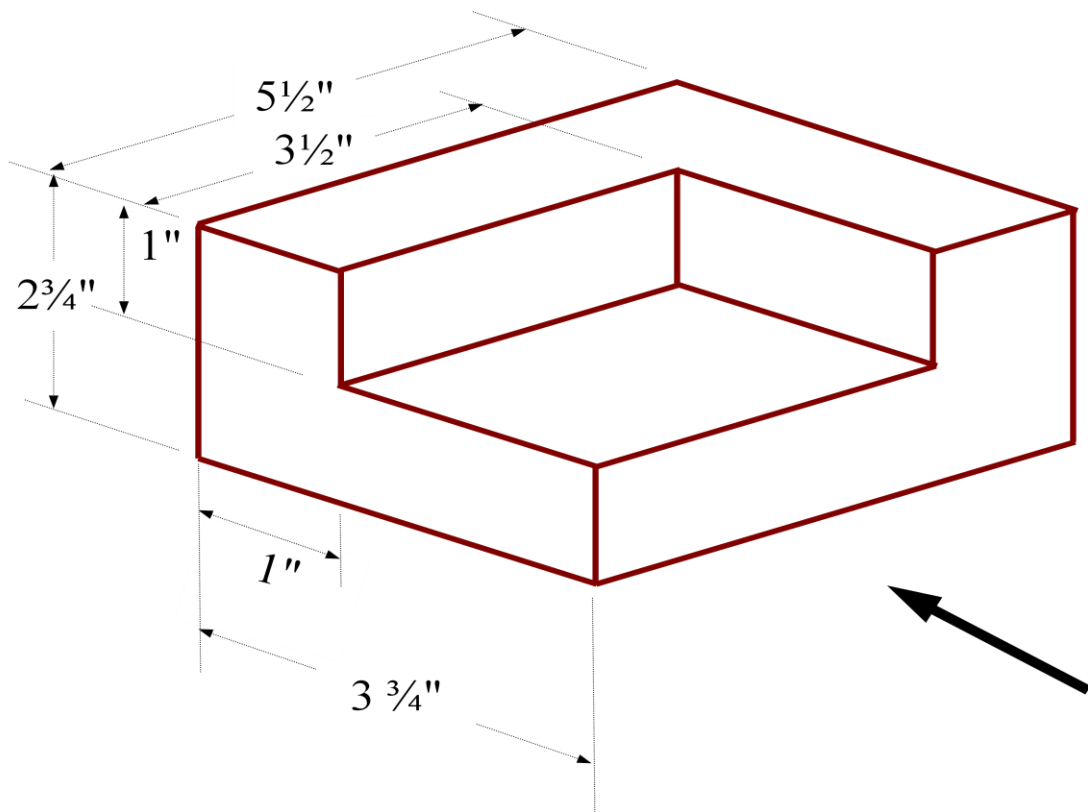


**FRONT VIEW**

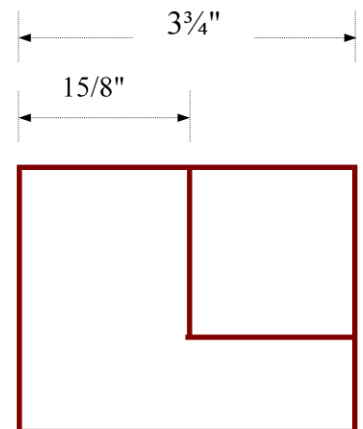
**LEFT VIEW**



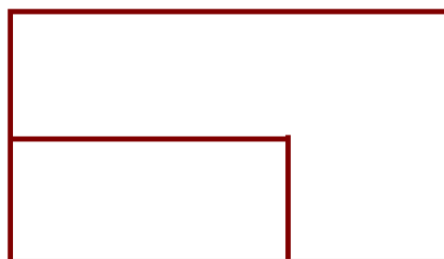
3.



**FRONT VIEW**

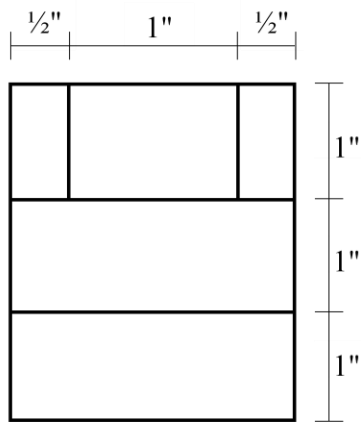
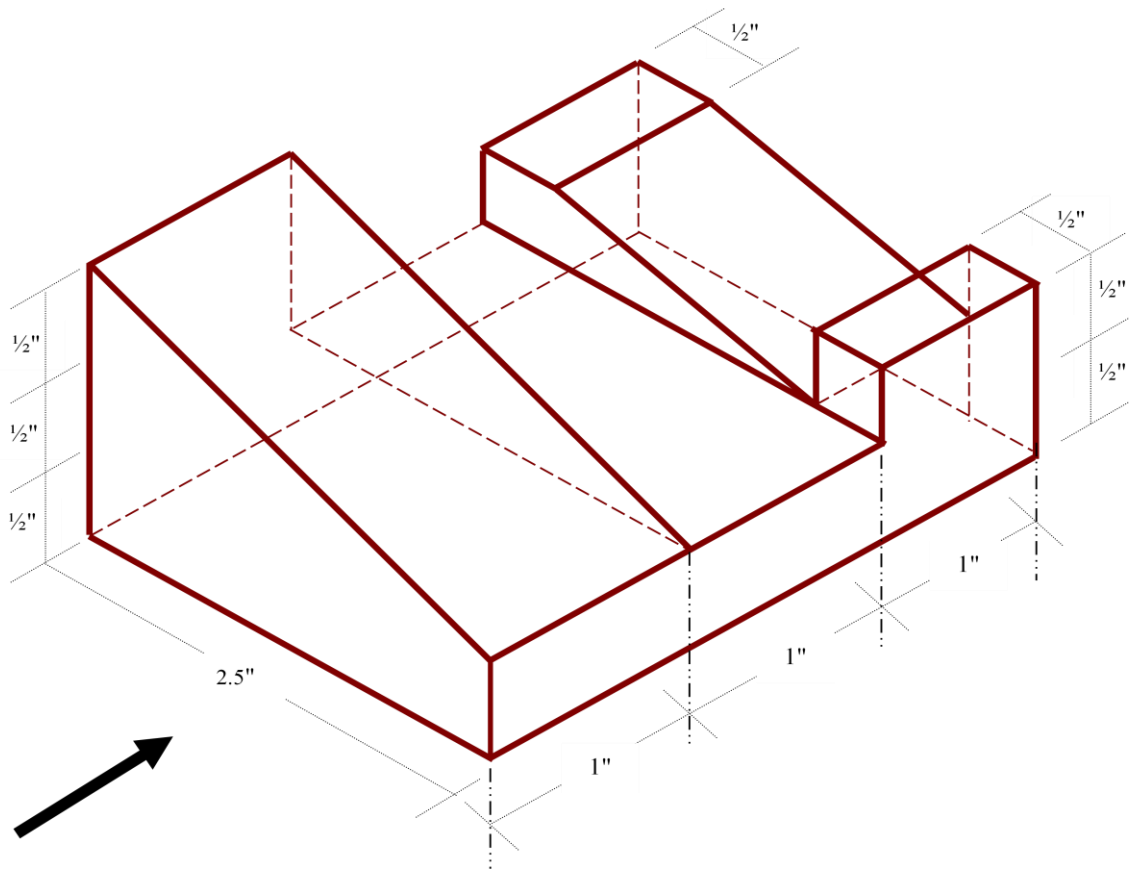


**LEFT VIEW**

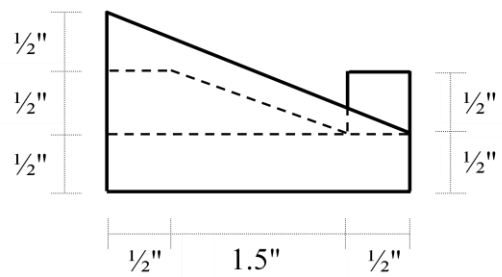


**TOP VIEW**

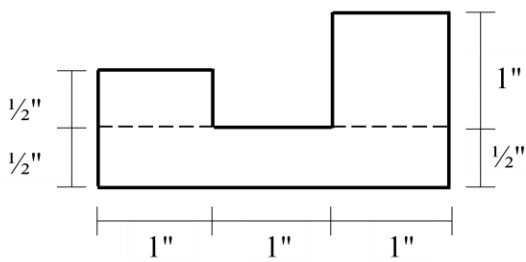
4.



**TOP VIEW**

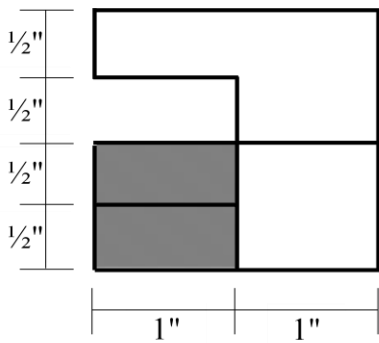
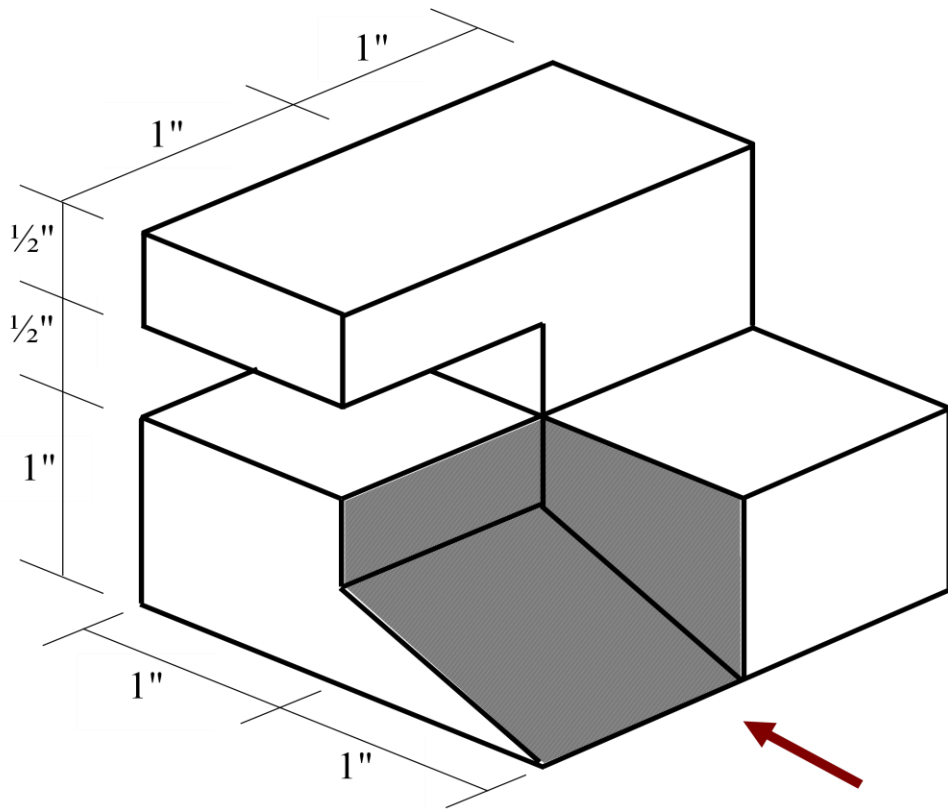


**FRONT VIEW**

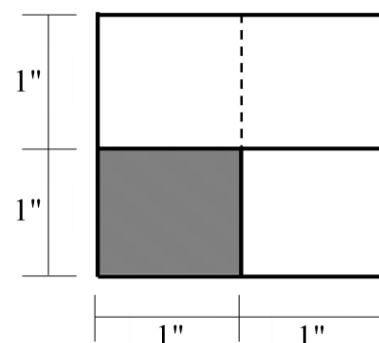


**LEFT VIEW**

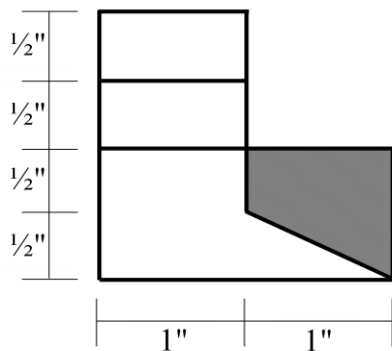
5.



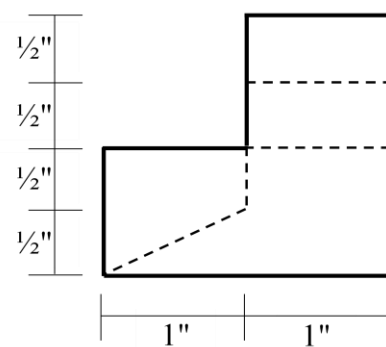
**FRONT VIEW**



**TOP VIEW**

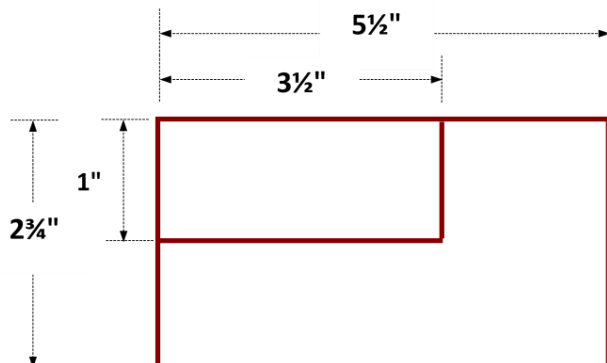
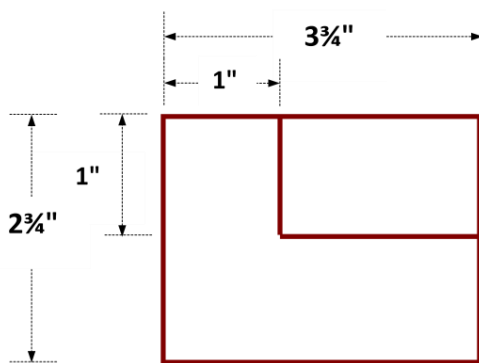
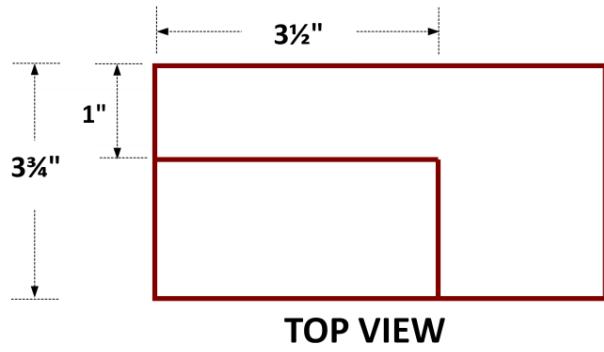
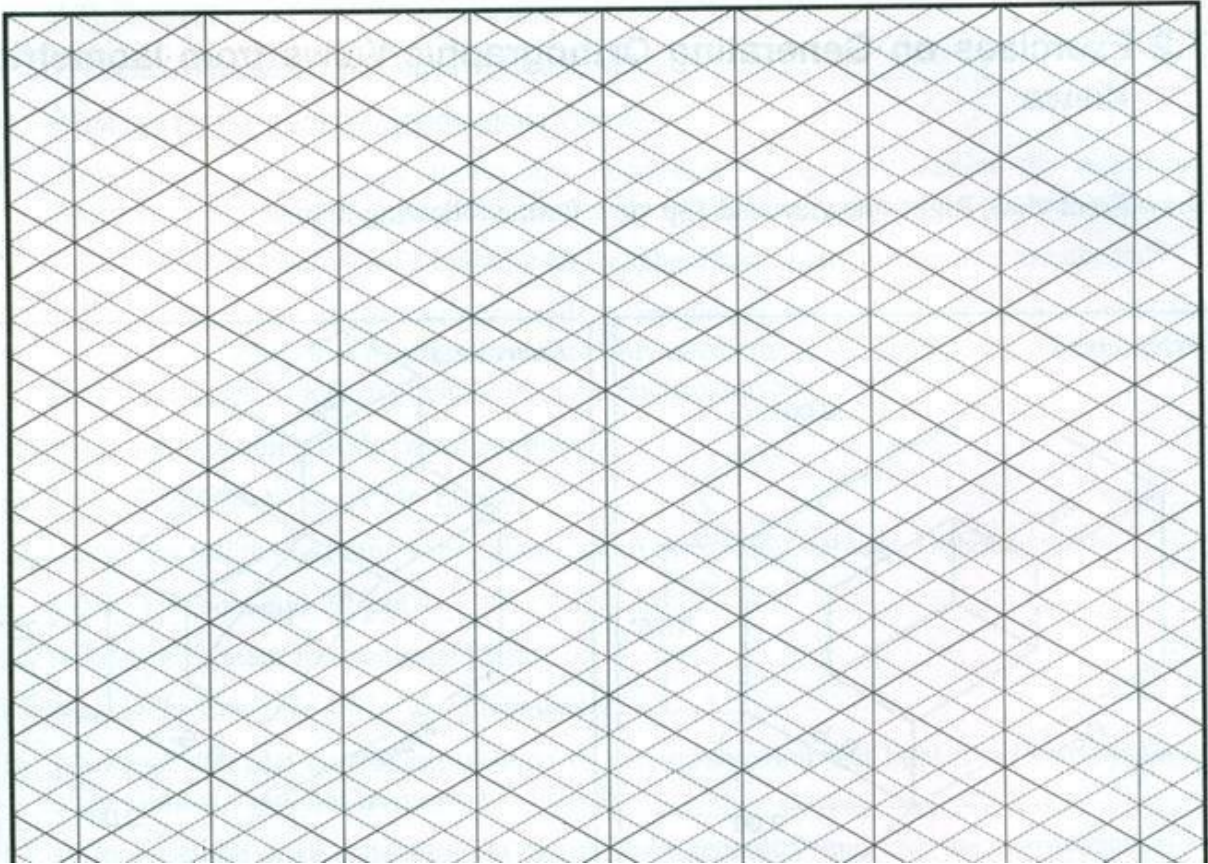


**LEFT VIEW**

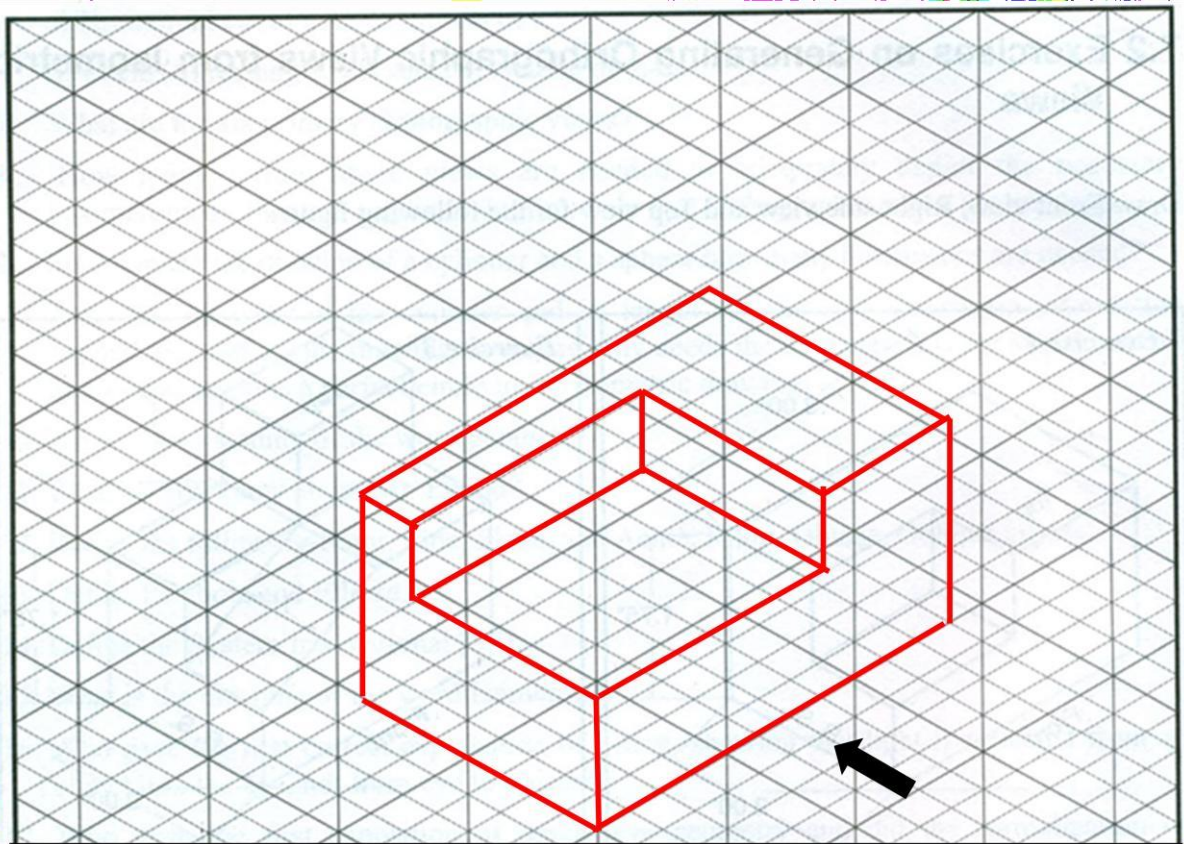
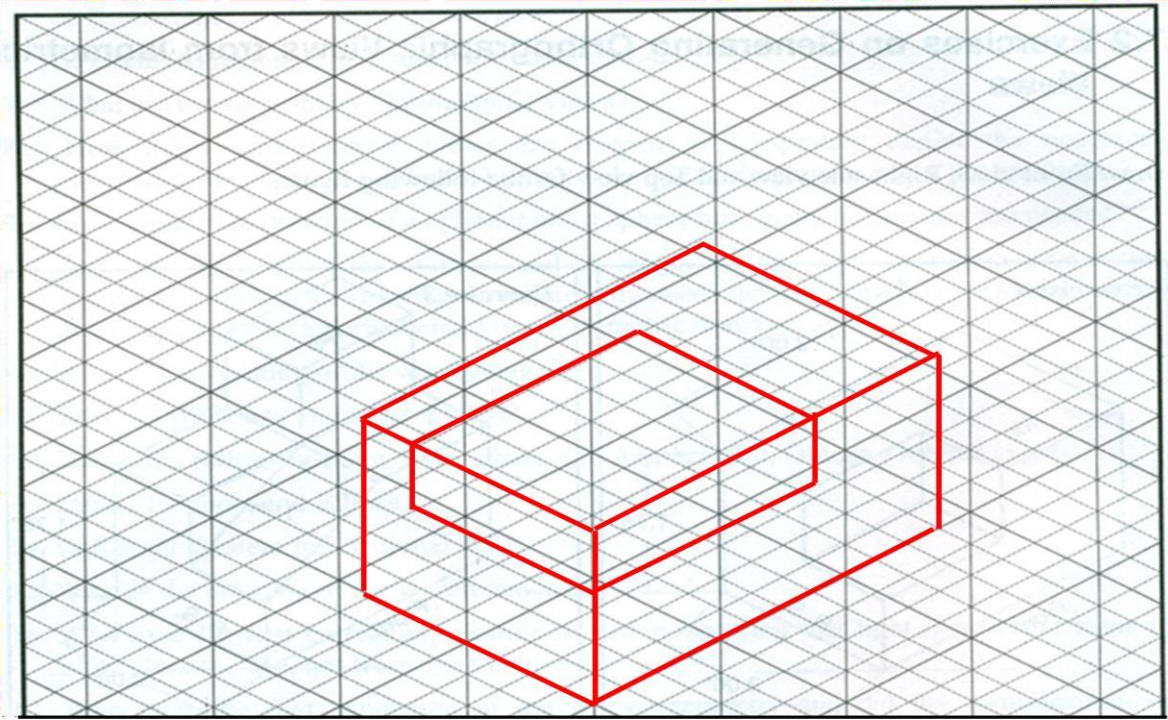


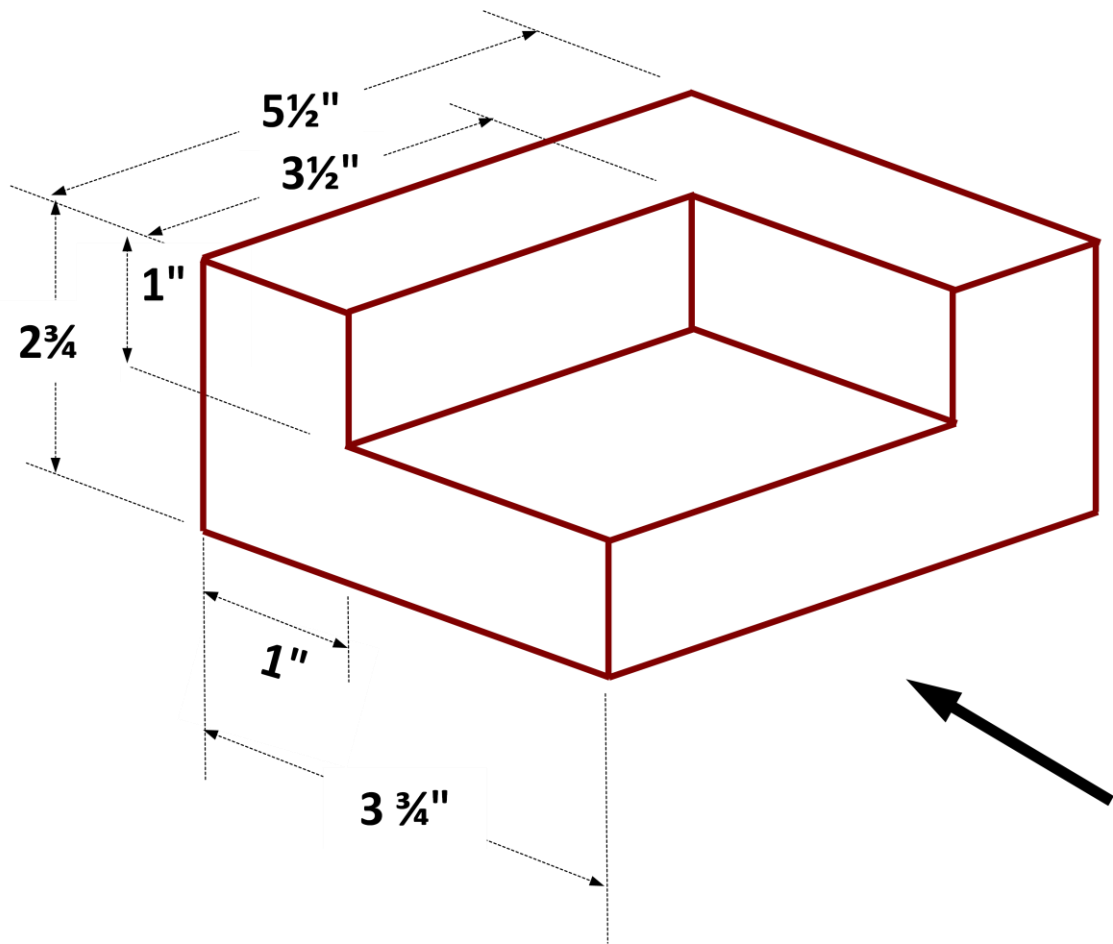
**RIGHT VIEW**

# Orthographic to Isometric Drawing

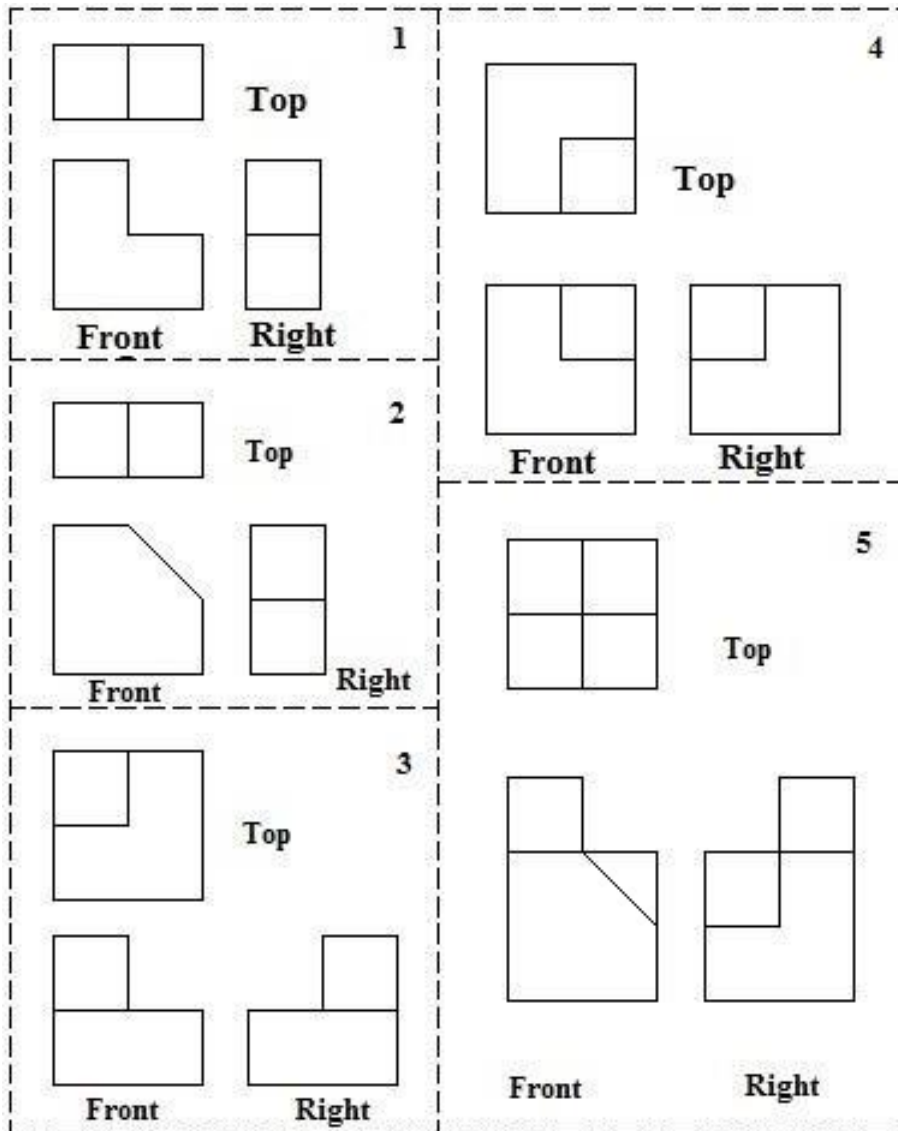








# Assignment

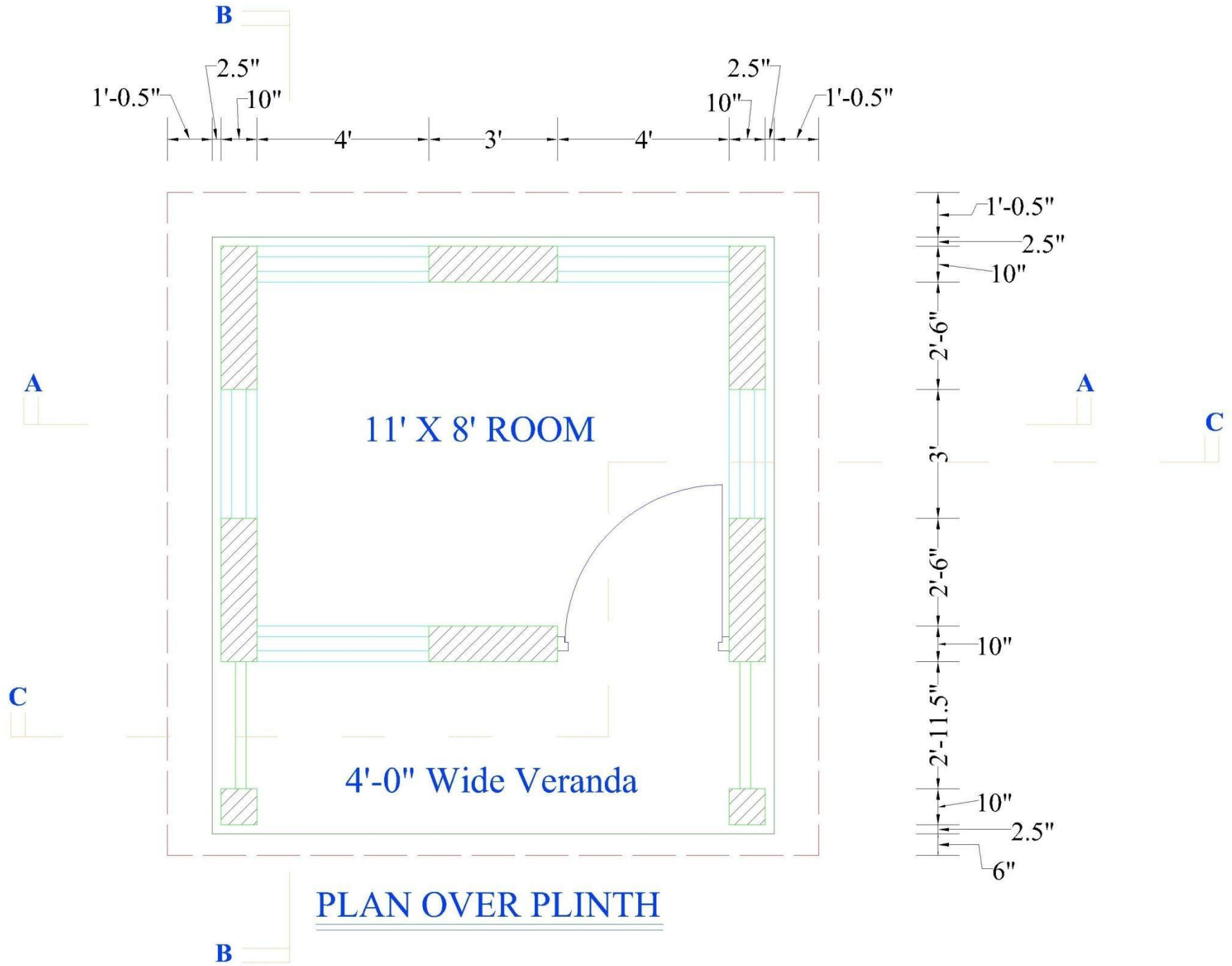


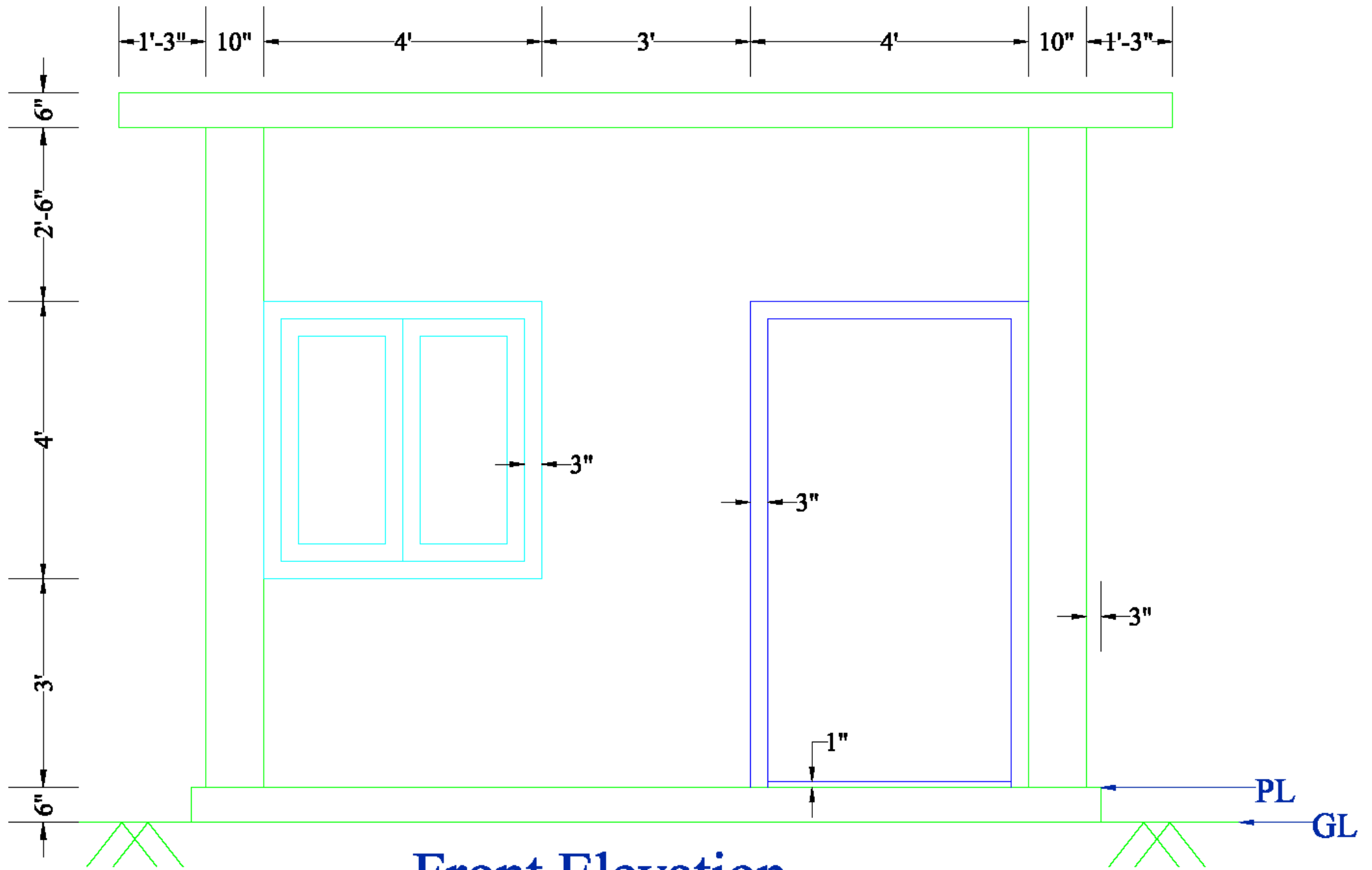


**(Week 10-11)**  
**Structural drawing – Plan view, Elevation view and Cross sectional view**

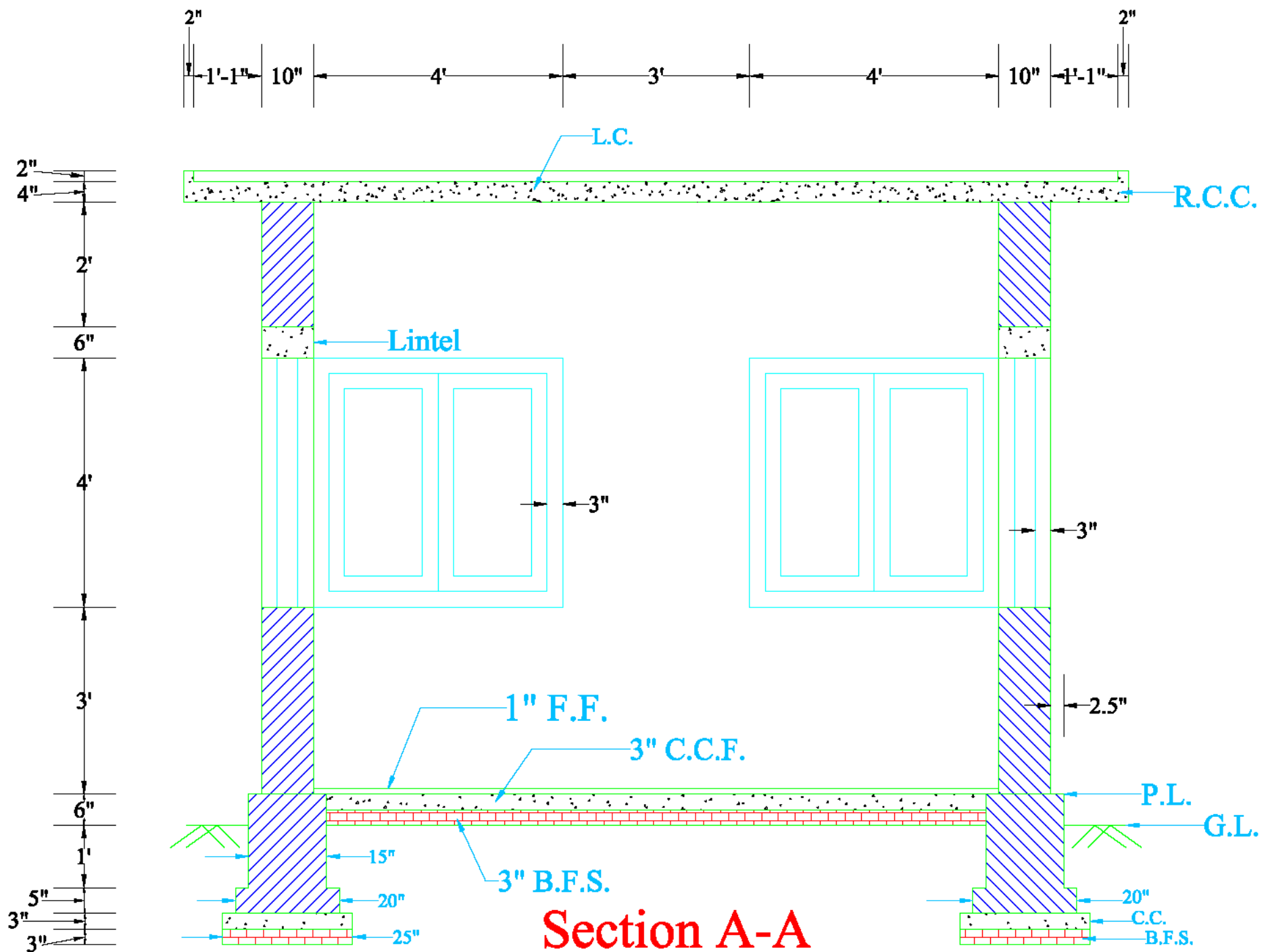




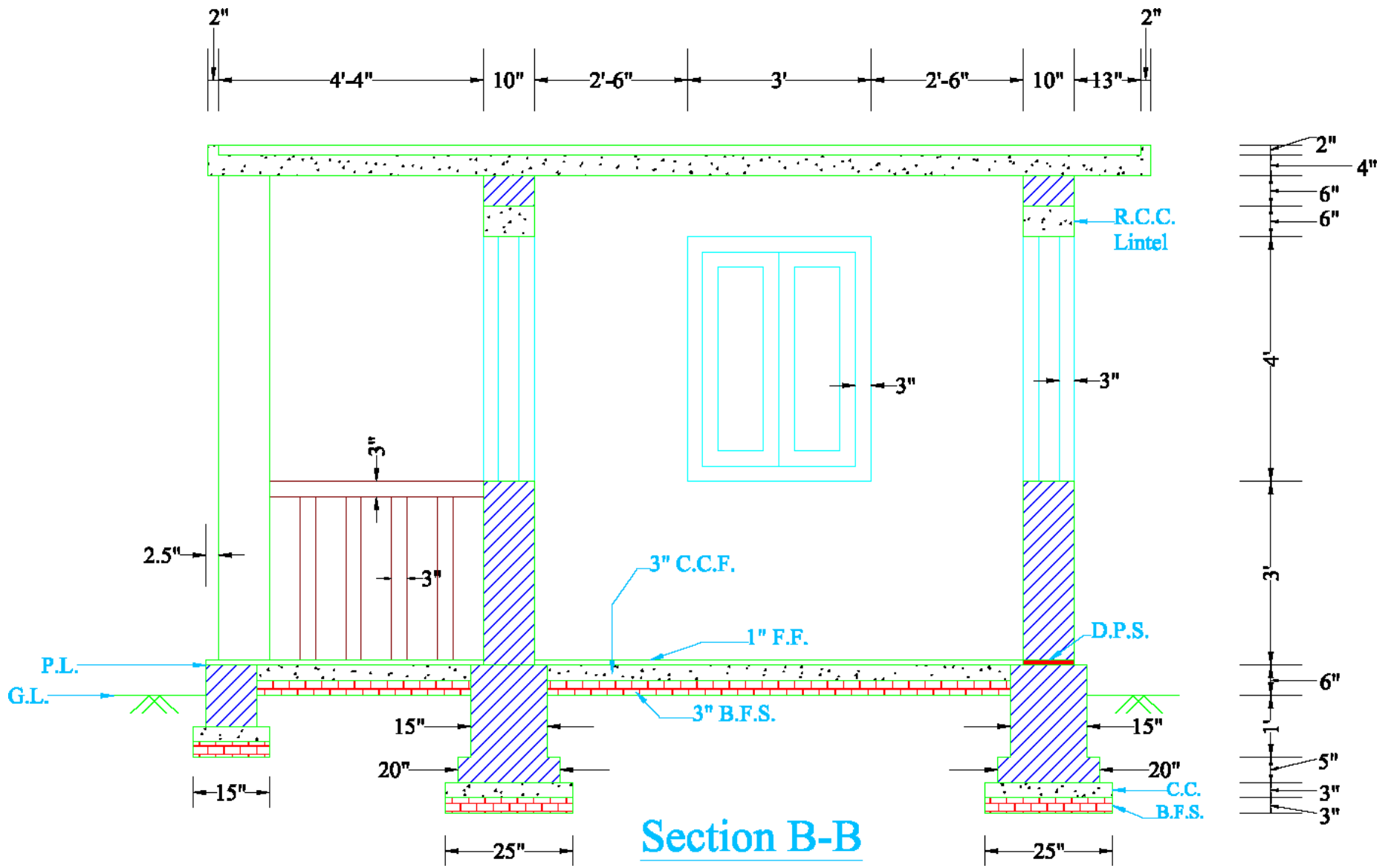


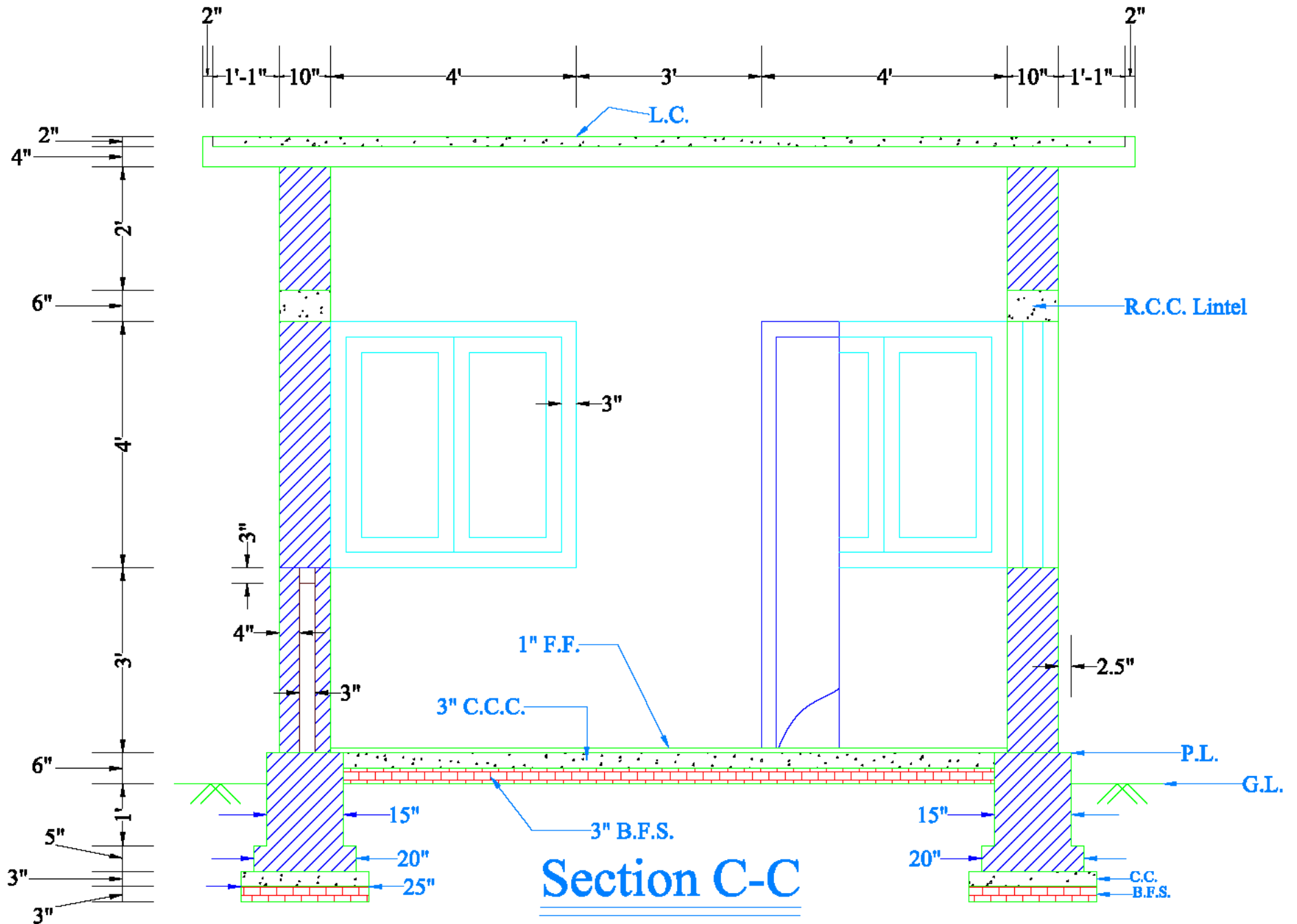


Front Elevation



## Section A-A

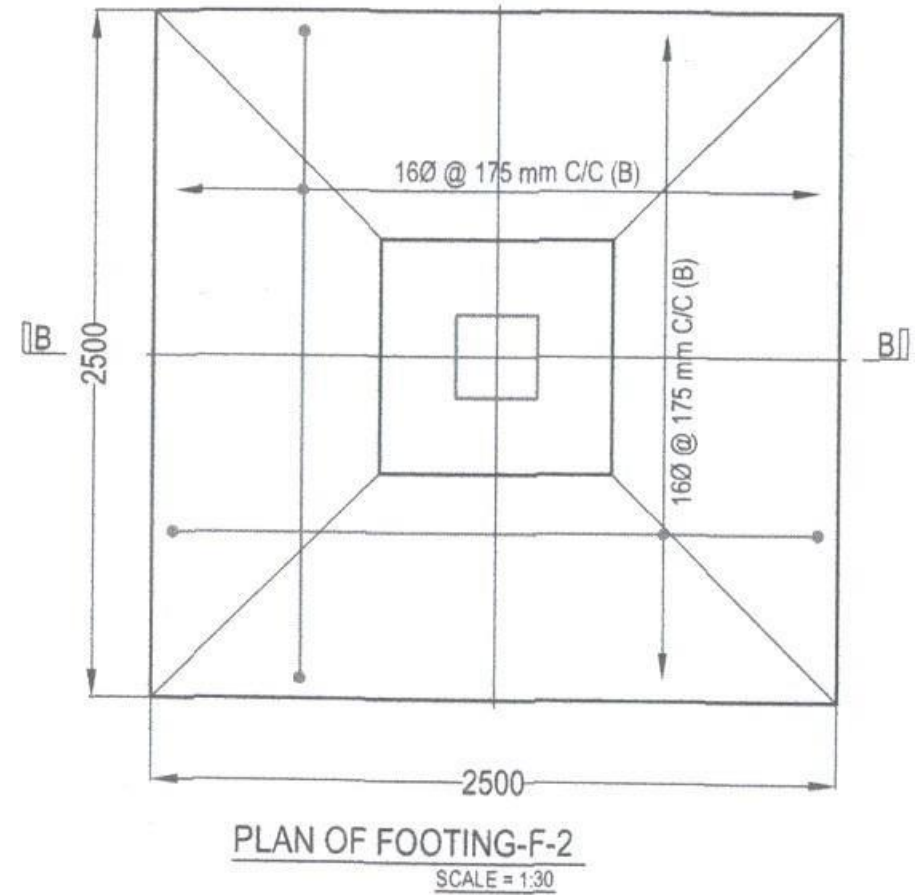
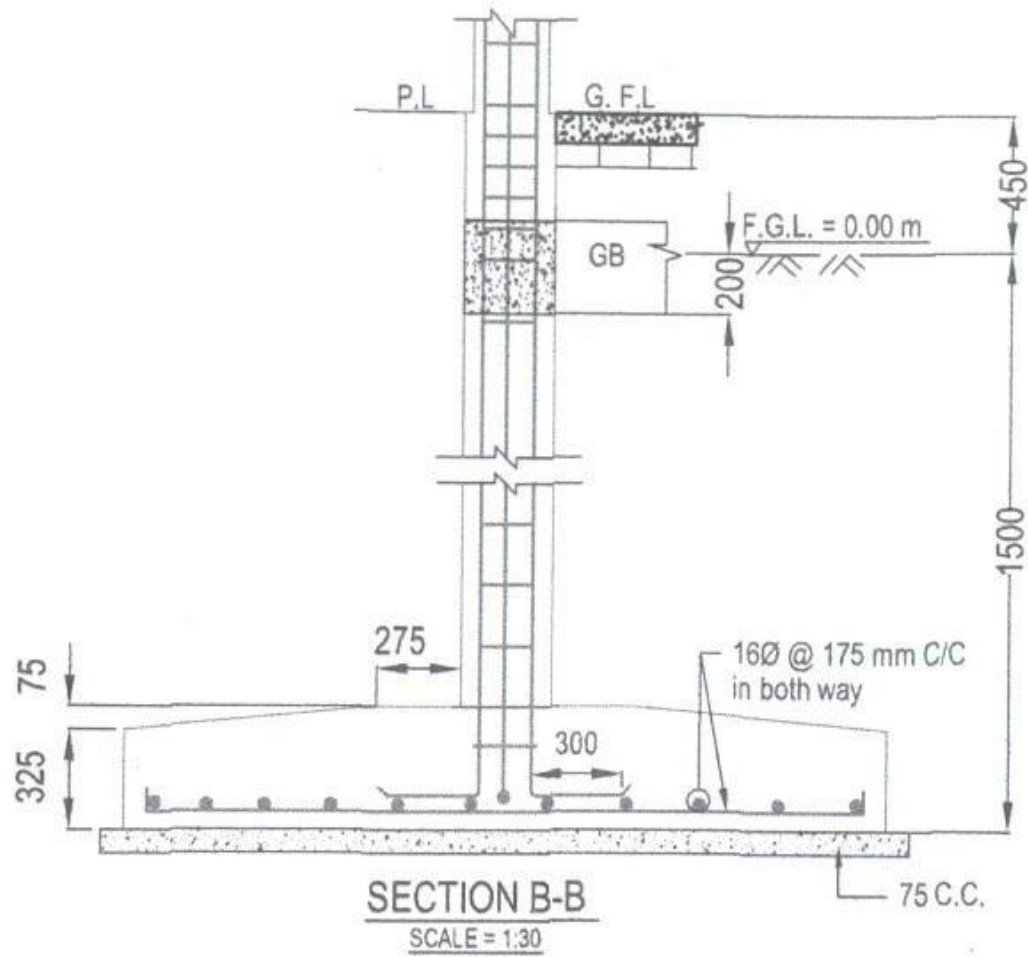




**(Week 12-13)**

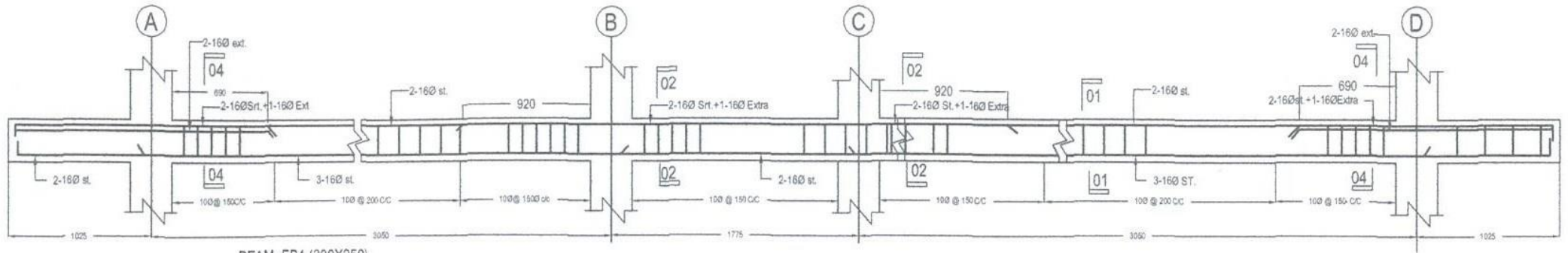
**Structural drawing –Isolated footing and beam  
longitudinal and cross sectional views**



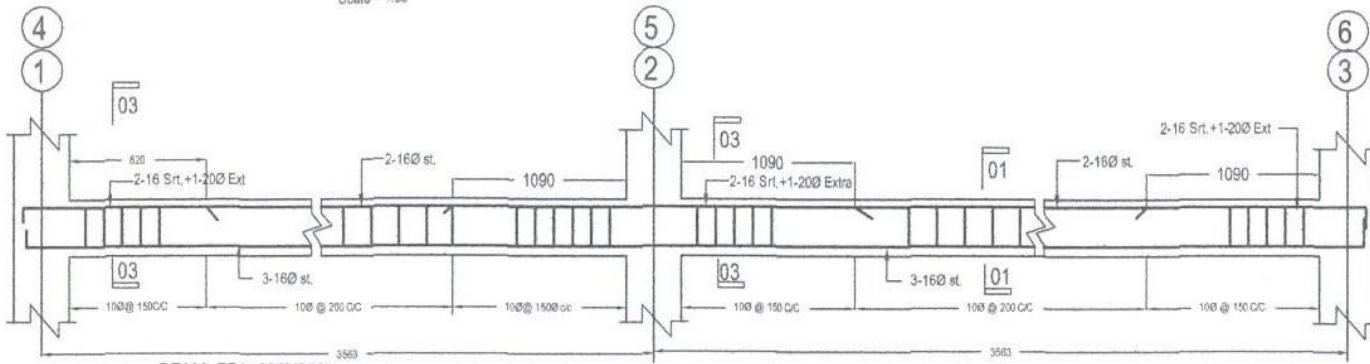


Cross Section of an Isolated column footing

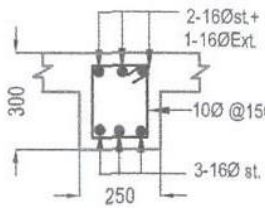




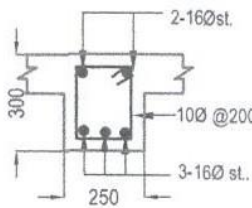
**BEAM-FB4 (300X250)**  
Scale = 1:35



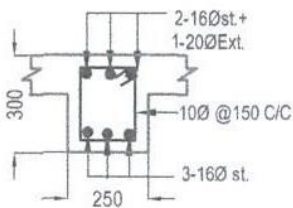
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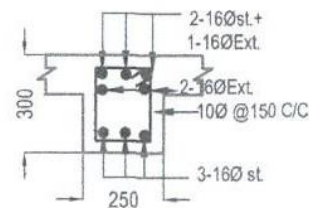
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**SEC:- 01-01**  
Scale = 1:20



**SEC:- 03-03**  
Scale = 1:20

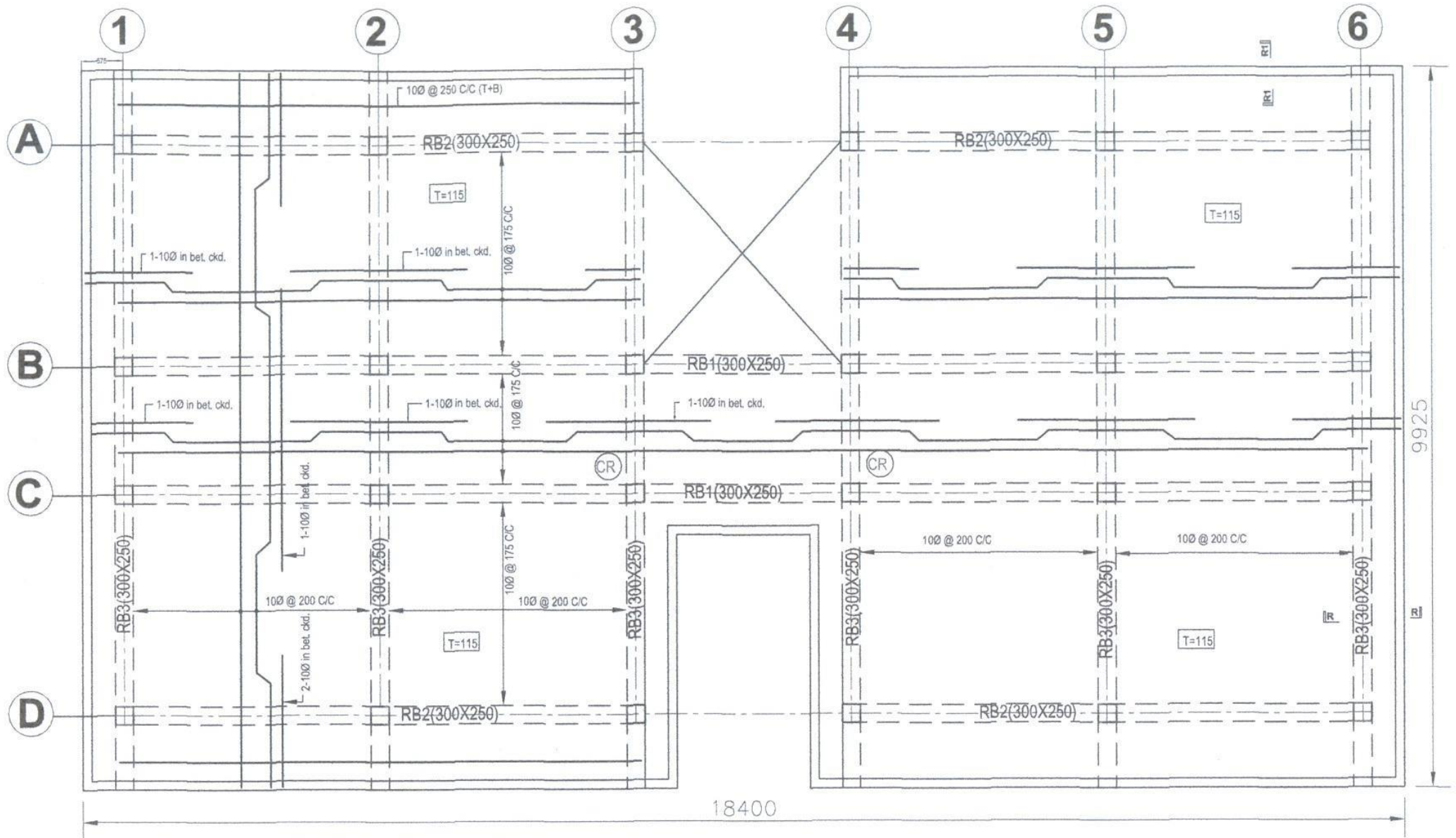


**SEC:- 04-04**  
Scale = 1:20

**(Week 14)**

**Structural drawing – Slab and Stair  
reinforcement detailing**





**REINFORCEMENT DETAILS OF ROOF SLAB.**

SCALE = 1:60



