

# **Engineering Drawings**

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Department of Civil Engineering

# CONTENT

1. Introduction
2. Drawing equipment
3. Engineering drawings



# CONTENT

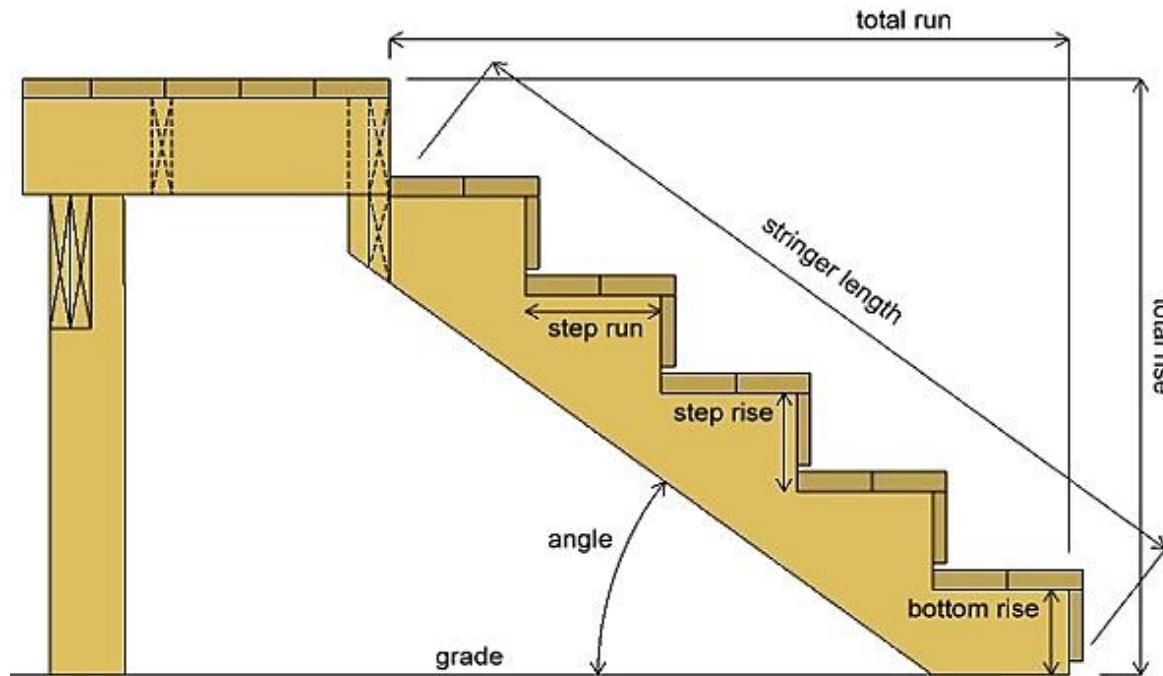
## 1. Introduction



# DRAWINGS IN ENGINEERING

## Civil Engineering

### Drop Mounted Steps

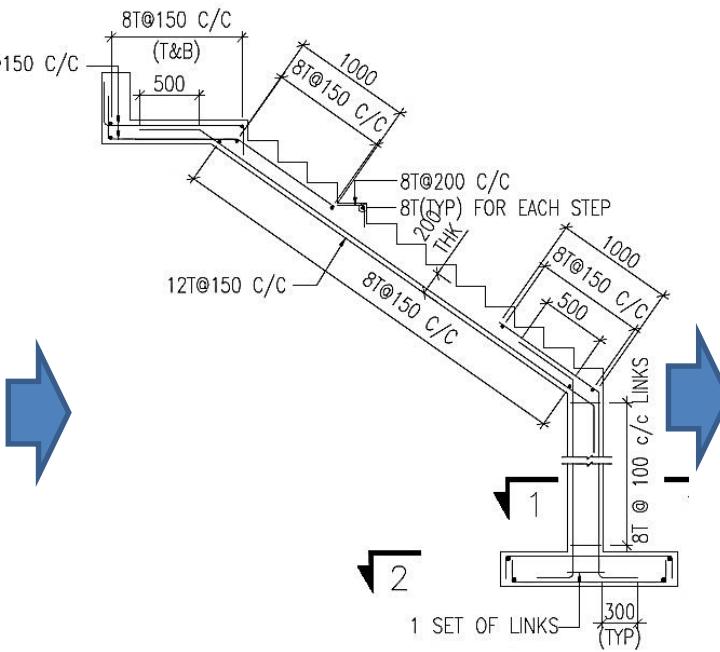


### Staircase

Can we construct this staircase without having dimensions?

# DRAWINGS IN ENGINEERING

## Civil Engineering



*Calculations*

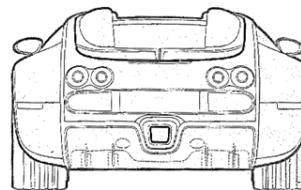
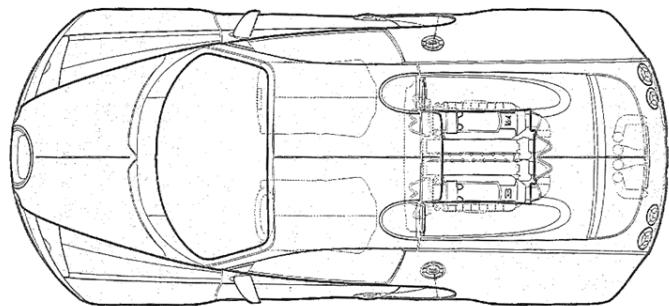
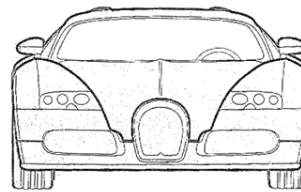
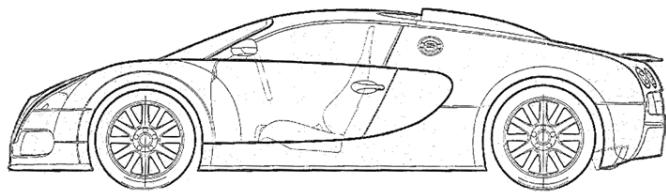
*Conversion to a Drawing*

*Construction*

**Basic Process of Engineering**

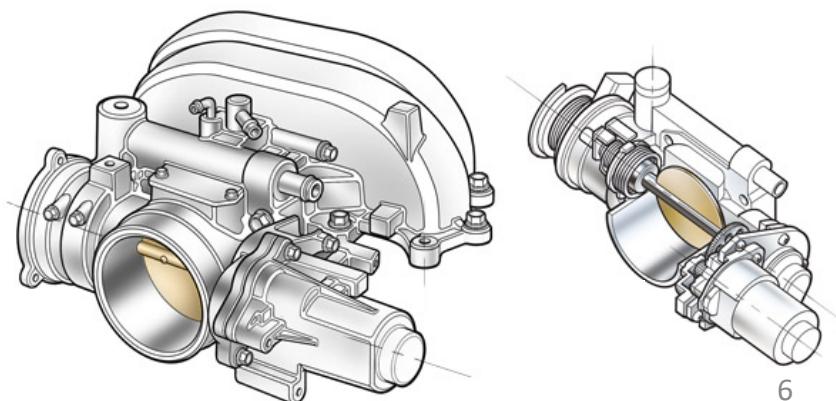
# DRAWINGS IN ENGINEERING

## Mechanical Engineering



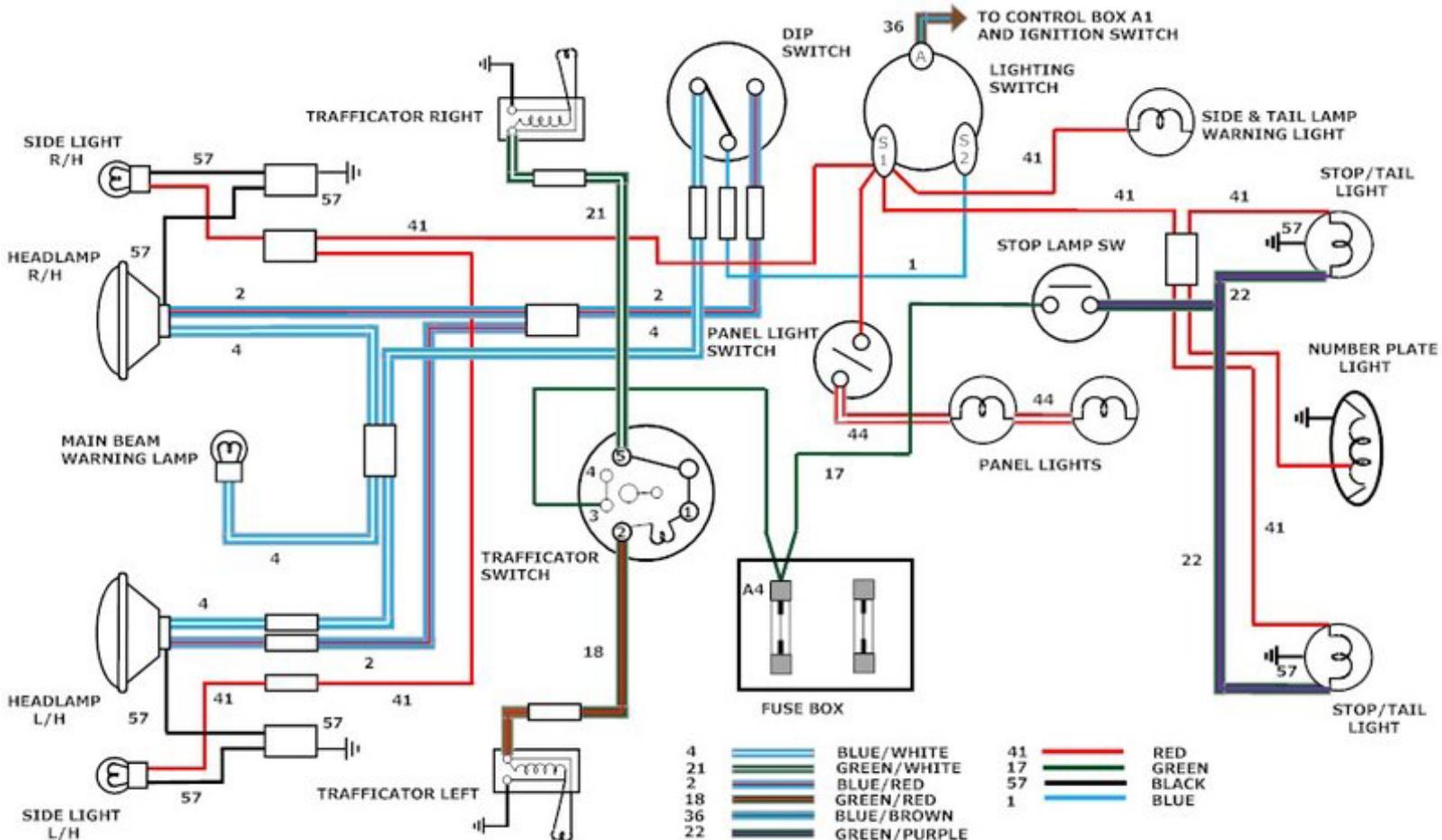
Car drawing

A part of the engine



# DRAWINGS IN ENGINEERING

## Electrical Engineering



# **DRAWINGS IN ENGINEERING**

Similarly other engineering fields such as, Electronic, Aeronautical, Chemical etc, are also using ENGINEERING DRAWINGS in the profession.

**Some professions use drawings in an artistic way  
rather than in engineering way.**

# ERRORS

**Calculations must be perfect.**

**Also NO mistake in drawings and at the construction**



# WHEN DRAWINGS ARE NEEDED?

**Everything we use probably have been produced as a result of solutions to a sequence of operations and considerations, they are:**

1. Conception
2. Analysis and Design
3. Manufacture
4. Verification
5. Disposal

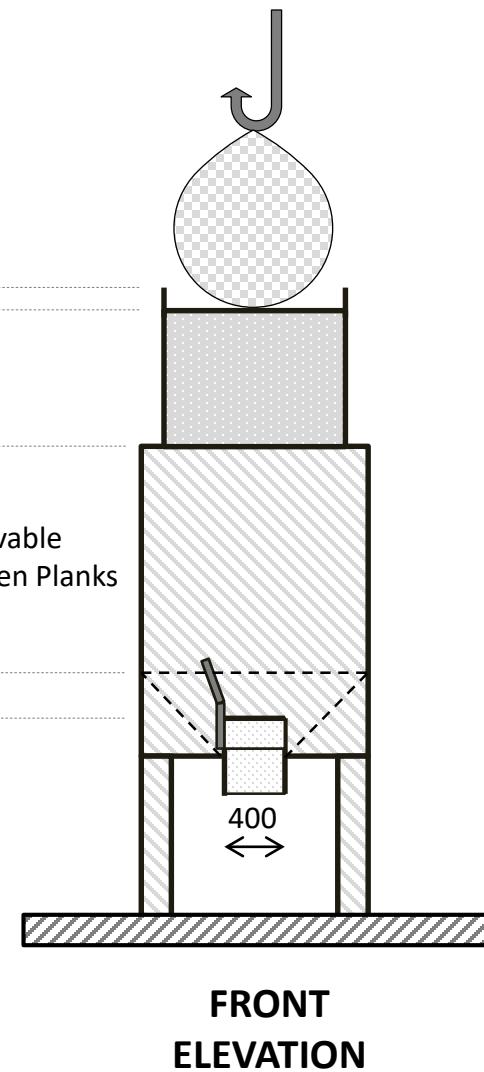
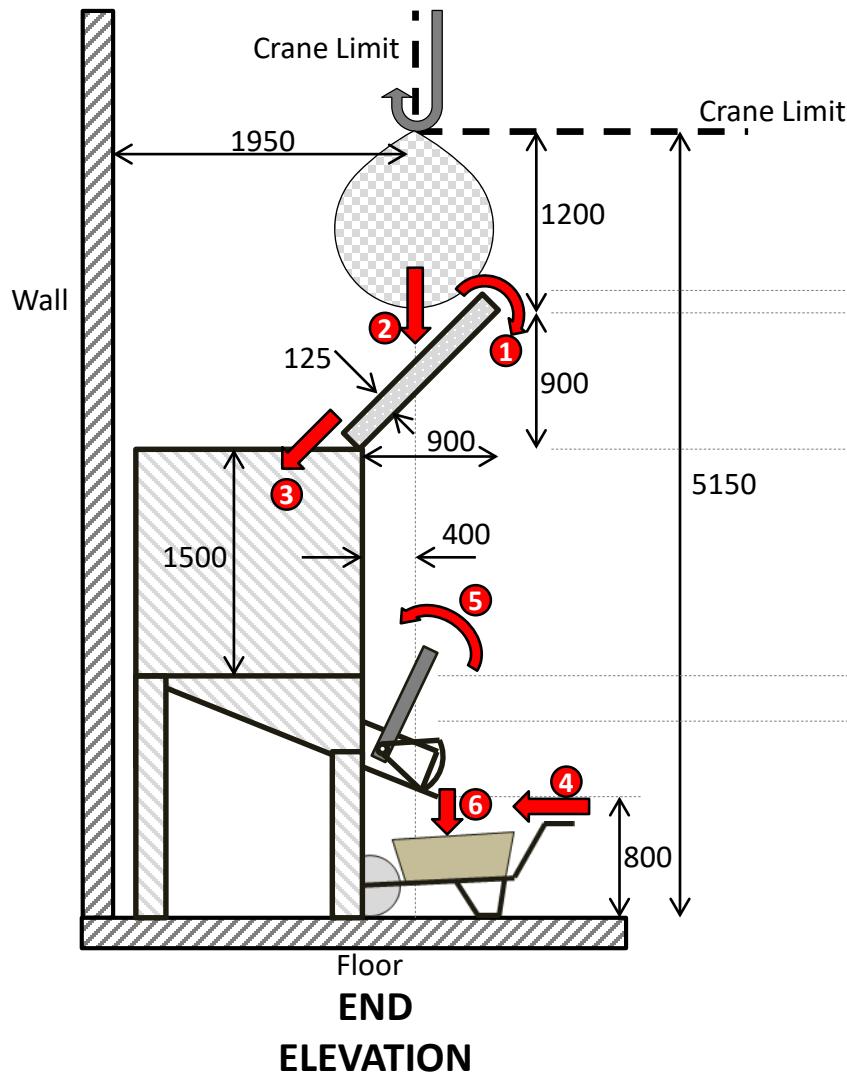
# AGGREGATE STORAGE BINS

This is an aggregate hopper which is used to store sand and gravel.



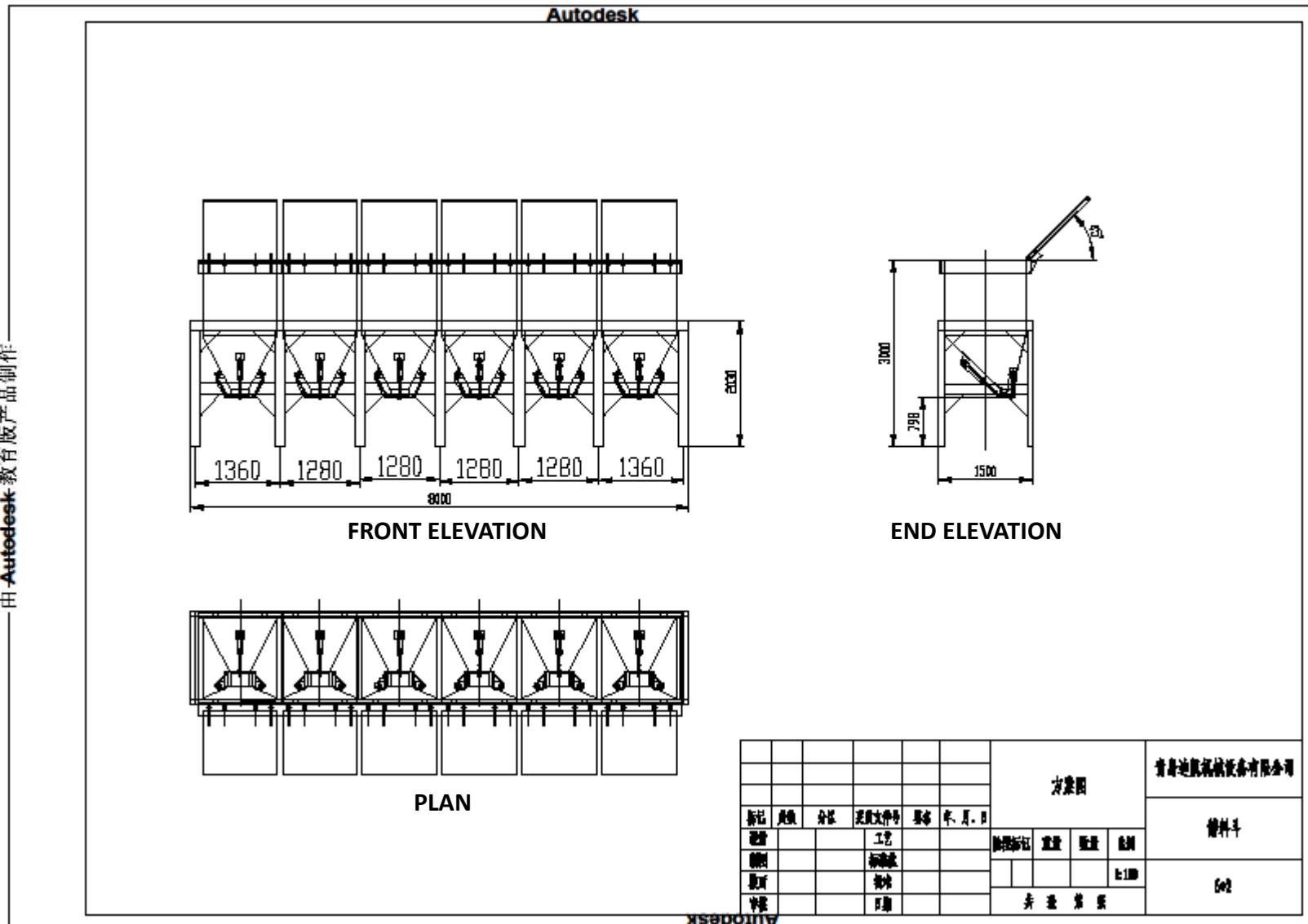
# AGGREGATE STORAGE BINS

## Concept



# AGGREGATE STORAGE BINS

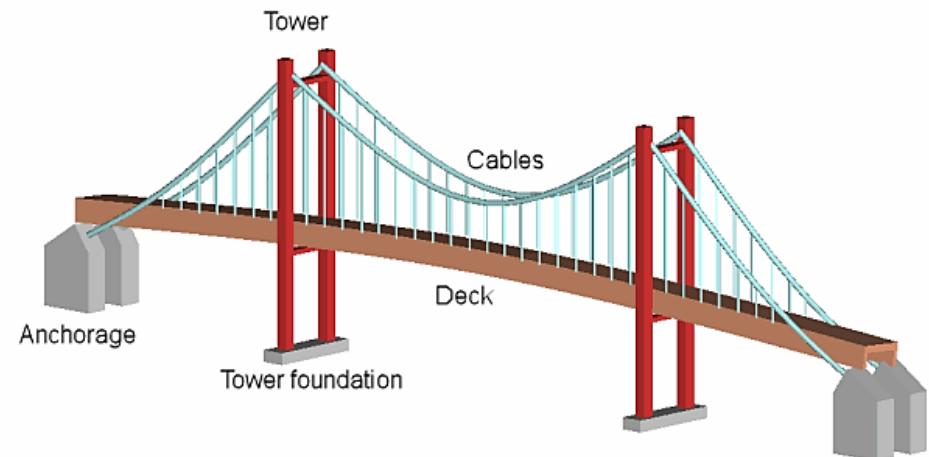
Drawings from Company



# Exercise

# EFFECTIVENESS

1. Try to write a description of this structure.
2. Test your written description by having someone attempt to make a sketch from your description.



*You can easily understand that ...*

The word languages are inadequate for describing the ***size***, ***shape*** and ***features*** completely as well as concisely.

# DRAWINGS AS A LANGUAGE

Graphic language in “engineering application”  
use *lines* to represent the *surfaces*, *edges* and  
*contours* of objects.

The language is known as “*drawing*” or “*drafting*”.

A drawing can be done using *freehand*, *instruments*  
or *computer* methods.

# ELEMENTS OF DRAWINGS

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

**Graphics  
language**

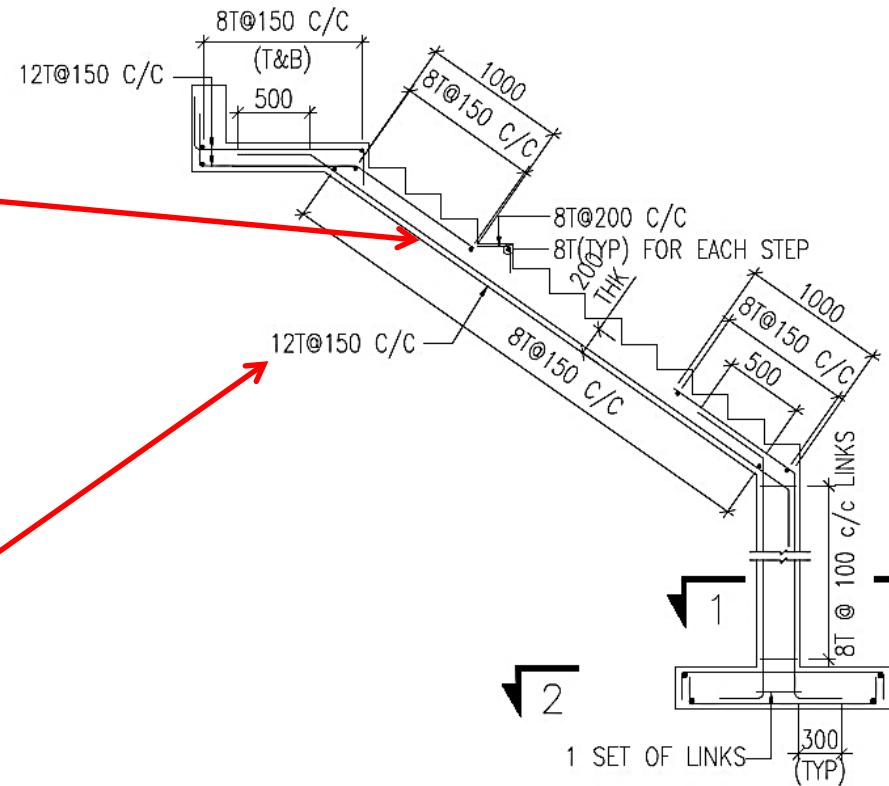


**Describes  
shape**

**Word  
language**

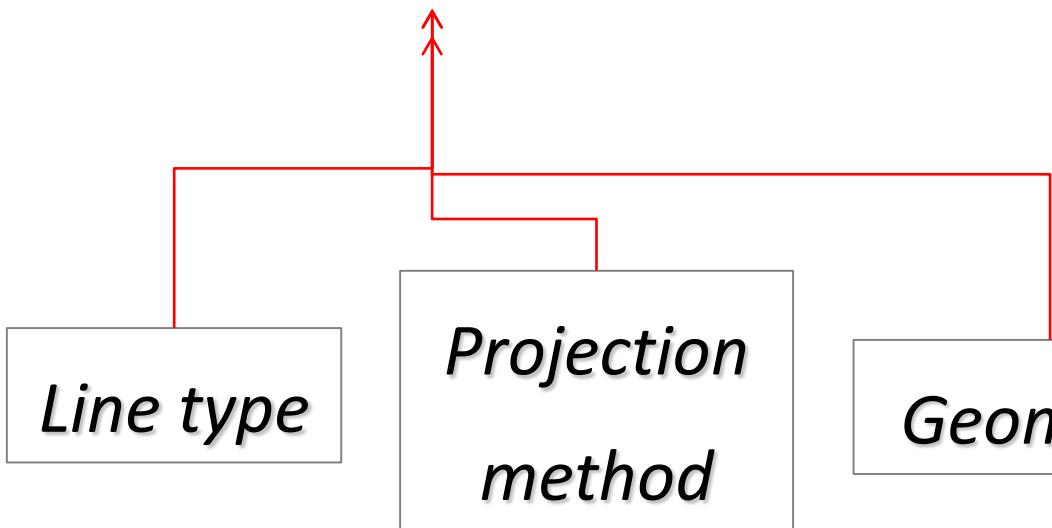


**Describes size,  
location,  
specification**

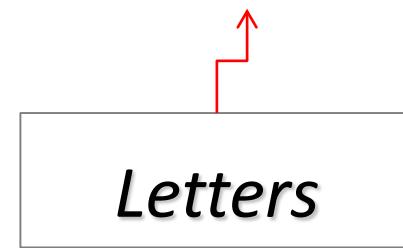


# ELEMENTS OF LANGUAGE

*Graphics language*



*Word language*



# DRAWING STANDARDS

**Standards** are set of rules that govern how technical information are presented. Especially in engineering, Standards are widely used.

Standards are used in Engineering Drawings.

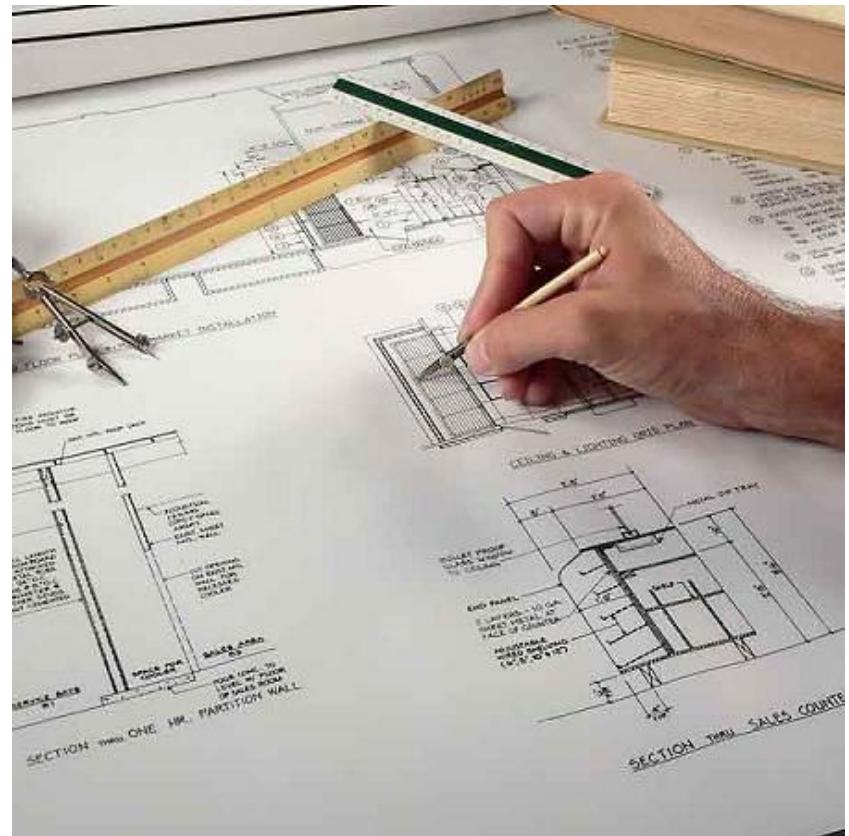
Drawing standards are used so that drawings ***convey the same meaning*** to everyone who reads them.

# STANDARDS

Country	Code	Full name
USA	ANSI	American National Standard Institute
Japan	JIS	Japanese Industrial Standard
UK	BS	British Standard
Australia	AS	Australian Standard
Germany	DIN	Deutsches Institut für Normung
	ISO	International Standards Organization

# CONTENT

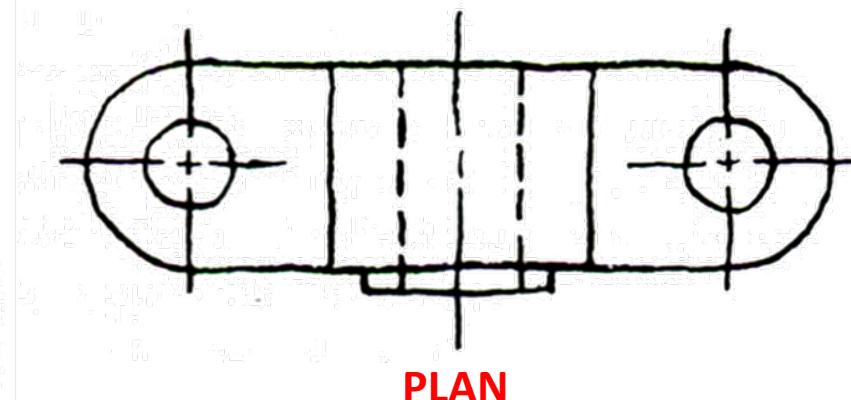
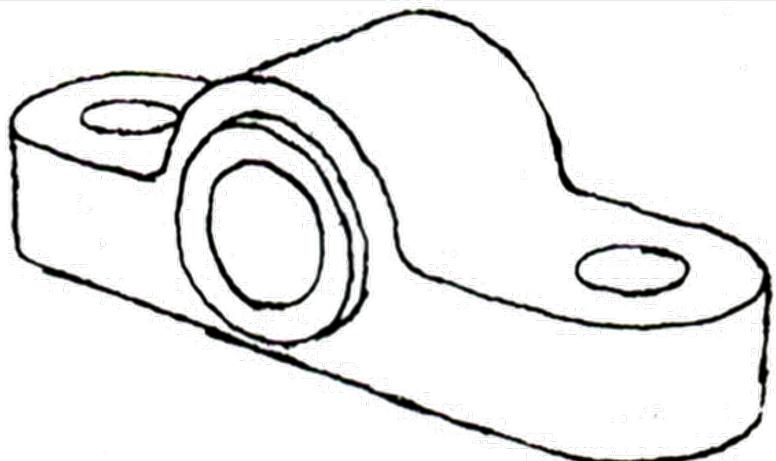
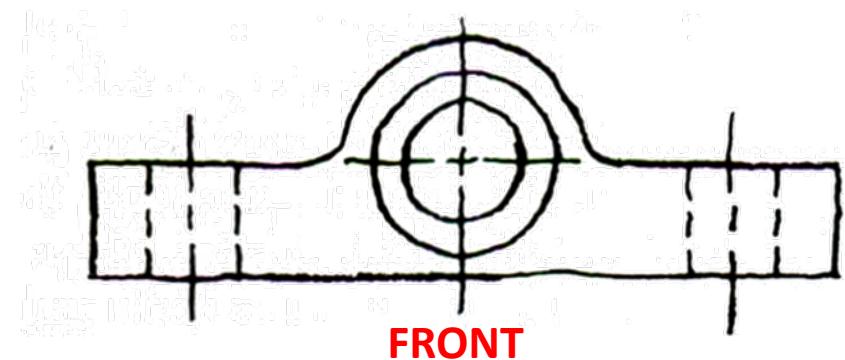
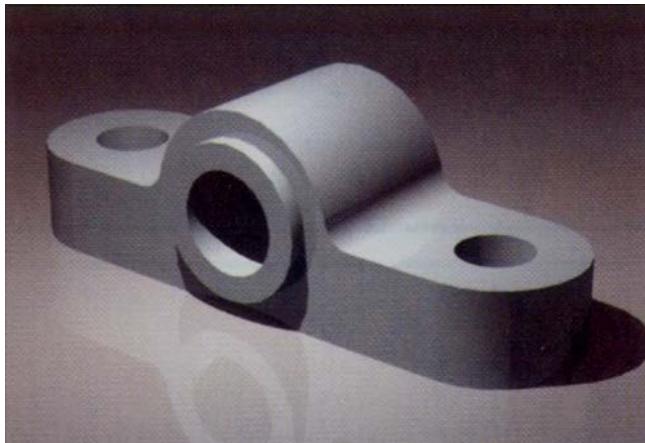
## 2. Drawing equipment



# FREE HAND DRAWINGS?

The lines are sketched without using instruments other than **pencils** and **erasers**.

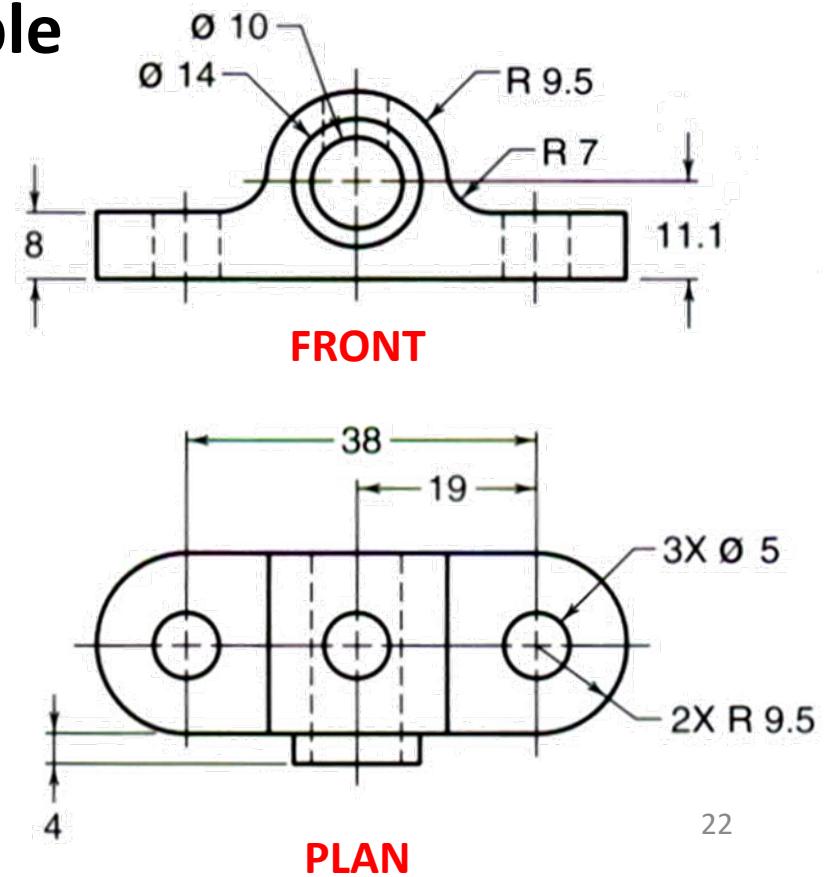
**Example**



# INSTRUMENT DRAWINGS?

Instruments are used to draw straight lines, circles, and curves concisely and accurately. Thus, the drawings are usually made to scale.

## Example

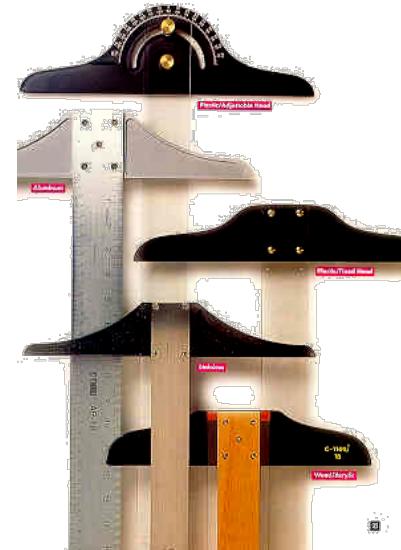


# DRAWING TOOLS

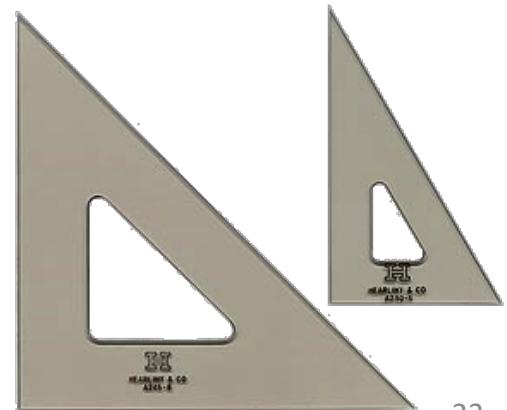
## TECHNICAL DRAWING BOARD



## T-SQUARE



## TRIANGLES



# DRAWING TOOLS

## PENCILS



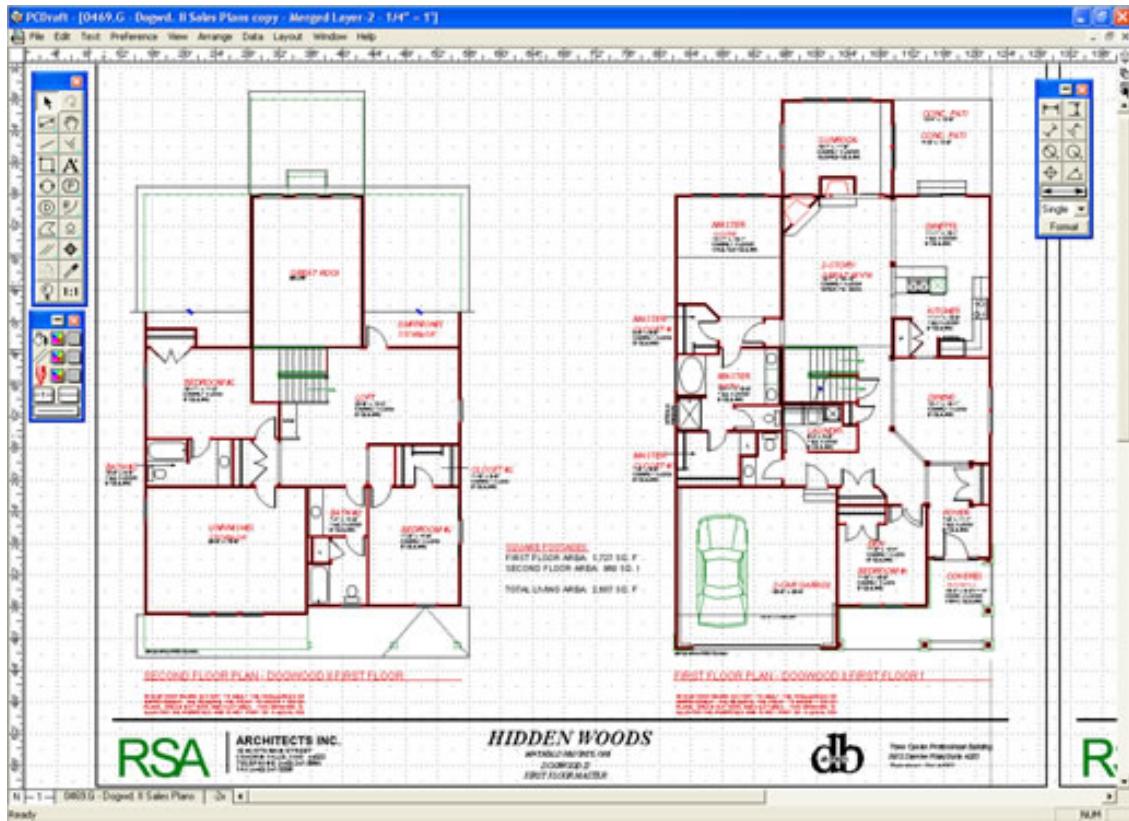
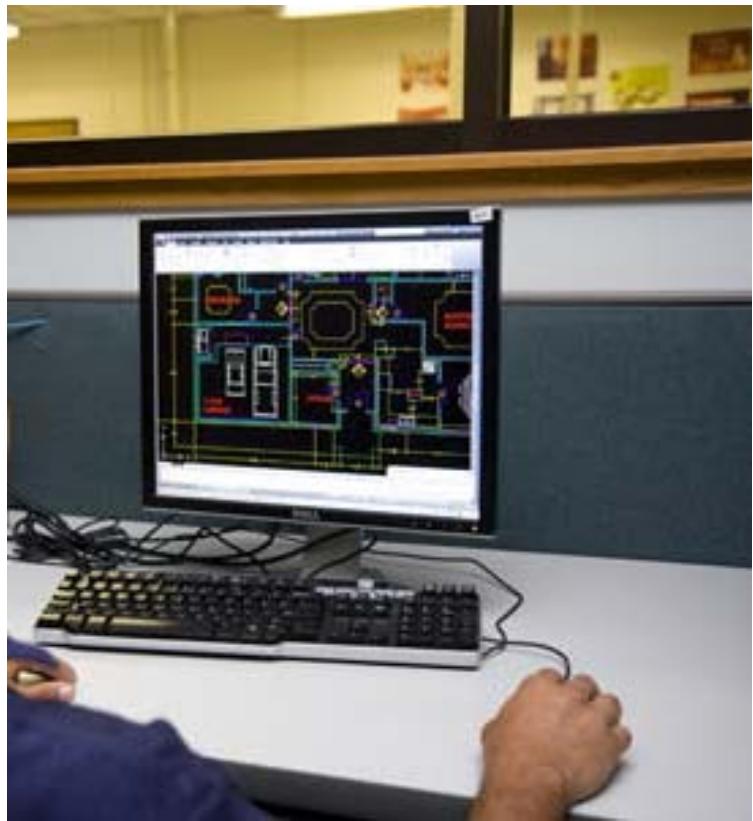
## COMPASS



2H or HB for thick line  
4H for thin line



# COMPUTER DRAWINGS?



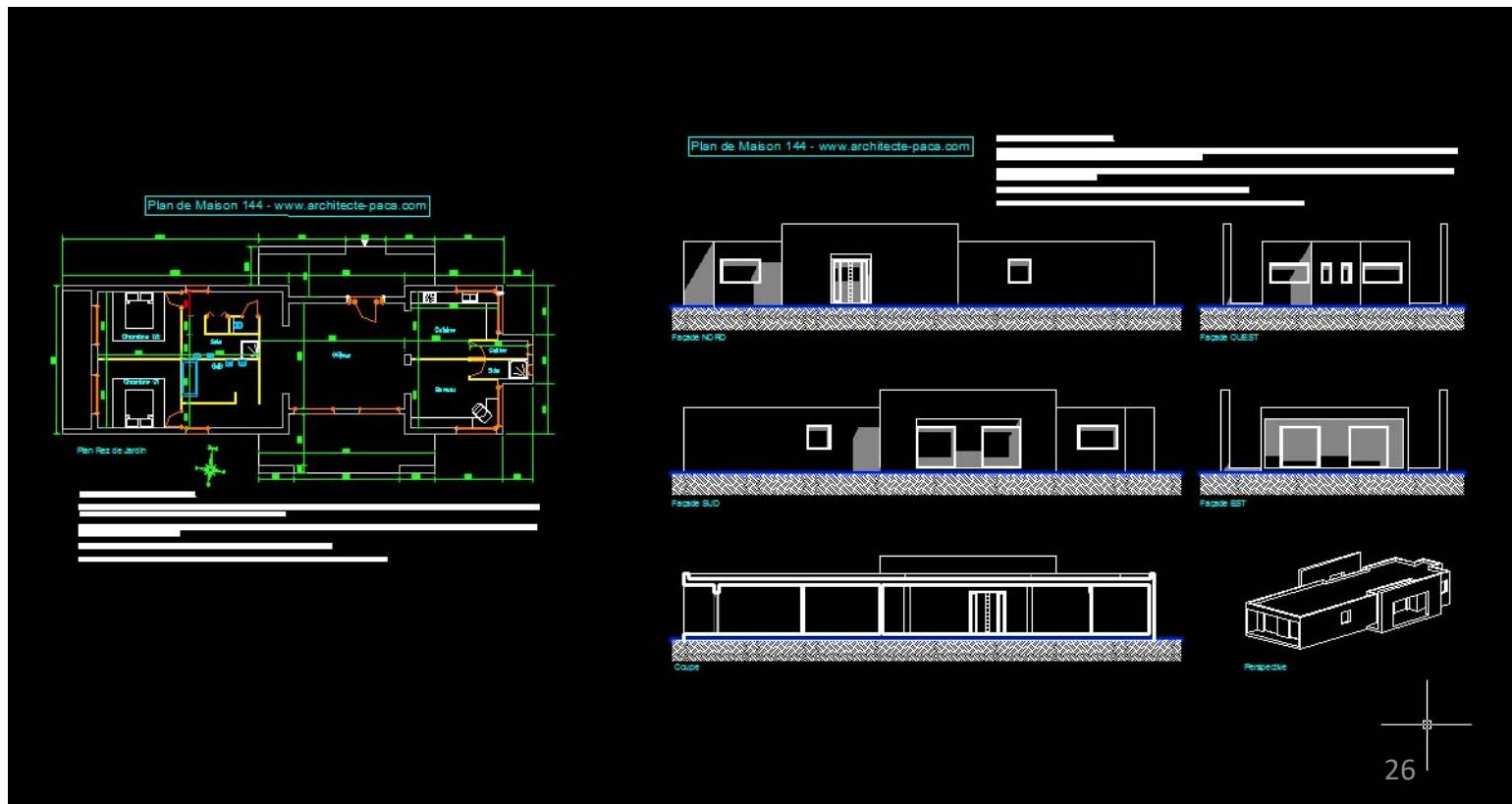
The drawings can be made by commercially available software.

# COMPUTER SOFTWARE

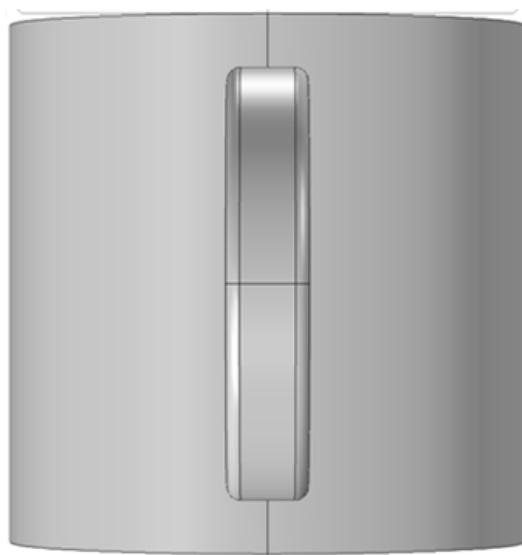
## Computer drawing

*The drawings are usually made by commercial software such as AutoCAD, solid works , PRO – E, etc.*

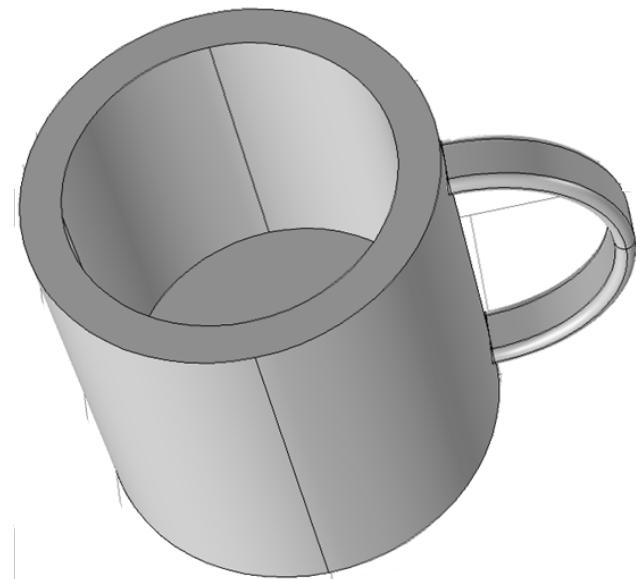
**AutoCAD**



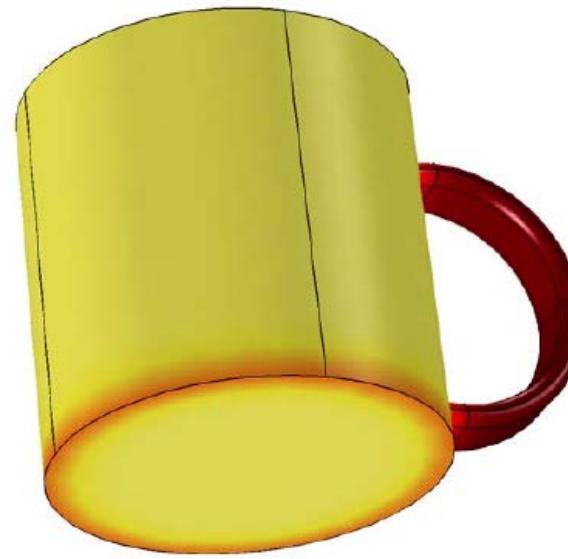
# COMPUTER DRAWINGS - CUP



One Direction view



3D view



3D view - Colored

# WHY COMPUTERS?

For a single project:

1. Many complex drawings are needed.
  2. Drawings from different angles are needed.
  3. Many copies of drawings are needed.
  4. Errors are possible but need to correct them quickly.
  5. Copies are needed by many parties.
  6. Drawings in different colors may be needed.
- many more...

*Any project aims efficiency in : Time, Finance, Service...*

# ARCHITECTURAL DRAWINGS

Perspective view of 'New Campus'



**NOTES:**

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, STRUCTURAL AND MECHANICAL DRAWINGS, SPECIFICATIONS, SCHEDULES AND PROJECT SPECIFIC DOCUMENTS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
3. REFER TO THE APPROPRIATE SECTION OF THE MANUFACTURER'S RECOMMENDATIONS ALLOWING FULL MAINTENANCE AND REMOVAL/REPLACEMENT.
4. ALL UNSHOWN DIMENSIONS ARE 20mm UNLESS OTHERWISE STATED.
5. DO NOT SCALE FROM THIS DRAWING.
6. FINAL LOCATIONS OF POWER AND DATA ACCESSORIES TO BE DETERMINED AT DETAILED DESIGN STAGE.
7. EQUIPMENT LAYOUT WITHIN THE ROOMS / AREAS AND FLOOR BOX LOCATIONS ARE APPROXIMATE ONLY.
8. SPECIALIST SERVICES, MECHANICAL AND OTHER EQUIPMENT LOCATIONS AND CONNECTIONS TO BE DETERMINED AT DETAILED DESIGN STAGE.
9. ALLOW FOR ACCESS TO DESK ELECTRICS TO DESK AREAS WITH FLOOR BOXES.

LEGEND:	#	Status	Description	Date
	13A SINGLE SWITCHED SOCKET OUTLET			
	13A TWIN SWITCHED SOCKET OUTLET			
	UNSWITCHED FUSED CONNECTION UNIT			
	SWITCHED FUSED CONNECTION UNIT			
	16A INDUSTRIAL SOCKET			
	FLEX OUTLET			
	CLOCK CONNECTION POINT			
	DATA OUTLET (N - DENOTES NUMBER OF OUTLETS)			
	SINGLE PHASE ISOLATOR (SPN)			
	THREE PHASE ISOLATOR (TPN)			
	POWER POLE			
	DISTRIBUTION BOARD			
	SUB MAIN DISTRIBUTION BOARD			
	4 COMPARTMENT FLOOR BOX CONTAINING 2nos. TWIN SWITCHED SOCKET OUTLETS, 3nos. DATA OUTLETS AND 1nos. POWER POLE			
	4 COMPARTMENT FLOOR BOX FOR LECTERN CONTAINING 2nos. TWIN SWITCHED SOCKET OUTLETS, 3nos. DATA OUTLETS AND 1nos. POWER POLE			
	3 COMPARTMENT FLOOR BOX CONTAINING 1no. TWIN SWITCHED SOCKET OUTLET, 2nos. DATA OUTLETS AND 1nos. POWER POLE			
	3 COMPARTMENT FLOOR BOX CONTAINING 2nos. TWIN SWITCHED SOCKET OUTLETS, 3nos. DATA OUTLETS AND 1nos. POWER POLE			
	3 COMPARTMENT FLOOR BOX CONTAINING 1no. TWIN SWITCHED SOCKET OUTLET			
	ATM			
	CL			
	CLK			
	CCTV			
	DB			
	EPOS			
	FR			
	PRJ			
	PRJSCR			
	PRT			
	RC			
	RMBK			
	SCNR			
	SMDB			
	TV			
	VENT			
	WIFI			
	WPC			
	WPS			
	ZT			



**Engineering consultant:** CUNDALL  
**Project manager:** Alexander Mac  
**Project:**  
**Client:** UNIVERSITY OF WOLLONGONG IN DUBAI  
**Issuer:** WOODS BAGOT.  
**Project number:** 1018631  
**Size check:**  
**Sheet size:** A0  
**Scale:** 1:250  
**Sheet title:** SMALL POWER LAYOUT LOW LEVEL GROUND FLOOR  
**Sheet number:** BS00 (62) 1001  
**Revision:** T1  
**Status:** ISSUED FOR TENDER

# DRAWING PAPER

Standard paper size **A0 ~ A4**.

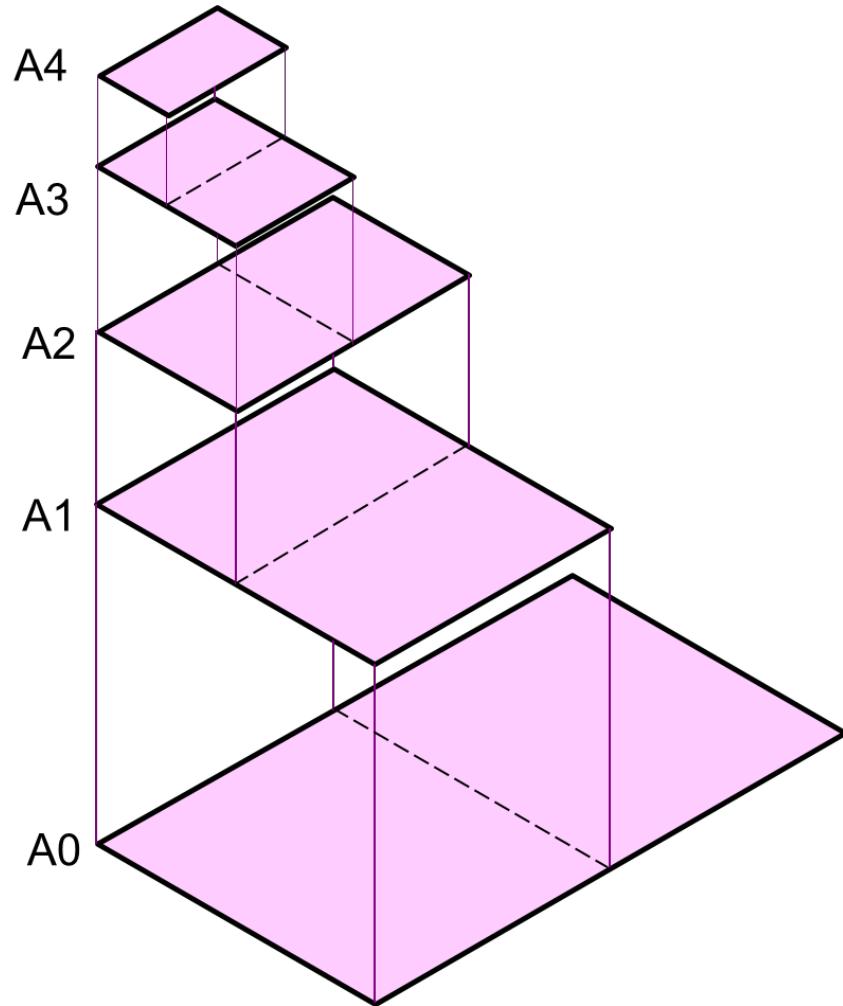
Sides are in the ratio of  $1:\sqrt{2}$

Standard Sheet	Size (ISO) (mm x mm)	Area (cm <sup>2</sup> )
----------------	-------------------------	----------------------------

<b>A4</b>	<b>210 x 297</b>	<b>625</b>
A3	297 x 420	1250
A2	420 x 594	2500
<b>A1</b>	<b>594 x 841</b>	<b>5000</b>
A0	841 x 1189	10000

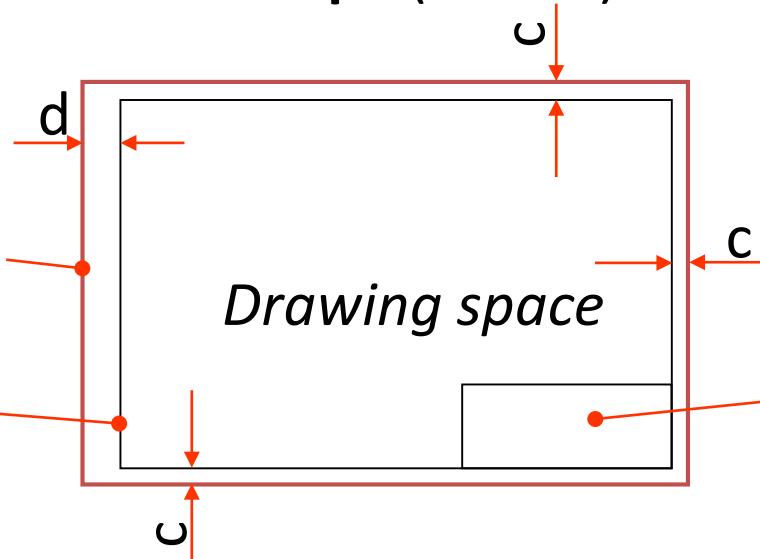
**A0, A1**  
Drawings, Posters

**A4**  
General writing purpose

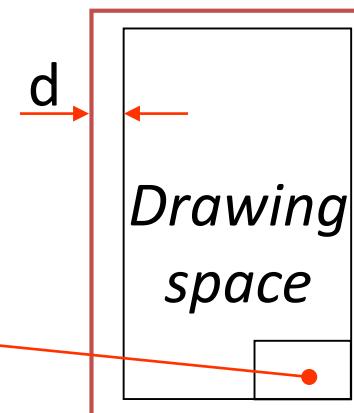


# PAPER ORIENTATION

Landscape (A0~A4)



Portrait (A4 only)



Sheet size    c (mm)    d (mm)

Sheet size	c (mm)	d (mm)
A4	10	25
A3	10	25
A2	10	25
A1	20	25
A0	20	25

# CONTENT

## 3. Engineering drawings



# MAIN DRAWING INFORMATION

## **Projected Views:**

Show as many sides as needed for completeness.

## **Cross sections:**

A view that is good for showing interior features.

## **Table:**

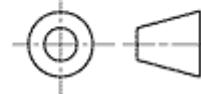
Title block.

## **Dimensions:**

Most important and complicated part of the drawing.

# TITLE BLOCK

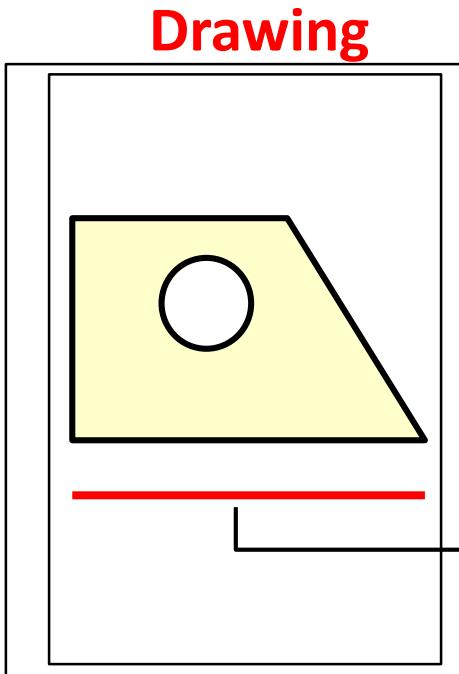
1. Name of firm
2. Drawing number
3. Component name
4. Drawing scale and units of measurement
5. Projection used (first or third angle) and or symbol
6. Draughtsman's name and checker's signature
7. Date of drawing and subsequent modifications
8. Cross references with associated drawings or assemblies.

TITLE WHEEL BEARING	
NAME John Smith	CHECKED 
VERSION 1.1	DATE 16.10.88
NO NEED TO MEASURE - ALL MEASUREMENTS IN MM	SCALE 1:1
ITI ENGINEERING 	

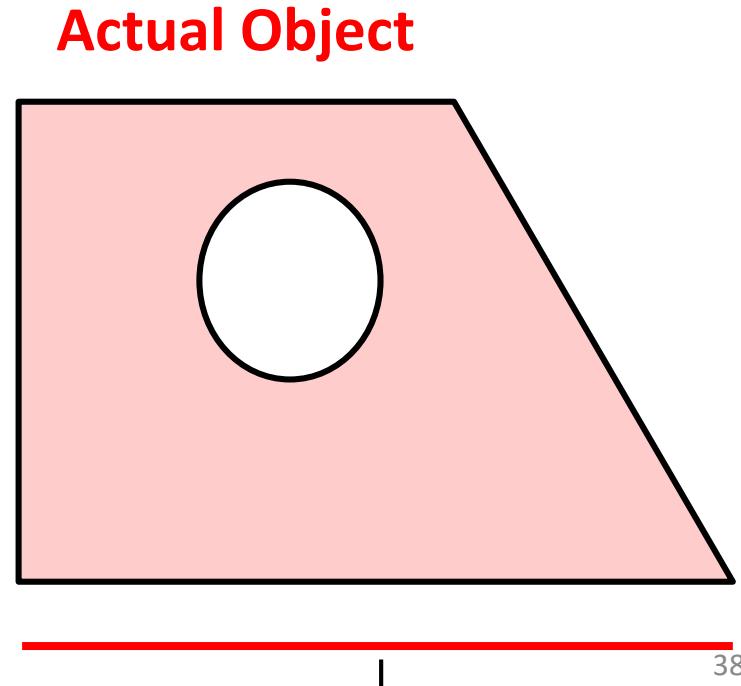
Other information will vary according to the branch and type of industry concerned but is often standardized by particular firms for their own specific purposes and convenience.

# WHAT IS DRAWING SCALE?

**Scale** is the ratio of the **linear dimension** of an element of the drawing to the **real linear dimension** of the same element of the actual object.



$$\frac{?}{\text{Drawing Dimension}} : \frac{?}{\text{Actual Object Dimension}}$$



# SCALE

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

SCALE      **1:1** for full size

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

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

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

# SCALE

***Reduction*** scales



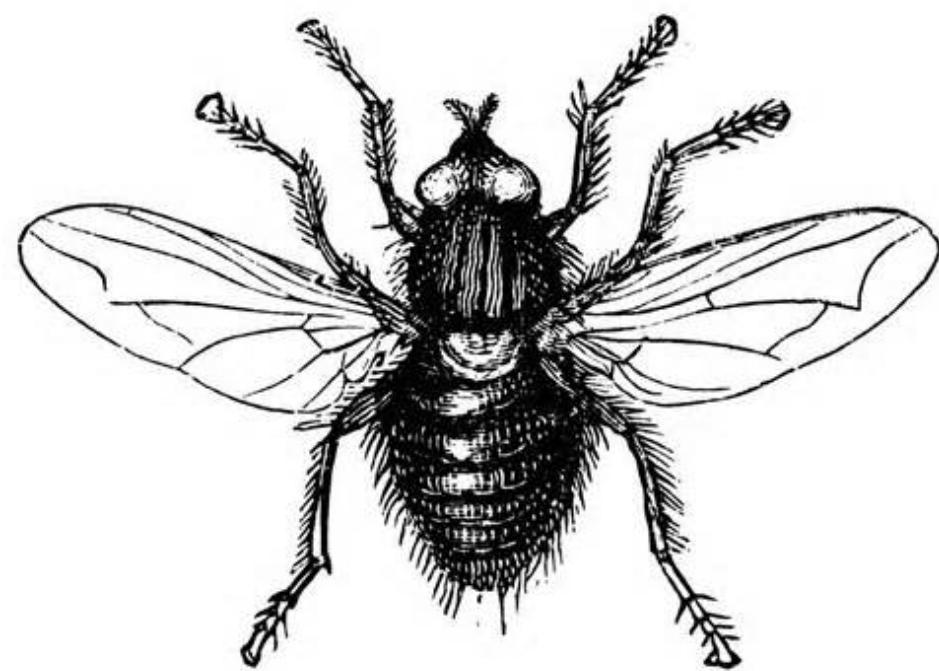
SCALE

**1:X**

SCALE

**1:500**

***Enlargement*** scales



SCALE

**X:1**

SCALE

**10:1**

# SCALE

*Reduction* scales



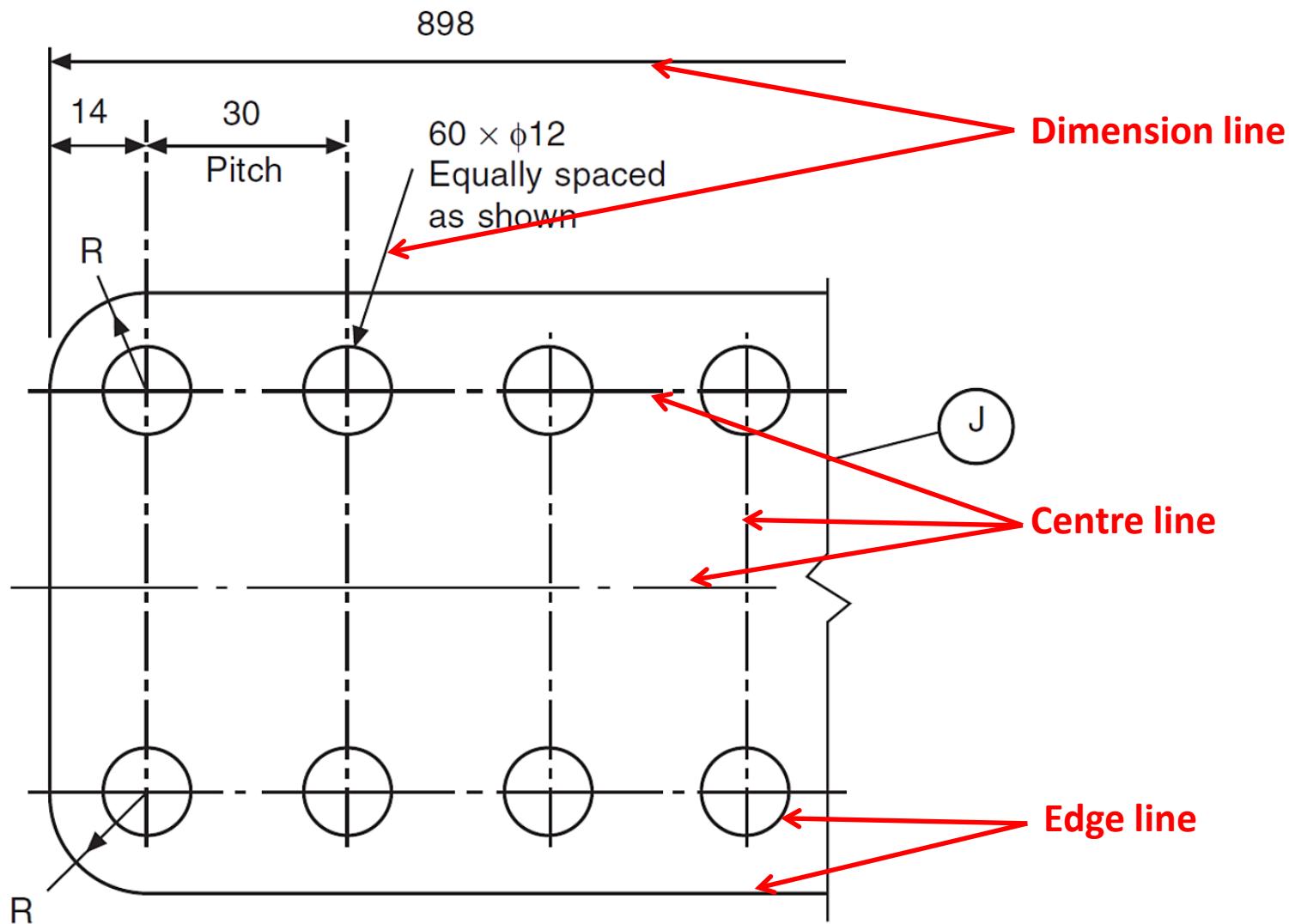
SCALE

1:200

If the actual height of the building is 30 metres,  
what is the height on the drawing?

150 mm

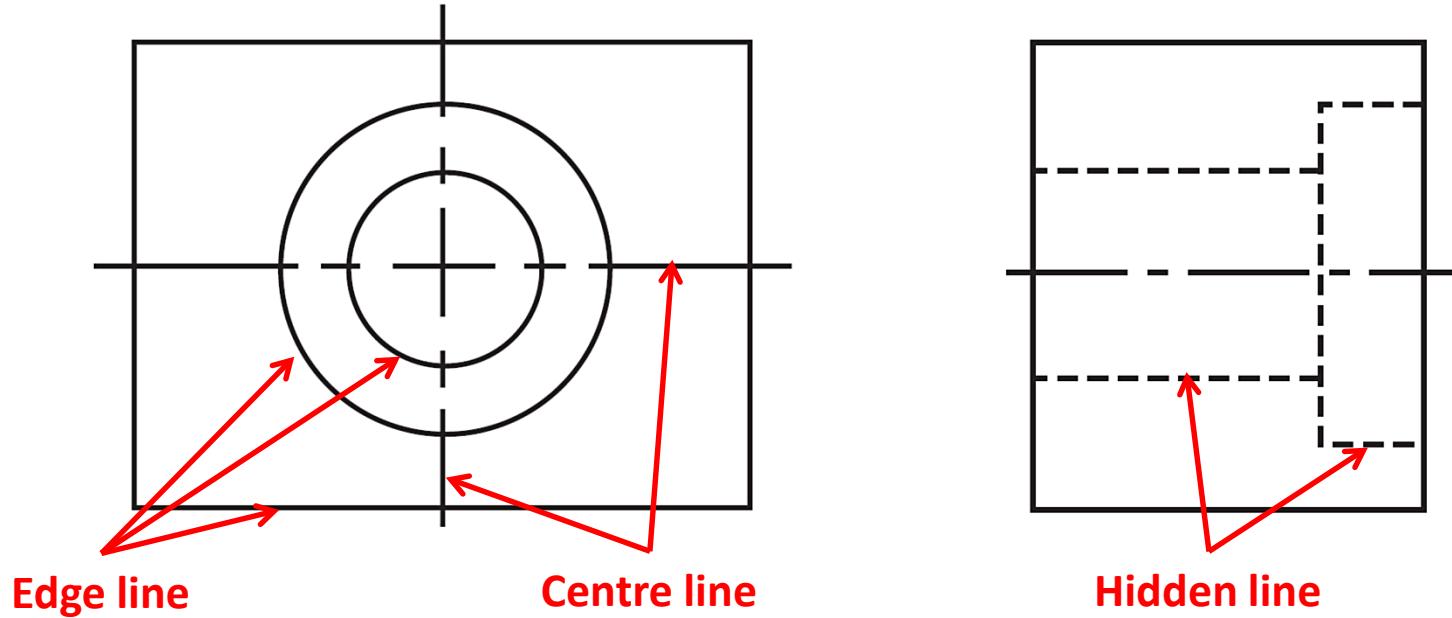
# DRAWING LINES - EXAMPLE



Interrupted view

# EXAMPLES

## Hidden and Centre lines

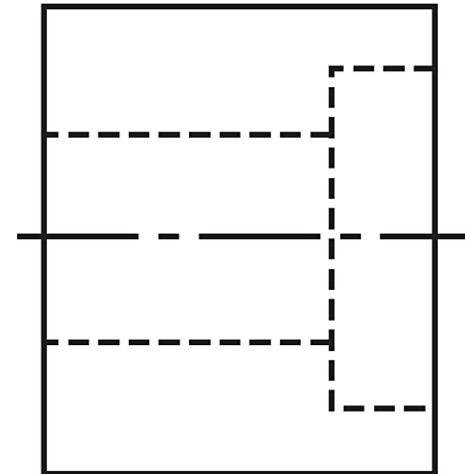
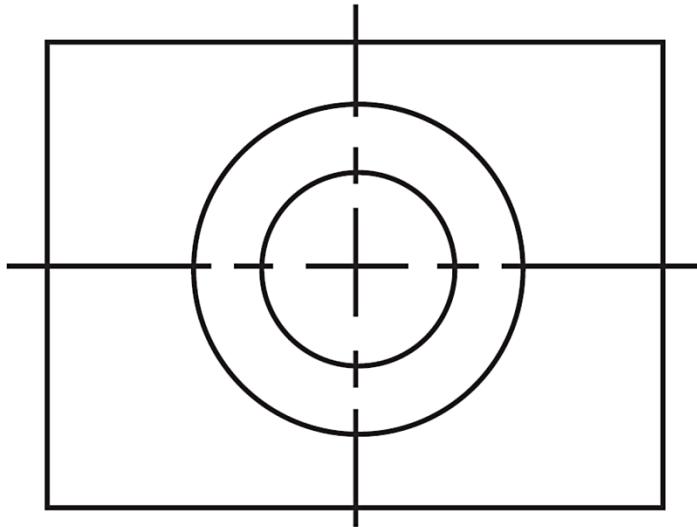


Can you imagine the **3D** object by looking at the given  
TWO views?

*Draw the 3D view on a piece of paper.*

# EXAMPLES

## Hidden and Centre lines

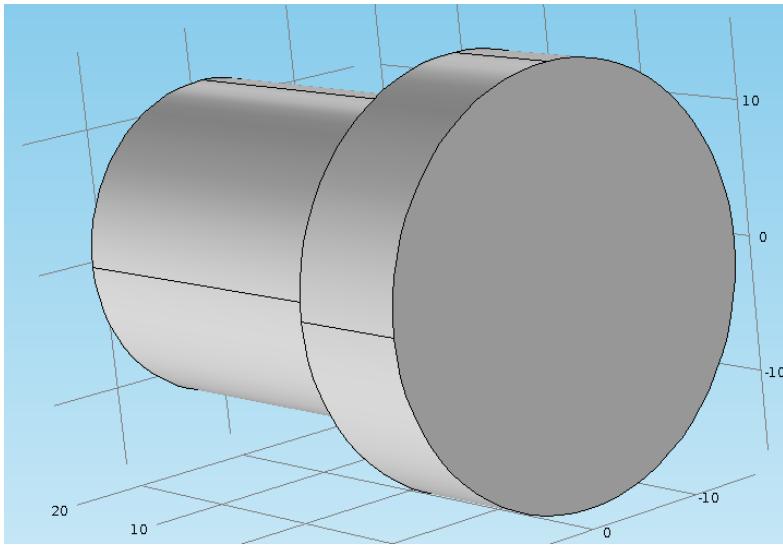


Can you imagine the **3D** object by looking at the given  
**TWO views?**

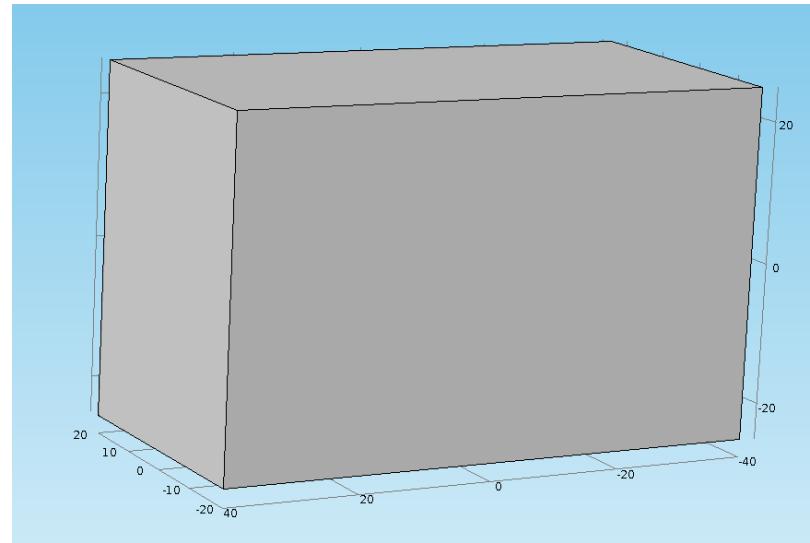
*Draw the 3D view on a piece of paper.*

# CHALLENGE - IMAGINATION

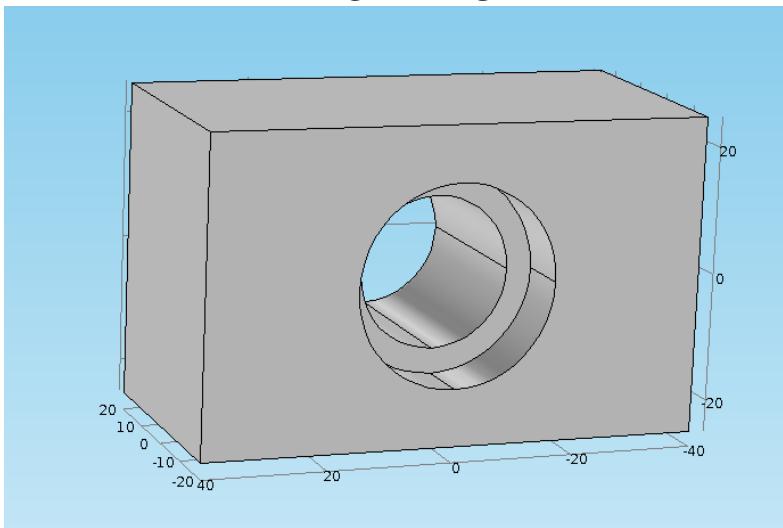
ANSWER 1



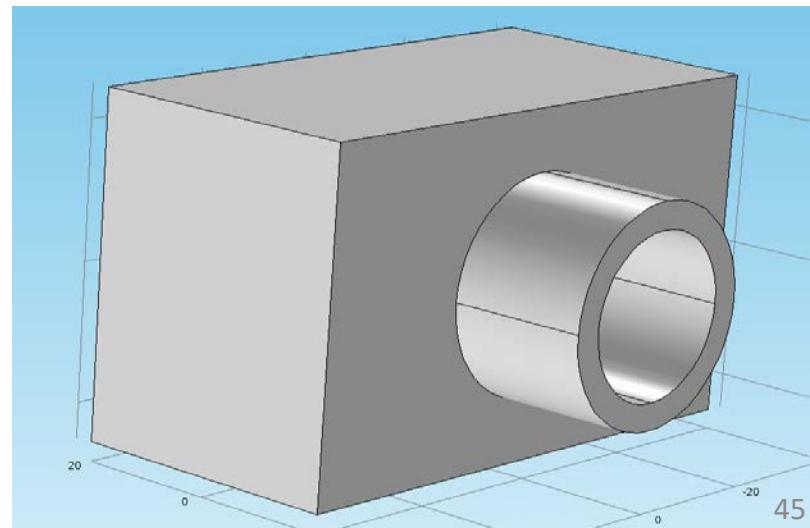
ANSWER 2



ANSWER 3



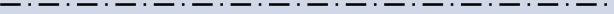
ANSWER 4



# LINES

EXAMPLE	DESCRIPTION & PRESENTATION	APPLICATION
A	Continuous wide line 	<b>Visible edges and outlines</b>
B	Continuous narrow line 	<b>1. Dimension, extension and projection lines</b> <b>2. Hatching lines for cross sections</b> <b>3. Leader and reference lines</b> <b>4. Outlines of revolved sections</b> <b>5. Imaginary lines of intersection</b> <b>6. Short centre lines</b> <b>7. Diagonals indicating flat surfaces</b> <b>8. Bending lines</b> <b>9. Indication of repetitive features</b>
C	Continuous narrow irregular line 	Limits of partial views or sections provided the line is not an axis

# LINES

EXAMPLE	DESCRIPTION & PRESENTATION	APPLICATION
D	Dashed narrow line 	<b>Hidden outlines and edges</b>
E	Long dashed dotted narrow line 	<b>1. Centre lines.</b> <b>2. Lines of symmetry</b> <b>3. Pitch circle for gears</b> <b>4. Pitch circle for holes</b>
F	Continuous narrow irregular line 	Surfaces which have to meet special requirements
G	Continuous straight narrow line with zig zags 	<b>Limits of partial or interrupted views;</b> Suitable for <b>CAD</b> drawings provided the line is not an axis. <b>CAD – Computer Aided Design</b>

# DRAWING REQUIREMENTS

1. **Unambiguous and clear** → only one interpretation possible
2. **Complete** → Provide all information for all stages of manufacture. i.e., detailed drawings, assembly drawings, bill of materials
3. **Suitable for duplication** → Suitable scale and clarity that the drawing can be copied
4. **Language independent** → Words dependent on a language should only be used in the title block; words should be replaced by symbols
5. **Conforms to standards** → Highest standards are ISO as numerous countries learn these rules

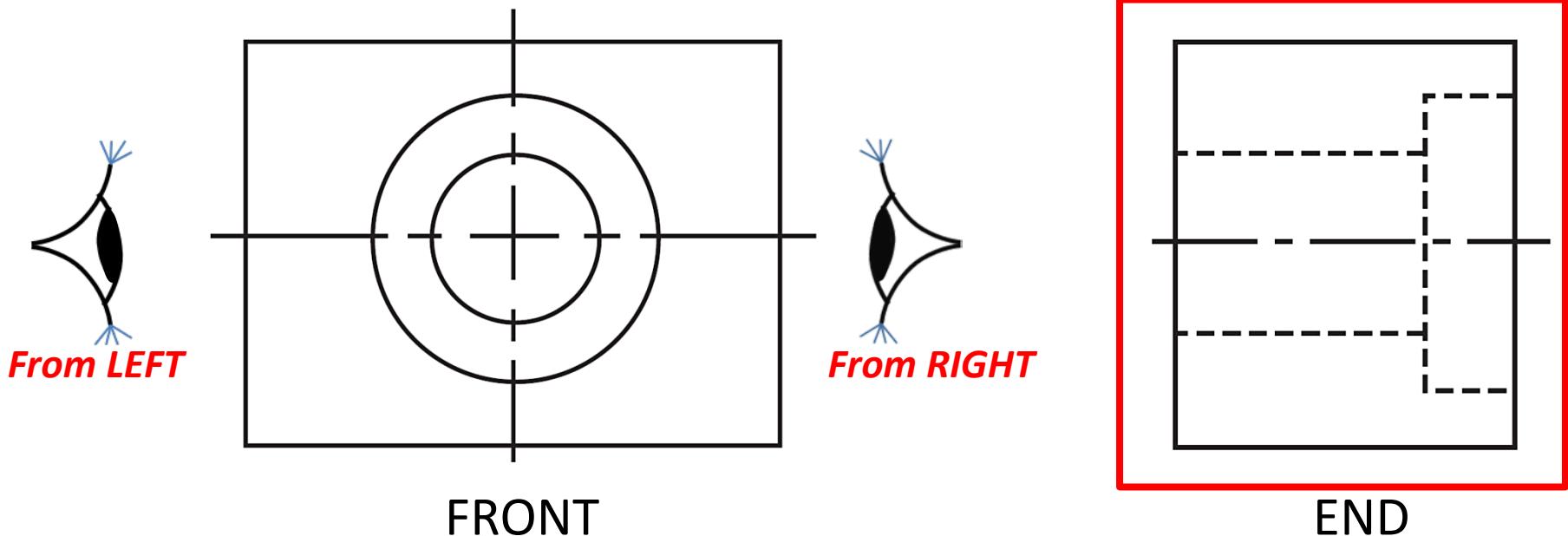
# PROFESSIONAL ENGINEERING DRAWINGS

1. The types of lines used must be of uniform thickness and density
2. Eliminate fancy printing, shading and associated artistry
3. Include on the drawing only the information which is required to ensure accurate clear communication
4. Use only standard symbols and abbreviations
5. Ensure that the drawing is correctly dimensioned (adequately but not over-dimensioned) with no unnecessary details.

***Remember that care and consideration given to small details make a BIG contribution towards perfection.***

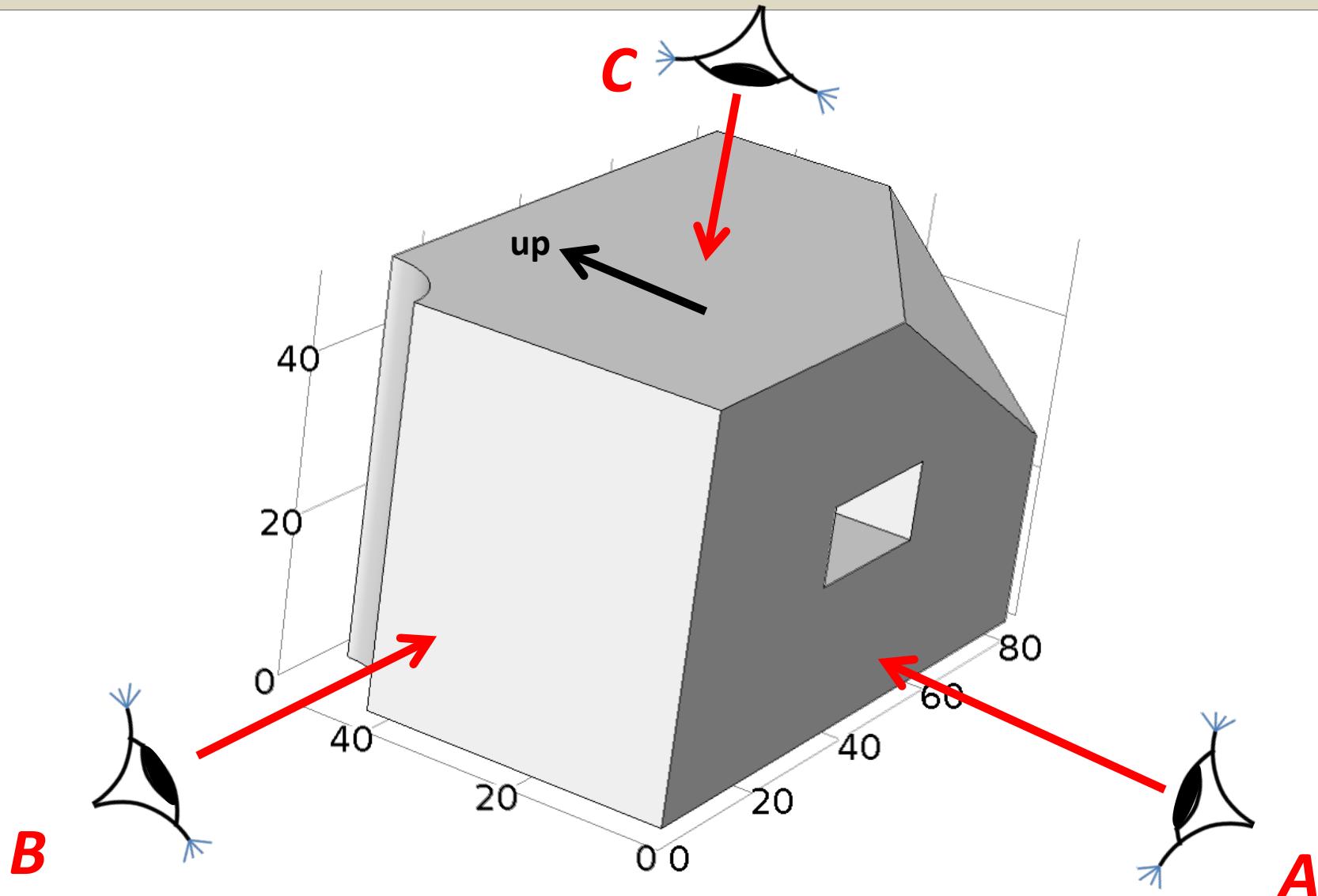
# CHALLENGE - IMAGINATION

Can you imagine the direction of the END VIEW by looking at the given TWO views?

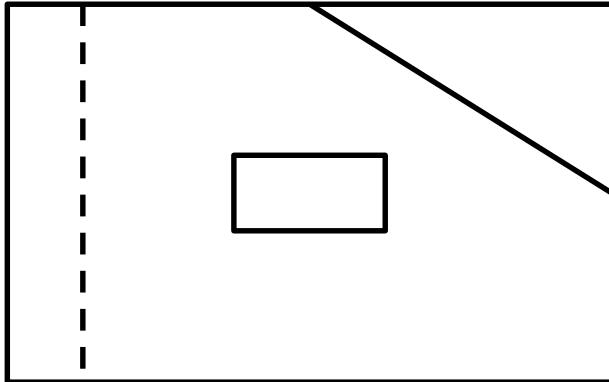


*LEFT hand or RIGHT hand?*

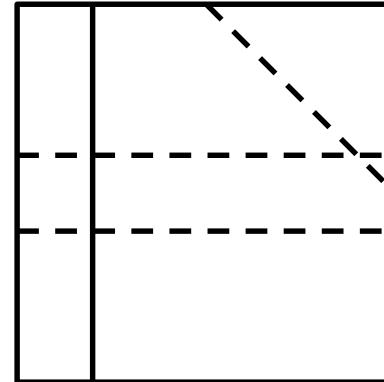
# CHALLENGE - IMAGINATION



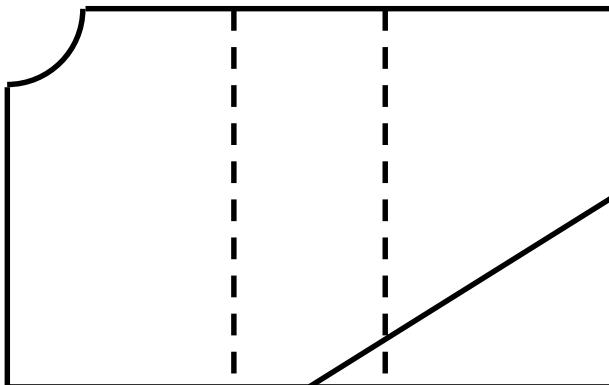
# CHALLENGE - IMAGINATION



**A**



**B**



**C**

**LINE**



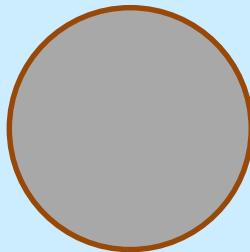
**ARROW**



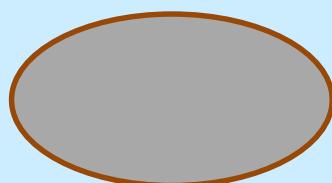
**ARC**



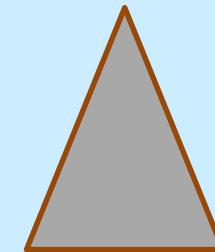
**CIRCLE**



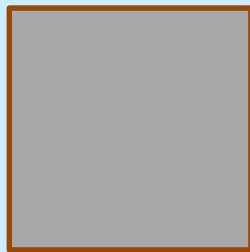
**ELIPSE**



**TRIANGLE**



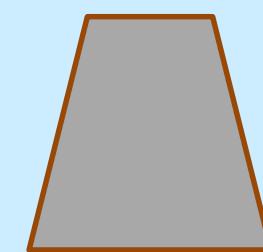
**SQUARE**



**RECTANGLE**

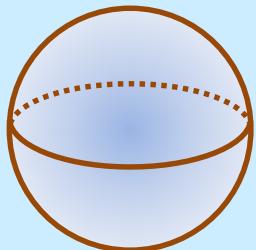


**TRAPEZOID**

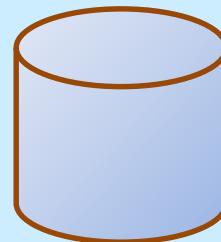


# 3D - OBJECTS

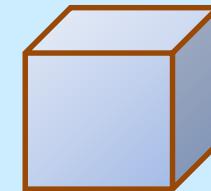
**SPHERE**



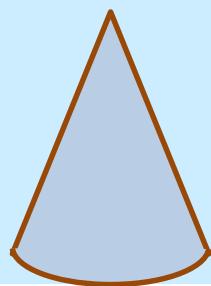
**CYLINDER**



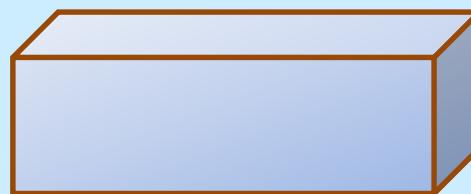
**CUBE**



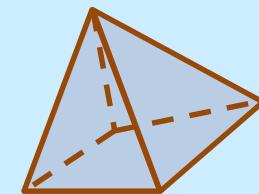
**CONE**



**RECTANGULAR PRISM**



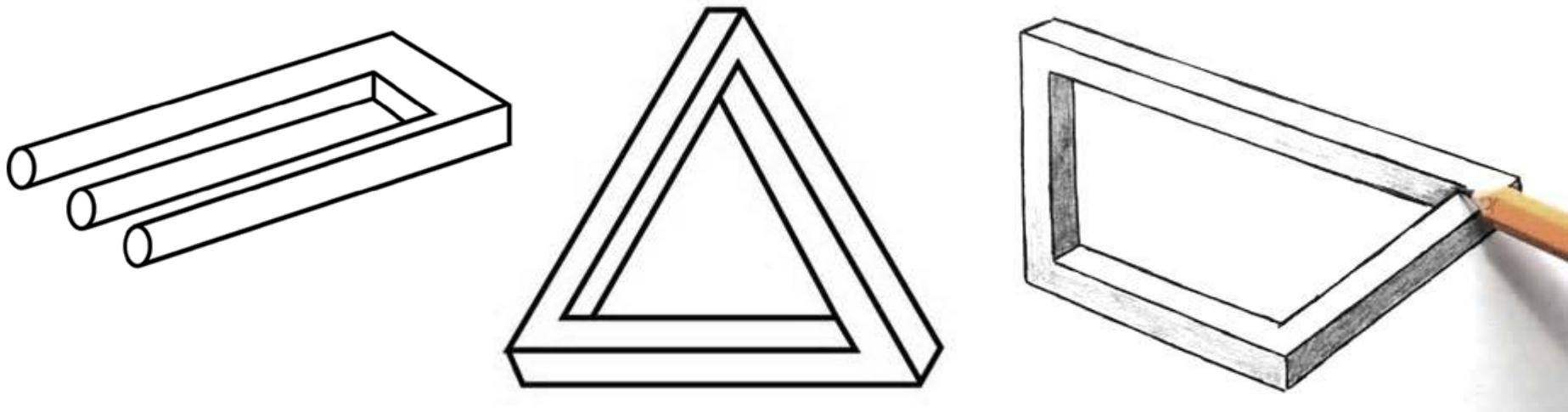
**TETRAHEDRON  
(PYRAMID)**



# DRAWING ILLUSIONS

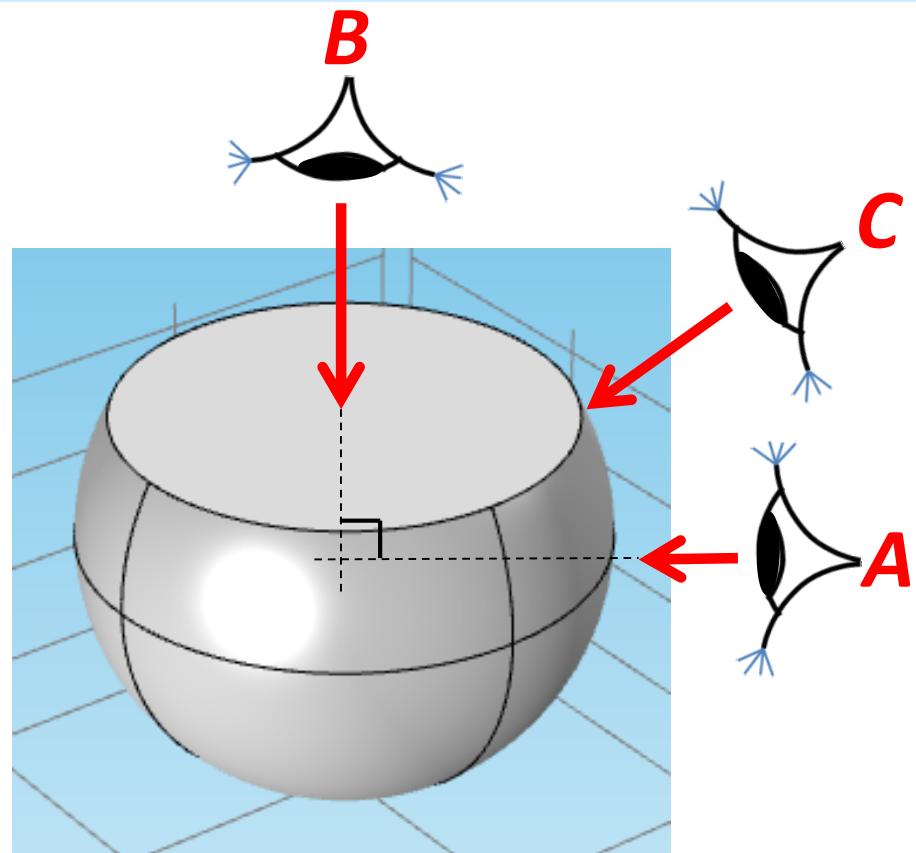
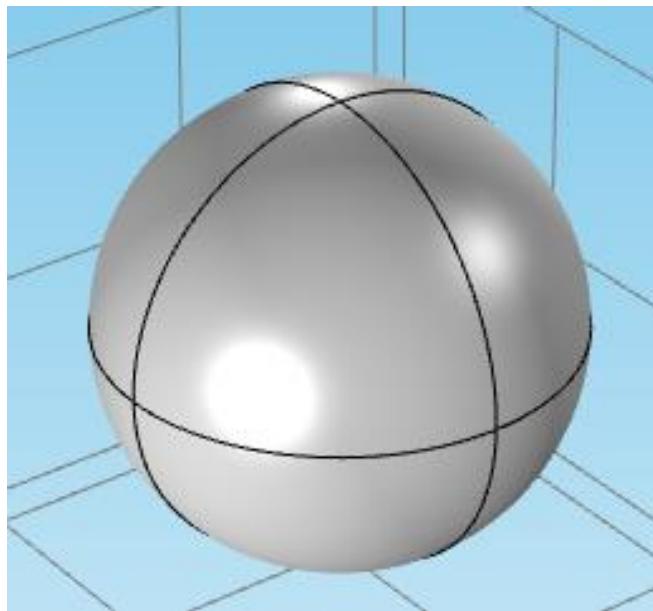
Despite rules in defining a language, whether spoken or drawn,  
errors can be made.

3-D objects presented in 2-D paper can lead to confusion  
and even illusion



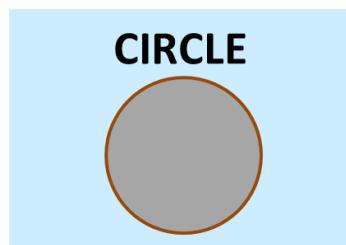
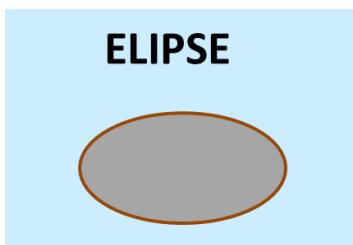
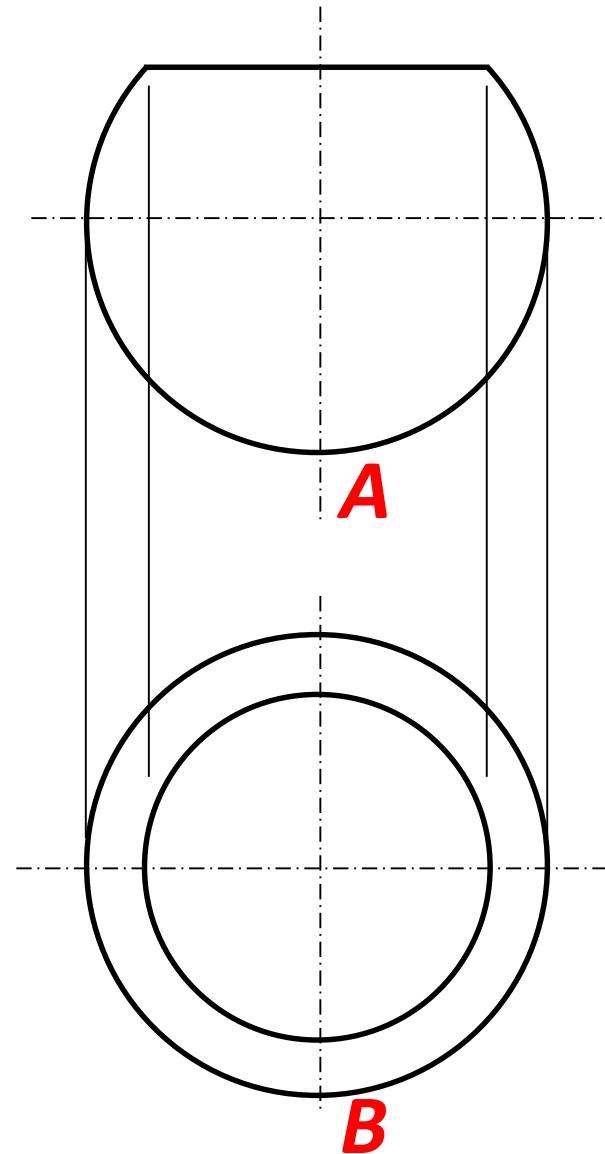
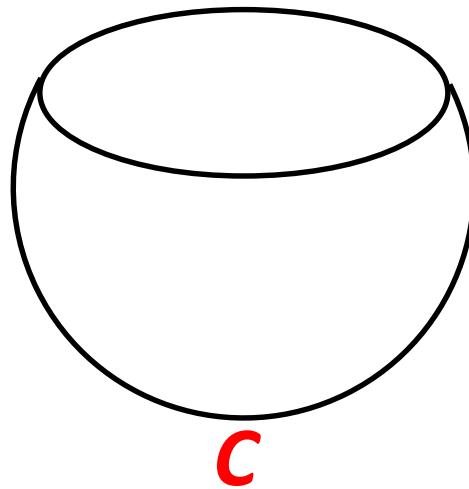
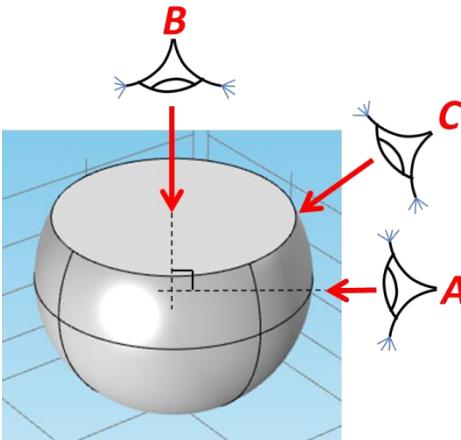
# CHALLENGE - IMAGINATION

Consider a ‘Sphere’. A portion in the top hemisphere is removed.



Can you draw the views A, B and C of this 3D object?

# CHALLENGE - IMAGINATION

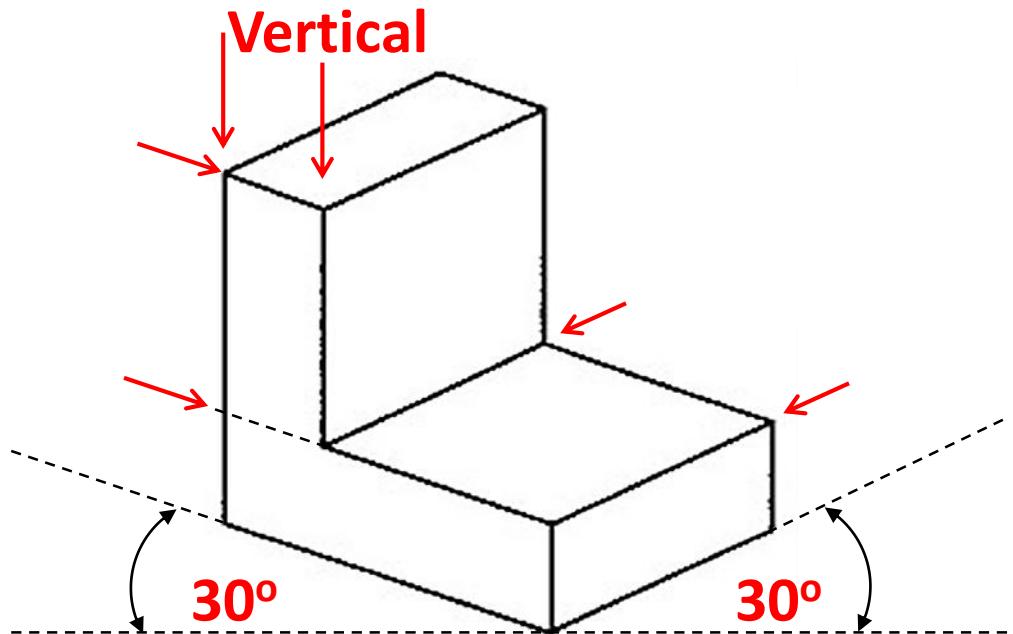


# 3D – VIEW (PICTORIAL)

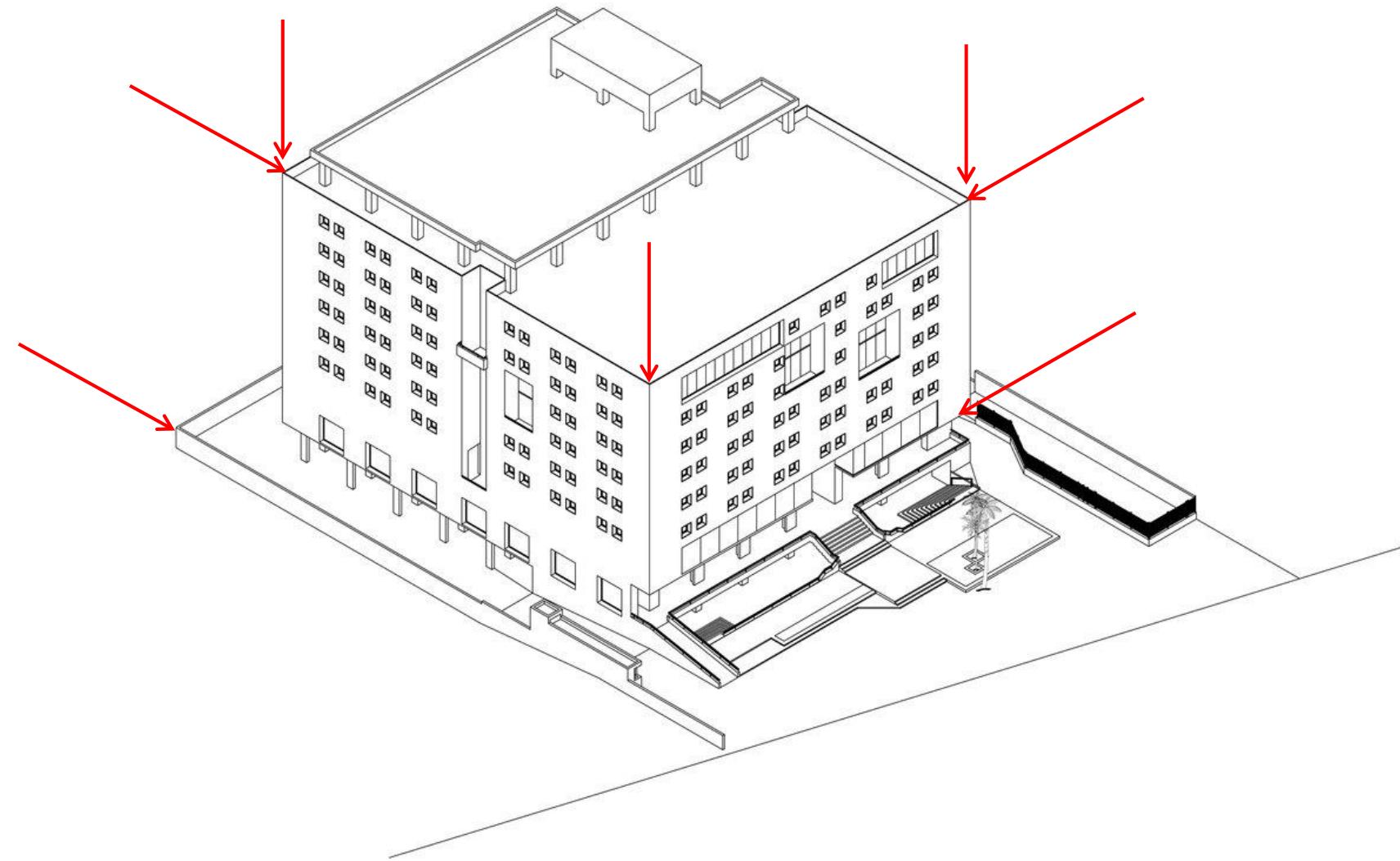
3D View of an object can be drawn in different ways.

## Isometric

- Drawing shows corner of object, but parallel lines on object are parallel in drawing.
- Shows three dimensions, but *no vanishing point(s)*.



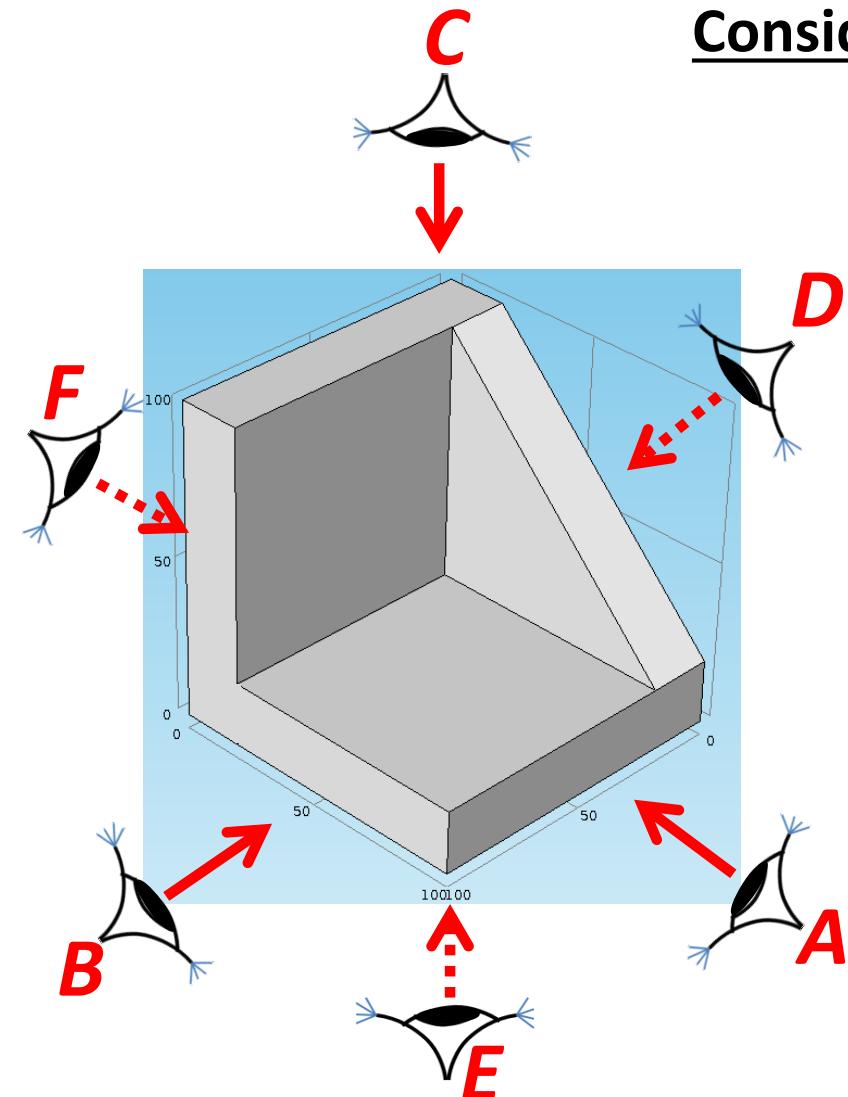
# 3D – VIEW (Isometric)



**Isometric view is widely used in Engineering**

# PROJECTIONS

Projection is the 2D view of a 3D object on a paper.



## Consider a 3D object

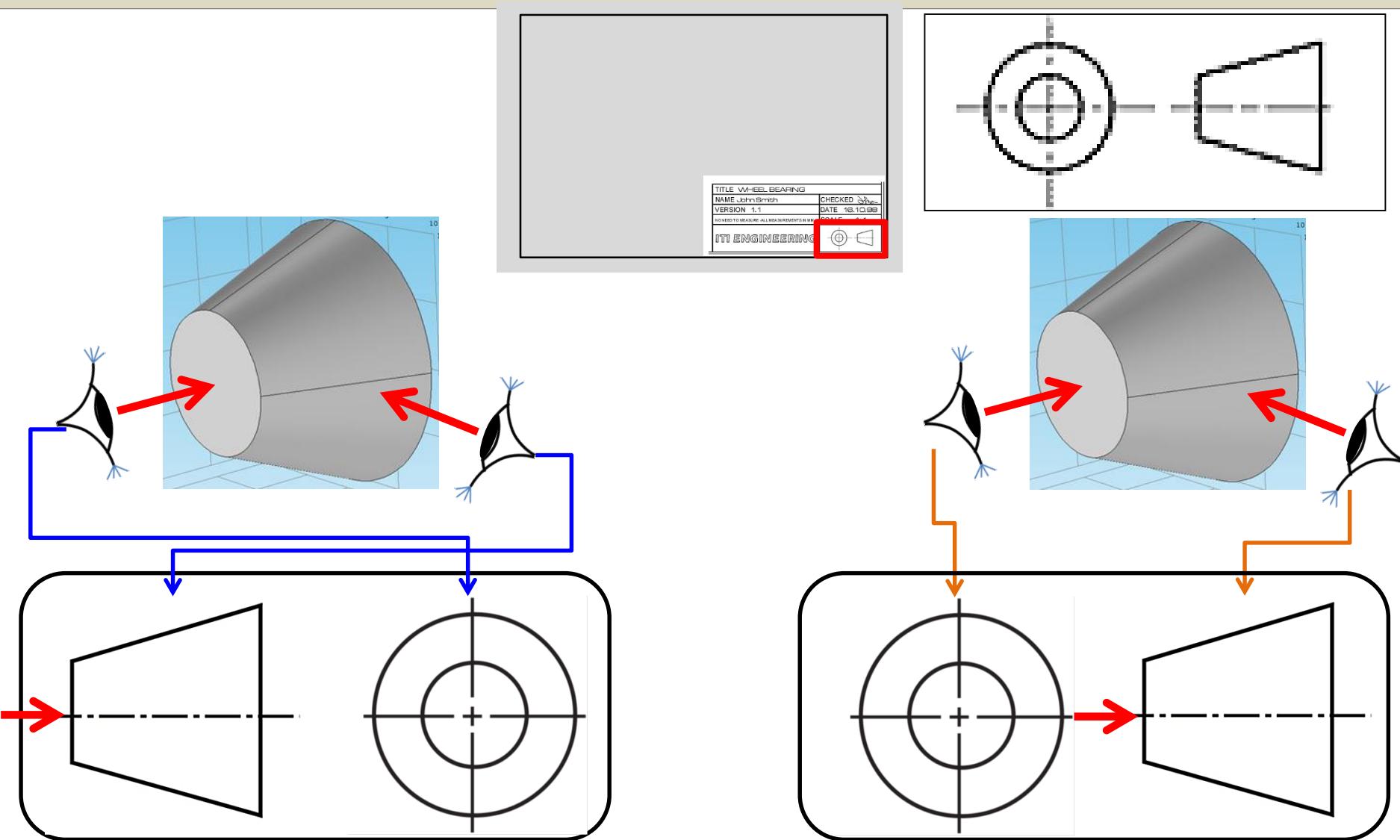
### Essential Views

- View in direction **A** is the view from the **Front**
- View in direction **B** is the view from the **Back (rear)**
- View in direction **C** is the view from **Above**

### Additional Views

- View in direction **D** is the view from the **Right**
- View in direction **E** is the view from **Below**
- View in direction **F** is the view from **Left**

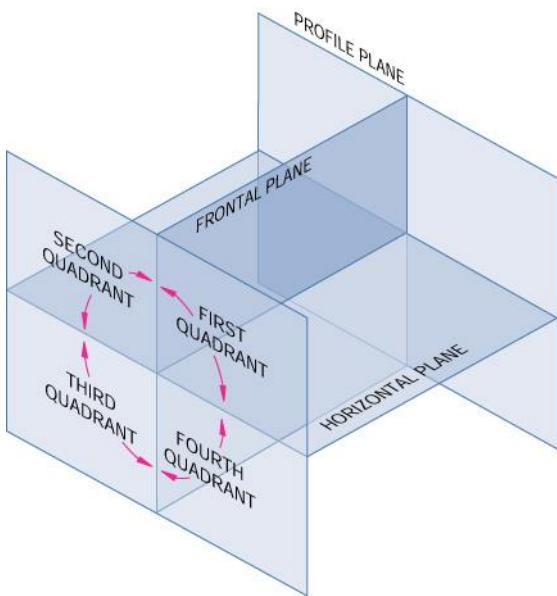
# PROJECTION NOTATION

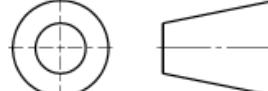
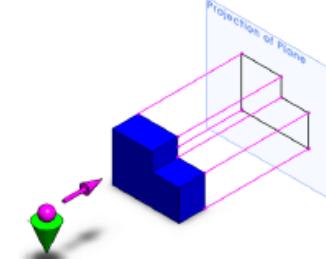
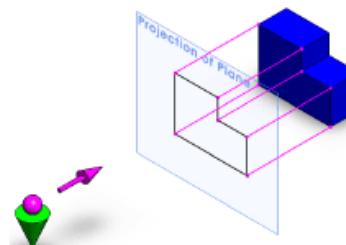
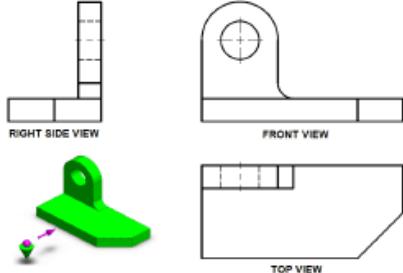
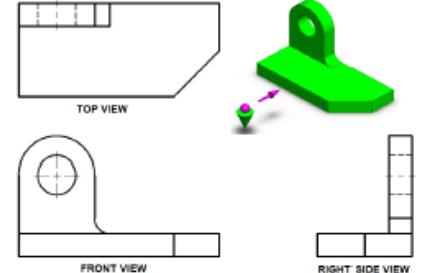


First angle projection

Third angle projection

# First vs. Third Angle Projection



First Angle Projection	Third Angle Projection
The object is imagined to be in first quadrant.	The object is imagined to be in third quadrant.
The object lies between the observer and plane of projection.	The plane of projection lies between the observer and object.
The plane of projection is assumed to be non transparent.	The plane of projection is assumed to be transparent.
When views are drawn in their relative position Top view comes below Front view, Right side view drawn to the left side of elevation.	When views are drawn in their relative position Top view comes above Front view, Right side view drawn to the right side of elevation.
 <b>SYMBOL</b>	 <b>SYMBOL</b>
	
 <b>RIGHT SIDE VIEW</b> <b>FRONT VIEW</b> <b>TOP VIEW</b>	 <b>TOP VIEW</b> <b>FRONT VIEW</b> <b>RIGHT SIDE VIEW</b>

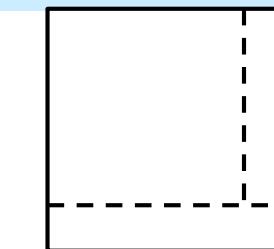
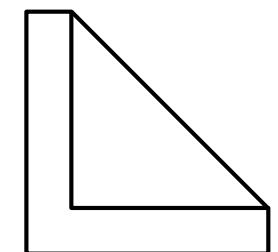
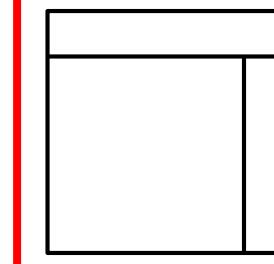
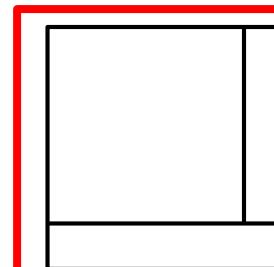
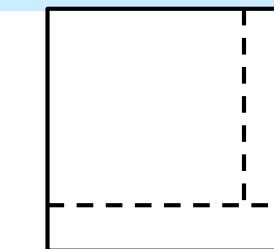
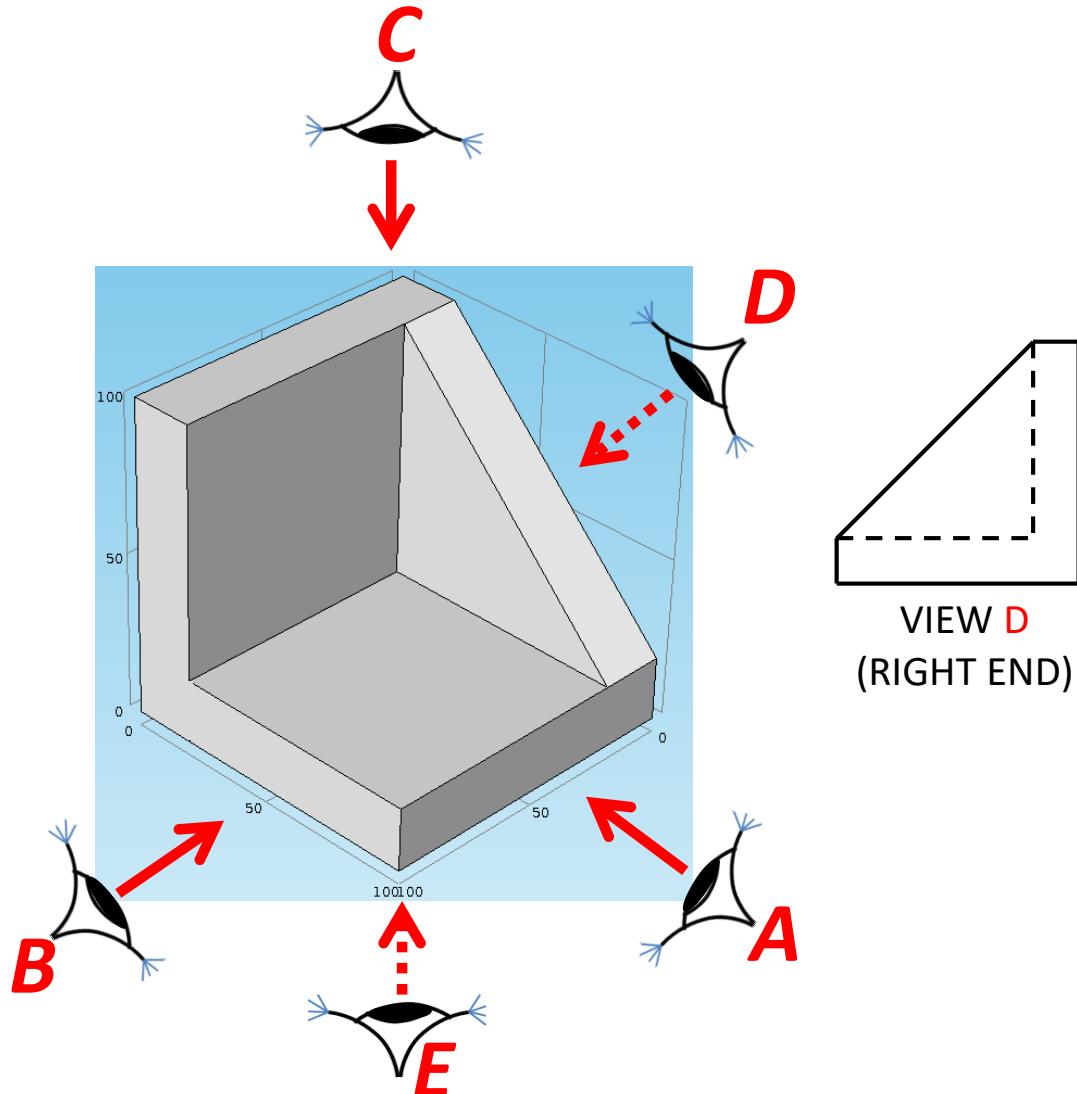
<https://www.youtube.com/watch?v=bk2E8P33Ztc>

<https://www.youtube.com/watch?v=yGjVnXgUpQM>

<https://www.youtube.com/watch?v=O R4vwrJF4A>

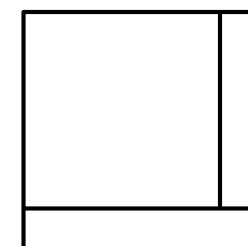
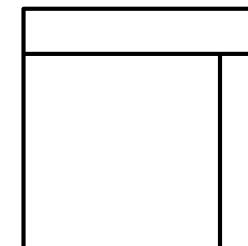
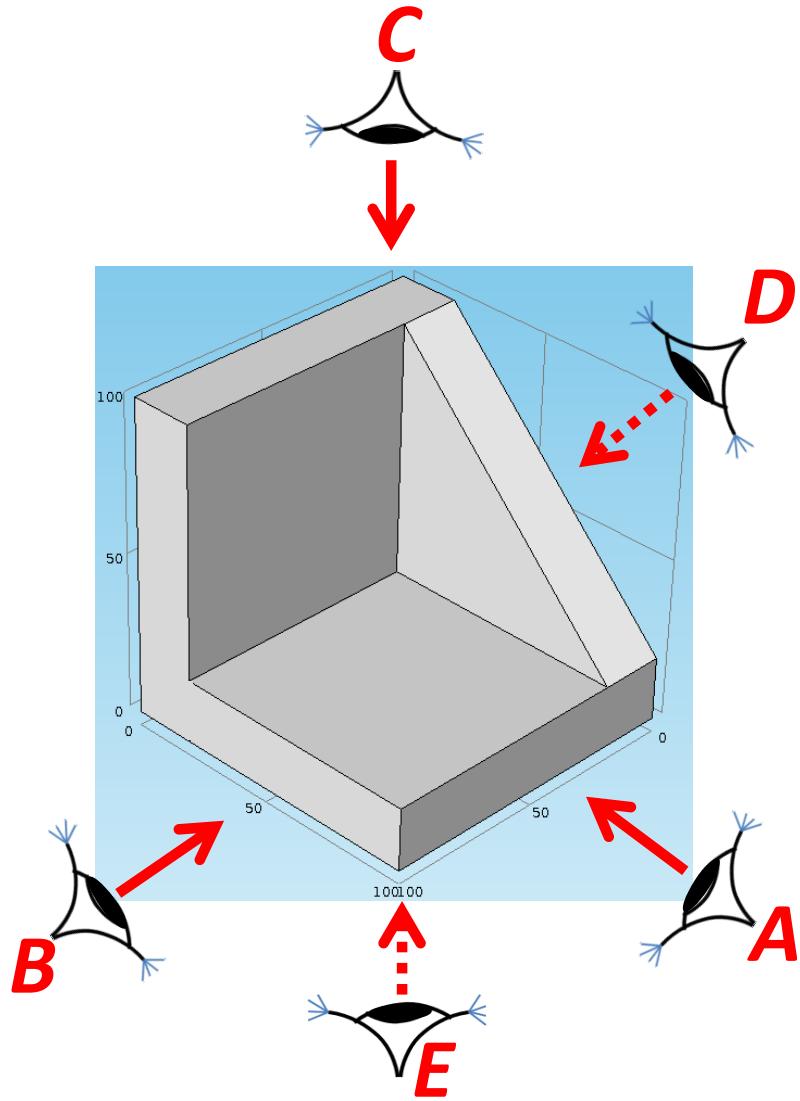
# PROJECTIONS

## First angle Orthographic Projections

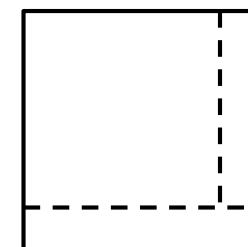


# PROJECTIONS

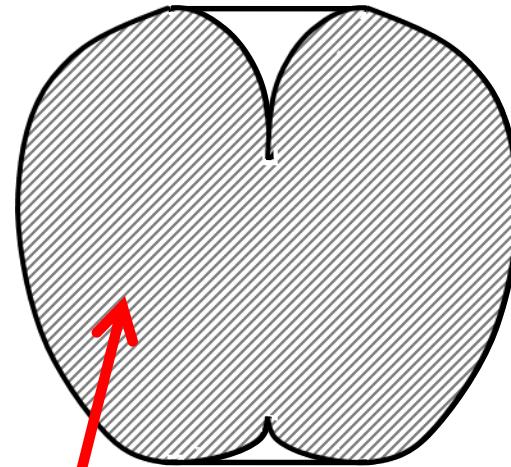
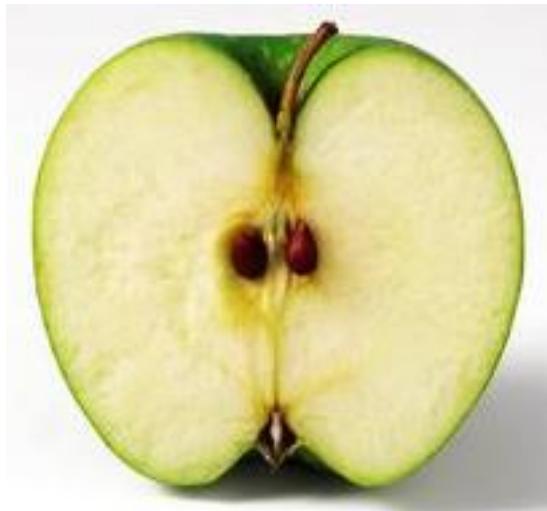
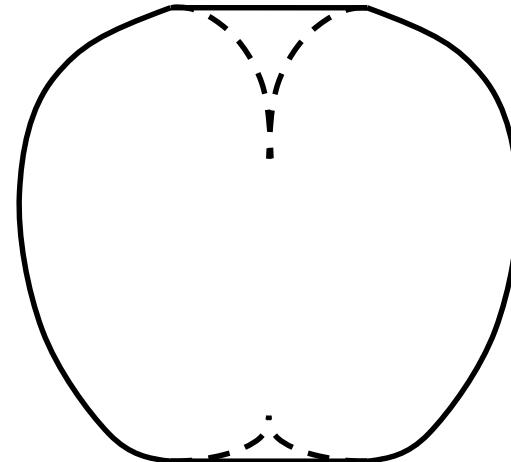
## Third angle Orthographic Projections



VIEW D  
(RIGHT END)



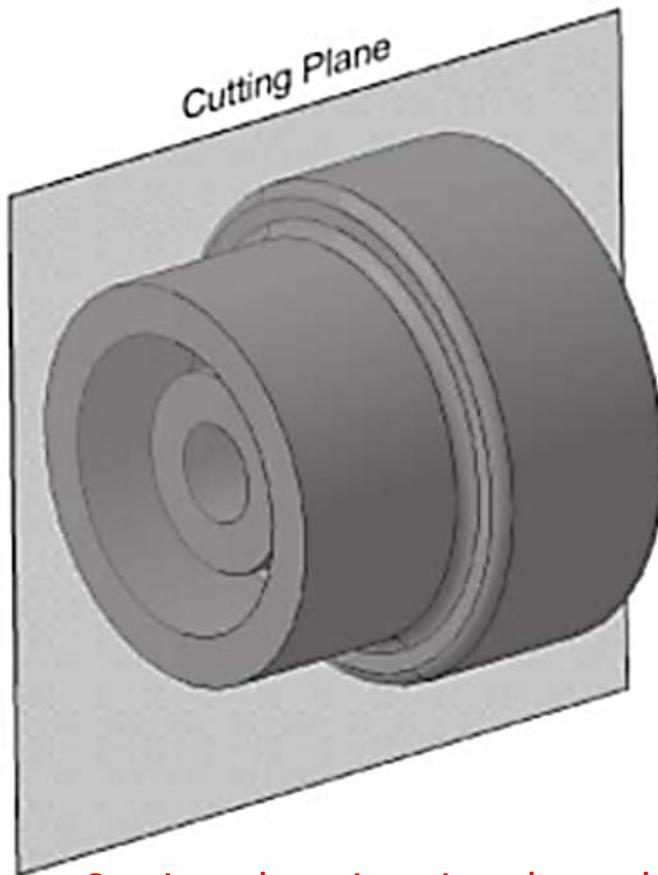
# SECTIONAL VIEWS



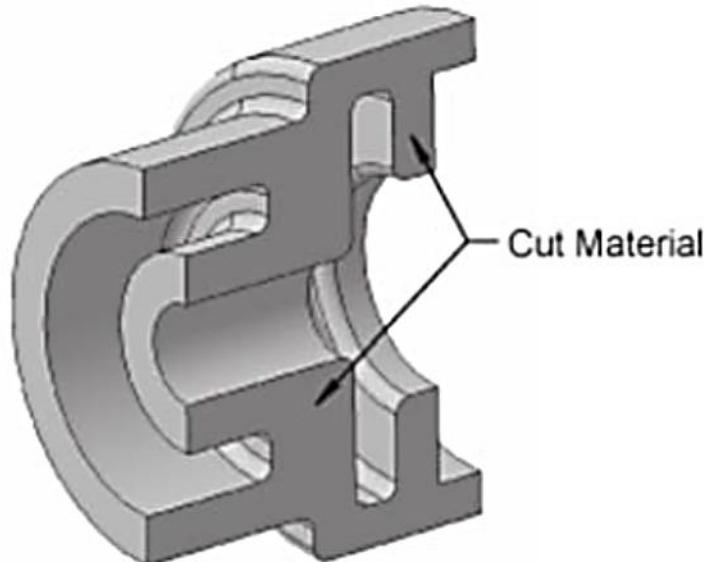
Hatched area represents  
the interior of the object.

# SECTIONAL VIEWS

Consider an object where only the **exterior** surfaces are shown.



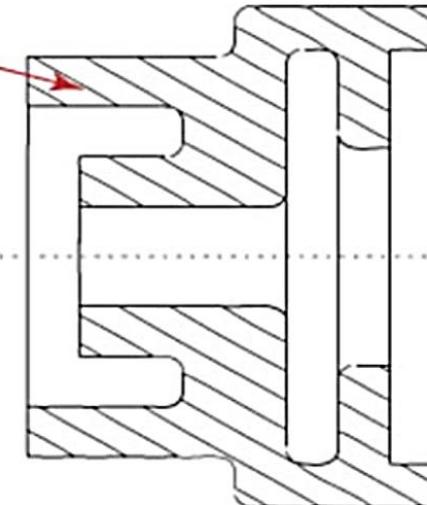
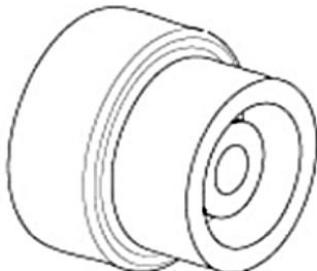
Cutting plane is going through the middle of the object.



After cut, interior parts can be visualised. Cut is imaginary.

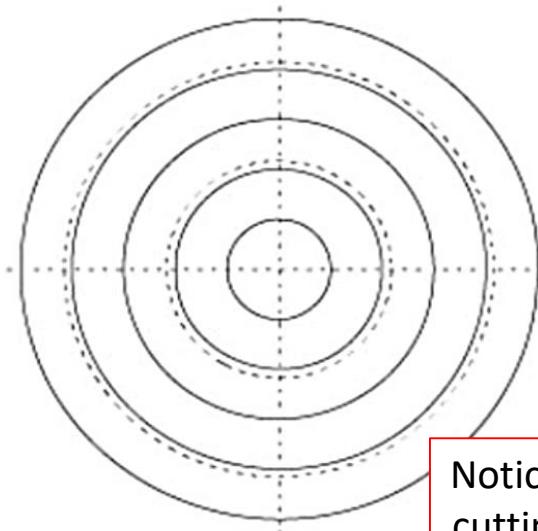
# SECTIONAL VIEWS

Notice how the cut material is shown

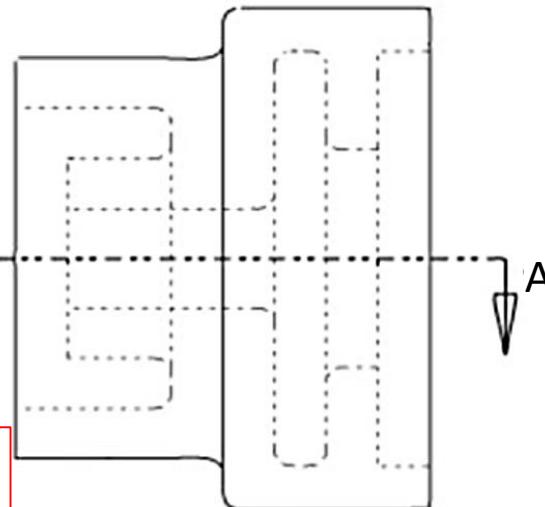


Section View Label

SECTION A - A

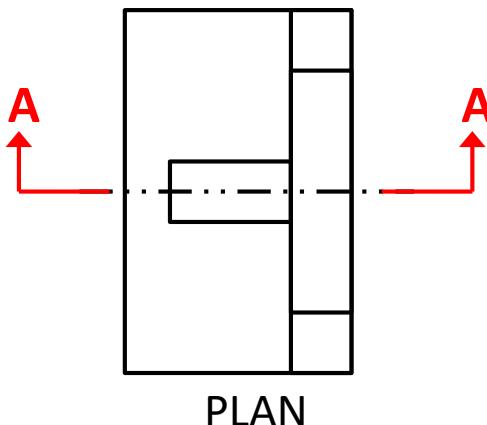
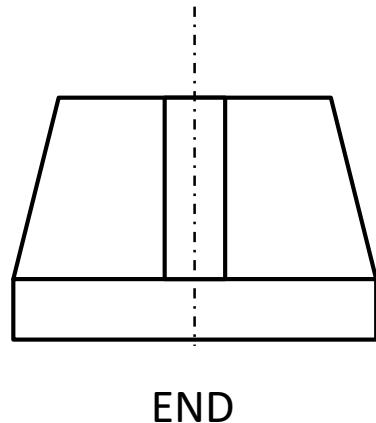
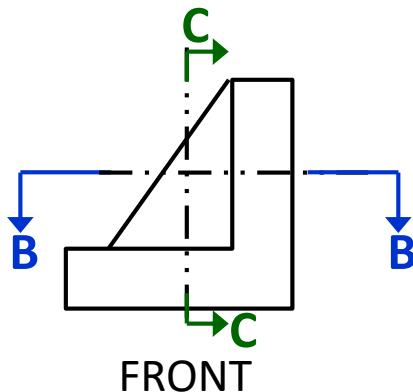


Notice how the cutting plane is represented



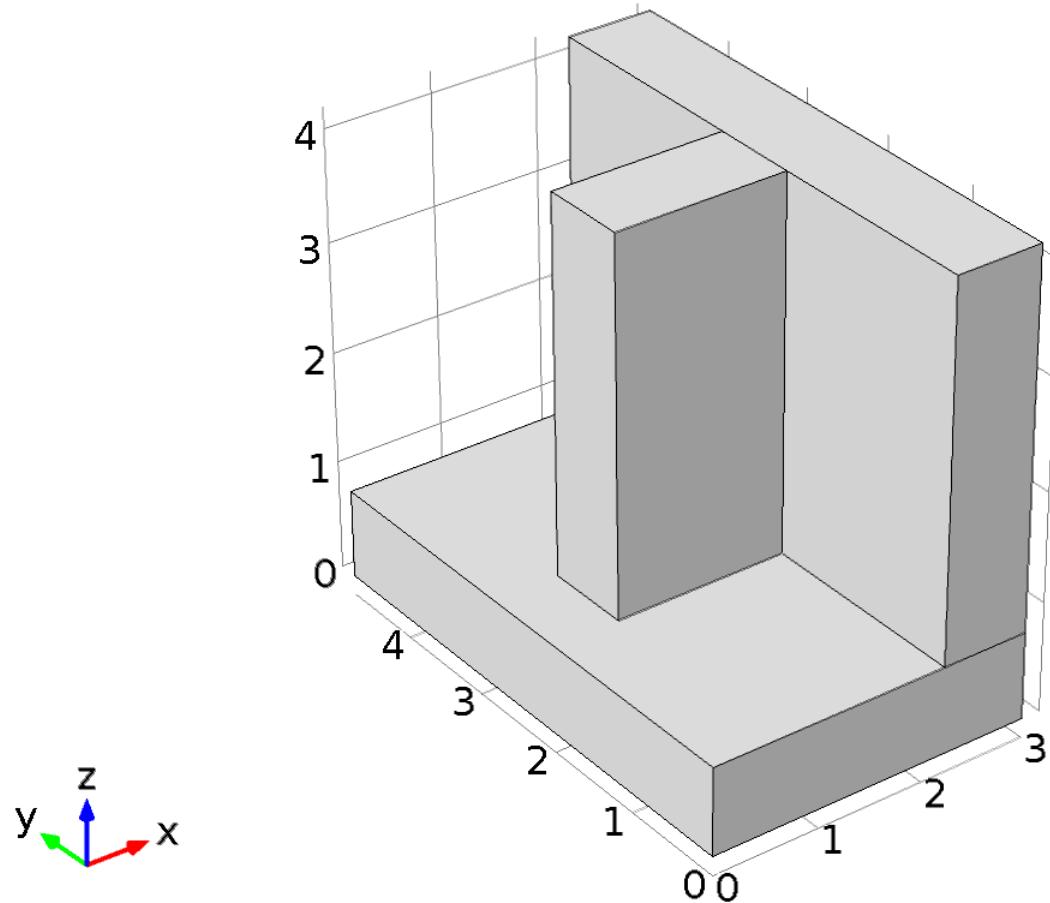
# SECTIONAL VIEWS

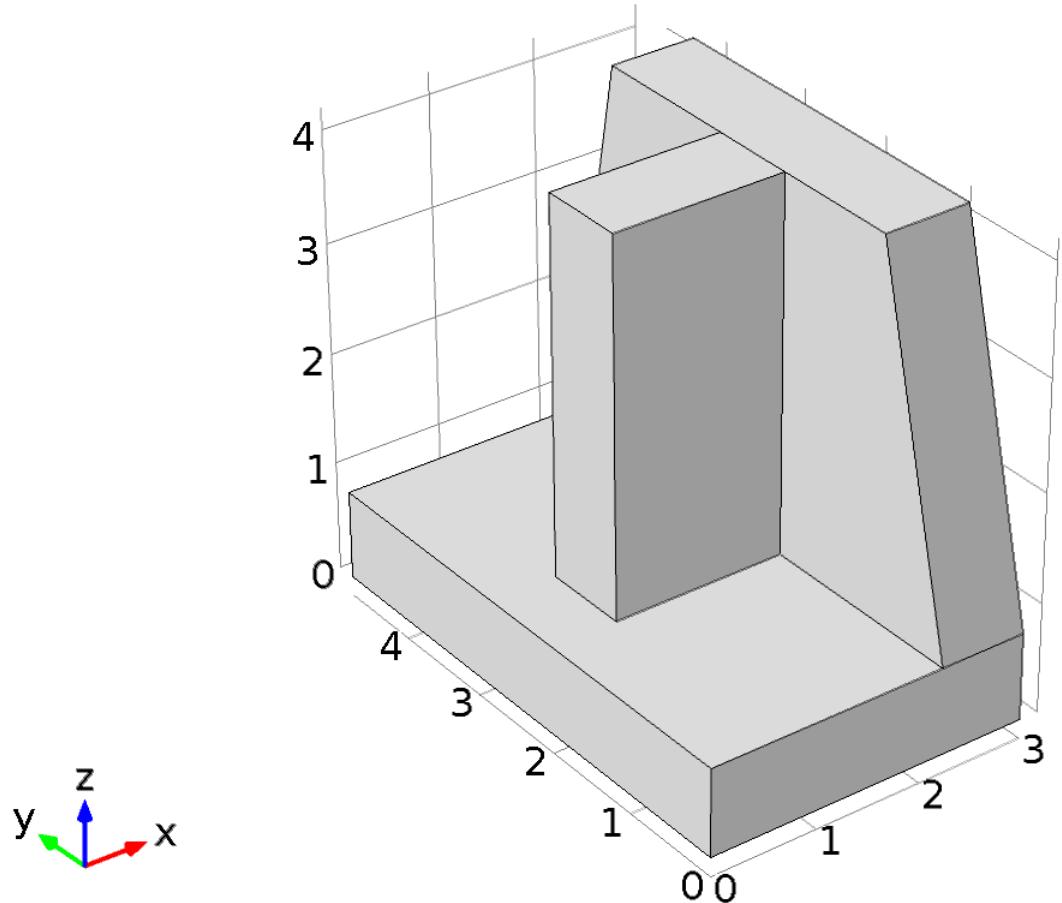
Consider an example object where only the **exterior** surfaces are shown in THREE Views.

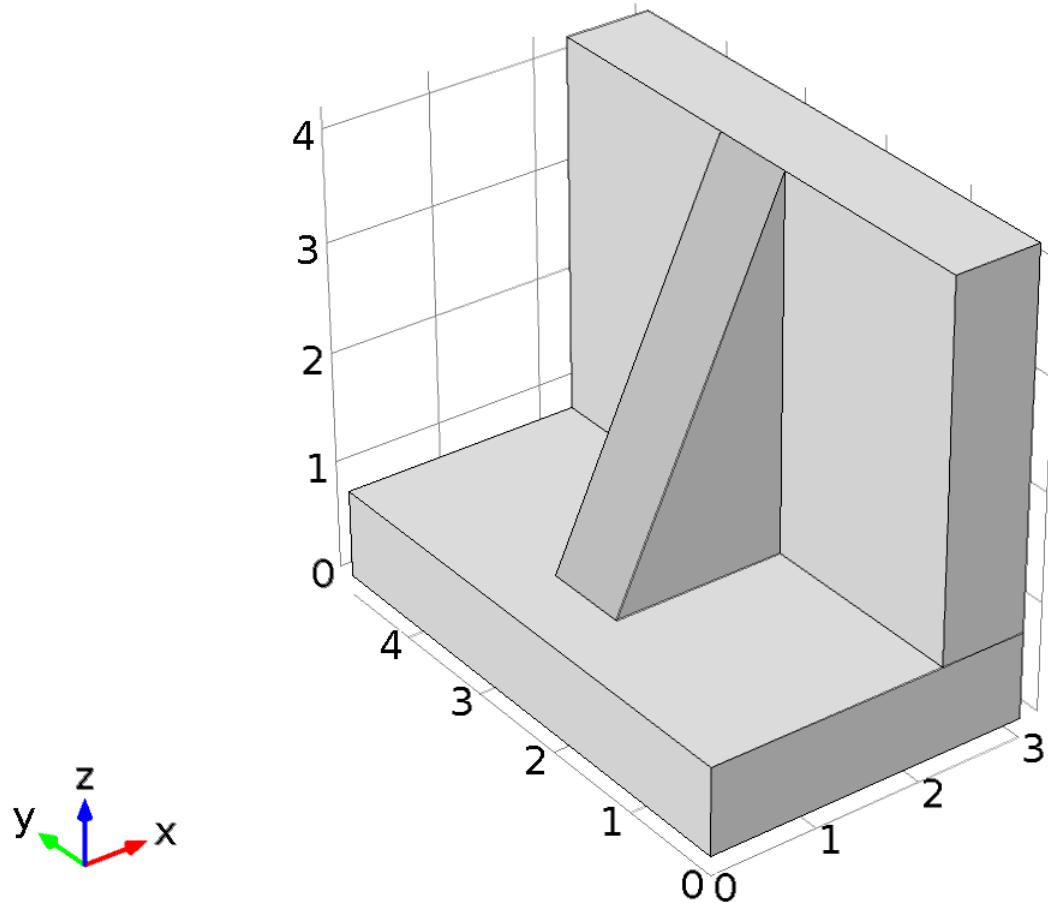


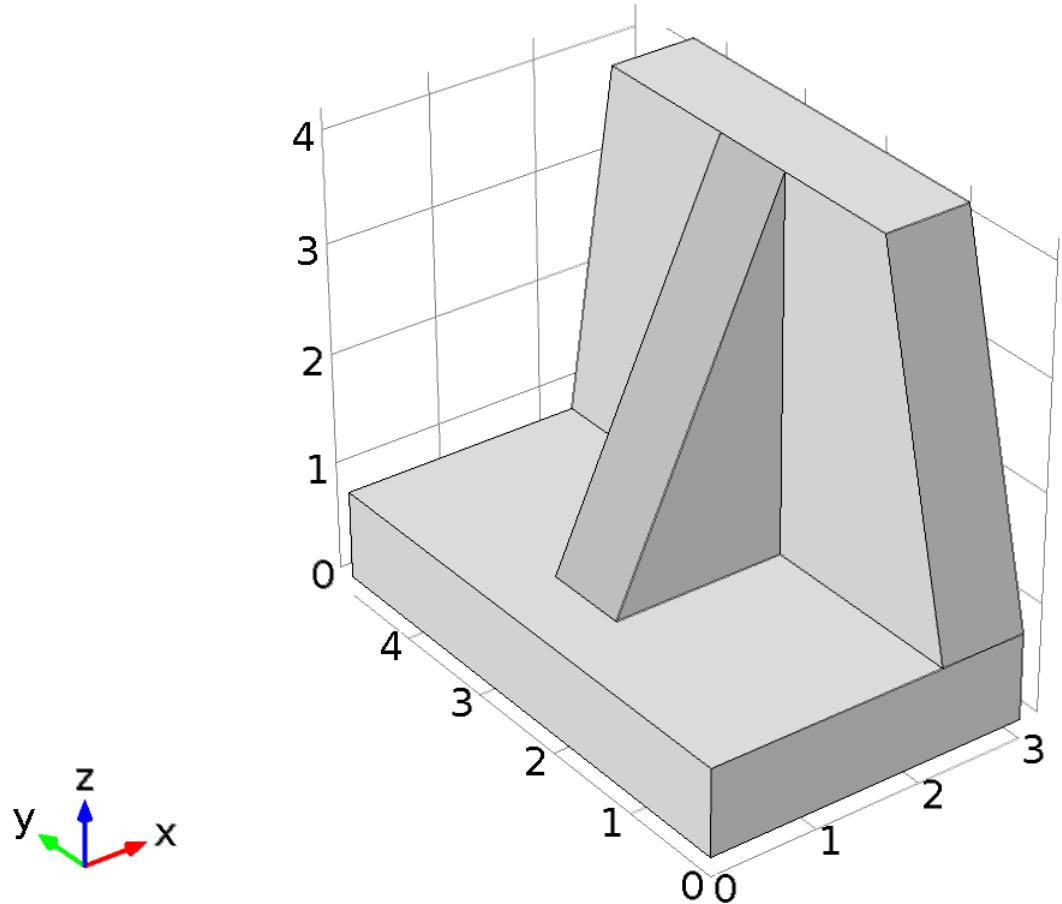
## Questions:

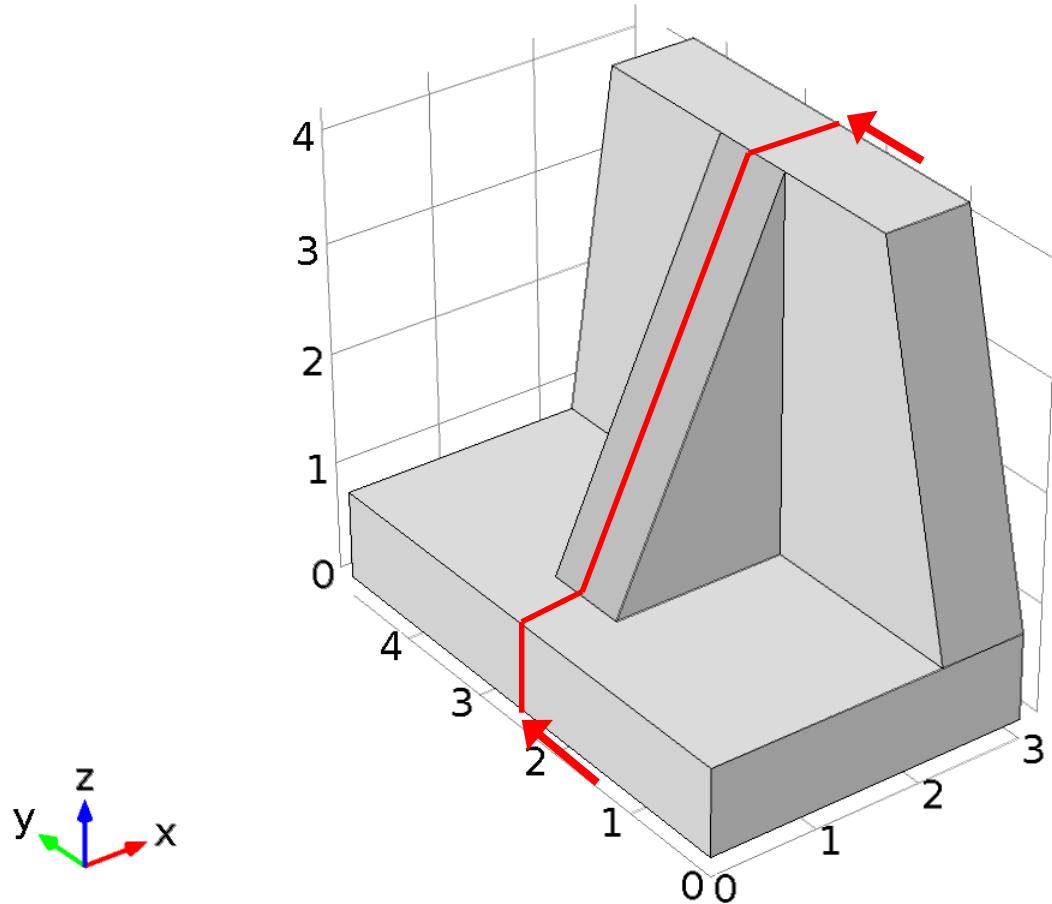
1. Can you imagine the 3D Object?
2. If the Object is cut through a given plane, can you DRAW the 2D view?
  - i) Cut through A – A
  - ii) Cut through B – B
  - iii) Cut through C – C

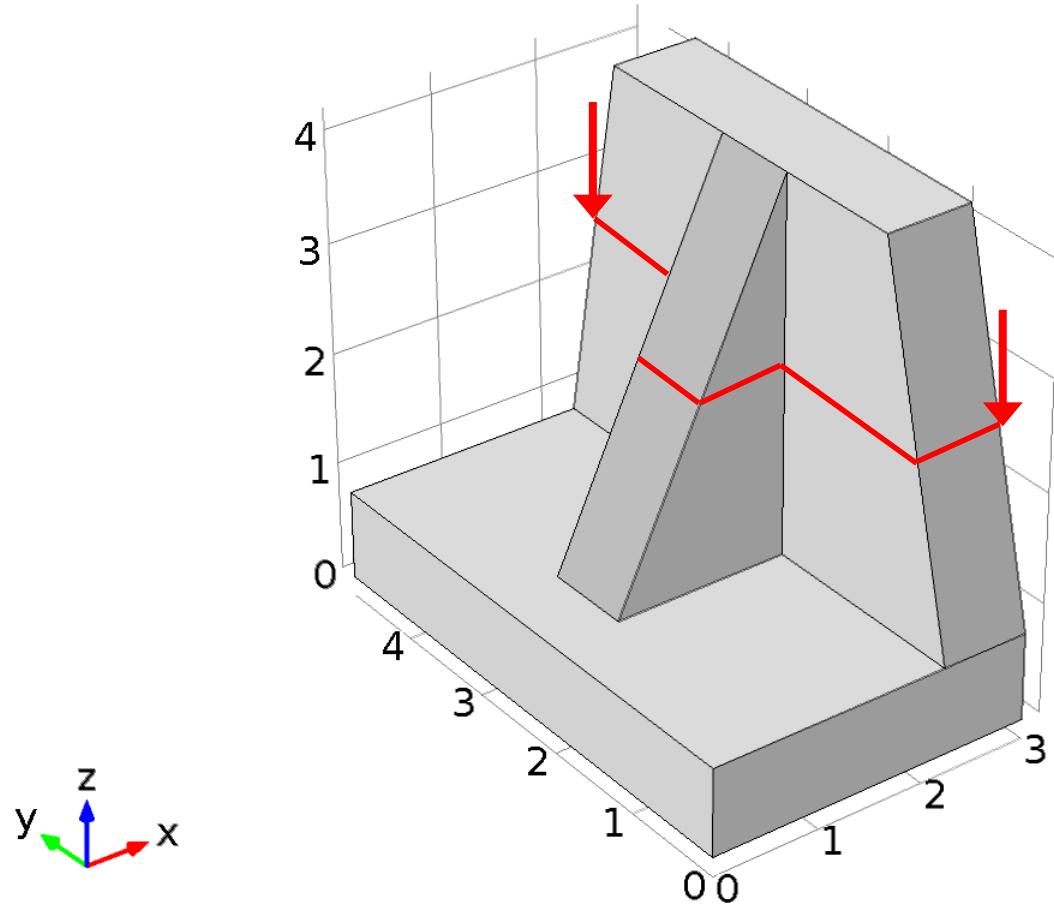






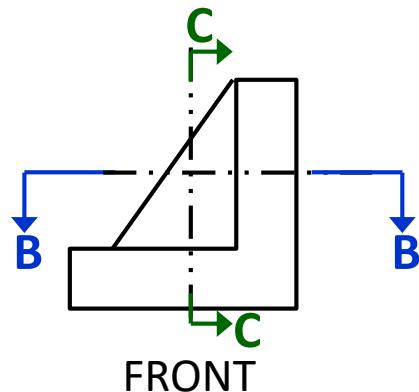




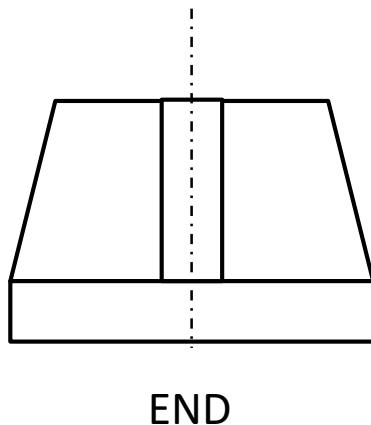


# SECTIONAL VIEWS

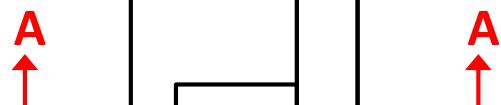
When parts have complex internal geometries, knowing the **interior** is as important as knowing the **exterior**.



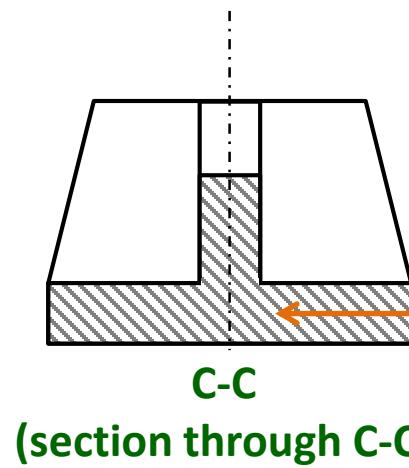
FRONT



END

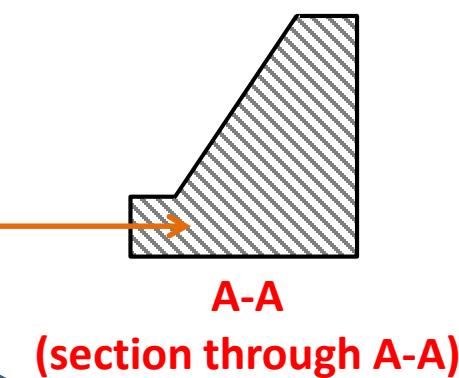


PLAN

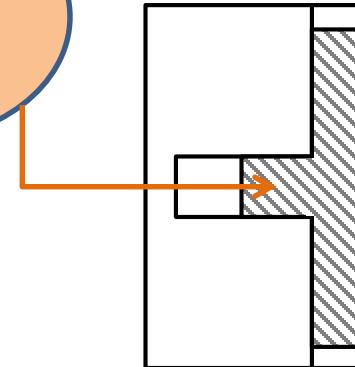


C-C  
(section through C-C)

Interior surfaces are hatched!



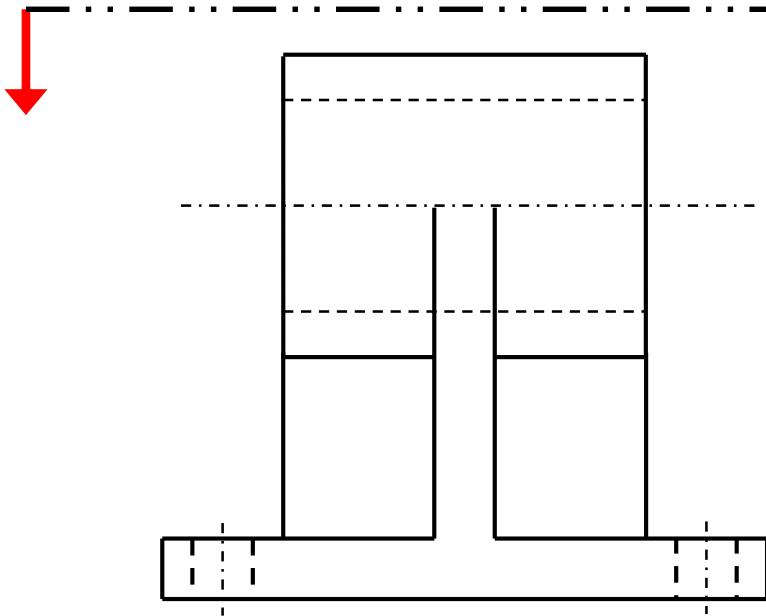
A-A  
(section through A-A)



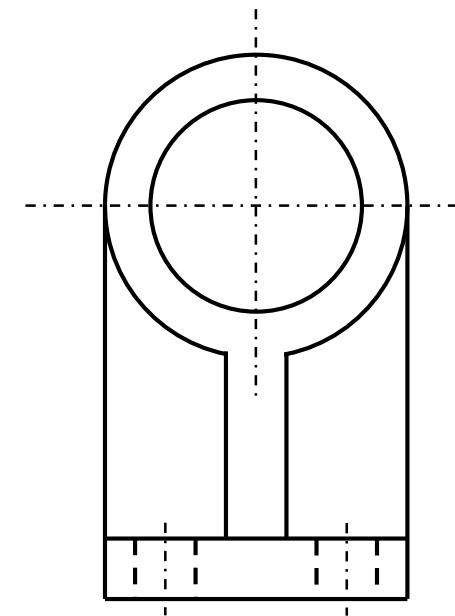
B-B  
(section through B-B)

# EXERCISE

Draw the '**PLAN**' view on a paper.



FRONT

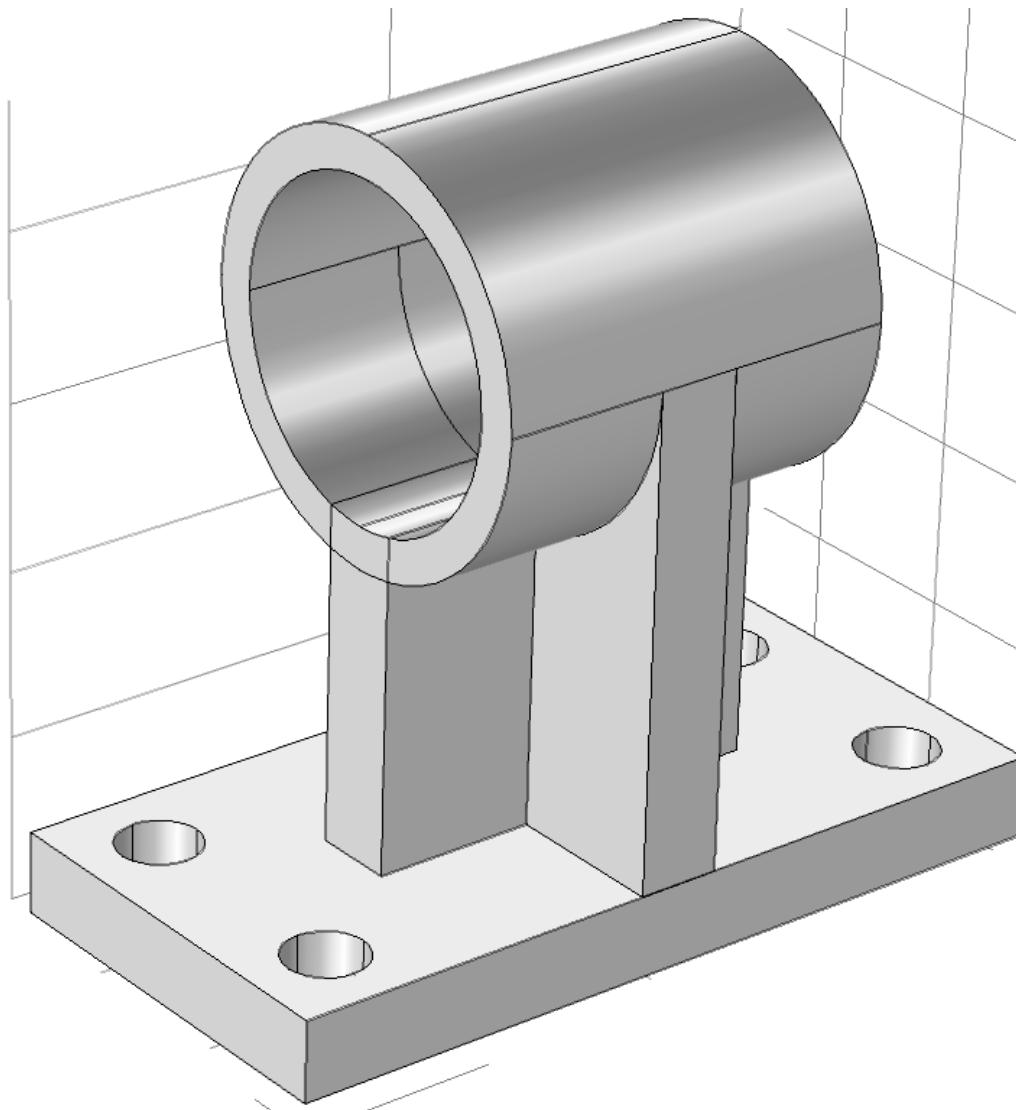


END

Can you imagine the 3D object?

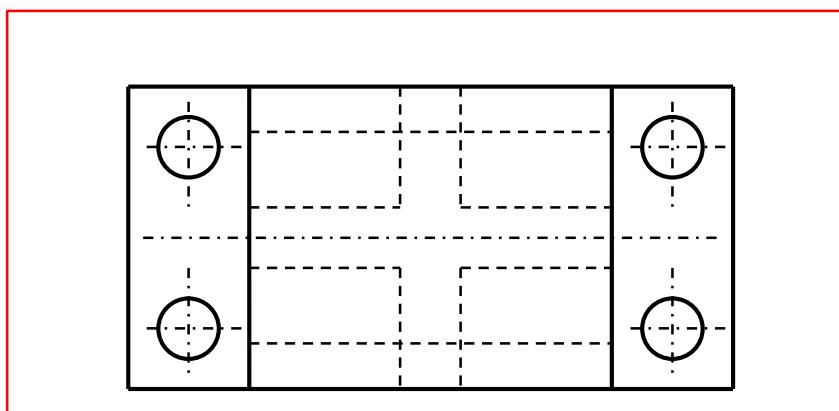
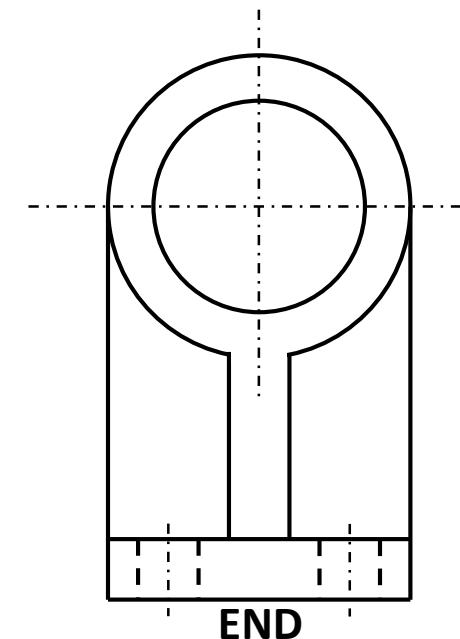
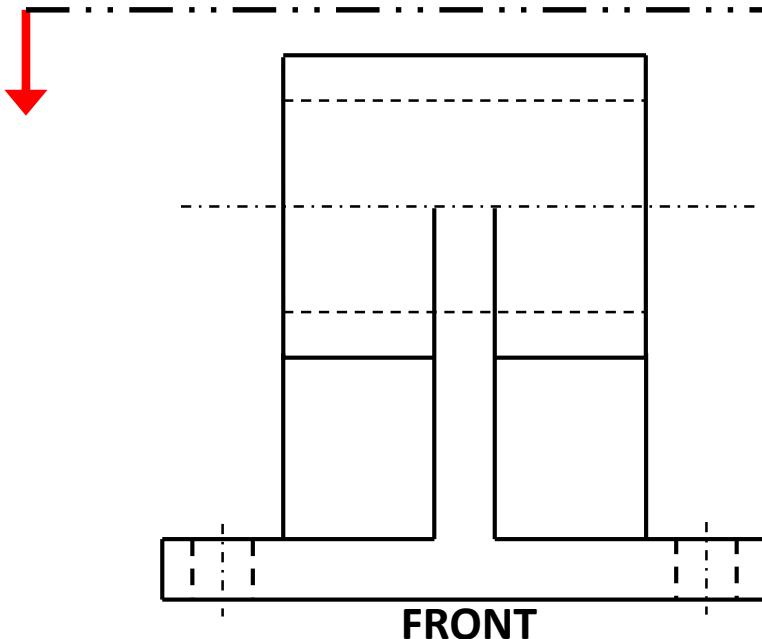
# EXERCISE

Have you imagined this 3D object?



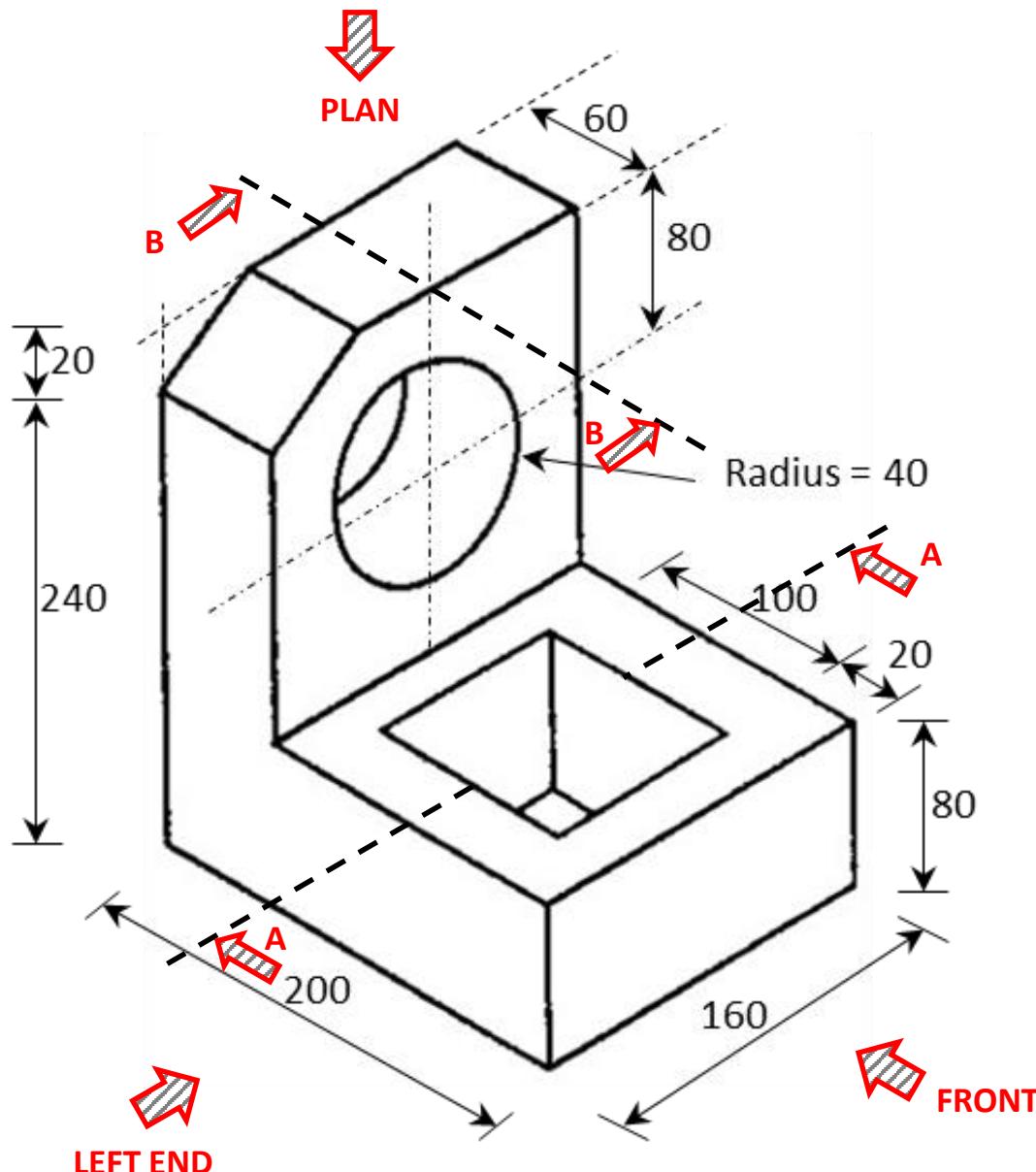
# EXERCISE

Draw the '**PLAN**' view on a paper.



**PLAN**

## Exercise

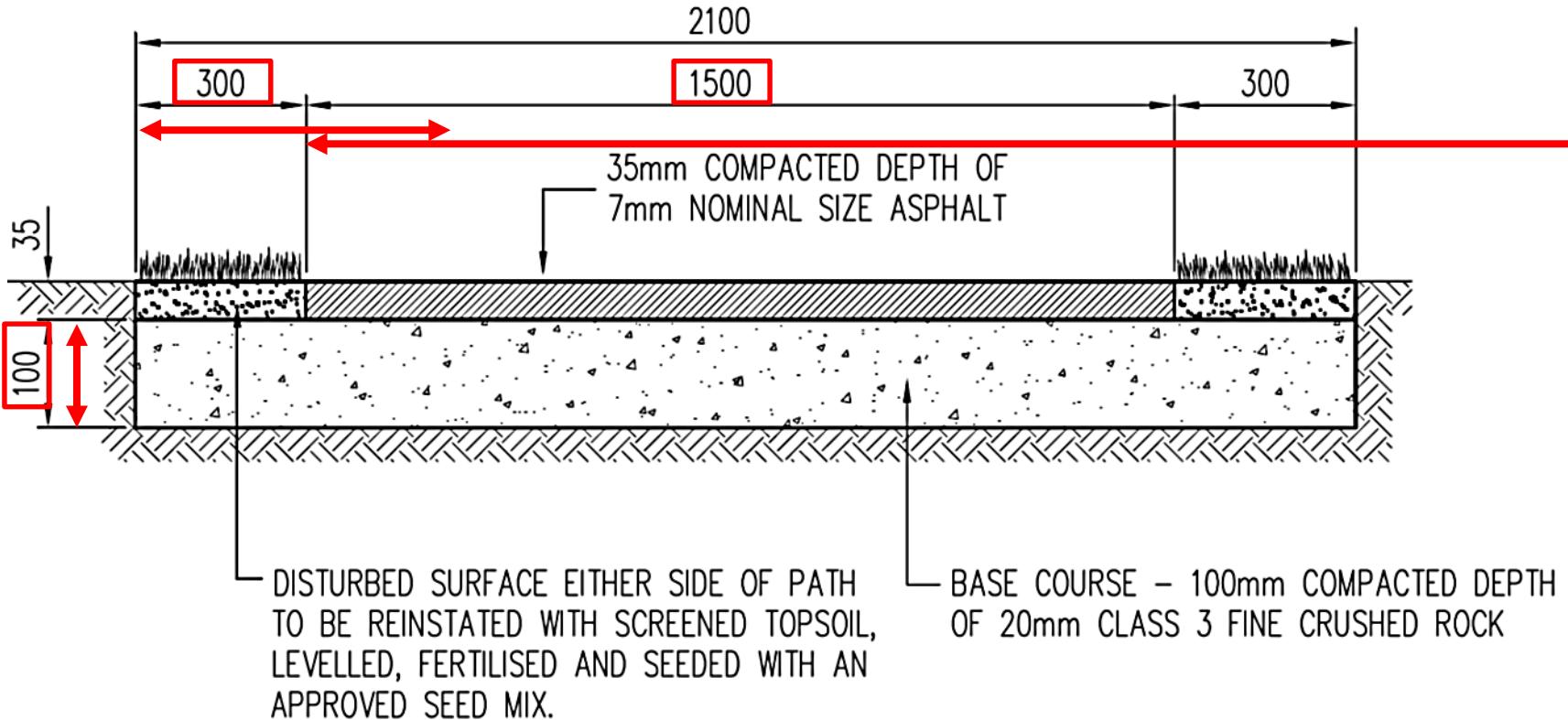


### Note:

1. Dimensions are in millimetres
2. Drawing is NOT TO SCALE

# DRAWINGS IN CIVIL ENGINEERING

## Footpath Cross - section

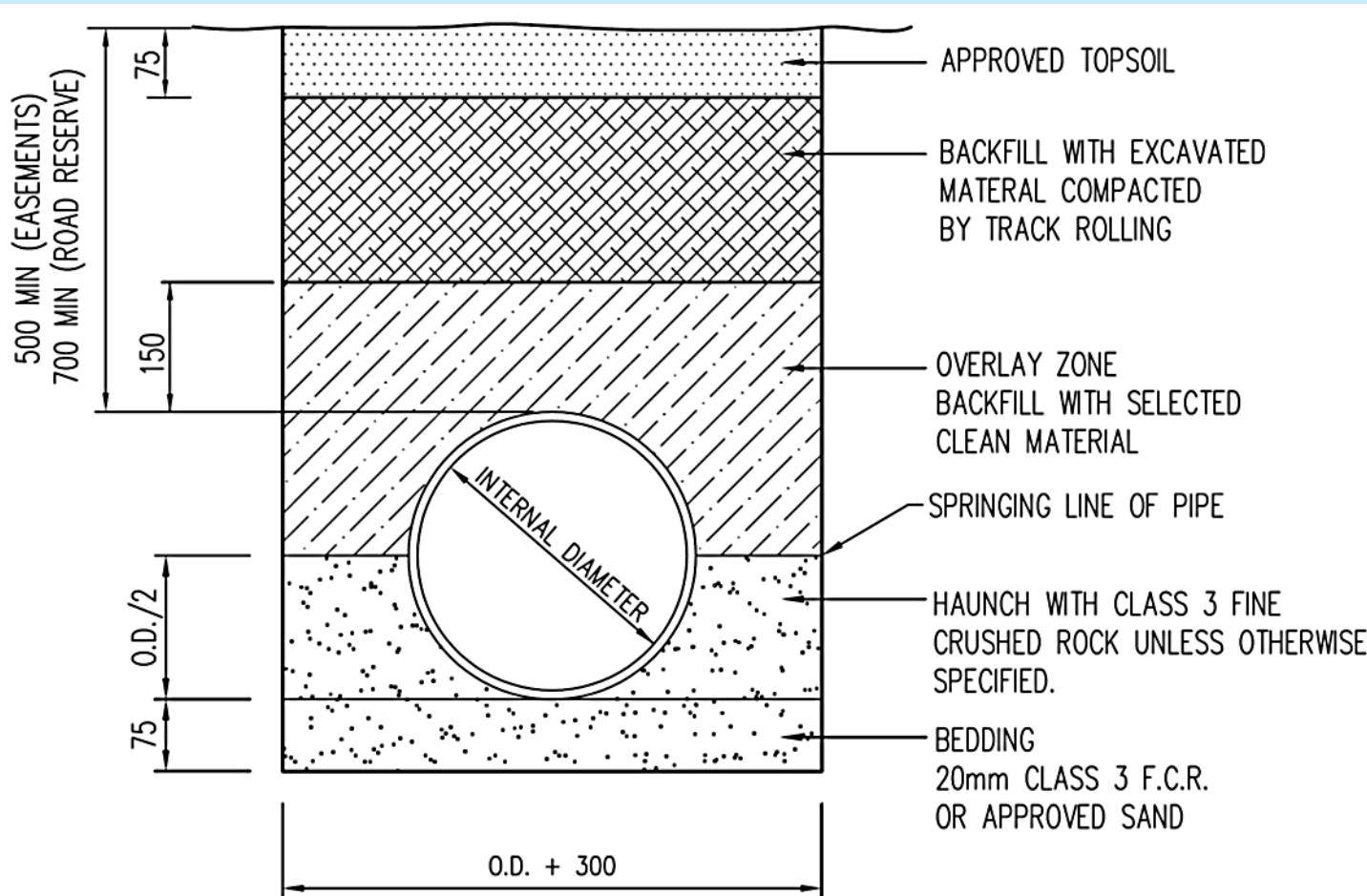


TYPICAL ASPHALT FOOTPATH ELEVATION

NOT TO SCALE

# DRAWINGS IN CIVIL ENGINEERING

## Underground Pipe - Section



PIPE BEDDING DETAIL

SCALE 1:10

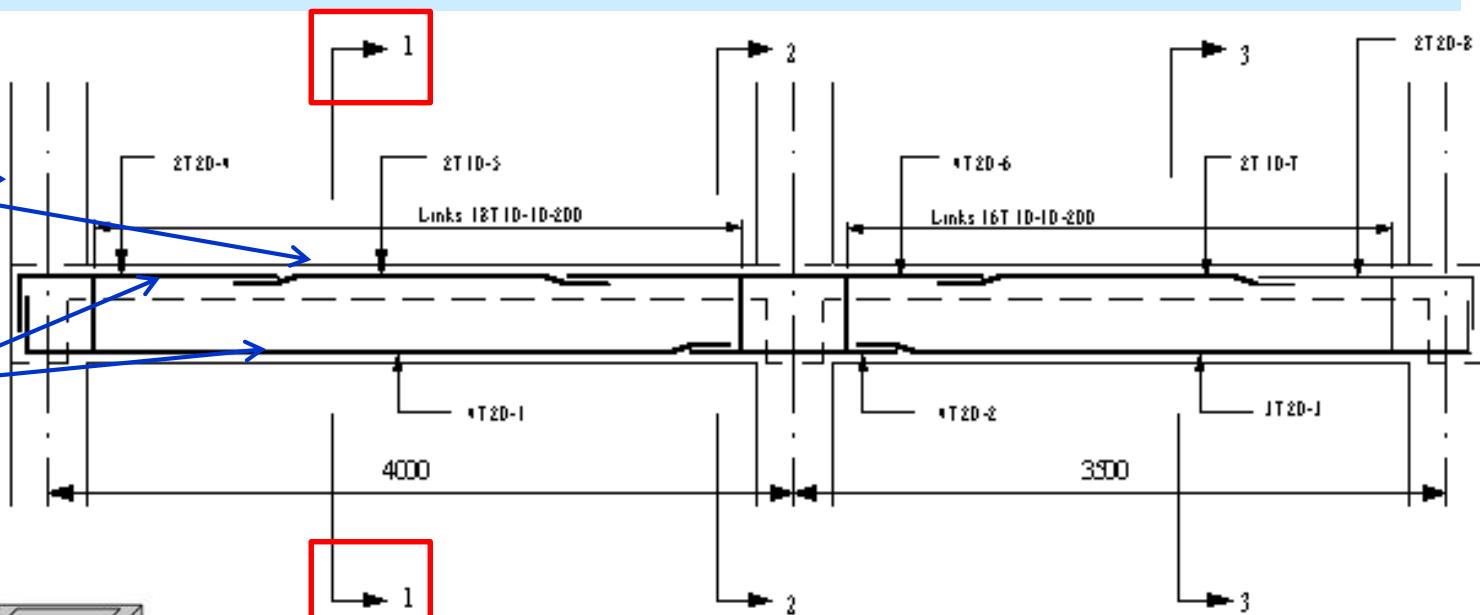
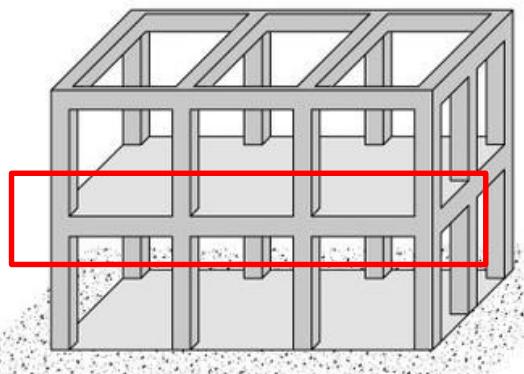
REFER TO THE RELEVANT SECTION OF THE CITY OF GREATER DANDELONG ENGINEERING CONSTRUCTION SPECIFICATION FOR COMPACTION REQUIREMENTS OF THE ABOVE ELEMENTS

# DRAWINGS IN CIVIL ENGINEERING

## Concrete beam – Front view & Sections

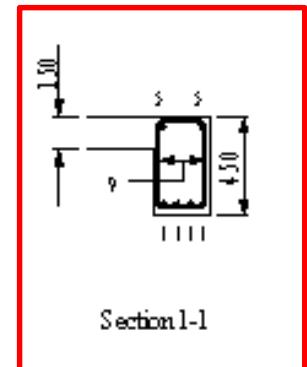
Concrete outer surface

Interior steel bars

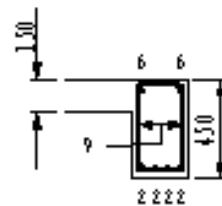


Beam 3/A-B

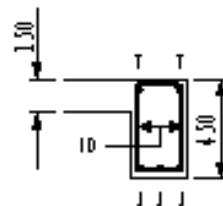
Beam 3/B-C



Section 1-1



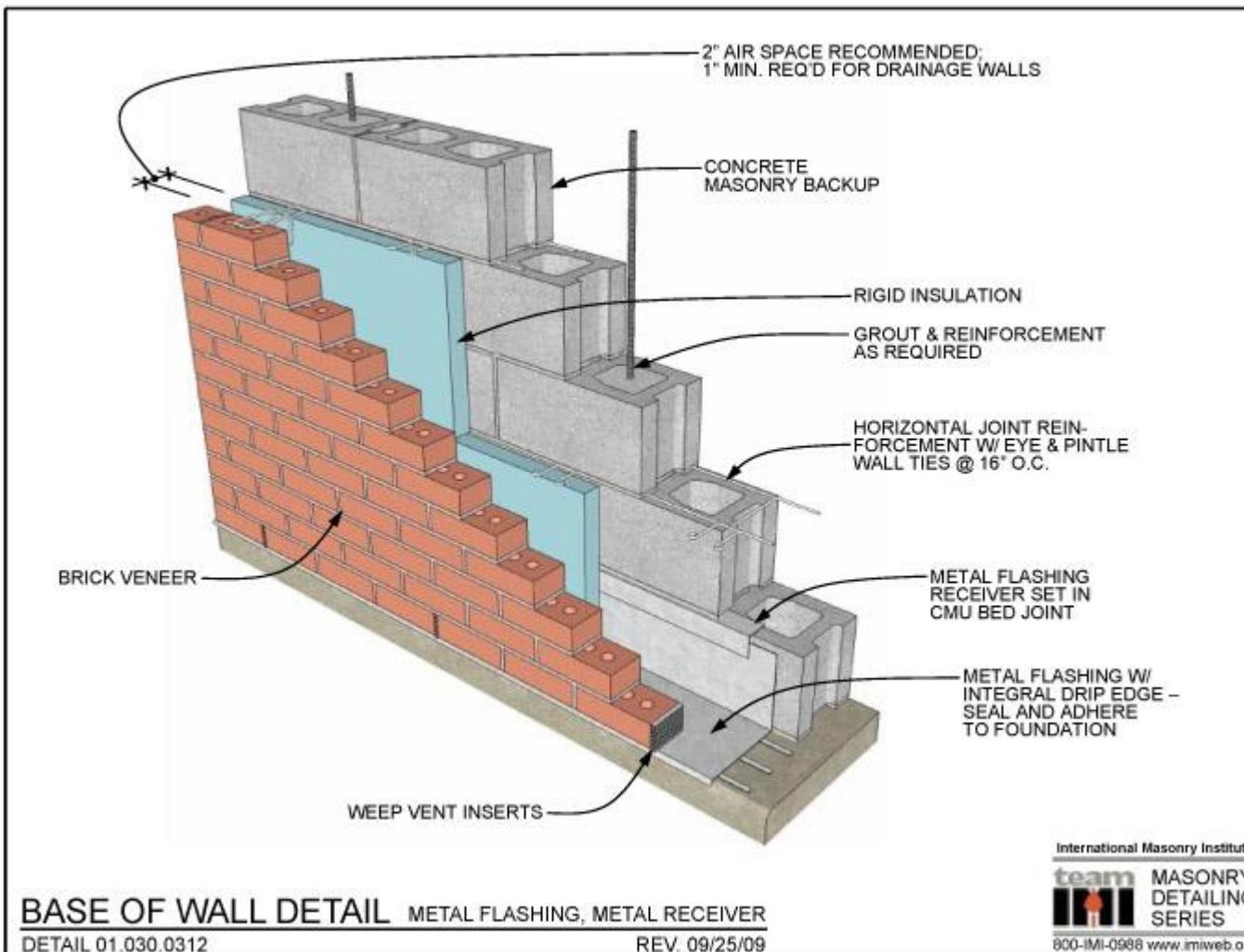
Section 2-2



Section 3-3

# DRAWINGS IN CIVIL ENGINEERING

## Brick Wall – Isometric view



International Masonry Institute

**team** MASONRY  
DETAILING  
SERIES

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You are required to show some drawing skills in your Final Report and Computer Lab test.

You will learn more and get more drawing skills at Year 2-4.



Thank you!