School of Mechanical and Manufacturing Engineering

MMAN2130 Design and Manufacturing

Term 2 – 2019

Week 3

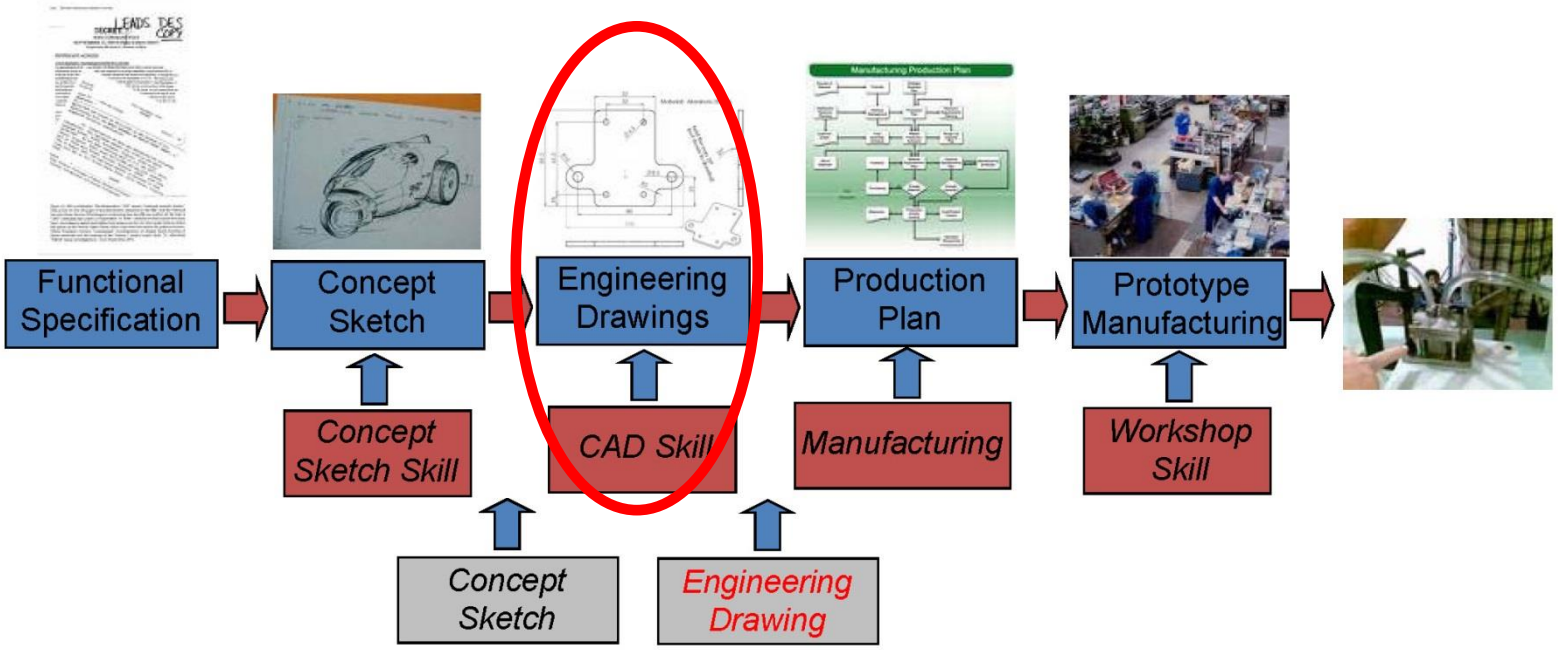
3-D Part Modelling & Engineering Drawing

Checking your progress in Week 3…

- **Pump group responsibilities: Base plate; piston; cylinder; valves; cover: 5 components.**
- **CAD Lab this week – 3D operations in Solidworks and progression to discuss the engineering drawing discipline, particularly AS1100.**

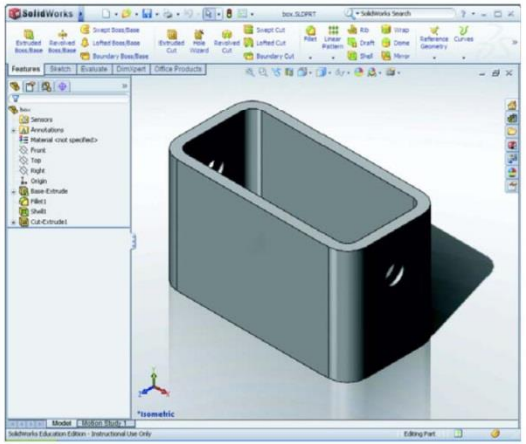
Context of this learning:

Pump Project

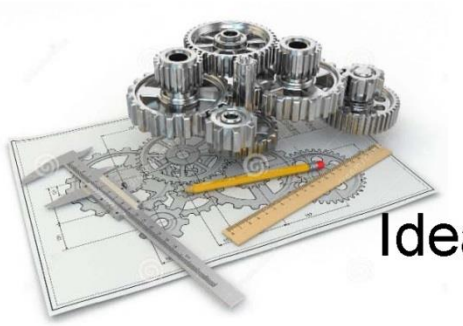


Computer Aided Design

- CAD creates 3D models or parts
- Assembles them
- Creates documentation for review and manufacture
  - Pictures
  - Engineering drawings



Slides 9 – 29 credit: Prof S Kara (UNSW, 2017)



SolidWorks CAD

Idea/Hand drawn concept sketch

↓

2D Sketch (Fully defined)

↓

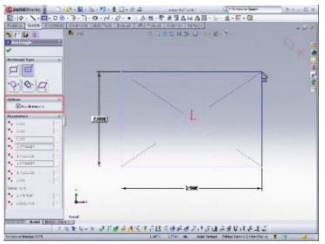
3D Part .prt (Extrude/Cut)

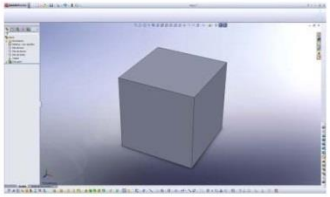
↓

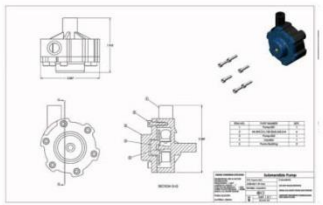
Engineering Drawing .drw
(AS1100 get it made)

↓

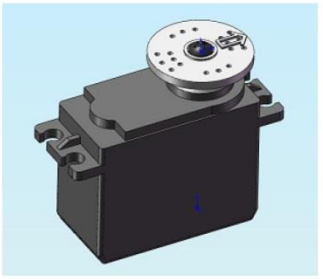
Model stress/strain(COSMOS),
Animation,
SolidCAM for machining



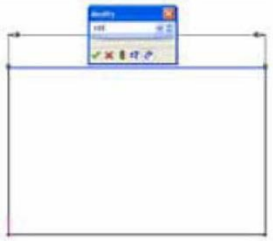




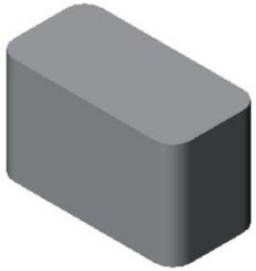
3D Assembly .asm



Typical Methods for CAD Modelling



- Most CAD programs operate in similar ways
- Build up your design in small simple steps
- Define each step as an *operation often specified from a 2D wire frame shape (Sketch)*
- Every step in the process can be revisited and modified later



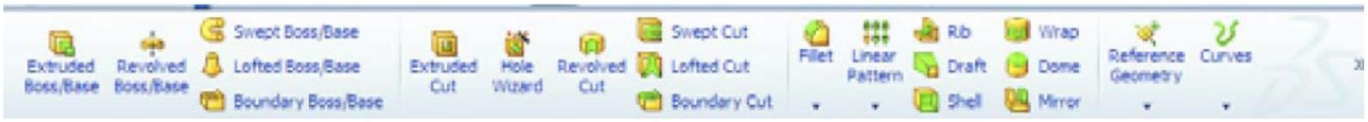
Typical Methods for CAD Modelling

1. 2D wireframe shape is sketched with the mouse
2. Lines and circles joined as a continuous closed chain
3. Constraints can be added or it could be left as it is
4. Lengths or angular dimensions (implicit or relative to another entity)
5. Other constraints (coincidence, parallel, vertical, horizontal etc.)
6. The 2D sketched shape is manipulated in a 3D *operation*
7. Other operations can be added to the resulting 3D solid in a sequence
8. You can revisit any sketch to modify or add any constraints, even when the part is finished.

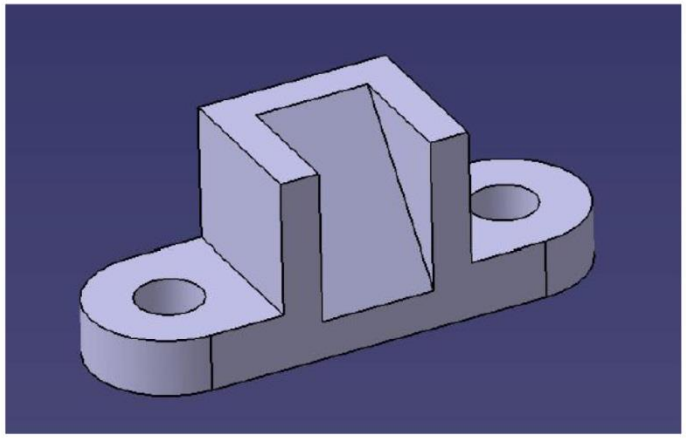
Typical Methods for CAD Modelling

Typical 3D Operations

- Extruded Boss/Base
- Revolved Boss/Base
- Extruded/Revolved Cut
- Hole
- Fillet
- Pattern

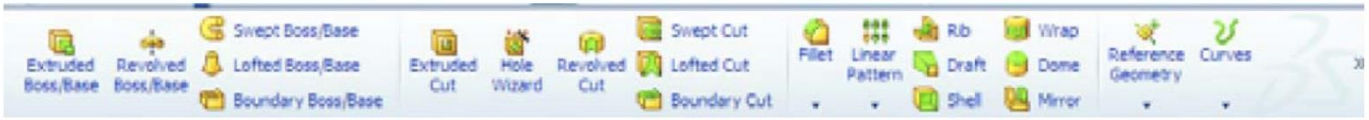


Example 1 : 3D Modelling Methods



- Sketch
- Extruded Boss/Base
- Extruded Cut
- Hole
- Pattern

Source – Engineering Drawing, A. W. Boundy



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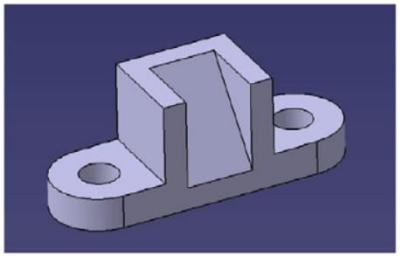
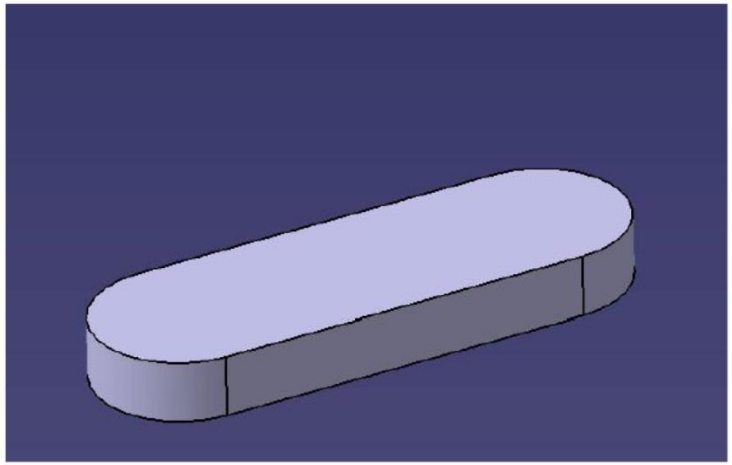
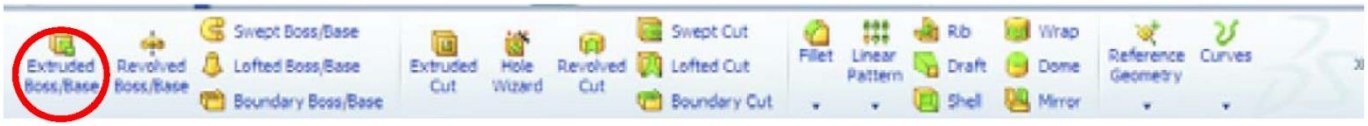


Source – Engineering Drawing, A. W. Boundy



- Sketch
- Extruded Boss/Base



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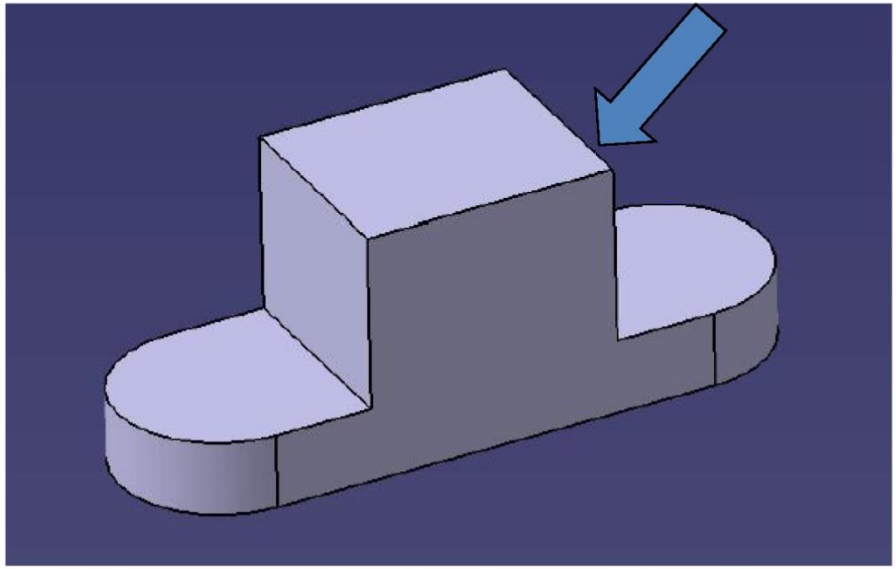
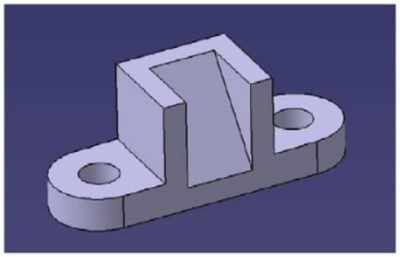
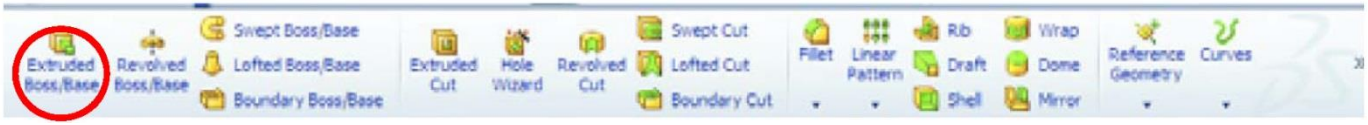




Source – Engineering Drawing, A. W. Boundy

- Sketch
- Extruded Boss/Base
- Sketch
- Extruded Boss/Base



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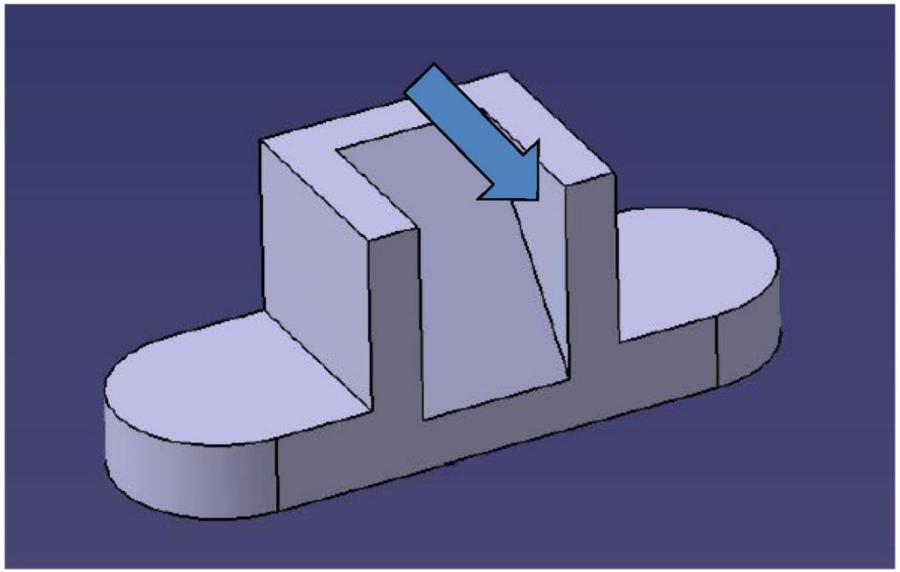
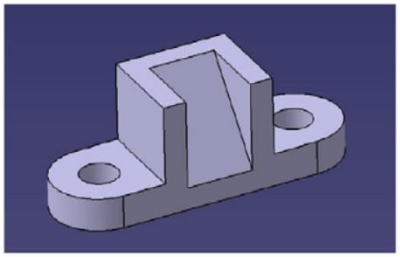
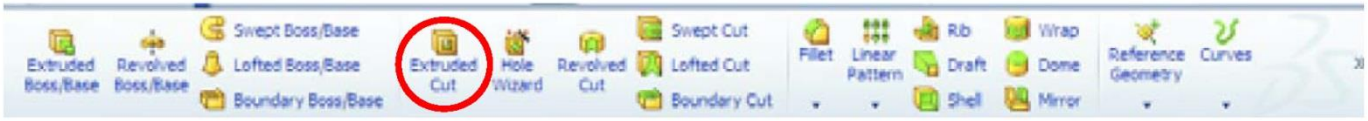


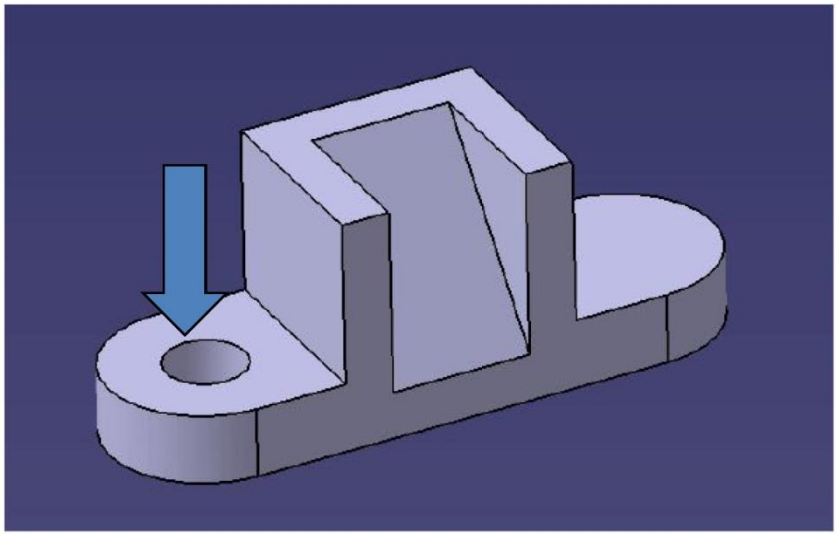


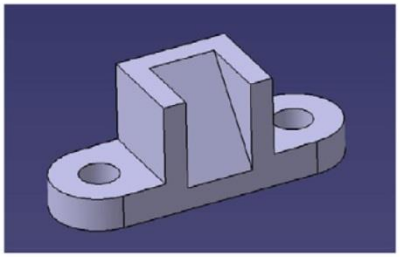
Source – Engineering Drawing, A. W. Boundy

- Sketch
- Extruded Boss/Base
- Sketch
- Extruded Boss/Base
- Sketch
- Extruded Cut



Example 1 : 3D Modelling Methods

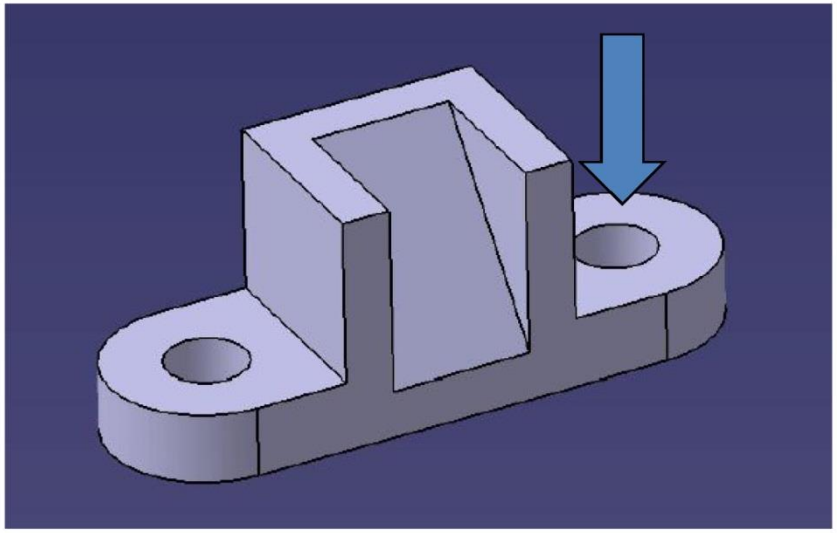


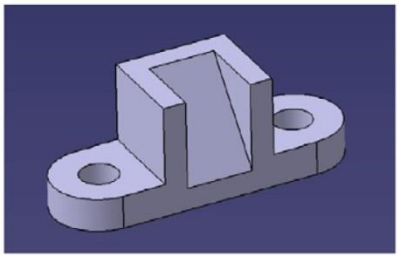


Source – Engineering Drawing, A. W. Boundy

- Sketch
- Extruded Boss/Base
- Sketch
- Extruded Boss/Base
- Sketch
- Extruded Cut
- Hole

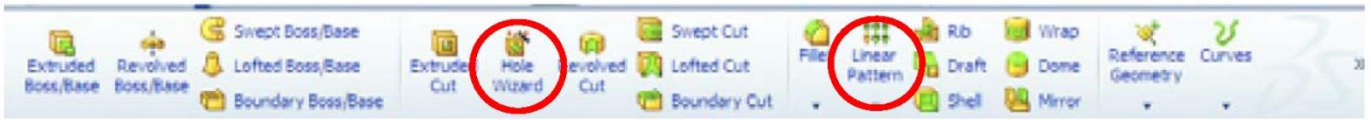
Example 1 : 3D Modelling Methods



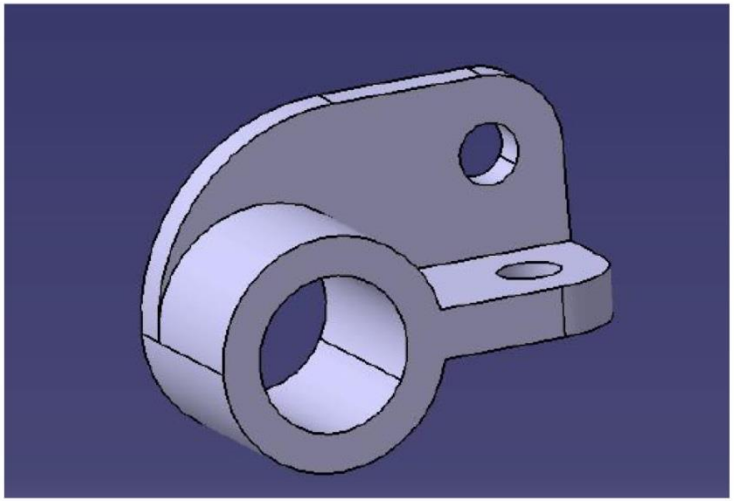


Source – Engineering Drawing, A. W. Boundy

- Sketch
- Extruded Boss/Base
- Sketch
- Extruded Boss/Base
- Sketch
- Extruded Cut
- Hole
- Hole/Pattern



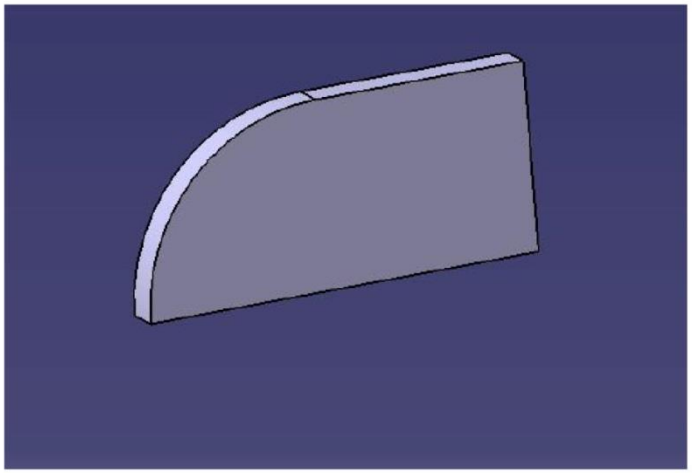
Example 2 : 3D Modelling Methods

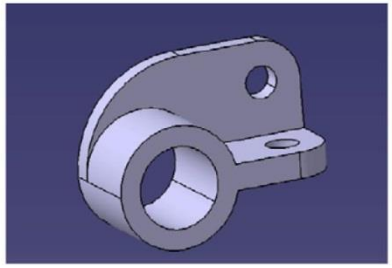


- Sketch
- Extruded Base
- Pocket
- Revolution
- Groove
- Hole
- Fillet
- Chamfer
- Draft
- Pattern

Source – Engineering Drawing, A. W. Boundy

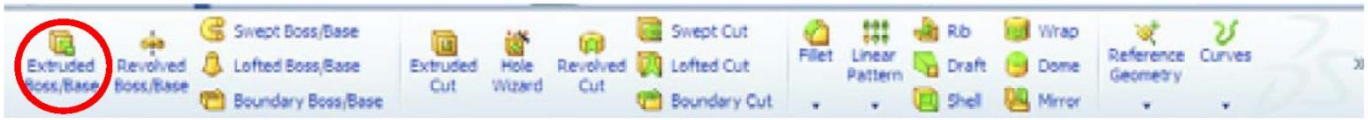
Example 2 : 3D Modelling Methods



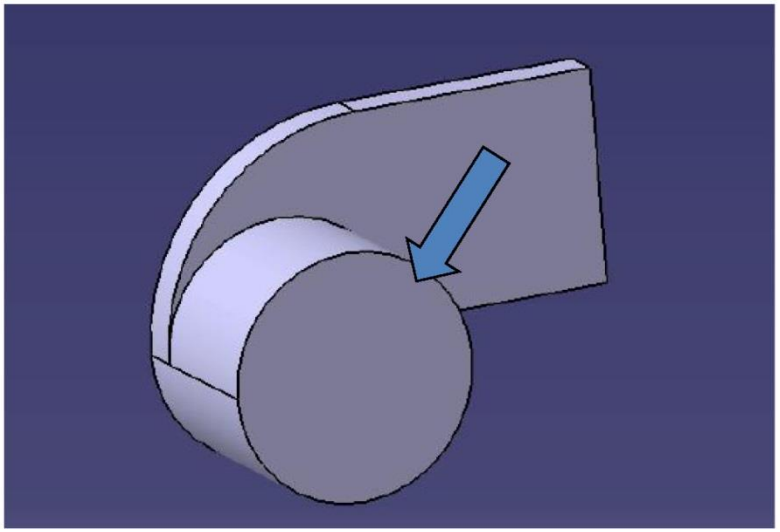


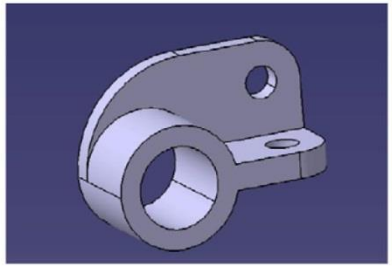
Source – Engineering Drawing, A. W. Boundy

- Sketch
- Extruded Base



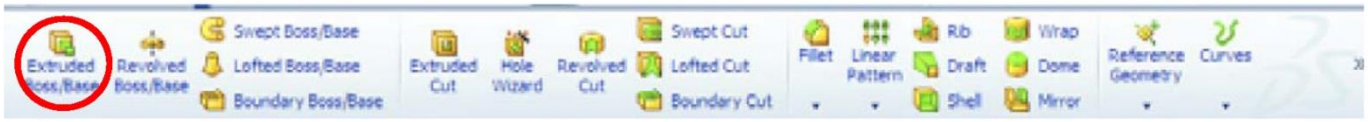
Example 2 : 3D Modelling Methods





Source – Engineering Drawing, A. W. Boundy

- Sketch
- Extruded Base
- Sketch
- Extruded Base



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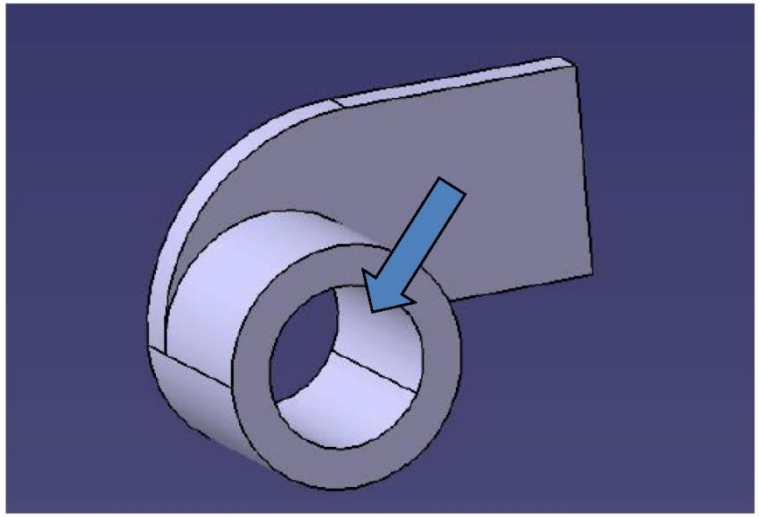
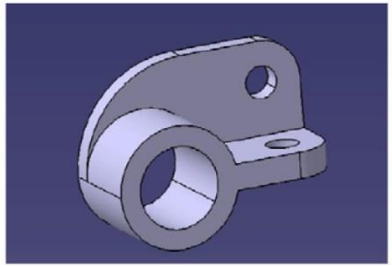


- Sketch
- Extruded Base
- Sketch
- Extruded Base
- Sketch
- Hole



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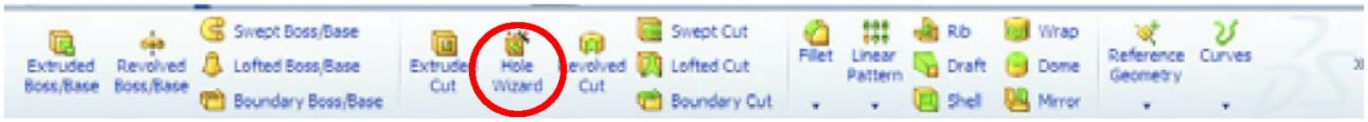
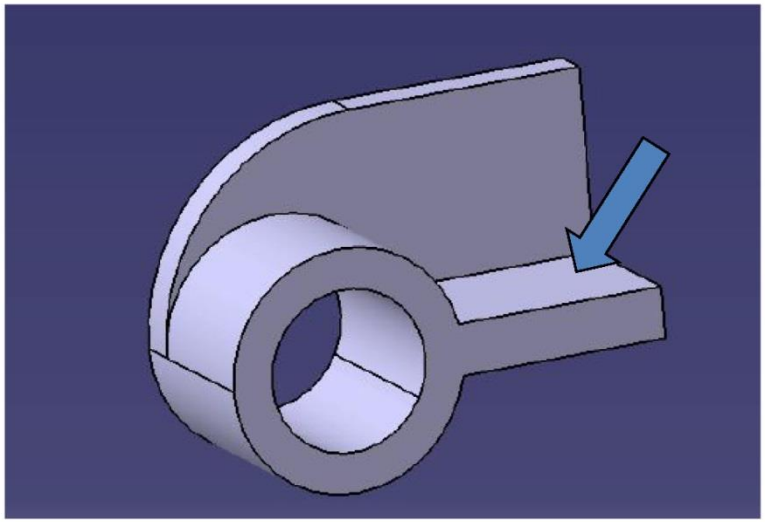
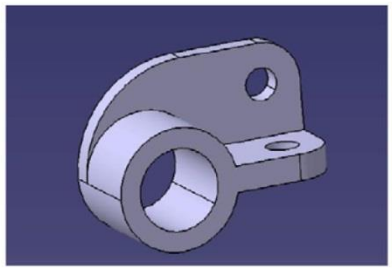


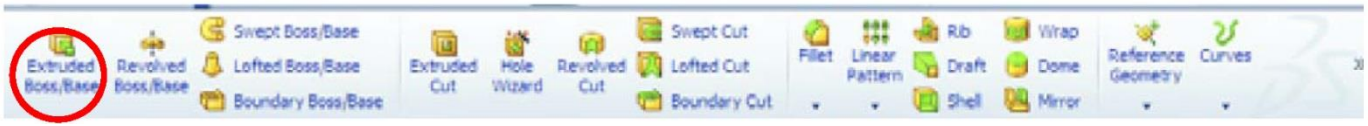
Example 2 : 3D Modelling Methods





Source – Engineering Drawing, A. W. Boundy

- Sketch
- Extruded Base
- Sketch
- Extruded Base
- Sketch
- Hole
- Sketch
- Extruded Base



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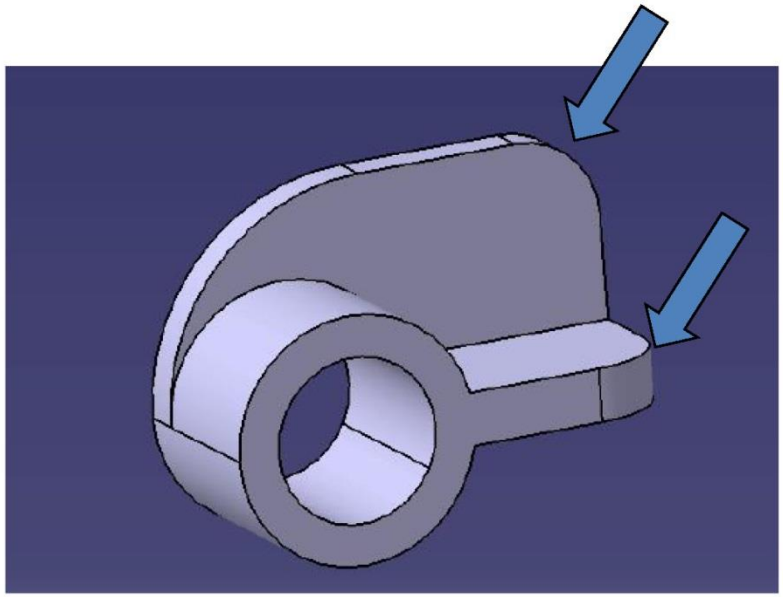
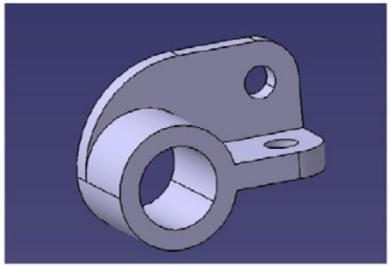


- Sketch
- Extruded Base
- Sketch
- Extruded Base
- Sketch
- Hole
- Sketch
- Extruded Base
- Fillet (2 edges in one)



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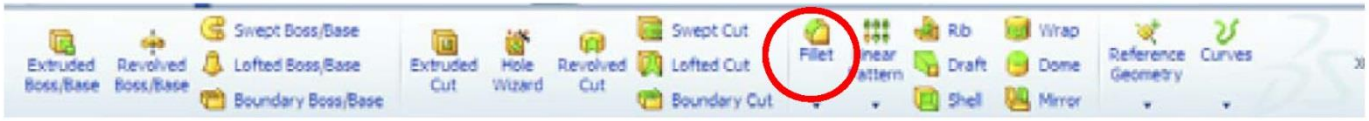
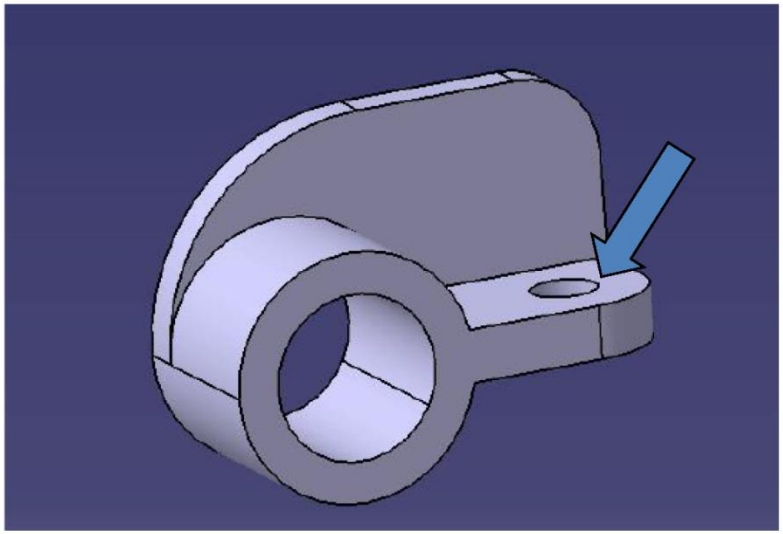
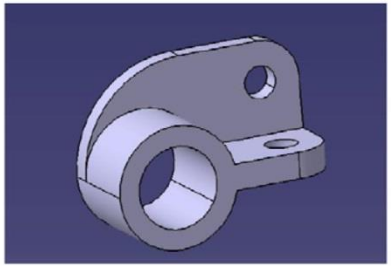


Example 2 : 3D Modelling Methods



- Sketch
- Extruded Base
- Sketch
- Extruded Base
- Hole
- Sketch
- Extruded Base
- Fillet (2 edges in one)
- Hole



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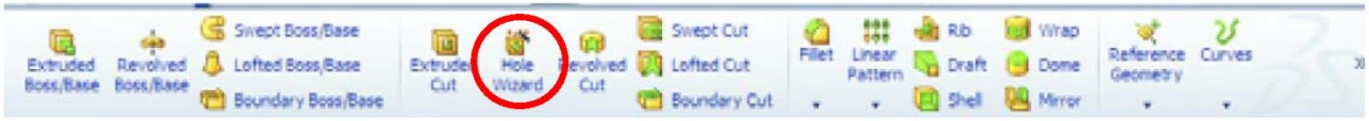

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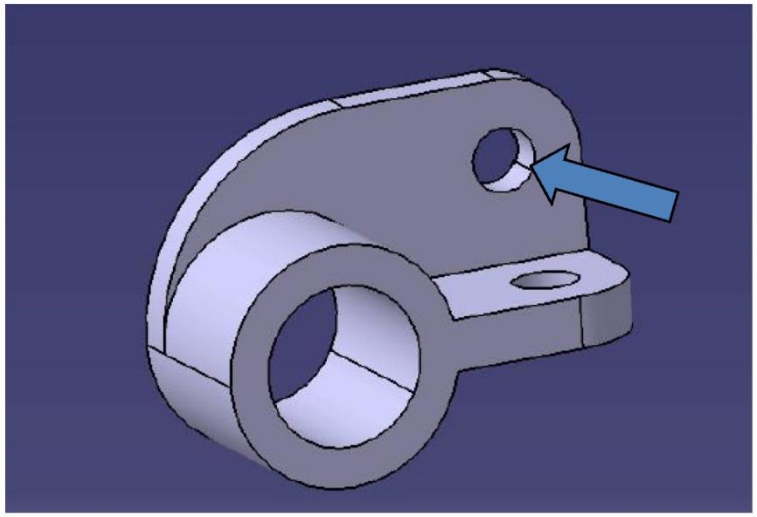
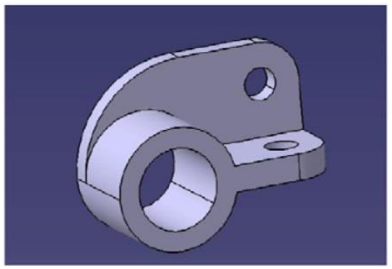
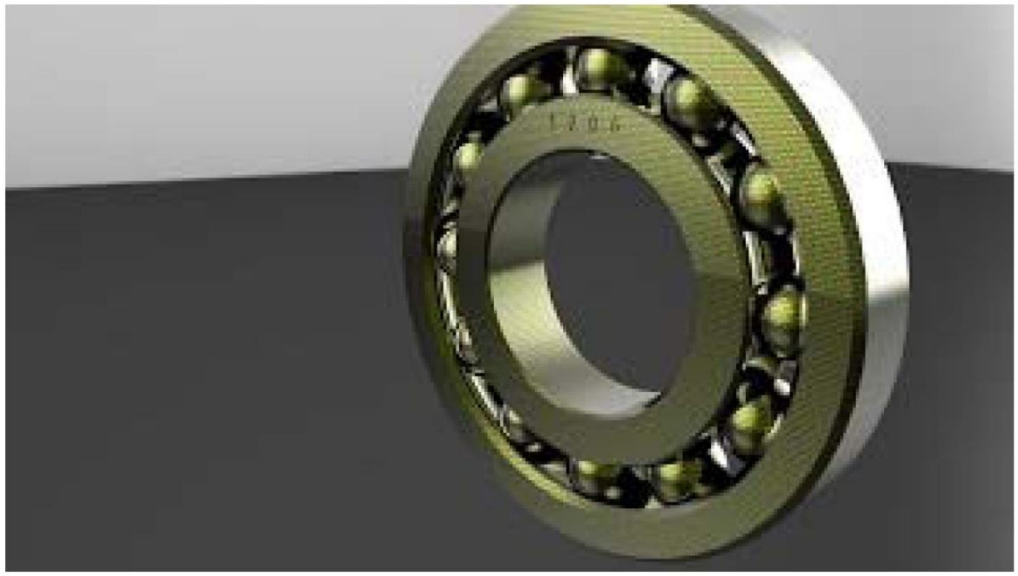


- Sketch
- Extruded Base
- Sketch
- Extruded Base
- Hole
- Sketch
- Extruded Base
- Fillet (2 edges in one
- Hole
- Hole (No pattern, not on the same plane)



Source – Engineering Drawing, A. W. Boundy

CAD A ball bearing



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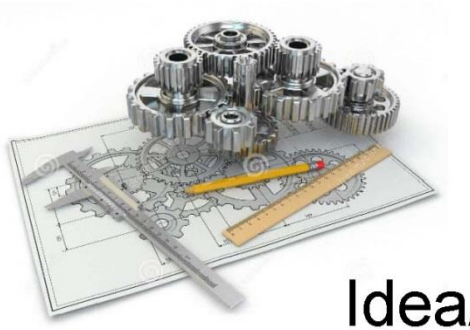
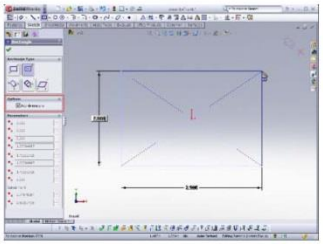
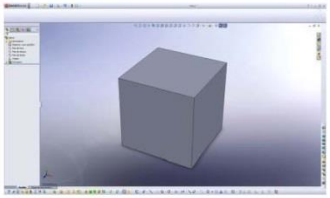


SolidWorks CAD

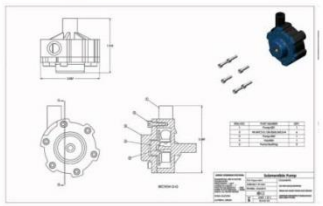
Idea/Hand drawn concept sketch



2D Sketch (Fully defined)



3D Part .prt (Extrude/Cut)



Engineering Drawing .drw
(AS1100 get it made)

Model stress/strain(COSMOS),
Animation,
SolidCAM for machining

3D Assembly .asm

Engineering Drawing

- Engineering drawing is your language of communication.
- Like any written and spoken language, **you must obey rules**.
- Without standards communication breaks down.
- Create engineering drawings of your designs
  - To communicate with other engineers.
  - To submit for manufacture.
- Australian Standards specify these rules:

(AS-1100 technical drawing standards and conventions)

AS1100 via the university library SAI Global subscription:

http://subjectguides.library.unsw.edu.au/engineering

- **Go to Standards tab on right-hand side;**
- **Australian standards (via SAI Global).**
- **Log in with zPass, search Australian Standard AS1100 Technical drawing in several parts – ensure you access *current* version.**

Demo …

AS 1100.201—1992
Reconfirmed 2014

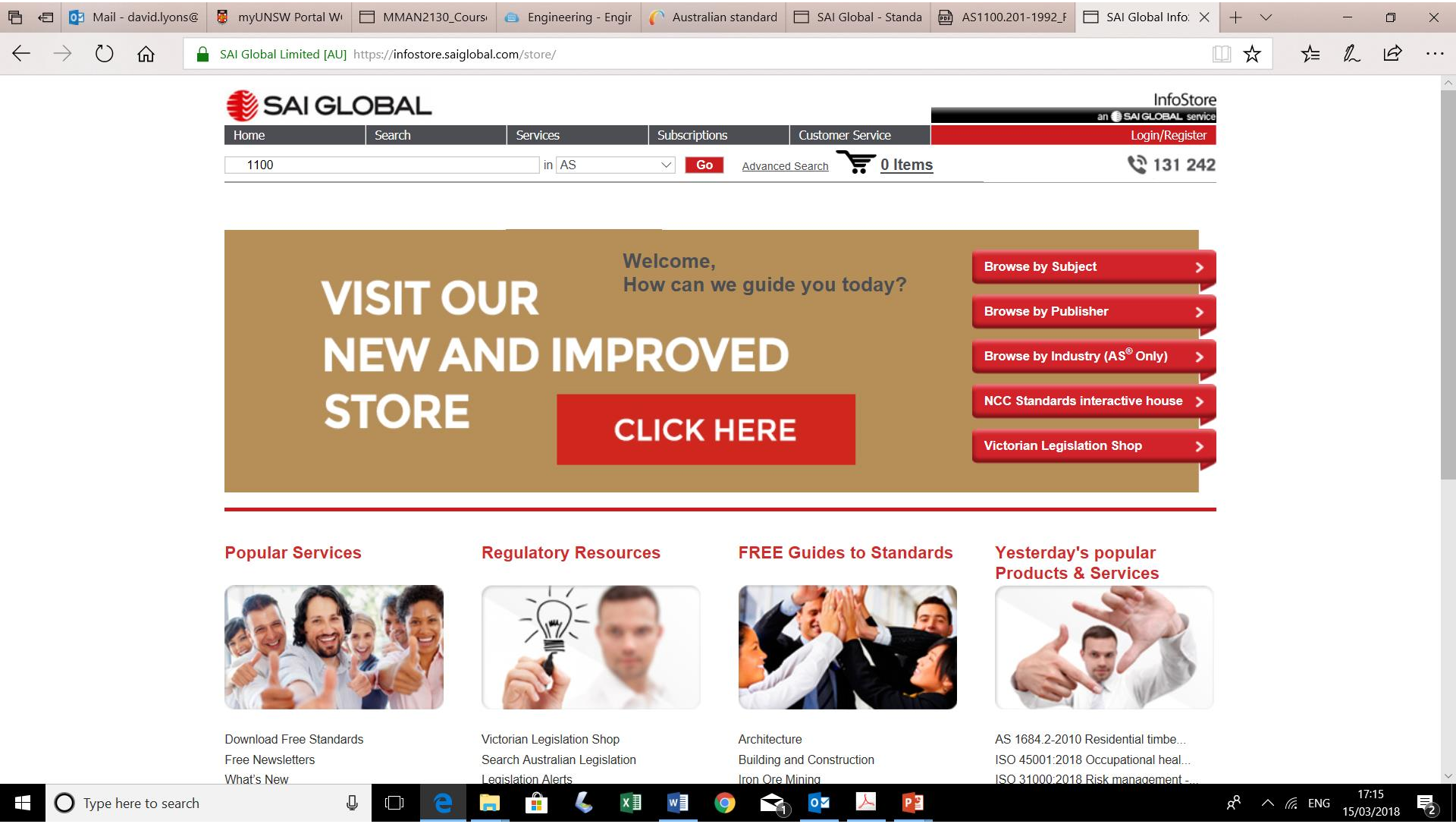
Australian Standard®

Technical drawing

Part 201: Mechanical engineering drawing

https://infostore.saiglobal.com/store/

CHECKING YOU ARE USING THE CURRENT REVISION OF A STANDARD



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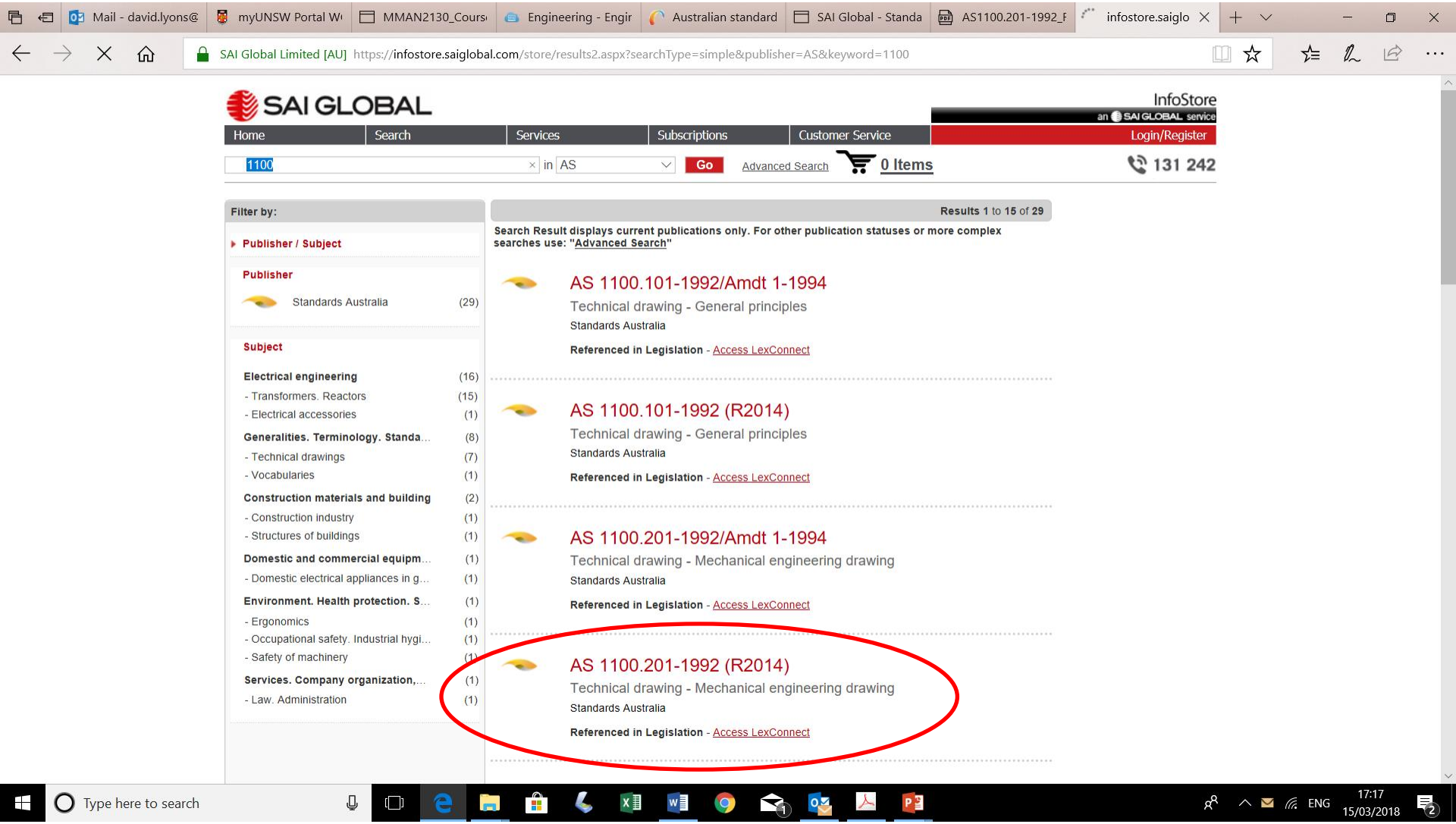

UNSW SYDNEY

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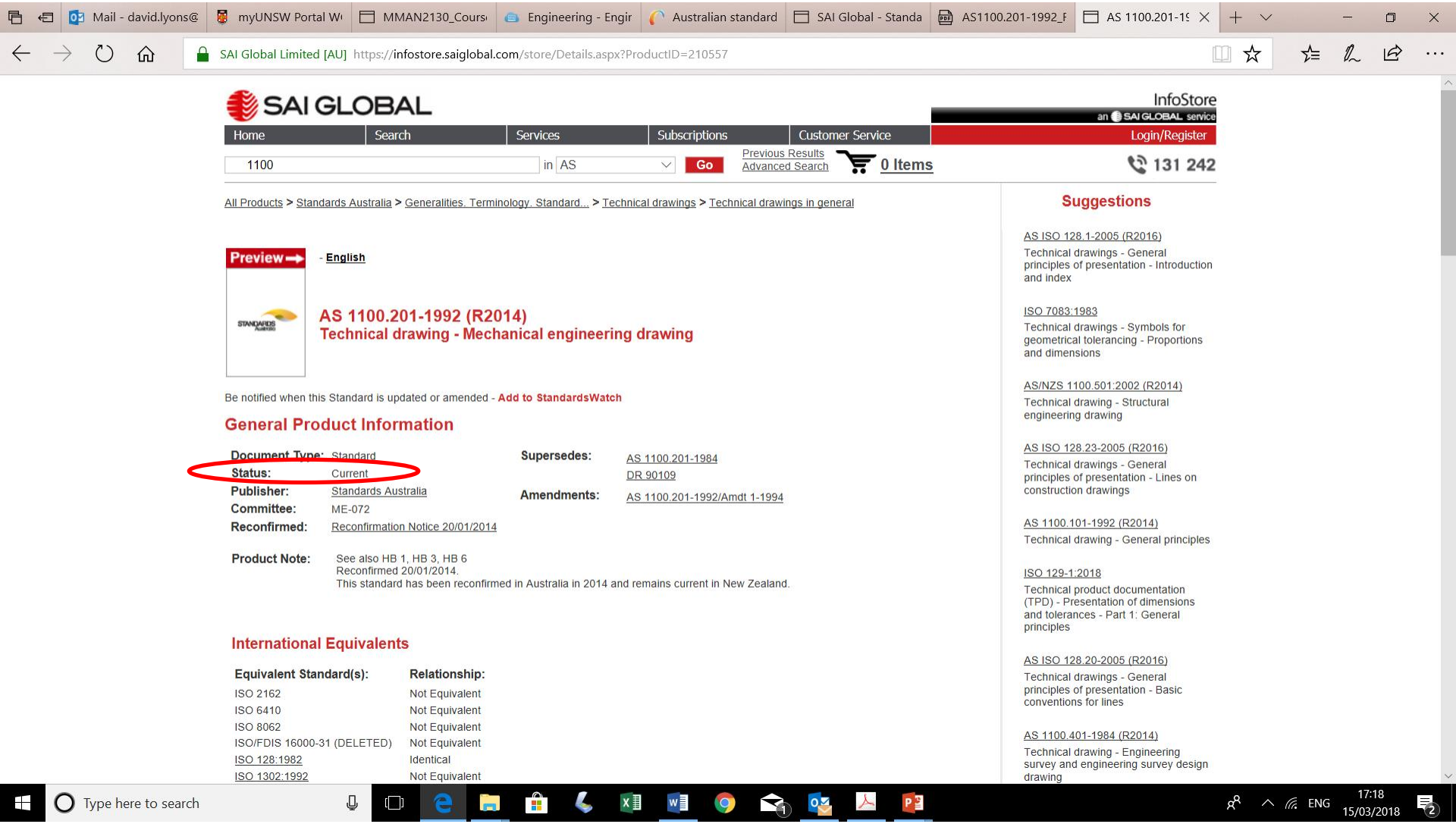

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1100 in AS Go Previous Results Advanced Search 0 Items 131 242

All Products > Standards Australia > Generalities. Terminology. Standard... > Technical drawings > Technical drawings in general

Preview - English

AS 1100.201-1992 (R2014)
Technical drawing - Mechanical engineering drawing

Be notified when this Standard is updated or amended - Add to StandardsWatch

General Product Information

Document Type:	Standard	Supersedes:	AS 1100.201-1984
Status:	Current		DR 90109
Publisher:	Standards Australia	Amendments:	AS 1100.201-1992/Amdt 1-1994
Committee:	ME-072		
Reconfirmed:	Reconfirmation Notice 20/01/2014		

Product Note: See also HB 1, HB 3, HB 6
Reconfirmed 20/01/2014.
This standard has been reconfirmed in Australia in 2014 and remains current in New Zealand.

International Equivalents

Equivalent Standard(s):	Relationship:
ISO 2162	Not Equivalent
ISO 6410	Not Equivalent
ISO 8062	Not Equivalent
ISO/FDIS 16000-31 (DELETED)	Not Equivalent
ISO 128:1982	Identical
ISO 1302:1992	Not Equivalent

Suggestions

AS ISO 128.1-2005 (R2016)
Technical drawings - General principles of presentation - Introduction and index

ISO 7083:1983
Technical drawings - Symbols for geometrical tolerancing - Proportions and dimensions

AS/NZS 1100.501:2002 (R2014)
Technical drawing - Structural engineering drawing

AS ISO 128.23-2005 (R2016)
Technical drawings - General principles of presentation - Lines on construction drawings

AS 1100.101-1992 (R2014)
Technical drawing - General principles

ISO 129-1:2018
Technical product documentation (TPD) - Presentation of dimensions and tolerances - Part 1: General principles

AS ISO 128.20-2005 (R2016)
Technical drawings - General principles of presentation - Basic conventions for lines

AS 1100.401-1984 (R2014)
Technical drawing - Engineering survey and engineering survey design drawing

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SAI Global Limited [AU] https://infostore.saiglobal.com/store/LexConnectAccess.aspx?ProductId=210503

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1100 in AS Go Previous Results Advanced Search 0 Items 131 242

LexConnect:
Australian Standards referenced in Legislation

LexConnect

The LexConnect online service provides anywhere, anytime understanding of which Standards are referenced in which Australian Commonwealth, State and Territory legislation.

Sign-In

Standards On-Line LexConnect

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LexConnect Benefits

LexConnect assists you with meeting your compliance obligations by indicating:

- if the Standard that interests you is mandated by, or referred to, in legislation
- where in the legislation it is referenced
- what other Standards are referenced in the same legislation.

How LexConnect Works

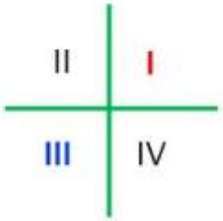
The simple to use service:

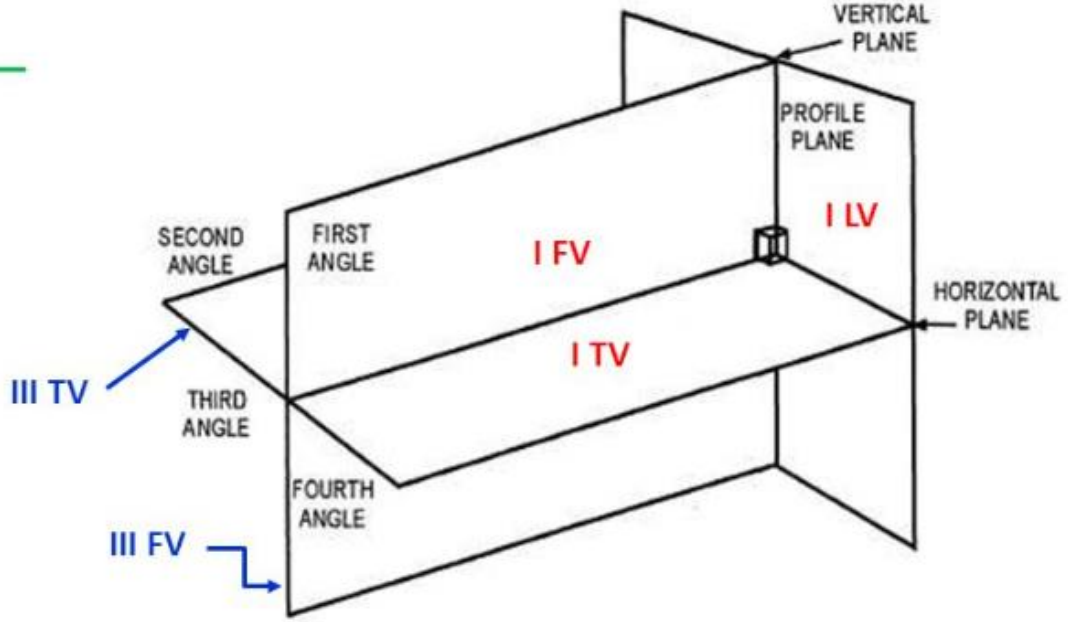
- allows you to search for a Standard by keyword or reference number
- presents the legislation in which the Standard is referenced or indicates whether the Standard is referenced in legislation.
- lists other standards referenced within that piece of legislation

Type here to search ENG 17:21 15/03/2018

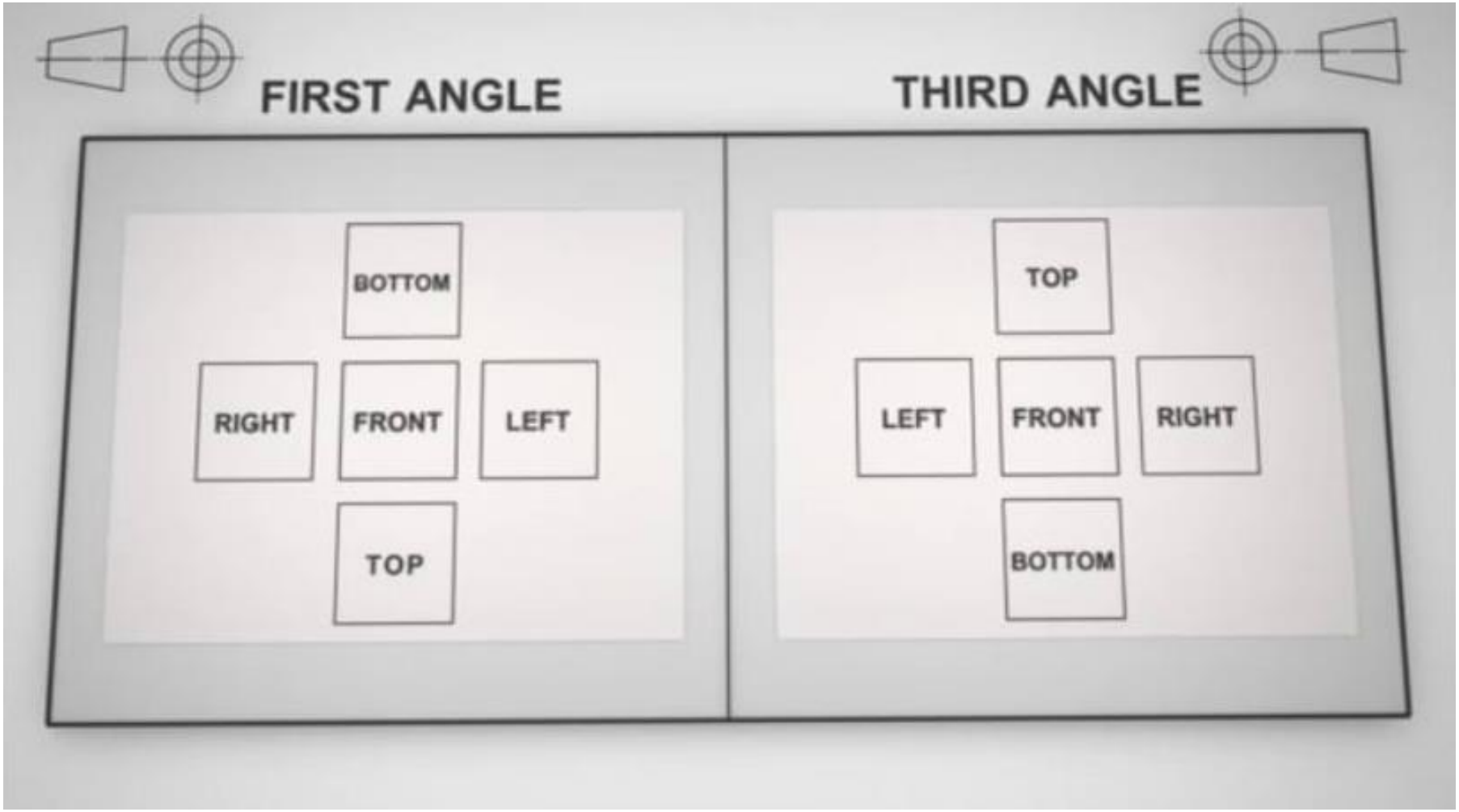
UNSW SYDNEY

First and Third angle Projection

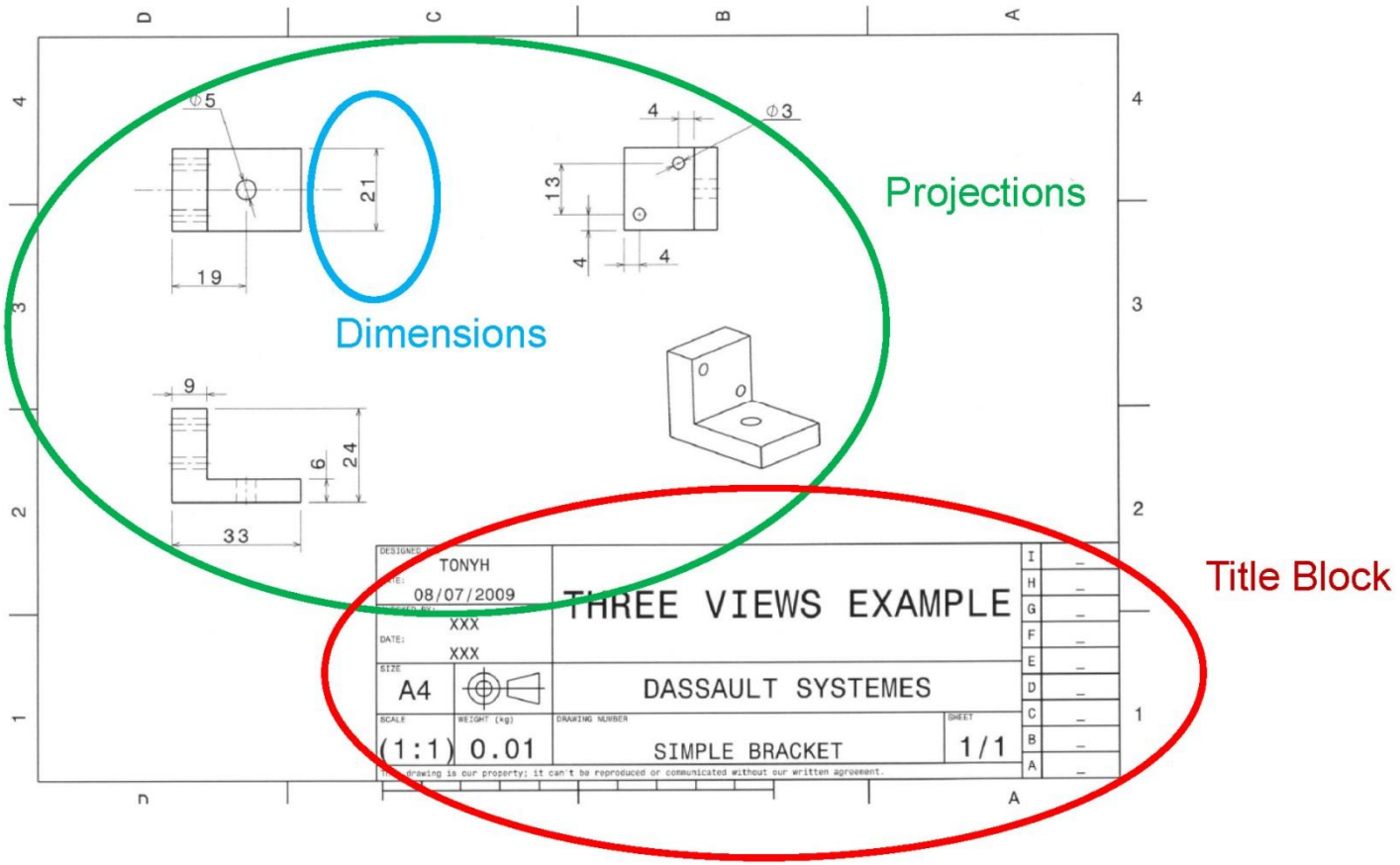




Object in 1st quadrant : FIRST ANGLE PROJECTION
Object in 3rd quadrant : THIRD ANGLE PROJECTION

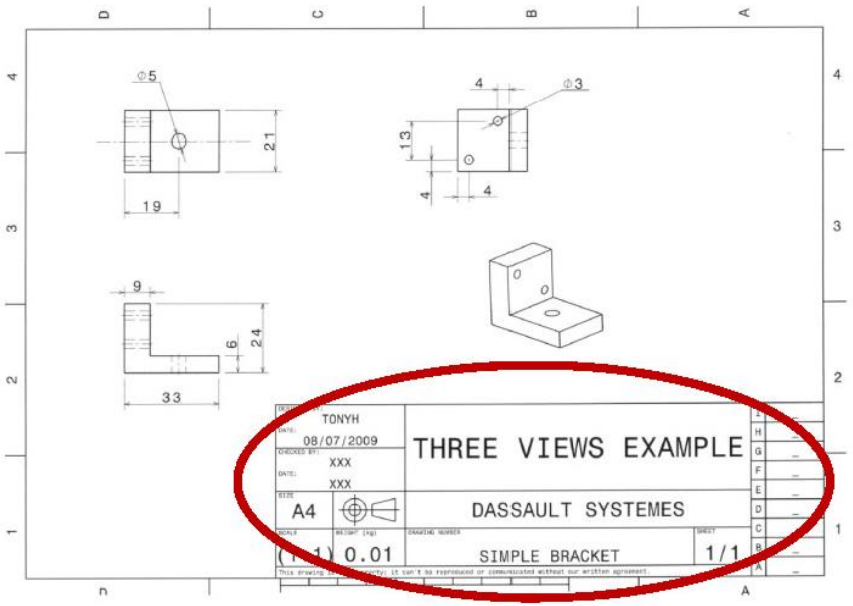

FIRST ANGLE
BOTTOM
RIGHT
FRONT
LEFT
TOP
THIRD ANGLE
TOP
LEFT
FRONT
RIGHT
BOTTOM

Typical Drawing Sheet



Slides 16 to 52 adapted from Prof S Kara (UNSW, 2017) with gratitude ..:

Title Block


TONYH
08/07/2009
XXX
XXX
A4
THREE VIEWS EXAMPLE
DASSAULT SYSTEMES
SIMPLE BRACKET
1/1
0.01

Engineering Drawing Standards

- Text should be UPPER CASE and should be 2.5mm, 3.5mm or 5mm in height.

- Dimensions should be spaced in an orderly fashion and there must be enough dimensions to **fully specify** the part.

- Redundant dimensions **should be avoided** but can be specified in parentheses if required.

- Units should **ALWAYS** be indicated by a note on the drawing:
  DIMENSIONS in MILLIMETRES

- AS1100 specifies **linear units** to be in **mm** and **angular units** to be in **degrees**.

- **Scaling dimensions** directly from drawings is **strictly prohibited** (even using CAD).

- **Centre lines** – denote the **axis of symmetrical views**, **axis** and **centre lines of holes.**

Engineering Drawing Standards - Scaling

Q) What does a scale of 2:1 mean?

Just remember: **Drawing : Real Life**

*"**Read as:** 2cm in the drawing corresponds to 1cm in real life"*

A) Scale – Enlargement
2:1, **5:1**, **10:1**, 20:1, 50:1

Q) What does a scale of 1:2 mean?

A) Scale - Reduction
1:2, 1:2.5, **1:5**, **1:10**, 1:20, 1:50, 1:100,1:200, 1:500,
1:1000, 1:2000, 1:5000, 1:10000

Use standard dimensions (shown in bold). In your assignment use 1:1 wherever possible.

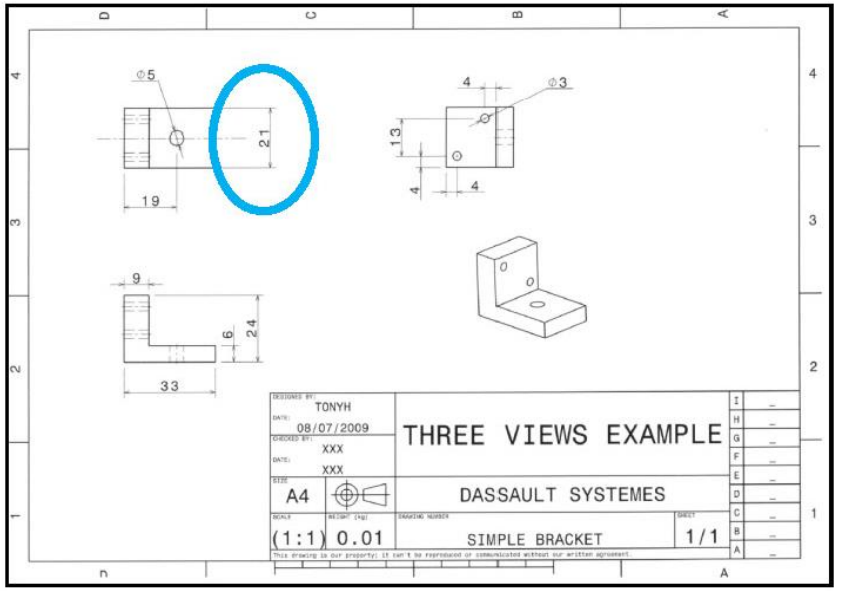
Engineering Drawing Standards - Scaling

Just remember: **Drawing : Real Life**

3:1 ?

Enlargement

Dimensions


Ø5
21
19
4
Ø3
13
4
4
9
6
24
33
TONYH
08/07/2009
XXX
XXX
A4
(1:1)
0.01
THREE VIEWS EXAMPLE
DASSAULT SYSTEMES
SIMPLE BRACKET
1/1

Dimensioning (Boundy pp19-34)

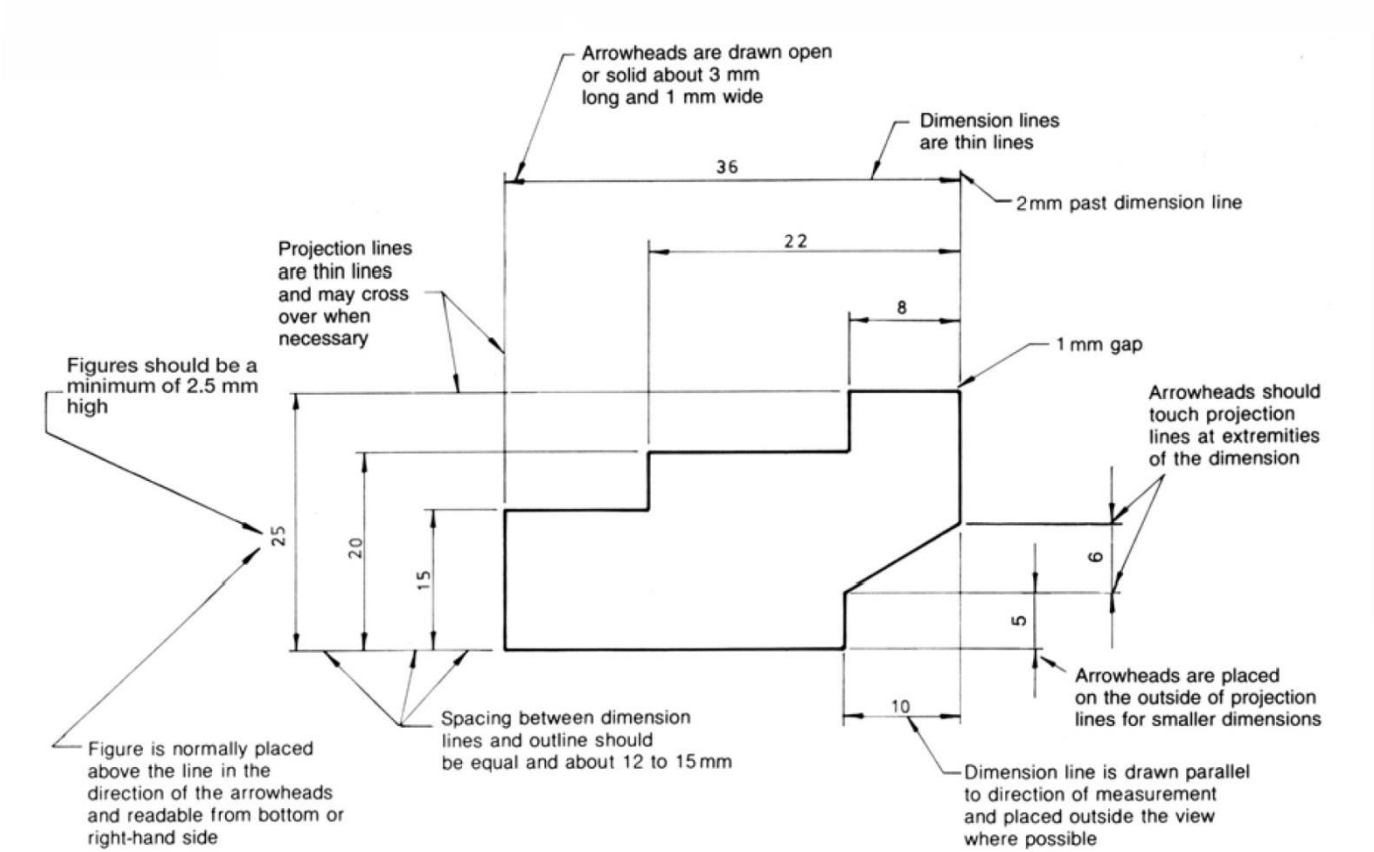
- Symbols used to dimensioning features.
- Shape definition – what it looks like.
- Size definition – dimensions added
- Need to know:
  - Technique – line types, spacing, arrow heads etc.
  - Placement – logical location.
  - Choice of dimensions – functions first.

Engineering Drawing, A. W. Boundy, McGraw Hill (7th Edition)

Dimensioning Lines and Dimensions

- "Dimensioning Lines"
  - These are thin lines.
  - Drawn **outside** the outline of your drawing wherever possible.
- Dimensions:
  - Linear dimensions – expressed in mm, not necessary to write the symbol "mm" after every dimension.
  - Include a general note " All dimensions are in mm" in the title block.
  - Angular dimensions – in degrees.

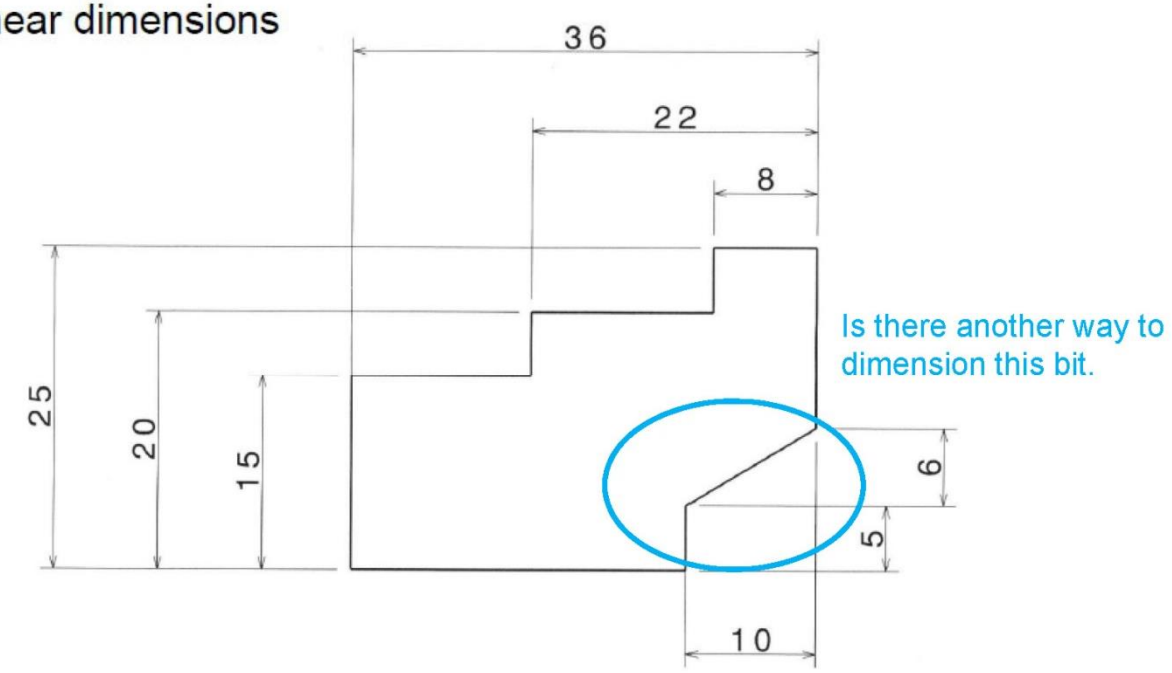
Use of Projection and Dimensioning Lines



Dimensions

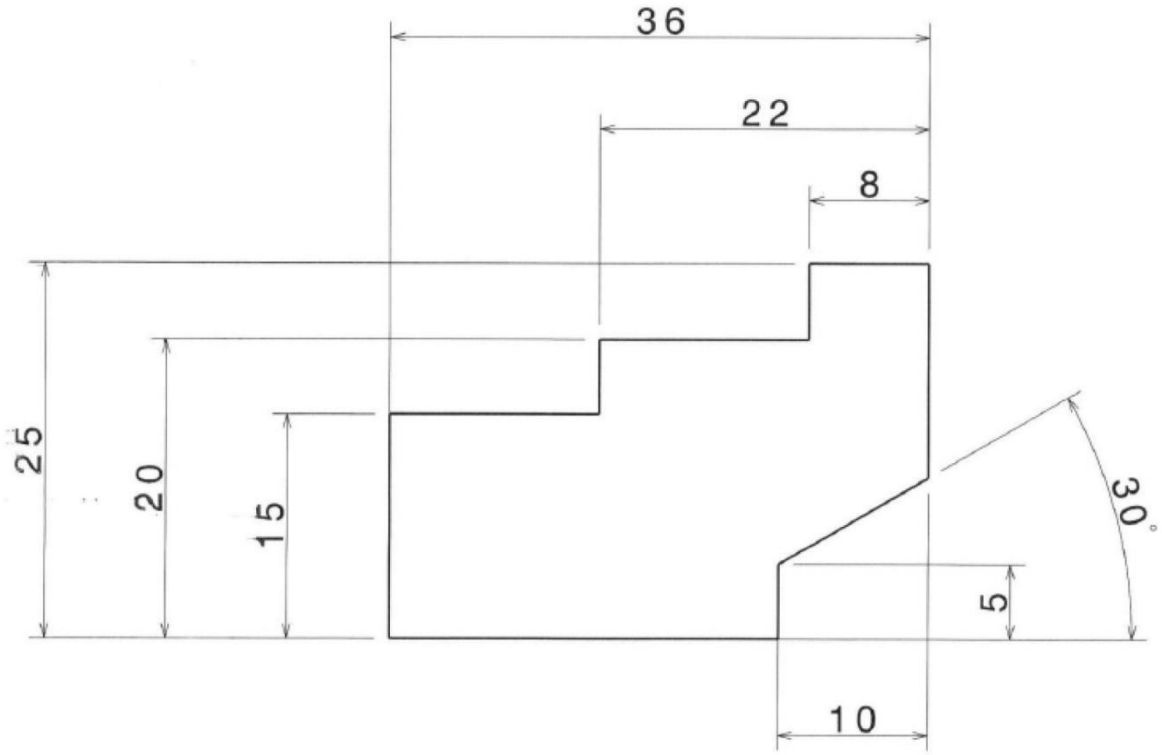
- Staggered dimensions
  - Where a number of parallel dimensions are close.
- Functional dimensions
  - Some dimensions are essential for the proper function of a component. (e.g. Pin in a hole; must have same diameters)
- Overall dimensions
  - When a length consists of a number of dimensions an overall dimension is shown

Linear dimensions



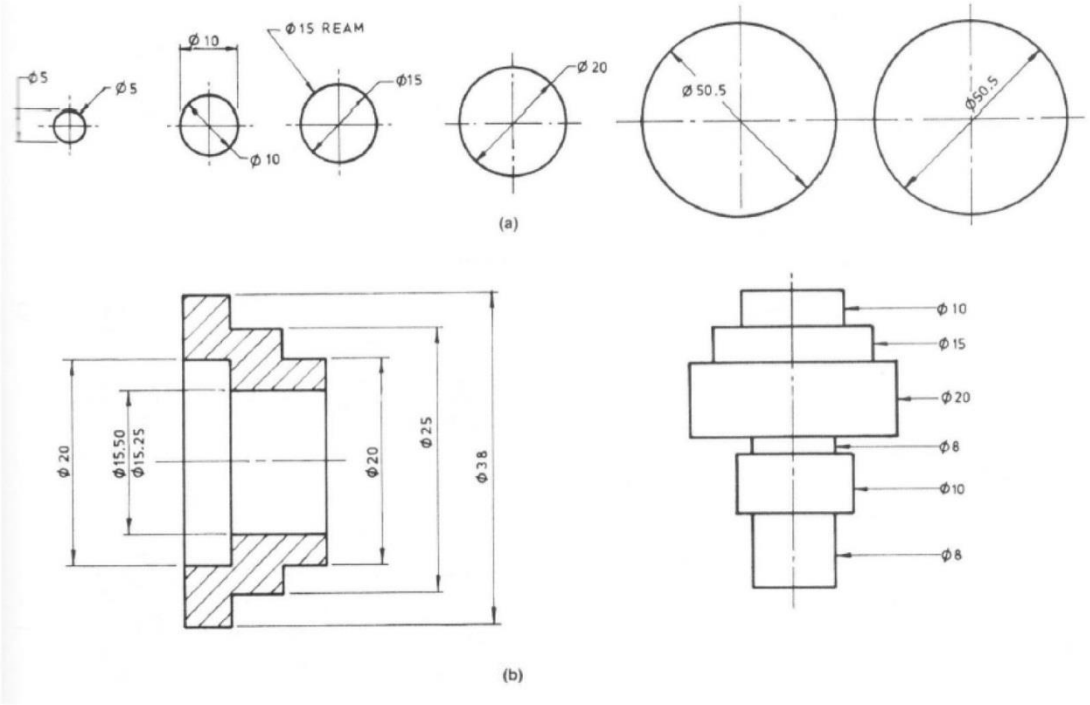
Source Engineering Drawing, A. W. Boundy

Angular dimension



Standards for Dimensioning

Dimensioning Holes or round shafts

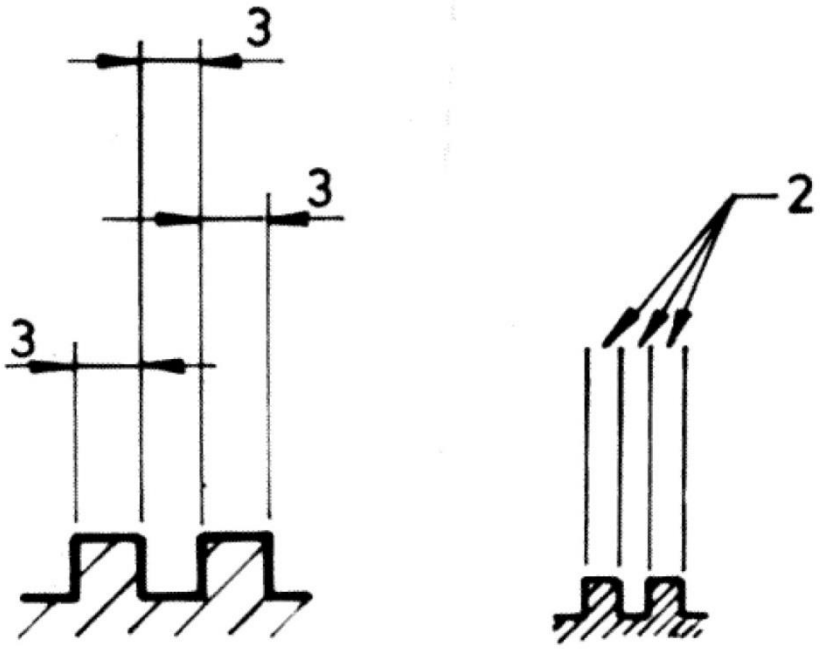


End-View

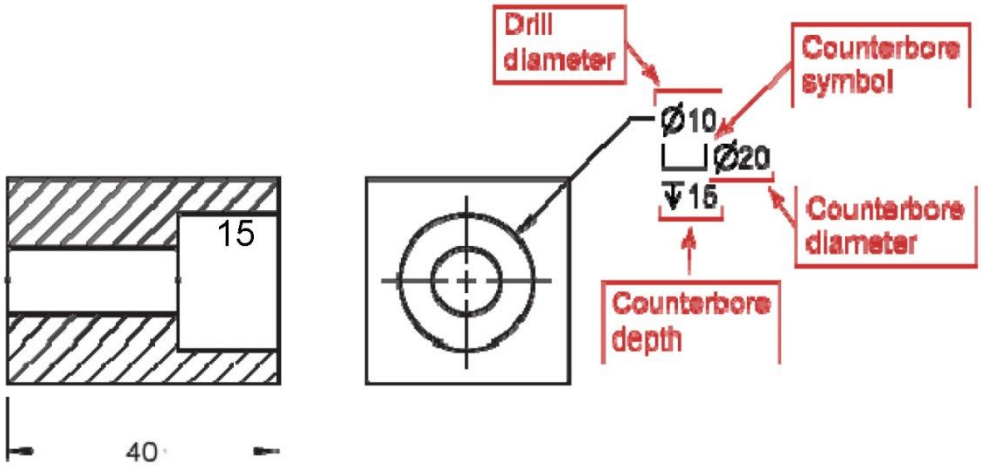
Side-View

Source Engineering Drawing, A. W. Boundy

Dimensioning Small Spaces

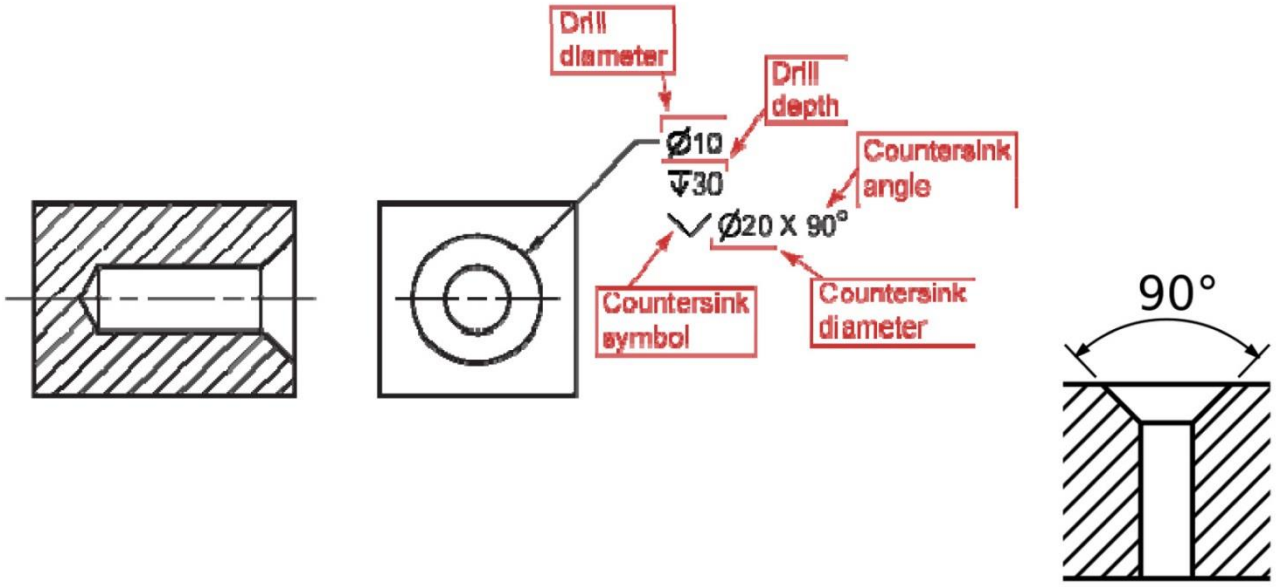


Dimensioning Holes
Counterbore



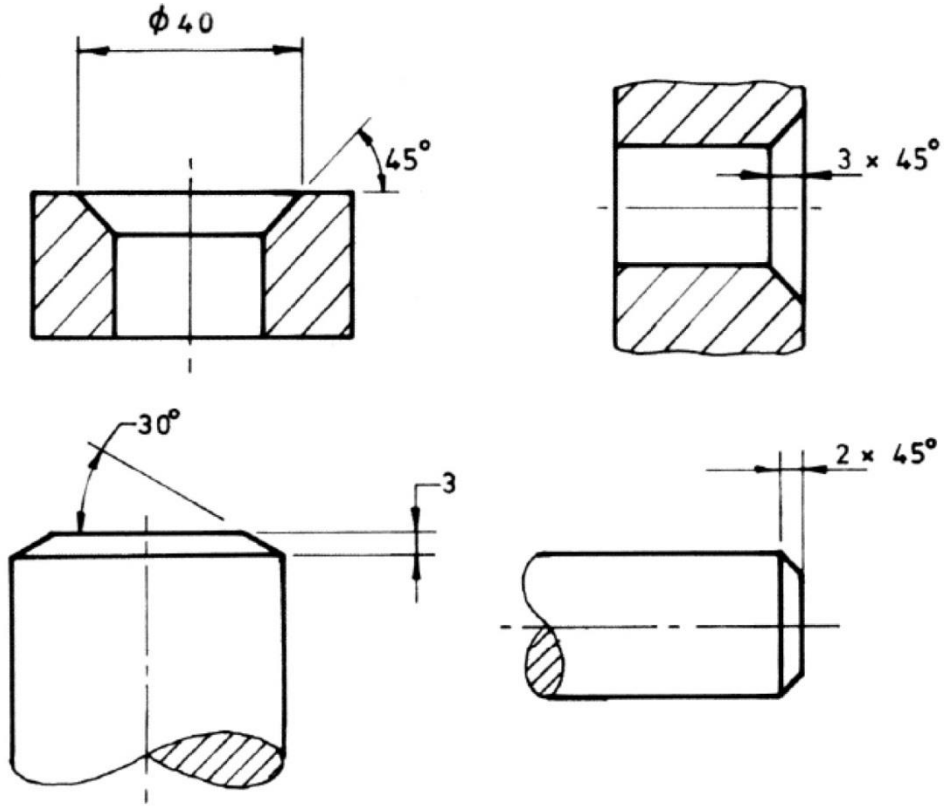
http://www.engineeringessentials.com/ege/dim/counterbore1.png

Dimensioning Holes
Countersink

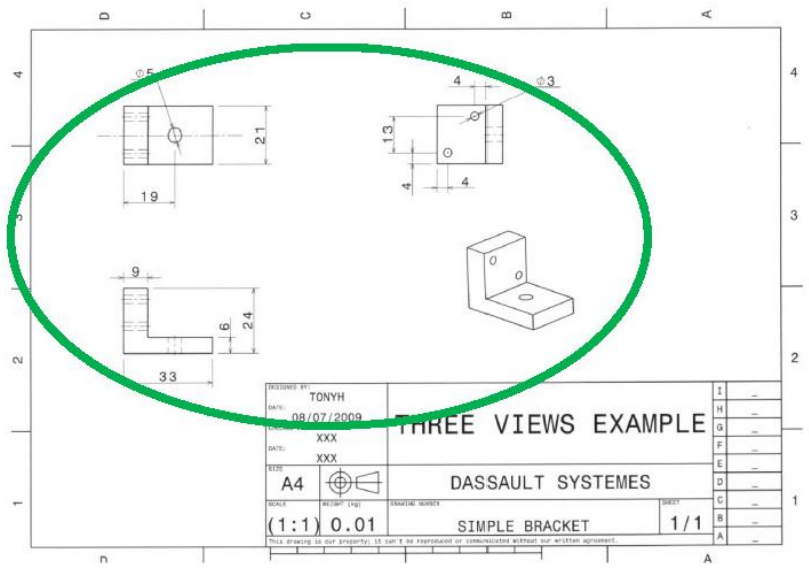


http://www.engineeringessentials.com/ege/dim/countersink.png

Dimensioning Chamfers

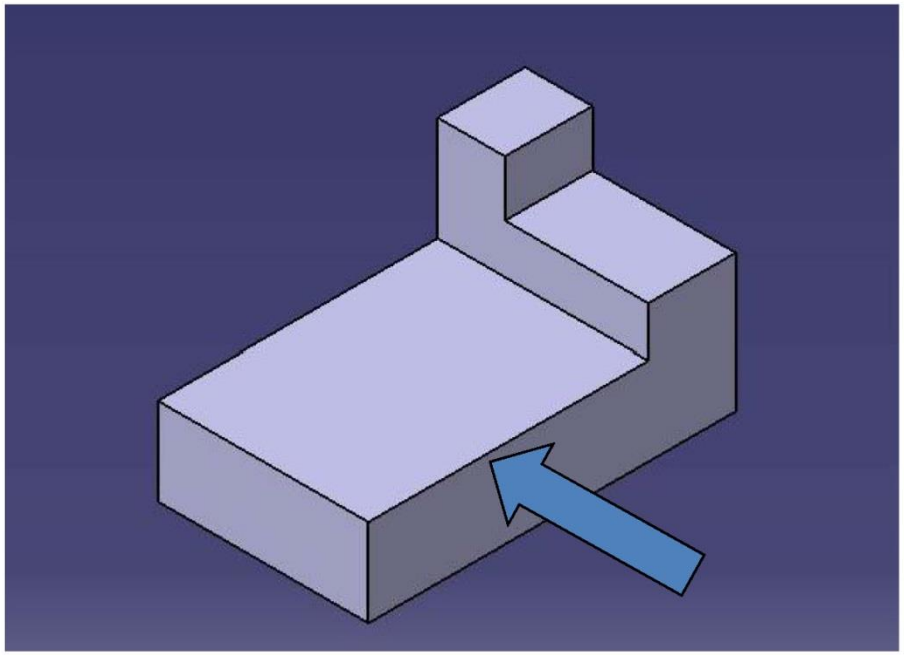


Projections



Orthogonal Projections – Third Angle View

- First, decide your front view

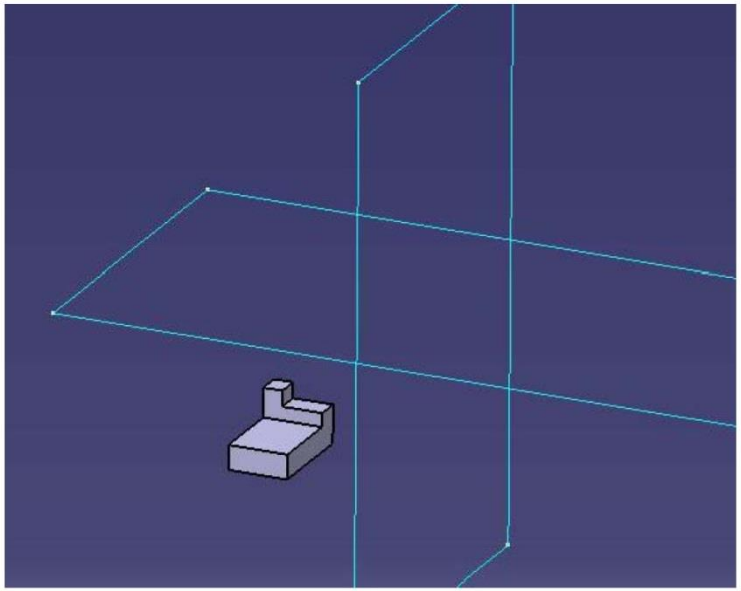


Orthogonal Projections – Third Angle View

- Imagine a vertical and horizontal plane intersecting at right angles in front of the object.

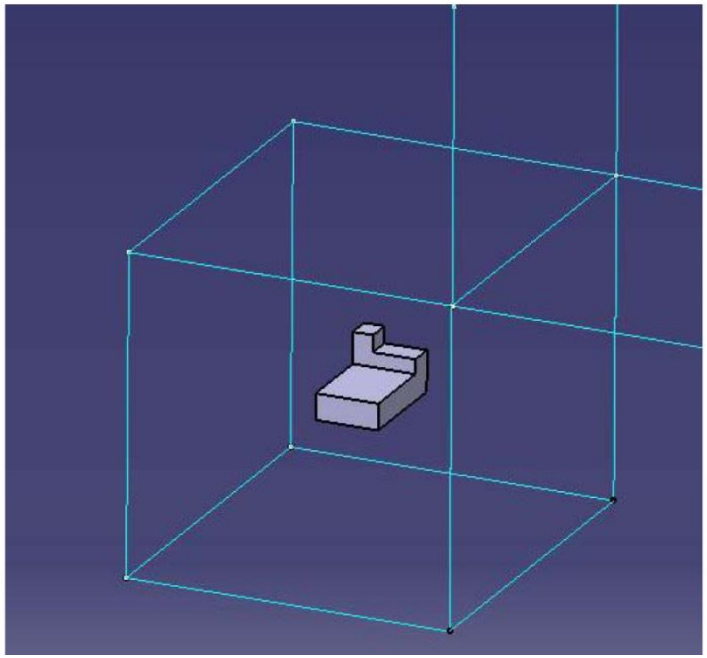
- There will be 4 possible right angles (known as dihedral angles) which have a numbering convention (1,2,3 and 4) starting at 3 o'clock and going anti clockwise.

- By placing our object in the 3rd dihedral angle, we are choosing to use Third Angle Projection



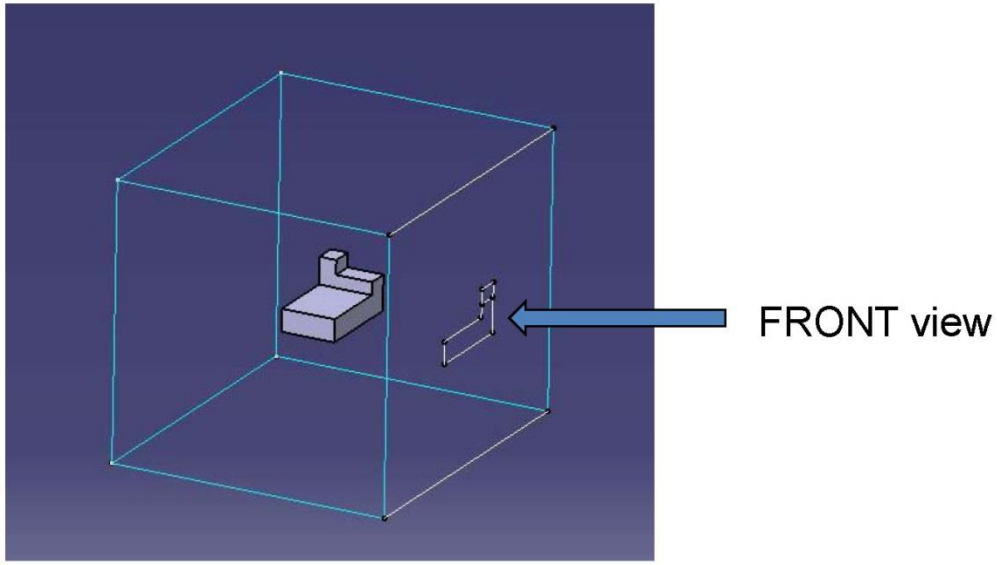
Orthogonal Projections – Third Angle View

• To create Third Angle Projections, now imagine a transparent box surrounding the object in the third dihedral angle.



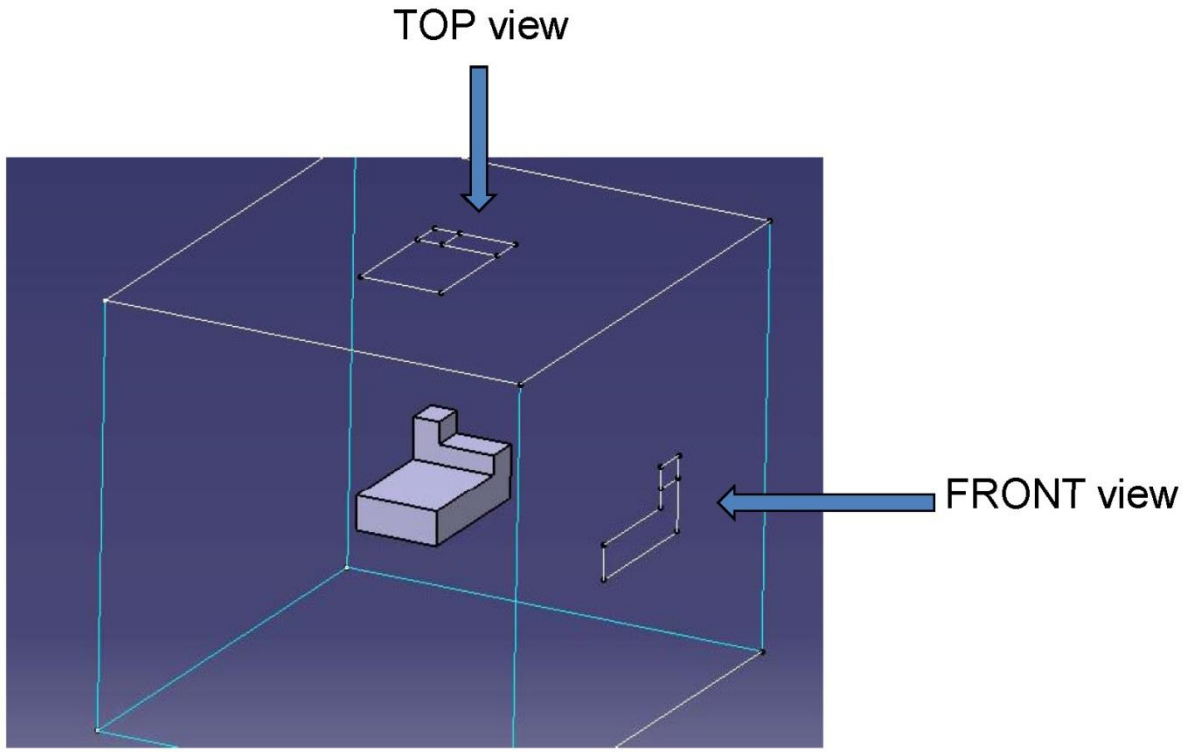
Orthogonal Projections – Third Angle View

•Projections are now defined as lines which represent the object's side nearest a chosen box face, exactly as if we were looking through the box's face.

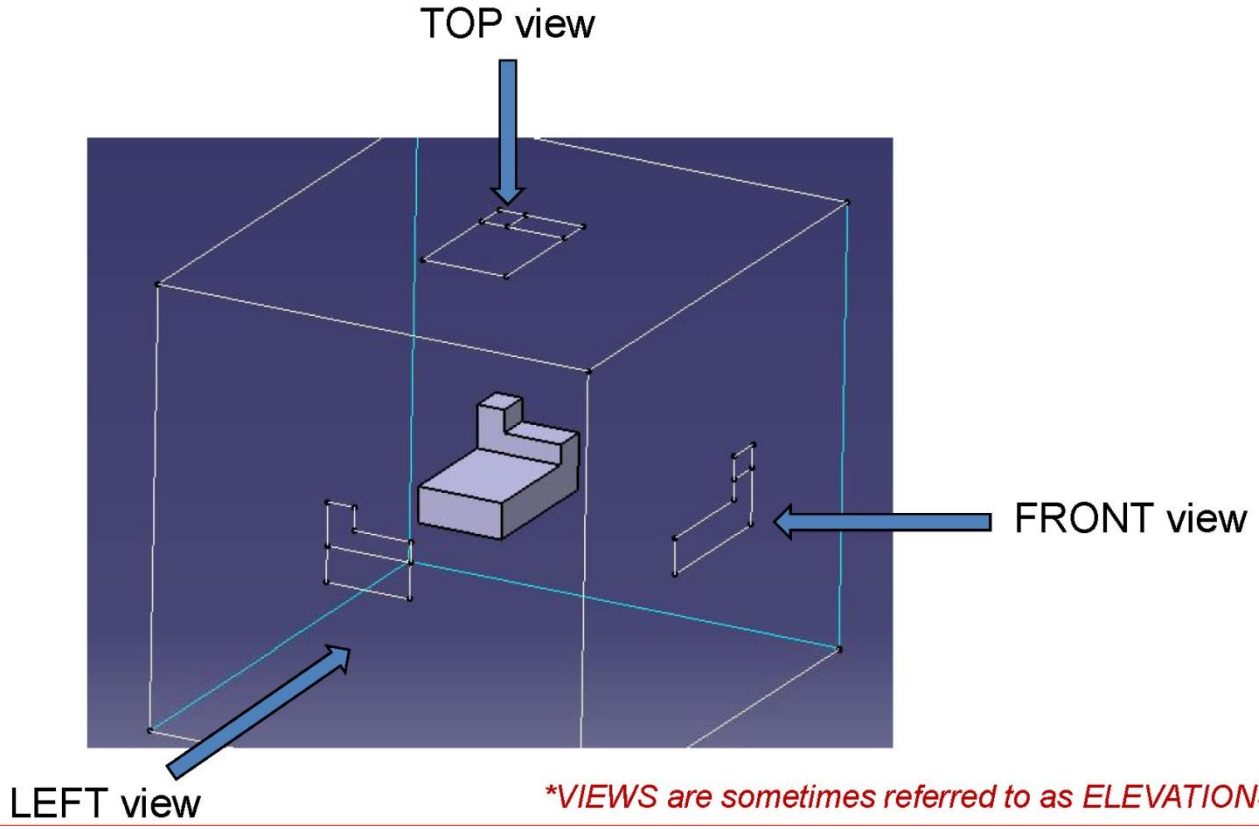


**VIEWS are sometimes referred to as ELEVATIONS*

Orthogonal Projections – Third Angle View



Orthogonal Projections – Third Angle View



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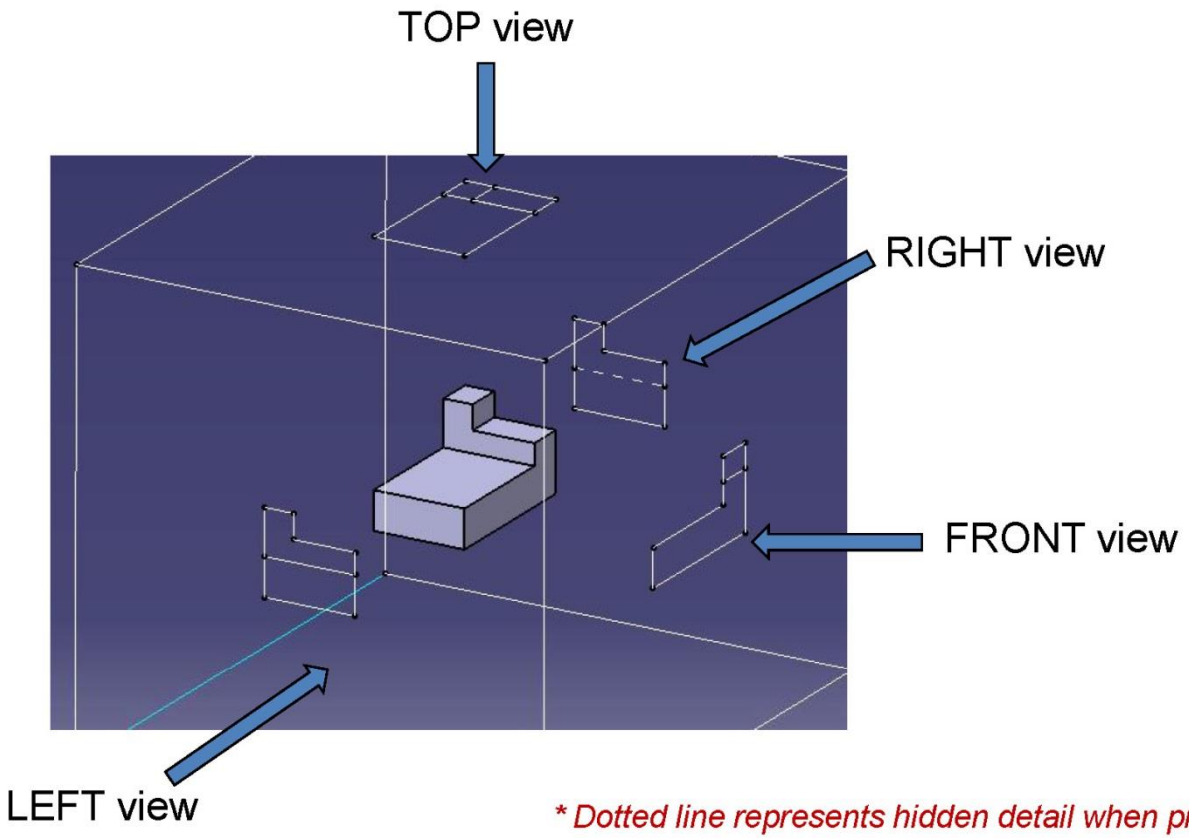
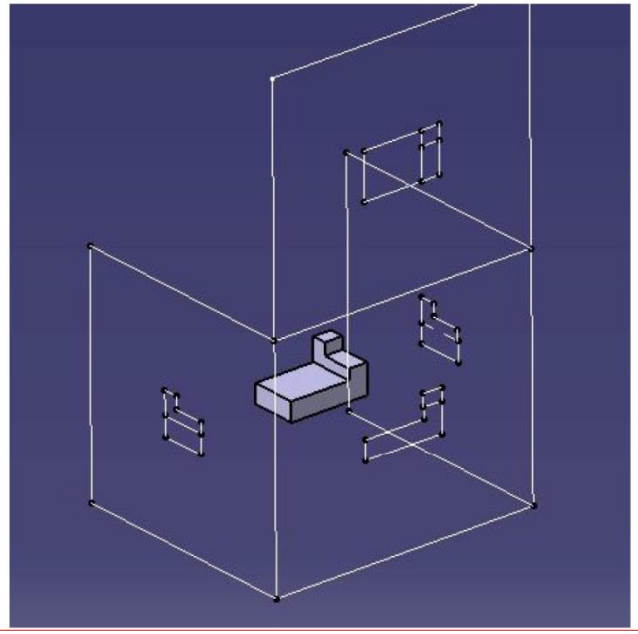
Orthogonal Projections – Third Angle View



** Dotted line represents hidden detail when projected*

Orthogonal Projections – Third Angle View

•To create a single 2D drawing of all the projection views, the box faces are unfolded using the edges of the FRONT VIEW as the hinges.



Orthogonal Projections – Third Angle View

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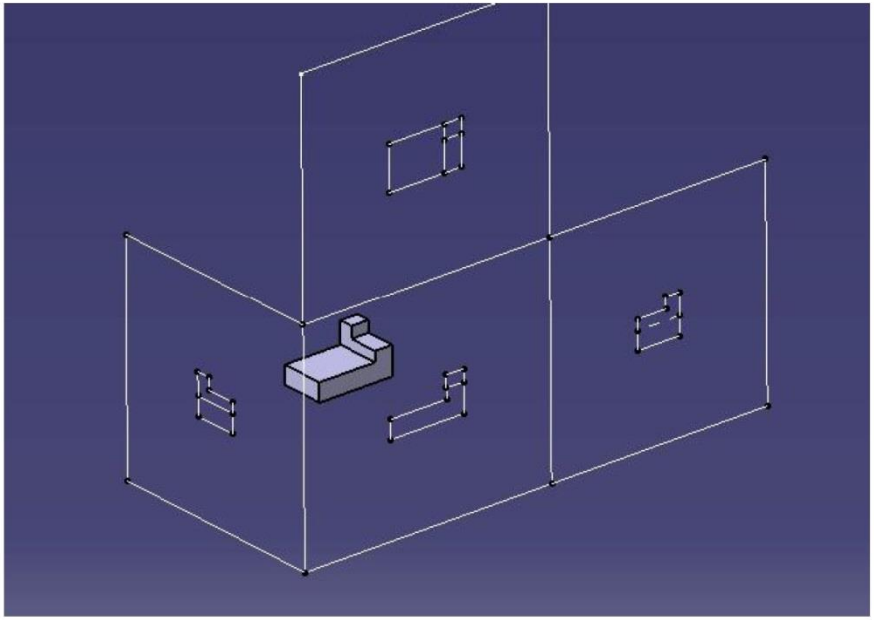
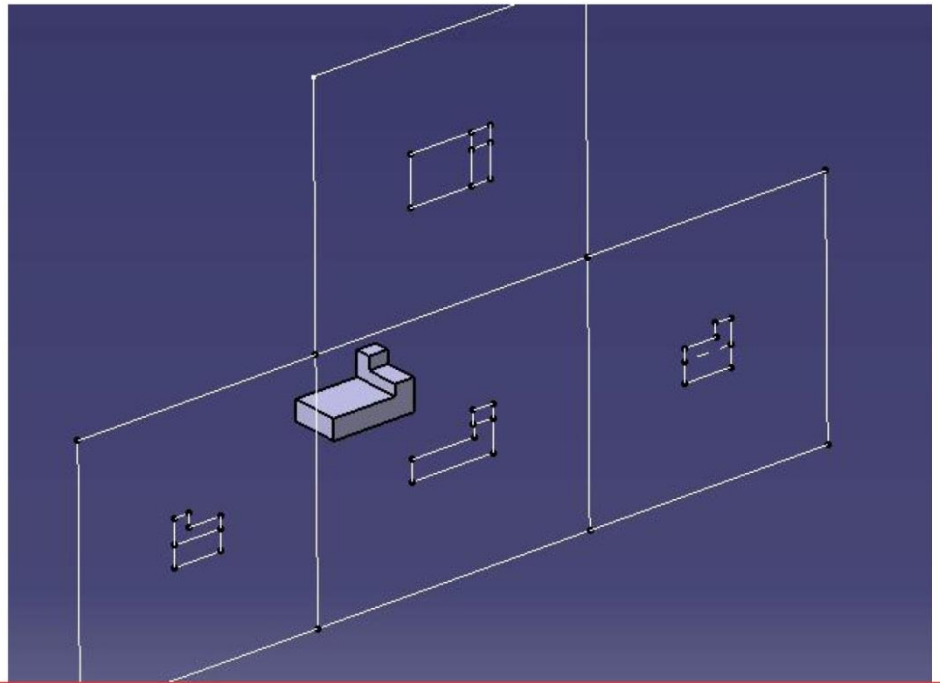


Orthogonal Projections – Third Angle View

• Other faces (bottom and rear faces) of the box can be used in a similar way to generate other views if required



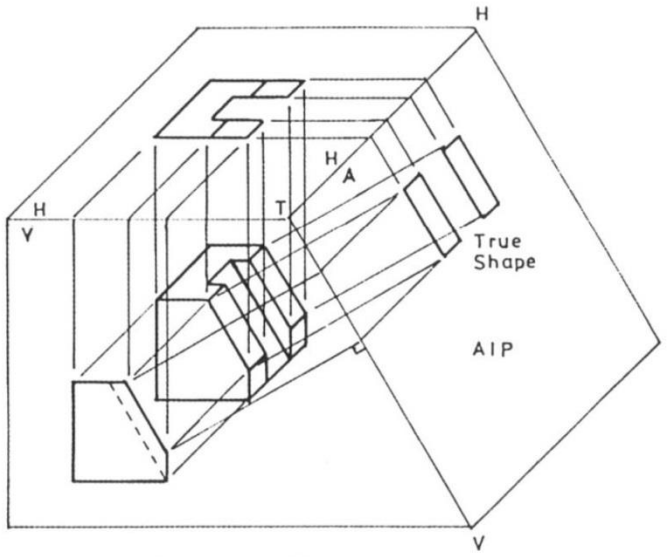
Auxiliary Views

- An auxiliary view is normally used to **detail an inclined face** of an object which would be distorted on a principal orthogonal view.

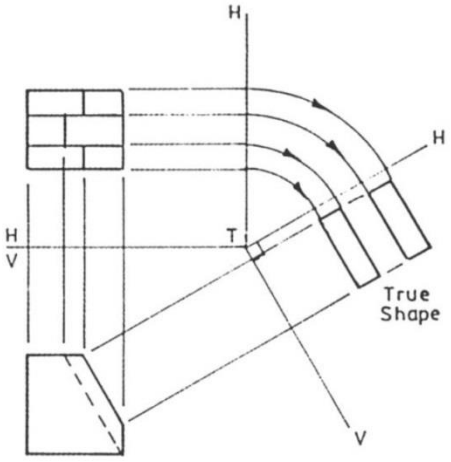
- An auxiliary view is **projected at right angles to the edge view of the inclined face** contained in a principal orthogonal view.

- In third-angle projection, the auxiliary view is placed on the same side of the normal view as the position of viewing.

Auxiliary Views

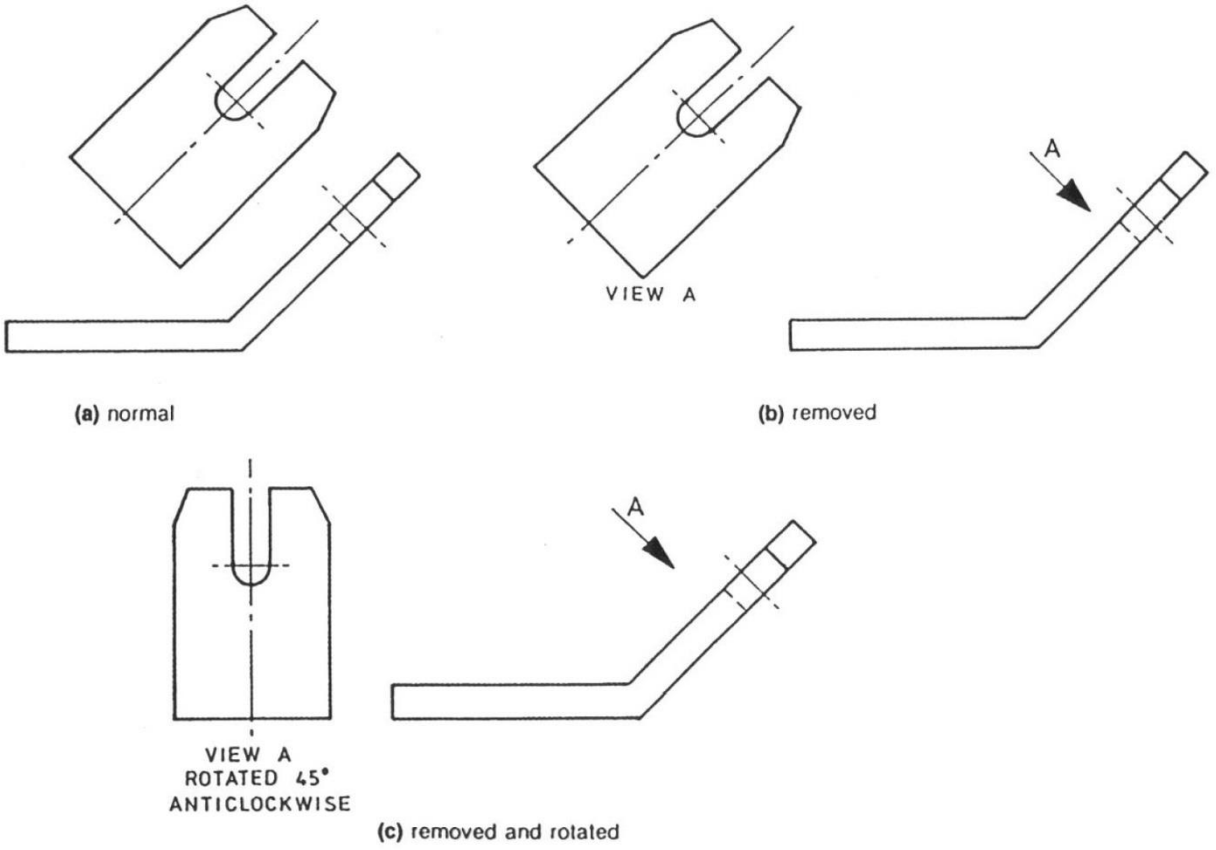


(a) Projection of true shape onto AIP



Note: H = horizontal plane
V = vertical plane
A = auxiliary inclined plane (AIP)
VTH = traces of inclined plane

Auxiliary Views - Types



(a) normal

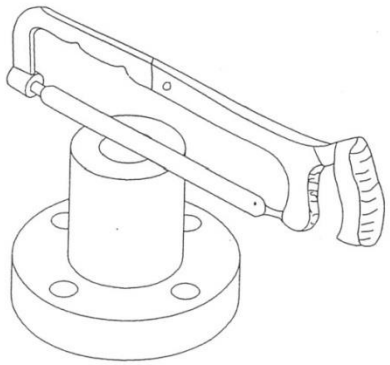
(b) removed

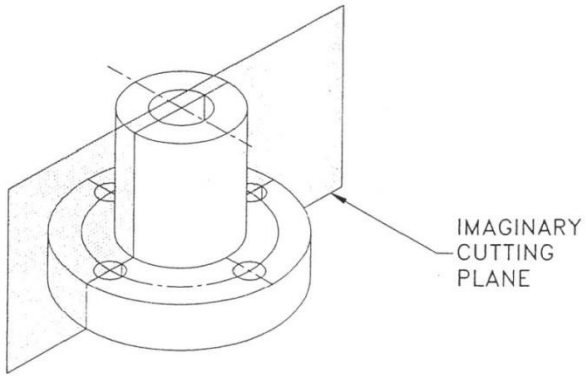
(c) removed and rotated

Sectioning

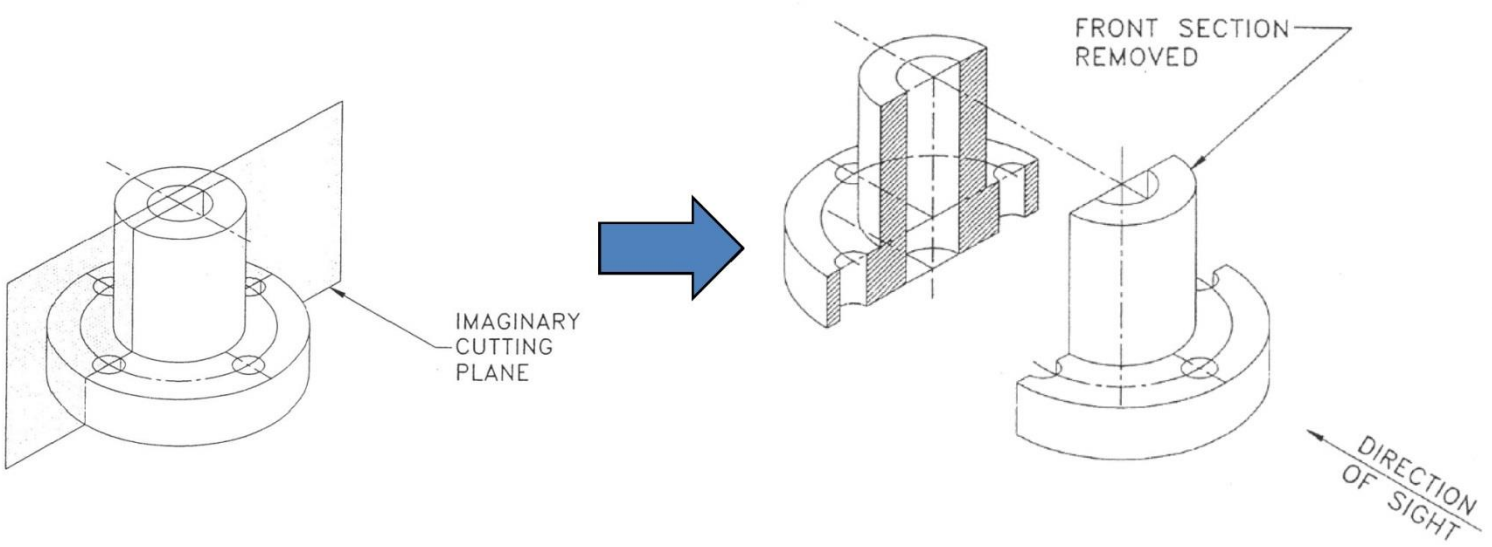
- Sectional Views are used to provide detail of the internal surfaces of a component

- In simple cases, hidden lines can be used but complex internal features are better illustrated using sectional views





Sectional View – Visualization

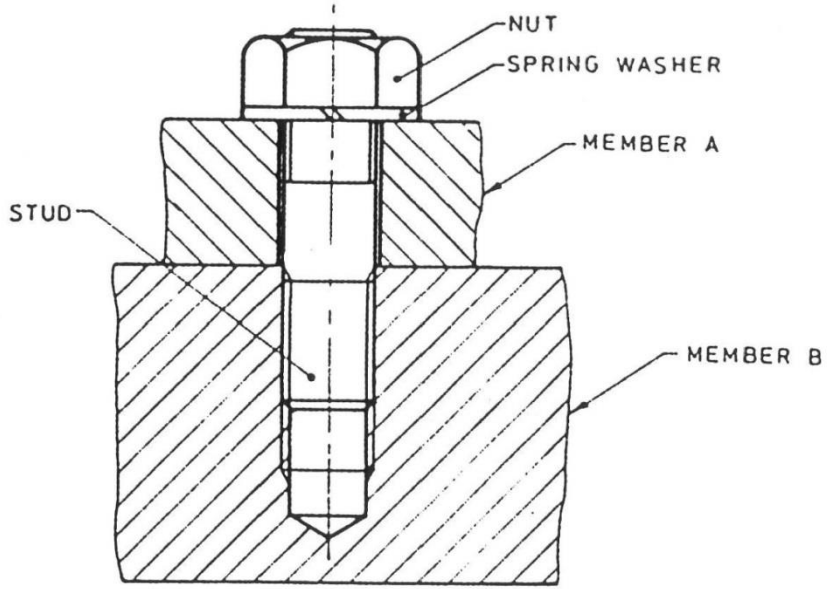


Rules for Sectioning

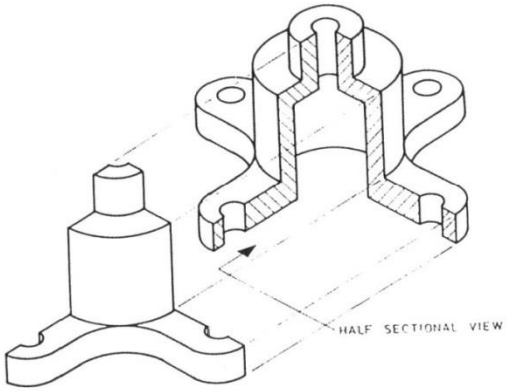
- A sectional view shows the part of the component in front of the cutting plane arrows.
- Material which has been cut by the cutting plane is hatched
- A sectional view must not have any full lines over hatched areas
- Dimensions are not inserted in hatched areas.

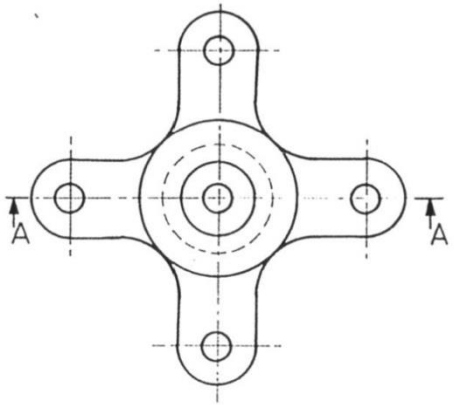
Rule Exception

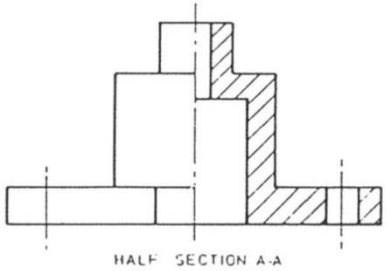
- When cutting plane passes through the centre of **webs, shafts, bolts, rivets, keys, pins, they are not shown sectioned.**



Sectional Views – Half Section







Concluding Remarks

• Third Angle Projection is preferred by Standards Australia It is the most common standard used.

• You must use it for this course

• However First Angle Projection is still sometimes used and you should be able to recognise the difference.

• There are many additional standards you must follow –we will cover them in these classes.

• BUT -if in doubt about any standards, consult *Engineering Drawing by Boundy*

In your own drawing (e.g. your assignment 1(b)), be aware of …

- Redundant views
- Redundant dimension
- Missing dimension
- Hidden lines
- Centerlines and center marks
- Hole and thread dimensioning