ChE 258 Drawing for Engineers

Lecture 1

Dr. L. Darkwah,
Chemical Engineering Department,
KNUST,
Kumasi.

@4th February, 2019

Course Objectives:

- Reviewed and deepened student's skills in Technical Drawing
- Revised student's knowledge in perspective drawing and geometric construction
- Acquired skills in dimensioning drawings of various engineering units
- Understood the drawing and interpretation of flowsheets for processing plants
- Understood the types and functionalities of valves in process industries
- Introduce student to Simulation Software for Process Engineering

Learning Outcomes:

At the end of the course, the student is expected to have the skills in:

- Drawing the Mechanical Engineering perspectives of Engineering units
- Designing and drawing Engineering units using softwares such as AUTOCAD and DraftSight
- Flowsheeting using manual methods and softwares such as ChemCAD, Aspen-HYSYS, COCO, etc.
- Pipeline Labelling
- Utilisation of Valves in Process Engineering

Course Outline

- Geometric Construction – Review & More Practice
- Sectioning
- Dimensioning
- Limits, Fits & Tolerance
- Chemical Process symbols - Symbology
- Valves
- Flowsheeting
- Introduction to AUTOCAD
- Introduction to Simulation software

Reference Materials 1 :

1. Books on Graphics Communication
2. Fisher (2004) – Control Valve Handbook, 4th Edition, Fisher Controls International LLC, U. S. A.
3. Hamedinia, M. (2009). Valve – Technical Report on Valve and Application.
4. US Department of Energy (1993) Fundamentals Handbook, MECHANICAL SCIENCE, Module 4, Valves, U. S. A.
5. Some Lecture Slides/Notes

Reference Materials 2

6. Bertoline, G. R. (2002). Introduction to Graphics Communications for Engineers, McGraw –Hill, Boston.
7. Bertoline, G. R. (2002). Fundamentals of Graphics Communications (4th Edition), McGraw –Hill, Boston.
8. Jensen, C. and Helsel, J. D. (1995). Engineering Drawing and Design (4th Edition), Glencoe/McGraw Hill.
9. Jensen, C. Fundamentals of Engineering Drawing, Glencoe/McGraw -Hill.
10. Wöhlers, T. T. (2003) Applying AUTOCAD 2002 Fundamentals, Glencoe/McGraw-Hill.
11. Sinnot, R. K. (1997) Coulson & Richardson's Chemical Engineering (3rd Edition) Vol. 6. Chemical Engineering Design, Butterworth-Heinemann, Oxford, pp. 129-186.
12. Wallas, S. M. (1990). Chemical Process Equipment – Selection and Design, Butterworth-Heinemann, Boston, pp. 19-31.

Guidelines / Agreements

- **Open Class System:**
  - No Distractions
  - Time Keeping = Onus on Student
- **Attendance:**
  - University Regulations 4(vi) (d) in 2014/15 Students Guide p. 58
- **No mobile devices (Phones/iPods, etc.)**
  - No Plug up
- **Dressing**
  - Decent

2015/16 ACADEMIC YEAR

Course Assessment

1. **Continuous -**
   a) Attendance – Register
      i. Lectures
      ii. Practice - (Manual & AUTOCAD)

   b) Quizzes - Random

   c) Assignments – Weekly

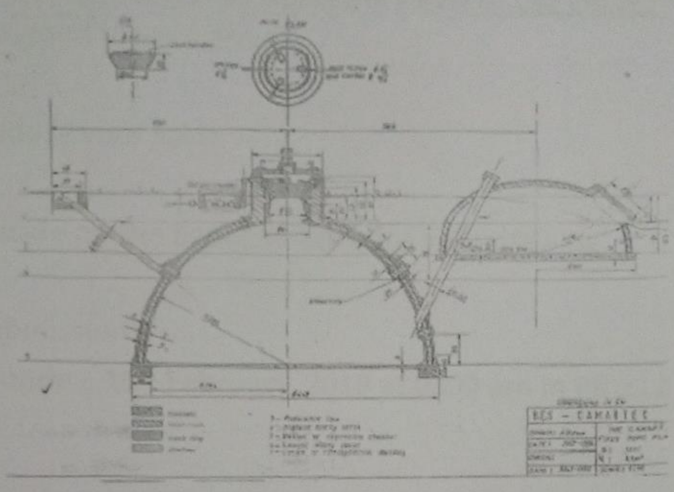
   d) Mid-Semester – Date to be Fixed

2. **End of Semester Exams – Date to be Confirmed**

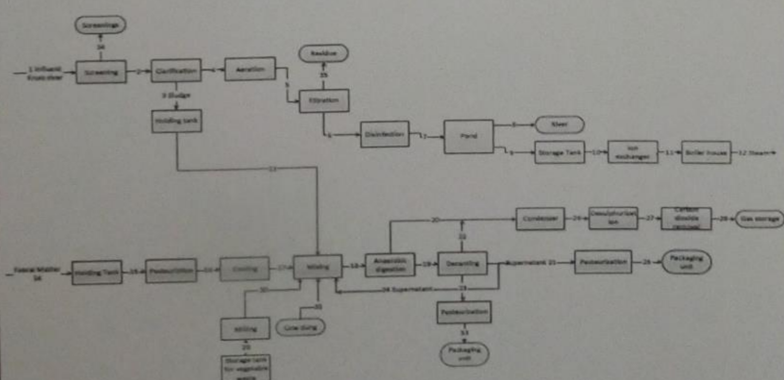
2015/16 ACADEMIC YEAR

Typical Engineering Drawing in Practice

1. Case Study of a Biogas Plant (Domestic Scale)



Case Study of a Biogas Production from Municipal Liquid Waste (Industrial Scale)



BLOCK DIAGRAM OF MUNICIPAL LIQUID WASTE PLANT

Assignment 1

1. Draw / Construct an isometric views of the Object assigned to your group

2. Choose your scale

3. Decide on the paper suitable for your drawing.

4. Submission:

   Monday, 11th February, 2019 at 0800 am in PB 212

AN INTRODUCTION TO DIMENSIONING & SYMBOLOGY

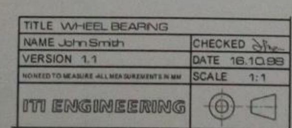
Lecture 2

DR. L. DARKWAH,
PB 305,
Petroleum Building,
College of Engineering,
KNUST, Kumasi

@ 27th Feb., 2019

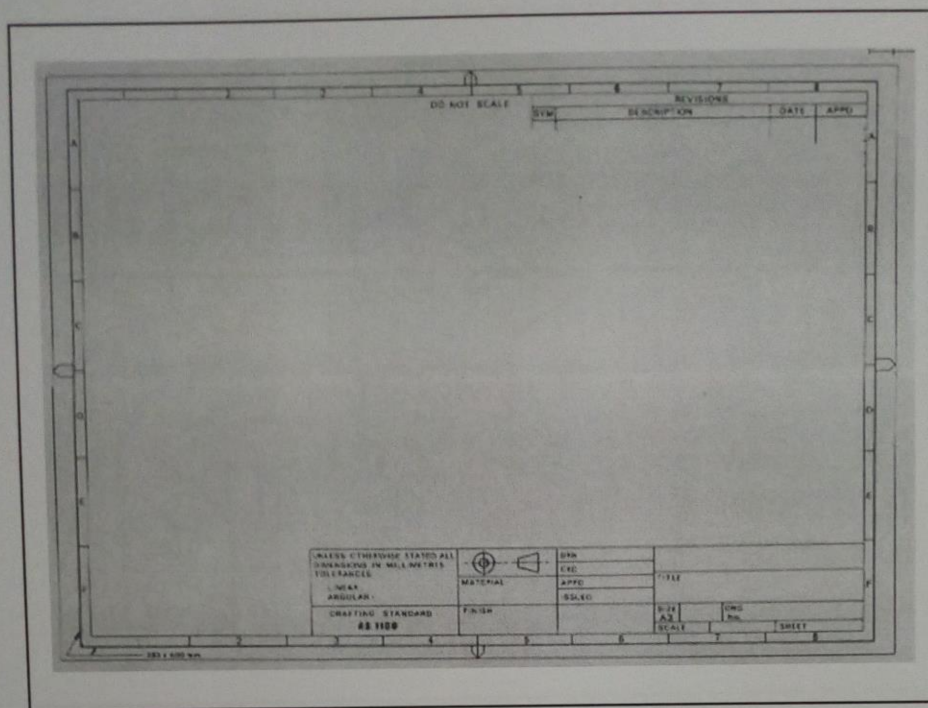
Drawing Layout

All engineering drawings should feature a title block.

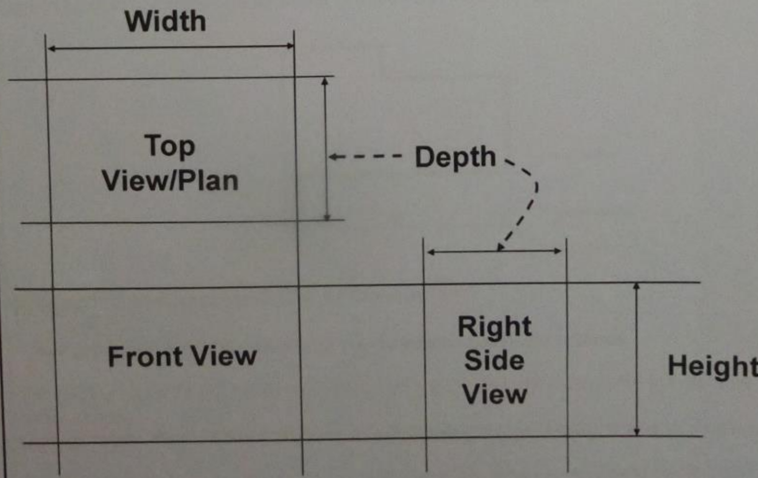


The title block should include:

1. Title:- title of the drawing
2. Name:- name of the person who produced the drawing
3. Checked:- before manufacture, drawings are usually checked
4. Version:- many drawings are amended, each revision must be noted
5. Company name:- name of the company
6. Date:- the date the drawing was produced or last amended
7. Scale:- the scale of the drawing
8. Projection:- the projection system used to create the drawing
9. Notes:- any note relevant to the drawing

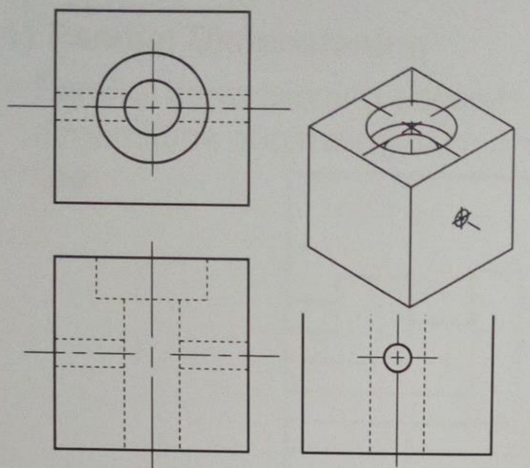


Conventional Orthographic Views



Minimum Spacing between each pair of parallel dimensions is 40 mm.

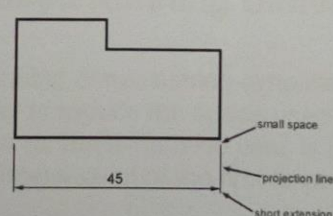
For Example:



1. **Visible**
2. **Hidden**
3. **Center**

Dimensioning

A dimensioned drawing should provide **all the information necessary** for a finished product or part to be manufactured. An example of dimension is shown below.



Properties or Characteristics of Dimension:

1.Two projection lines indicate where the dimension starts and finishes.

2.Projection lines do not touch the object and are drawn perpendicular to the element you are dimensioning.
(Assignment: What is the minimum space between object outline and projection line?)

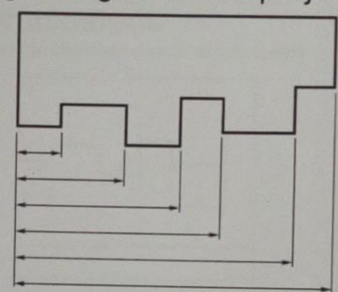
3.Dimensions are always drawn using continuous thin lines except where the figure is to be provided within the line that it is broken into 2 (usually equal distances).

4.All dimensions less than 1 should have a leading zero. i.e. .35 should be written as 0.35

4 Types of Dimensioning

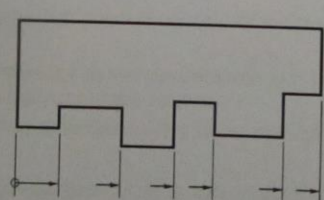
1) Parallel Dimensioning

- Parallel dimensioning consists of several dimensions originating from one projection line.

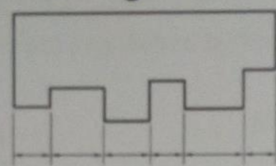


2. Superimposed Running Dimensions

•Superimposed running dimensioning simplifies parallel dimensions in order to reduce the space used on a drawing. The common origin for the dimension lines is indicated by a small circle at the intersection of the first dimension and the projection line.

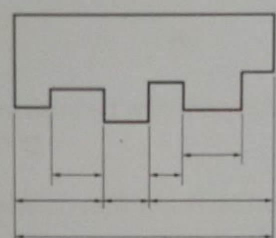


3. Chain Dimensioning

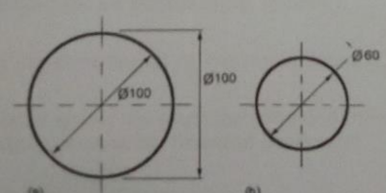


4. Combined Dimensions

A combined dimension uses both chain and parallel dimensioning.



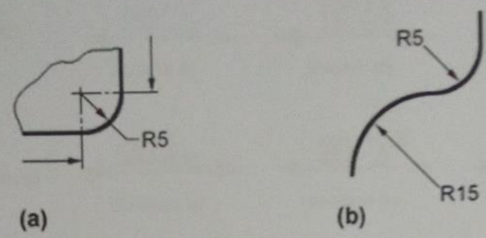
Dimensioning of Circles



- Figure (a) shows two common methods of dimensioning a circle:
  - One method dimensions the circle between two lines projected from two diametrically opposite points.
  - The second method dimensions the circle internally.
- Figure (b) is used when the circle is too small for the dimension to be easily read if it was placed inside the circle.

Dimensioning Radii

- All radial dimensions are proceeded by the capital **R**.



(a) shows a radius dimensioned with the centre of the radius located on the drawing.

(b) shows how to dimension radii which do not need their centres locating.

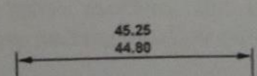
Tolerancing

- **It is not possible in practice to manufacture products to the exact figures displayed on an engineering drawing.**
- The accuracy depends largely on the manufacturing process.
- A tolerance value shows the manufacturing department the maximum permissible variation from the ***nominal*** dimension.
- Each dimension on a drawing must include a tolerance value. This can appear either as:

1. A general tolerance value applicable to several dimensions. i.e. a note specifying that the General Tolerance +/- 0.5 mm

OR

2. a tolerance specific to that dimension



2 Sub-classifications of Tolerance:

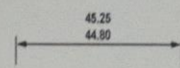
i) Bi-lateral	$20^{+0,1}_{-0,2}$	$\begin{matrix}20,15\\19,99\end{matrix}$	$20 \pm 0,1$
	Bi-lateral (a)	Bi-lateral (b)	Bi-lateral (c)
ii) Uni-lateral	$20^{0}_{-0,15}$	$20^{+0,25}_{0}$	$\begin{matrix}20,00\\19,98\end{matrix}$
	Uni-lateral (d)	Uni-lateral (e)	Uni-lateral (f)

Specific Tolerance

The first three are *bi-lateral tolerances* in that the tolerance is plus and minus about the nominal value whereas the last three are *uni-lateral tolerances* in that either the upper or the lower value of the tolerance is the same as the nominal dimension. The use of bi-lateral or uni-lateral tolerances will depend upon the tolerance situation and the functional performance. Note that, irrespective of whether bi-lateral or uni-lateral tolerancing is used, there are two general methods of writing the tolerances. The first is by putting the nominal value (e.g. 20) followed by the tolerance variability about that nominal dimension (e.g. +0,1 and –0,2). Alternatively, the maximum and minimum values of the dimension, including the tolerance can be given (e.g. 20,15 and 19,99). When dimensions are written down like this either as a tolerance about the nominal value or the upper and lower value method, the largest allowable dimension is placed at the top and the smallest allowable dimension at the bottom.

Limits & Clearance

- **Limits:**
  Refers to the largest and smallest permissible sizes.



- **Clearance:**
  This refers to the intentional space or gap that is allowed between two parts to avoid friction between them. Usually one or both parts may be rotary or sliding in nature.

  The formula for this computation is:

$$C_{max} = G_{max} - W_{min} = \sum T_{all}$$

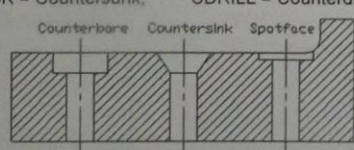
where C_{max} = clearance,
G_{max} = Groove size,
W_{min} = Width of Slider or Rotary component
T_{all} = Tolerances of all parts

Symbology

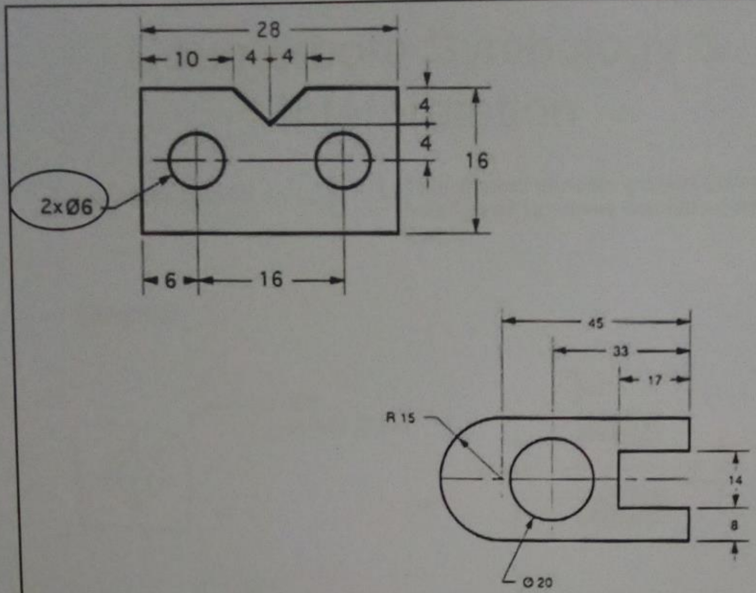
- Figures (e.g. 2X) given before the circular symbol usually denotes the number of occurrence of that shape in that object.
- Notes (Symbols or Words) after circular (usually holes) dimensions describe the details or specificity of the particular circle (or hole).
- Examples : THRU = Through hole, EQL SP = Equal spacing

  CBORE = Counterbore, SFACE = Spotface

  CSK = Countersunk, CDRILL = Counterdrill



⊤ indicates Depth of the Upper portion of a hole
M (below a circular symbol, Ø) indicates Threaded hole



Examples of various views with dimensions

Symbology

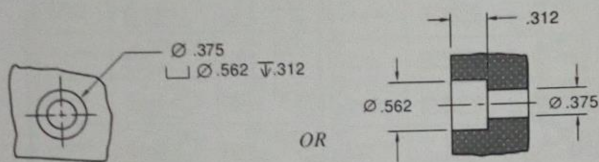
'ϕ' or 'DIA' or 'D' or 'd' = diameter
'⌒' = arc
'CL' = centre line
'CRS' = centres
'CSK' = countersunk
'CYL' = cylinder
'DRG' = drawing
'HEX' = hexagonal
'MMC' = maximum material condition
'PCD' = pitch circle diameter
'R' or 'RAD' = radius
'SP' = spherical diameter
'SQ' or □ (a small square) = a square feature
'SR' or 'ϕ' = spherical radius
'THD' = thread
'THK' = thick
'TOL' = tolerance
'VOL' = volume

Counterbore Symbology & Interpretation

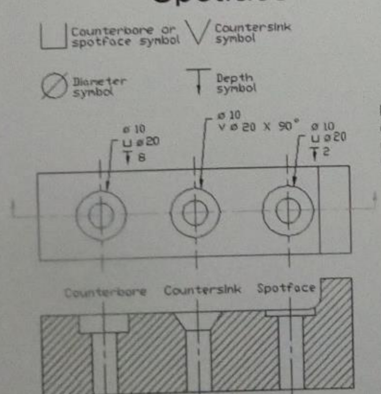
Counterbore Symbol ⌴

- **This symbol denotes *counterbored* holes used to recess machine screw heads.**

EXAMPLE

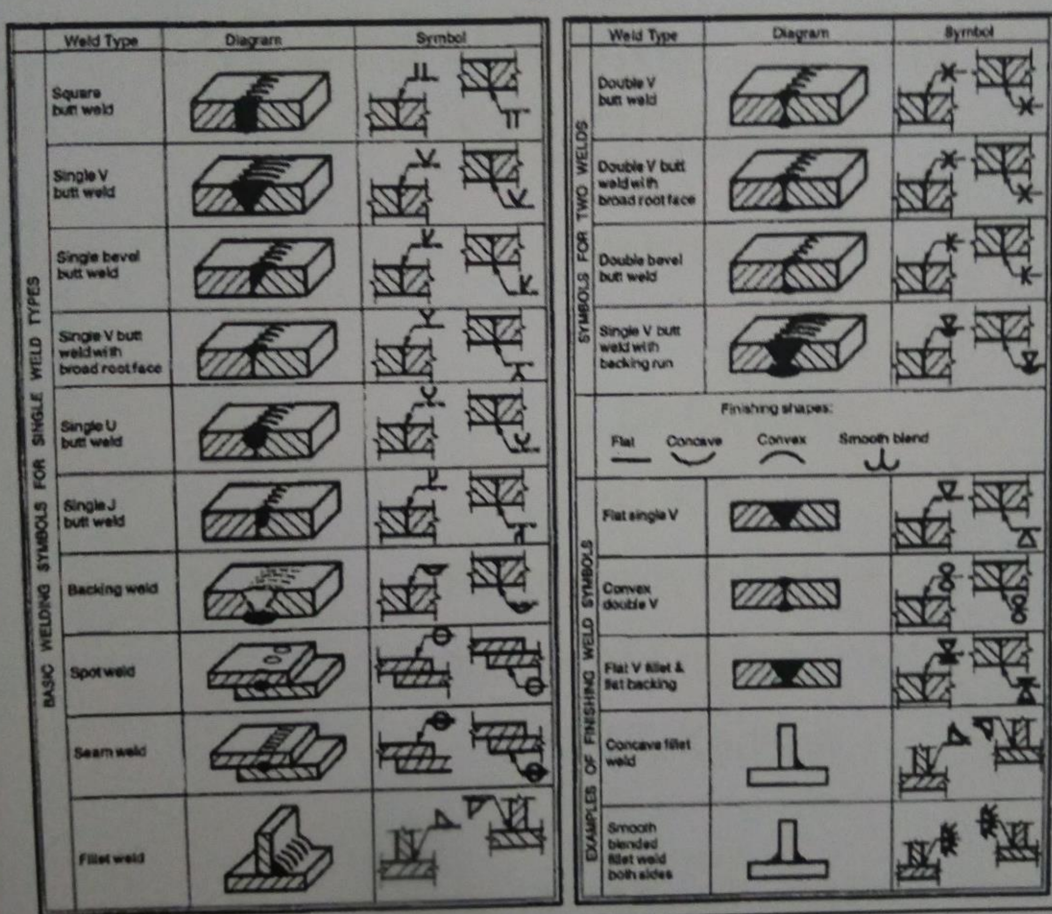


Examples of Counterbore, Countersink & Spotface



Note: Depth of spotface may often be omitted.

Welding Symbols

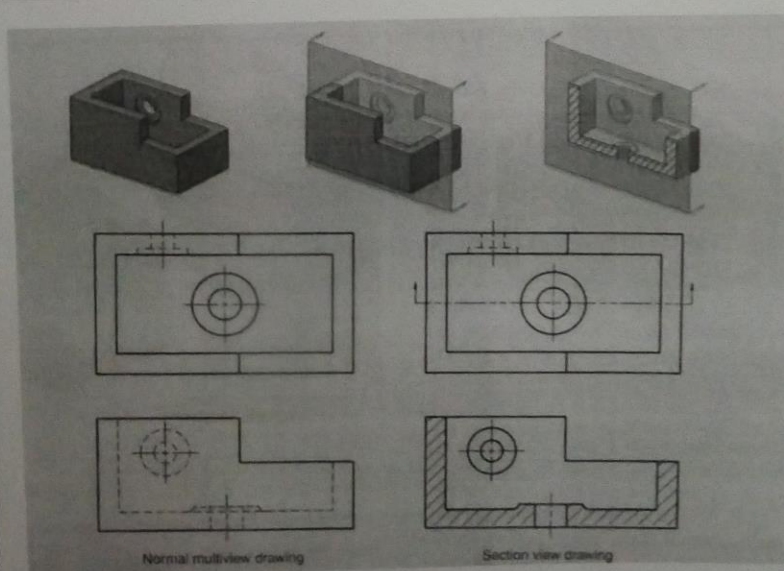


ChE 258 Drawing for Engineers
SECTIONING

Lecture 3

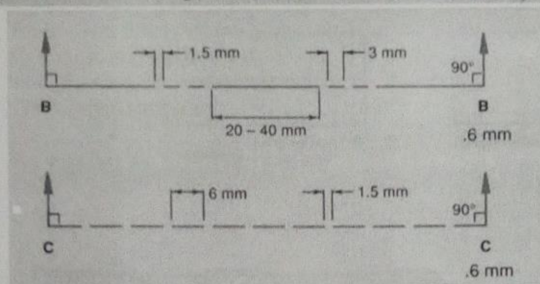
DR. L. DARKWAH,
PB 305,
Petroleum Building,
College of Engineering,
KNUST, Kumasi

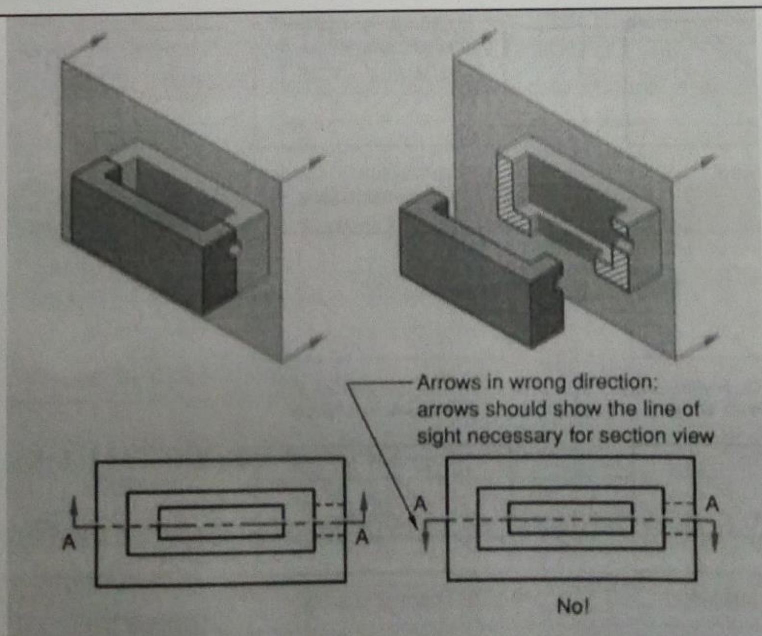
@ 11th March, 2019



Traditional section views are based on the use of an imaginary cutting plane that cuts through the object to reveal interior features.

This imaginary cutting plane is controlled by the designer and can (1) go completely through the object (full section), (2) go halfway through the object (half section), (3) be bent to go through features that are not aligned (offset section), or (4) go through part of the object (broken-out section).



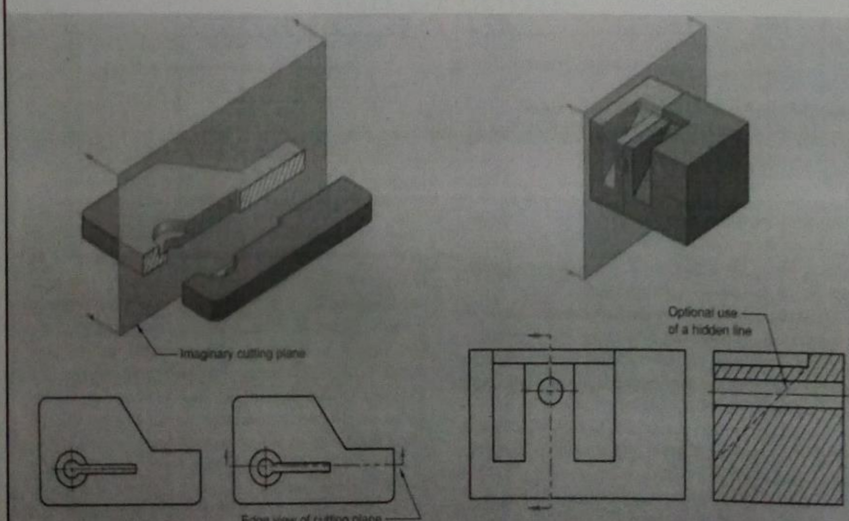


2

Types of Sections

1. Full Section
2. Half Section
3. Broken Out Section
4. Revolved Section
5. Removed Section
6. Offset Section
7. Assembly Section

Full Section

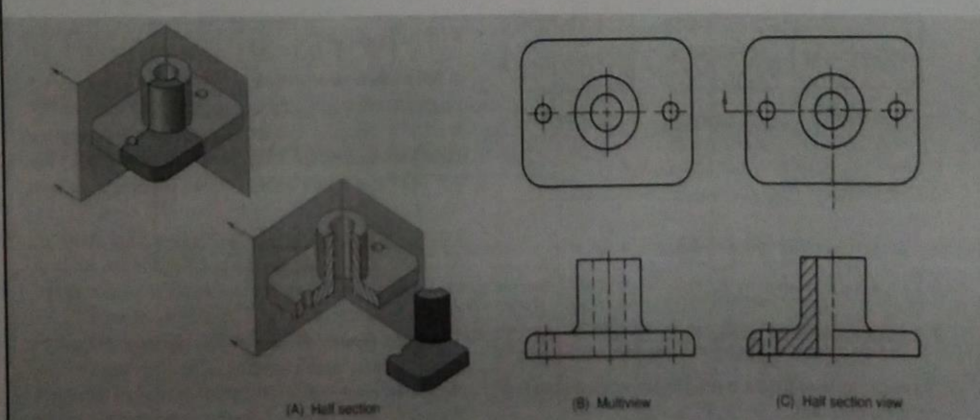


3

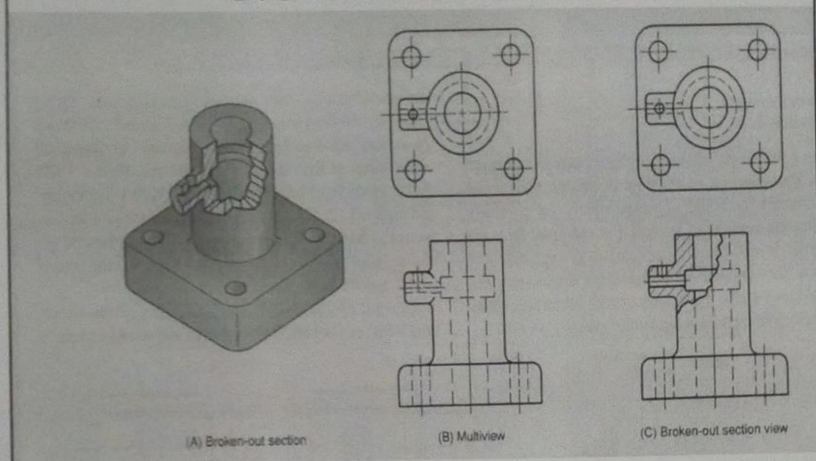
Example of a Full Section
or Sectional View

<u>Biogas Digester Drawing 1</u>

Half Section



Broken Out Section

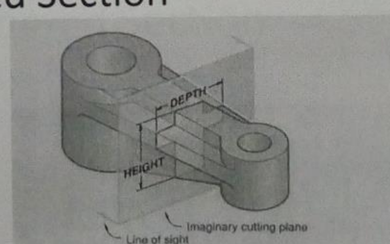


(A) Broken-out section (B) Multiview (C) Broken-out section view

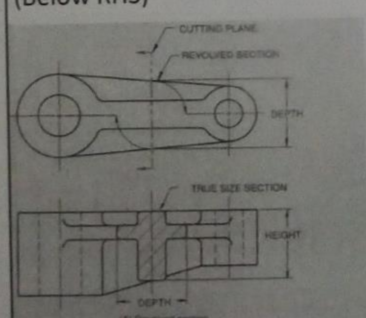
Revolved Section

– 2 Types:

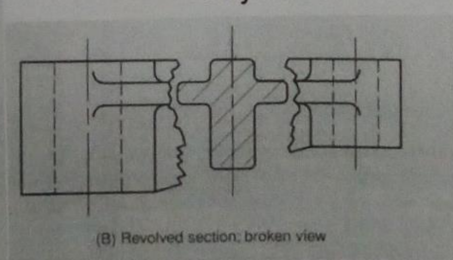
A) Revolved (In place)
(Below LHS) and
B) Revolved (Broken view)
(Below RHS)



Object

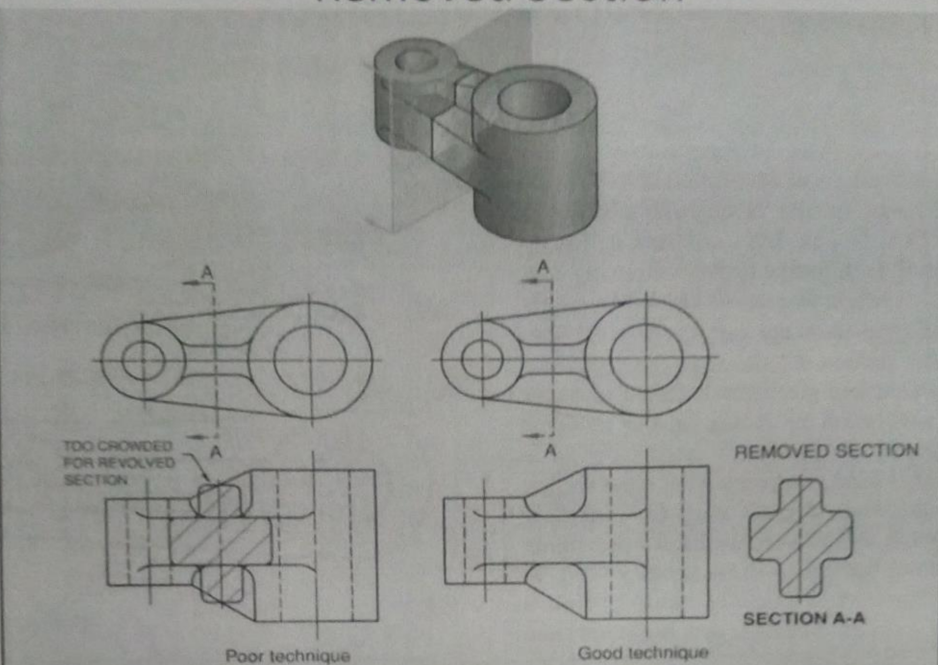


(A) Revolved section

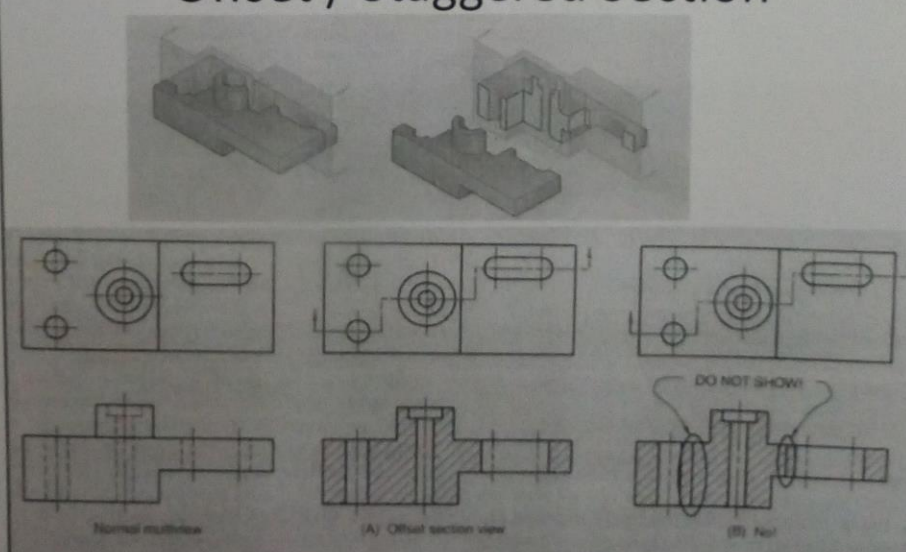


(B) Revolved section; broken view

Removed Section



Offset / Staggered Section

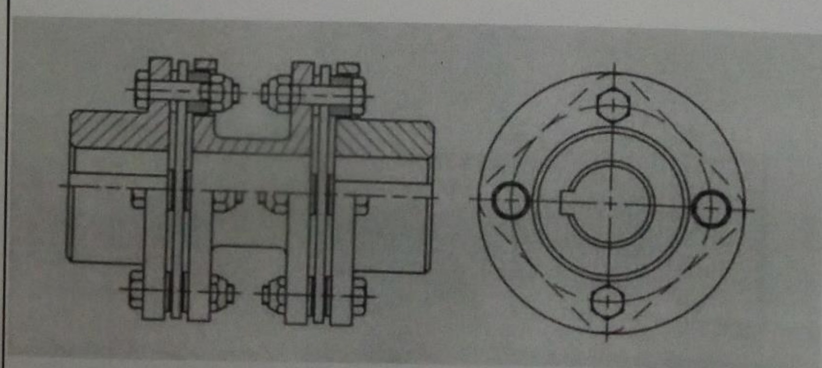


Assembly Section

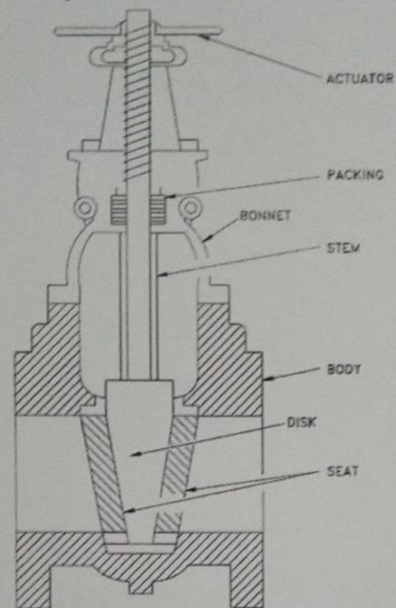
List of Features that are NOT sectioned:

1. Shafts
2. Bearings, Roller or Ball
3. Gear Teeth
4. Threaded Fasteners
5. Nuts & Bolts
6. Rivets
7. Ribs
8. Spokes
9. Lugs
10. Washers
11. Keys
12. Pins

Assembly Section of Flanges and Bolts & Nuts



Assembly Section of a Valve



Assembly Section of a Twin Biogas Digester