Technical English - I
4th week

ENGINEERING DRAWING
Engineering drawing

What is engineering drawing?

It is the art of representation of geometrical objects on a drawing sheet. An engineering drawing is used to fully and clearly define requirements for engineered items. It is a separate language for communicating between designer, manufacturer and inspection. It is prepared, based on certain principles, symbolic representations, standard convention and notation, etc.

Importance of engineering drawings

Engineering drawing is a two dimensional representation of a three-dimensional object. It is the graphic language and called the universal language of engineers. As an engineering drawing display a precise picture of the object to be produced. It conveys the same picture and information to every trained eye.
### Types of technical drawings

#### Types of drawings

- Civil
- Architectural
- Structural
- Mechanical
- Plumbing
- Piping
- Pneumatic/Hydraulic
- Electrical

#### Civil engineering drawing

- architectural plan / foundation plan / reinforcement / utility plan / as built plan

**Civil engineering drawings include:**

- **Architectural plans**
- **Structural working drawings** (Foundation plan, reinforcement details, utility plans such as water supply and electrification plan etc.)
- **Completion drawings** (As built drawings) (Drawings showing the actually constructed feature)
Types of technical drawings

**Mechanical Engineering**
- *Side views (Top, left, right)*
- *Isometric views*

**Civil Engineering**
- *Plans*
- *Cross Sections*
- *Details*

side view / isometric plan / plan / section / detail
Manual drawing versus CAD

Drawing styles
- Manual drawing (Conventional hand drawing)
- CAD (Computed Aided Drafting)

“I HAVEN’T MUCH EXPERIENCE OF SUCH AN EARLY VERSION OF AUTOCAD”
## Comparison of Manual drafting over CAD

<table>
<thead>
<tr>
<th>Advantages</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manual method</strong></td>
<td><strong>Computer aided method</strong></td>
</tr>
<tr>
<td>- Low purchase cost of equipment</td>
<td>- All drawing tools are electronic; Designs can be made quickly and consistently</td>
</tr>
<tr>
<td>- No need any electronic equipments</td>
<td>- Absolute accuracy can be maintained, and mistakes can be minimized</td>
</tr>
<tr>
<td>- Drawings can be seen straight away any shapes, sizes and angles.</td>
<td>- The computer keeps a record of all dimensions in the drawing</td>
</tr>
<tr>
<td></td>
<td>- Changes to drawing can be made easily (Editing processes include the ability to copy, move, rotate, mirror and erase drawing parts)</td>
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<tr>
<td></td>
<td>- Drawing storage is on a hard drive, memory stick, CD, DVD or floppy disk rather than in a drawing folio; Minimizes storage space</td>
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<tr>
<td></td>
<td>- Exact copies of drawings can be produced quickly; Hard copies can be produced in color and to a high professional standard</td>
</tr>
<tr>
<td></td>
<td>- The drawings can be reproduced as often and as quickly as you want</td>
</tr>
<tr>
<td></td>
<td>- Improves the productivity, efficiency and accuracy of drawings</td>
</tr>
<tr>
<td></td>
<td>- Objects can be viewed in 3D and as animation (visualization capabilities)</td>
</tr>
<tr>
<td></td>
<td>- Automatic drawing (Drawing via a programming language)</td>
</tr>
</tbody>
</table>
# Comparison of Manual drafting over CAD

## Disadvantages

<table>
<thead>
<tr>
<th>Manual method</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ For large drawings you need a great deal of space to set it out</td>
<td></td>
</tr>
<tr>
<td>▪ Doesn't link to Computer Numeric Controlled (CNC) devices.</td>
<td></td>
</tr>
<tr>
<td>▪ The time that it takes to reproduce / redraw the drawing in comparison to a</td>
<td></td>
</tr>
<tr>
<td>CAD drawing.</td>
<td></td>
</tr>
<tr>
<td>▪ Storage facilities required to keep manual drawings is far greater than CAD</td>
<td></td>
</tr>
<tr>
<td>drawings.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Computer aided method</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ There are still some shapes that are difficult to draw using CAD software.</td>
<td></td>
</tr>
<tr>
<td>▪ Preferably the computer equipment should be in a climate controlled, dust-</td>
<td></td>
</tr>
<tr>
<td>proof environment.</td>
<td></td>
</tr>
<tr>
<td>▪ The cost of purchasing and replacement cost of the equipment is expensive</td>
<td></td>
</tr>
<tr>
<td>compared to equipment used to draw manually.</td>
<td></td>
</tr>
</tbody>
</table>

- disadvantage / great deal of space / device / redraw / storage facility     
- climate controlled / dust proof environment / replacement cost
List of drawing instruments

1. Drawing board
2. Drawing sheets
3. Mini-drafter/Drafting machine
4. Instrument box
5. Set-squares (45° triangle and 30° - 60° triangle)
6. Protractor
7. Scales (celluloid/card-board - M₁, M₂ . . . . M₈)
8. Drawing Pencils (HB, H and 2H Grades)
9. Eraser
10. Clips or Adhesive tape (cello-tape)
11. Sharpner and Emery paper
12. French curves.
These drawings dawn by hand are taken from the project plans of the waste water treatment plants of the coastal cities in Aegean sea; Drawn in 1980.
CAD System Requirements
- CPU Central Processing Unit
- OS Operation System
- RAM Random Access Memory
- Monitor Resolution / Video Card
- CAD Software

CAD requires a high-specification computer with a lot of processing power, storage and high-resolution screen.
CAD Software

- AutoCAD
- MicroStation
- ArchiCAD
- NX
- ProEngineer
- BricsCAD (IntelliCAD)
- BRL-STR
- Caddie
- CATIA
- GSTariCAD
- CADKey
- ProgeCAD
- QCAD
- Shark CAD
- Solid edge
- Solidworks
Turkish CAD Software
Standards

Engineering drawings, being one of the many forms of technical communication, have to fulfill some accepted standards. There are various national, multinational and international standards, but the current trend in most countries is to adhere (adopt) the ISO (The International Organization for Standardization) standards.

- Paper Sizes
- Drawing sheet layout
- Title block
- Scale
- Line styles
- Dimensioning
- Text styles
- Symbols
- Printing and plotting standards
- Archive library

Note that some companies have their own drawing template, which inserts drafting standard automatically into into the new drawing.
Drawing standards

- Paper Sizes
- Sheet layout

Paper sizes

- A - (letter) 8 ½ by 11 inches
- B - 11 by 17 inches
- C - 17 by 22 inches
- D - 22 by 34 inches
- E - 34 by 44 inches
- F - 28 by 40 inches

Metric sizes

- A4 (210 x 297)
- A3 (297 x 420)
- A2 (420 x 594)
- A1 (594 x 841)
- A0 (841 x 1189)

Drawing sheet layout

Paper size / drawing sheet layout / title block / margin / border line
What is drawing scale?

**Scale**

**Title block**

**Scales**

Dimensions of large objects must be reduced to accommodate on standard size drawing sheet. This reduction creates a scale of that reduction ratio, which is generally a fraction. Such a scale is called reducing scale and that ratio is called representative factor.

Similarly in case of tiny objects dimensions must be increased for above purpose. Hence this scale is called enlarging scale. Here the ratio called representative factor is more than unity.

?!...

**Object size**

**Paper size**

**Representative factor (R.F.)** =

- **Dimension of drawing**
  - **Dimension of object**
  - **Length of drawing**
    - **Actual length**
  - **Area of drawing**
    - **Actual area**
  - **Volume as per drwg.**
    - **Actual volume**
The recommended scales in Engineering Drawing are

<table>
<thead>
<tr>
<th>True Size</th>
<th>1:1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Scales for Reduction</td>
<td>1:2</td>
<td>1:5</td>
<td>1:10</td>
</tr>
<tr>
<td></td>
<td>1:20</td>
<td>1:50</td>
<td>1:100</td>
</tr>
<tr>
<td></td>
<td>1:200</td>
<td>1:500</td>
<td>1:1000</td>
</tr>
<tr>
<td>Scales for Enlargement</td>
<td>2:1</td>
<td>5:1</td>
<td>10:1</td>
</tr>
<tr>
<td></td>
<td>20:1</td>
<td>50:1</td>
<td>100:1</td>
</tr>
<tr>
<td></td>
<td>200:1</td>
<td>500:1</td>
<td>1000:1</td>
</tr>
</tbody>
</table>

An example for the drawing title:

- Title block
- Scale

projection / format / remarks / reduction / enlargement
An example for a custom drawing sheet title block
Drawing standards

- Line styles

**Basic Lines**
- Object lines
- Hidden lines
- Cutting plane lines
- Centerlines
- Extension lines
- Dimension lines
- Leaders line
- Phantom lines

**Contour lines**

**Line styles**
- Break line
- Centerline
- Hidden line
- Object line
- Leader line
- Extension line
- Dimension line

object line / hidden line / centerline / extension line / dimension line / break line
**Drawing standards**

- **Line styles**

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**Drawing standards**

- **Line styles**
- **Hatching styles**

**Section Lines**
- Section lines are used where a surface is illustrated as cut.
- It normally is used in a sectional view.
- The lines are normally drawn diagonally.

**Hatching styles**

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**Cutting Plane Line**

- Cutting plane lines are used to indicate where an imaginary cut is made through the object. If it is labeled the section may be redrawn in detail in another part of the drawing.
Drawing standards

- Symbols
- Archive library

glass  metal  sand  ceramic  gravel  plywood  marble  concrete  stone  wood  zinc  slate  iron  steel  stucco  tile

MATERIAL SYMBOLS
CAD Line properties

Line properties

- Type (solid, continuous, dash, center, dotted, dash-dot, custom, etc)
- Color (black, red, blue, gray, etc or codes such as 0, 0.5, 1, 2 etc)
- Width/thickness (Light, medium, heavy or codes such as 0, 0.5, 1, 2 etc)
- Layer/level (specific names or codes such as “Plan”, “Section”, “Roads” etc)

By organizing drawings into levels, it can more easily control which areas of the drawing are visible at any time.
Drawing standards

- Symbols
- Archive library

Prepared engineering symbols

Cell or block library / terminator pattern / weld symbols

North arrow cell
Drawing standards

- Dimensioning
- Text styles

Dimension styles

dimension / linear / aligned / ordinate / radius / diameter / angular / baseline
Drawing standards

- Dimensioning
- Text styles

dimension / linear / aligned / ordinate / radius / diameter / angular / baseline
Both 2D and 3D have their own unique benefits. “2D” is display as two dimensional geometry which is expressed in length & height on flat planes but have no depth. In a 3D drawing file, objects have (x,y,z) coordinates while objects in 2D file have only (x,y) coordinates.

**Length**

**Height**

**2D Drawing (False 3D view)**

**3D Drawing**

**Length**

**Height**

**Depth**
The software goes far beyond CAD software. CAD Software vendors offers comprehensive *project solutions* beyond a standard CAD package.

MicroStation-based platform products
Thank you...
What are the most common “commands” used in CAD?

(Please ask people who are using any CAD software. Make a list by selecting top 10 favorite ones.)