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
- 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)

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

**Advantages**

**Manual method**
- Low purchase cost of equipment
- No need any electronic equipments
- Drawings can be seen straght away any shapes, sizes and angles.

**Computer aided method**
- All drawing tools are electronic; Designs can be made quickly and consistently
- Absolute accuracy can be maintained, and mistakes can be minimized
- The computer keeps a record of all dimensions in the drawing
- Changes to drawing can be made easily (Editing processes include the ability to copy, move, rotate, mirror and erase drawing parts)
- Exact copies of drawings can be produced quickly; Hard copies can be produced in color and to a high professional standard
- The drawings can be reproduced as often and as quickly as you want
- Improves the productivity, efficiency and accuracy of drawings
- Objects can be viewed in 3D and as animation (visualization capabilities)
- Automatic drawing (Drawing via a programming language)

**Disadvantages**

**Manual method**
- For large drawings you need a great deal of space to set it out
- Doesn’t link to Computer Numeric Controlled (CNC) devices.
- The time that it takes to reproduce / redraw the drawing in comparison to a CAD drawing.
- Storage facilities required to keep manual drawings is far greater than CAD drawings.

**Computer aided method**
- There are still some shapes that are difficult to draw using CAD software.
- Preferably the computer equipment should be in a climate controlled, dust proof environment.
- The cost of purchasing and replacement cost of the equipment is expensive compared to equipment used to draw manually.

Manual Drawing Tools

1. Drawing board
2. Drawing sheets
3. Mono-draft/Drafting machine
4. Instrument box
5. Set-squares (45° triangle and 30° - 60° triangle)
6. Protractor
7. Scales (celluloid/card-board - My, M₁, M₂, . . . , Mₙ)
8. Drawing Pencils (H₆, H₇ and 2H Grades)
9. Eraser
10. Clips or Adhesive tape (cello-tape)
11. Sharpener and Eraser paper
12. French curves.

Some example of manual drawing

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.

AutoCAD
MicroStation
Archicad
NX
ProEngineer
BricsCAD (IntelliCAD)
BRL-STR
Caddie
CATIA
GStarCAD
CADKey
ProgeCAD
QCAD
Shark CAD
Solid edge
Solidworks

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 the new drawing.

Drawing standards
Paper Sizes
- Metric sizes
- A-series
  - A0: 841 x 1189
  - A1: 594 x 841
  - A2: 420 x 594
  - A3: 297 x 420
  - A4: 210 x 297
  - A5: 148 x 210

Drawing sheet layout

Title block

Scale

Dimension 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 reduction scale. And that ratio is called representative factor.

Similarly if case of tiny objects dimensions must be increased for above purpose, hence this scale is called enlargement scale. Here the ratio called its presentation factor is more than unity.

An example for the drawing title:

<table>
<thead>
<tr>
<th>True Size</th>
<th>1:1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:2</td>
<td>1.5</td>
</tr>
<tr>
<td>1:10</td>
<td>1</td>
</tr>
<tr>
<td>1:200</td>
<td>1</td>
</tr>
<tr>
<td>1:1000</td>
<td>1</td>
</tr>
</tbody>
</table>

Object Size

An example for a custom drawing sheet title block:
**Drawing standards**

- **Line styles**
  - Basic Lines
    - Object line
    - Hidden line
    - Centerline
    - Extension line
    - Dimension line
    - Leaders line
    - Phantom line

- **Contour lines**

**Line styles**

- **Line types**
  - Object line
  - Hidden line
  - Centerline
  - Extension line
  - Dimension line
  - Leaders line
  - Phantom lines

**Objects**

- Glass
- Metal
- Sand
- Ceramic
- Concrete
- Stone
- Wood
- Zinc
- Slate
- Iron
- Steel
- Stucco
- Tile

**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.
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.

CAD Software vendors offers comprehensive project solutions beyond a standard CAD package.

The software goes far beyond CAD software
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.)