Introduction to CAD Systems

Objectives:

- To define computer aided design.
- To compare CAD versus manual drafting.
- To recognise the applications of CAD in engineering.
- To recognise the software and hardware requirement for a CAD system.
- To start AutoCAD and establish basic setups for a new drawing.
- To understand the AutoCAD interface.

Subject Matters:

What is CAD?

CAD stands for "**computer aided design**". It refers to the application of computer hardware and software to aid in the different stages of the design process. As the initial CAD systems were primarily used for two-dimensional drafting, it was misinterpreted as "computer-aided drafting".

Advantages of using CAD systems versus manual drafting

1. Much quicker than manual drafting.
2. Any technical drawing can be produced.
3. Drafting is less tedious when working with CAD system.
4. CAD software editing tools, such as copy, move, etc. eliminate redrawing the same detail again.
5. Associative dimensioning reduces the possibilities of dimensioning error.
6. Electronic drawings saved as files on disk reduce storage space required for paper drawings.
7. Drawings can be plotted or printed to any scale from CAD drawing files.
8. The database of a CAD drawing can be used in many other ways such as CAM, CAE, etc.

Disadvantages of using CAD systems versus manual drafting

1. High initial expense in the setting up of a CAD system.
2. CAD is sometimes unsuitable for the making of some design sketches, some of which may need to be drawn freehand.
3. Need to fully train an operator new to CAD drafting.

Applications of CAD in engineering

Most commercially available CAD systems are drafting systems, and have been associated with the design of 2D and 3D objects. However CAD can be considered as a discipline that provides the required know-how in computer hardware and software, in systems analysis and in engineering methodology for specifying, designing, implementing, introducing and using computer based systems for design purpose. The typical classes of application of CAD are:

1. **Numerical analysis and presentation**
2. **Three-dimensional applications**
3. **Functional and geometrical layout**

Some of the application examples in engineering are:

1. Mechanical engineering
   (i) Design of 2D and 3D objects.
   (ii) Simulation of machine tool path.
   (iii) Interfacing with machines for production.
2. Electronic engineering
   (i) Automatic optimum positioning of components on a printed circuit board design.
   (ii) Circuit testing.
   (iii) Generation of silkscreen masters, printed circuit artwork masters, drill template masters and solder masks.
3. Architecture and civil engineering
   (i) Floor layout.
   (ii) 3D building layout.
   (iii) Presentation of finite element analysis results for a pre-stressed concrete structure.
   (iv) Building services layout and interference checks.
4. Textile and clothing technology
   (i) Pattern design.
   (ii) Pattern detailing.
   (iii) Pattern grading
   (iv) Marker layout.

Hardware requirement for CAD system

The recommended hardware requirements for a typical CAD system with AutoCAD 2004 running on PC are:

1. Intel Pentium III or later based PC, with 800 MHz or faster processor, or compatible
2. 256 Mbytes memory (RAM)
3. 300 Mbytes or more free disk space for installation
4. VGA display 1024 x 768 or higher
5. CD-ROM drive
6. Mouse or other pointing device

Software requirement for CAD system

A typical CAD system with AutoCAD 2004 running on PC requires the following software:

1. Microsoft Windows XP (Professional, Home Edition or Tablet PC Edition), Windows 2000, or Windows NT 4.0 (SP6a or later)
2. AutoCAD 2004 software package

Starting AutoCAD

To start AutoCAD 2004, three methods are available:

1. On the Windows desktop, double-click the **AutoCAD 2004 shortcut icon**.

2. Click the "**Start**" button on the Windows desktop, select "**Programs**", then look for "**AutoCAD 2004**" folder and click "**AutoCAD 2004**" in the listing.
3. Open **Windows Explorer**, locate the AutoCAD 2004 folder and double-click the **acad** application file.

New drawing startup

There are two options of drawing startup settings:

1. When "**Do not show a startup dialog**" is selected in the system setting, a new drawing is opened when AutoCAD 2004 starts.
2. When "**Show Startup dialog box**" is selected in the system setting, the **Startup** dialogue is shown on screen. Initialise a new drawing by one of the following methods:

1. **Start from Scratch**

   This is the simplest method to initialise a new drawing. Select "**Start from Scratch"** in the **Startup** dialogue.

   (i) Select **Imperial (feet and inches)** for the Imperial drawing settings, the new drawing is appropriate for models created in feet and inches, or

   (ii) Select **Metric** for the default metric drawing settings, the new drawing is appropriate for models created in millimetres.

   The new drawing file does not have a file name and there are no objects or custom definition in the drawing.

2. **Use a Template**

   A template is a drawing file with pre-established settings for new drawings. AutoCAD is supplied with many template files already created and they are stored in the Template folder by default. Template files are identical to drawing files except they have a **.dwt** file name extension (instead of the normal **.dwg** extension). Select **"Use a Template"** in the **Startup** dialogue and select a template file, or left-click on the **Browse** link to select a template file saved elsewhere.

3. **Use a Wizard**

   Select **"Use a Wizards"** in the **Startup** dialogue.

   Advanced Setup – for initial drawing setup of all drawing parameters: unit of measurement and its precision, angle of measurement and its precision, direction for angle measurement, orientation for angle measurement, and drawing area.

   Quick Setup – for initial drawing setup of two most critical parameters: unit of measurement and drawing area.

Opening an existing drawing

When the **Startup** dialogue appears, select "**Open a Drawing"** icon in the dialogue. Click the **Browse** link to browse for drawings similar to looking for a file using Windows Explorer, or click on a drawing file listed in the "Select a File:" window.

The AutoCAD interface

When AutoCAD 2004 starts, the initial screen displays menu bars, toolbars, status bar, drawing window, etc. They are:

1. **Title bar**
   Displays AutoCAD 2004 icon, the name of the drawing, and 3 window control buttons.
2. **Menu bar**
   Contains a list of commands, i.e. File, Edit, View, …., Help. These commands are issued by pulling down a menu and selecting the command with the pointing device.
3. **Standard toolbar**
   Contains a set of icons of those tools in frequent use, but not used for drawing construction. To start a command, press one of the icons.
4. **Styles toolbar**
   Contains tools for setting text style and dimension style and displays the current styles in use.
5. **Layers toolbar**
   Displays tools associated with making layers and showing layer properties.
6. **Properties toolbar**
   Displays selected drawing object properties, such as colour, line type, and line thickness.
7. **Draw toolbar**
   Contains a set of icons representing commands that are use to draw objects. To start a draw command, press the appropriate icon.
8. **Modify toolbar**
   Contains a set of icons representing commands that are used to edit drawn objects. To start a modify command, press the appropriate icon.
9. **Drawing window**
   Majority of the screen area is the drawing window. It is used to draw and display the drawing.
10. **Cursor cross hairs**
11. **UCS icon**
    The User Co-ordinate System icon indicates which co-ordinate system is in use.
12. **Command window**
    It is used for entering commands. The window contains a history of action taken from the start of a construction.
13. **Status bar**
    Displays the x, y, z co-ordinates of the position of the intersection of the cursor hairs and 8 buttons (SNAP, GRID, ORTHO, POLAR, OSNAP, OTRACK, LWT and MODEL).

14. **Windows Task bar**
    Shows the software applications in action concurrently with AutoCAD.

Active Assistance

Active Assistance provides automatic or on-demand context sensitive assistance. When a command is invoked, a window is popped up, from which you can get assistance on how to use the command and the related information.
To control or restrict the use of the Active Assistance, right-click in the Active Assistance window and pick **Settings**. Select the mode of activation (e.g. On demand).

Closing AutoCAD

AutoCAD can be closed using standard Windows methods and any unsaved changes to drawings will be prompted to save.
To close the current session of AutoCAD:

1. Pick the **Close** button in the upper right corner of the AutoCAD window, or
2. Pick **File** then **Exit** in the menu bar, or
3. In the command window, use **quit** command.

AutoCAD cannot be closed if a command is still running (busy).

Hands on practice

1. Create new drawings with metric drawing settings using the following methods:
   (i) start from scratch
   (ii) use a wizard
   (iii) use an existing AutoCAD provided template
2. Familiarise yourself the AutoCAD interface.
3. Write down the tools which are available from the following commands in the menu bar:
   (i) Draw
   (ii) Modify
   (iii) Format
4. Move the cursor cross hairs to any toolbar, right-click on it. Find and pick **Object Snap**. Drag and dock the toolbar to the right of the drawing window.
5. Select the **Line** tool, then look at the command window and find out what you are prompted to do.
6. Close the AutoCAD session without saving.