

# CAD BASICS & TERMINOLOGY

## What is CAD?

CAD stands for Computer Aided Design, although you may also see it spelt CADD meaning Computer Aided Design and Draughting. Either way, at it's most basic level CAD is designed to replace the drawing board with a computer, printer or plotter and some CAD software. The CAD draughtsman can then draw on screen to a higher standard of precision and presentation than possible when drawing by hand, plot as many copies of the drawing as required and then save it for future alterations and prints.

## Who uses CAD?

Traditionally seen as a tool for architects and mechanical engineers CAD is now reaching a much broader market; our customers include landscape gardeners, office planners, surveyors, musical instrument manufacturers, police forces, cabin manufacturers, councils, educational establishments, telephone operators, waterboards and more. Because any good CAD system can be programmed and modified, tools and functions can be created for even the most unusual applications.

## Absolute and relative co-ordinates

CAD systems utilise a co-ordinate system to allow accurate scale drawing. The default co-ordinate system is absolute, whereby all the points in the drawing are referenced relative to an origin. The x co-ordinate runs from 0 to infinity left to right, while the y co-ordinate runs from 0 to infinity from bottom to top just like a sheet of graph paper. Relative co-ordinates define 0,0 not as a fixed point but as the last point defined, which can be useful when drawing an outline of an object where you know the dimensions of each side.

## Drawing Tools

CAD software achieves a high level of accuracy by providing the user with basic drawing tools such as line, polygon, circle, arc, bezier curve etc. The more advanced a CAD package is, the more tools it is likely to have to assist in the creation and modification of a drawing.

## Snaps modifiers and constraints

Snaps, modifiers or constraints are all different names for the same thing, from here on referred to as snaps. When drawing with CAD, precision is of the highest priority; if a line needs to originate at the end of another or in the exact centre of a circle it is not good enough to simply position the mouse as close as possible and click. Instead a snap is used to precisely attach the cursor to an appropriate point of an existing entity - different snaps exist to attach to endpoint, intersection, mid point, centre point etc. Because snaps are such a useful tool most CAD packages allow them to be initiated by pressing a function key. Visual CADD features 'Running Snaps' which allows any combination of the available snaps to be permanently triggered; when in close enough proximity to a snap triggering point a cursor preview appears to show the user the type of snap that is active. FastCAD 32 also has an attach mode where any one of it's snaps can be permanently switched on.

## Layers

A typical CAD drawing will be spread across several layers. Each layer can be thought of as a sheet of acetate with part of the drawing on it; for example floor plans, electrics, and dimensions can all be on separate layers.. A layer can be made visible or invisible, printable or non-printable or locked so that no changes can be made. In this way a variety of printouts can be achieved from the same drawing.

## Symbols

Thanks to CD-ROMs many modern CAD programs come with literally thousands of free symbols ranging from transistors to office furniture and plants. A symbol is a predrawn entity that can be called up and placed on the current drawing at any scale or angle; they can be included with a CAD program, easily created by the user or bought as a separate library. If you intend to make use of symbols be sure to buy a CAD system with a good symbol manager that lets you drag and drop symbols into the drawing, Visual CADD has a particularly good symbol manager that also lets you preview whole directories of symbols and set a scale and rotation for symbols before placing. Some CAD systems have recently made symbols intelligent! For example FastCAD32 v6 introduced 'Smart Symbols' which, when dragged towards a line, will align themselves with it and when placed will cut an appropriate sized gap in the line. Placing doors and windows in a wall is an example of the value of this feature.

## Macros and Scripts

Macros or Scripts are very basic programs that can be written by the user and called up with a keyboard shortcut. They can be used to combine several of the native CAD commands to speed up repetitive tasks. FastCAD32 v6 has a very good Macro interface whereas Visual CADD's is quite basic as the product is geared up to API programming.

## API Programs

The **Advanced Programmers Interface** allows anyone with a good knowledge of computer programming and CAD to add completely new tools to a CAD system or even write a whole new application that invisibly utilises the 'engine' of the CAD product. Visual CADD lends itself very well to API enhancement; find out about the toolkits we have produced [here](#) or, if you could use a specific function please contact us [here](#) to discuss the possibilities. If you have the ability to programme Visual CADD yourself, you can download tutorials and support files [here](#).

## Add-ons & Toolkits

Using the API feature described above third party developers such as ourselves have written off-the-shelf add-ons or toolkits for several CAD systems that can be used simply to add time saving and convenient functions or customise the product for a particular use - e.g. Mechanical drawings, Architectural drawings etc. Find out about our Visual CADD toolkits [here](#). Several FastCAD32 toolkits are also available; they have been divided into [add-ons](#) and the smaller [plug-ins](#).

## Raster to Vector Conversion

A CAD drawing is made up from lines and other entities defined mathematically, known as Vectors thus enabling rapid manipulation and scaling. Drawings input into a computer via a scanner are made up of millions of tiny dots, known as a raster format, and consequently incompatible with CAD software. Raster to vector conversion software changes one to the other and saves the result in a vector format that can be imported into a CAD program and manipulated as a normal drawing. Simple Raster to Vector conversion is included in Visual CADD and TurboCAD Professional. If however you want a more sophisticated raster to vector programme or your CAD system of choice does not include one, you can buy a separate product called [Trac Trix](#).

## Drawing Viewers

Any good CAD system should be accompanied by a drawing viewer which can be distributed within the company and sent out with drawings. Viewers allow persons within an organisation who do not have access to the CAD software to view and print out drawings; additionally some viewers can be freely sent to other businesses along with CAD drawings, thus negating the need to send large plots through the post when the recipients don't have a CAD system. Download free CAD drawing viewers [here](#).

## 2D or 3D

A traditional CAD package only allows the creation of two dimensional drawings (just like a drawing board) but some now include the ability to create 3 dimensional objects. This can be implemented by wire frame modelling where 3D objects are drawn in the normal manner except that Z co-ordinates are defined along with the X and Y. The CAD package must then be able to view the drawing from a number of angles and surfaces can then be applied to the wireframe to create what appears to be a solid object. Alternatively objects can be extruded - for example a circle can be converted into a cylinder - and these extruded objects can interact with each other using boolean functions. While both these methods are fine for very occasional and simple 3D work, a true solid modelling package allows creation of far more sophisticated entities with much less effort.

## Solid Modelling

Solid modelling is a more advanced way of creating 3D objects which are treated as actual solids which have a material, mass, weight, volume, centre of gravity etc. Objects are created by extruding 2D profiles or introducing primitive objects such as a cube or sphere. Boolean options can again be used but more advanced editing tools like chamfer and shell increase the usability of the product. A good solid modeller includes a number of rendering options to create realistic images of the models in a variety of materials, views and lighting conditions.

## Basic AutoCAD Terminology

Here are some basic terms that you will need to know to begin using AutoCAD. The terms in BLUE have links to give you more information.

<b>Absolute co-ordinates</b>	A way of inputting points based on AutoCAD's origin.
<b>Acad.dwt</b>	This is the default template that automatically loads whenever you start a drawing session. It can be customized.
<b>Associated Dimensioning</b>	Dimensions that are associated with specific points will update as that point is moved.
<b>Backup file</b>	AutoCAD can be set to automatically backup your drawing and save it. This is a safeguard in case your file gets corrupted. It is saved with a .BAK extension
<b>Block</b>	A pre-drawn image you can insert in your drawing to save time and make your file size smaller.
<b>Crosshairs</b>	This is your cursor when it is in the drawing space.
<b>Cursor</b>	Your cursor will change depending on where it is in the program.
<b>Database</b>	An AutoCAD drawing file is actually one large database containing all the information needed to reproduce the objects when the file is opened. Info for layers and linetypes, etc are stored in this manner.
<b>Dialog box</b>	AutoCAD uses a large number of dialog boxes to get information from you. You must know how input the information that it asks for.
<b>Drawing template file</b>	This is a file that contains preset values for frequently used settings. AKA a prototype drawing.
<b>Extents</b>	The outer boundaries of the objects you

	have drawn.
<b>Grid</b>	This is pattern of dots displayed on the screen to guide you. It can be toggled on and off by pressing the F7 key.
<b>Grips</b>	Small 'handles' on objects that allow for quick editing.
<b>Layer</b>	All objects are drawn on a layer. You can group objects (such as electrical) on a single layer and organize your drawing.
<b>Limits</b>	A setting to impose an 'artificial' boundary on your drawing and scale your text and dimensions, etc.
<b>Linetype</b>	All objects are drawn with a particular linetype. Examples would be solid, center, dashed, etc.
<b>Model space</b>	The drawing space where you 'model' the objects.
<b>Modify</b>	A generic term used for changing your objects
<b>Object</b>	Any item that is in the AutoCAD database. Also known as an entity.
<b>Origin</b>	The (0,0) point of your current co-ordinate system.
<b>Ortho mode</b>	This is a drawing mode that allows you to draw only perpendicular lines. It is toggled on and off by pressing the F8 key.
<b>Osnap - Object Snap</b>	This is a method of 'snapping' to certain, precise points on an object.
<b>Paper space</b>	An optional area used for plotting your drawings.
<b>Path</b>	The specific folder where AutoCAD looks for, or saves files.
<b>Pick</b>	To select an object by 'left-clicking' on it.

<b>Plot</b>	Also known as print. To make a hard copy of your drawing.
<b>Polar co-ordinates</b>	A way of inputting points based on distance and angle.
<b>Property</b>	Any specific characteristic of an object such as layer, scale, linetype, start point, etc.
<b>Relative co-ordinates</b>	A way of inputting points based on a starting point.
<b>Selection set</b>	The current group of objects selected for modifying.
<b>Snap</b>	This is a drawing mode that allows you to snap your cursor to precise points laid out in a grid pattern. Toggle with the F9 key.
<b>Styles</b>	Formatting that defines the look of text, dimensions, etc.
<b>Units</b>	The basic drawing unit set for you drawing. For example, you can use inches or millimeters depending on your needs. You can also set the precision you want displayed, such nearest 1/4", 1/2" 1/64", etc.
<b>User co-ordinate system (UCS)</b>	Modifications made to the World Co-ordinate System (WCS) results in a User Co-ordinate System (UCS)
<b>View</b>	A particular area of your drawing.
<b>Viewport</b>	A separate 'window' on your drawing. You may have more than one viewport visible to see different areas of your drawing at the same time.
<b>Wizard</b>	An easy step-by-step instruction set to help you set-up certain aspects of your drawing.
<b>World Co-ordinate System (WCS)</b>	This is the common X-Y co-ordinate system that is the default. If it is modified, it becomes a User co-ordinate System (UCS)

<b>Zoom</b>	To view either a smaller section of your drawing (zoom in) or a larger section (zoom out)
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### 3-D CAD TERMINOLOGY

<b>2-D</b>	A concept of displaying real-world objects on a flat surface showing only height and width. This system uses only the X and Y axes.
<b>3-D</b>	A way of displaying real-world object in a more natural way by adding depth to the height and width. This system uses the X Y and Z axes.
<b>Boolean operations</b>	Commands that allow you to add, subtract or intersect solid objects in AutoCAD.
<b>Complex surface</b>	Generally a curved surface. Examples: car fender, landscape contour.
<b>Elevation</b>	The difference between an object being at zero on the Z-axis and the height that it is above zero.
<b>Face</b>	The simplest true 3-D surface.
<b>Facet</b>	A three or four sided polygon that represents a piece (or section) of a 3-D surface.
<b>Hidden line removal</b>	A way of hiding lines that would not be visible if you were viewing the actual object you have drawn in AutoCAD. (Command: <code>HIDE</code> )
<b>Isometric Drawing</b>	A simple way of achieving a '3-D' appearance using 2-D drawing methods.
<b>Plan View</b>	Also known as the top view, a plan view looks directly down the WCS Z-axis to the X-Y axis.
<b>Primitive</b>	A basic solid building block. Examples would be boxes, cones, cylinders.
<b>Region</b>	A 2-D area consisting of lines, arcs, etc.
<b>Rendering</b>	A complex way of adding photo-realistic qualities to a 3-D model you have created.

<b>Shading</b>	A quick way of adding color to a 3-D object you have drawn. (Command: <code>SHADE</code> )
<b>Solid Model</b>	A 3-D model creating using solid 'building blocks'. This is the most accurate way of representing real-world objects in CAD.
<b>Surface Model</b>	A 3-D model defined by surfaces. The surface consists of polygons. (See facets.)
<b>Thickness</b>	A property of lines and other objects that gives them a 3-D like appearance.
<b>UCS</b>	The user co-ordinate system. This is defined by the person drawing to have easier access to portions of a 3-D model.
<b>View</b>	A particular view of the object you have created.
<b>Viewport</b>	A window into your drawing showing a particular view. You can have several viewports on your screen.
<b>Wire-frame Model</b>	A 3-D shape that is defined by lines and curves. A skeletal representation. Hidden line removal is not possible with this model.
<b>Z-Axis</b>	The third axis that defines the depth.