CAD Professional
Sample Material
# VS-1065

1. INTRODUCTION TO CAD

Computer-aided design (CAD) is the use of computer systems to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. The term CADD (for Computer Aided Design and Drafting) is also used.

1.1. Basics of CAD

The evolution of the informatics has increasing influence in every field of the our life, so the engineering is not mean exception. The work of engineers is changing, we can solve more complex problems, but the different software tools ensure effective and productive work.

CAD may be used to design curves and figures in two-dimensional (2D) space; or curves, surfaces, and solids in three-dimensional (3D) space.

CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more. CAD is also widely used to produce computer animation for special effects in movies, advertising and technical manuals, often called DCC digital content creation. The modern ubiquity and power of computers means that even perfume bottles and shampoo dispensers are designed using techniques unheard of by engineers of the 1960s. Because of its enormous economic importance, CAD has been a major driving force for research in computational geometry, computer graphics (both hardware and software), and discrete differential geometry.
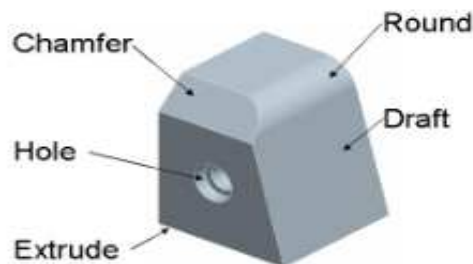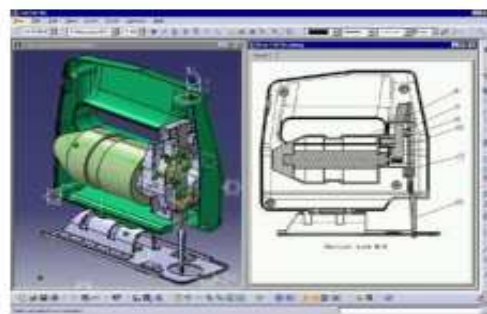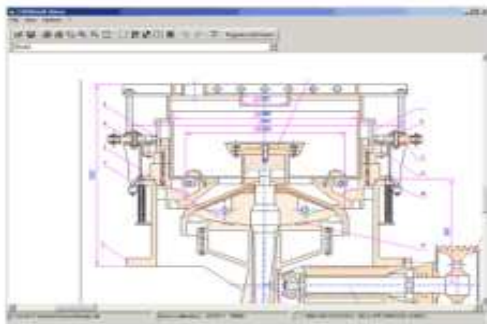
A CAD system can be a simple 2D drawing system or a parametric associative hybrid modelling system. The up-to-date method is this last concept, where
✓ the parametric means the dimension driven modelling,
✓ the associative means the live connection between the geometric elements,
✓ the hybrid means the parallel and synergic surface and solid modelling.

CAD Classification

The CAD systems can be classified by several viewpoint
✓ The first is the application field. The CAD systems are developed in every industrial areas, so we can find systems in the field of mechanical engineering, electric engineering, architectural design, civil engineering, cloth and shoe design, medical application.
✓ The type of the modelling can be 2D, when the representation of the part is similar to the engineering drawing. The other method is the 3D modelling, when the model of the part is build in the virtual space.
✓ The applied modelling method can be wireframe modelling, when only the edges of the part are defined. In case of surface modelling the CAD model is hollow, only the boundary „skin" is defined. The solid modelling ensures realistic representation, the model consists of simple elementary elements.
✓ In case of parametric model, the size of the model is driven by the geometric parameters. The size of a non-parametric model is defined by user's modelling activity and the dimensioning value is driven by the modelled object.

CAD Application

The typical application fields are
✓ Mechanical engineering
✓ Electronic design
✓ Architectural design
✓ Civil engineering
✓ Textile industry
✓ Medical

Product Creation and Development

The new product creation process consists of four main step.
✓ The first is the product development, when the full design documentation is produced based on the market, customer and financial requirements.
✓ The production needs manufacturing equipments, like tools, machine tools, moulds etc. And if there are no exist, we have to design them. Then the manufacturing equipments have to purchase or create, which sometimes need lot of time and it has a high cost.
✓ The last step is the production, which means part production and assembly.
✓ As the figure shows, some sub-processes can be performed with overlapping in order to reduce the lead time.
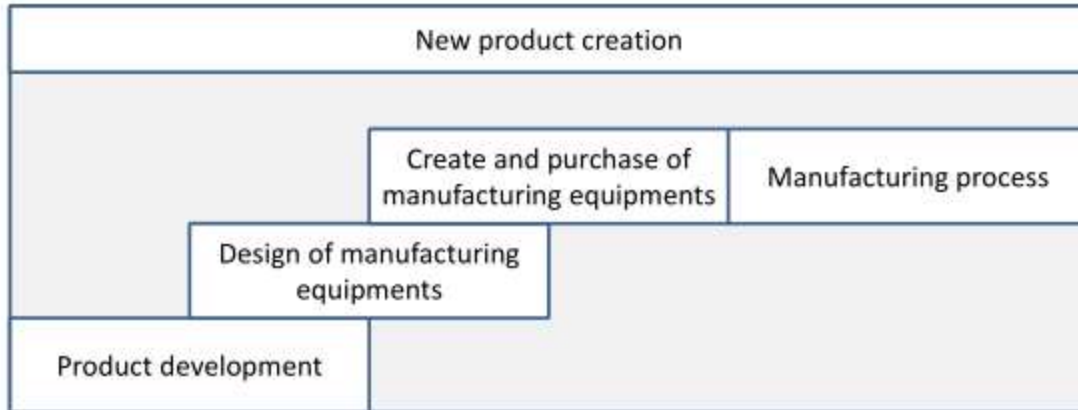
The steps of the product development are the next in general case
- ✓ Creation of product concept. The function, engineering, quality, market and other requirements are collected in order to define the aim of the development.
- ✓ Conceptional design. The possible solution of each requirements are summarized.
- ✓ Synthesis. Unite the separated elements.
- ✓ Design assessment. The result is investigated in order to check, than it is suitable for the initial requirements.
- ✓ Detail design. The details of the product are designed.
- ✓ Analysis of the design. The product design is complete for analysis and every of important properties can be tested.
- ✓ Documenting. The result of the design process is the full design documentation.
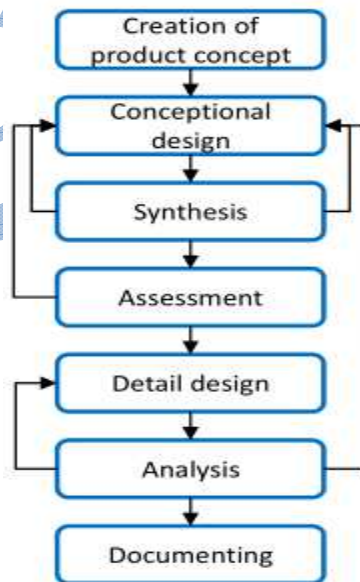
CAx Technologies

The product development and production process is supported by computer software. The name of this technology is CAx – computer aided something. These software tools support the specific engineering activities. The help of the computer means different things. In case of manufacturing the CNC programs are generated by a CAM system, the CAE means the collection of every

engineering analysis and calculation. The task of the CAPP is to generate a process plan for manufacturing. The CAQA is the programming of coordinate measurement machines in general.

The most often used abbreviations are the next:
- ✓ CAD – computer aided design
- ✓ CAM – computer aided manufacturing
- ✓ CAE – computer aided engineering
- ✓ CAPP – computer aided process planning
- ✓ CAQA – computer aided quality assurance
- ✓ CAPPS – computer aided production planning and scheduling
- ✓ CAST – computer aided storage and transport

1.2. Geometric Elements

Coordinate System

In geometry, a coordinate system is a system which uses one or more numbers, or coordinates, to uniquely determine the position of a point or other geometric element. Various coordinate systems, are

Number line - The simplest example of a coordinate system is the identification of points on a line with real numbers using the number line. In this system, an arbitrary point O (the origin) is chosen on a given line. The coordinate of a point P is defined as the signed distance from O to P, where the signed distance is the distance taken as positive or negative depending on which side of the line P lies. Each point is given a unique coordinate and each real number is the coordinate of a unique point.
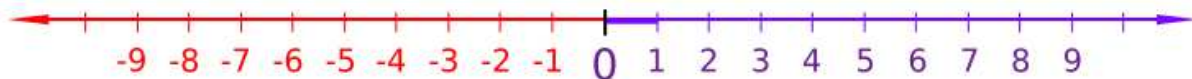
Cartesian coordinate system - The prototypical example of a coordinate system is the Cartesian coordinate system. In the plane, two perpendicular lines are chosen and the coordinates of a point are taken to be the signed distances to the lines.

In three dimensions, three perpendicular planes are chosen and the three coordinates of a point are the signed distances to each of the planes. This can be generalized to create n coordinates for any point in n-dimensional Euclidean space.
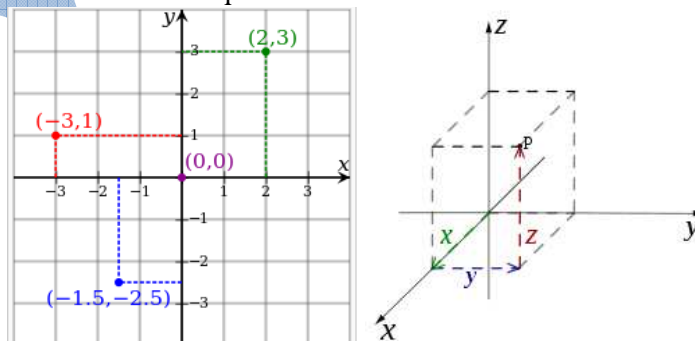
Everything that you draw in AutoCAD is exact. It will be more accurate than you will ever need it to be. All objects drawn on the screen are placed there based on a simple X,Y co-ordinate system.

In AutoCAD this is known as the World Co-ordinate System (WCS). You must understand this to know how to put things where you want them. (3-D work has an added axis, the Z-axis)

AutoCAD uses points to determine where an object is located. There is an origin where it begins counting from. This point is (0,0). Every object is located in relation to the origin. If you were to draw a line straight out to the right from the origin, this would be considered the positive X-axis. If you were to draw a line straight up, this would be the positive Y-axis. The picture above shows a point located at (9,6). This means that the point is 9 units over in the X-axis and 6 units up in the Y-axis. When you are working with points, X always comes first. The other point shown is (-10,-4). This means that the point is 10 units in the negative X-axis (left) and 4 units in the negative Y-axis (down).

A line has two points, a start point and an end point. AutoCAD works with the points to display the line on the screen. Move your cursor over the picture above and you will see line drawn from the absolute points of (-10,-4) to (9,6).

Most of the time you will not have an indication of where the origin is. You may need to draw a line from the endpoint of an existing line. To do this you use relative points. These work the same way, but you have to add the @ symbol (shift+2) to tell AutoCAD that this next point is relative from the last point entered.

Polar coordinate system - Another common coordinate system for the plane is the polar coordinate system. A point is chosen as the pole and a ray from this point is taken as the polar axis. For a given angle θ, there is a single line through the pole whose angle with the polar axis is θ (measured counterclockwise from the axis to the line). Then there is a unique point on this line whose signed distance from the origin is r for given number r. For a given pair of coordinates (r, θ) there is a single point, but any point is represented by many pairs of coordinates. For example, (r, θ), (r, θ+2π) and (−r, θ+π) are all polar coordinates for the same point. The pole is represented by (0, θ) for any value of θ.

AutoCAD measures angles in a particular way also. Look at the diagram below and then place your mouse on it to see how this is done. When drawing lines at an angle, you have to begin measuring the angle from 0 degrees, which is at the 3 o'clock position. If you drew a line at 90 degrees, it would go straight up. The example above (when you move your mouse over it) shows a line drawn at +300 degrees (270+30), or -60 degrees.
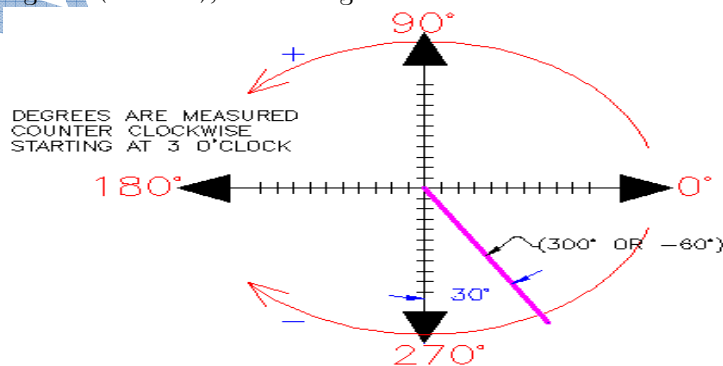
You might not always have an obvious reference point for 0 degrees. The image shows the angle for 30 DEGREES
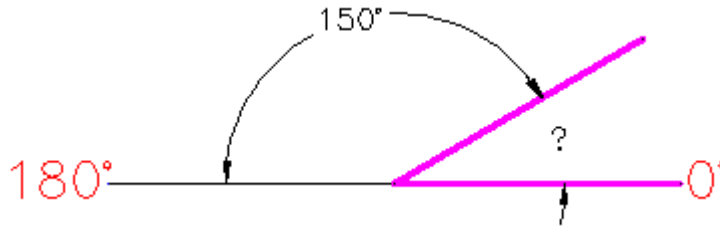

In this example, you are given information about the lines, but not the angle AutoCAD needs to draw the line from the start point. What you are given though, is (a) the knowledge that 0° is at the 3 o'clock position (b) the knowledge that 180° is at the 9 o'clock position and (c) the angle between 180° and the line you want to draw is 150°. With this information, you can figure out what angle you need. Here is a fool-proof way of getting the angle you need:

✓ Start at the 0° position and measure counter-clockwise (+) to 180°.
✓ From 180°, measure clockwise 150°.
✓ Consider that you just went +180-150 and use that as an equation: +180-150=30
✓ Now you can draw your line using polar co-ordinates

Point

In a CAD system in the 3D virtual space the geometric elements are represented in a Descartian coordinate system by x, y, and z values.

The simplest geometric element is the point, which is used as datum elements in a CAD modelling. The representation of a point is done by the 3 coordinate value.

$$r = x_1 \cdot i + x_2 \cdot j + x_3 \cdot k = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$
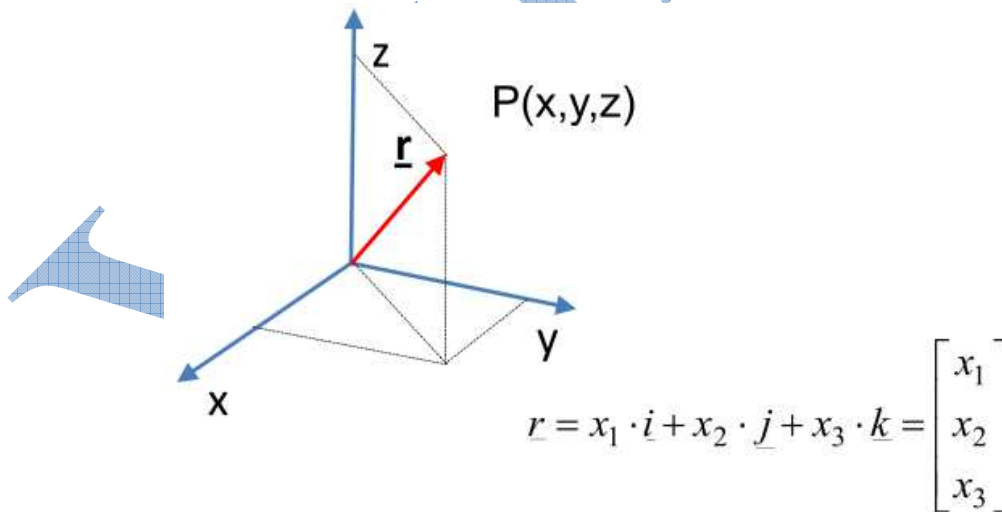
You can enter points directly on the command line using three different systems. The one you use will depend on which is more applicable for the situation. The first assignment will get you used to this. The three systems are as

✓ Absolute co-ordinates - Using this method, you enter the points as they relate to the origin of the WCS. To enter a point just enter in the exact point as X,Y.

- ✓ Relative co-ordinates - This allows you to enter points in relation to the first point you have entered. After you've entered one point, the next would be entered as @X,Y. This means that AutoCAD will draw a line from the first point to another point X units over and Y units up relative to the previous point.
- ✓ Polar co-ordinates - You would use this system if you know that you want to draw a line a certain distance at a particular angle. You would enter this as @D<A. In this case, D is the distance and A is the angle. Example: @10<90 will draw a line 10 units straight up from the first point.

Certifications

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– Certified AML-KYC Compliance Officer
– Certified Business Accountant
– Certified Commercial Banker
– Certified Foreign Exchange Professional
– Certified GAAP Accounting Standards Professional
– Certified Financial Risk Management Professional
– Certified Merger and Acquisition Analyst
– Certified Tally 9.0 Professional
– Certified Treasury Market Professional
– Certified Wealth Manager

Big Data
– Certified Hadoop and Mapreduce Professional

Cloud Computing
– Certified Cloud Computing Professional

Design
– Certified Interior Designer

Digital Media
– Certified Social Media Marketing Professional
– Certified Inbound Marketing Professional
– Certified Digital Marketing Master

Foreign Trade
– Certified Export Import (Foreign Trade) Professional

Health, Nutrition and Well Being
– Certified Fitness Instructor

Hospitality
– Certified Restaurant Team Member (Hospitality)

Human Resources
– Certified HR Compensation Manager
– Certified HR Stafffing Manager
– Certified Human Resources Manager
– Certified Performance Appraisal Manager

Office Skills
– Certified Data Entry Operator
– Certified Office Administrator

Project Management
– Certified Project Management Professional

Real Estate
– Certified Real Estate Consultant

Marketing
– Certified Marketing Manager

Quality
– Certified Six Sigma Green Belt Professional
– Certified Six Sigma Black Belt Professional
– Certified TQM Professional

Logistics & Supply Chain Management
– Certified International Logistics Professional
– Certified Logistics & SCM Professional
– Certified Purchase Manager
– Certified Supply Chain Management Professional

Legal
– Certified IPR & Legal Manager
– Certified Labour Law Analyst
– Certified Business Law Analyst
– Certified Corporate Law Analyst

Information Technology
– Certified ASP.NET Programmer
– Certified Basic Network Support Professional
– Certified Business Intelligence Professional
– Certified Core Java Developer
– Certified E-commerce Professional
– Certified IT Support Professional
– Certified PHP Professional
– Certified Selenium Professional
– Certified SEO Professional
– Certified Software Quality Assurance Professional

Mobile Application Development
– Certified Android Apps Developer
– Certified iPhone Apps Developer

Security
– Certified Ethical Hacking and Security Professional
– Certified Network Security Professional

Management
– Certified Corporate Goverance Professional
– Certified Corporate Social Responsibility Professional

Life Skills
– Certified Business Communication Specialist
– Certified Public Relations Officer

Media
– Certified Advertising Manager
– Certified Advertising Sales Professional

Sales, BPO
– Certified Sales Manager
– Certified Telesales Executive

& many more job related certifications

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