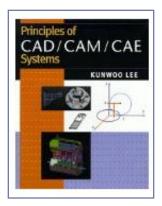
Computer Aided Design & Manufacturing MSc. Course / Production Engineering

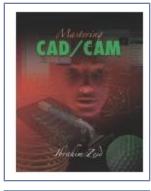
Dr. Laith Abdullah Mohammed

Dep. of Production Eng. & Metallurgy University of Technology, Baghdad, Iraq

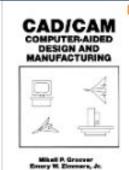
References:



Principles of CAD/CAM/CAE By: Kunwoo Lee 1999



Mastering CAD/CAM (Engineering Series) By: Ibrahim Zeid 2004



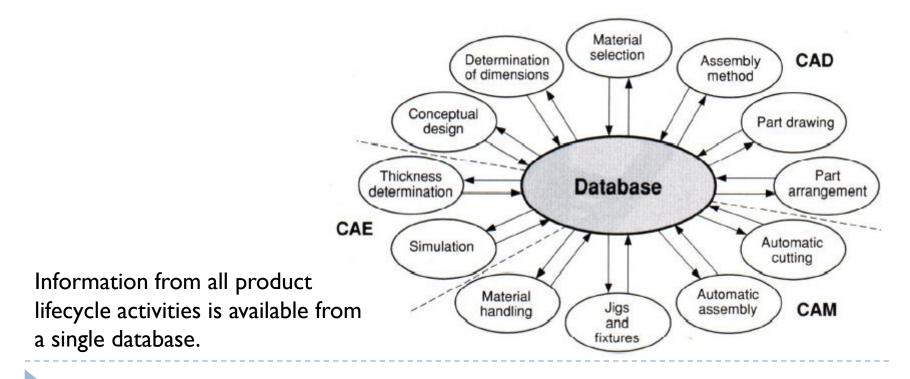
CAD/CAM: Computer-Aided Design and Manufacturing By: M. Groover and E. Zimmers 1983

Basic Definitions:

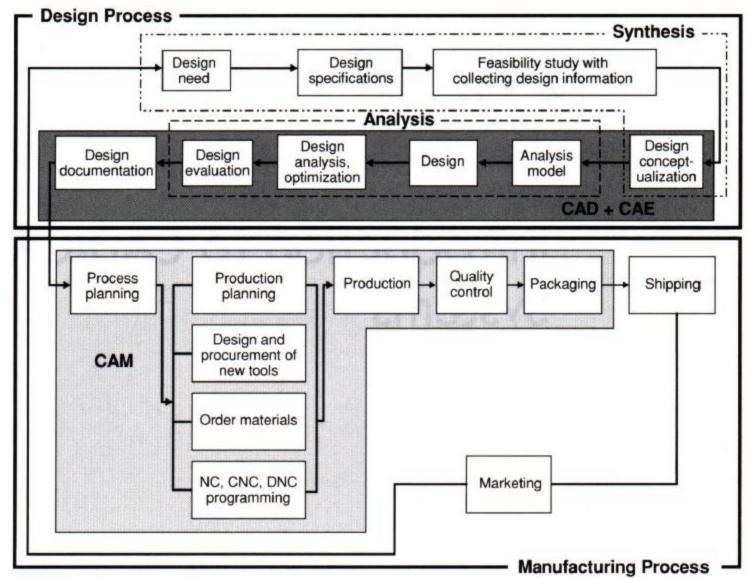
Computer-Aided Design (CAD) is the technology concerned with the use of computer systems to assist in the creation, modification, analysis, and optimization of a design.

Computer-Aided Manufacturing (CAM) is the technology concerned with the use of computer systems to plan, manage, and control manufacturing operations.

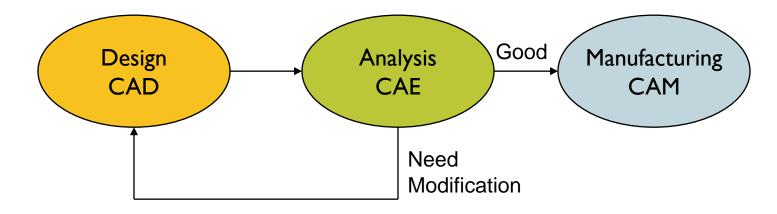
Computer-Aided Engineering (CAE) is the technology concerned with the use of computer systems to analyze CAD geometry, allowing the designer to simulate and study how the product will behave.

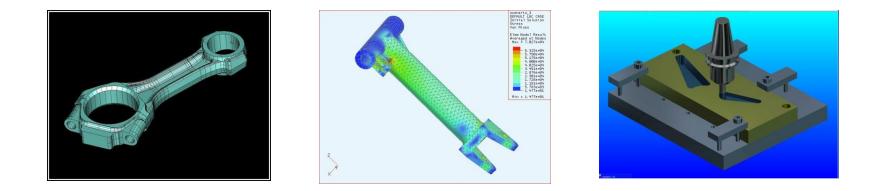


Typical Product Life Cycle



Simple CAD/CAE/CAM Product Lifecycle





CAD/CAM : It is the technology concerned with the use of computers to perform design and manufacturing functions.

Manufacturing Methods

Net shape

- Plastics (Injection Molding)
- Bulk Deformation
 - (Forging, Rolling, Extrusion, Drawing)
- Sheet Metal
- Casting
- Powder Metallurgy (P/M)
- Ceramic Forming

<u>Machining</u>

Cutting with single or multipoint tools (Mills, Lathes, Saws....)
Abrasive processes- (Grinding)
"Non-traditional" machining- (EDM, ECM, Laser, Electron Beam, Water Jet)

Joining

Weld, Braze, Solder
 Adhesion (Glue, Epoxy...)
 Mechanical Fasteners

Computer Aided Design

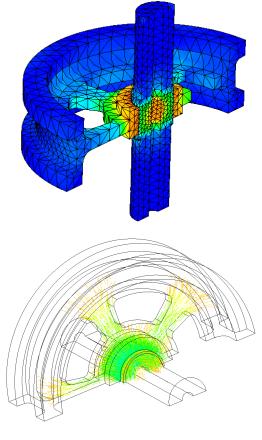
- In industry, CAD refers to any computer software that is used to produce high quality drawings and models which meet exact specifications.
- CAD software is often then linked to machinery to perform a task to manufacture part of or a whole product; this is known as CAM (Computer Aided Manufacture).

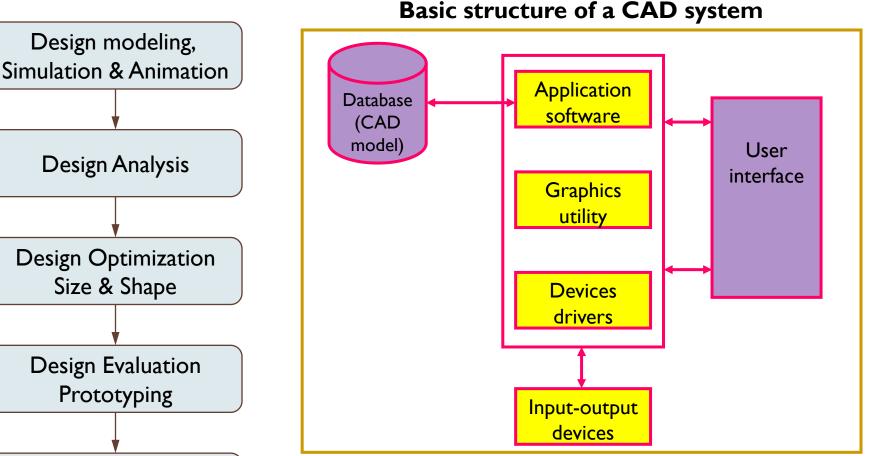
• Typical tools in CAD:

- Tolerance analysis
- Mass property calculations: Curve length, Mass, Center of mass, First moment of inertia, Products of intertia, Surface area, Volume, Centroid of a volume, Center of surface area, Cross sectional area.
- Finite-element modeling and visualization.

A CAD system consists of three major parts:

- Hardware: computer and input/output devices.
- Operating system software.
- Application software: CAD package.





 \succ The application software is at the top level and is used to manipulate the CAD model database.

 \succ The graphics utility system performs the coordinate transformation, windowing, and display control.

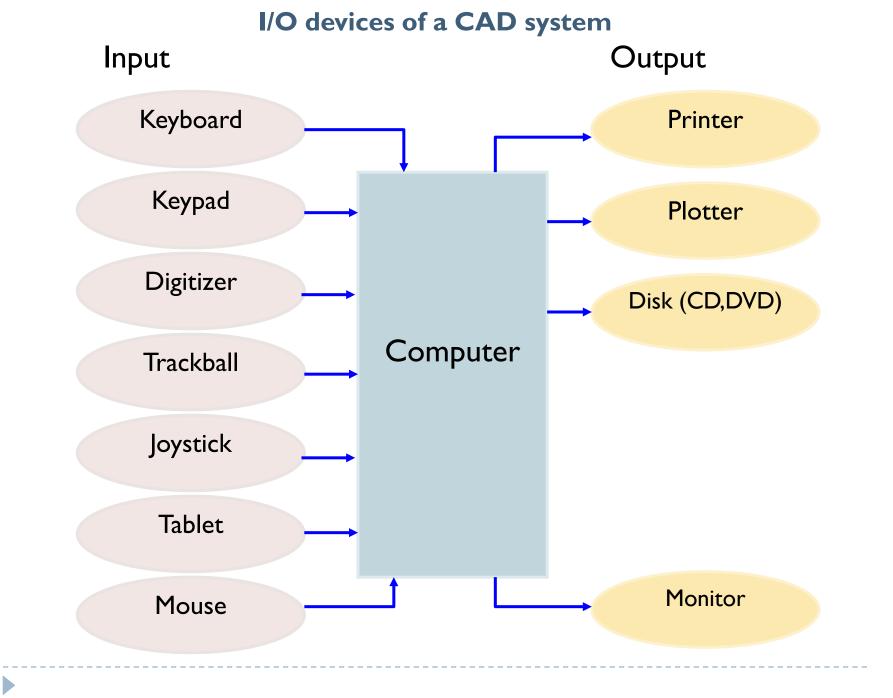
>Devices drivers are used to translate the data into and out of the specific format used by each device , they also control the devices.

 \succ The operating system is run in background to coordinate the entire operations.

>User interface links the human and the system.

Design Documentation

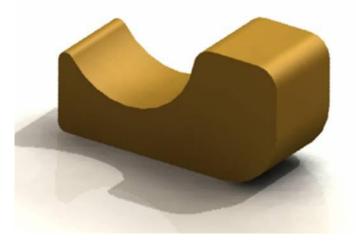
The CAD Process



Mass Properties – CAD/CAM Systems

CAD systems typically calculate the mass properties, the user is responsible for setting up the correct and units for length, angles and density.

Example: SolidWorks



Determine the mass properties

DrawCompare... SolidWorks Explorer... COSMOSXpress... MoldflowXpress... Invert Selection Sketch Entities Sketch Tools Sketch Settings Blocks Spline Tools Dimensions Relations Measure... Mass Properties... <u>রু</u> Section Properties... Check... Feature Statistics...

🗊 Mass Properties			×
Print Copy	Close Options	. Recalculate]
Output coordinate system:	default	~	-
Selected items:	Part1.SLDPRT		
Include hidden bodies/comp	oonents		
Show output coordinate sys	stem in corner of window		
Assigned mass properties			
Mass properties of Part1 (Part	Configuration - Default)		^
Output coordinate System: o	default		
Density = 0.31 pounds per cubi	ic inch		
Mass = 0.83 pounds			
Volume = 2.69 cubic inches			
Surface area = 13.58 inches^2	6		
Center of mass: (inches) X = 1.63 Y = 0.59 Z = 0.50			
Principal axes of inertia and prin Taken at the center of mass. Ix = $(0.97, 0.26, 0.00)$ Iy = $(-0.26, 0.97, 0.00)$ Iz = $(0.00, 0.00, 1.00)$	Px = 0.17	ounds * square inc	
Moments of inertia: (pounds * Taken at the center of mass an Lxx = 0.20 Lyx = 0.12 Lzx = 0.00	square inches) d aligned with the output coo Lxy = 0.12 Lyy = 0.61 Lzy = 0.00	rdinate system. Lxz = 0.00 Lyz = 0.00 Lzz = 0.67	~
<		>	.:

Mass Properties -SolidWorks

Option button allows to set the proper units

Mass/Section Property Options
Units Units Scientific Notation Use document settings Use custom settings
Length: Decimal places:
Inches 💟 2
Mass:
pounds 💌
Per unit volume:
inches^3
Material Properties Density: 0.00855309 g/mm^3
Accuracy level Default mass/section property precision Maximum property precision (Slower)
OK Cancel Help

Useful Software & Internet Resources



Version 7.10.0.499 (R2010a) 64-bit (win64) February 5, 2010 License Number: 161051

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The Language of Technical Computing

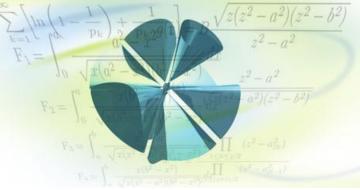
http://www.solidworks.com/

http://www.mathworks.com/



http://www.mastercam.com/

Wolfram MathWorld[™] the web's most extensive mathematics resource



http://mathworld.wolfram.com/

Assignment:

Write a brief report about one of the CAD/CAM software

- I. OneCNC
- 2. SURFCAM
- 3. EdgeCAM
- 4. EZ-CAM
- 5. AlphaCAM
- 6. CATIA
- 7. IronCAD
- 8. Pro/Engineer
- 9. SolidEdge
- 10. CAMWorks

- II. Delcam
- 12. Bob CAD/CAM
- **I3. ESPRIT**
- 14. GibbsCAM
- 15. Vero software
- 16. Cimatron
- 17. TopSolid
- 18. Dolphin CAD/CAM
- 19. RhinoCAM
- 20. Visual Mill