

An Overview of AutoCAD Design and Drafting System

1. AutoCAD Functions

Basic AutoCAD Electric Drafting Functions

- 2-D Drafting (Mechanical, Electrical, Architectural, etc.)
Lines, circles, arcs, polylines, rectangles, polygons, splines, points, texts, and area hatching
- 3-D Modeling
Wireframe modeling, surface modeling, and solid modeling
 - 3-D primitives including boxes, wedges, cones, cylinders, spheres, and toruses; extruded and revolved solids from 2-D objects, and
 - Boolean operations to the 3-D objects including union, subtraction, and intersection).
- Operations to 2-D and 3-D Objects
Moving, rotating, copying, mirroring, and erasing.
- Viewing
Zooming and panning, multiple viewport generation, user coordinate system (UCS) definition, and viewing direction selection.
- Dimensioning and Tolerancing
Linear dimensions, angular dimensions, radius dimensions, diameter dimensions, baseline dimensions, continuous dimensions, leaders, and size and geometric tolerances.
- 3-D Images
Wireframe images, hidden line images, shading images, and rendering images.
- Organization of Objects
Layers, colors, linetypes, groups, blocks, attributes, and references.
- Plotting
Generation of PostScript files.

Data Exchange

- IGES Interface – a module of AutoCAD to read and to output graphics data into a data file in the standard (ISO and ANSI) IGES format. The IGES format was introduced for graphics data communication among various CAD/CAM systems.
- Functions of AutoLISP, ADS and API – accessing AutoCAD database.
- DXF File Format – AutoCAD drawing exchange format.

AutoCAD Interface Environment

The user's interface of AutoCAD consists of a graphics window and a text window.

Graphics Window

When you start with a drawing the AutoCAD graphics window will show up. The five primary areas of the AutoCAD graphics window are as follows:

- MenuBar -- AutoCAD's pull-down menus are accessed through the menu bar.
- StatusBar -- The status bar provides status information including color, layer, coordinate display, and so on.
- Drawing Area -- The center area, called the drawing area, is the area in which you draw.
- Screen Menu -- The screen menu was AutoCAD's original menu interface, but is now primarily used for option selection.
- Command Line -- The command line is the area where you enter commands and options from the keyboard. The command line prompts you for input and provides status on the results of AutoCAD commands, even when those commands are issued by the menus.

AutoCAD has hundreds of commands, most of which feature numerous options. Almost all these commands relate to specific functions, such as drawing, editing, or dimensioning. Because it is difficult to remember the hundreds of AutoCAD commands with all their options and modifiers, the menu system offers an efficient alternative. AutoCAD's menu is organized for simple navigation through the software. All menu items are organized in a hierarchical data structure.

Text Window

AutoCAD has a text window that displays a full window of command line text. You can switch back and forth between the graphics window and text window.

Interactive Graphics Programming

Most modern CAD programs offer some capabilities to program additional commands, or to write programs with available functions. AutoCAD Release 12 & 13 support three different programming environments: AutoLISP, AutoCAD Development System (ADS), and AutoCAD Runtime Extension (ARX).

- **AutoLISP** – AutoLISP is an implementation of the LISP programming language (an interpreter) embedded within AutoCAD. This interactive programming language in AutoCAD allows you to program external applications, using the AutoCAD drawing generation and manipulation functions for 2D geometry, 3D wireframe structures and 3D curved surfaces. Customizing AutoCAD into a more useful tool for your particular application can be done using AutoLISP programs. The AutoLISP language retains most of the general LISP functions. In addition, a group of database access functions are provided, and most AutoCAD commands can be called as AutoLISP functions. Since AutoLISP is an interpreter, it can be debugged by typing a line of the program and inspecting the results. It is also slow to run due to the need for on-line interpreting.
- **AutoCAD Development System (ADS)** – ADS is an implementation of the C programming language (a compiler) embedded within AutoCAD. Functionally equivalent to AutoLISP, this interactive programming language in AutoCAD allows

you to program external applications, using the AutoCAD drawing generation and manipulation functions for 2D geometry, 3D wireframe structures and 3D curved surfaces. Customizing AutoCAD into a more useful tool for your particular application can be done through ADS C programming. The ADS language retains most of the general C functions. In addition, a group of database access functions are provided, and most AutoCAD commands can be called as ADS functions. Since ADS is a C compiler, running the pre-compiled binary codes leads to faster program execution.

In the release 12 of AutoCAD, interactive graphical programming of 3D Solid Models was supported by the AutoCAD *Application Programming Interface (API)*. API is an implementation of the C programming language (a compiler) embedded within the AutoCAD AME Solid Modeling module. The API environment allows you to program advanced external applications, using the AME 3D model generation and manipulation functions. The API language retains most of the general C functions. In addition, a group of database access functions are provided, and most AME modeling and manipulation commands can be called as API functions. The API library serves as a simple translator, translating a function call into the concurrently running ADS through the *ads_invoke* call and passing results back. At present, the functions supported by AutoCAD (release 12) API is part of the *AutoCAD Development System (ADS)*.

- **AutoCAD Runtime Extension (ARX)** – An ARX application is a dynamic link library (DLL) that shares AutoCAD's address space and makes direct function calls to AutoCAD. Designed with extensibility in mind, the ARX libraries include macros to facilitate defining new classes and offer the ability to add functionality to existing classes in the library at run time. The ARX libraries can be used in conjunction with the AutoCAD Development System (ADS) and the AutoLISP application programming interfaces.

The ARX programming environment provides an object-oriented C++ application programming interface that enables developers to use, customize, and extend AutoCAD. The ARX libraries comprise a versatile set of tools for application developers to take advantage of AutoCAD's open architecture, providing direct access to AutoCAD database structures, the graphics system, and native command definition. In addition, these libraries are designed to work in conjunction with the AutoLISP and AutoCAD Development System (ADS) application programming interfaces so that developers can choose the programming tools best suited to their needs and experience.

- **Extended Applications** – Many third party application programs, interfaced to AutoCAD, have been developed for dedicated applications.

Manuals and References

- AutoCAD Documentation (from *AutoCAD Release 13 Documentation Guide*, Autodesk, 1995)
A set of the manual is available in the Design Lab.
- On-line Reference and Learning Support.
Access context-sensitive hypertext **Help** resources, including the AutoCAD Release 13 Command Reference. Easily learn basic features through "Quick

Tour" and an interactive tutorial. "What's New" illustrates new features in Release 13. Use key words to access and search AutoCAD manuals on-line.

2. The Major Differences between AutoCAD Release 11 and 13

ENGR150 was offered using AutoCAD R11. At present the department Design Laboratory has AutoCAD R13, and the UNIX workstations in the Faculty of Engineering Undergraduate Laboratory is loaded with AutoCAD R12 – the last AutoCAD release that Autodesk provides on a UNIX platform. The most recent products from Autodesk include AutoCAD R14 and Mechanical Desktop 2.0.

Mechanical Desktop consists of AutoCAD, AutoCAD Vision, AutoSurf, AutoCAD Designer and AutoCAD IGES Translator.

Autodesk made some progress between AutoCAD Release 11 and 13 both in its modeling capability and programming flexibility. In terms of modeling capability, the newer release offers a family of mechanical design products from 2D drafting/design and 3D product modeling to integrated design-through-manufacturing applications. The newer release Autodesk product offers the following functions:

- Improved 2D Drafting/Design and 3D Solid Modeling capability – *AutoCAD R14* has a more powerful solid modeler, and supports new features such as automatic shelling, variable radius blends and parametric Boolean. It utilizes the Window interface and supports the *AutoCAD Runtime Extension (ARX)* system-level programming environment. Some of these functions are included in R13.
- 3D Product Modeling – *AutoCAD Mechanical Desktop* integrates 2D drafting/design with 3D solid, surface, and assembly modeling, thus supporting broader applications.
- 3D Solid Modeling – *AutoCAD Designer* extends AutoCAD by adding 3D feature-based, solid modeling and assembly modeling.
- 3D Surface Modeling – *AutoSurf* extends AutoCAD by adding NURBS modeling.
- Data Translation – *AutoCAD IGES Translator* transfers data from other CAD systems to AutoCAD and Mechanical Desktop.
- Standard Components/Materials – Autodesk *Mechanical Library* includes PartSpec and MaterialSpec CD-ROM-based parts and materials libraries.
- Web-Based Parts – *Catalog PartSpec Online* access a Web-based catalog with over 400,000 pre-drawn parts and 35,000 materials.
- Viewing/Redlining Software -- Autodesk *View* allows viewing, redlining, and annotation of Mechanical Desktop and AutoCAD software files.
- Design-through-Manufacturing -- Through the *Mechanical Applications Initiative (MAI)*, Autodesk is working with top mechanical application developers to develop new software that can automate the complete engineering process, including finite-element analysis, dynamic simulation, NC programming, etc. These *MAI partner applications* add integrated design-through-manufacturing capabilities to Mechanical Desktop.