TVET CERTIFICATE IV INWELDING

COMPUTER AIDED DESIGN

WELDCD 401

Apply CAD

Competence

Credits: 12

Learning hours: 120

Sector: Mining and Manufacturing.

Sub-sector: Welding.

Module Note Issue date: June, 2020

Purpose statement

This general module describes the performance outcomes, skills and knowledge required to make part modelling, views, sections, assembly and upgrade the hand drafting documentation skills with AutoCAD and Solid works CAD software. Additionally, this is module is useful to support learning within the specialization of some core modules.

Table of Contents

Total Number of Pages: 98

Learning Unit 1 – Analyze the CAD work.

LO 1.1 – Introduce CAD.

Content/Topic 1: Definition and History of Computer Aided Design (CAD).

CAD (computer-aided design) software is used by architects, engineers, drafters, artists, and others to create precision drawings or technical illustrations. CAD software can be used to create two-dimensional (2-D) drawings or three-dimensional (3-D) models.
CAD is the use of computer software to design and document a product's design process. Engineering drawing entails the use of graphical symbols such as points, lines, curves, planes and shapes. Essentially, it gives detailed description about any component in a graphical form.
The beginnings of CAD can be traced to the year 1957, when Dr. Patrick J. Hanratty developed PRONTO, the first commercial numerical-control programming system. In 1960, Ivan Sutherland MIT's Lincoln Laboratory created SKETCHPAD, which demonstrated the basic principles and feasibility of computer technical.

In most engineering and archectural offices drafters and designers produce technical drawing using CAD systems . A CAD system consists of a personal computer (PC) or workstation coupled with a CAD software program, One of the most widely used CAD software program is called AutoCAD.

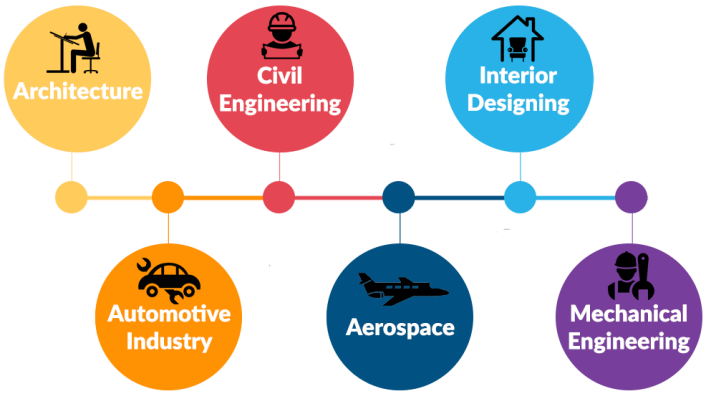
When AutoCAD was introduced in 1982 it was one of the first CAD programs that could operate on PC. Aotodesk the parent company that publishes AutoCAD software, reports that there are now millions of AutoCAD user worldwide. The price for a single station of AutoCAD for a professiona ser is about $4700,but at the present time ,Autodesk offer free downloads of AutoCAD 2017 and other CAD product to students ,educators , and educational institutional at its website; www.autodesk.com/education/home.

There are many other CAD programs on te market as well. Some CAD program are designed to perform wok in a specialzed area. In Mechanical design ,Inventor ,Creo, and Solidworks are three of principles CAD program, in electronics design, cadense ,and mentor are widely used. In the civil and archetectural field ,land desktop, civil 3D and Microstation are poular CAD.

Content /Topic2: Application of CAD.

- **CAD** is widely used in the area of engineering.
- **Is** important in chips building, aerospace industries, automotive industries, textiles industries and architectural industries.
- It is used for manufacturing, planning, computer aided analysis.
- When it comes to material requirements, CAD inventory control and production planning, you can always use CAD.

- It also helps in purchasing, manufacturing, planning and several other activities.



Content /Topic3: Types of CAD Software.

a) **2D CAD software: AutoCAD:** AutoCAD is a computer-aided design (CAD) program used for 2-D and 3-D design and drafting. AutoCAD is developed and marketed by Autodesk Inc. and was one of the first CAD programs that could be executed on personal computers.
b) **3D CAD Software: ArchiCAD:** ArchiCAD is architectural BIM CAD software for Windows developed by the Hungarian company Graphisoft.ArchiCAD offers computer aided solutions for handling all common aspects of aesthetics and engineering during the whole design process of the built environment buildings, interiors, urban areas, etc.
c) **Artlantis:** Artlantis is a family of stand-alone rendering applications developed for architects and designers. Artlantis Render is designed for those wanting high-resolution 3D renderings, while Artlantis Studio is ideal for quickly and easily creating high-resolution 3D renderings. Recognized and recommended by leading software developers, Artlantis is compatible with models designed using most 3D software. Artlantis is the rendering software used by architects, designers and urban design professionals in more than 80 countries.
d) **Plot maker:** plot maker was a lay outing that was part of the ArchiCADpackage. This standalone application was optimized to prepare an architectural documentation set based on the views, drawings and images created in ArchiCAD. Plot maker could also accommodate data from external sources such as other CAD and image files, word processing documents and spreadsheets. Since ArchiCAD 10 the Plot maker is integrated into ArchiCAD. Thus, no ore separate layout files are needed.
Plot maker is primarily a sheet layout and numbering tool. Most of the task you will perform I Plot maker involve laying out viewports on a page, and cropping them to size. Plot maker will sequentially number you sheets and fill in most of your section & details references.

e) **Solid Works:** Solid Works is a solid modelling computer-aided design (CAD) and computer-aided engineering (CAE) computer program that runs on Microsoft Windows. Solid Works is published by Dassault Systems.
Initially based in Waltham, Massachusetts, United States, Hirschtick recruited a team of engineers with the goal of building 3D CAD software that was easy-to-use, affordable, and available on the Windows desktop.

LO 1.2 – Select appropriate CAD software.

Content/Topic 1: Advantages and disadvantages of CAD.

Advantages	Disadvantages
- CAD Reduced storage space. - Corrections can be made easily. - Repetitive parts of the drawing can be saved and imported as part of a "CAD library." - CAD systems can be linked with CAM machines to produce objects straight from the drawings. - 3D CAD designs can be made to look realistic by using the material library for clients to see. - CAD designs can be easily shared between companies or department using email. - CAD can be used to create simulated environments to show the client.	- Work can be lost if the computer crashes. - Work could be corrupted by viruses. - Work could be stolen or hacked. - Time taken to learn how to use the software is too much. - Initial costs of buying a computers system are high. - Time and cost of training staff. - Continual need for updating software or operating systems. - CAD/CAM systems mean less people need to be employed.

Content/Topic 2: Application of AutoCAD and ArchiCAD software's.

AutoCAD is a 2-D and 3-D computer-aided drafting software application used in architecture, construction, and manufacturing to assist in the preparation of blue prints and other engineering plans. Professionals who use AutoCAD are often referred to as drafters. AutoCAD is a commercial computer-aided design (CAD) and drafting software application. Developed and marketed by Autodesk, AutoCAD was first released in December 1982 as a desktop application running on micro-computers with internal graphics controllers.

AutoCAD application	ArchiCAD application
- AutoCAD is used worldwide across industries by architects, engineers, town planners and many experienced professionals. - It helps in applying different 3D modelling	- Used for Virtual Building Modelling. It has specific building tools like walls, slab, door, windows, etc. It is also used to create 2D/3D models.

techniques to create robust 3D models of products and their parts. - AutoCAD aids the user to create and design better buildings, deliver scalable and feasible infrastructure assignments, manage production cost and predict project outcomes. - In AutoCAD the users are able to control the appearance of the materials attached to the 3D models, they can view lighting and shadows in their scenes, thus helping them in attaining much realistic renders of 3D models. - Section planes one of the best features of AutoCAD, which helps to obtain cross-section view of 3D objects. These sections planes aid in examining the mirror details of 3D objects that helps them to cut through solids, surface meshes and regions. - A special feature in AutoCAD is that the user gets to link the tables. Within their 2D drawings directly to Microsoft Excel spreadsheet, with this feature they can even import formulas and data from excel into the table. Also, this feature has an auto update default setting. - The user can also import Pdf files into AutoCAD; they can import 2D geometry, true type text also. - Any non-Autodesk 3D models' geographic locations and online maps can also be imported into AutoCAD. - Used for product designing, civil infrastructure, 2D drawings, drafts, documents, as well as 3D models.	- ArchiCAD is a very important program as it is the first application that includes both 2D/3D geometry and BIM program as well. - This software is used for real-time editing and communication which helps in boosting the overall BIM experience of the user. It allows aids in working more progressively and competently. - This software is a master in workspace arrangements and the only widely-used functions are displayed. Rest all the functions are saved as favorites. - ArchiCAD is a smooth application for its use in 2D zooming and panning experience, despite any complexity. - ArchiCAD enhances multiple workflows and productivity. The enhancements deliver realistic buildings, designs, accurate construction documentation, and precise cost estimations. - With ArchiCAD, the user gets a façade design workflow that boosts to develop, design and detail hierarchical curtain wall systems with a lot of simplicity.

LO 1.3 – Configure CAD Software's.

Content/Topic 1: Scale.

In technical drawings objects are often drawn to *scale.* This term refers to relationship between the size of the object in the drawing and the actual size of the object after it's manufactured. Following are four of the scales most commonly used in the creation of mechanical drawing:

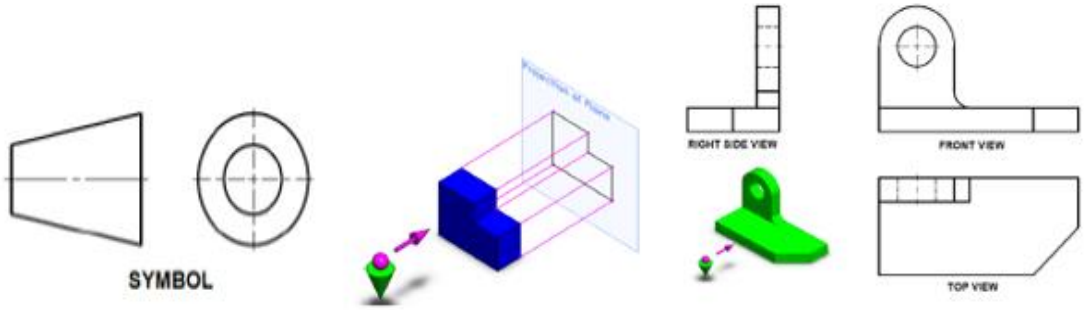
A. **Full scale:** this means that the size of the objects in the drawing will be the same size as the object after it is manufactured. This is usually only feasible on smaller objects such as machine parts. When noting on a drawing that the object is drawn full scale, the drafter may write 1=1, 1/1 or 1:1.
B. **Half scale**: this means that the size of the objects in the drawing is half the size of the object after it is manufactured. The drafter will still place the full-size dimensions on the views of the object so that even though the drawing is half size, the part will be manufactured full size. When noting on a drawing that the object in drawn half scale, the drafter may write 1=2, 1/2, 0.5x, or 1:2.
C. **Quarter scale:** this means that the size of the object in the drawing is on four the size of the object after it is manufactured. The drafter will still place the full-size dimensions on the views of the object so that even though the drawing is one-fourth size, the part will be manufactured full size. When noting on a drawing he object is drawn quarter scale, the drafter may write 1=4, 1/4, 0.25x or 1:4.
D. **Double scale:** this means that the size of the object in the drawing is twice the size of the object after it is manufactured. The drafter will still place the full-size dimensions on the views of the object so that even though the drawing is twice the size, the part will be manufactured full size. This scale is used for small objects that would be difficult to dimension if drawn at actual size. When noting on a drawing that the object is drawn double scale, the drafter may write 2=1, 2/1,2xor 2:1.

Following are two of the scales most commonly used in the creation of architectural drawings:

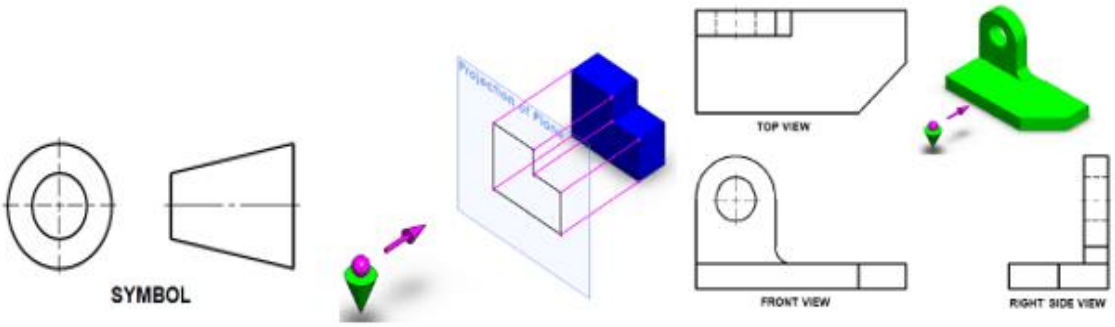
A. **Quarter inch equals one foot**: this means that every 1/4 "on the plotted drawing represent a measurement of 1" on the actual construction project.
B. **Eighth inch equals one foot**: this means that every 1/8 "on the plotted drawing represent a measurement of 1" on the actual construction project.

Content/Topic 2: Projection.

a) **First angle projection:** The object is imagined to be in first quadrant, the object is lies between the observer and plane of projection, the plane of projection is assumed to be non-transparent, when views are drawn in their relative position top view comes below front view, Right side view drawn to the left side of elevation.



b) Third angle projection: The object is imagined to be in third quadrant, the plane of projection lies between the observer and object, the plane of projection is assumed to be transparent, when views are drawn in their relative position top view comes above front view, Right side view drawn to the right side of elevation.



Content /Topic 3: Unit configuration MKS and CGS.

The Unit Configuration feature is a sub-system that describes the structure of an assembled electromechanical system. The Unit Configuration feature also monitors components modelling to support the management of a single part of interest, or a complex assembly that consists of a hierarchy of monitored items.

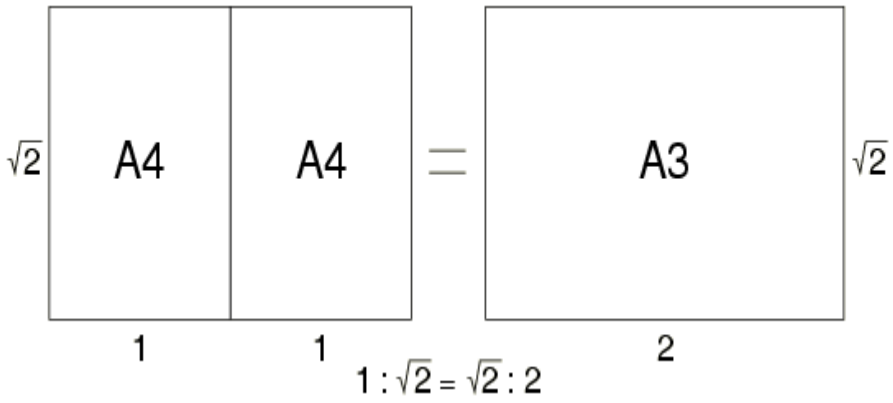
Unit system:

- ✓ **MKS**: MKS is the system of units based on measuring lengths in meters, mass in kilograms, and time in seconds. MKS is generally used in engineering and beginning physics, where the so-called cgs system (based on the centimeter, gram, and second) is commonly used in theoretic physics.
- ✓ **CGS**: The(centimeter-gram-second) system of units (abbreviated CGS) is a variant of the metric system based on the centimeter as the unit of length, the gram as the unit of mass, and the second as the unit of time. For example, the CGS unit of force is the dyne which is defined as 1 g.

Content /Topic 4: Standard sheet size of paper setting.

a) ISO standards: The International Standard Organization (**ISO**), the international paper size standard is ISO 216. It is based on the German DIN 476 standard for paper sizes. ISO paper sizes are all based on a single aspect ratio of the square root

of 2, or approximately 1:1.4142. There are different series, as well as several extensions.



The following table shows the width and height of all ***ISOA and B paper formats***, as well as the ***ISO C envelope formats***. The dimensions are in millimeters:

A Serie Formats			**B Serie Formats**			**C Serie Formats**		
Format	**Width × Height (mm)**	**Width × Height (in)**	**Format**	**Width × Height (mm)**	**Width × Height (in)**	**Format**	**Width × Height (mm)**	**Width × Height (in)**
2A0	1189 × 1682	46.8 × 66.2						
4A0	1682 × 2378	66.2 × 93.6						
A0+	914 × 1292	36 × 50.9	***B0+***	1118 × 1580	44 × 62.2			
A1+	609 × 914	24 × 36	***B1+***	720 × 1020	28.3 × 40.2			
A3+	329 × 483	13 × 19 in	***B2+***	520 × 720	20.5 × 28.3			
A0	841 × 1189	33.1 × 46.8	***B0***	1000 × 1414	39.4 × 55.7	***C0***	917 × 1297	36.1 × 51.1
A1	594 × 841	23.4 × 33.1	***B1***	707 × 1000	27.8 × 39.4	***C1***	648 × 917	25.5 × 36.1
A2	420 × 594	16.5 × 23.4	***B2***	500 × 707	19.7 × 27.8	***C2***	458 × 648	18 × 25.5
A3	297 × 420	11.7 × 16.5	***B3***	353 × 500	13.9 × 19.7	***C3***	324 × 458	12.8 × 18
A4	210 × 297	8.3 × 11.7	***B4***	250 × 353	9.8 × 13.9	***C4***	229 × 324	9 × 12.8
A5	148 × 210	5.8 × 8.3	***B5***	176 × 250	6.9 × 9.8	***C5***	162 × 229	6.4 × 9
A6	105 × 148	4.1 × 5.8	***B6***	125 × 176	4.9 × 6.9	***C6***	114 × 162	4.5 × 6.4
A7	74 × 105	2.9 × 4.1	***B7***	88 × 125	3.5 × 4.9	***C7***	81 × 114	3.2 × 4.5
A8	52 × 74	2 × 2.9	***B8***	62 × 88	2.4 × 3.5	***C8***	57 × 81	2.2 × 3.2
A9	37 × 52	1.5 × 2	***B9***	44 × 62	1.7 × 2.4	***C9***	40 × 57	1.6 × 2.2
A10	26 × 37	1 × 1.5	***B10***	31 × 44	1.2 × 1.7	***C10***	28 × 40	1.1 × 1.6
A11	18 × 26	0.7 × 1	***B11***	22 × 31	0.9 × 1.2			
A12	13 × 18	0.5 × 0.7	***B12***	15 × 22	0.6 × 0.9			
A13	9 × 13	0.4 × 0.5	***B13***	11 × 15	0.4 × 0.6			

b) ANSI standards: It is an **American National Standards Institute** that applies widely which defined a regular series of paper sizes based standard letter size which it assigned ANSI A. This series includes **ANSI A, ANSI B, ANSI C, ANSI D, ANSI E, ANSI F, ANSI G, ANSI H, ANSI J, ANSI K**. It is somewhat similar to the ISO 216 standard in that cutting a sheet in half would produce two sheets of the next smaller size.

ANSI Sizes	mm	cm	inches
ANSI A	216 × 279	21.6 × 27.9	8.5 × 11
ANSI B Ledger	432 × 279	43.2 × 27.9	17 × 11
ANSI B Tabloid	279 × 432	27.9 × 43.2	11 × 17
ANSI C	432 × 559	43.2 × 55.9	17 × 22
ANSI D	559 × 864	55.9 × 86.4	22 × 34
ANSI E	864 × 1118	86.4 × 111.8	34 × 44
ANSI F	711 × 1016	71.1 × 101.6	28 × 40
ANSI G	279 × 572–2286	27.9 × 57.2–228.6	11 × 22.5–90
ANSI H	711 × 1118–3632	71.1 × 111.8–363.2	28 × 44–143
ANSI J	864 × 1397–4470	86.4 × 139.7–447	34 × 55–176
ANSI K	1016 × 1397–3632	101.6 × 139.7–363.2	40 × 55–143

c) DIN standards: DIN(Deutsches Institut for Normung). German Institute for Standardization develops norms and **standards** for rationalization, quality assurance, environmental protection, safety and communication in industry, technology, science, and government, as well as the public domain.**DIN A" Papers**: In the metric system paper is measured in square meters. The base measurement for an A0 sheet is 841 millimeters by 1,189 mm (.841 × 1189 ≅ 1 square meter). A DIN A1 paper is half of DIN A0, DIN A2 is half of DIN A1, and so on.

DIN a paper sizes		DIN B paper sizes		DIN C paper sizes		DIN D paper sizes	
DIN A0	841 × 1189 mm	*DIN B0*	1000 × 1414 mm	*DIN C0*	917×1297 mm	*DIN D0*	771 ×1091 mm
DIN A1	594 × 841 mm	*DIN B1*	707 × 1000 mm	*DIN C1*	648 × 917 mm	*DIN D1*	545 × 771 mm
DIN A2	420 × 594 mm	*DIN B2*	500 × 707 mm	*DIN C2*	458 × 648 mm	*DIN D2*	545 × 771 mm
DIN A3	297 × 420 mm	*DIN B3*	353 × 500 mm	*DIN C3*	324 × 458 mm	*DIN D3*	272 × 385 mm
DIN A4	210 × 297 mm	*DIN B4*	250 × 353 mm	*DIN C4*	229 × 324 mm	*DIN D4*	192 × 272 mm
DIN A5	148 × 210 mm	*DIN B5*	176 × 250 mm	*DIN C5*	162 × 229 mm	*DIN D5*	136 × 192 mm
DIN A6	105 × 148 mm	*DIN B6*	125 × 176 mm	*DIN C6*	114 × 162 mm	*DIN D6*	96 × 136 mm
DIN A7	74 × 105 mm	*DIN B7*	88 × 125 mm	*DIN C7*	81 × 114 mm	*DIN D7*	68 × 96 mm
DIN A8	52 × 74 mm	*DIN B8*	62 × 88 mm	*DIN C8*	57 × 81 mm		
DIN A9	37 × 52 mm	*DIN B9*	44 × 62 mm	*DIN C9*	40 × 57 mm		
DIN A10	26 × 37 mm	*DIN B10*	31 × 44 mm	*DIN C10*	28 × 40 mm		

d) JIS standards: The Japanese Industrial Standards organization (JIS) has defined two paper size series the JIS A that is the same as ISO 216 a size with minor differences in tolerances. JIS B series paper is not the same as ISO 216 B series paper, with the

JIS B sizes having an area of 1.5 times the A paper size rather than the root 2 times the size in ISO 216.

JIS A Sizes (mm)		**JIS B Sizes(mm)**	
4A	1682 x 2378		
2A	1189 x 1682		
A0	841 x 1189	B0	1030 x 1456
A1	594 x 841	B1	728 x 1030
A2	420 x 594	B2	515 x 728
A3	297 x 420	B3	364 x 515
A4	210 x 297	B4	257 x 364
A5	148 x 210	B5	182 x 257
A6	105 x 148	B6	128 x 182
A7	74 x 105	B7	91 x 128
A8	52 x 74	B8	64 x 91
A9	37 x 52	B9	45 x 64
A10	26 x 37	B10	32 x 45

e) BIS Standards: The Bureau of Indian Standards (**BIS**) is the national Standards Body of India working under the aegis of Ministry of Consumer Affairs, Food & Public Distribution, and Government of India. It is established by the Bureau of Indian Standards Act, 1986 which came into effect on 23 December 1986.

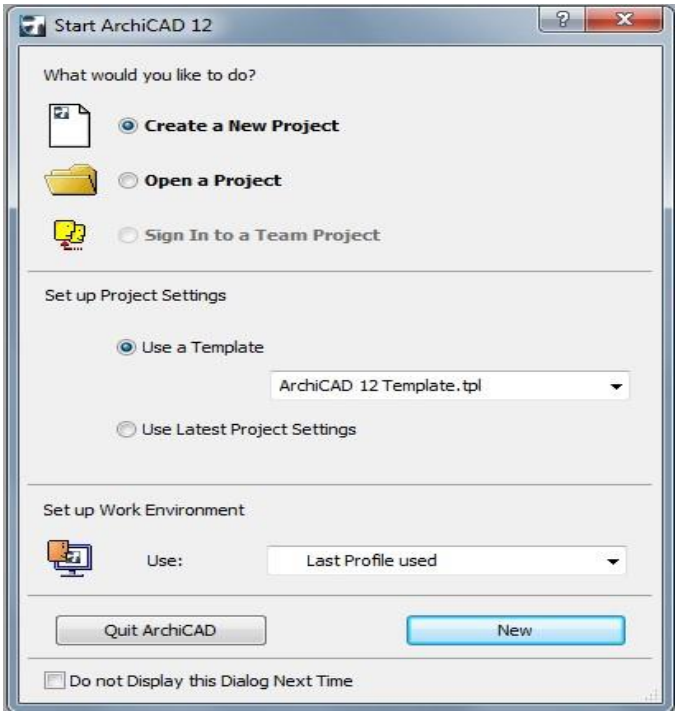
Learning Unit 2 – Perform ArchiCAD Drawing.

LO 2.1 – Introduce basic concepts of ArchiCAD.

Content/Topic 1: Introduction to ArchiCAD.

A. Starting of ArchiCAD: When you start ArchiCAD, you are presented with several choices in how you begin your work. The Start ArchiCAD dialog offers three primary choices:

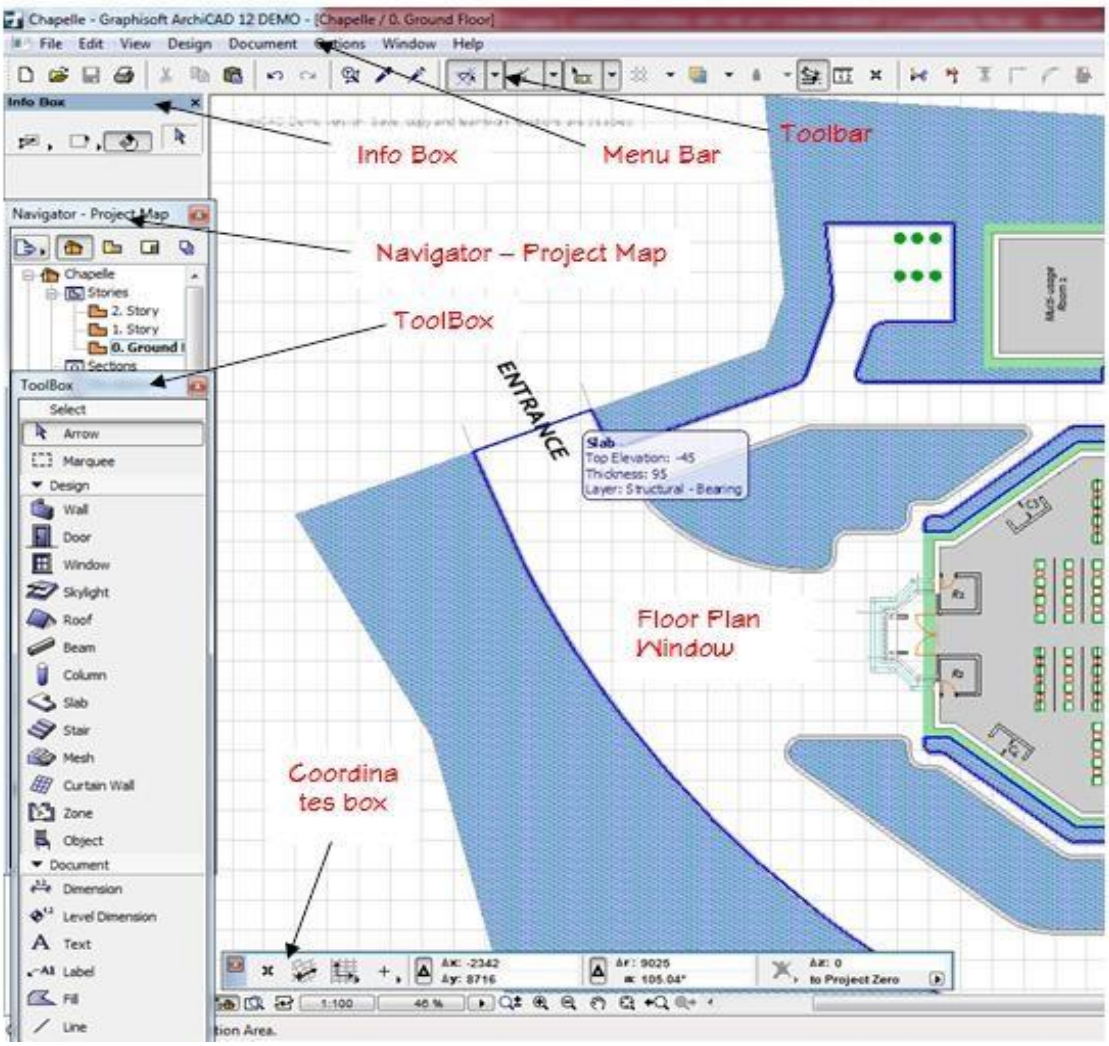
- Open ArchiCAD.
- The **Start ArchiCAD** dialog box will appear. Select the **Create a New Project** radio button at the top.
- Select the Use a Template radio button under Set up Project Settings.
- Select **ArchiCAD 19 Residential Template.tpl** from the drop-down list. If you have the International version of ArchiCAD, then the residential template may not be available.
- Click on **New**. This will open a blank project file.



B. ArchiCAD Workplace: This part introduces the visible elements of the ArchiCAD working environment, to help you find your way around the ArchiCAD workplace and understand the role of each component in ArchiCAD.

The interface provides plan, section, elevation, and detail and 3D views of the building and maintains a database of building information such as area calculations and door/window schedules.

The components of the working environment that first loads when a project is opened are: the title bar, menu bar, toolbar, the floor plan window, the control box, the toolbox, the navigator and the info box.



C. **Floor Plan Window:** The Floor Plan Window is the basic construction area where most editing operations take place. It shows a representation of the current project as a traditional architectural drawing. The center of the ArchiCAD workplace is the **Floor Plan** worksheet. This Window plays two roles at the same time:
   - It displays a representation of the project as a traditional architectural drawing.
   - It is a 2D/3D modelling environment that is interactive with the Sections/Elevations and 3D workspace.

The Floor Plan worksheet is like a sheet of drafting paper. However, a traditional mechanical drafting board is limited by the size of the paper you can fit on it, while the ArchiCAD worksheet can be as big as you want it to be. You can pan and zoom the Window within the full drawing space to obtain the best view of the work you are doing.

D. **Section/Elevation Window:** Section/Elevation window helps to access the building information (sections, North Elevation, South Elevation, West Elevation and East

Elevation) that has been created through the process of modelling the building (on the floor plan window)

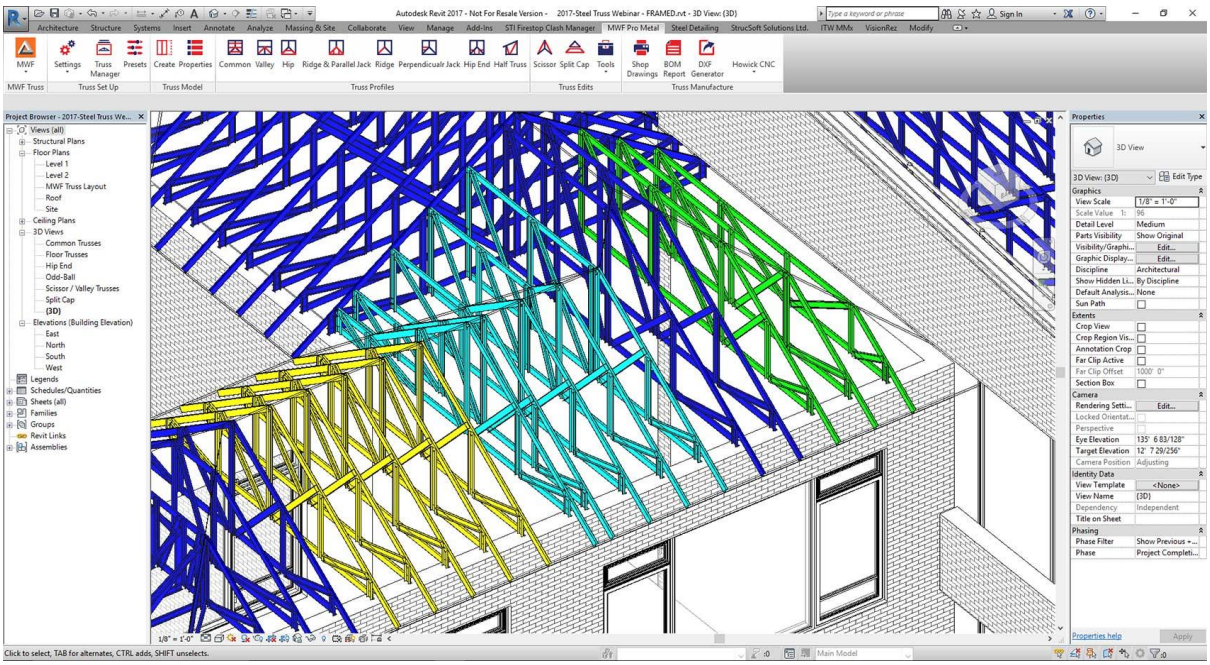
E. 3D Window: The 3D window gives you instant feedback on the construction operations performed in other views and at the same time allows you to directly edit your model in either perspective or axonometric view. The 3D Window is used to visualize the three-dimensional components of an architectural project and as an editing environment. You can choose to display the complete project in the 3D Window, or only selected parts of plan view.

The **3D** window is directly linked to the **Floor Plan** and to the **Section/Elevation** windows: any changes made on the **Floor Plan** or in any of the **Section/Elevation** windows will be visible in the **3D** window and vice versa.

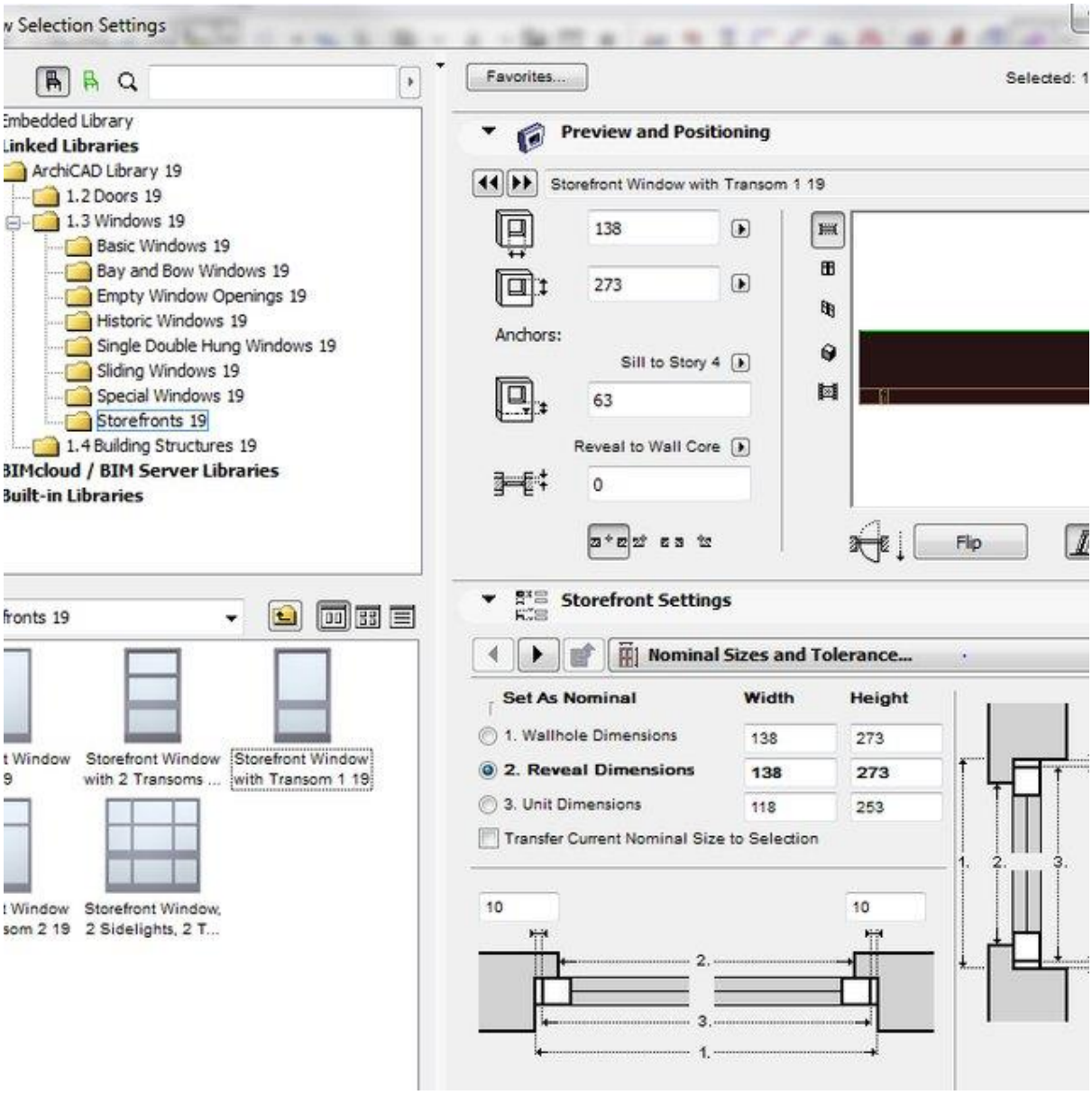
F. Concepts of parametric: Architectural studies are gradually moving towards very practical approach: developing BIM (building information modeling) technology skills, solving problematic tasks, bringing them closer to real-life situations.

BIM and parametric design-based software is very different in its approach and logics of modelling thus, while learners are prepared for real-life practice, it is generally understood that it is more important for them to learn BIM related programs. These, to name most relevant and popular, would be Revit or ArchiCAD.

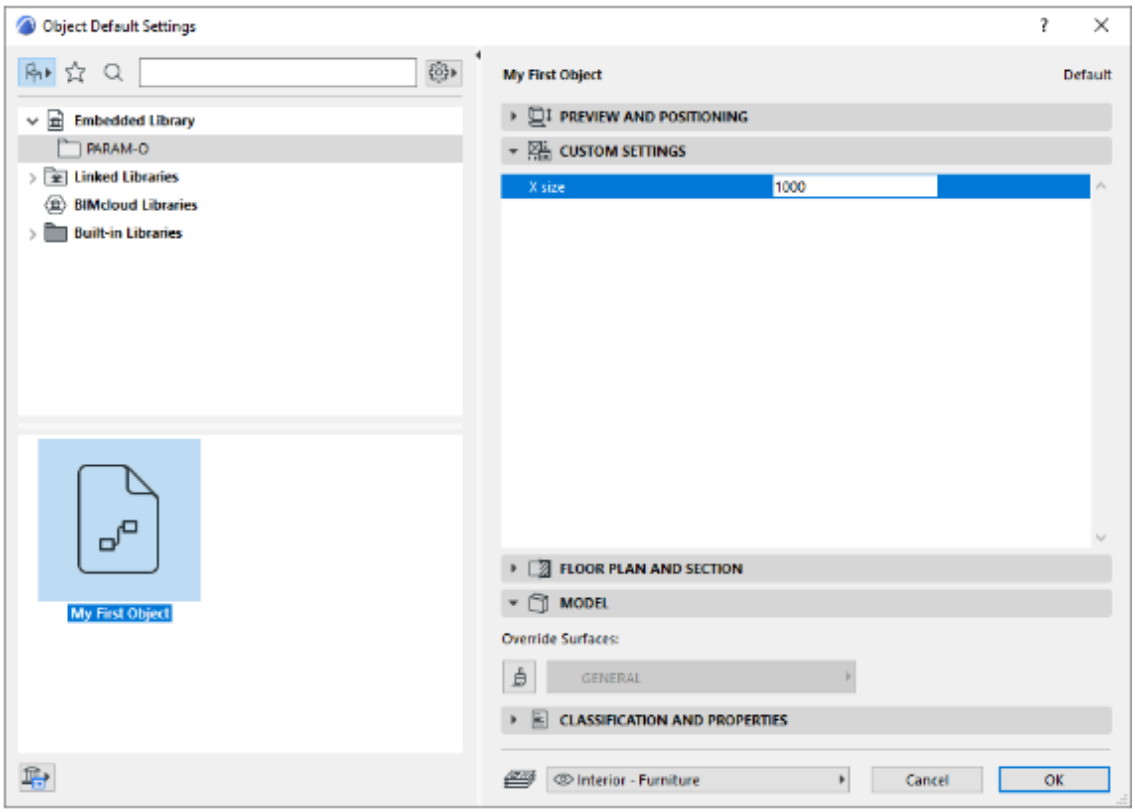
Decent BIM modelling of the building this way requires a lot of knowledge about construction and building practice,



To make an object parametric, you have to use an input node. For example, you can create a Length node and connect it to the Size X input of the Block node.



Now the value can be set by modifying the value of the Length node. To make an object parameter from the Length node, open the settings dialog and set the Create Parameter value to true. You can also set a name for this parameter. This name will be visible in the Object Settings Dialog.

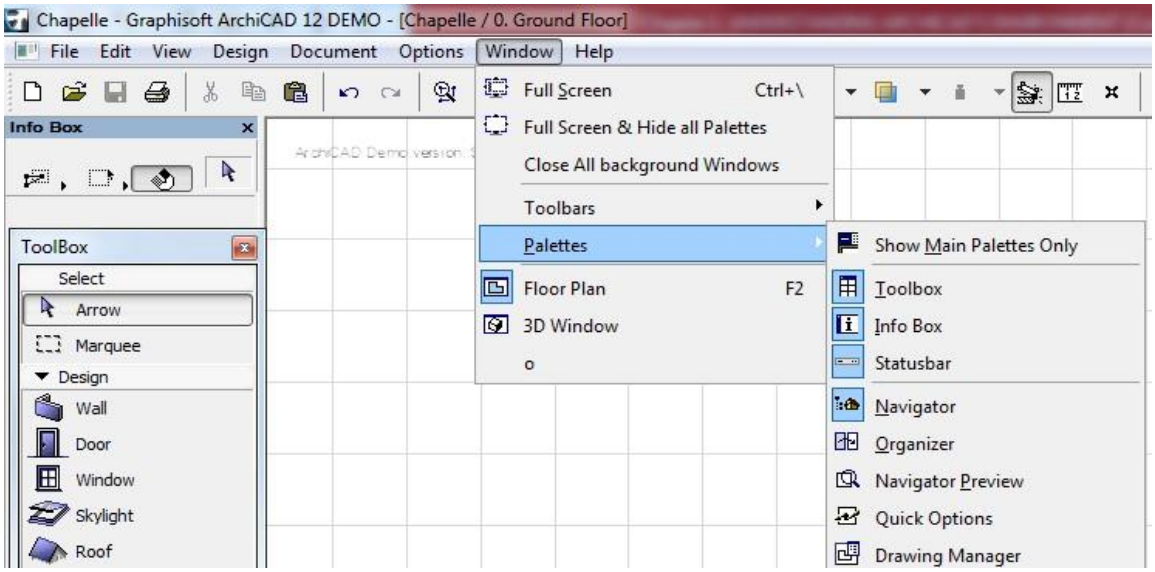


G. ArchiCAD help's system: All GRAPHISOFT products are available on both Windows and Mac platforms. BIMx has both iOS and Android based version for mobile devices. Choose the platform according to your taste. The two versions (Mac and Win) are fully compatible (file formats, Teamwork) so you can even work in mixed environments.

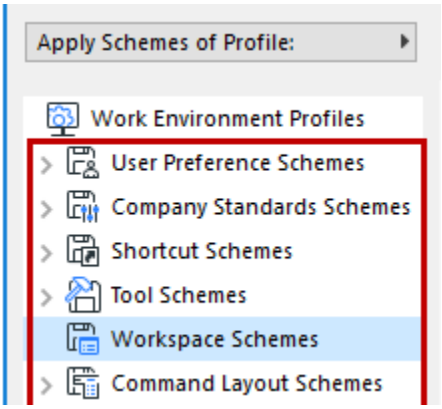
LO 2.2 – Use tools in ArchiCAD.

Content/Topic 1: Tools and Palettes.

ArchiCAD's palettes help you construct, modify and locate elements. Each palette can be shown or hidden separately using the **Window**>**Palettes** command.
The main palettes (Toolbox, Info Box,Quick Optionsand Navigator) can be enabled all at once, using the **Window > Palettes > Show Main Palettes Only** command.



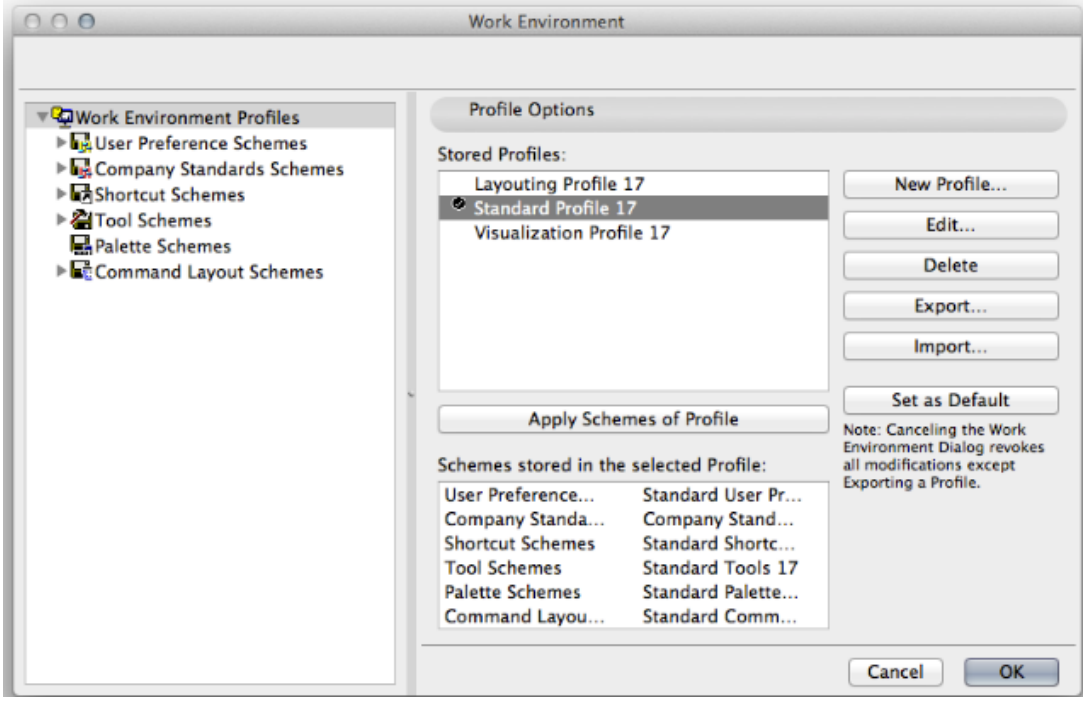
A. Customizing the Workplace: Work Environment settings (**Options > Work Environment**) are divided into six self-contained **schemes**. Each scheme is a thematic collection of settings.



- User Preference Schemes
- Company Standard Schemes
- Shortcut Schemes
- Tool Schemes
- Command Layout Schemes
- Workspace Schemes

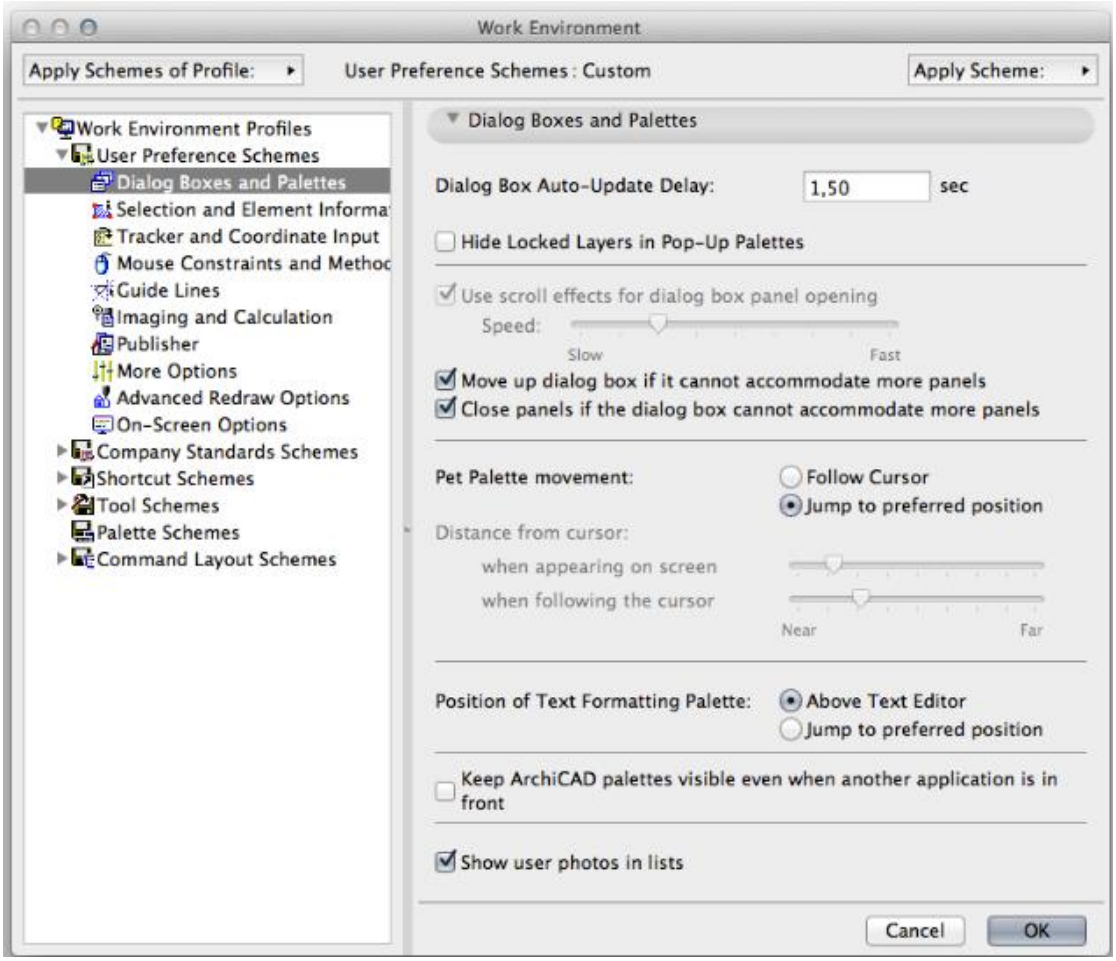
If you want to customize and save your Work Environment Profile you have to be aware using a “button-up” method. The Work Environment builds-up as follows:

- **First level – Work Environment:** Here you can create and save the individual Profiles



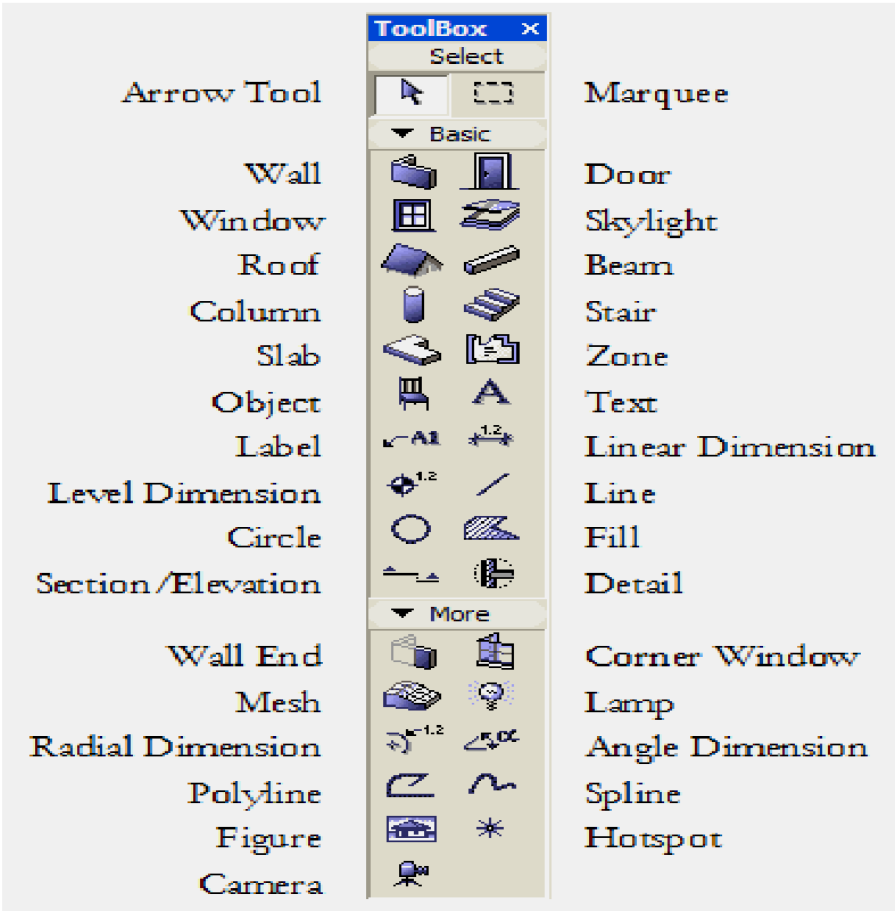
- **Second level:** You can manage the following Schemes here:
  - User Preference Schemes (such as 2D Redraw and Cache file location preferences)
  - Shortcut Schemes
  - Tool Schemes
  - Palette Schemes
  - Command Layout Schemes

– **Third level:** This is the lowest level – Here you can assign particular options to the Schemes. Such as: Dialog Boxes and Palettes, On-Screen Options etc.

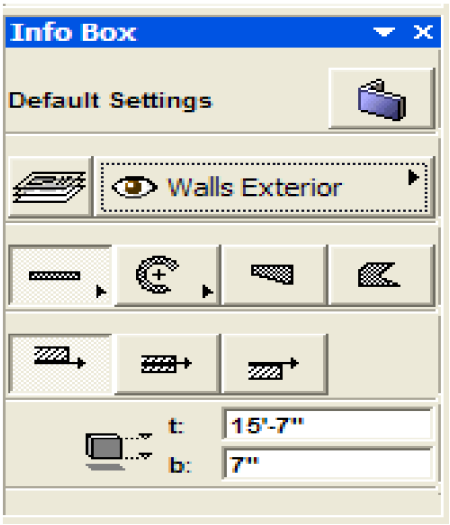


B. Toolbox: The Toolbox, located by default on the left edge of the Floor Plan window, shows a variety of tools for selection, 3D construction, 2D drawing and visualization.

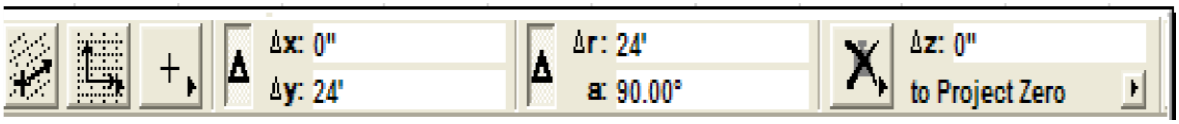
In its default shape, Toolbox does not display every single tool icon; some tools are grouped into Panels that can be opened or closed as well as scrolled up or down. The following image shows the Toolbox as it appears in the Novice mode with the two-column display option. *Examples of tools:* wall, window, door, roof, beam, slab, stair, object, linear dimension, section/elevation, camera, text, line etc.



C. Info Box: An Info Box is available for each tool in the toolbox. When you activate a tool or select a placed element, its Info Box palette will display current settings for that tool/element. If several elements are selected, the Info Box displays the controls for the last selected element. The Info Box contains a condensed collection of input and parameter controls that are specific to the selected tool/element. While some of these controls are also available in the Tool Settings dialog box, the Info Box is a quicker way to access these controls, because it stays on screen while you work.



D. Coordinate Box: The Coordinate Boxes available when working in any construction window. By default, it appears in the bottom of the screen.



The Coordinate Box:

- Shows you the precise location of the ArchiCADcursor within both the *Cartesian* and *Polar* coordinate system for your drawing.
- Enables you to enter numeric drawing coordinates for greater precision.
- Houses the **Origin**, **Grid** and **Gravity** control icons.
- Allows you to draw in both Relative and Absolute coordinates.

E. Control Box: The Control Box is not visible by default. To show it, choose its name from the Window > Palettes menu.

The **Control Box** contains a number of drawing aids in the form of icons:

- **Relative Construction Methods** constrain the cursor to a defined angle or distance during drafting or editing. They are linked to the **Mouse Constraints** feature which helps you place the endpoints of linear elements at predefined angles.
- **Cursor Snap Variants** control the way the current position of the cursor is projected.
- **The** Enable/**Suspend Groups** switch allows you to choose between editing grouped elements together or on their own.
- The **Magic Wand** traces the contours of existing elements in order to create new elements of others types.
- The **Special Snap Point** definition controls automatically generate temporary snap points on different parts of edges and help you position elements at exact points or distances along lines and edges.

Content/Topic 2: Cursor forms.

Cursor is a movable indicator on a computer screen identifying the point that will be affected by input from the user.

A. **The Intelligent Cursor:** The cursor changes shape as you work, depending on the tool you are using, and whether an editing/input operation is underway or not. Cursor variations help you identify particular nodes and edges, as an aid in editing.

	Empty Space	Reference Line	Other Edge	Intersection	Node of Reference Line	Other Node
Before Input (Arrow Tool)						
Before Input (Other Tools)						
During Input (Other Tools)						
Magic Wand						
Trim Elements						
Pick Up Parameters						
Transfer Parameters						

B. **Types of cursor forms.**

There are three types of cursor form whose are;

- **Search cursor:** SearchCursor establishes read-only access to the records returned from a feature class or table.
- **Insert cursor:** InsertCursor establishes a write cursor on a feature class or table. Insert Cursor can be used to add new rows.
- **Update cursor:** UpdateCursor establishes read-write access to records returned from a feature class or table. Use Update Cursor to update a field value by evaluating the values of other fields.

C. **Function of cursor.**

- Cursor allows access of collection of records, it allows:
  - Iterating over the set of rows in a table.
  - It allows inserting new rows in a table.
  - It allows accessing geometry.

- Cursor read and writes values while looping through a cursor one record at time. This can allow us to edit a table by adding or deleting records.

Content /Topic3: Editing and Notation.

a) **Editing:** In addition to the standard editing commands (such as Undo/Rendo, Cut, Copy, Paste and Clear), ArchiCAD's standard Edit menu contains more sophisticated transformation commands and options for editing text windows. All those commands are in the Menu tools or select any elements/objects and right click some of them are shown others are in the move tools.

i. **Undo/Redo**: The undo and Redo commands allow you to undo (revert to a previous step) and redo a large number of construction operations.

ii. ***Cut:*** The Cut command removes selected elements from a project and places them on the clipboard for future use via the Past command. The cut command is not available in the 3D window.

iii. ***Copy:*** The Copy command is similar to the Cut command. Unlike Cut, Copy can be used in the 3D window to get image data.

iv. **Paste:** With the Paste command, you can paste the contents of the clipboard onto the current project or a text window.

v. **Clear:** Selected items are removed from project or text windows when you choose the clear command. As opposed to cut or copy, the cleared elements are not preserved on the clipboard. They are easily retrieved by Undo.

vi. **Select All**: Choosing the Select All command selects all the elements of the currently active window that have been created by the currently active tool in all visible layers.

vii. **Find &Select:** With this command, you can search and select elements based on a set of customizable conditions. The range of available criteria depends on the selected element type.

viii. **Drag: The** Drag command allows you to move any selected construction element in the project.

ix. **Rotate: The** Rotate command allows you to rotate any selected element in the Floor Plan or in the 3D window, or to rotate manually added elements in the Section/Elevation windows. Even in the 3D window, rotation is always performed across a horizontal plane.

x. **Mirror**: The Mirror command creates a mirror image of any selected construction element on the Floor Plan or in the 3D window.

xi. **Elevate: The** Elevate command allows you to move selected elements vertically along the Z axis.

xii. **Split: This** menu command allows you to split elements along a line segment, arc or polygon edge.

xiii. **Fillet/ Chamfer**: This menu command opens the Fillet/Chamfer dialog box, allowing you to fillet or chamfer the intersection of two straight line segments.

xiv. **Intersect: This** menu command will create an interaction of two selected line segments.

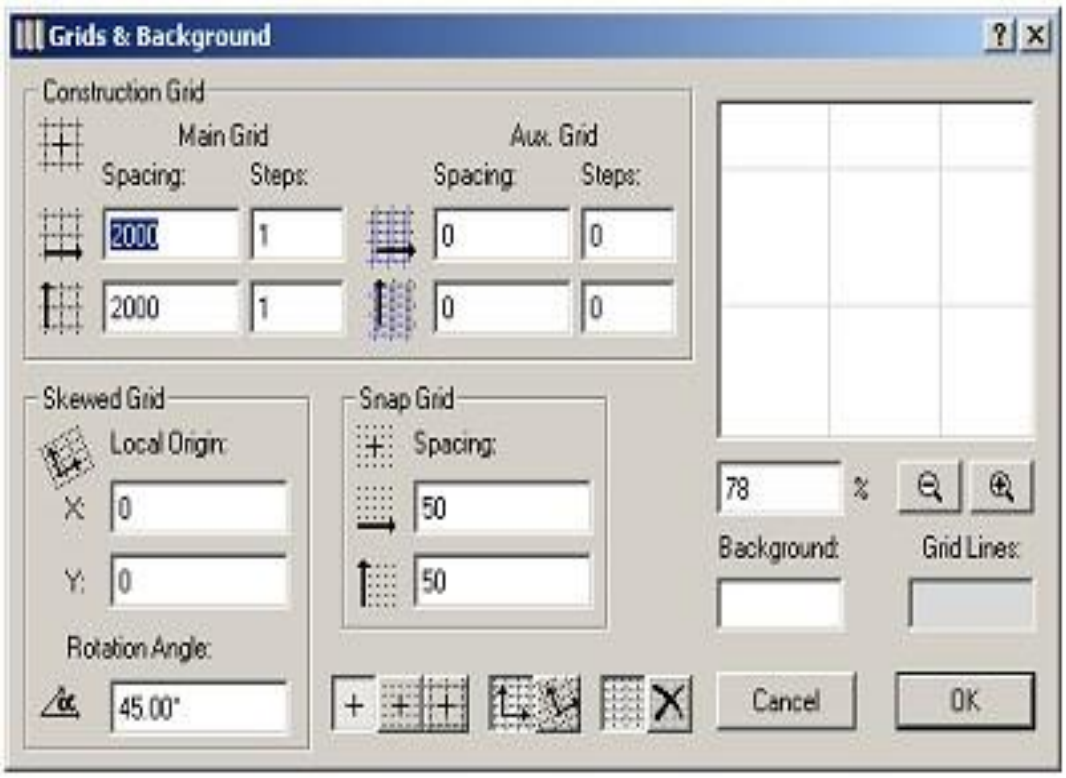
xv. **Adjust: This** menu command adjusts (extends or trims) the endpoints of Walls, Beams, Arcs and Lines to a line or arc segment or polygon edge.

xvi. **Trim to Roof**: You can cut gable shapes from Walls, Beams, Columns, Slabs and Library Parts (including Doors and Windows) to fit under roofs.

xvii. **Trim Zone**: This command allows you to trim the 3D shape of Zones with Roofs, Slabs and Beams.

xviii. **Modify Wall (Add-on)**: Modify Wall is a hierarchical menu that allows you to modify the thickness, the reference line position and the direction of selected wall type elements.

b) Drawing Grid: Two grid systems are provided to help you put ArchiCAD's accuracy to work: The *Construction Grid* and the *Snap Grid*. To define the snap and construction grids, choose the *Grids & Background* command in the View menu.



i. The **Construction Grid** is used to reflect any characteristic spacing of your project. The construction grid could also be used to define the foundation footings or the column grid of a building. The construction grid can be enhanced with an **Auxiliary Grid,** which is also visible on the screen. The

Auxiliary Grid is often used to indicate the thickness of concrete walls or foundation footings.

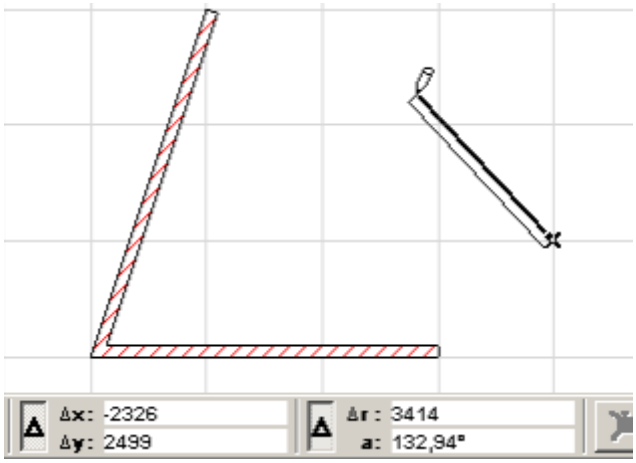
ii. The **Snap Grid** is an invisible grid that can be used to define the smallest unit of measurement relevant to your project. The **Skewed Grid,** you can specify a local origin that is different from the project origin, as well as a rotation angle.

c) Setting Mouse Constraints: Mouse Constraints are editing aids that can be used as an alternative to Snap Guides and Guide Lines. The angle pairs they define can be used to lock the cursor at a particular drawing angle, by pressingShiftduring input. The mechanism can only be engaged while drawing or editing an element, as indicated by the thick rubber band line shown in the Floor Plan or the ghosted element contour shown in the 3D Window. It temporarily locks the cursor's polar angle value in the Coordinates Palette using one of the angle pairs defined in the Options > Work Environment > Input Constraints and Guides.

Using Mouse Constraints

Constraining the drawing direction helps you precisely align or connect new elements. To use the orthogonal direction sets for drawing a new element:

1. Make sure the grid snap function is disabled.
2. Click to start drawing an element.



3. Move the cursor from this starting point and hold down the Shift key. ARCHICAD will search for the closest enabled constraint direction.

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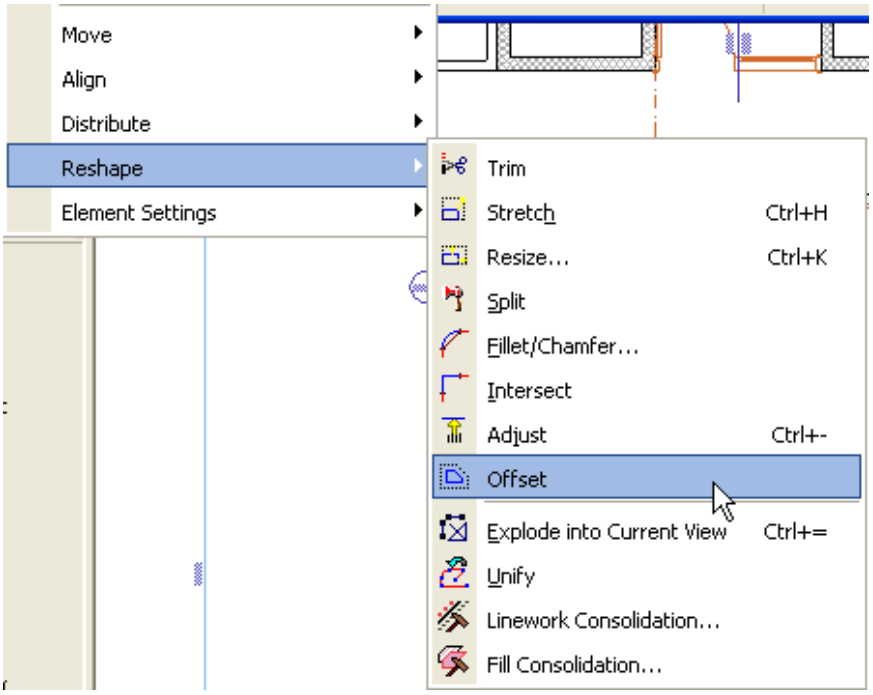
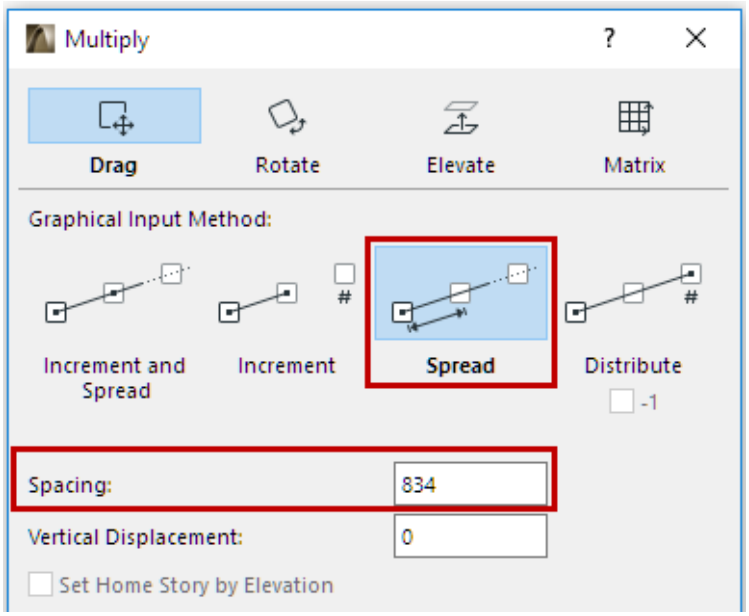
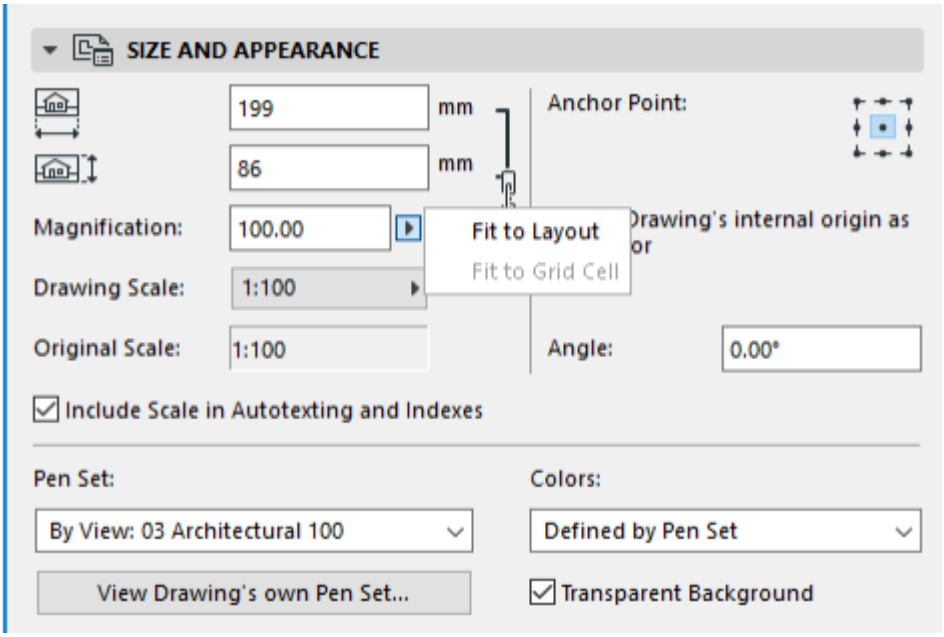
d) Offset Controls: Creates concentric circles, parallel lines, and parallel curves. Find. You can offset an object at a specified distance or through a point. After you offset objects, you can trim and extend them as an efficient method to create drawings containing many parallel lines and curves.



e) Multiply Command: The multiply command creates any number of exact copies of selected elements.

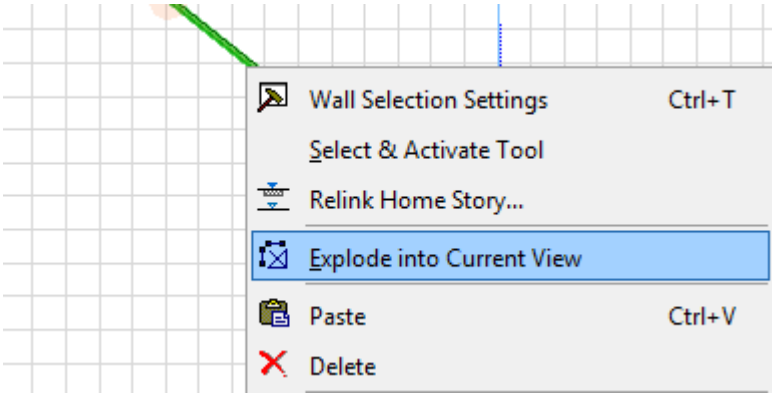


f) Resize Command: Choosing the Resize command allows enlarging or reducing selected elements either through numeric input or graphically.



g) **Stretch Command:** The stretch command is used to stretch or shrink selected elements.

h) **Explode Command:** Explode command breaks a compound object into its component objects. Explode command explodes a compound object when you want to modify its components separately. Objects that can be exploded include blocks, polylines and regions, among others.



i) **Notation:** The **architecture** of a software system is defined as its static structure, regarding packages, modules, and classes and the relationships among them. The best way to specify the **architecture** of software system is to use a graphical **notation** which shows the relations between the numerous units of the system.

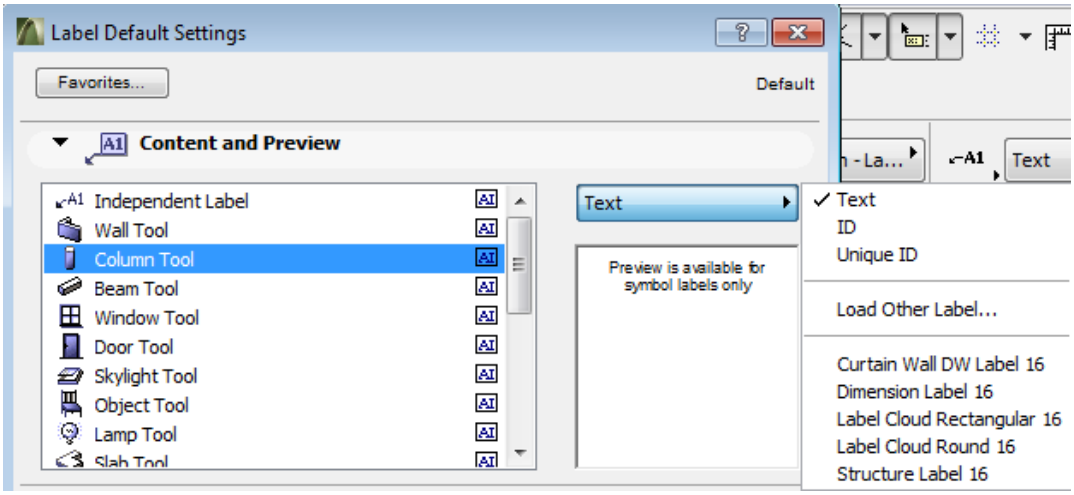
When examining the applicability of these modelling languages to analysis and design of the spectral envelope library and the VIEWENV program, several shortcomings are apparent:

- Except for the now defunct OMT *(Object Modelling Technique)*, these notations have no means of specifying data flow structures, but are specialized in describing object-oriented analysis and design.

- It is advantageous to keep the distinction between abstract data types and functional module classes. In the above notations, principally all classes look the same. There are options to specify roles of classes, or to use adornments to express types of classes, but for the spectral envelope library, the distinction between data classes and functional modules is so important that it should be obvious on first sight.
- The object-oriented VIEW program would be amenable to one of the above standard notations while some other standard notation could be used for the mainly transformational spectral envelope library.
- As the library is written in non-object-oriented C, it is unavoidable that the description of the architecture for the implementation will at some level of detail not match the structure of the implemented code anymore. That is, the notation for the architecture does not have to provide for means of adding more detailed information; it can be kept clean and simple.

j) Text: The Text tool offers multiline texts, full-scale font options, multiple styles and justification in any direction.

k) Label: A label is a graphical control element which displays text on a form. A label is generally used to identify a nearby text box or another widget. Some labels can respond to events such as mouse clicks, allowing the text of the label to be copied, but this is not standard user-interface practice.



Content /Topic4: Dimension.

ArchiCAD's dimensioning tools give you great flexibility in annotating the Virtual Building with your choice of measurement units and standards. Dimensions are associative, which means that dimension values will be updated automatically if the element they are associated to is modified.

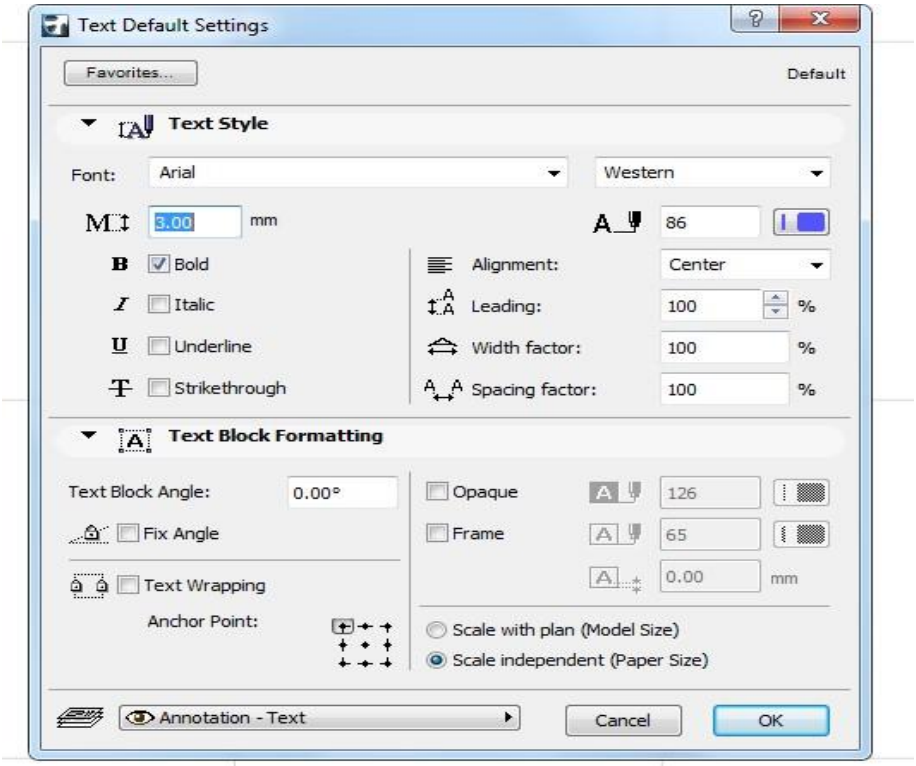
The following dimensioning construction options are available:

- **Linear Dimensions** display element lengths, both curved and straight.

-  **Elevation Dimensions** (a construction method of the Linear Dimension tool) display height values in Section/Elevation and 3D Document views.
-  **Level Dimensions** display height values on the Floor Plan.
-  **Radial Dimensions** display the radius of curved elements.
-  **Angle Dimensions** display the angle in degrees between pairs of lines or edges.

A. Find & Select:

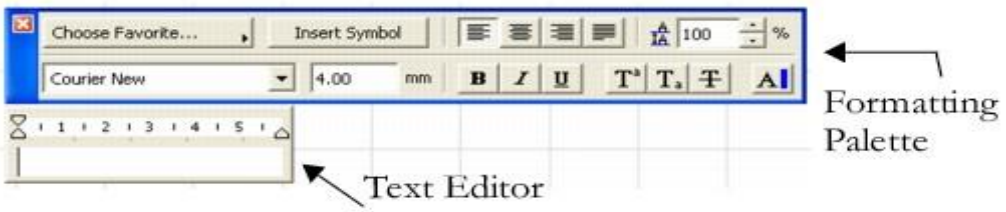
1. Configure the Text Tool Settings



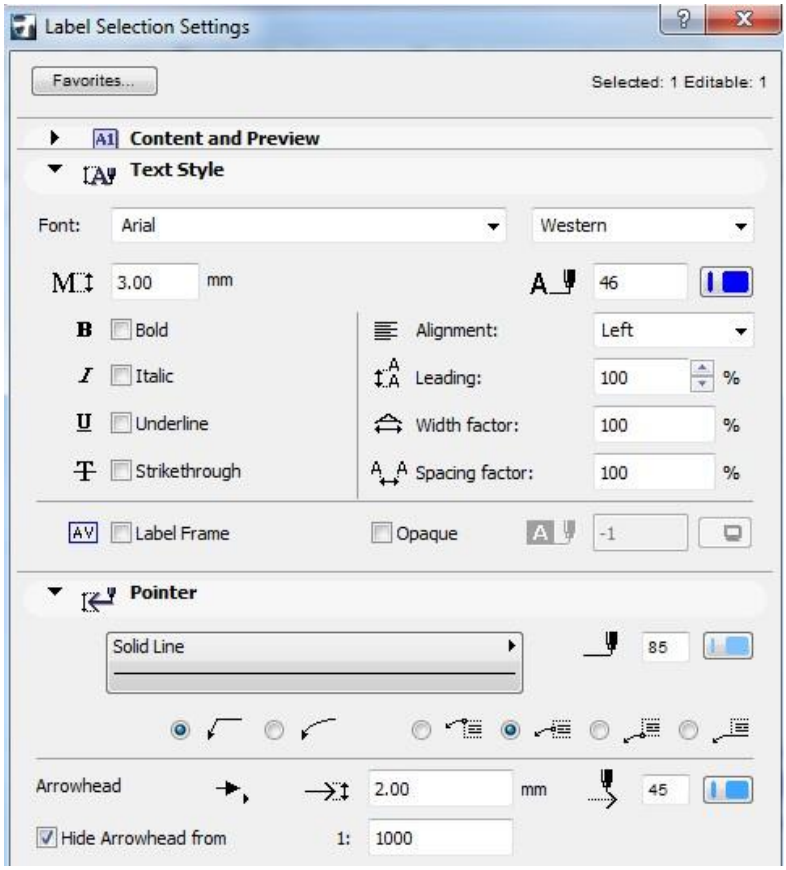
Using the **Text** tool, you can create multiline texts with full-scale font options, multiple styles and alignment in any direction.

2. Placing Text Blocks

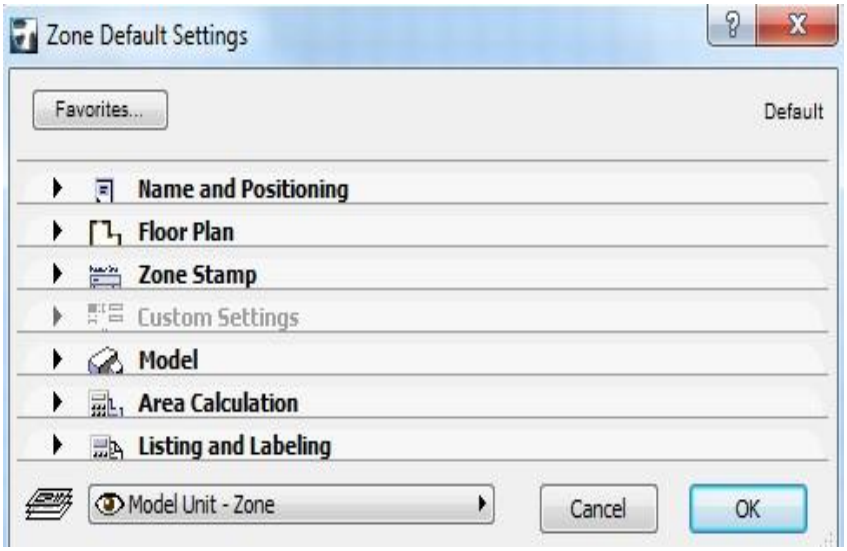
Before starting to type into a text block, you can determine whether it will be a “breaking” or “non-breaking” text block.



3. **Label tool and settings**: Labels are text blocks or symbols optionally linked to construction elements and 2D fills. Labels allow you to identify or comment elements or parts of your design.

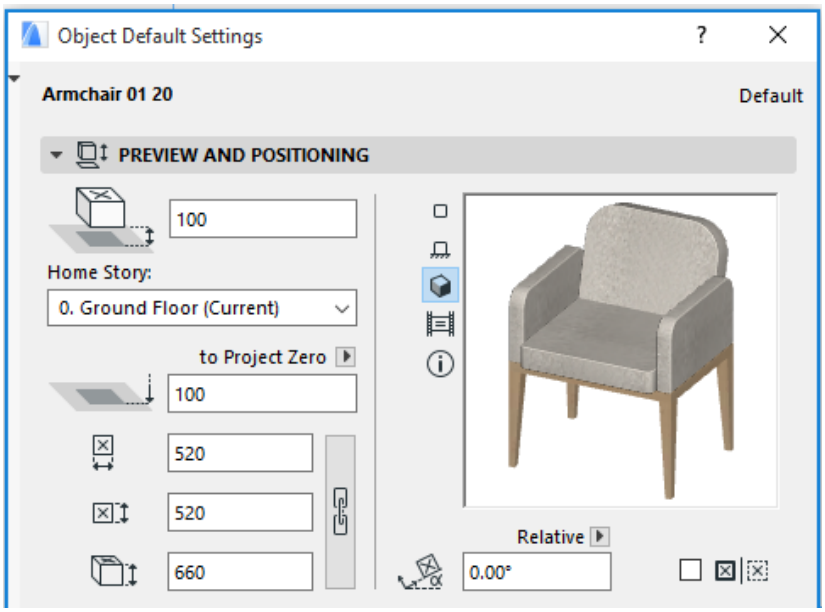


4. **Zone tool and settings;** The Zone tool is located in the Design panel of the Toolbox. Double-click it to open the Zone Settings dialog box. This window has seven panels: Name and Positioning, Floor Plan, Zone Stamp, Custom Settings, Model, Area Calculation and Listing and Labelling.



Content /Topic5: Libraries in ArchiCAD.

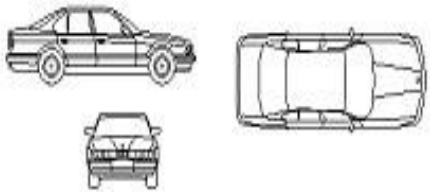
A. **What are Objects**: Some types of construction elements and objects placed in ArchiCAD as the instances of predefined, parametric objects residing in external files. These parametric objects are stored in libraries and can be used in many projects; many are associated with their own tool in the Toolbox.
B. **Types of Objects:** The object used in ArchiCAD include Wall End, Window, Door, Corner Window, Skylight, Object, Lamp and Stair.
C. **Purpose of Objects: objects** contain all the information necessary to completely describe building elements as 2D CAD symbols, 3D models and text specifications for use in drawings, presentations and calculations.
D. **Object Parameters:** The settings dialog boxes of Library Part type elements are more complex than those of basic construction elements presented. They consist of two parts:
   -On the left, the browser area allows you to locate single library parts corresponding to the active tool in the loaded libraries, either by browsing or by entering search terms to find a library part by name.
   -The right-hand side of the dialog box contains settings panels, similar to the ones described for construction elements.



The panel on the right always shows the content of the folder selected on the browser area. If you select an element (not a folder) in the browser panel, its settings appear on the right-hand side of the dialog box.

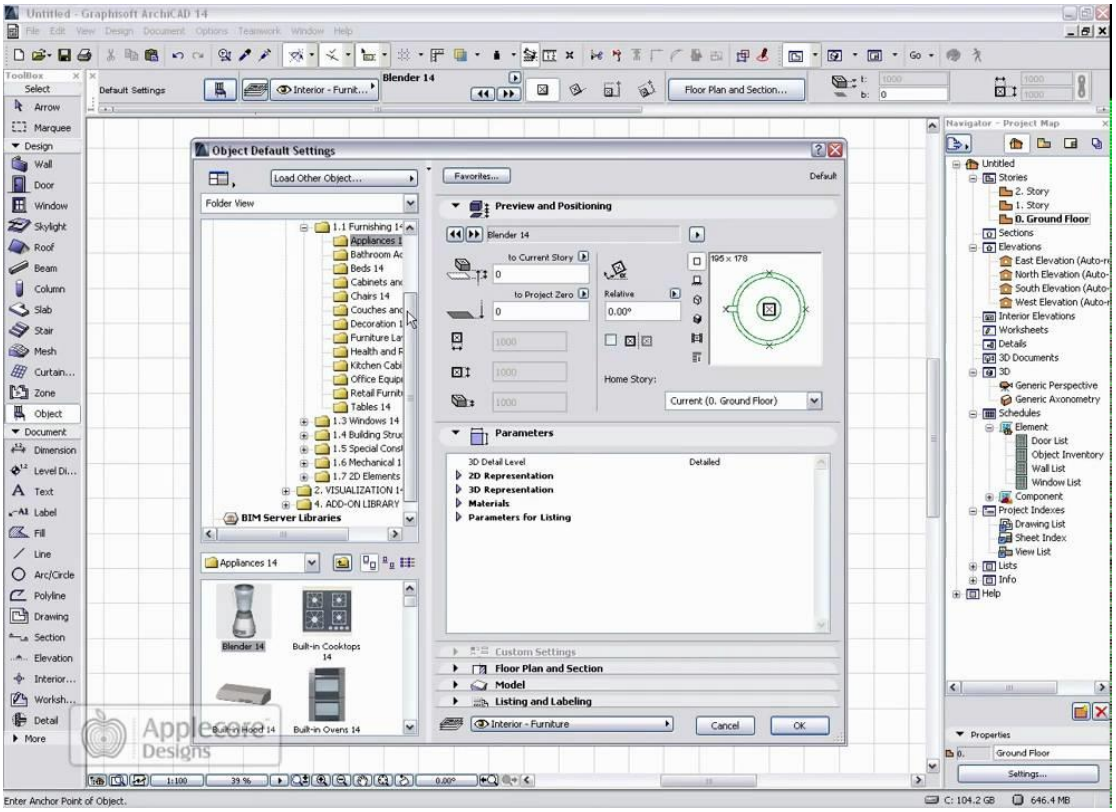
On the Floor Plan, Objects are represented by a 2D symbol while their 3D view is generated from the 3D script that consider the parameter choices made by the user.

Some 2D only objects have special 2D symbols especially designed for use in the Section/Elevation window.

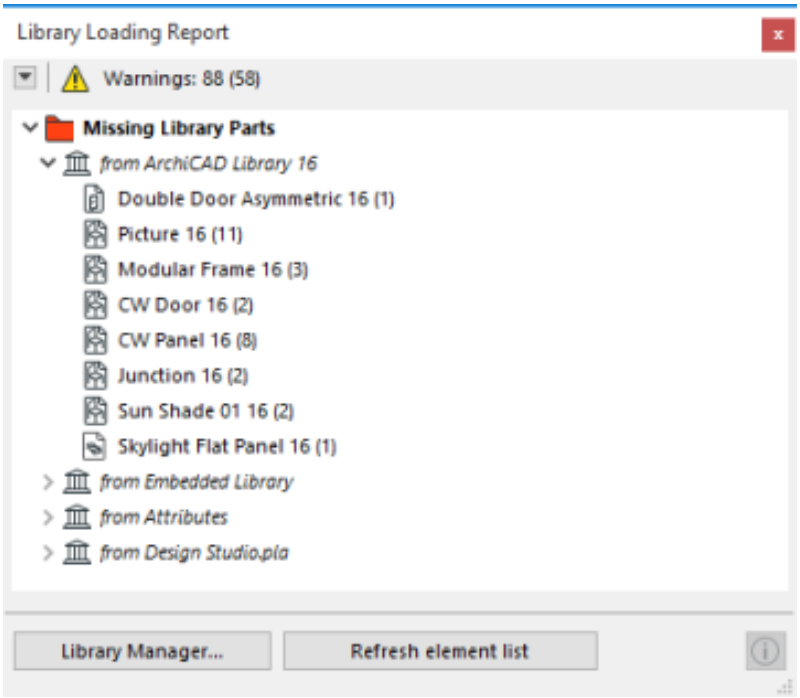


E. **Starting with the ArchiCAD Library:**

ArchiCAD library part is the basic item through which the CAD software ArchiCAD handles external dynamic content elements which are grouped into libraries. A library part is a file in a library.



F. **Loading a Project Library:**

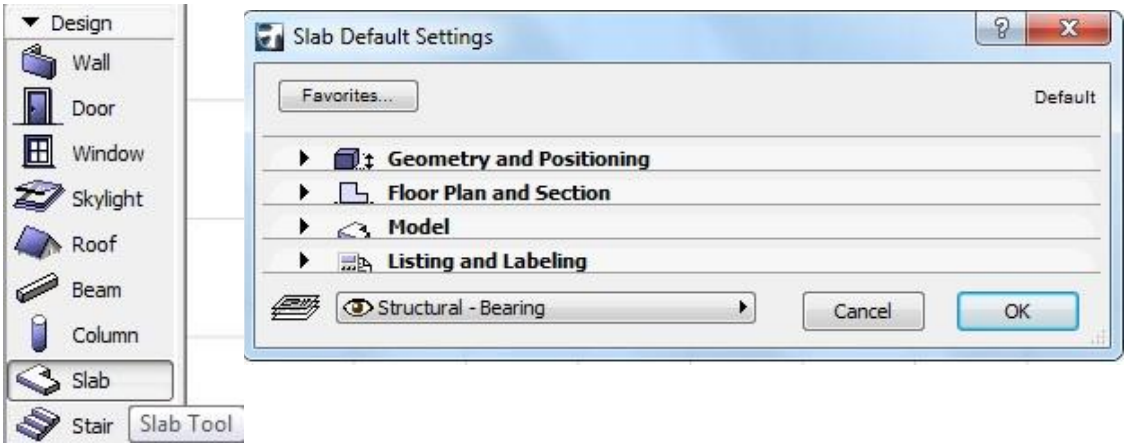


G. **Loading an Internet Library:** Is the way of adding missing library trough internet automatically downloaded.

LO 2.3 – Create virtual building.

Content/Topic 1: Element of virtual building.

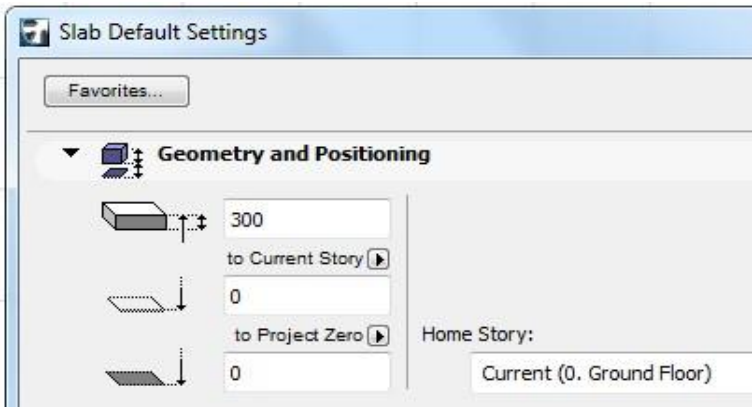
A. **Building Slab:** Slabs are the horizontal building blocks in ArchiCAD. They are typically used for modelling floors or split levels. Slabs can be drawn either on the Floor Plan or in the 3D Window. The Slab Tool Settings dialog box contains five panels: Geometry and Positioning, Floor Plan and Section, Model and Listing and Labelling. At the bottom of the dialog box, as for all tools, the current layer choice is displayed in a pop-up menu.



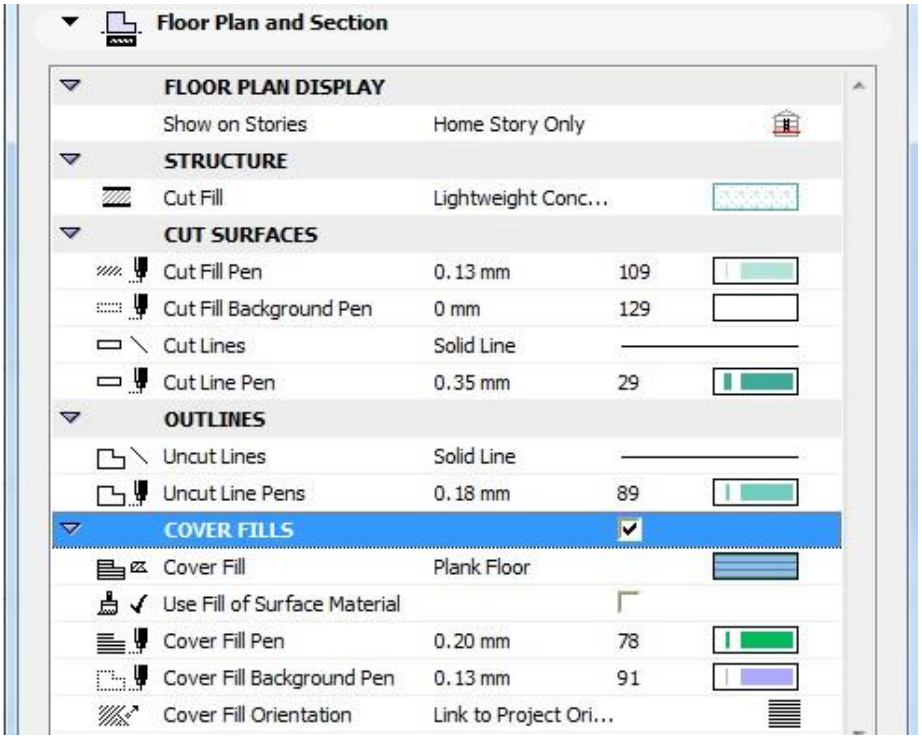
Slab Settings

i. Double-click the Slab Tool to open the settings dialog.

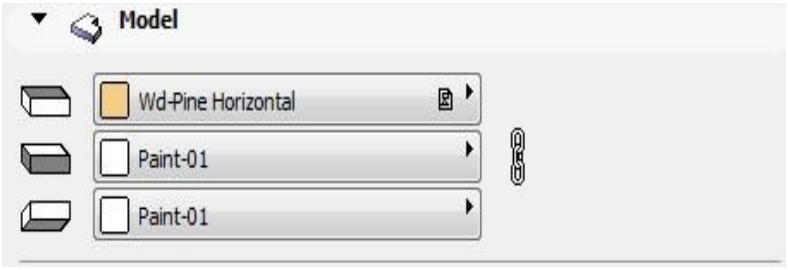
ii. The Geometry and Positioning panel contains the Slab's thickness and elevation values as well as the option to show it on multiple stories.



iii. In the Floor Plan and Section panel you can set the line type, fill pattern and pen color that will be used to represent the Slab's outline in the Floor Plan and Section/Elevation Windows.



iv. The Model panel's most important controls define the Materials used for displaying the different surfaces of the Slab in 3D view. You can use three different materials for the Slab's different surfaces or click the chain icon to use the last selected material for all surfaces.

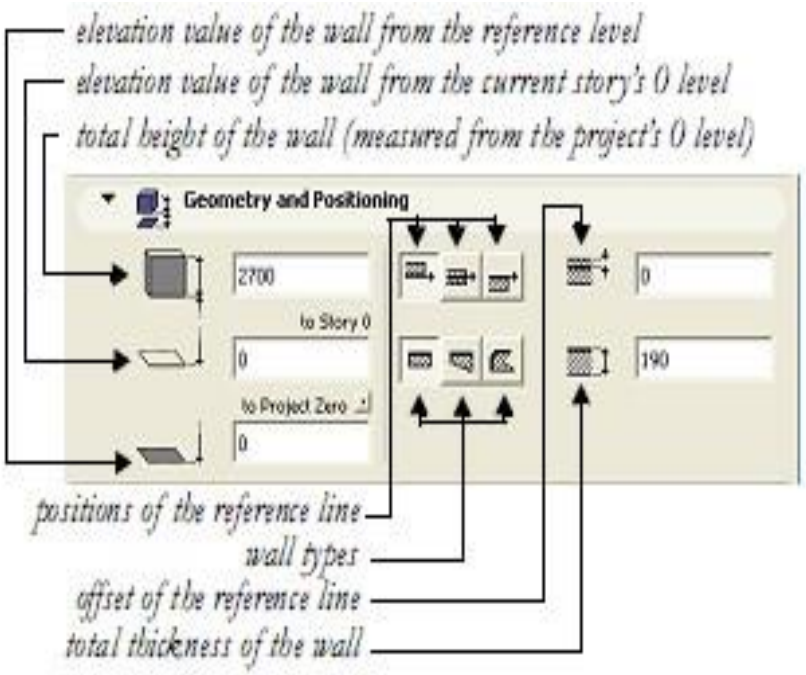


v. The fifth panel is called Listing and Labelling and controls the handling of the Slab in calculations.

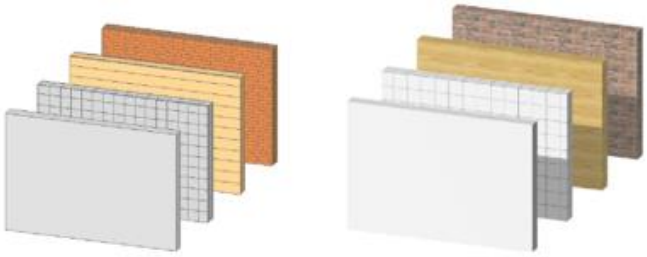
vi. Finally, set the layer and when finished, click OK.

B. Walls and Columns:

1. The Wallis a fundamental element in the practice of architecture. When you create a Wall in *ArchiCAD*, you create the outline and hatching of a Wall in 2D and a solid Wall body in 3D.

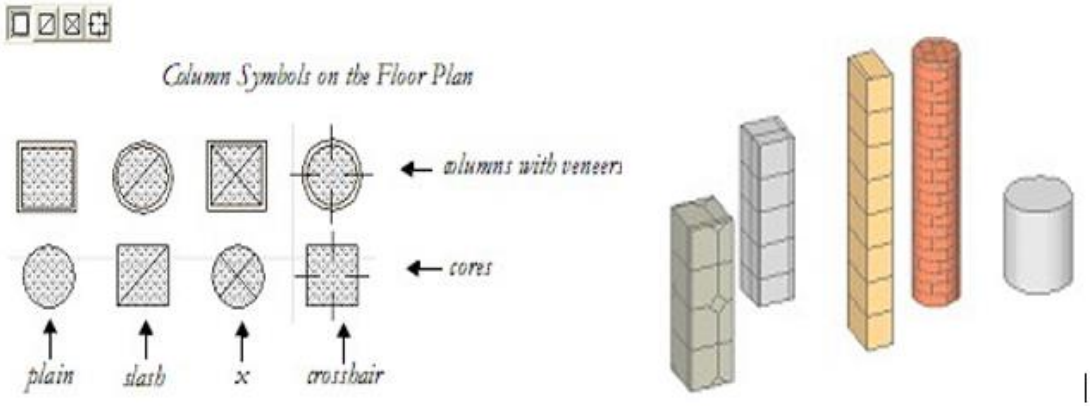


In 3D views and Photo renderings, the look of the wall's surfaces is provided by the Materials assigned to them.



Wall tool and settings: The Wall Tool Settings dialog box contains four panels: Geometry and Positioning, Floor Plan and Section, Model and Listing and Labelling.

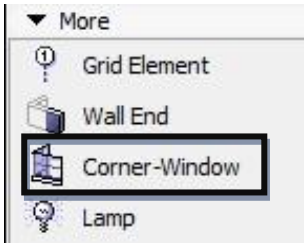
2. **Columns:** Use the Column tool to create new columns in either the Floor Plan or the 3D Window.Choose the desired column attributes and geometry from the Column Settings Dialog box, then click to place the column into the project.



The column settings dialog box contains four panels: Geometry andPositioning, Floor Plan and Section, Model and Listingand Labelling. At the bottom of the dialog box, as for all tools, the current layer choice is displayed in a pop-up menu.

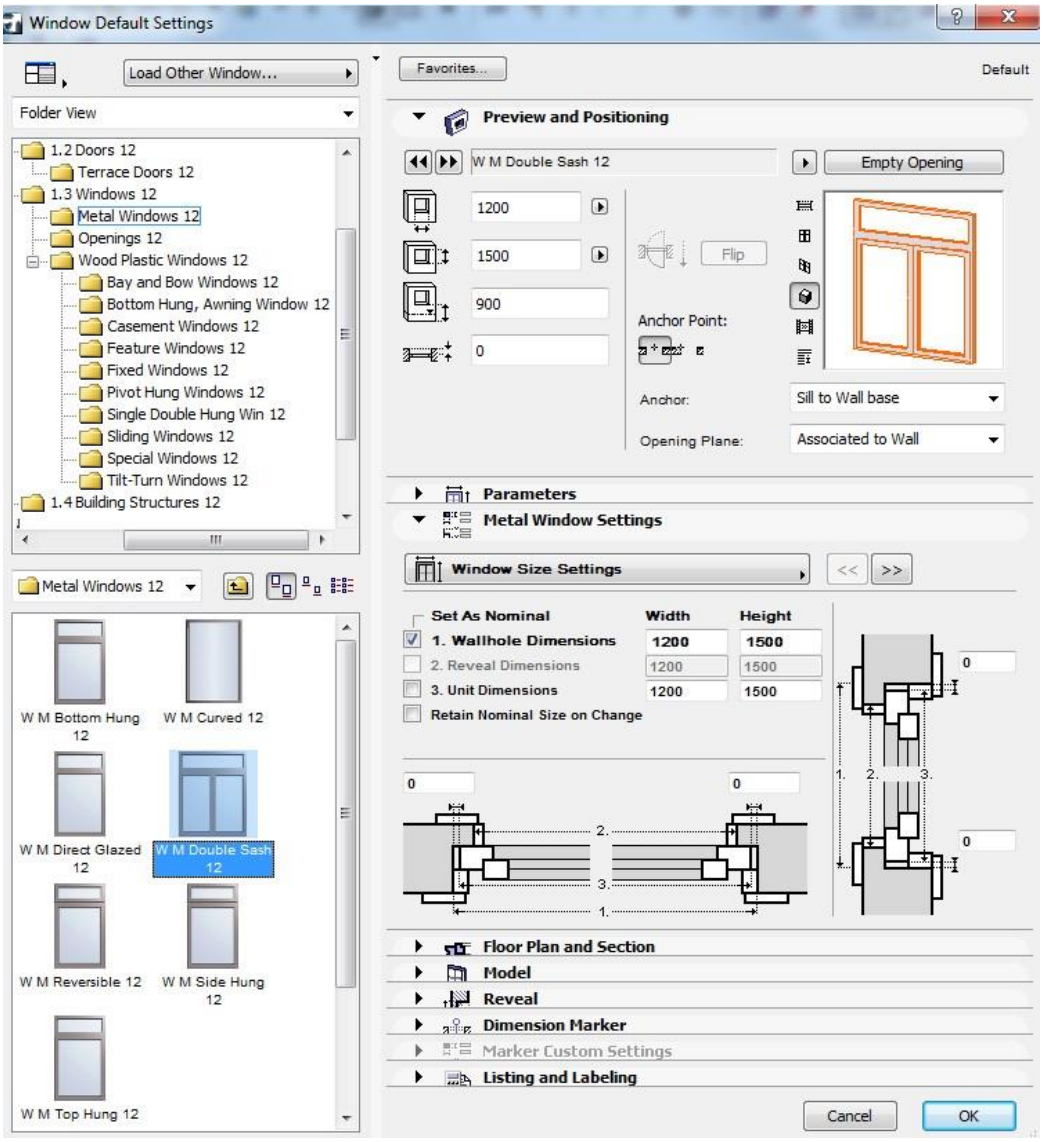
C. Doors and Windows: The handling and behavior of Windows and Doors are quite similar; therefore, they will be described together. In ArchiCAD, Doors and Windows simulate the look and behavior of real-life Windows and Doors. They are always placed into walls. Doors and Windows cut real, see-through openings into the wall, so that 3D visualizations are more accurate and lifelike. However, glass panes are represented as solid shapes, allowing opaque openings for standard elevations. The glass material lets light in and you can look through the Windows and glass Doors in Photo Rendered views.

i. The Window,Door and Skylight tools are represented by icons within the Design panel of the Toolbox. The Corner Window and Skylight tools are located in the more panel of the Toolbox.



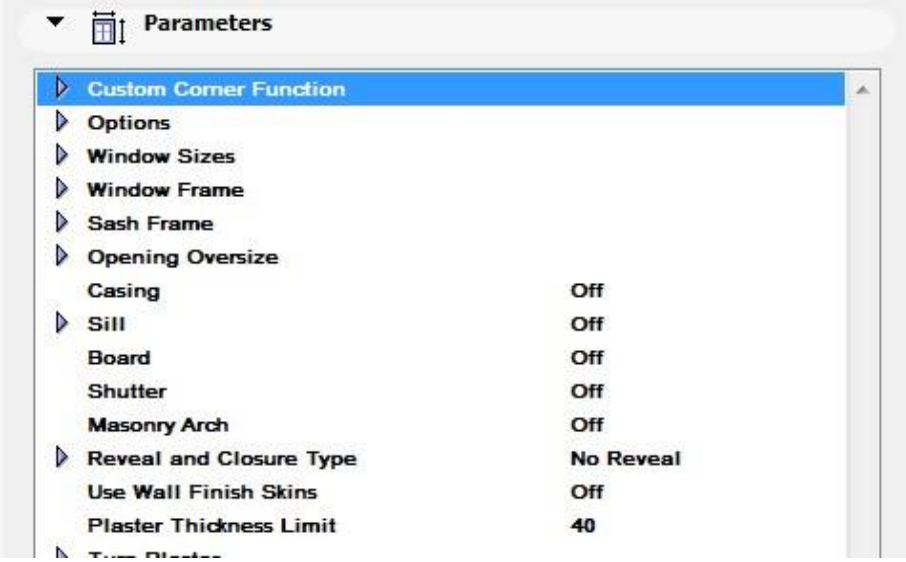
ii. Configure the Window Settings

- . Open the Window Settings dialog from the Toolbox. The Window and Door Settings dialog boxes are alike. They comprise a browser area to the left and a number of panels on the right.

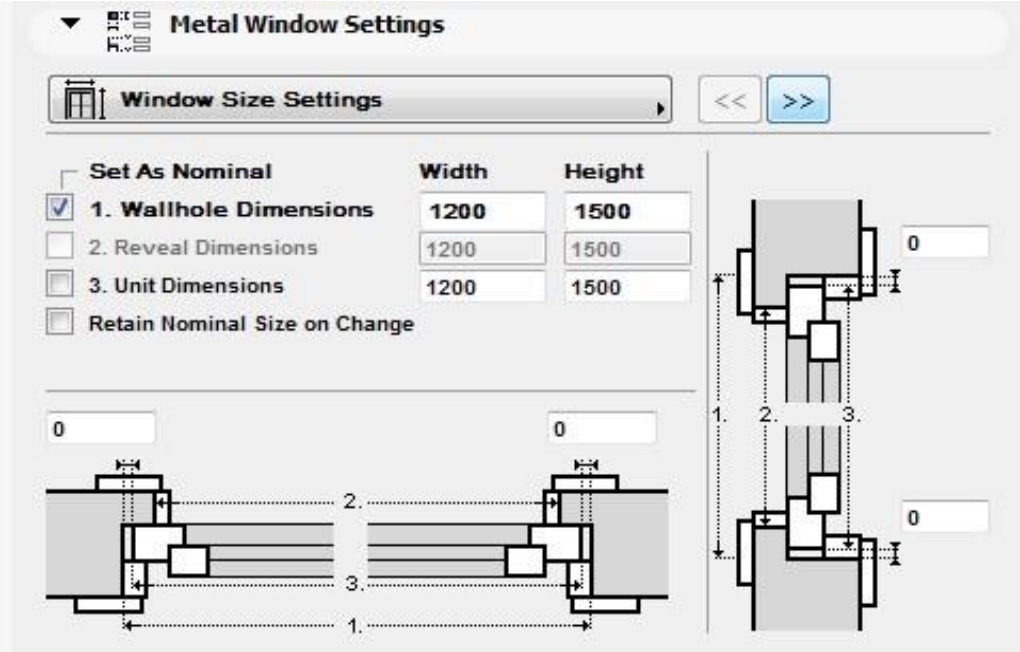


- From the navigation tree on the left, select the “Metal Windows 12” folder.
- A list of available windows will appear in the window below. Select the “W M Double Sash” window.

b . The second panel is called **Parameters**. It contains the nominal dimensions of the opening as well as the set of parameters defined in the Library Part.



C . The third panel, the Metal Window Settings, is a wizard dialog for the most commonly used parameters found within the Parameters panel. Navigating these settings will vary from object to object. Some objects may use a Next and Back button while others, like this object, will use a pop-up menu.

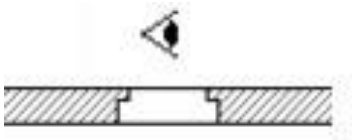


iii. Placing doors and windows

Windows and Doors can only be inserted into Walls; they cannot be placed independently in the project. Placement methods are defined in the **Preview and Positioning** tab page of the Door/Window Settings dialog boxes. The Anchor Point setting decides whether you will place the Window or Door by its center point or its side.

In the Floor Plan, you can place a Window or Door opening at any **Checkmark** or **Mercedes** cursor position on a wall.

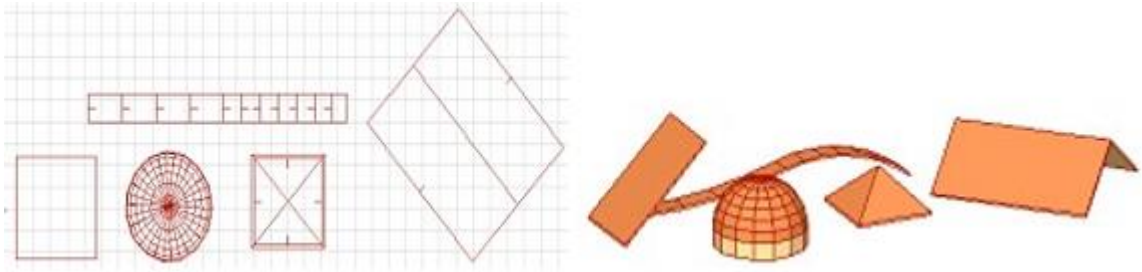
- To place Door and window



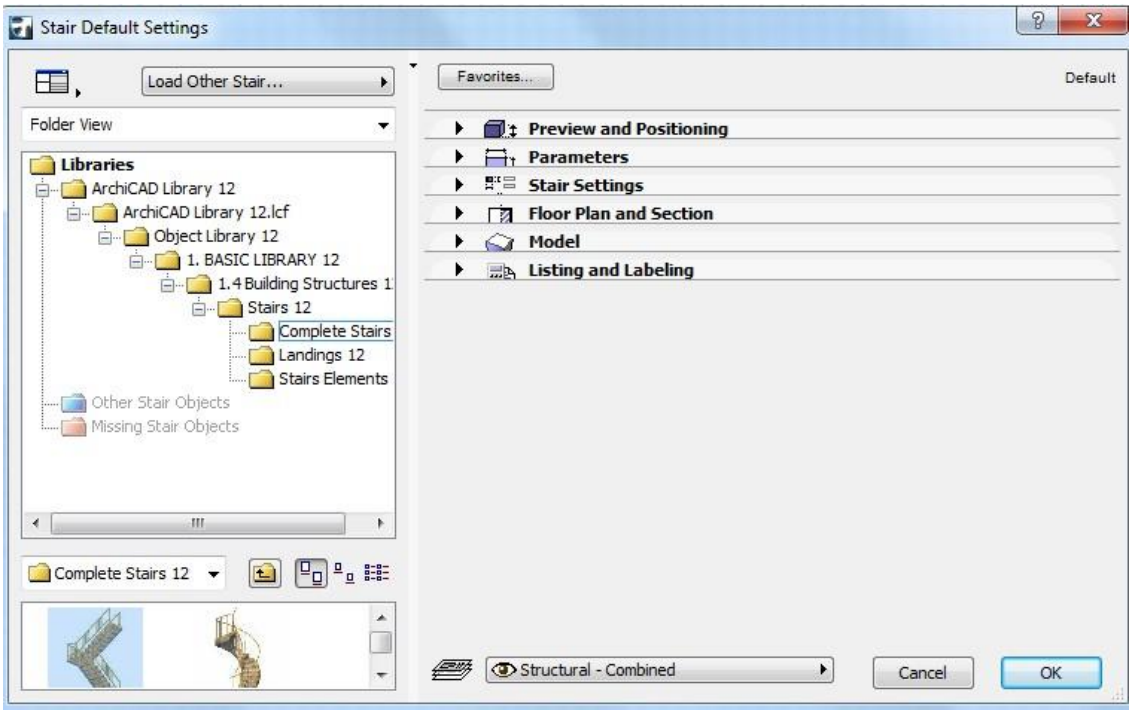
D. Stairs and HandrailsRoof Plan:

ArchiCAD Roofs have very flexible characteristics. They can be used to create abstract 3D shapes meeting a wide variety of needs. In Floor Plan view, the outline of the Roofs is shown together with them pivot lines. This horizontal non-printing element is part of the lower surface of the roof.

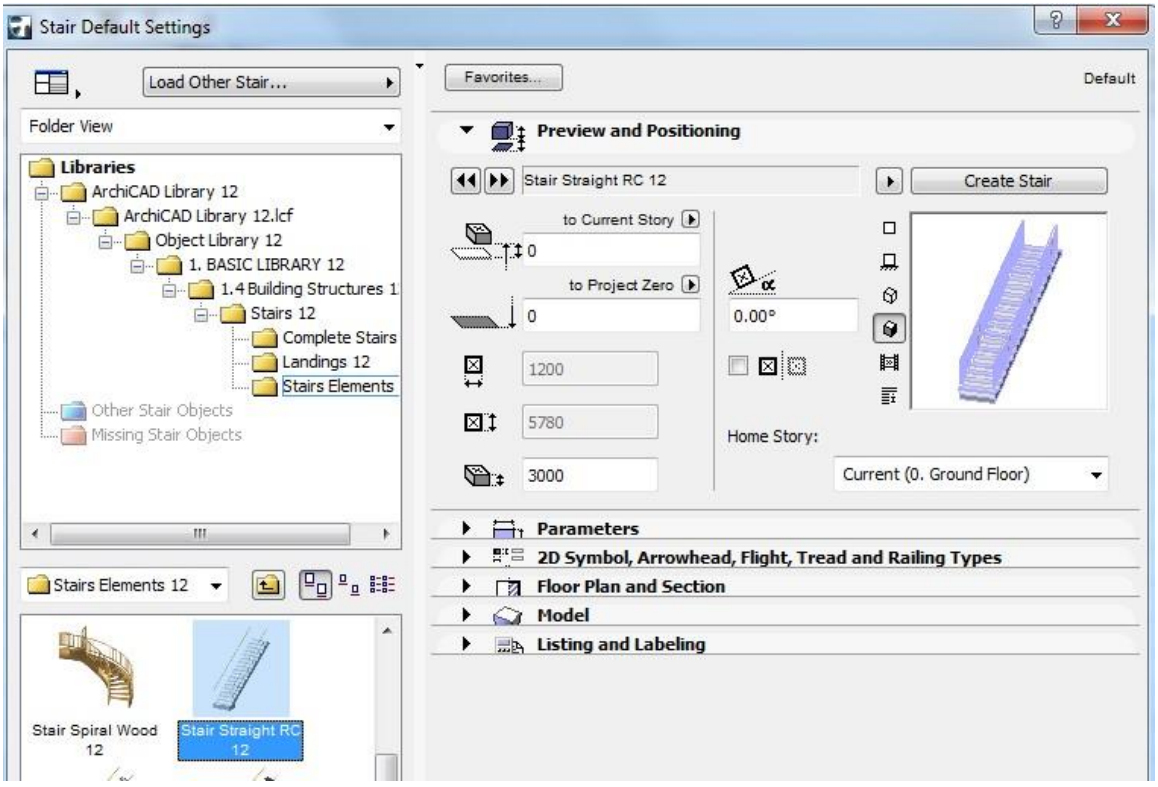
1. Open the Roof Settings dialog from the Toolbox and configure the settings from the following options.



2. The Stair tool is used to place stair type library parts into the Project. The Stair tool's Settings dialog box includes many of the same panels as that of the Object and Lamp tools: Preview and Positioning, Parameters, Floor Plan and Section, Model, and Listing and Labelling. These settings apply to stair objects placed directly from the Stair Settings dialog box, similarly to other objects.



In the Stair Settings dialog, select the Stair Straight RC 12 object from the Stairs Elements folder within Stair 12.



E. Building Structure: ARCHICAD is a complete design suite with 2D and 3D drafting, visualization and other **building** information modelling functions for architects, designers and planners. 3D Modeling software (is a 3D CAD interface specially developed for architects capable of creating various kind of **building** forms).

F. Furnitures And Equipment: Objects are predefined complex parametric elements that can be freely placed in the project.

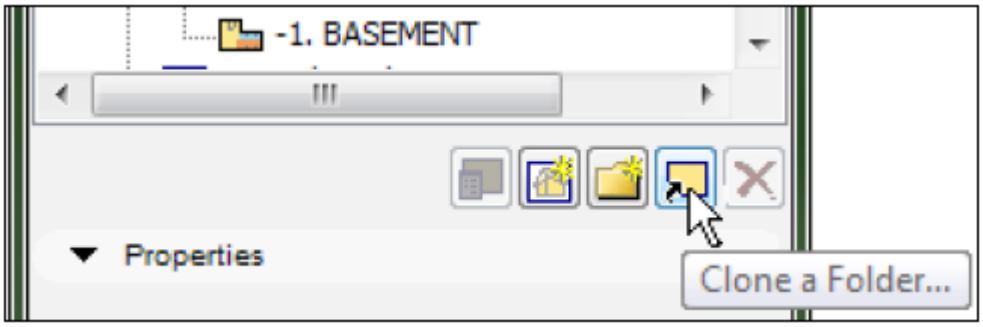
1. Object settings

- ✓ Double-click the Object Tool to open the Object Settings dialog.
- ✓ From the Folder View open ArchiCAD Library > Furnishing > Kitchen Cabinet. Select the “Cabinet Base Corn-L”.
- ✓ The Preview and Positioning panel includes simple navigation controls, elevation input for the Object or Lamp as well as a Preview Area that displays the 2D symbol, the hidden line front view, the hidden line axonometry, the 3D shaded axonometry, the predefined preview picture or theoptional information notes of the selected Object or Lamp.
- ✓ The second panel is called Parameters. It contains the dimensions of the Object as well as the set of parameters defined in the Library Part.
- ✓ The other panels are Door, End panel, Counter. These panels will change for each object and is designed to display graphically the most commonly used parameters.
- ✓ The following panel is Kitchen Cabinet Settings.
- ✓ When finished with the settings, click the OK button.

G. Ceiling and lights: You need to create a set of views for your ceiling plans to show the locations of your lights. Ceiling plans are graphically different from regular floor plans. Because of this, we need a separate set of views that have their own model views. This situation calls for the creation of a clone folder.

Cloning a folder is a complete copy of a viewpoint category from the project map, such as stories, sections, or elevations, with its own view settings saved. Here is how to create one for your ceiling plans:

1. From the view map, click on the **Clone a Folder** button. The Clone a Folder configuration window will appear.

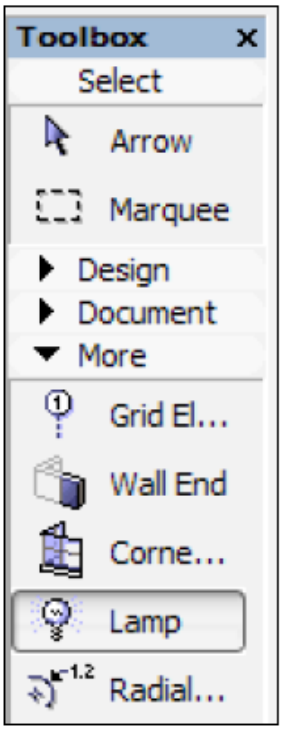


2. In the Identification panel, click on Stories, change the Name setting to Custom and enter CD Ceiling Plans in the text box. (CD stands for construction documents).
3. In the General panel, change Layer Combination to Reflected Ceiling Plan, set the Scale to 1/4" = 1'-0", the model view options to Reflected Ceiling Plan, and Renovation Filter to 04 New Construction.
4. In the 2D/3D Documents panel, change the zooming to Fit in window.
5. Click on the Clone button.
6. Find the new folder in View Map; select it and drag it up to the position just below CD floor plans.

Light fixture objects in ArchiCAD are called Lamps. Now that you have your ceiling views ready, you can insert the lamp objects you need to light the inside of your house. They are as follows:

1. Open the second-floor view under the CD Ceiling Plans folder.
2. Click on the **Lamp tool** on the Toolbox palette (located under the More panel). Click on the **Lamp setting button** on the Info Box palette.
3. Navigate to **26 Electrical | 26 51 00 Interior Lighting**and select Ceiling Lamp.
4. Under the Parameters panel, change the Style to Type 2.
5. Under the Parameters panel, click on **Show Text**, and then enter the letter A in the text box.
6. Place one in the center of each bedroom.

The following screenshot shows the **Lamp** option:

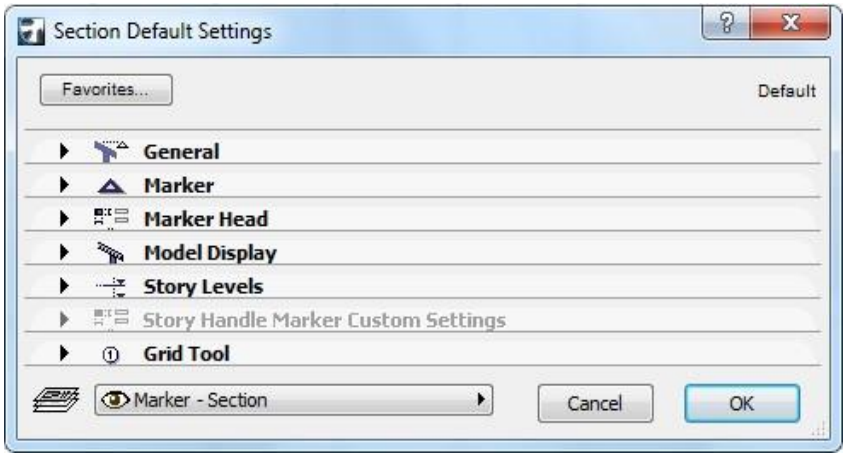


H. **Molding and Panels:**Panel molding is a decorative molding originally used to trim raised panel wall construction. Panel molding adds depth and style to any wall and comes in many patterns and styles. Restorers Architectural panel molding is made from lightweight urethane that is primed and molded to create beautiful historic and new designs. Urethane can be cut, drilled, nailed and screwed just like wood and can be used outdoors as well. Acanthus, egg and dart, rope, dentil, traditional, Bradford, and many other designs are available.

I. **Zones and Section/Elevation:** Double-clicking the Section tool  opens the Section Settings dialog box, which consists of seven panels: General, Marker, Marker Head, Model Display, Story Levels, Story Handle Marker Custom Settings and Grid Tool. Some of the panels' settings concern the Floor Plan appearance of the Section Line, while others control the contents of the Section/Elevation window.

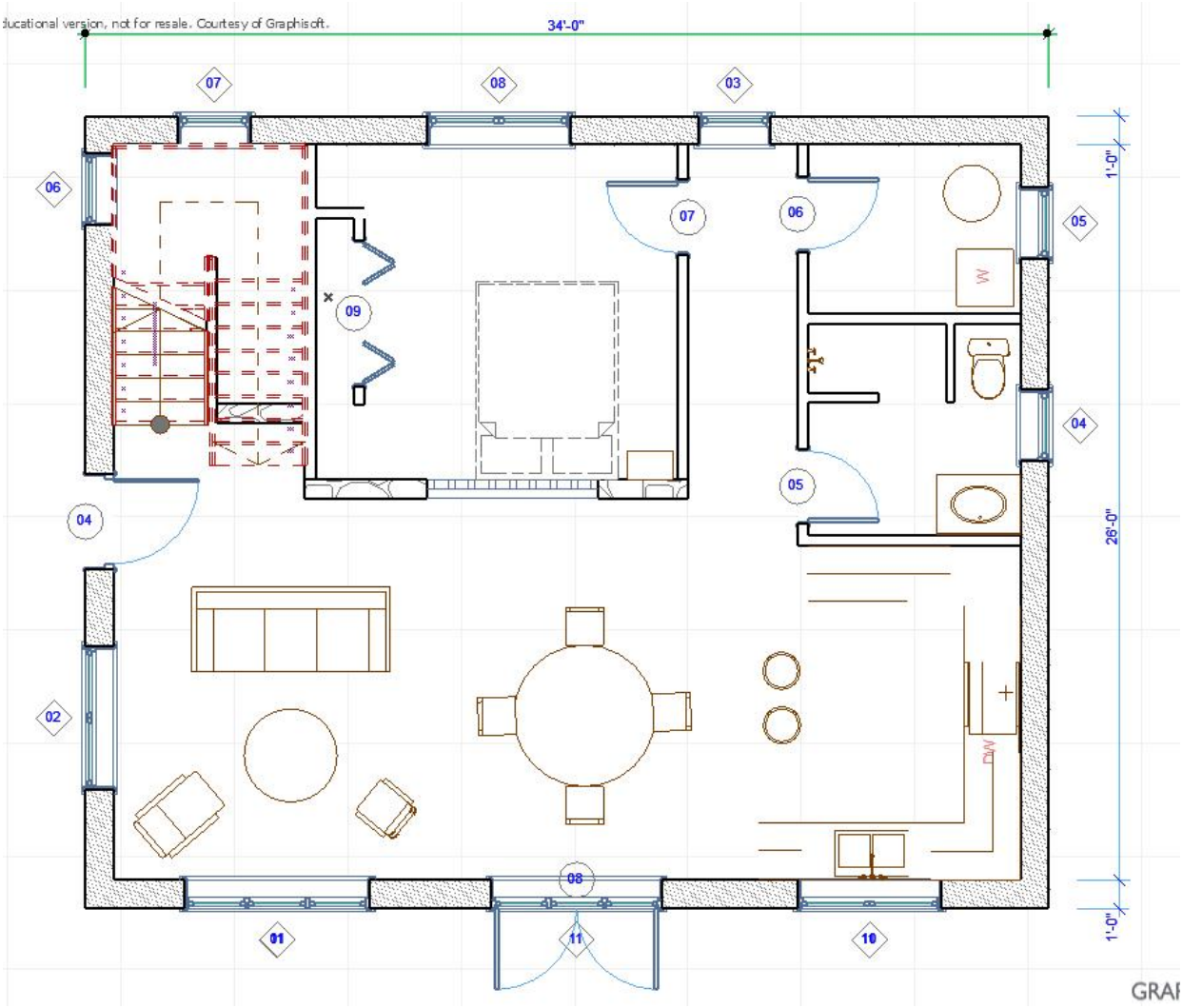
Configure Section Settings

Open the Section Settings dialog from the Toolbox and configure the settings per the following:



J. **Site Layout:**

I'm trying to make a site plan of my projects in ArchiCAD, But I couldn't figure it out how is the best way. is there a view that shows the projection of all model, using the projected of the stories I couldn't do it, how did you do it?



K. Creating Library Parts: This step-by-step walkthrough shows how to create a static library (.lib file) for use with C++ apps. Using a static library is a great way to reuse code. Rather than re-implementing the same routines in every app that requires the functionality, you write them one time in a static library and then reference it from the apps. Code linked from a static library becomes part of your app, you don't have to install another file to use the code.

This walkthrough covers these tasks:

- Creating a static library project
- Adding a class to the static library
- Creating a C++ console app that references the static library
- Using the functionality from the static library in the app
- Running the app

To create a static library project

a. On the menu bar, choose **File**, **New**, **Project**.

b. In the left pane of the **New Project** dialog box, expand **Installed**, **Templates**, **Visual C++**, and then select **Win32**.

c. In the center pane, select **Win32 Console Application**.
d. Specify a name for the project for example, *Math Funcs Lib* in the **Name** box. Specify a name for the solution for example, **Static Library** in the **Solution Name** box. Choose the **OK** button.
e. On the **Overview** page of the **Win32 Application Wizard** dialog box, choose the **Next** button.
f. On the **Application Settings** page, under **Application type**, select **Static library.**
g. On the **Application Settings** page, under **Additional options**, clear the **Precompiled header** check box.
h. Choose the **Finish** button to create the project.

LO 2.4 – Apply Updating layout, printing and plotting.

Content/Topic 1: Purpose of linked drawing:

Linked drawings allow us to create drawings from data that is changeable and most conveniently stored within geocoded tables or queries.Manifold can create ***linked drawings*** from geometry data in tables or from geometry data fetched or created by queries. Using ***geometry data in tables*** and then creating linked drawings from that data allows storing drawings within tables in a fully read/write and editable way. However, at times we deal with simple, non-geometry data in tables and would like a simpler way of displaying such data in drawings.

Like all linked drawings, the linked drawing is created from geometry data; however, in this case the geometry data from which the linked drawing is created comes from the intermediate query. The automatically-created query takes data from the coordinate columns in the table and creates geometry data necessary for a linked drawing. There is nothing special about this process that could not be done manually, if we were so inclined.

The only magic in this process is that if we try to link a drawing from a table that contains no geometry data (Manifold can see right away if a table contains geometry data or not), then Manifold assumes we want to create a linked drawing from a geocoded table and so it launches the appropriate dialog. When we use that dialog to specify which columns are to be used as coordinate columns (that is, for the longitude and latitude columns or X and Y columns), then Manifold knows what columns to use in the query it writes for us.

To create a linked drawing from a geocoded table:

1. Choose **File - Link - Drawing** and open the desired database file or connect to the desired data source.
2. Choose the table desired and check the desired fields. Specify the fields that contain latitude and longitude values (by default, the system will guess that any fields named "Latitude" and "Longitude" are the fields to use. Press **OK**.

Four new components will appear in the project:

- A linked table - This linked table is a way of linking the table data from the geocoded table that will provide the data for the linked drawing.
- A query - This query transforms the ordinary, geocoded data in the coordinate columns into geometry data from which the linked drawing will be created.
- A linked drawing and the linked drawing's table - The linked drawing is like any drawing, except it is created dynamically from the data within the geocoded table.

Uses for Linked Drawings

Linked drawings allow us to create drawings from data that is changeable and most conveniently stored within geocoded tables or queries. The classic use for a linked drawing is within a **Manifold IMS** application such as a vehicle tracking web site. Suppose we have a fleet of trucks or ships or other vehicles and we would like to display the location of each vehicle on a web site map. Suppose we can acquire the location of each vehicle through some other application that receives location data from a GPS in each vehicle and places it into a table in our database. Showing the location of each vehicle in Manifold is as easy as creating a linked drawing using that table.

Content/Topic 2: Updating linked drawings:

The Linked objects sidebar gives users the ability to quickly access all linked content to see if anything is outdated and update all the content with a single click.

This means that the drawing placed on the layout will be updated automatically when the layout is activated (brought to front or selected for output). Automatic updates also occur before publishing. If a drawing comes from a different source than the currently opened project file, then ARCHICAD will check whether it requires updating or not, and perform an update if necessary.
Although a linked drawing that appears in the project pane is normally read-only, it is usually possible to edit that linked drawing by editing the linked table within the project from which it is created, which will end up editing the table in the data source as well. We could also edit the original data source. For example, suppose we have a linked drawing created from a query that grabs data from a table in an external database file. We could change that linked drawing by editing either the external table or by editing the query.

Linked drawings normally are used not for the purpose of interactive editing through the Manifold console graphical user interface but rather to display visually data from some database table. The assumption is that the database table from which the drawing is

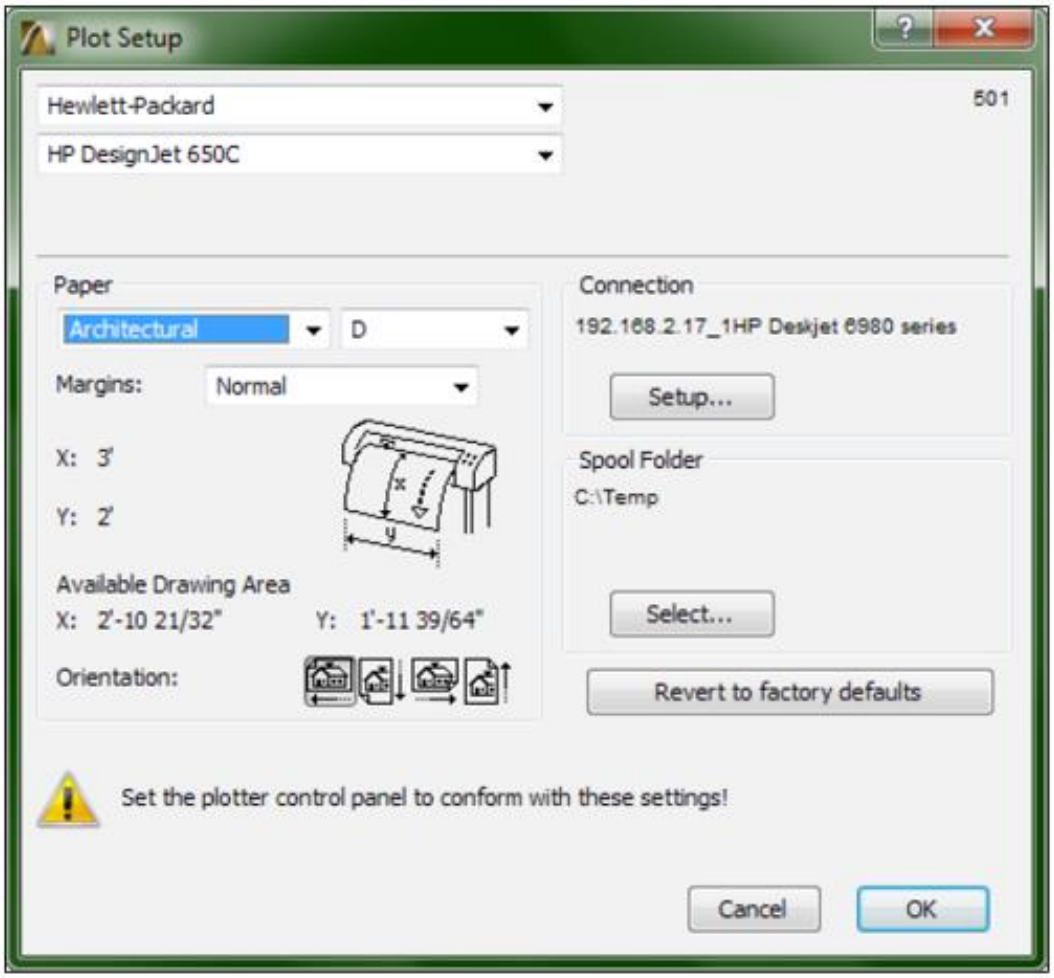
created will be edited through the database management system or by other programs which will change the data in the table.

A. **Save special command**. To update the data in a multiple charts or tables:
   - In Docs or Slides, at the top click *Tools > Linked objects*.
   - A sidebar will open on the right, at the bottom click **Update all**.
     Note: Click **Update** next to specific objects to update them individually.

Content /Topic 3: Printing and plotting from ArchiCAD.

A. **Printing:**You will learn that printing in ArchiCAD offers you a robust array of features. There are three ways in which you can print something from ArchiCAD. You can use the *Print command*, *Plot command*, or Publisher using a preconfigured publisher set. The Print command is typically used for your small format printing, such as 1'' x 17''and smaller. The Plot command is typically used for everything larger than 1'' x 17''. You can print a view, single sheet, or multiple sheets at a time or just the area within a marquee in a view.

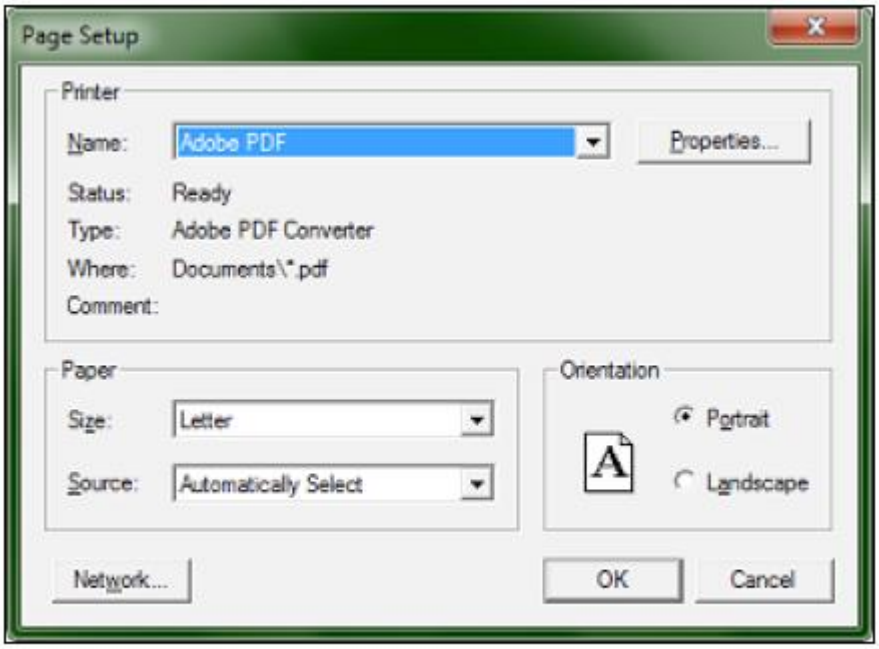
B. **Setting up to print or plot:** Before you plot anything on a large-format printer (known as a plotter), you need to configure the **plot setup** for your plotter typethe connection port/path, sheet size, and location of your spool folder, as follows:
   1. Go to the **File** menu and select **Plot Setup.** The **Plot Setup** window will appear.
   2. Select the manufacturer (make) of your plotter from the top drop-down list. Then, select the model number from the second drop-down list. If your plotter makes and model does not appear in the list, use **Hewlett Packard**, **HP Design Jet 650C**.
   3. Set your paper size category and size designation.
   4. Click on the **Setup** button under the **Connection** heading and set it to connect to your plotter.
   5. Click on the **Select** button under the **Spool Folder** heading and set it to a location where you would want to save your plot files.
   6. Click on **OK**.



A plot setup example

C. **Page setup:**Setting up for printing using a small-format printer with the Print command is a bit simpler than the plot setup. It assigns the printer, paper size and orientation:

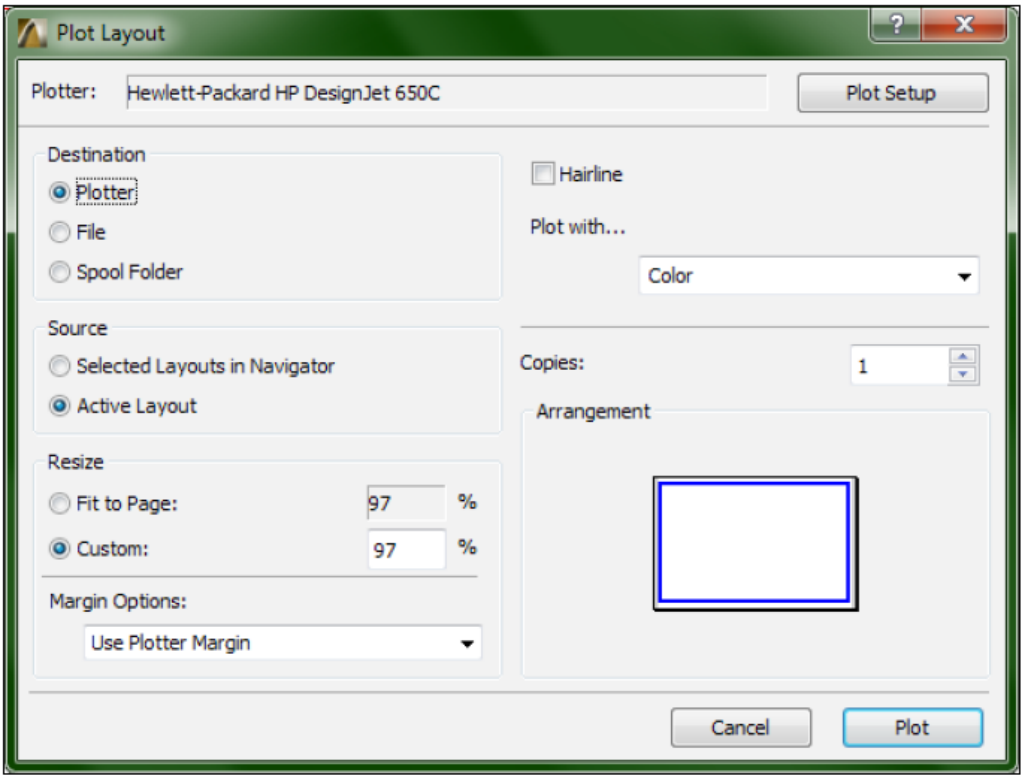
1. Go to the **File** menu and select **Page Setup**. The Page Setup window will appear.
2. Select your printer from the **Name** list. If the printer you want to use is not in the list, then click on the **Network** button and browse connect to a new printer.
3. Then, set your paper size and orientation.
4. Click on **OK**.



The page setup example

D. **Plotting a layout:** For our first printing task, let's plot a single full-size sheet with the Plot command, as follows:

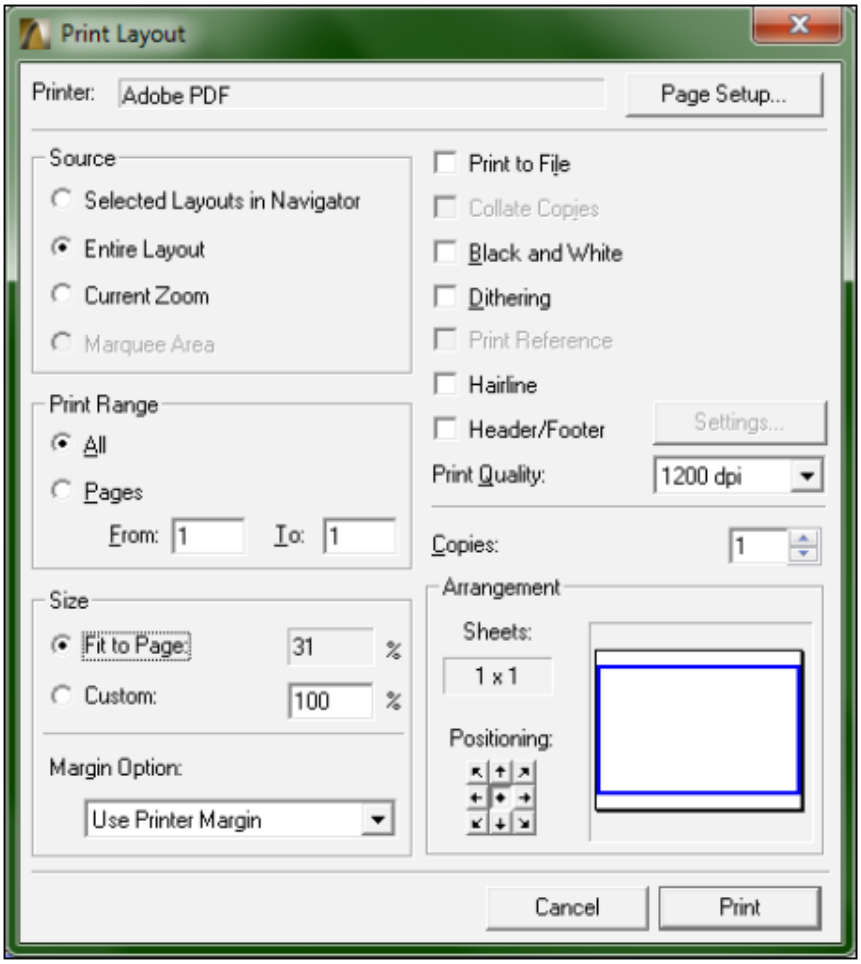
1. Open the **A-101 1st FLOOR PLAN** layout from the **Layout Book** palette.
2. Go to the Filemenu and click on **Plot.**The **Plot Layout** window will open.
3. Under the Destinationheading, select **Plotter**.
4. Under the Sourceheading, select **Active Layout**.
5. Under the Resizeheading, select **Custom**. If the value is less than 100 percent, then don't worry; it is acceptable because there is a margin to accommodate.
6. Under **Margin Options**, select **Use Plotter Margin**.
7. Under **Plot with…** you can select whatever is appropriate for your plotter and needs, such as **Color**, **Grayscale**, or **Black and White**.
8. Under the **Arrangement** heading, you will see a blue rectangle representing the layout graphics inside a black rectangle that represents the paper's edge.
9. Finally, click on the **Plot** button.



The Plot Layout window

E. **Printing a layout (to fit):** Now, let's print that same layout to a small format printer, scaled to fit within a letter size print:

1. Keep the same layout open from the preceding exercise. Go to the **File** menu and select **Print** or press the key combination of *Ctrl* + *P.* The **Print Layout** window will open.
2. The printer will be identified at the top of the window. If it is incorrect, then click on the **Page Setup** button and assign the correct printer.
3. Under the **Source** heading, select **Entire Layout**.
4. Under the **Size** heading, select **Fit to Page**.
5. Under the **Arrangement** heading, the blue rectangle should fit inside the black rectangle (there should only be one black rectangle).
6. Compare the other settings to the following screenshot.
7. Finally, click on the **Print** button.



The Print Layout window

Content /Topic4: Printing and plotting from Plotmaker.

Is there a way to have **Plotmaker** print the date when printed and possibly the source of the file on the edge of the sheet every time one plots or prints from Plotmaker? I have discovered how you do this in ArchiCAD but not in Plotmaker.

Just put the right Autotext on your master sheet. You can insert it into a text area using the **Edit > Autotext >** and select from the popup list or you can type the placeholder text directly (once you know what it is).

You can print files in the following ways:

- From the **File** menu you can print with the following options: scaling, clipping, displaying the plot on the screen, or sending the plot directly to the printer. You can also print shaded images from this menu. You can create plot files of the current object (sketch, part, drawing, assembly, or layout) and send them to the print queue of a plotter. The plotting interface to HPGL and PostScript formats is standard.
- Use the Distributed Batch utility to create a command file of print or plot files without having to choose from the interactive menus. The command file contains a

list of objects to plot. For example, you can submit the job at the end of a workday, and the plot files are created and plotted offline.

- Hidden lines appear as gray for a screen plot, but as dashed lines on paper.
- You cannot plot when the option Use Fast HLR is checked in the Environment dialog box.
- When Creo Parametric plots the system line fonts, it scales them to the size of a sheet. It does not scale the user-defined line fonts, which do not plot as defined.
- You can use the configuration file option use software line fonts to make sure that the plotter plots a user-defined font exactly as it appears in Creo Parametric.
- With the CROSS-SEC menu active, you can plot a cross section from Part or Assembly mode.
- You can write plot files in Calcomp, Gerber, HPGL2, and Versatec format.
- For the HPGL2 driver to print a screen capture of OLE objects, the printer must support the HP RTL extension.

Learning Unit 3 – Perform AutoCAD Drawing.

LO 3.1 – Introduce AutoCAD.

Content/Topic 1: Introduction to AutoCAD.

Engineering graphics is the process of defining an object graphically before is constructed and used by consumers. Previously, this process for producing a drawing involved the use of drawing aids such as pencils, ink pens, triangles, T- squares, and so forth to place an idea on paper before making changes and producing blue-line prints for distribution. The basic principles and concepts of producing engineering drawing have not changed, even when the CADs are used as a tool. For this case AutoCAD is the Computer Aided Design under consideration.

The main objective of this course is to provide participants with:

- Basic theoretical and practical knowledge/skills to produce 2D technical/engineering drawings with the aid of AutoCAD.
- Understanding of concepts, tools and methods for drafting and preparing layouts in AutoCAD.

There are four workspaces supplied with AutoCAD: 2D drafting and annotation, Initial Setup workspace, AutoCAD Classic, and 3D Modelling.

Content/Topic 2: Advantages of AutoCAD.

The following are the advantages of AutoCAD.

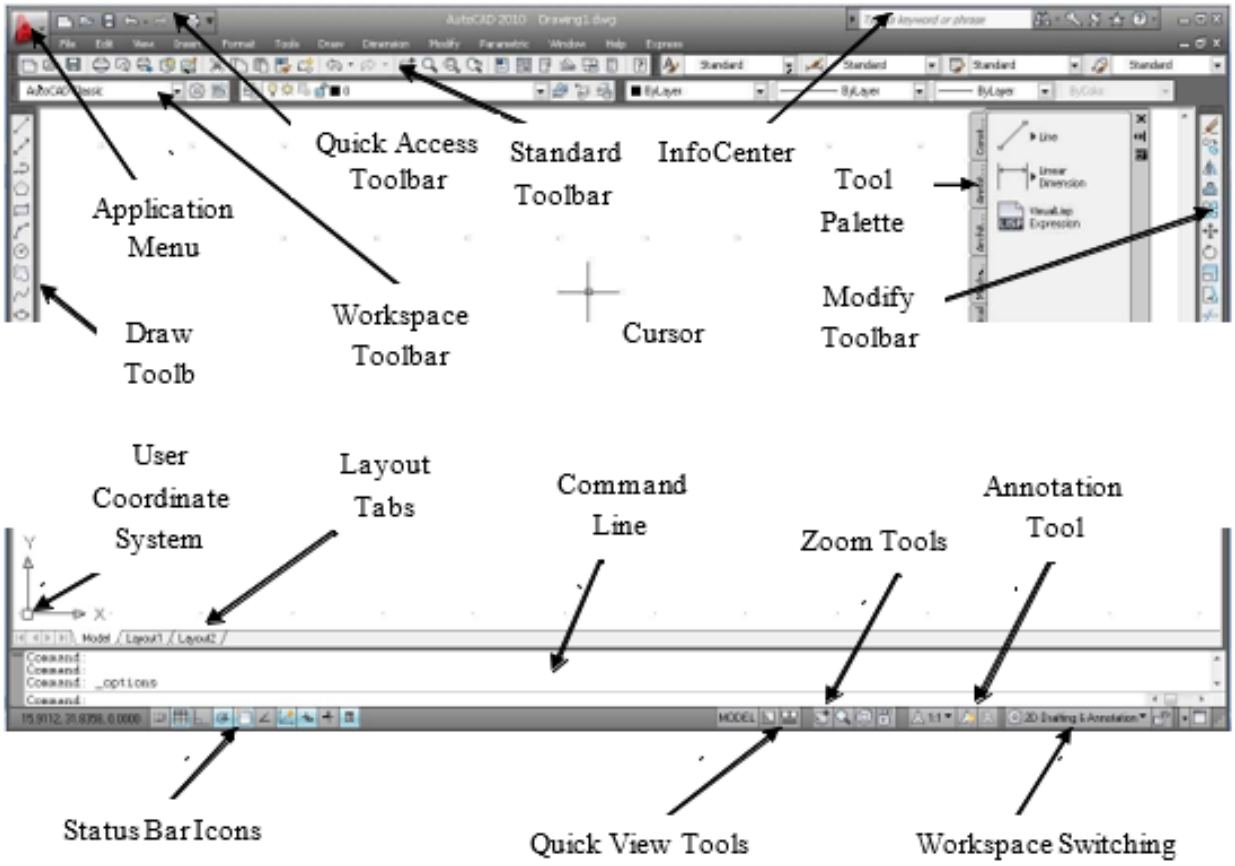
1. **Accurate and Reduces Errors –** The principle on which AutoCAD works is a dynamic Engineering model. This model blends design and production drafting together which allows the changes to be made to any part of the design at any point of time in the entire project. These results in error reduction and fewer chances of mistakes. Furthermore, the designs which are made digitally always have room for enhancements and improvement.
2. **Save Time & Money –** With a specific and user-friendly interface and workflow, AutoCAD works speedily which saves the time of the designer. *AutoCAD support documentation tools* that not only increase productivity but also help the designers and architects to streamline the designs and documentation workflows. It also provides solutions to implement modifications in the projects, thus reducing the time taken. It is an efficient program that undertakes the work process of the designer and helps in saving time and money and reducing errors.
3. **Easier Data Transfer –** Using AutoCAD in Architect Designing has made it easier to share files with multiple people simultaneously. It is not easy to work on heavy files

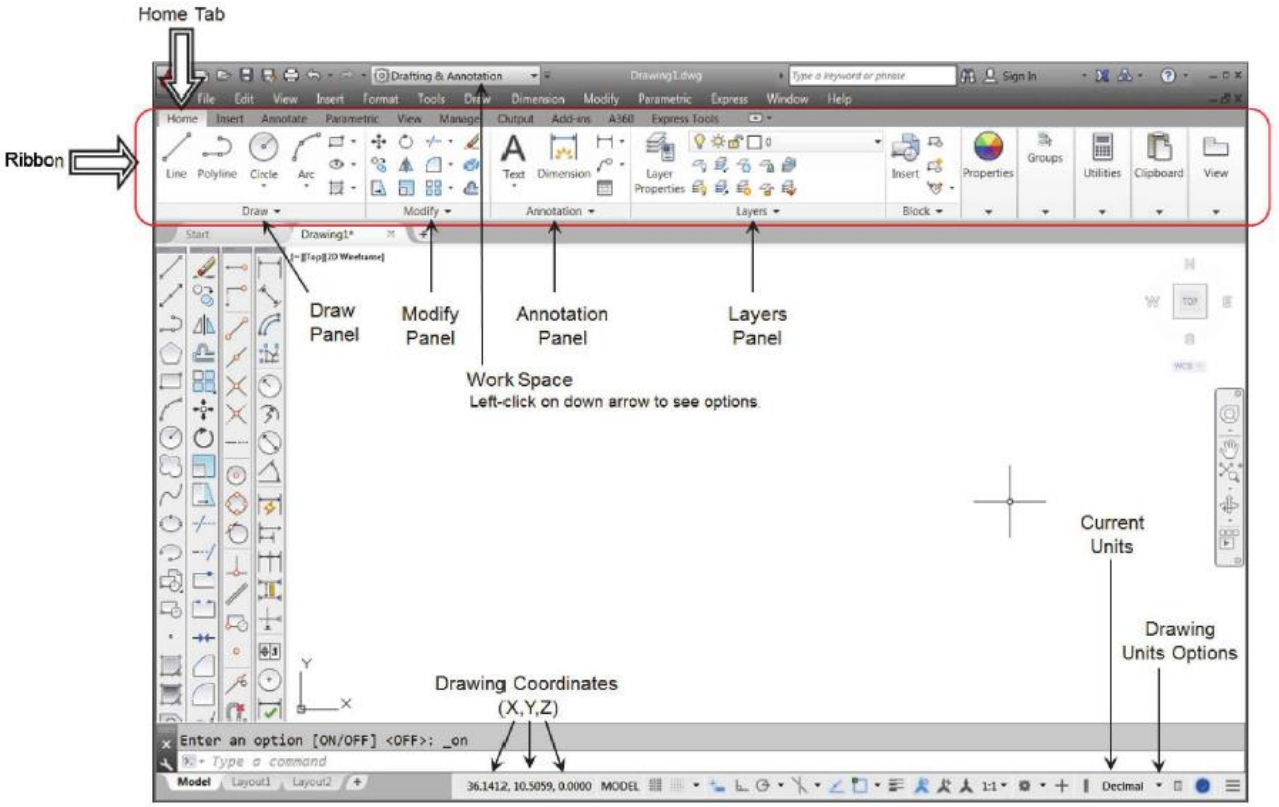
and then share them without any data loss. But, this software has made it easy to upload the designed data on the internet and sharing it with numerous other designers.

4. **Controllable in nature –** This advantage of AutoCAD supports the scanning feature for the data. This technique helps in measuring the quantity of the materials used. It also helps in calculating the exact cost of the products. Eventually, it helps in managing production and post-production processes.
5. **Database for manufacturing –** AutoCAD allows in creating manufacturing data such as materials required for components, dimensions, and shape of the models, product and component drawings. This helps in creating and managing a wide database which is an important part of the production process.
6. **Easier Import/ Export of files –** AutoCAD Inventor supports file import and export feature. AutoCAD allows the users to import models from Inventor and it also manages to do it quite easily and speedily. AutoCAD also supports various other tools and features that boost the productivity of the program. Some of them being; PDF support, compatible with Autodesk 360, social media sharing, AutoCAD WS, DWG Convert and many more. *AutoCAD also supports PRESSPULL operations* which allows the users to create surfaces, solids and offset curves with much ease. These meshes are dynamic in nature and can easily be manipulated. The designers can easily develop physical 3D Frameworks of their designs with the *3D printing capabilities* of AutoCAD.
7. **Apply Point Clouds –** Point Cloud is a large collection of points resulted by 3D laser scanners to create a 3D presentation of default structures. The users can join these point clouds to use as a starting point for their designs.
8. AutoCAD inhibits the Layering feature. This feature allows the user to hide or show specific details of a complicated complex group of drawings for clear understanding.
9. Another advantage of using AutoCAD is user can calculate Mass, Area, volume, Center of Gravity in no time. This program has an Auto- Dimensioning feature *that helps in designing easy* and accurate sketches. The users can also generate 2D drawings from 3D models.
10. Commands like Fill, Hatch, Section lines, chamfer, and fillet makes AutoCAD one-stop solutions to many designers as these operations are impossible in manual drafting.
11. It also supports Image tracing feature. This helps in a digital tracing of conventional diagrams and drawing.

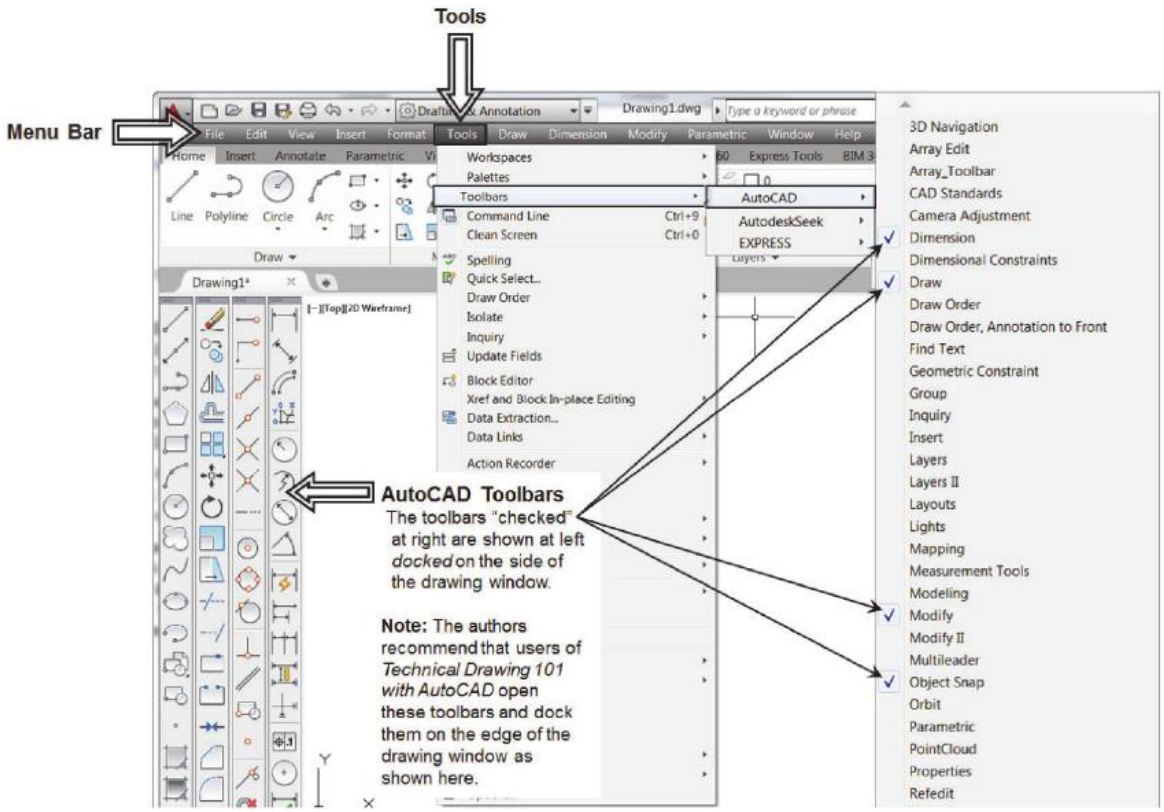
    AutoCAD supports PDF import enhancements. It also has an SHF text recognition tool which converts the geometries imported from PDF text to Text objects which can be edited more conveniently.

Content /Topic3: AutoCAD user interface.



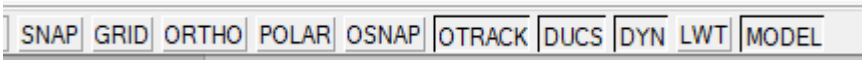


a) The Menu Bar: In either workspace, Menu Bar provides an easy way to access most AutoCAD commands. This bar helps the designer to open the documents, to save the work done, to cut, to copy, to paste, Edit, View, Insert, and so on.



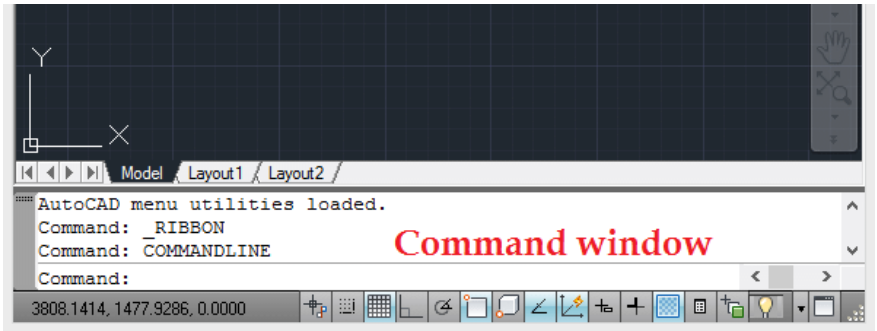
b) Toolbars: Activating the AutoCAD Classic workspace will automatically display toolbars. The toolbar also contains the tools for modifying the drawn objects such as: move, rotate, trim, offset and so on, this is mostly located on the right side of the AutoCAD interface. The following image shows the Standard, Workspaces, Layers, Properties, Styles, and Draw toolbars displayed.

c) Status bar: Let's talk abit about the status bar which gives you information at a glance about the state of the drawing.



i. **SNAP (F9):** Restricts cursor movement to specified intervals.
ii. **GRID (F7):** Displays a grid in the current viewport that is plotted**.**
iii. **ORTHO (F8):** Constrains cursor movement to the horizontal or vertical.
iv. **OSNAP (F3):** Sets running object snap modes. Osnap let you accurately select specific points on an object, such as endpoints or midpoints**.**

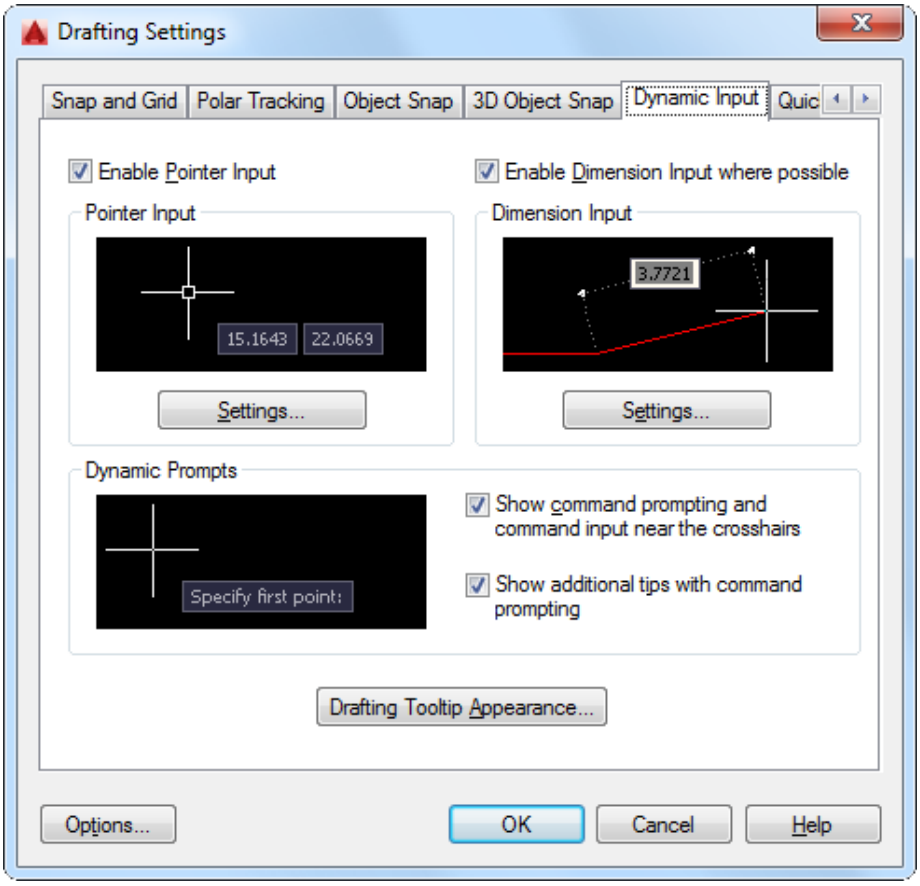
d) The command windows: This command helps the designer, to write the command for drawing or for modifying an object.

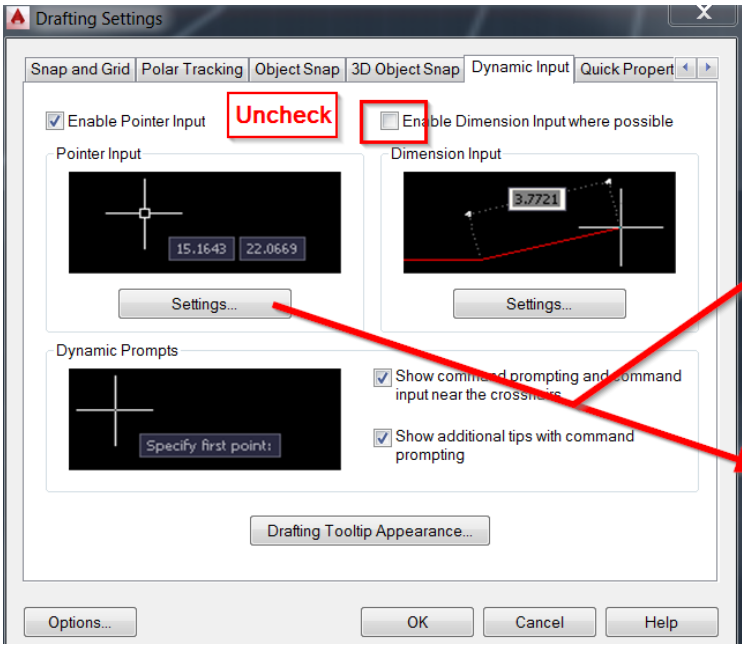


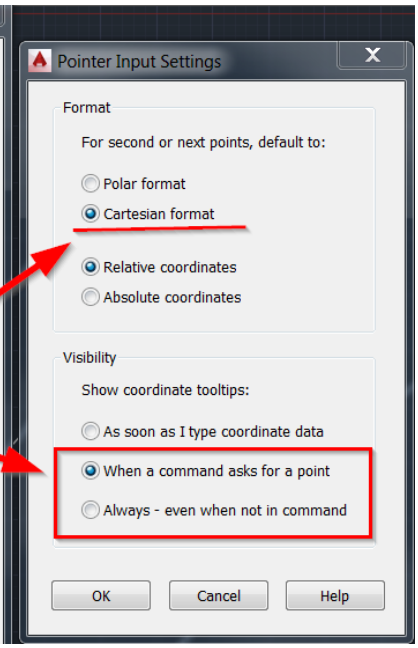
Open or Close the Command Window

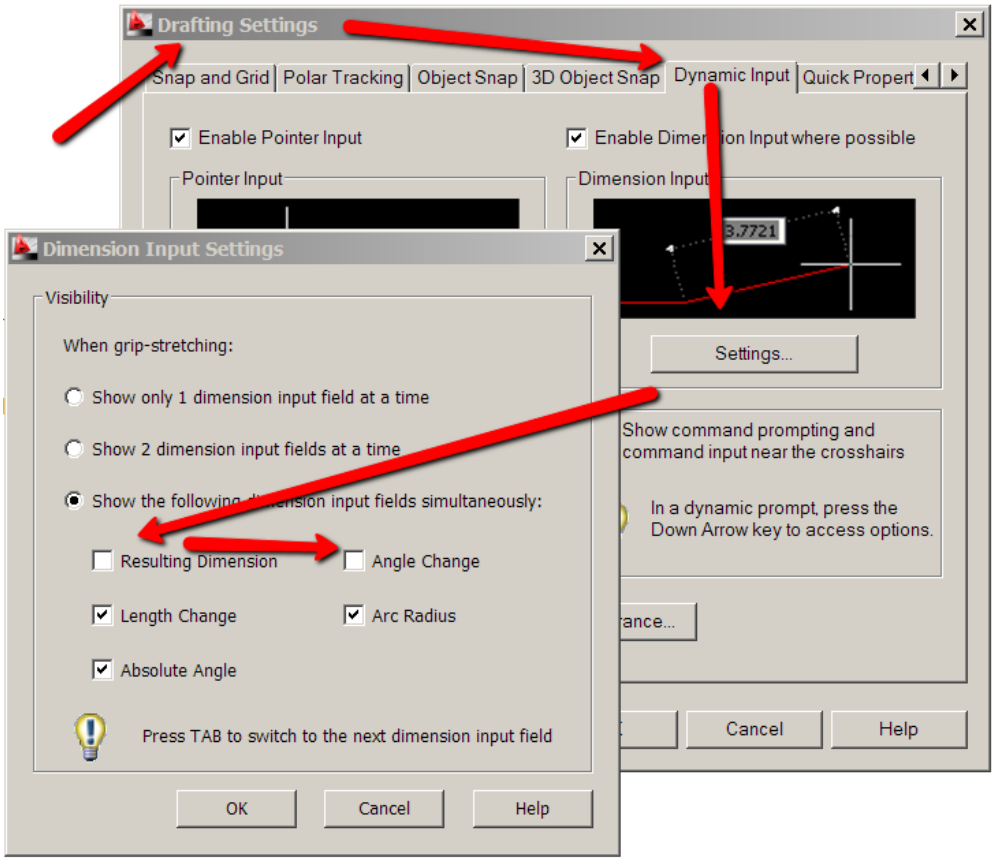
- Click View tab Palettes panel **Command** Line. Find.
- Press Ctrl+9.
- At the **Command** prompt, enter command line or command line hide.

e) Dynamic Input: Dynamic input provides a command interface near the cursor in the drawing area. When **dynamic input** is turned on, a tooltip displays dynamically updated information near the cursor. When a command is in progress, you can specify options and values in the tooltip text box.


Drafting Settings
Snap and Grid
Polar Tracking
Object Snap
3D Object Snap
Dynamic Input
Quic
Enable Pointer Input
Enable Dimension Input where possible
Pointer Input
15.1643
22.0669
Settings...
Dimension Input
3.7721
Settings...
Dynamic Prompts
Specify first point:
Show command prompting and command input near the crosshairs
Show additional tips with command prompting
Drafting Tooltip Appearance...
Options...
OK
Cancel
Help


Drafting Settings
Snap and Grid
Polar Tracking
Object Snap
3D Object Snap
Dynamic Input
Quick Propert
Enable Pointer Input
Uncheck
Enable Dimension Input where possible
Pointer Input
15.1643
22.0669
Settings...
Dimension Input
3.7721
Settings...
Dynamic Prompts
Specify first point:
Show command prompting and command input near the crosshairs
Show additional tips with command prompting
Drafting Tooltip Appearance...
Options...
OK
Cancel
Help


Pointer Input Settings
Format
For second or next points, default to:
Polar format
Cartesian format
Relative coordinates
Absolute coordinates
Visibility
Show coordinate tooltips:
As soon as I type coordinate data
When a command asks for a point
Always - even when not in command
OK
Cancel
Help

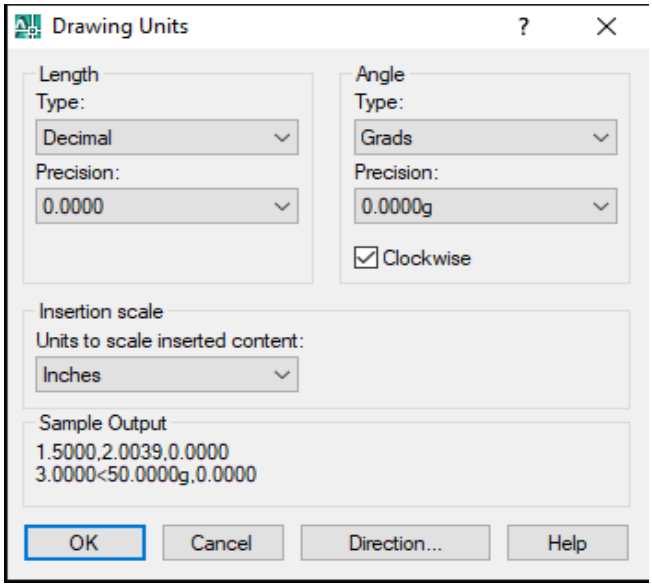


Content /Topic4: Set units of measurement and angles.

Before you start drawing, it's important to decide what one drawing unit represents in the real world. Architects in the United States typically equate one drawing unit with 1 inch in AutoCAD. You need to choose a unit type that matches your country's industry standard.

A. **Set units of Measurement:** Before beginning an AutoCAD drawing a drafter must first determine the appropriate drawing units for the type of drawing being created.

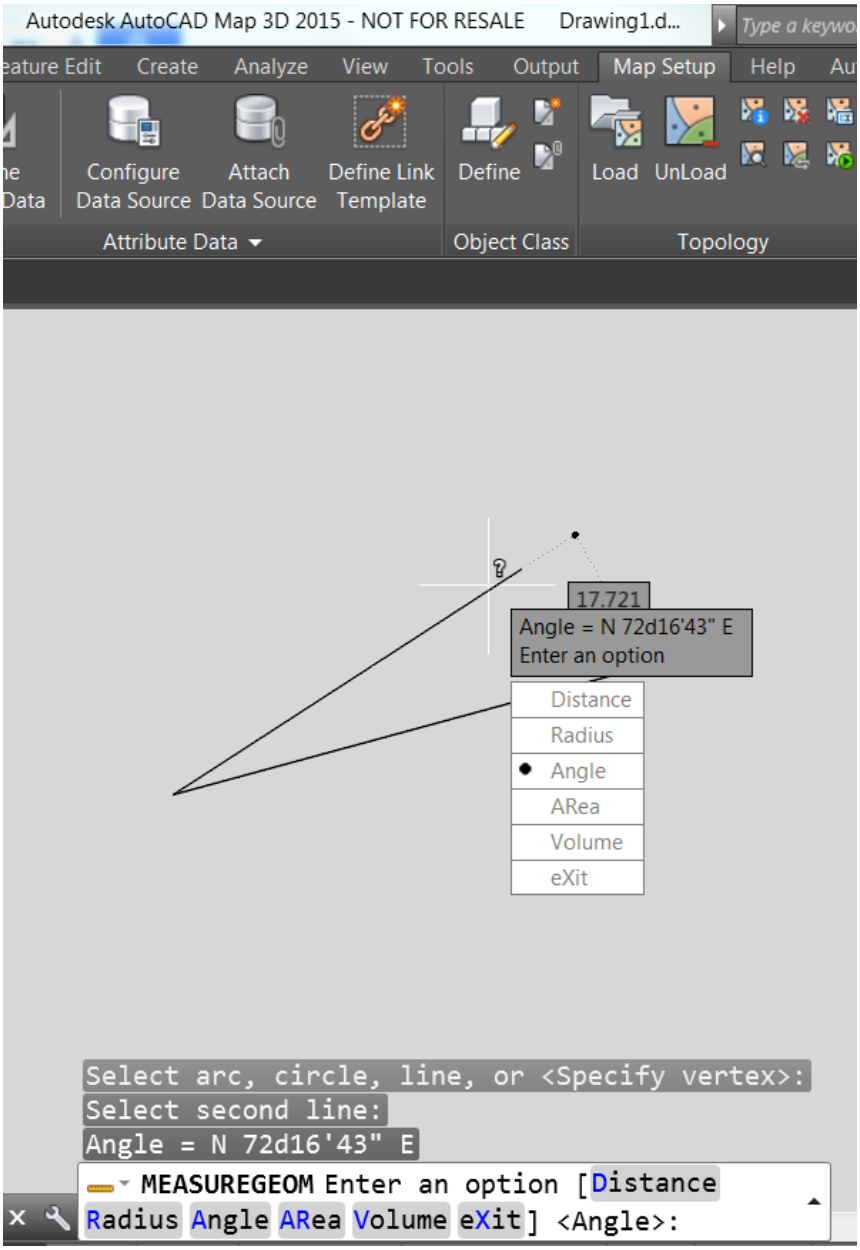
- Click the New button on the Quick Access toolbar. Click the arrow button next to the Open button in the Select Template dialog box and choose Open with No Template
- Type **UN** and press Enter to bring up the Drawing Units dialog box. UN is the command alias (abbreviation) of the UNITS command. Most commands have aliases that minimize typing.



- Select Architectural from the Type drop-down menu. I'm using Architectural in this book, but you should select the unit type that fits your industry when working professionally. Metric users should select Decimal length units.
- Click the Length Precision drop-down menu and select 1/8g (or 0.0 for metric). Set Angle Type to Decimal Degrees and Angle Precision to 0.0.
- Click the Insertion Scale drop-down menu and select Inches (or Centimeters for metric). Click OK to close the Drawing Units dialog box.

B. Set angles convention: On the following table, the designer can be able to set the units and the angles. You can specify that positive values of angles are measured either clockwise or counter clockwise, and the direction of angle 0 (usually East or North). You can enter angles in grads, radians, or surveyor's units or in degrees, minutes, and seconds.

If you use surveyor's angles when specifying polar coordinates, indicate whether the surveyor's angles are in the north, south, east, or west direction. For example, to enter the relative coordinates for a property line that is 72 feet, 8 inches long with a bearing of 45 degrees north, 20 minutes, 6 seconds east, enter **@72'8"<n45d20'6"e**.



LO 3.2 – Create geometric objects.

Content/Topic 1: Creation of geometric objects.

With large or complex drawings, you can create and preserve geometric objects that serve as references for creating new objects and checking existing objects.

Reference geometry, also known as construction geometry, typically includes lines, circles, points, lines, and rays. Reference geometry can be used for defining the basic envelope of a 2D design, interference boundaries, centerlines, and critical locations such as the center of gravity in a rotating part or a benchmark on a map.

For 3D modeling in AutoCAD, reference geometry includes 2D profiles, axes of rotation, paths of travel, and 3D wireframe models.

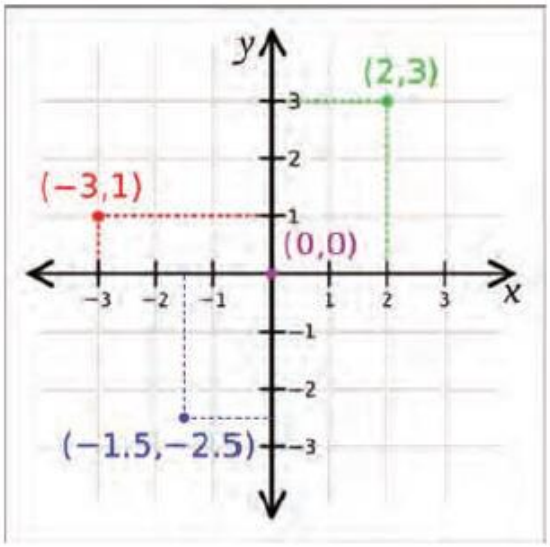
- **Benefits of Reference Geometry:** Use reference geometry to create other objects using Copy, or Offset and Trim. When you work from existing geometry, you receive the following benefits:
    - Facilitate creating, modifying, and reconstructing areas within a drawing
    - Use object snaps, object snap tracking, and polar tracking from reference geometry
    - Avoid proliferating an error to other geometric objects
    - Check locations, rotations, and distances easily
    - Find and correct incorrectly sized or misallocated objects
- **Manage with Layers:** Keep your reference geometry on dedicated layers. If you choose layer names using a numeric prefix such as 00, 01, and so on, you can ensure that the layers will appear at the top of the layer list.

Content/Topic 2: Use coordinates and coordinates systems.

You can draw objects in Euclidean space using the following coordinate systems: Cartesian, polar, cylindrical, and spherical. (The last two are rarely used).

- Cartesian coordinates are useful for drawing rectangles with specific length and width measurements.
- Polar coordinates are used most often for drawing lines with specific lengths and angles, with respect to horizontal.

Once you learn coordinate system syntax, you can use the systems interchangeably to draw accurately in any context. In the Cartesian system, every point is defined by three values, expressed in terms of distances along the x-, y-, and z-axes. In two-dimensional drawings, the z-coordinate value of all objects is 0, so objects are expressed solely in terms of x- and y-coordinates.



Cartesian two-dimensional coordinates

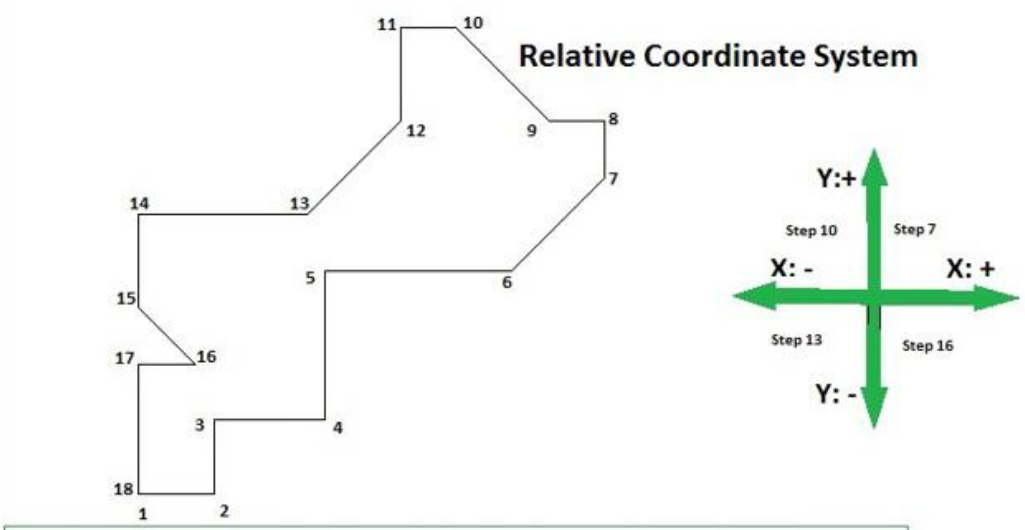
A. **Use Absolute Coordinates:** Coordinates can be *absolute* or *relative,* no matter which coordinate system is used. Let's first focus on drawing a line using absolute coordinates. To begin, open the fi le Ex02.5-start.dwg from this chapter's companion fi les.

   - Click the Line tool on the Draw panel. The prompt in the Command window reads as follows: LINE Specify first point: Type **0, 0** and press Enter. The origin point of Euclidean space has coordinates 0 in x and 0 in y, which is written as 0, 0.
   - Now the prompt in the Command window reads as follows: LINE Specify next point or [Undo]: Type 3', 0 (or 90, 0 for metric) and press Enter. Right-click to finish the LINE command.
   - Save your work. Your model should now resemble Ex 02.5-end.dwg,which is available among this chapter's companion fi les.

B. **Use Relative Coordinates:** Calculating where every object is in relation to the origin point (which is what absolute coordinates require) would be far too cumbersome in practice.

   Therefore, relative coordinates are used more frequently. Let's explore how-to use them. To begin, open the fi le Ex02.6-start.dwg from this chapter's companion fi les.

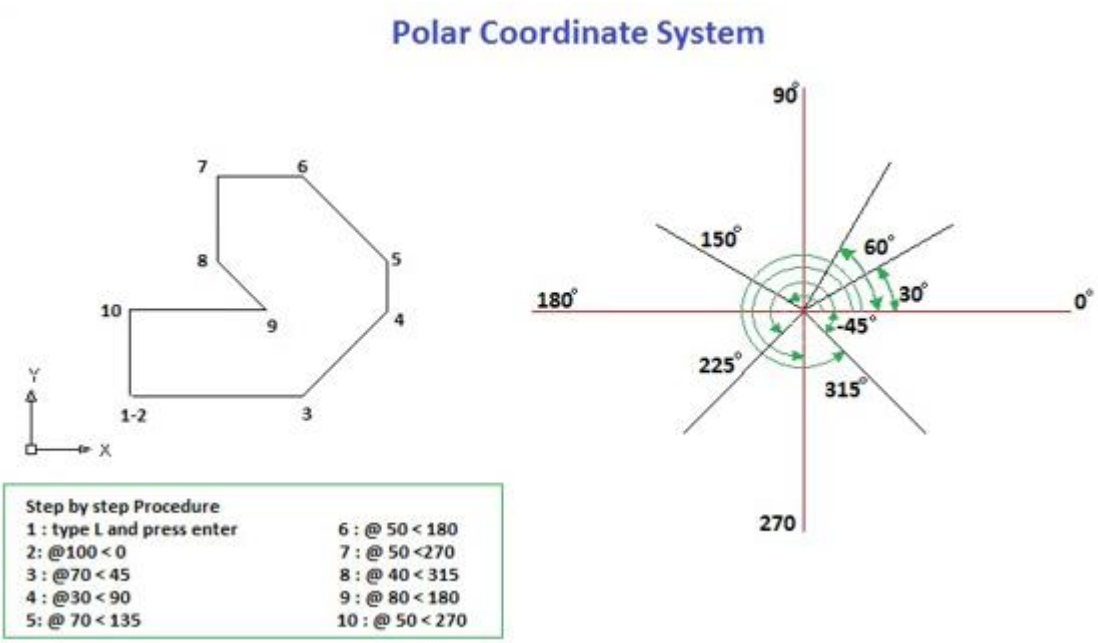
   - Click the Line tool on the Draw panel. Click an arbitrary point in the middle of the living room. The coordinates of the point you clicked are unknown; thankfully, with relative coordinates you won't ever need to find out what they are.
   - Type **@3', 0** (or **@90, 0** for metric) and press Enter twice.
   - Press Enter to repeat the last command. You'll see this prompt: LINE Specify first point:
   - Right-click in the drawing canvas and hold (for longer than250 milliseconds) to open the context menu. Select the first coordinate value from the Recent Input menu.



Step by step procedure	1: L enter for line & specify andy point			
2: @ 40,0	3: @ 0,40	4: @60,0	5: @ 0,80	6: @ 100,0
7 : @50,50	8 :@ 0,30	9: @ 0,-30	10: @-50,-50	11: @-30,0
12: @0,-50	13: @ -50,-50	14: @ 0,-50	15: @ 30,-30	16 : @0,-30
17: @ 0,-70 or c				

- Type **@0, 6'** (or **@0,180** for metric) and press Enter. A line measuring 6f (or 1.8m) is drawn vertically along the y-axis.
- Type **@-3', 0** (or **@-90, 0** for metric) and press Enter. Type **@0, -6**' (or **@0, -180** for metric) and press Enter twice to complete a rectangle.
- Click the Rectangle tool on the Draw panel and then click an arbitrary point at the bottom of the living room. The prompt reads as follows: RECTANG Specify other corner point or [Area Dimensions Rotation]:
- Type **@3', 6'** (or **@90,180** for metric) and press Enter. The same rectangle that you more laboriously drew with lines is already done.
- Save your work. Your model should now resemble Ex02.6-end.dwg, which is available among this chapter's companion fi les.

C. Use Polar Coordinates: Polar coordinates are another useful way of measuring Euclidean space. In polar coordinates, points are located using two measurements: the distance from the origin points and the angle from zero degrees. East is the default direction of zero degrees.



Let's explore how to use polar coordinates. To begin, open the fi le Ex02.7-start.dwg.

- Click the Line tool on the Draw panel. Click an arbitrary first point in the living room; then type **@3'<45** (or **@90<45** for metric) and press **Enter to end the LINE command**.
- Press Enter to repeat the last command. Click an arbitrary first point, move the cursor up and to the left, type **3'**(or **90** for metric), **and press Enter twice**. A 3'(or 90 for metric) line is drawn at an arbitrary angle.
- Press **L** and then press the spacebar. Click an arbitrary first point, type **@4'<180** (or **@120** <**180** for metric), and press Enter. The line is drawn to the left from the first point because 180 degrees is the same direction as angle zero but leads in the opposite direction.
- Type **@3'<–90** (or **@90** <**-90** for metric) and press Enter. Negative angles are measured clockwise from angle zero by default. Press **C** and then Enter to close the 3:4:5 triangles you've just drawn.
- Type **UCSICON** and press Enter. *UCS* stands for *user coordinate system.* You, the user, can change the coordinate system's orientation. Type **on** and press Enter. An icon indicating the directions of the positive x- and y-axes is displayed in the lower-left corner of the canvas.

UCS icon in the default orientation

- Type **UCS** and press Enter. The prompt in the Command window reads as follows:

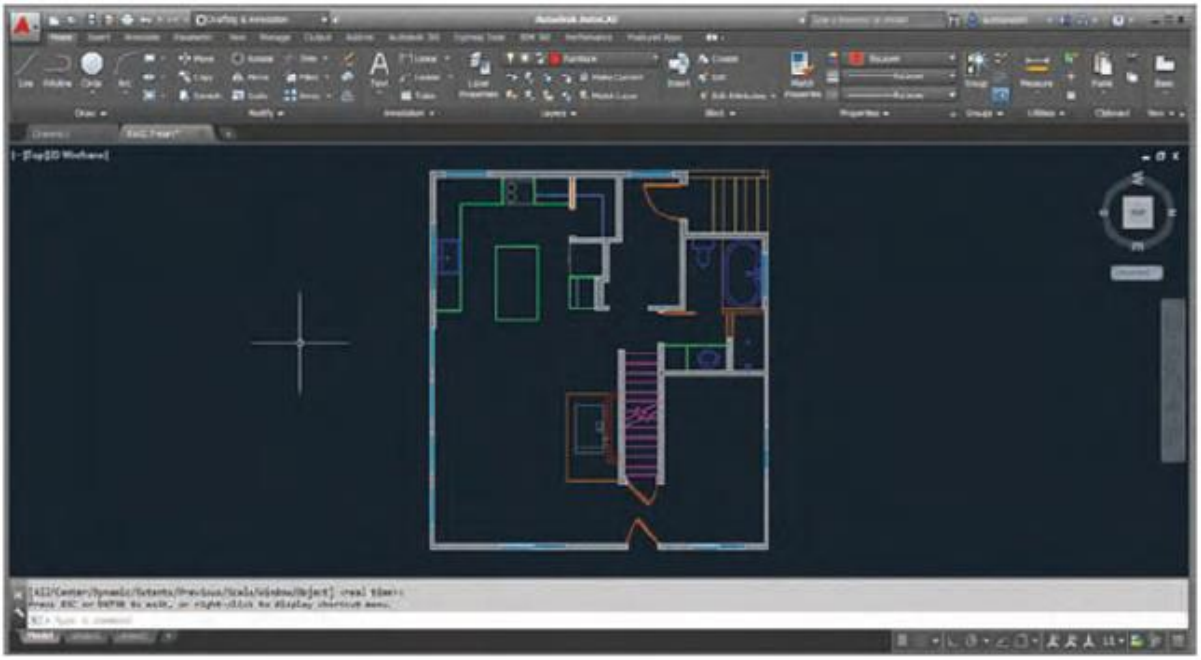
UCS Specify origin of UCS or [Face Named Object Previous View World X Y Z-axis] <World>:

There is much you can do with the UCS, but here you will simply rotate the UCS about its z-axis (the axis coming out of the screen). **Type Z and press Enter.**

- Type **90** and press Enter to rotate the coordinate system. Observe that the UCS icon has changed to reflect the new orientation

Rotating the UCS about its z-axis

- Type **PLAN** and press Enter. The prompt in the Command window reads as follows: PLAN Enter an option [Current UCS World] <Current>: The option in the angled brackets, <Current>, is what you want, so press Enter to make this selection. The house is reoriented with respect to the current UCS.



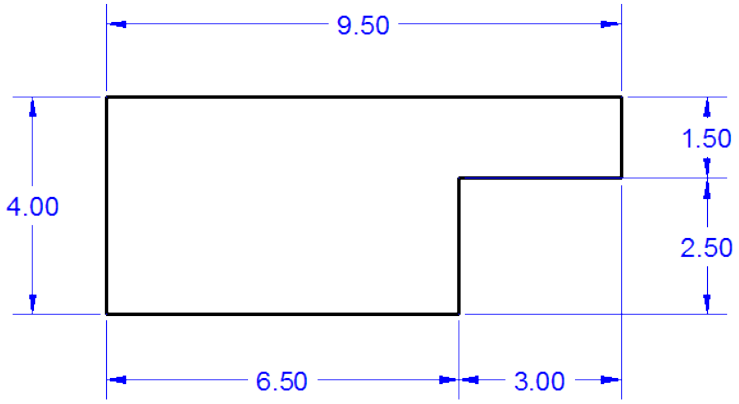
Reorienting the drawing to the x y plane of the UCS

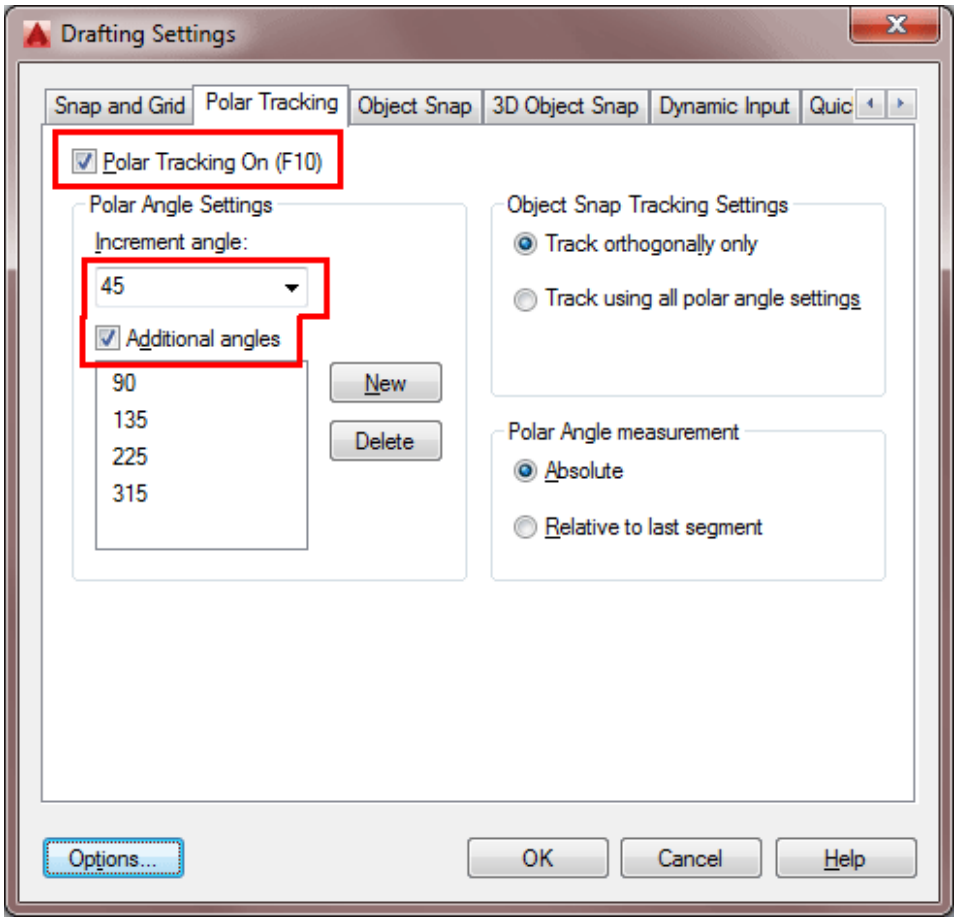
- Click the Line tool on the Draw panel. Click an arbitrary first point in the living room, type **@3**' <**45** (or **@90** <**45** for metric), and **press Enter twice** to end the LINE command. The new line has a different orientation with respect to the original line you drew in step 1.
- To restore the current coordinate system to its original state, called the *world coordinate system (WCS)*, type **UCS** and press Enter twice. Then type **PLAN** and press Enter twice more. The plan is oriented to the WCS as it was initially.

- Save your work. Your model should now resemble Ex02.7-end.dwg, which is available among this chapter's companion fi les.

Content /Topic 3: Enter direct distance (modifier command.

With direct distance entry, you can quickly specify a point relative to the last point you entered. At any prompt for a point location, you move the cursor first to specify the direction, and then enter a numeric distance.





Content /Topic4: Use precision tools.

By far, the most important way for you to specify **precise** locations on objects is to use object snaps. In the following illustration, several different kinds of object snaps are represented by markers. Object snaps become available during a **command** whenever **AutoCAD** prompts you to specify a point.

There are several precision features available, including

- Polar tracking. Snap to the closest preset angle and specify a distance along that angle.
- Locking angles. Lock to a single, specified angle and specify a distance along that angle.
- Object snaps. Snap to precise locations on existing objects, such as an endpoint of a polyline, the midpoint of a line, or the center point of a circle.
- Grid snaps. Snap to increments in a rectangular grid.
- Coordinate entry. Specify a location by its Cartesian or polar coordinates, either absolute or relative.

The three most commonly used features are polar tracking, locking angles, and object snaps. Recheck your geometry to catch mistakes early. Enter the DIST command (or just DI) to measure the distance between any two points in your model.

Content /Topic5: Management of geometric objects.

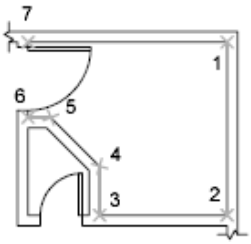
A. **Extract or Calculate Geometric information from objects:** The inquiry and calculation commands can provide information about objects in your drawing and do useful calculations.
   - **Obtain Distances, Angles, and Point Locations:** You can obtain information about the relation between two specified points or multiple points; for example, the distance between points or their angle in the *XY* plane.

     To determine the relation between points, you can display the
     - Distance between them.
     - Angle between the points in the *XY* plane.
     - Angle of the points from the *XY* plane.
     - Delta, or changed, *X*, *Y*, and *Z* distances between them.

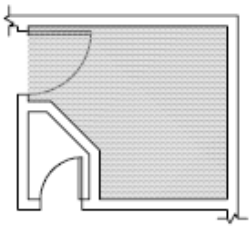
The ID command lists the *X*, *Y*, and *Z* coordinate values of a specified point

   - **Obtain Area and Mass Properties Information:** You can obtain the area, perimeter, and mass properties defined by selected objects or a sequence of points.

     You can calculate the area and perimeter of a sequence of points. You can also obtain the area, perimeter, and mass properties of any of several types of objects.



points specified


arbitrary closed region

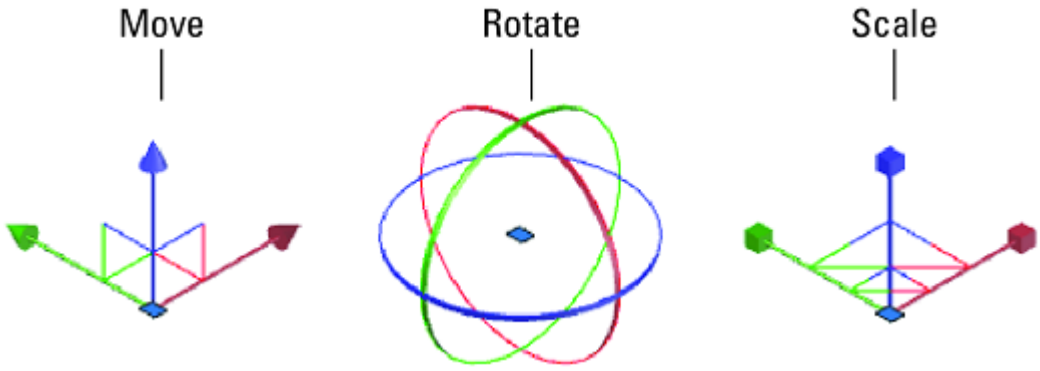
B. **Control the user coordinate system:** About Controlling the User Coordinate System (UCS).
   - **Use** the PLAN command to rotate the view such that the X and Y axes are horizontal and vertical.
   - Restore the UCS to being concurrent with the World **Coordinate System** (WCS) with the UCS command.

LO 3.3 – Modify objects.

Content/Topic 1: Overview of modifying objects.

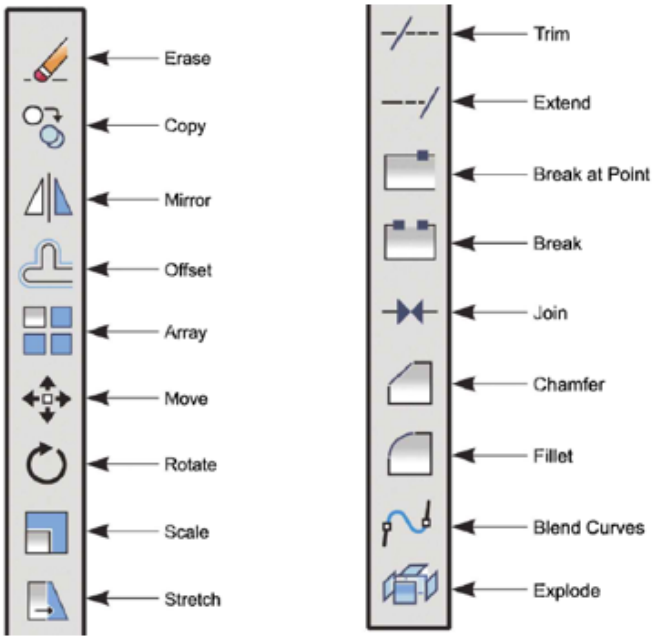
The drawn objects always require the modification at every step made. Most of architectural drawings have a big set of features and most of the time to simplify the work modification commands may have to be used.

Many modification techniques and AutoCAD commands that you use in 2D drafting can be applied to 3D modelling. In addition, a specialized set of 3D editing commands is available in AutoCAD. All these AutoCAD commands are in the Modify panel on the Home tab when the 3D Modelling workspace is current.
Although you can use the **Move**, **Rotate**, and **Scale** commands to modify 3D objects, they can sometimes give unexpected results in 3D. Enter the 3DMOVE, 3DROTATE, and 3DSCALE commands, which all use a gizmo or grip tool when a non-orthographic view is current.

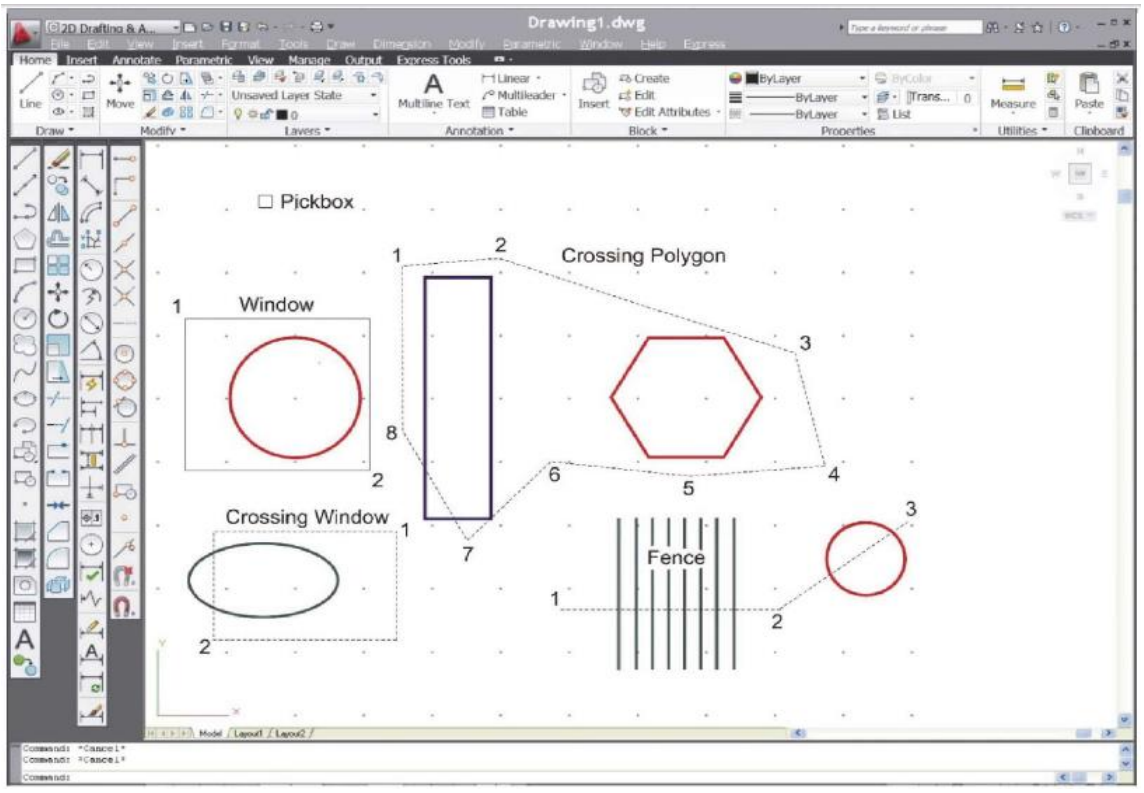


Content /Topic 2: Modify menu tools.

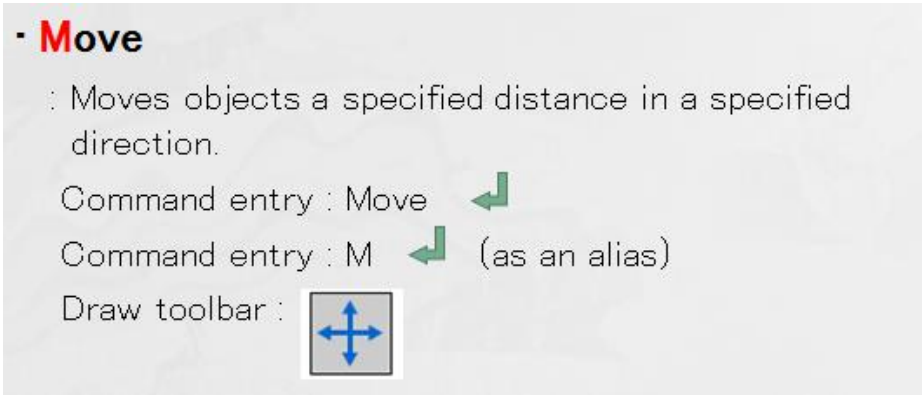
The icon of modify command located on the **Modify toolbar** or **Modify panel** of the home tab of the ribbon. Although you may find yourself using a few of the commands on this toolbar, such as **Move, Trim, Offset, Copy, Remove** and so on**.**



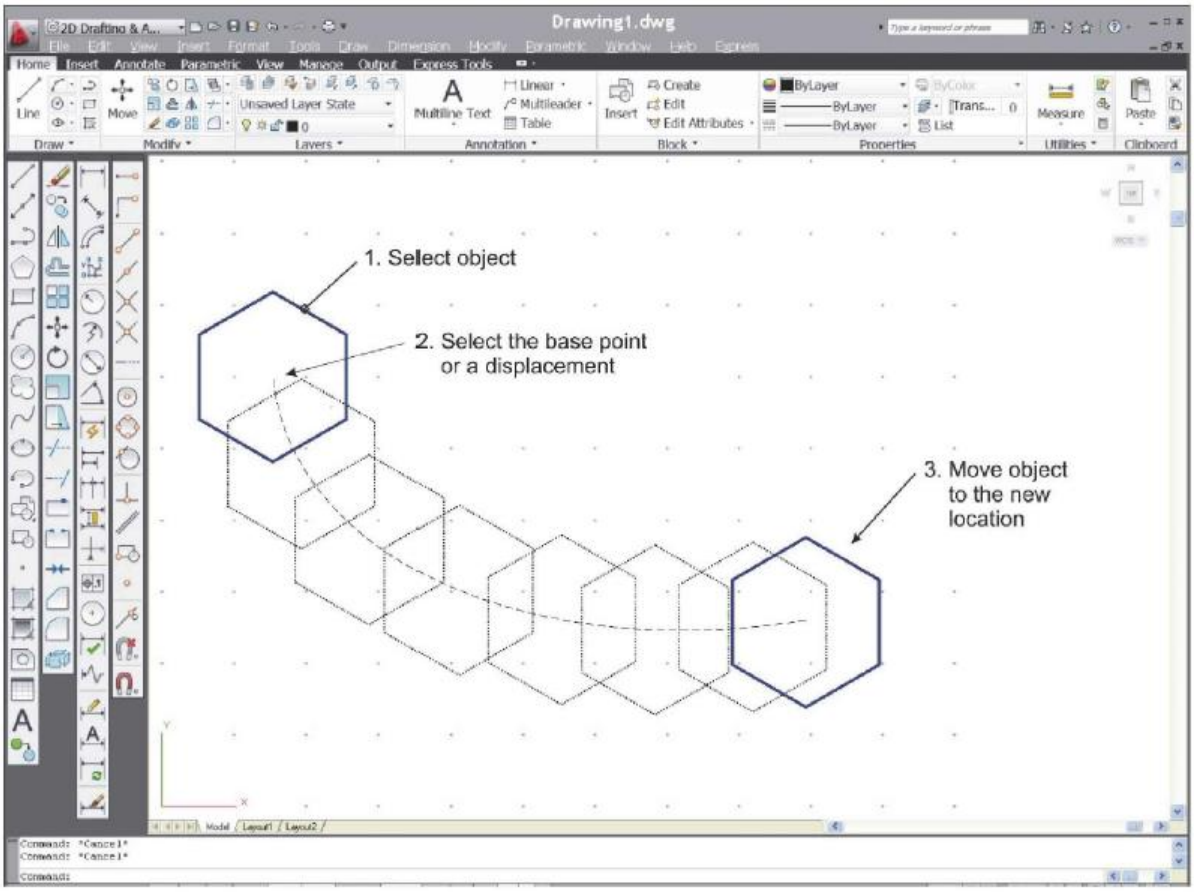
1. **Remove (erase) objects:** To remove the drawn object,
   - Select by clicking continually from right side to the left side of the drawing.
   - Right click.
   - Erase.



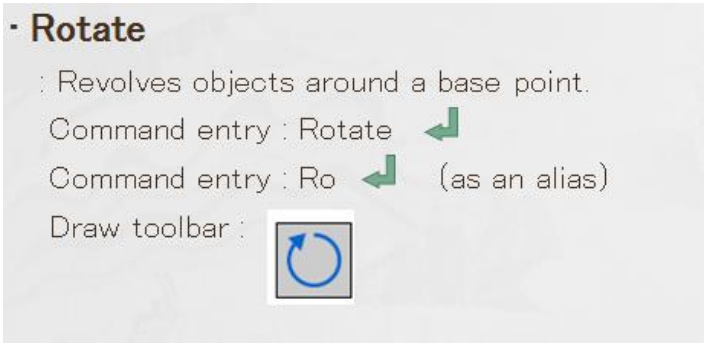
2. **Move objects:**

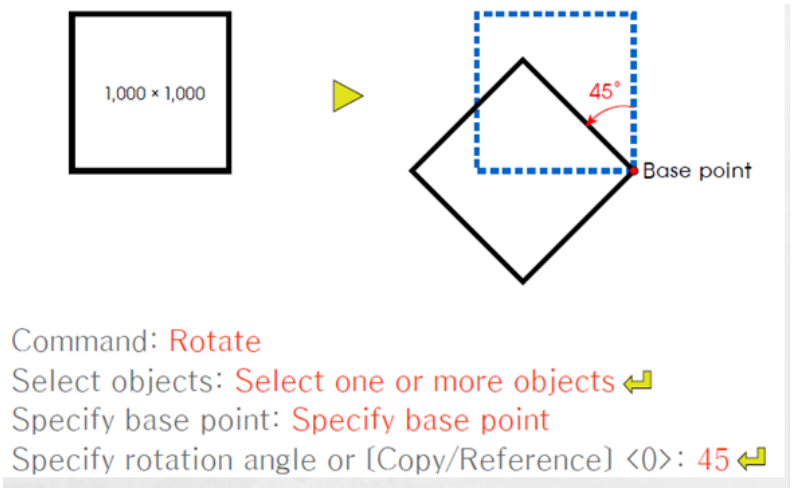


- Select the **Move** icon from the **Modify tool** or the modify panel of the **Home** tab.
- When prompted to *select objects,* pick the objects you would like to move by selecting them either individually or with a window and press **< Enter>**
- When prompted to *specify the base point* pick a point on the object. The base point is like handle on the object to be moved.
- When prompted to *define the displacement* pick a point at specific distance from the original object or enter absolute, relative, or polar coordinate value.

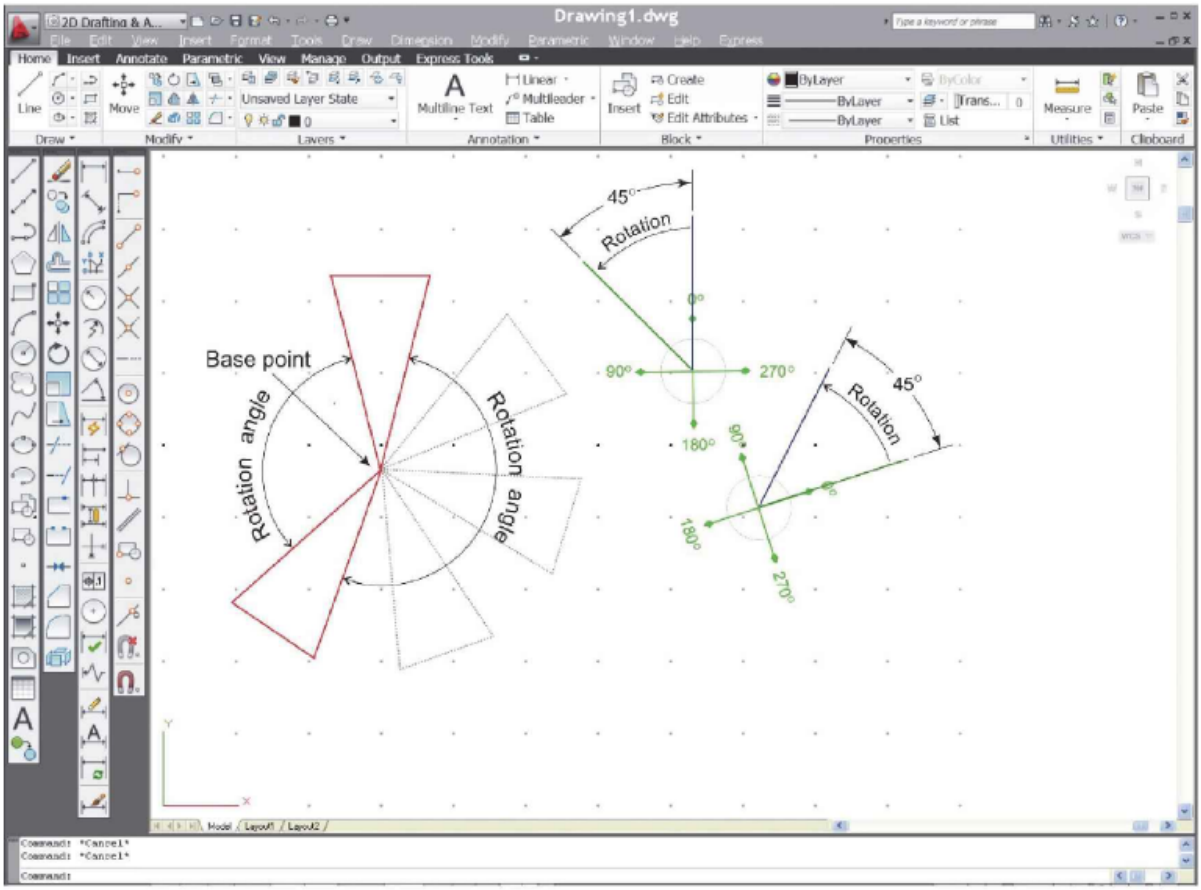


3. **Rotate objects:**

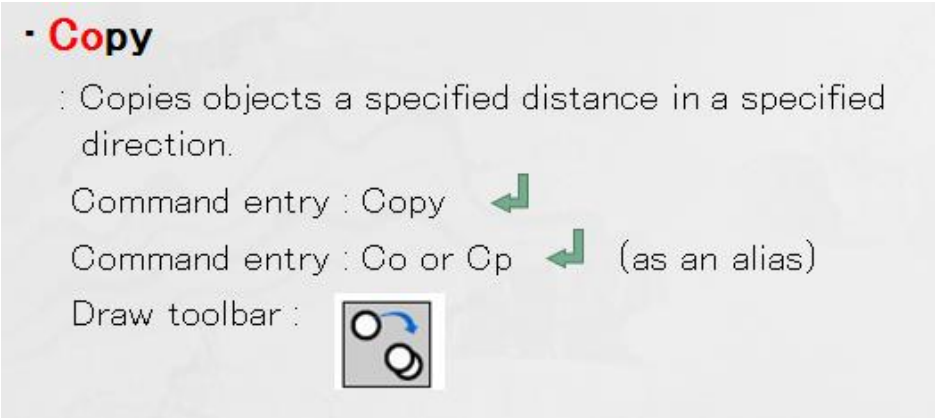




- Select the **Rotate** icon from the **Modify tool** or the modify panel of the **Home** tab.
- When prompted to *select objects*, pick the objects you would like to rotate by selecting them either individually or with a window and press **< Enter>**
- Wen prompted to *specify the base point,* select a point on the object. The base point is pivot point around which the rotation will occur.
- Wen prompted to *specify rotation angle* enter a value and press **< Enter>**

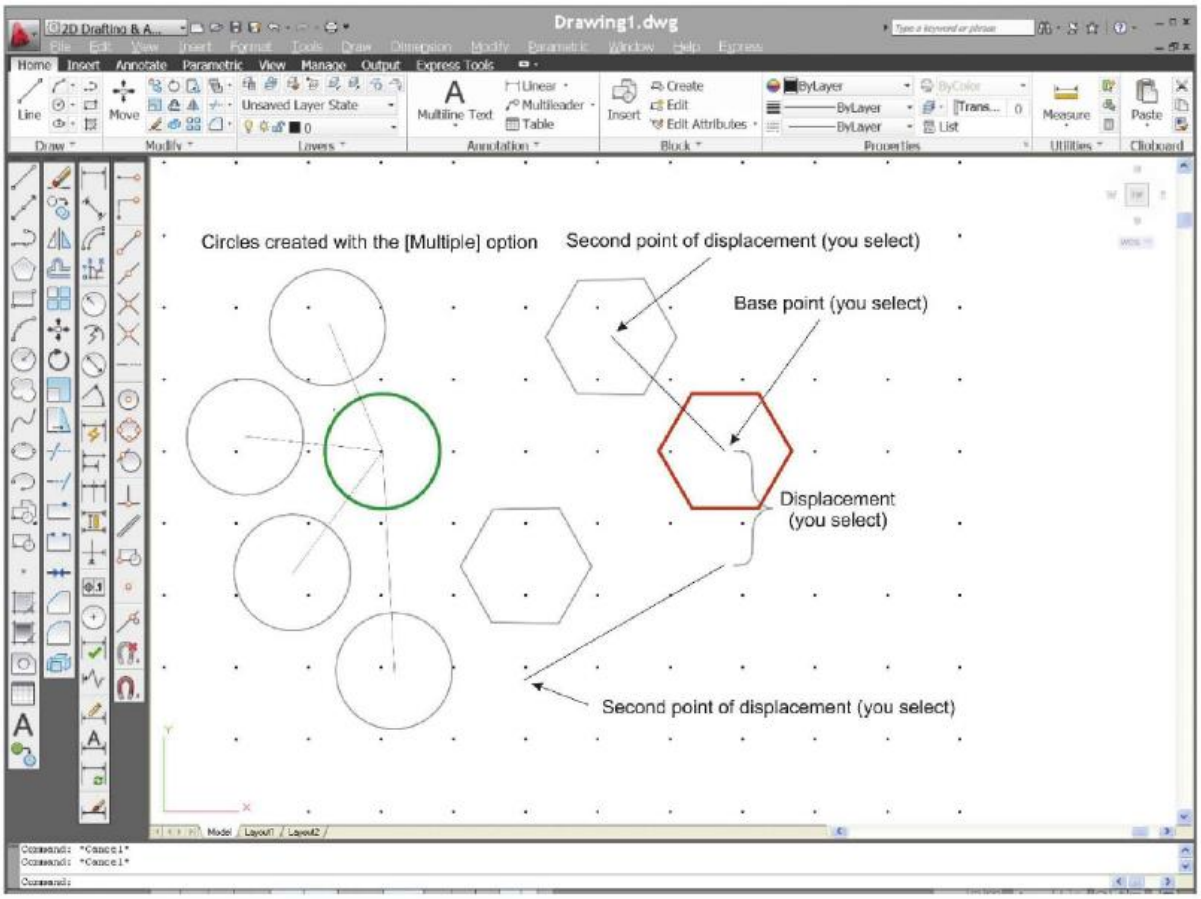


4. **Copy, Offset or Mirror objects:**



- Select the copy icon from the **Modify tool** or the modify panel of the **Home** tab.
- When prompted to select objects, pick the objects you would like to copy by selecting them either individually or with a window and press **< Enter>**
- When prompted to specify the base point, pick a point on the object. The base point can thought of as a handle o the object to be copied.
- When prompted to define the displacement, use the mouse top pick a point in the drawing window located at a specific distance from the base point of the original object, or enter absolute, relative, or polar coordinates, to define

the point where you want to place the copy. You can continue to place copies by defining more points. Press **< Esc>**or**< Enter>**to end the command.



· Offset

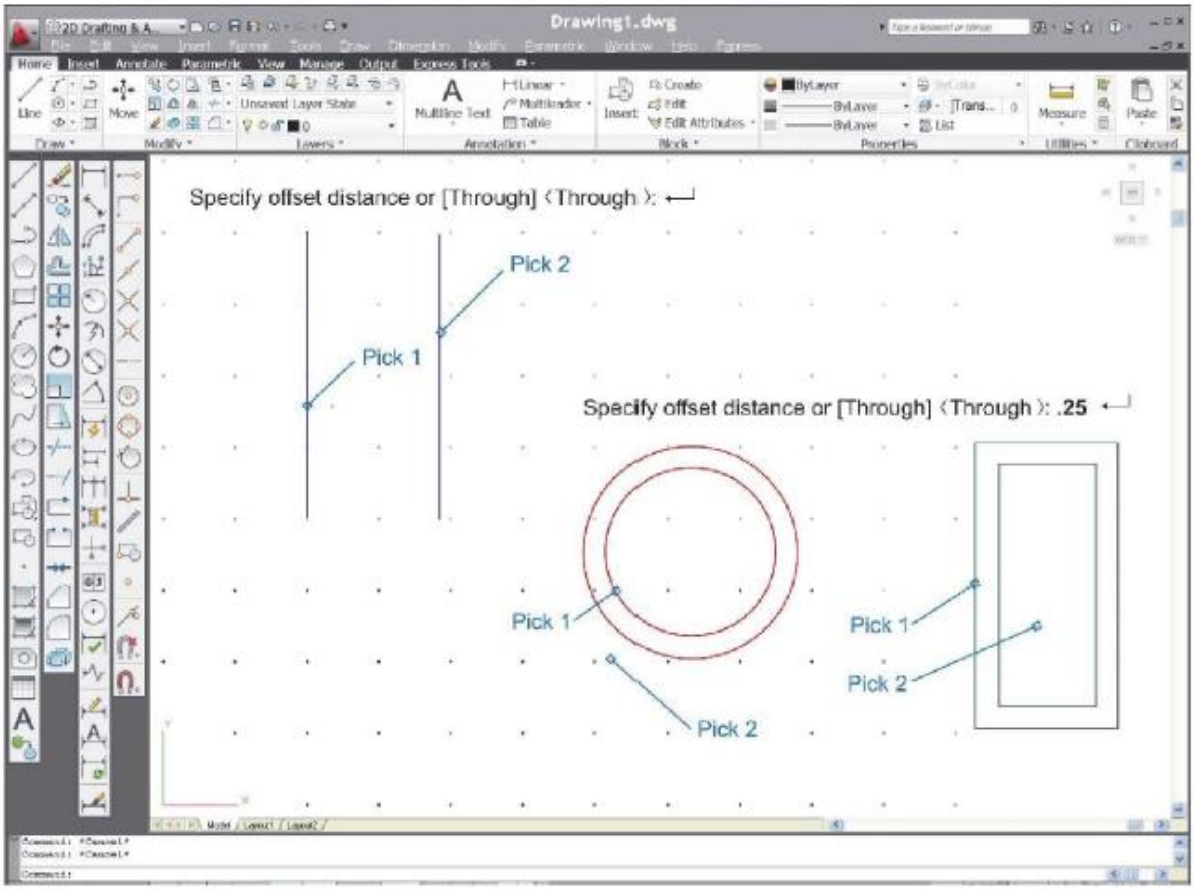
: Creates concentric circles, parallel lines, and parallel curves. The OFFSET command repeats for convenience.

Command entry : Offset ↵

Command entry : O ↵ (as an alias)

Draw toolbar :

- Select the **Offset** icon from the **Modify tool** or the modify panel of the **Home** tab.
- When prompted to *specify the offset distance*, type the value of desired offset distance and press **< Enter>**
- When prompted to *select object to offset*, select the object by left-clicking.
- At the *specify point on side to offset prompt*, pick a point on the side of the object where you want the new object to be created.



· Mirror

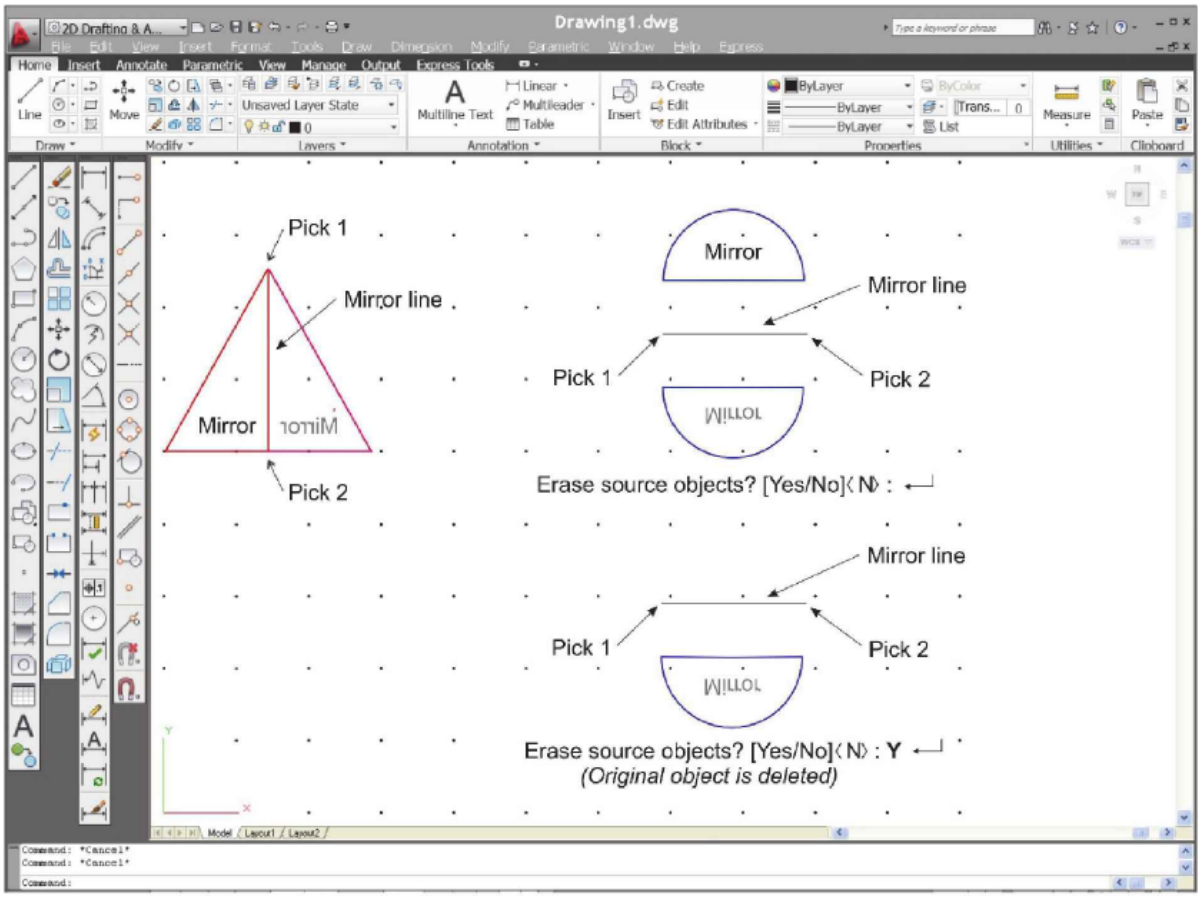
: Creates a mirror image copy of object.

Command entry : Mirror ↵

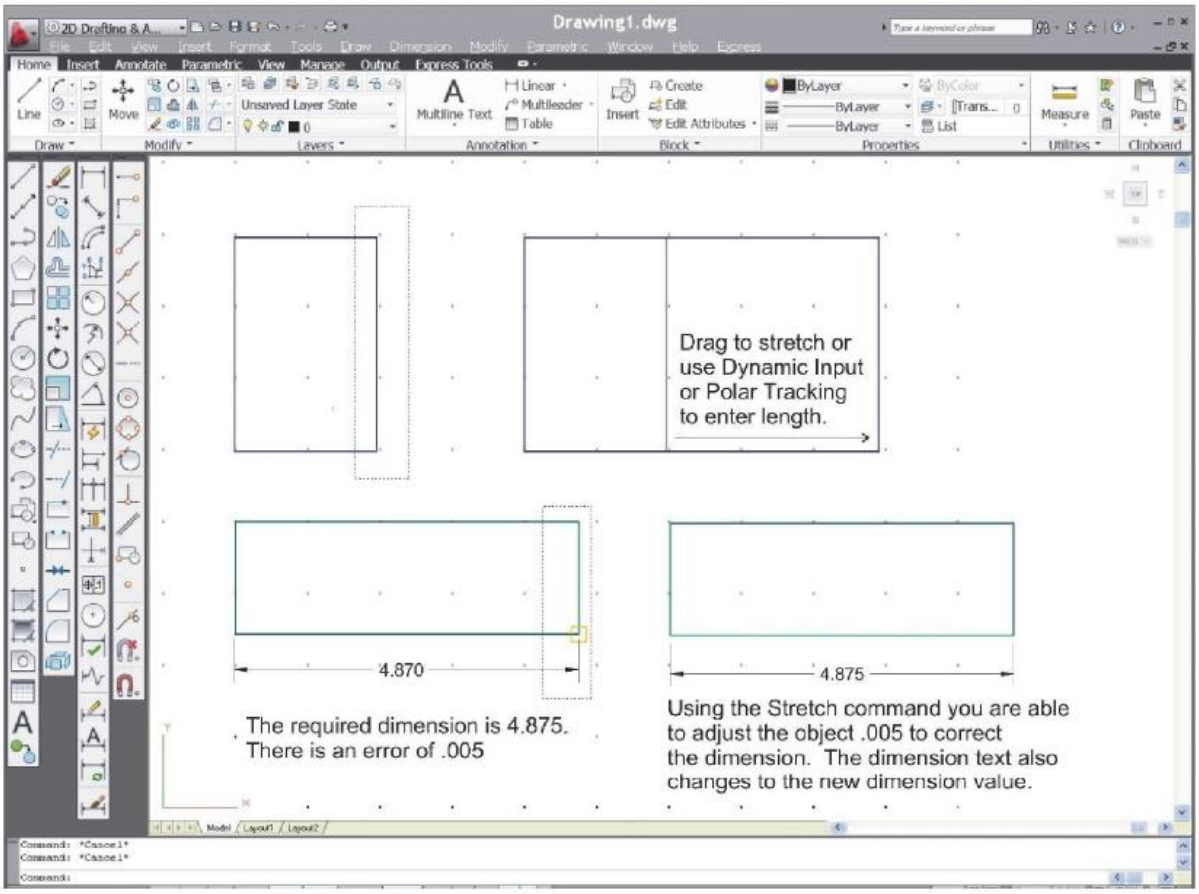
Command entry : Mi ↵ (as an alias)

Draw toolbar :

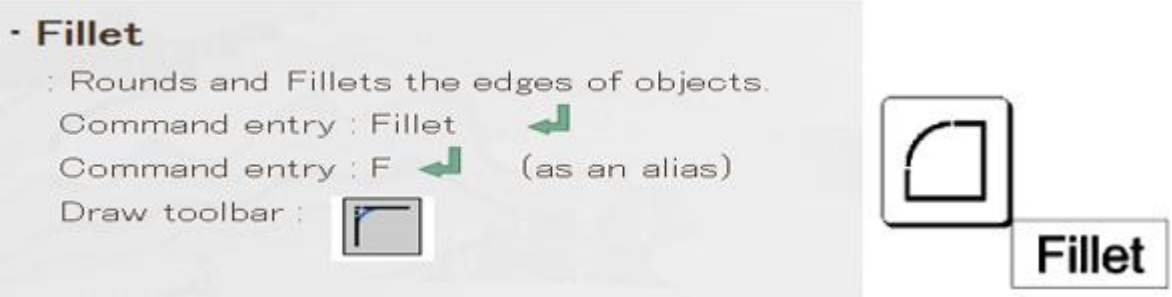
- Select the **Mirror** icon from the modify toolbar or the mofify panel of the **Home** tab.
- At the select objects prompt ,pick the objects you would like to mirror by selecting them either individually or with a window ,and press **< Enter>**
- When prompted to sprcify first point of mirror line, define the first point of the mirror axis by selecting a point in the graphics window ,where you want the mirror axis to begin.
- When you are prompted to select the second point of the mirror line ,select a second point in the graphics window defining the other end of the mirror axis.
- When prompted to erase source objects [Y/N] ,press **< Enter>**to retainthesource object (the prompts default is **No),** or type a **Y** and press **< Enter>**to erasethe object being mirrored.



5. **Change the size and shape objects (stretch command):** the icon of stretch command can be used to lengthen or shorten objects .it can also distort objects. To stretch objects, you can either drag the base point to a new location or enter coordinates.
    - Select the **stretch** icon from the **Modify toolbar** or **modify** panel of the **HOME** tab.
    - When prompted to *select objects*, pick the object you would like to stretch with a crossing window (define the window by picking from right to left) and press **< Enter>**
    - When prompted to *specify base point*, select a point located on the object to be stretched.
    - When prompted to *specify second point*, define the point you wish the object to stretch to by picking a point with the mouse, or entering absolute, relative, or polar coordinate values.

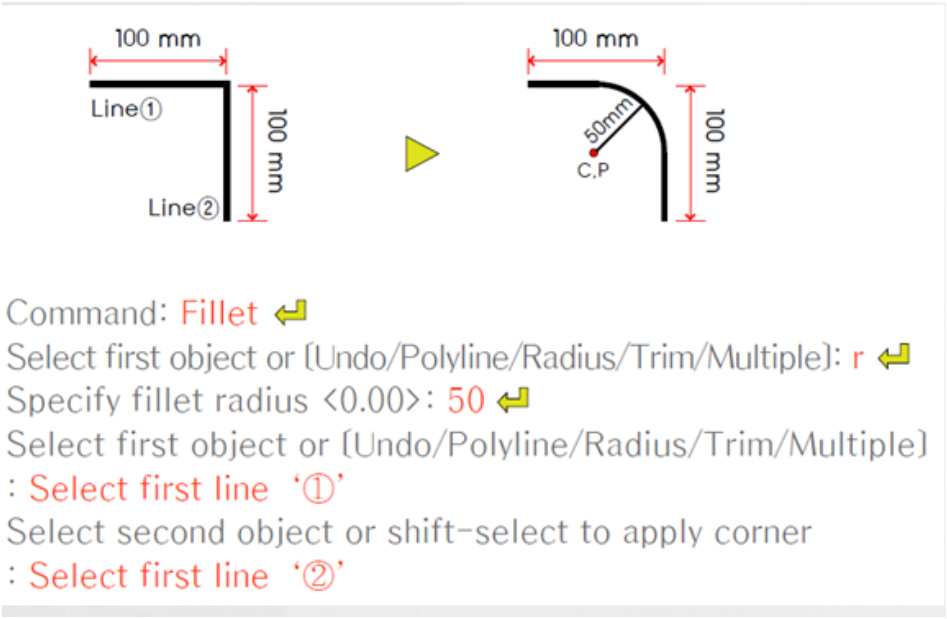


6. **Create fillets, Chamfers or Breaks in objects:**

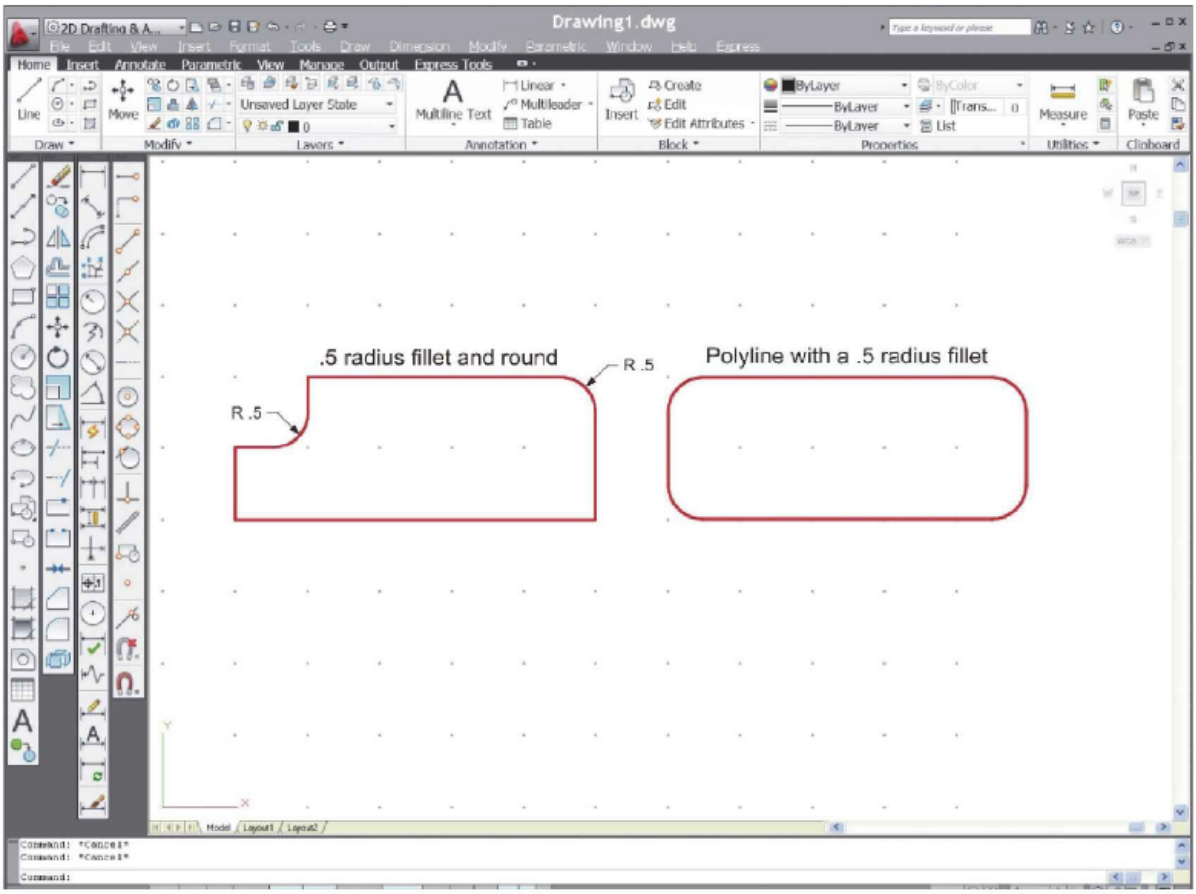


This command is use to create fillets (rounded inside corners) and rounds (rounded outside corners) o the objects. The **polyline** option creates fillets and rounds on the corner of polyline.

- Select the **Fillet** icon from the modify toolbar or **modify** panel of the **HOME** tab.
- Type **R** (for radius) and press **< Enter >**
- When prompted o *specify fillet radius*, enter the radius of the fillet and press **< Enter >**
- When prompted to *select first object,* pick the first line to be filleted near the end to be filleted.
- When prompted to *select second object,* pick the second line to be filleted.

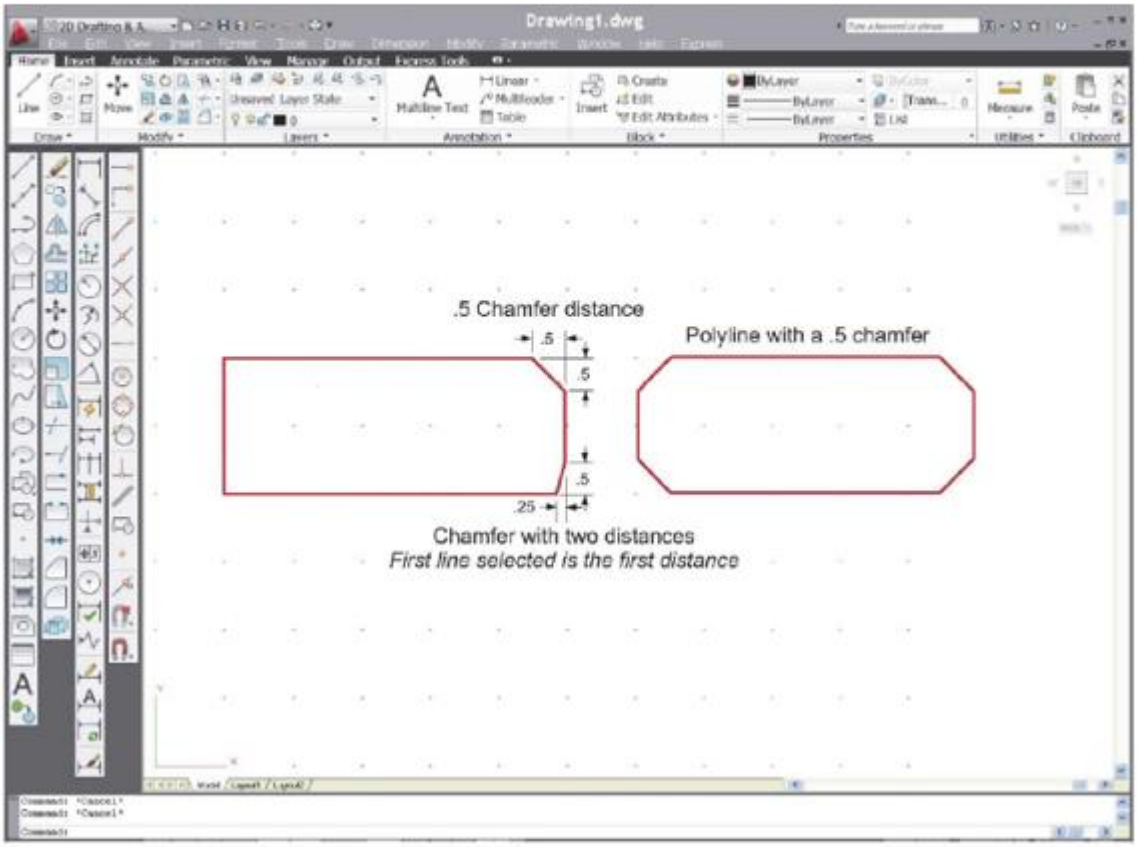


Command: Fillet ↵
Select first object or [Undo/Polyline/Radius/Trim/Multiple]: r ↵
Specify fillet radius <0.00>: 50 ↵
Select first object or [Undo/Polyline/Radius/Trim/Multiple]
: Select first line '①'
Select second object or shift-select to apply corner
: Select first line '②'



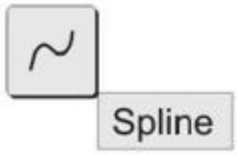
Chamfer command: The icon of chamfer command is used to bevel the corners of objects. The distance option allows you to enter a chamfer distance for both sides of the bevelled corner. The angle option allows you to enter a distance and an angle for the bevelled corner.

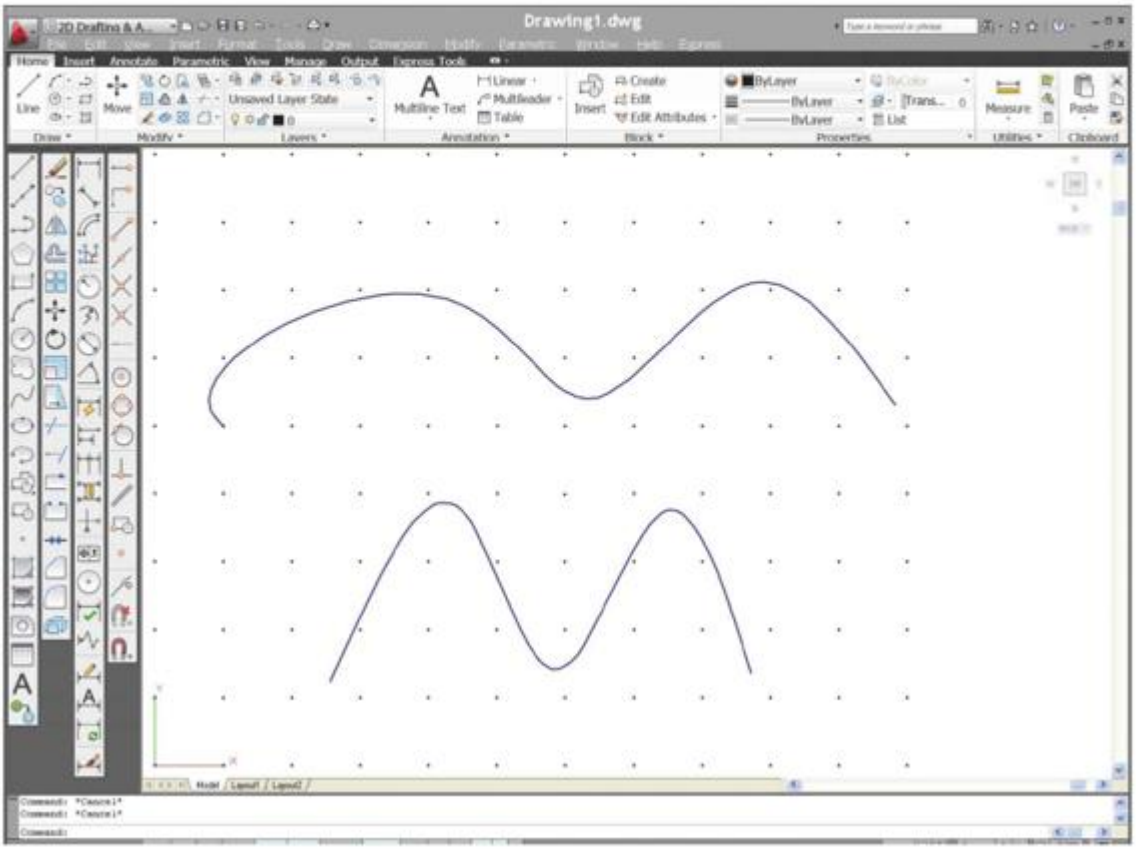
- Select the **Chamfer** icon from the modify toolbar or **modify** panel of the **HOME** tab. (select the drawn arrow next to the **Fillet** icon and choose from the drop-down list).
- Type **D** (for distance) and press **< Enter >**
- When prompted to *specify first chamfer distance,* enter the distance to bevel the first edge and press **< Enter >**
- When prompted to *specify second chamfer distance,* enter the distance to bevel the first edge and press **< Enter >**
- When prompted to *select first line,* pick the first line to be bevelled near the end to be bevelled.
- When prompted to *select second line,* pick the first line to be bevelled near the end to be bevelled.



7. **Modify Splines:**The icon of spline (**SPL**) command shown helps to crates non-uniform spline curve.**Spline line command tutorials:**
   - Select the **spline** icon from the draw toolbar or **draw** panel of the **HOME** tab.
   - When prompted to *specify first point or [object]*, type **2,2**and press**< Enter >**

- When prompted to *specify next point,* type **#4,5**(with dynamic input on**)**and press**< Enter >**
- When prompted to *specify next point,* type **#6,2** and press**< Enter >**
- When prompted to *specify next point,* type **#8,5** and press**< Enter >**
- When prompted to *specify next point,* type **#10,2** and press**< Enter >**
- When prompted to *specify next point,* press**< Enter >**





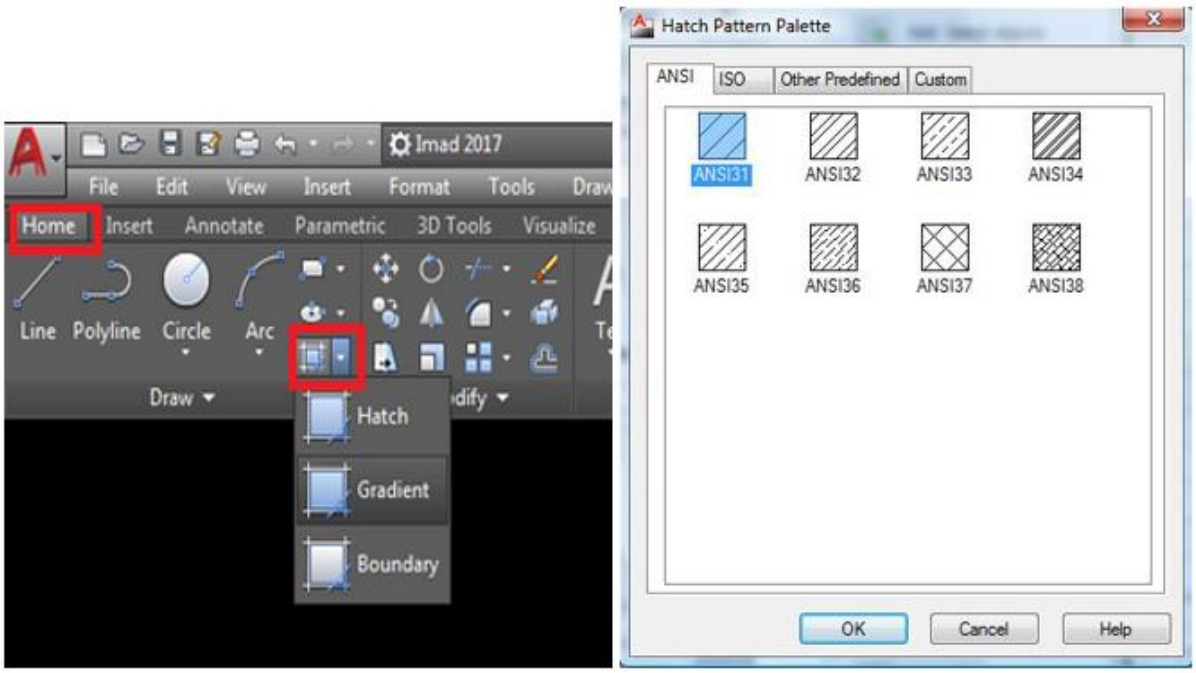
LO 3.4 – Apply Notes, Hatches and dimensions.

Content/Topic 1: Hatches.

The term hatching refers to filling bounded areas with solids, patterns, and/or gradients. You create hatching in the AutoCAD program to indicate transitions between materials and to improve the readability of drawings in general. Hatching with solid fill, patterns, and/or tonal gradients can transform staid line drawings into attractive illustrations.

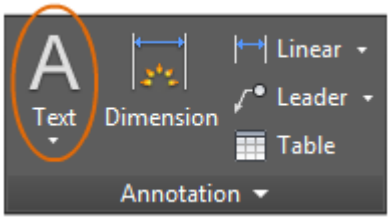
Every hatch area is defined by a boundary containing the solid fill, pattern, or gradient. You can determine the boundary either by picking a point on the drawing canvas or by selecting an object or set of objects.

A temporary tab called **Hatch** Creation appears on the ribbon. This tab will remain active while you configure the hatch object you are creating. Click Solid in the Pattern panel, and turn off Associative mode if it is on by clicking its button in the Options panel.

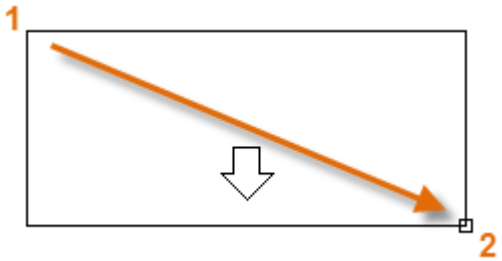


Content/Topic 2: Notes and labels.

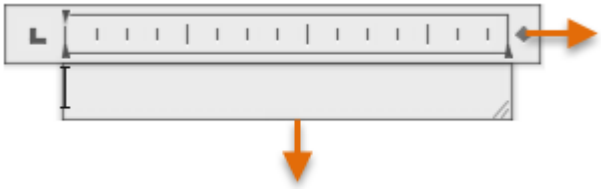
Create notes, labels, bubbles, and callouts. Save and restore style settings by name. You create general notes using the MTEXT command (or enter MT in the Command window), which stands for *multiline text*. The multiline text tool is available on the Annotation panel.



After you start the MTEXT command, you are prompted to create a "text box" with two diagonal clicks.



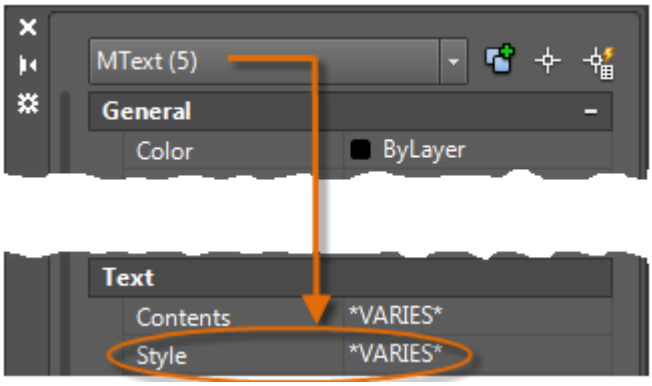
The exact size of the text box is not that important. After you specify the text box, the In-Place Editor is displayed and you can easily change the length and width of the note before, during, or after typing the text.



All the usual controls are available in the In-Place Editor, including tabs, indents, and columns. Also notice that when you start the MTEXT command, the ribbon temporarily changes, displaying many options such as text styles, columns, spell checking, and so on.

- To exit the text editor after you finish entering the text, click anywhere outside it.
- To edit a note, simply double-click it to open the text editor.

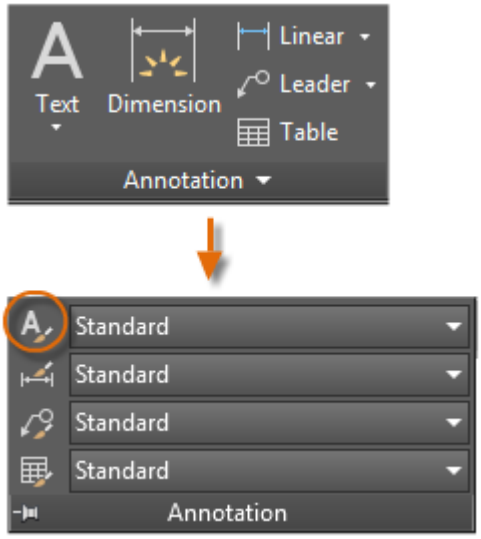
Tip: You can use the Properties palette to control the text style used for one or more selected multiline text objects. For example, after selecting five notes that use different styles, click the Style column and choose a style from the list.



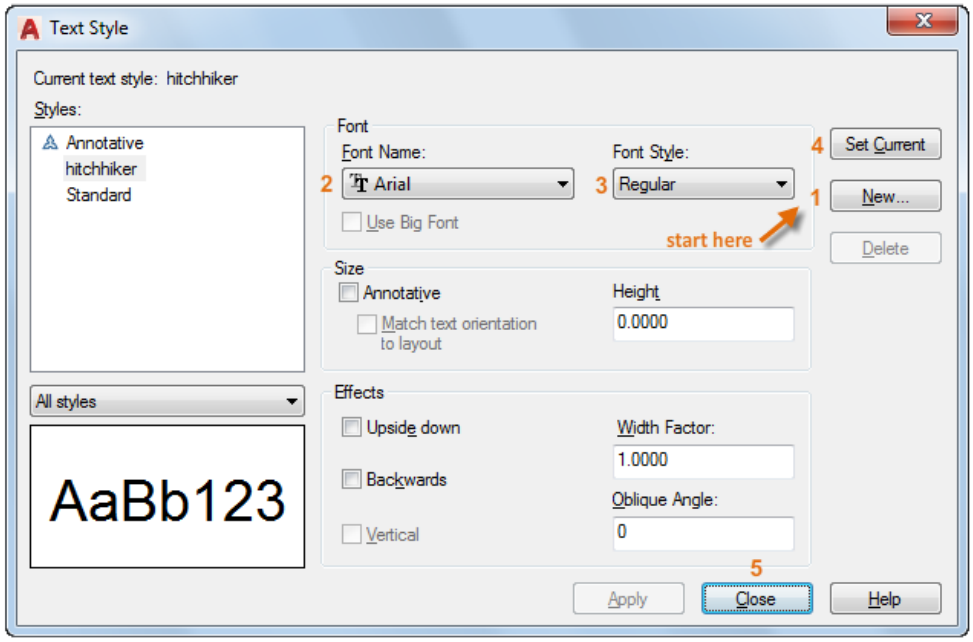
Create a Text Style

As with several other annotation features, multiline text provides a lot of settings. You can save these settings as a *text style* using the STYLE command, and then you can access the text styles you've saved by clicking the drop-down arrow on the Annotation panel. The current text style is displayed at the top of the drop-down list.

To create a new text style, click the Text Style control as shown.



When you create a new text style, you give it a name, and then choose a font and a font style. The order in which you click the buttons is shown below:



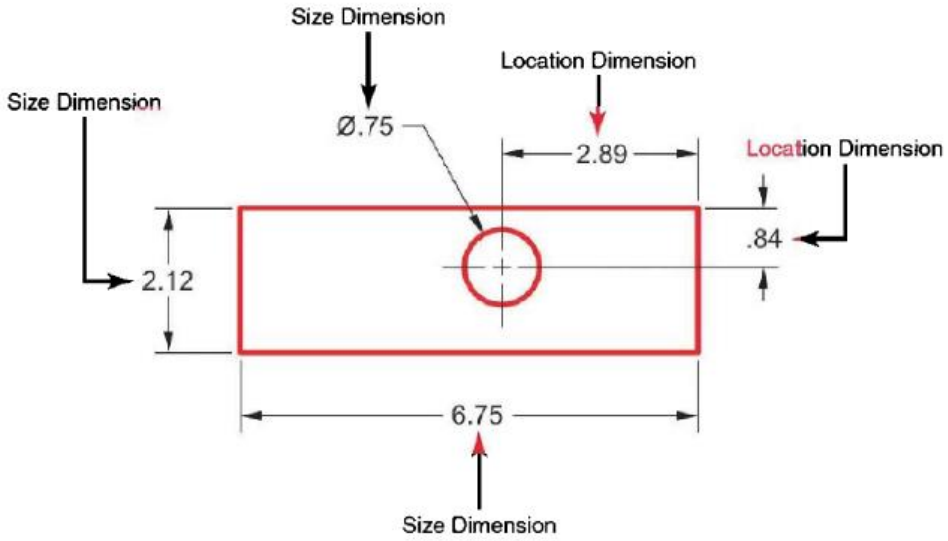
Content /Topic 3: Dimensions.

When adding dimensions on the drawing the designer has to consult the “menu bar” and click on “dimension”. Here the designer can Work with all types of dimensions.

Essentially there are two types of dimensions: **Size** and **Location** dimensions. The overall width and height of the part are size dimensions, the diameter of the hole through the part is also a size dimension, but the location of the center point of the hole is defined with location dimensions. Generally, the features of an object are located on the object with location dimensions and described with size dimensions.

Dimensional information may also include notes that provide information necessary to manufacture a machine part. For example, notes that specify the type of material from

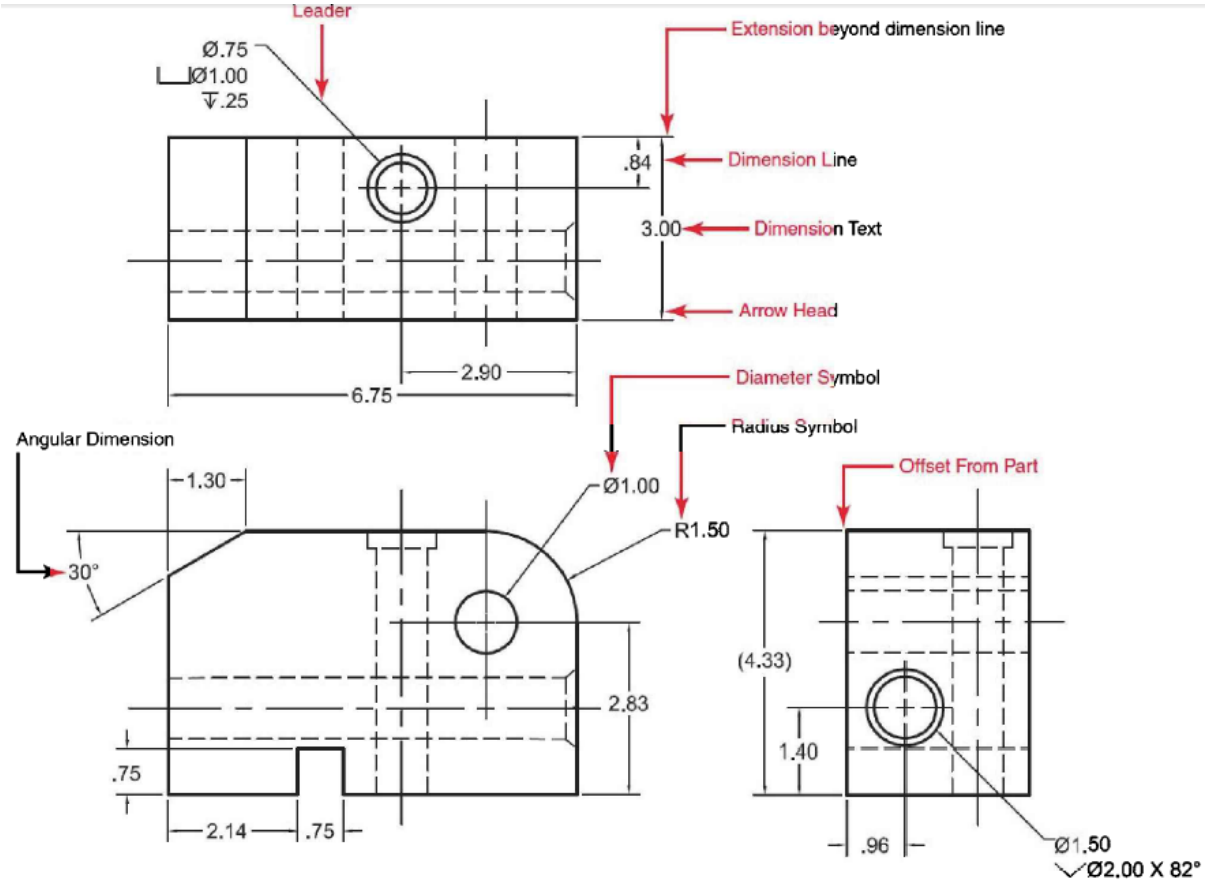
which the part is manufactured. Or special processes to be performed on the part during manufacture (heat treating or polishing), are included in the field of the drawing. If the notes included on the designer's input are omitted from the technical drawing, the part may not be manufactured as the designer intended.



A. Identification of basic concepts of dimensioning

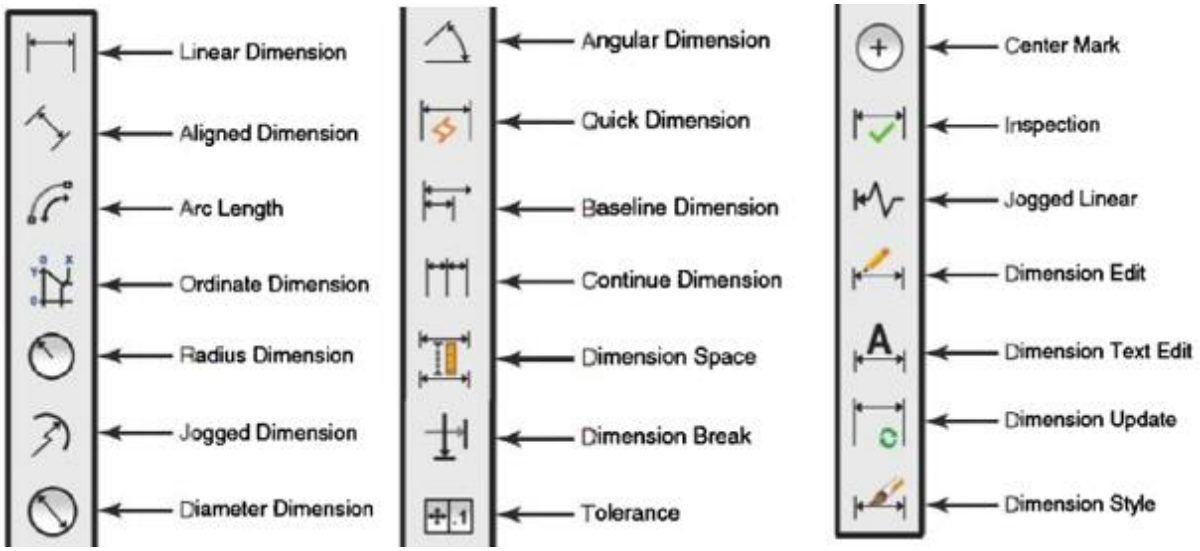
The below figure shows the terminologies used to refer to the elements of dimensioning. Locate the *dimension* and *extension* lines noted in the figure. Extension line extends out from the features of the object that are being dimensioned. Dimension lines are drawn between the extension lines and typically terminate in arrowheads that point to the extension lines. Dimensions lines contain text that denotes the distance or angle between the extension lines. Now locate the *Leader* in the figure.

Leader point to the features of the part and are used in notations that describe the feature, like the diameter of a hole or the radius of an arc. Later in this chapter you will be required to relate the terminology shown in the below figure to the corresponding setting in AutoCAD's **Dimension style manager** dialog box to create an AutoCAD dimension style.

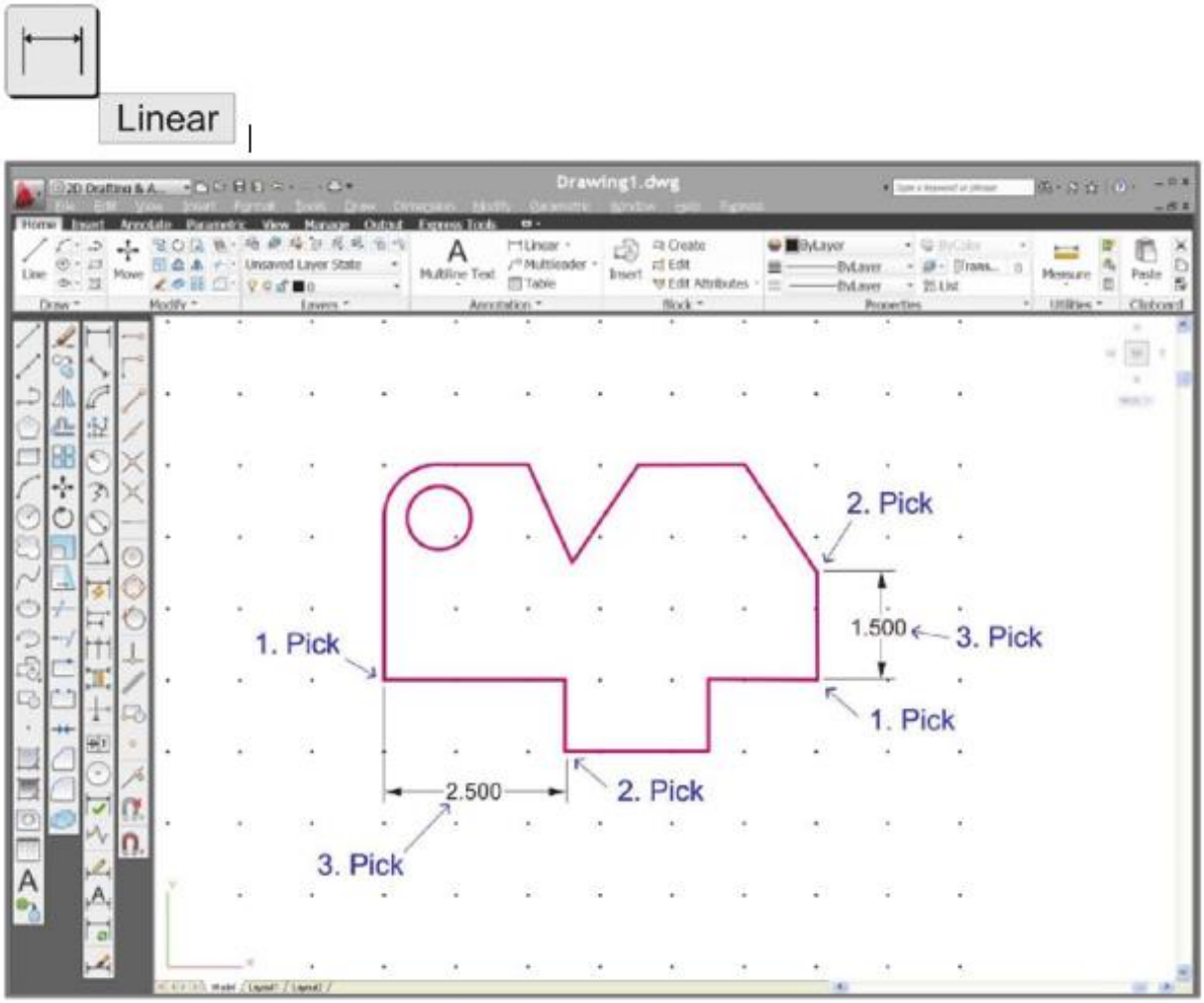


B. Create dimensions: many possible dimensions types are available like: *linear dimensions*, *aligned dimensions, arc length dimensions* and so on.

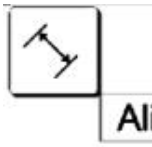
The AutoCAD dimension toolbar containing all the commands necessary to add dimensions to a drawing as shown in the figure below. These commands are also located in the dimension panel of the **Annotate** tab of the ribbon. In the follow figure each **dimension command** icon is labelled with its function.

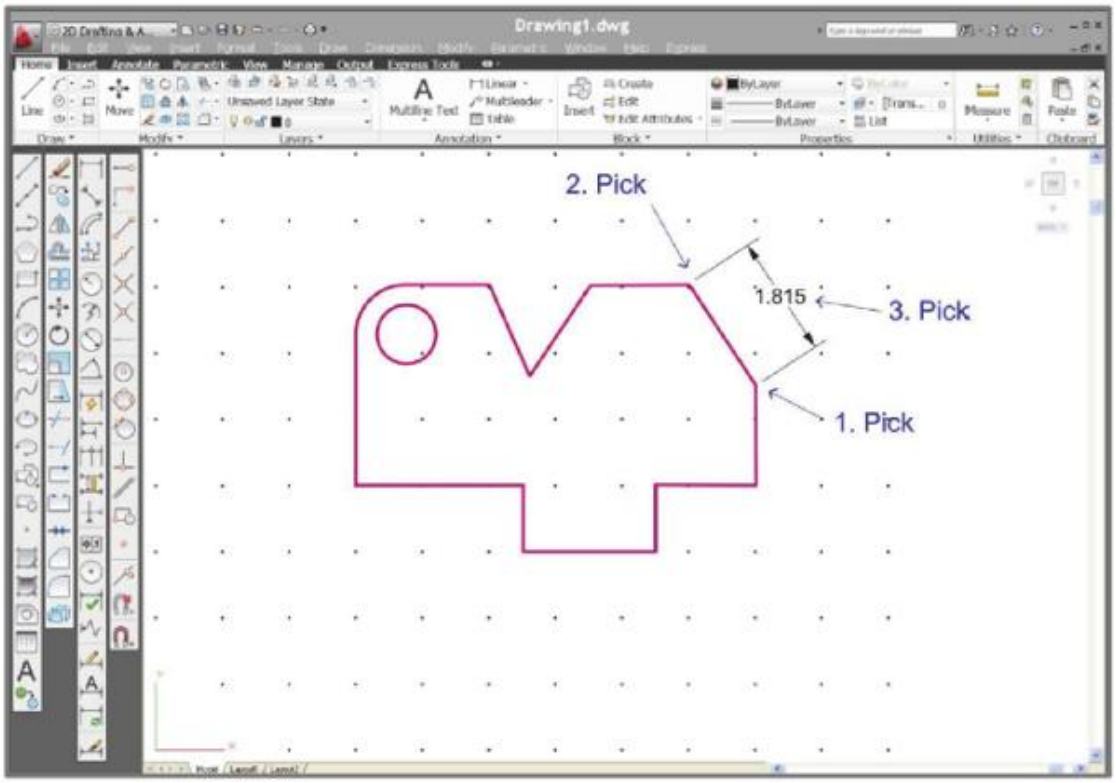


i. **Linear dimension command:** the icon of the linear dimension command is shown in the figure below. This command displays the linear distance between two selected pints. This option is used to dimension both vertical and horizontal features



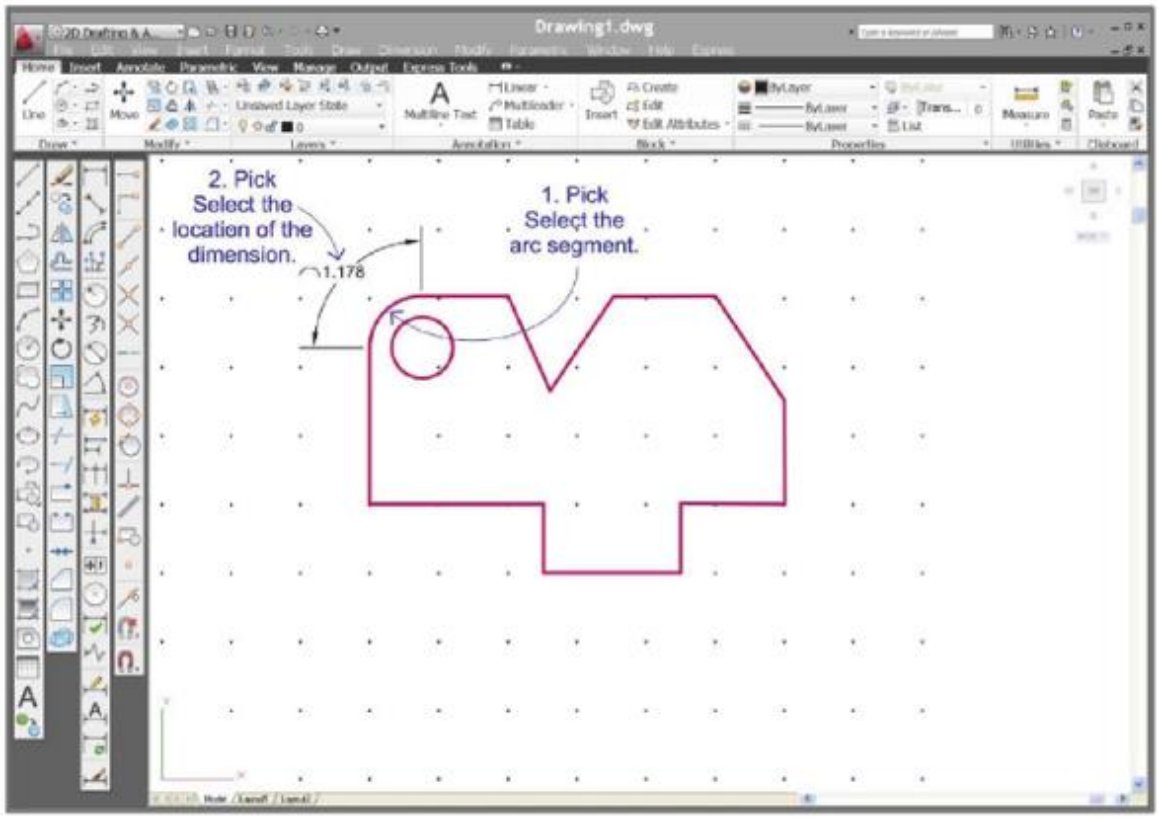
ii. **Aligned dimension command:** the icon for aligned dimension command is shown as bellow; this command is used to display the length of an angled line.



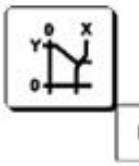


iii. **Arc length command:** the icon for arc length command is as bellow. This command is used to denote the length dimension of an arc or polyline arc segment.

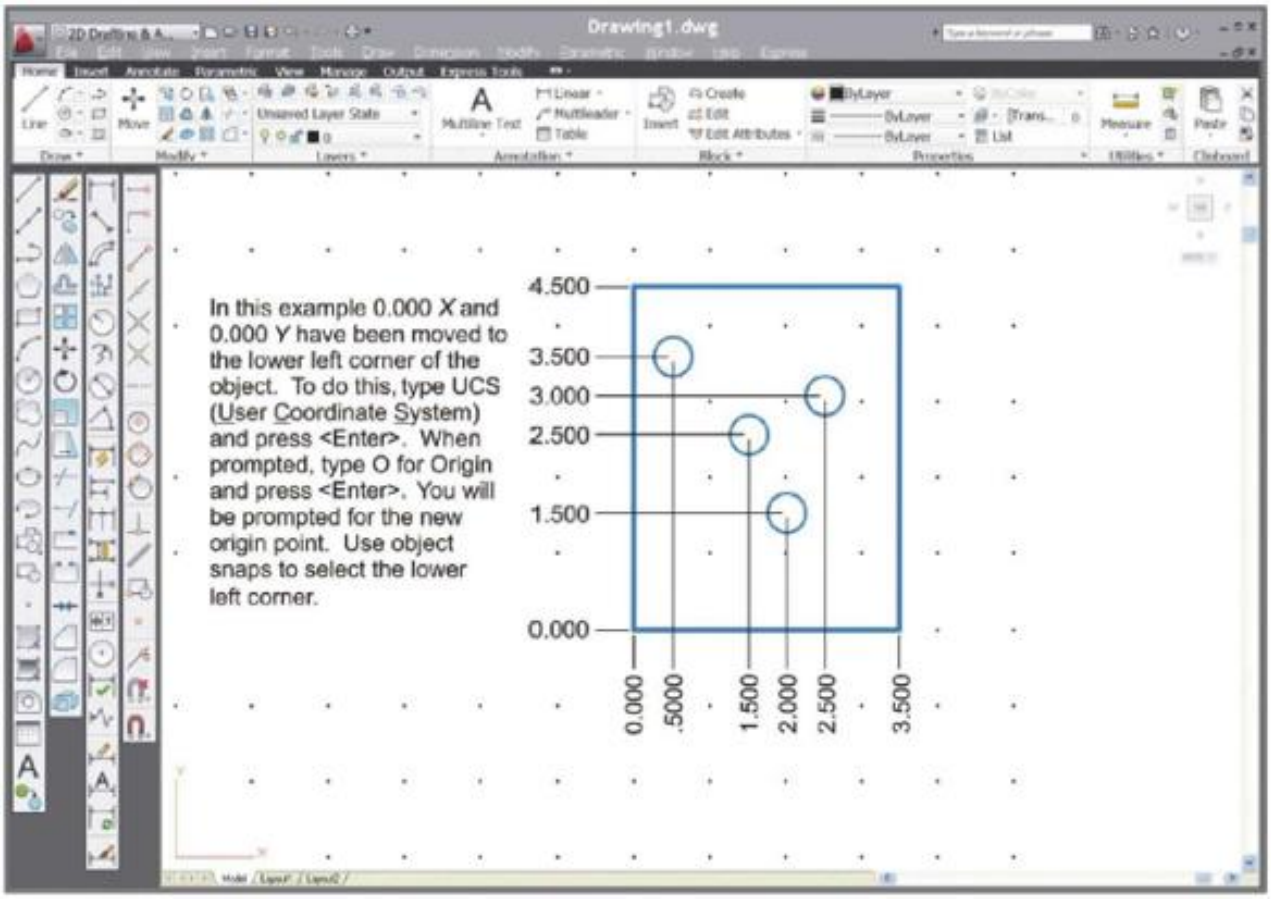
Arc Length



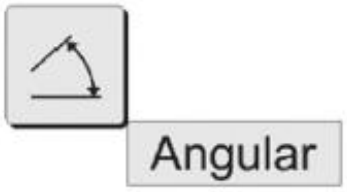
iv. **Ordinate dimension command**: this icon of Ordinate dimension command is used to denote distances along X- and Y-axes relative to a defined origin point (usually labelled 0, 0).

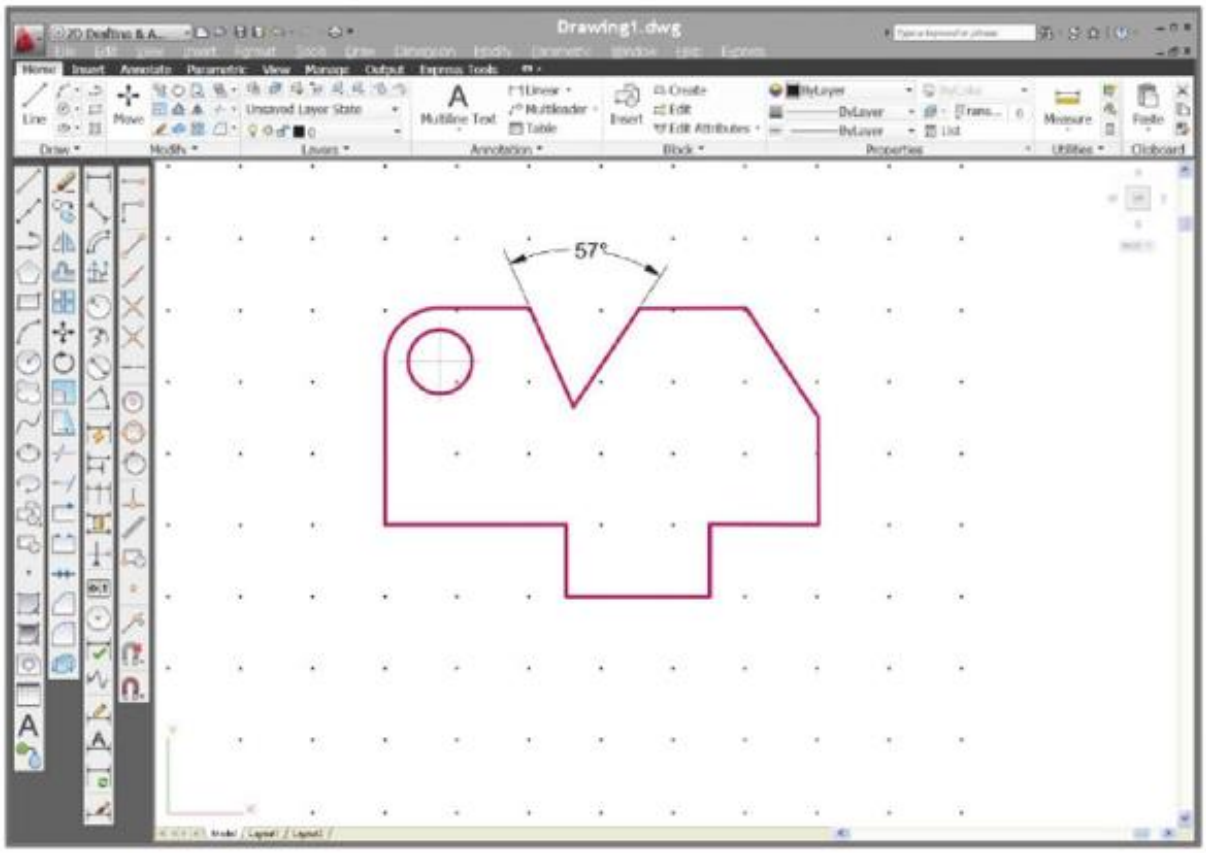


Ordinate



v. **Angular dimension command:** The icon for angular dimension is used to denote the angle between two features of objects.

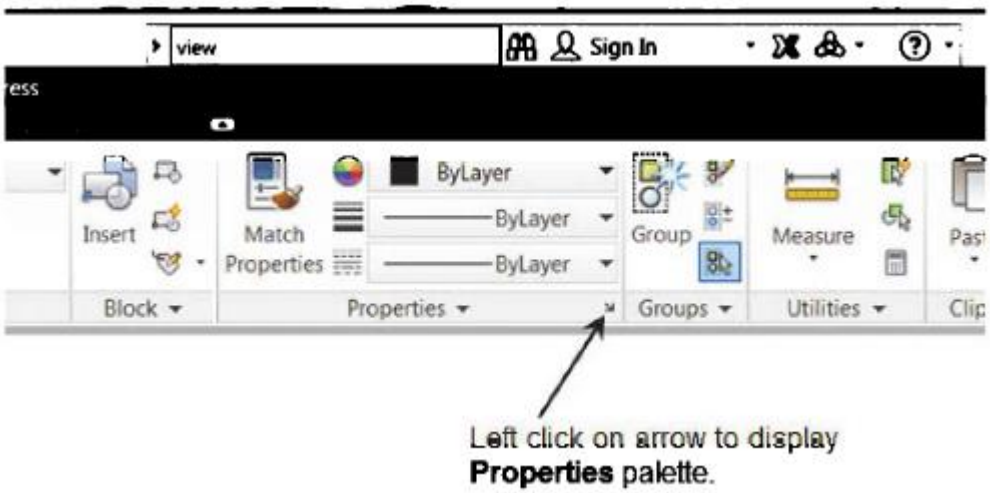




LO 3.5 – Proper control the properties of object.

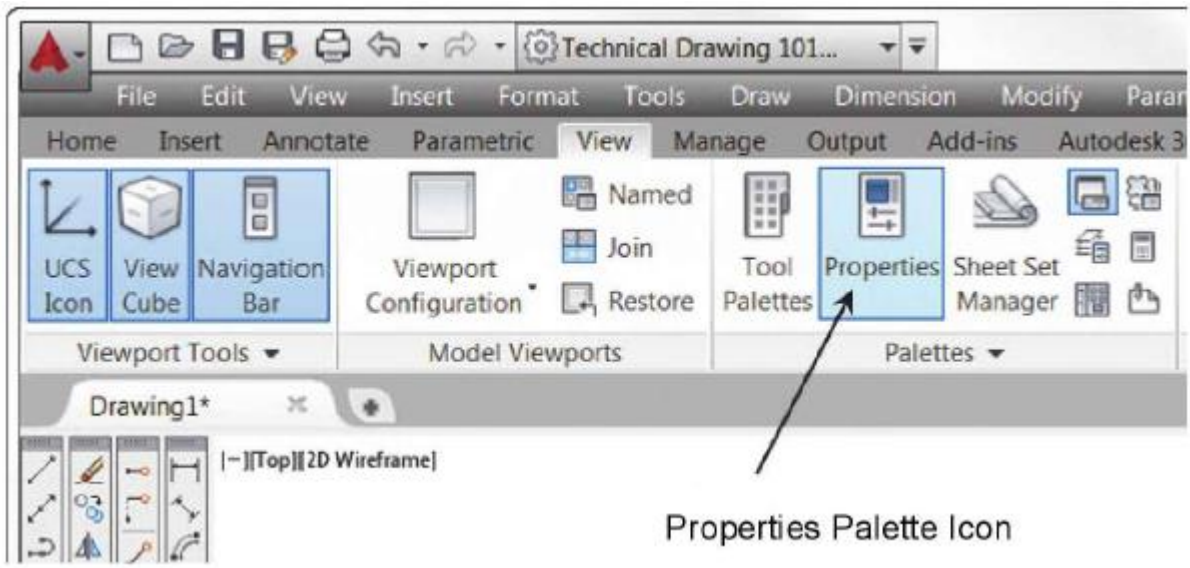
Content/Topic 1: overview of the object's properties.

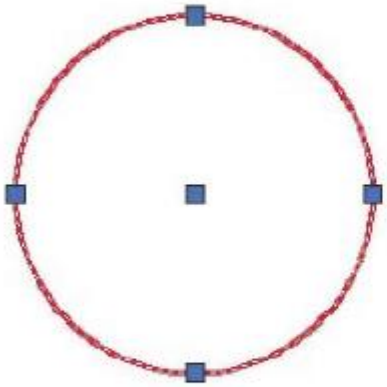
The properties command is used to display or change the properties of an object or group of 0bjects, such as color, line weight layer, line type, a line type scale. This is a very useful feature of AutoCAD. Begin this command by choosing the arrow next to **Properties** at the bottom of the icon from the **palettes panel** of the view tab of the ribbon, or by selecting the properties icon from the palettes panel of the view tab of the ribbon. Next, select an object I the drawing window and a properties palette will open that displays the objects properties. In the follow example, the circle has been selected and its properties are displayed in the property's palette.

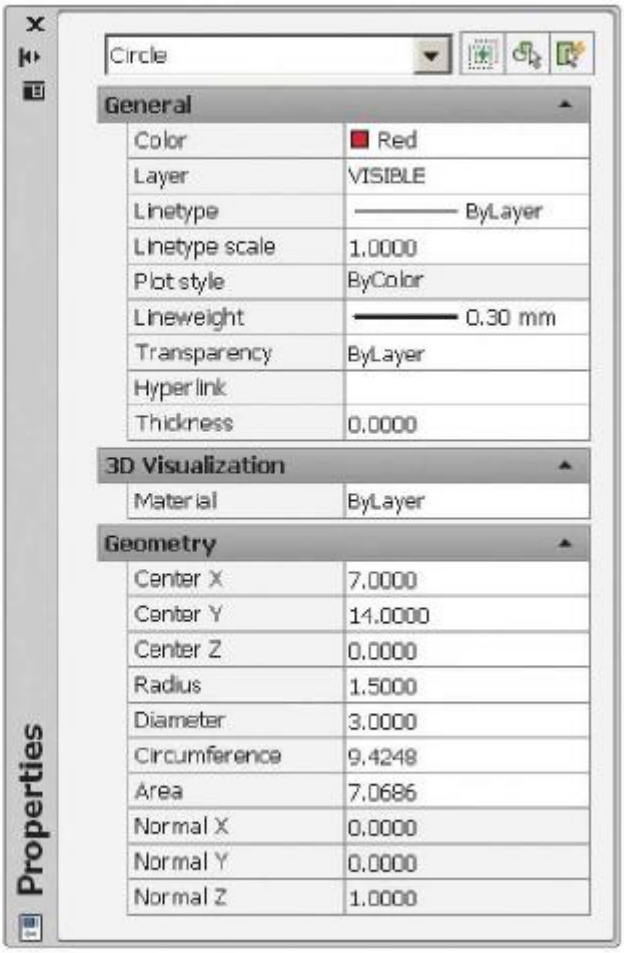


Content/Topic 2: Display and change the objects properties.

To change the properties of the circle, select the field in the palette next to the property to be changed. For the follow example, the circle is on the **visible** layer. Clicking on the field next to the **layer** properties displays a list of available layers. Selecting a different layer from the list moves the circles to the selected layer. The circle's other properties such as line weight, or line type scale, can be changed in a similar fashion. Other information about the circle, such as its diameter, radius, circumference, area and center location, can be located or changed in the property's palette under the **Geometry** heading.







To close the palette properties, left-click the **X**in the upper left corner of the palette.

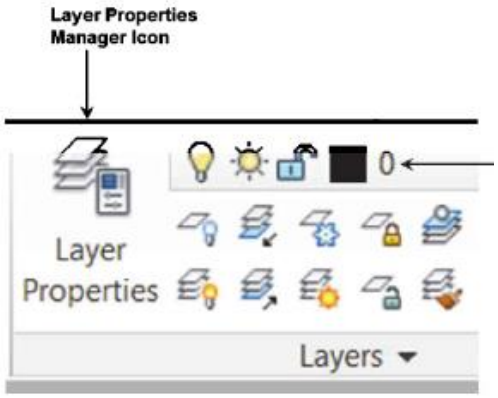
Content /Topic3: Work with layers.

In AutoCAD drawings, lines and others entities are drawn on layers. Think of layer as sheet of clear glass layered one on top of the other. A layer can have its own color, line type or lineweightassigned to it.

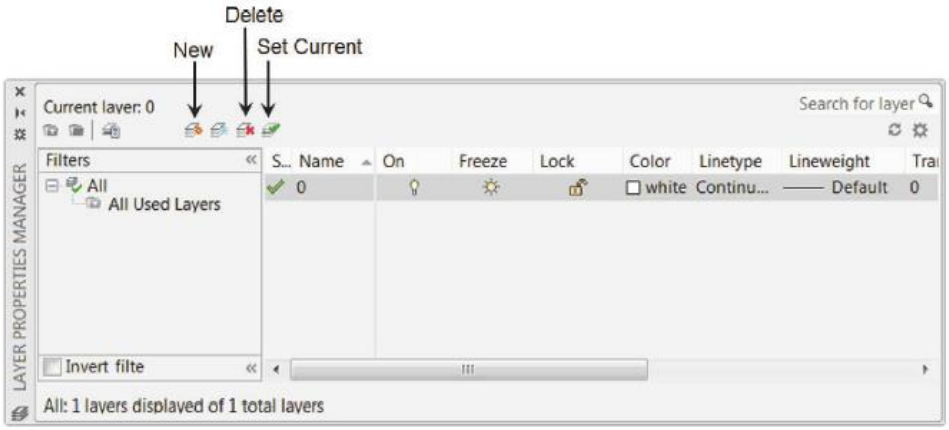
When you begin an AutoCAD drawing from scratch, it consists only one layer, layer zero (**0**), if more layers are needed there must be created.

A. Creation of new layer.

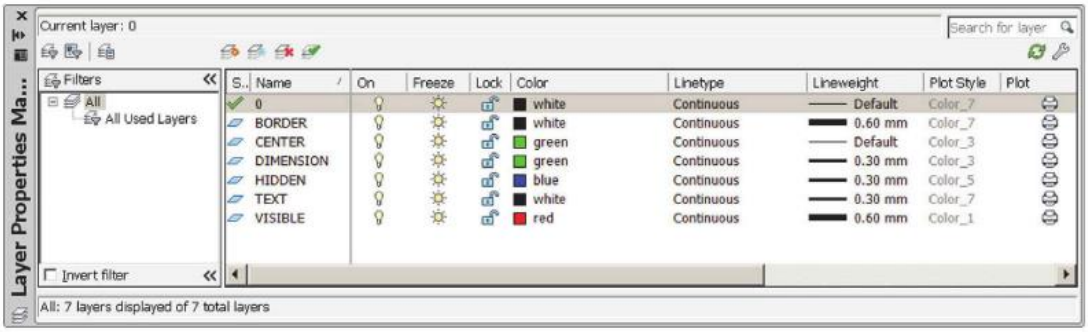
- Click on the layer properties manager icon located in the layers panel of the home tab on the ribbon.



- When the layer properties manager open palette open, click the new button.



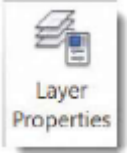
- Select the new layer and replace its default name, **Layer 1**, with new name.
- Repeat step 3 to create more layers, when all the new layers created click **OK,** and shows the layer created for mechanical drawing.



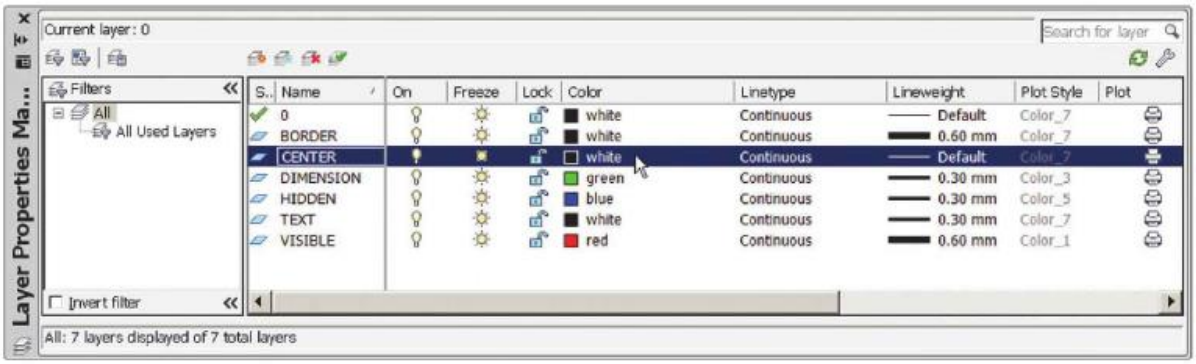
Content /Topic 4: Work with colors.

When setting the layer color, you have to follow this,

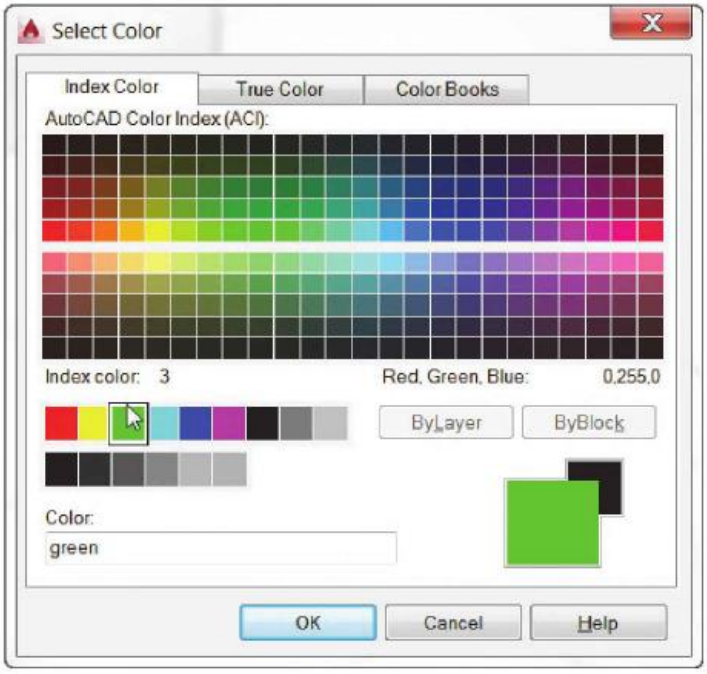
- Click on the layer properties manager icon located in the upper left corner of the layer panel of the home tab on the ribbon.



- Select the layer to which you want to assign anew color and click on the color assigned to the layer in the color column in the diagonal box.



– When the select color dialog box open, select the desired tile from the color palette and click **OK.**

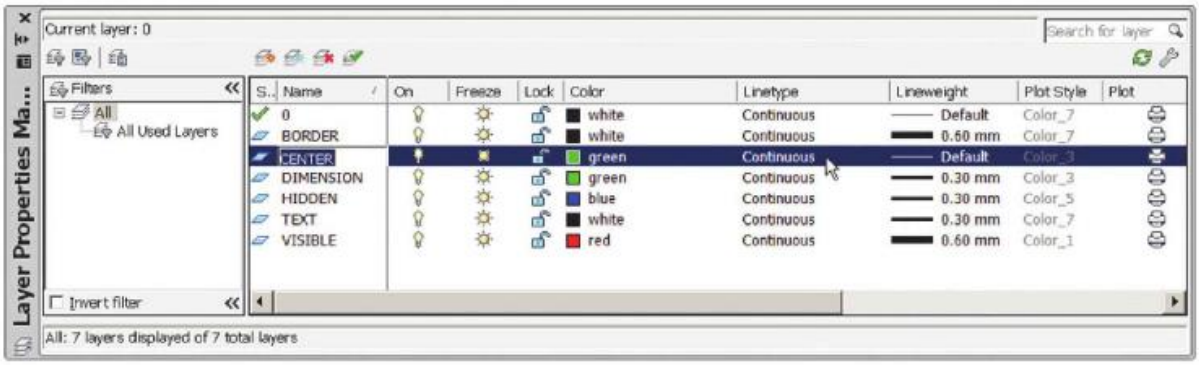


Content /Topic5: Work with lines types.

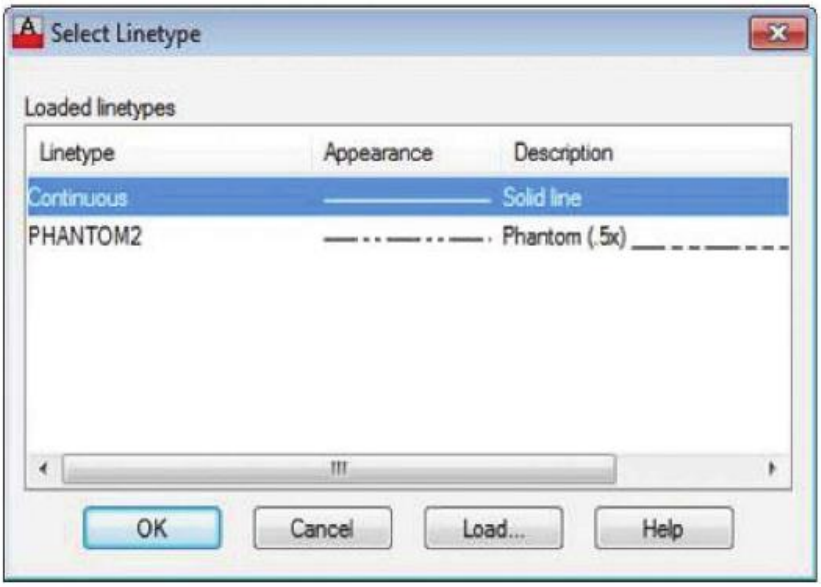
Setting layer line type is performed as follow,

– Click on the layer properties manager icon located in the upper left corner of the layer panel of the home tab on the ribbon.

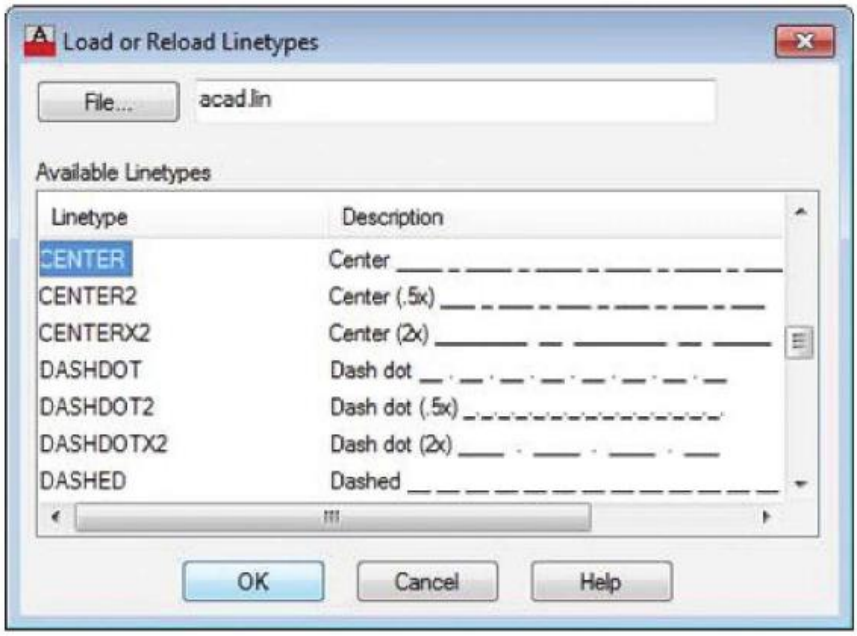
– Select the layer to which you want to assign a new line type and click on its line type name in the **Line type** column.



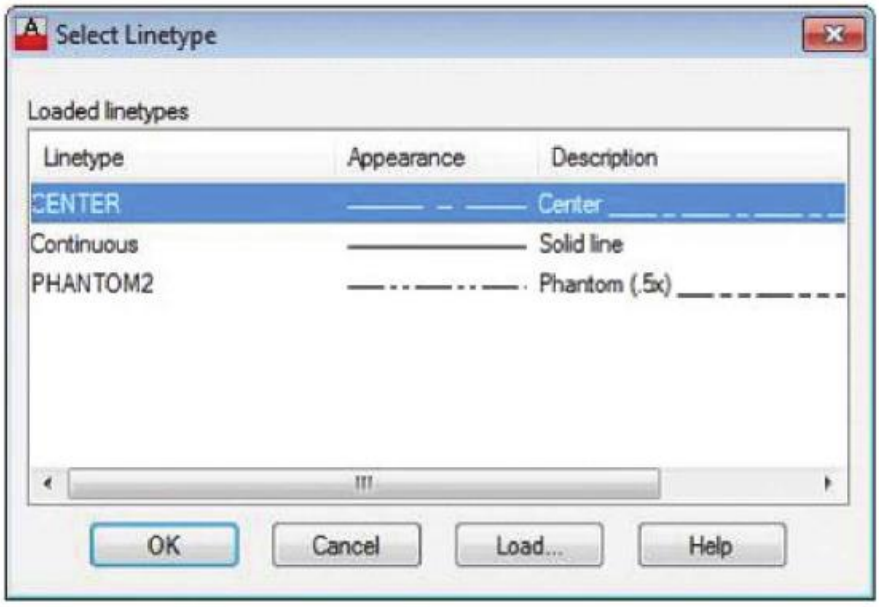
– The select line type dialog box will open. If you don't see the desired line type listed click the **Load** bouton.



– The **load or reload line type** dialog box will open. Scroll through the line types and select the line type you wish to load and click **OK**.



- Select the newly loaded line type from the **selected linetype**dialog box and click **OK.**The new line type will be assigned to the layer selected in step 2.

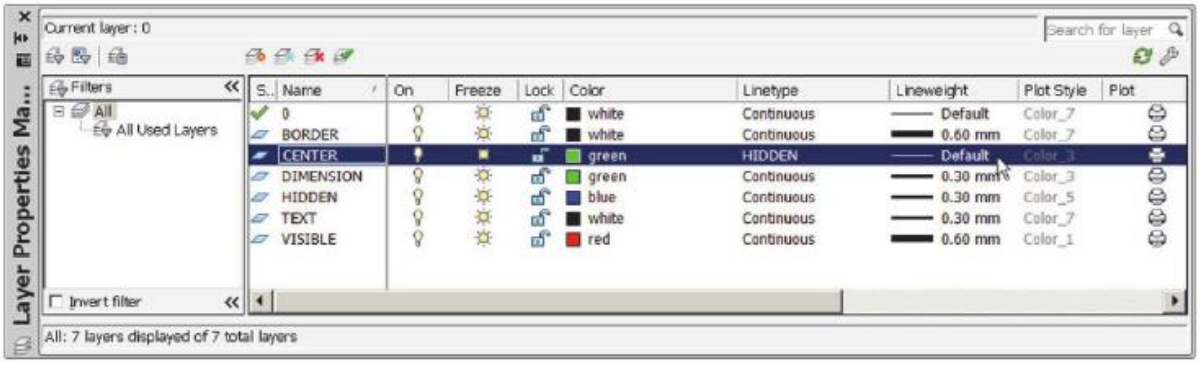


Content /Topic 6: Control line weights.

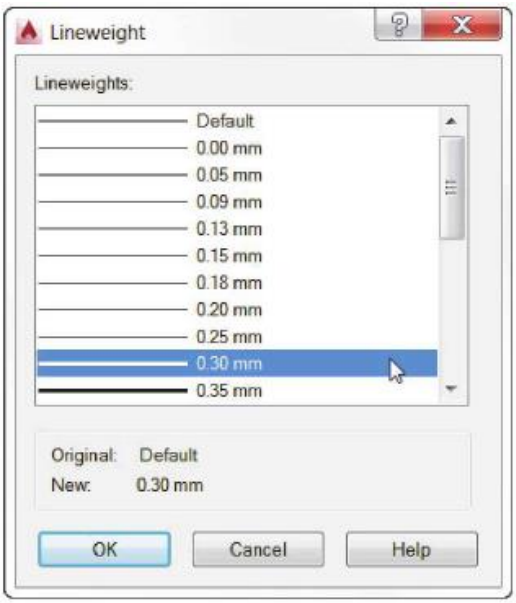
Line weight control is performed as follow,

- Click on the layer properties manager icon located in the upper left corner of the layer panel of the home tab on the ribbon.

- When the layer properties manger palette open, select the layer to which you want to assign new line weight, and click on the line weight setting in the **lineweight**column.



- When the **line weight** dialog box open, scroll through and select the desired line thickness in which you want the layer to be printed and click **OK.**


Lineweight
Lineweights:
Default
0.00 mm
0.05 mm
0.09 mm
0.13 mm
0.15 mm
0.18 mm
0.20 mm
0.25 mm
0.30 mm
0.35 mm
Original: Default
New: 0.30 mm
OK
Cancel
Help

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