

Міністерство освіти і науки України
Харківська національна академія міського господарства

Building floor plans and facades computer-aided design.

Guidance for laboratory works for “Informatics and computer modeling basics” course /for foreign students of 2nd year studying by orientation 6.060102 «Architecture»/

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Автоматизоване проектування поверхових планів і фасадів будівель:
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Theme: Building floor plans and facades computer-aided design.

Purpose: to learn how to use AutoCAD for a real architectural project automated implementation.

To develop skills of entities creating and editing, working with layers, geometrical constructing, using drawing and displaying procedures, text information input and editing. To acquire skills of design drawing constructing for the projects executed in the AutoCAD program. To learn how to plot the drawings on paper.

This laboratory work is basic for the process of two-dimensional graphics studying.

It is necessary to build plans of a cottage (not less than two floors). Apartments plans and specifications development for two floors will be described later on. However it is very useful to add something to the project (for example, a basement).

Work order:

1. Preliminary work (without a computer).
 - 1.1. Think the project over and draw sketches.
 - 1.2. Define approximately which information will be plotted on A4 format paper.
Minimum set of leaves (for a two-storied cottage): the ground and the 1st floor plans and apartment specifications.
 - 1.3. Taking into account the objects sizes, define the scale to be used on the A4 format paper. You must enter all the objects sizes in natural scale units (1 unit of drawing equals to 1 meter). However to define basic data of project is necessary

just at this stage.

2. Create a new drawing.
3. Create a new layer to draw a boundary and a stamp for the A4 format. Enter the boundary and stamp sizes in natural scale units (1 unit of drawing equals to 1 millimeter).
4. Draw the plan of the ground floor.
 - 4.1. In a new layer, draw a sketch of the ground floor using thin lines. Windows and doors are not to be indicated at this stage. Enter the objects sizes in natural scale plan units (1 unit of the drawing is equal to 1 millimeter).
 - 4.2. Create doorways and window openings.
 - 4.3. In a new layer, outline the walls with wide polylines.
 - 4.4. In a new layer insert windows and doors.
 - 4.5. In a new layer insert the numbers of apartments.
5. Draw the ground floor apartments specification.
 - 5.1. Create a new layer.
 - 5.2. Copy and paste the boundary and the stamp in this layer.
 - 5.3. In the boundary, create a list of the apartments. All the sizes related to the text enter in millimeters.
6. Copy and paste the information for the 1st floor in new layers. Edit the information.
 - 6.1. Create necessary new layers.
 - 6.2. Copy and paste the information for the ground floor in new layers.
 - 6.3. Edit the information and get a plan and apartments specification for the 1st floor.
7. Place the floors plans within the boundaries.
 - 7.1. Create a new layer.
 - 7.2. Copy and paste the boundary and the stamp on this layer.
 - 7.3. Match the boundary and plan sizes of the ground floor. Do not change the plan, but change the sizes of the boundary in accordance with the scale chosen.
 - 7.4. Transfer the plan to a proper place within the boundary.

- 7.5.Repeat actions of pp. 7.1-7.4 for the 1st floor.
8. Print out the information, using **Window** output region determination option and **Fit** output scale determination option.
9. Save the drawing in the personal folder and compress it (Zip).
10. Save this archive in the Academy distance learning system.

Create Single-View Drawings (Model Space)

If you are going to create a two dimensional drawing that has one view, you can create the drawing and its annotation entirely in model space. This is the traditional method for creating drawings with AutoCAD.

Model Space Drafting

The process of creating and plotting a drawing file in model space is very different from the process used in manual drafting.

In AutoCAD, there are two distinct working environments that are represented by the Model and layout tabs. These tabs are located near the bottom of the drawing area.

If you are going to create a two-dimensional drawing that has one view, you can create both the model and its annotation entirely in model space, not using a layout tab. This is the traditional method for creating drawings with AutoCAD. This method is simple but has several limitations, including

- It is suitable for 2D drawings only.
- It does not support multiple views and view-dependent layer settings.
- Scaling the annotation and title block requires computation unless you use annotative objects.

With this method, you always draw geometric objects at full scale (1:1) and text, dimensions, and other annotation at a scale that will appear at the correct size when the drawing is plotted.

Draw, Scale, and Annotate in Model Space

If you draw and plot from model space, you must determine and apply a scale factor to annotate objects before you plot.

You can draw and plot entirely from model space. This method is useful primarily for two-dimensional drawings that have a single view. With this method, you use the following process:

- Determine the unit of measurement (drawing units) for the drawing.
- Specify the display style for the drawing unit.
- Calculate and set the scale for dimensions, annotations, and blocks.
- Draw at full scale (1:1) in model space.
- Create the annotation and insert the blocks in model space.
- Plot the drawing at the predetermined scale.

You can also use annotative objects if you want to scale annotations automatically. For information about using annotative objects and scaling annotations automatically, see *Scale Annotations*.

Determine the Unit of Measurement

Before you begin drawing in model space, you determine the unit of measurement (drawing units) that you plan to use. You decide what each unit on the screen represents, such as an inch, a millimeter, a kilometer, or some other unit of measurement. For example, if you are drawing a motor part, you might decide that one drawing unit equals a millimeter. If you are drawing a map, you might decide that one unit equals a kilometer.

For architectural projects you might decide that one unit equals a meter.

Specify the Display Style of Drawing Units

Once you have determined a drawing unit for the drawing, you need to specify the style for displaying the drawing unit, which includes the unit type and precision.

For example, a value of 14.5 can be displayed as 14.500, 14-1/2, or 1'2-1/2".

Specify the display style of drawing units with the UNITS command. The default drawing unit type is decimal.

Set the Scale for Annotations and Blocks

Before you draw, you should set the scale for dimensions, annotations, and blocks in your drawings. Scaling these elements beforehand ensures that they are at the correct size when you plot the final drawing.

You should enter the scale for the following objects:

Text. Set the text height as you create text or by setting a fixed text height in the text style (STYLE).

Dimensions. Set the dimension scale in a dimension style (DIMSTYLE) or with the DIMSCALE system variable.

Linetypes. Set the scale for noncontinuous linetypes with the CELTSCALE and LTSCALE system variables.

Hatch patterns. Set the scale for hatch patterns in the Hatch and Gradient dialog box (HATCH) or with the HPSCALE system variable.

Blocks. Specify the insertion scale for blocks either as you insert them, or set an insertion scale in the Insert dialog box (INSERT) or in DesignCenter (ADCENTER). The system variables used for inserting blocks are INSUNITS, INSUNITSDEFSOURCE, and INSUNITSDEFTARGET. This also applies to the border and title block of the drawing.

You can also use annotative objects if you want to scale annotations automatically. For information about using annotative objects and scaling annotations automatically, see Scale Annotations.

Determine the Scale Factor for Plotting

To plot your drawing from the Model tab, you calculate the exact scale factor by converting the drawing scale to a ratio of 1:n. This ratio compares plotted units to drawing units that represent the actual size of the objects you are drawing.

For example, if you plan to plot at a scale of 1/4 inch = 1 foot, you would calculate the scale factor 48 as follows:

$$1/4" = 12"$$

$$1 = 12 \times 4$$

$$1 \text{ (plotted unit)} = 48 \text{ (drawing units)}$$

Using the same calculation, the scale factor for 1 centimeter = 1 meter is 100, and the scale factor for 1 inch = 20 feet is 240.

Create Multiple-View Drawing Layouts (Paper Space)

Paper space is a sheet layout environment where you can specify the size of your sheet, add a title block, display multiple views of your model, and create dimensions and notes for your drawing.

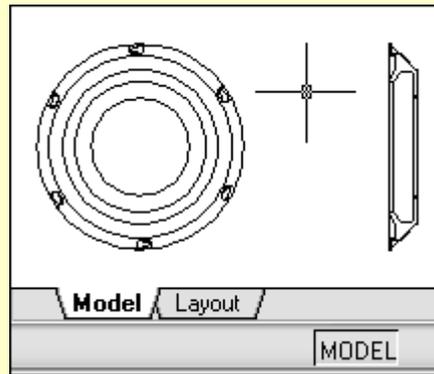
Understand the Layout Process

There are two distinct working environments, or “spaces,” in which you can create objects in a drawing. These are represented by the Model and layout tabs.

Typically, a model composed of geometric objects is created in a three-dimensional space called model space. A final layout of specific views and annotations of this model is created in a two-dimensional space called paper space. These spaces are accessible on two or more tabs near the bottom of the drawing area: the Model tab and one or more layout tabs.

Note. These tabs can be hidden, appearing instead as buttons on the status bar at the bottom-center of the application window.

Working on the Model tab, you draw a model of your subject at 1:1 scale. Working on a layout tab, you can create one or more layout viewports, dimensions, notes, and a title block to represent a drawing sheet.



Each layout viewport is like a picture frame containing a “photograph” of the model in model space. Each layout viewport contains a view that displays the model at the scale and orientation that you specify. You can also specify which layers are visible in each layout viewport.

After you finish arranging the layout, you turn off the layer that contains the layout viewport objects. The views are still visible, and you can plot the layout without displaying the viewport boundaries.

When you use a layout tab to prepare your drawing for plotting, you follow a series of steps in a process.

You design the subject of your drawing on the Model tab (in model space) and prepare it for plotting on a layout tab (in paper space).

There is one Model tab and one or more layout tabs at the bottom of the drawing window.

Note. These tabs can be hidden, appearing instead as buttons on the status bar at the bottom-center of the application window.

Process Summary

When you prepare a layout, you typically step through the following process:

- Create a model of your subject on the Model tab.
- Click a layout tab.
- Specify layout page settings such as plotting device, paper size, plot area, plot scale, and drawing orientation.
- Insert a title block into the layout (unless you have started with a drawing template that already has a title block).
- Create a new layer to be used for layout viewports.

- Create layout viewports and position them on the layout.
- Set the orientation, scale, and layer visibility of the view in each layout viewport.
- Add dimensions and annotate in the layout as needed.
- Turn off the layer containing the layout viewports.
- Plot your layout.

You can also use annotative objects if you want to annotate your drawing in model space and scale the annotations automatically. For information about using annotative objects and scaling annotations automatically, see [Scale Annotations](#).

Work with Model Space and Paper Space

There are several benefits to switching between model space and paper space to perform certain tasks. Use model space for creating and editing your model. Use paper space for composing your drawing sheet and defining views.

Work on the Model Tab

The Model tab accesses a limitless drawing area called model space. In model space, you draw, view, and edit your model.

In model space, you draw your model at 1:1 scale, and you decide whether one unit represents one millimeter, one centimeter, one inch, one foot, or whatever unit is most convenient or customary in your business.

On the Model tab, you can view and edit model space objects. The crosshairs cursor is active over the entire drawing area.

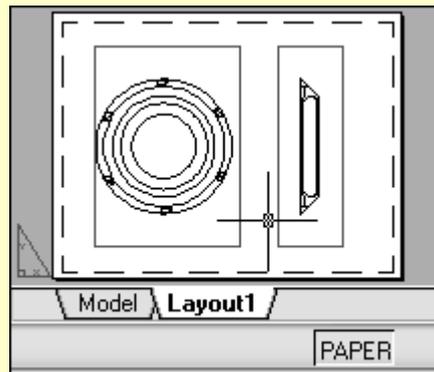
Work on a Layout Tab

Layout tabs access an area called paper space. In paper space, you place your title block, create layout viewports to display views, dimension your drawing, and add notes.

In paper space, one unit represents the paper distance on a plotted sheet. The units will be in either millimeters or inches, depending on the plot setup for your

plotter.

On a layout tab, you can view and edit paper space objects, such as layout viewports and title blocks. You can also move an object (such as a leader or a title block) from model space to paper space (or vice versa). The crosshairs cursor is active over the entire layout area.



Note. These tabs can be hidden, appearing instead as buttons on the status bar at the bottom-center of the application window. To display the tabs, right-click the Model or layout button and click Display Layout and Model Tabs on the shortcut menu.

Access Model Space from a Layout Viewport

You can access model space from a layout viewport to edit objects, to freeze and thaw layers, and to adjust the view.

After creating viewport objects, you can access model space from a layout viewport to perform the following tasks:

- Create and modify objects in model space inside the layout viewport.
- Pan the view inside the layout viewport and change layer visibility.

The method you use to access model space depends on what you plan to do.

Create and Modify Objects in a Layout Viewport

If you plan to create or modify objects, use the button on the status bar to maximize the layout viewport. The maximized layout viewport expands to fill the

drawing area. The center point and the layer visibility settings of the viewport are retained, and the surrounding objects are displayed.

You can pan and zoom while you are working in model space, but when you restore the viewport to return to paper space, the position and scale of the objects in the layout viewport are restored.

Note. If you use PLOT while a viewport is maximized, the layout tab is restored before the Plot dialog box is displayed. If you save and close the drawing while a viewport is maximized, the drawing opens with the layout tab restored.

If you choose to switch to the Model tab to make changes, the layer visibility settings are the settings for the drawing as a whole, not the settings for that particular layout viewport. Also, the view is not centered or magnified the same way it is in the layout viewport.

Adjust the View in a Layout Viewport

If you plan to pan the view and change the visibility of layers, double-click within a layout viewport to access model space. The viewport border becomes thicker, and the crosshairs cursor is visible in the current viewport only. All active viewports in the layout remain visible while you work. You can freeze and thaw layers in the current viewport in the Layer Properties Manager, and you can pan the view. To return to paper space, double-click an empty area on the layout outside a viewport. The changes you made are displayed in the viewport.

If you set the scale in the layout viewport before you access model space, you can lock the scale to prevent changes. When the scale is locked, you cannot use ZOOM while you work in model space.

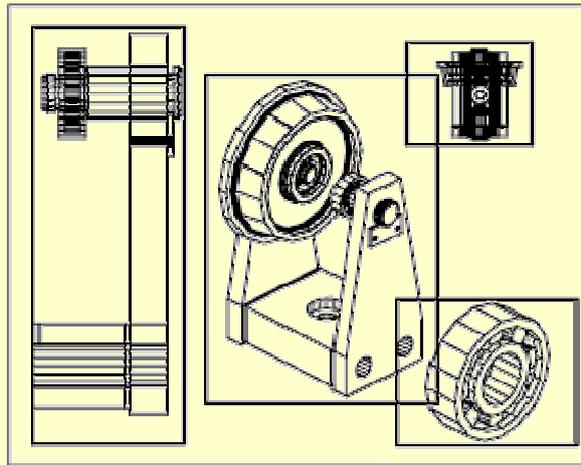
Create and Modify Layout Viewports

You can create a single layout viewport that fits the entire layout or create multiple layout viewports in the layout. Once you create the viewports, you can

change their size, their properties, and also scale and move them as needed.

Note. It is important to create layout viewports on their own layer. When you are ready to plot, you can turn off the layer and plot the layout without plotting the boundaries of the layout viewports.

With MVIEW, you have several options for creating one or more layout viewports. You can also use COPY and ARRAY to create multiple layout viewports.



Create Nonrectangular Layout Viewports

You can create a new viewport with nonrectangular boundaries by converting an object drawn in paper space into a layout viewport.

The MVIEW command provides two options to assist you in defining an irregularly shaped viewport.

With the Object option, you can select a closed object, such as a circle or closed polyline created in paper space, to convert into a layout viewport. The object that defines the viewport boundary is associated with the viewport after the viewport is created.

The Polygonal option can be used to create a nonrectangular layout viewport by specifying points. The prompt sequence is the same as the prompt sequence for creating a polyline.

Note. When you want to suppress the display of the boundary of a layout viewport, you should turn off the layer of the nonrectangular viewport instead of freezing it. If

the layer of a nonrectangular layout viewport is frozen, the boundary is not displayed, but the viewport is not clipped.

Resize Layout Viewports

If you want to change the shape or size of a layout viewport, you can use grips to edit the vertices just as you edit any object with grips.

Clip Layout Viewports

You can redefine the boundary of a layout viewport by using the VPCLIP command. To clip a layout viewport, you can use your pointing device to either select an existing object to designate as the new boundary, or specify the points of a new boundary.

Control Views in Layout Viewports

When you create a layout, you can add layout viewports that act as windows into model space. In each layout viewport, you can control the view that is displayed.

Scale Views in Layout Viewports

To scale each displayed view in the plotted drawing accurately, set the scale of each view relative to paper space.

You can change the view scale of the viewport using

- The Properties palette
- The XP option of the ZOOM command
- The Viewports toolbar

Note. You can modify the list of scales that are displayed in all view and plot scale lists with SCALELISTEDIT.

When you work in a layout, the scale factor of a view in a layout viewport represents a ratio between the actual size of the model displayed in the viewport and

the size of the layout. The ratio is determined by dividing the paper space units by the model space units. For example, for a quarter-scale drawing, the ratio would be a scale factor of one paper space unit to four model space units, or 1:4.

Scaling or stretching the layout viewport border does not change the scale of the view within the viewport.

Lock the Scale of Layout Viewports

Once you set the viewport scale, you cannot zoom within a viewport without changing the viewport scale. By locking the viewport scale first, you can zoom in to view different levels of detail in your viewport without altering the viewport scale.

Scale locking locks the scale that you set for the selected viewport. Once the scale is locked, you can continue to modify the geometry in the viewport without affecting the viewport scale. If you turn a viewport's scale locking on, most of the viewing commands, such as VPOINT, DVIEW, 3DORBIT, PLAN, and VIEW, no longer function in that viewport.

Note. Viewport scale locking is also available for nonrectangular viewports. To lock a nonrectangular viewport, you must perform an extra step in the Properties palette to select the viewport object rather than the viewport clipping boundary.

Control Visibility in Layout Viewports

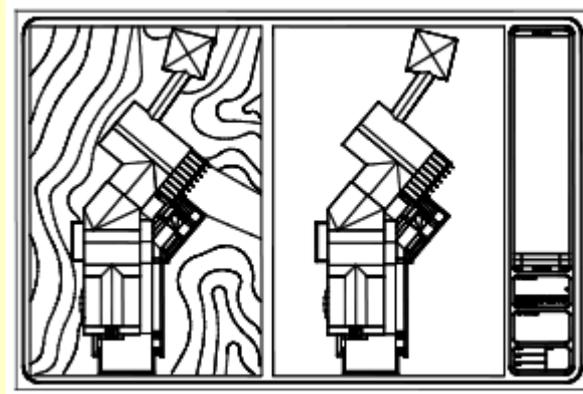
You can control the visibility of objects in layout viewports using several methods. These methods are useful for emphasizing or hiding different elements of a drawing, and for reducing screen regeneration time.

Freeze Specified Layers in a Layout Viewport

A major benefit to using layout viewports is that you can selectively freeze layers in each layout viewport. You can also specify default visibility settings for new

viewports and for new layers. As a result, you can view different objects in each layout viewport.

You can freeze or thaw layers in current and future layout viewports without affecting other viewports. Frozen layers are invisible. They are not regenerated or plotted. In the illustration, the layer showing terrain has been frozen in one viewport.



Thawing the layer restores visibility. The easiest way to freeze or thaw layers in the current viewport is to use the Layer Properties Manager.

In the Layer Properties Manager, on the right side, use the column labeled VP Freeze to freeze one or more layers in the current layout viewport. To display the VP Freeze column, you must be on a layout tab. Specify the current layout viewport by double-clicking anywhere within its borders.

Freeze or Thaw Layers Automatically in New Layout Viewports

You can set visibility defaults for specific layers in all new layout viewports. For example, you can restrict the display of dimensions by freezing the DIMENSIONS layer in all new viewports. If you create a viewport that requires dimensions, you can override the default setting by changing the setting in the current viewport. Changing the default for new viewports does not affect existing viewports.

Create New Layers That Are Frozen in All Layout Viewports

You can create new layers that are frozen in all existing and new layout viewports. Then you can thaw the layers in the viewports you specify. This is a shortcut for creating a new layer that is visible only in a single viewport.

Screen Objects in Layout Viewports

Screening refers to applying less ink to an object when it is plotted. The object appears dimmer on the screen and on the plotted paper. Screening can be used to help differentiate objects in a drawing without changing the objects' color properties.

To assign a screening value to an object, you must assign a plot style to the object, and then define the screening value in that plot style.

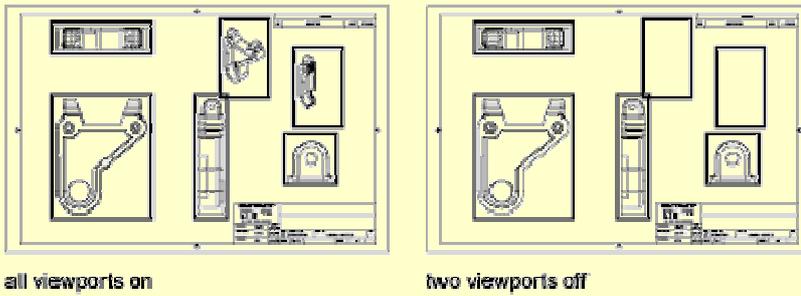
You can assign a screening value from 0 to 100. The default setting, 100, means no screening is applied, and the object is displayed with normal ink intensity. A screening value of 0 means the object contains no ink and is thus invisible in that viewport.

Turn Layout Viewports On or Off

You can save time by turning some layout viewports off or by limiting the number of active viewports.

Displaying a large number of active layout viewports can affect your system's performance as the content of each layout viewport regenerates. You can save time by turning some layout viewports off or by limiting the number of active viewports. The following illustration shows the effects of turning off two layout viewports.

New layout viewports are turned on by default. If you turn off the layout viewports you aren't using, you can copy layout viewports without waiting for each one to regenerate.

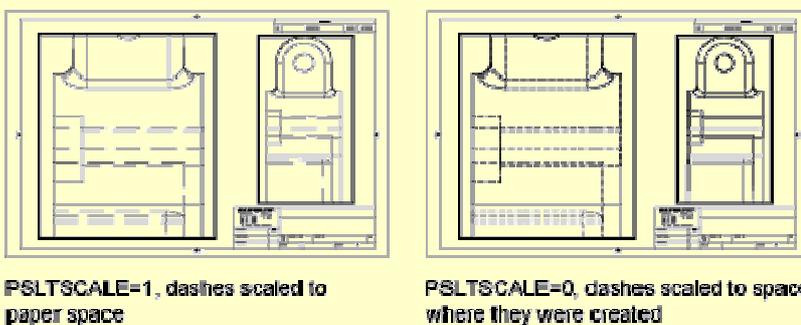


If you don't want to plot a layout viewport, you can turn the layout viewport off.

Scale Linetypes in Layout Viewports

You can scale linetypes in paper space either based on the drawing units of the space in which the object was created or based on the paper space units.

You can set the PSLTSCALE system variable to maintain the same linetype scaling for objects displayed at different zoom factors in a layout and in a layout viewport. For example, with PSLTSCALE set to 1 (default), set the current linetype to dashed, and then draw a line in a paper space layout. In the layout, create a viewport with a zoom factor of 1x, make that layout viewport current, and then draw a line using the same dashed linetype. The dashed lines should appear to be the same. If you change the viewport zoom factor to 2x, the linetype scaling for the dashed line in the layout and the dashed line in the layout viewport will be the same, regardless of the difference in the zoom factor.



With PSLTSCALE turned on, you can still control the dash lengths with LTSCALE and CELTSCALE. In the following illustration, the pattern of the

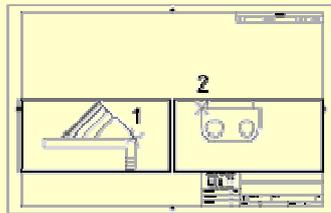
linetypes in the drawing on the left has been scaled to be the same regardless of the scale of the view. In the drawing on the right, the scale of the linetypes matches the scale of each view.

Align Views in Layout Viewports

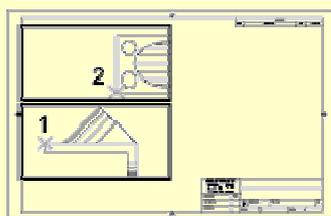
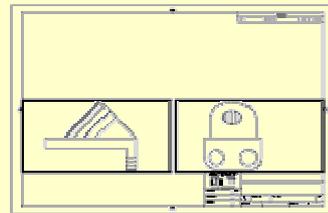
You can arrange the elements of your drawing by aligning the view in one layout viewport with the view in another viewport.

For angled, horizontal, and vertical alignments, you can move each layout viewport relative to distances defined by the model-space geometry displayed.

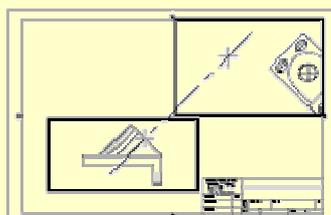
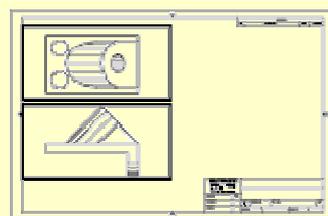
To adjust the views on a layout with precision, you can create construction geometry, use object snaps on the model-space objects displayed in layout viewports, or use one of the cursor constraint features available on the status bar.



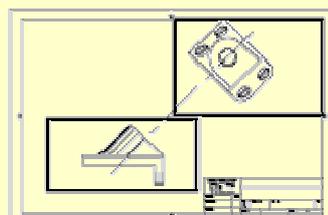
Horizontal alignments



Vertical alignments



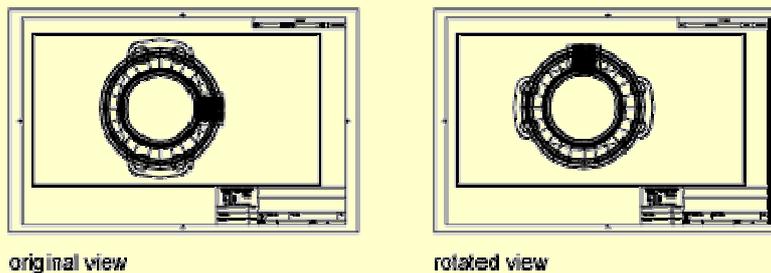
Angled alignments



Rotate Views in Layout Viewports

You can rotate an entire view within a layout viewport by changing the UCS and using the PLAN command.

With the UCS command, you can rotate the XY plane at any angle around the Z axis. When you enter the PLAN command, the view rotates to match the orientation of the XY plane.



For a faster method, use the Align and then Rotate View options in the MVSETUP command.

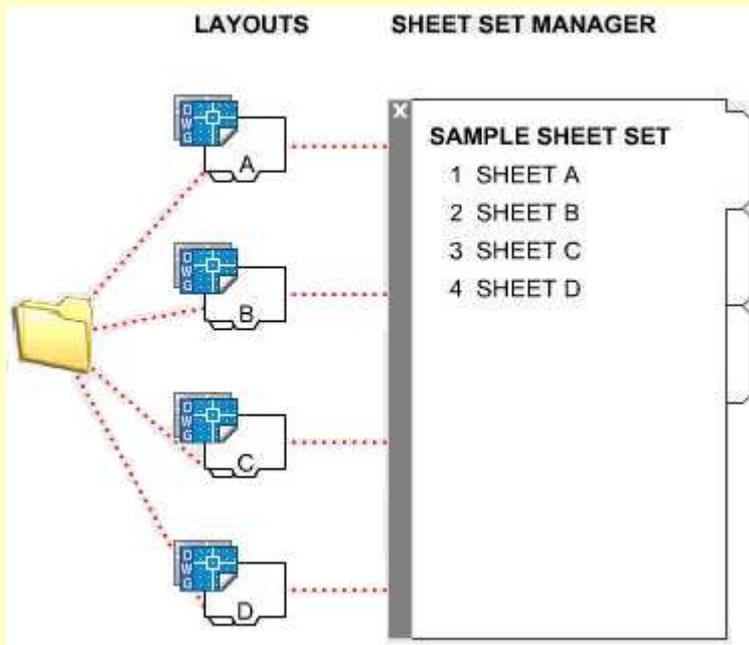
Note. The ROTATE command rotates individual objects only and should not be used to try to rotate a view.

Work with Sheets in a Sheet Set

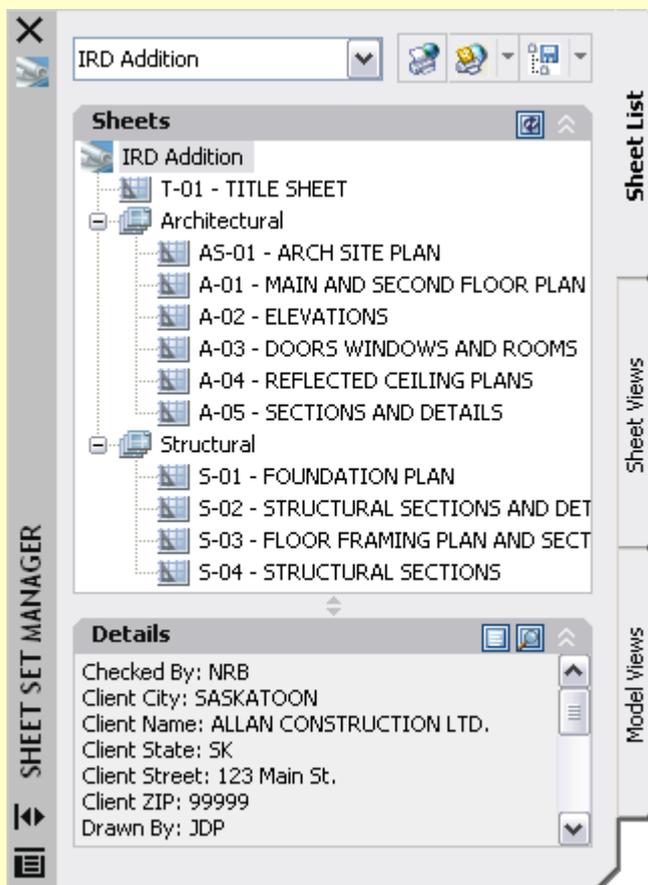
With the Sheet Set Manager, you can organize drawing layouts into named sheet sets. The sheets in a sheet set can be transmitted, published, and archived as a unit.

A sheet set is an organized collection of sheets from several drawing files. A sheet is a selected layout from a drawing file.

Sets of drawings are the primary deliverable for most design groups. Sets of drawings communicate the overall design intent of a project and provide the documentation and specifications for the project. However, managing sets of drawings manually can be complicated and time consuming.



With the Sheet Set Manager, you can manage drawings as sheet sets. A sheet set is an organized and named collection of sheets from several drawing files. A sheet is a selected layout from a drawing file. You can import a layout from any drawing into a sheet set as a numbered sheet.



You can manage, transmit, publish, and archive sheet sets as a unit.

Using the controls in the Sheet Set Manager, you can create, organize, and manage sheets in a sheet set.

