



Creating 2D Drawings from 3D AutoCAD® Models

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GD205-2P This class explores the various techniques in creating 2D part and assembly drawings from 3D AutoCAD models. As part of the AutoCAD 3D Power Track, you will learn best practices for creating drawings from your 3D models. While not always required, it is still necessary to generate drawings for an object to be built. Using the tools and methods presented in this class, you will learn to quickly and efficiently create those drawings.

About the Speaker:

David develops technical course content for CrWare, LP, which is used in both Autodesk Official Training Courseware and CrWare training manuals. In addition, he provides custom training and consulting services to Autodesk product users throughout the U.S. David has over 17 years of teaching experience in CAD, 3D solid modeling, and CNC programming and is a journeyman mold maker. He is an Autodesk Inventor Certified Expert, an Autodesk Approved Instructor, and chair of the Autodesk Training Center Advisory Board. David earned a Bachelor's degree in Manufacturing Engineering and an Associate's degree in Machine Tool Technology through Ferris State University.

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Objectives

After completing this class you will be able to:

- Extract geometry from solid models
- Use Flatshot to create 2D views from your 3D solids
- Create and manipulate section planes
- Create 2D sections or elevations and 3D sections of your 3D solid parts and assemblies
- Create layouts of 3D models including annotation and dimensions

Prerequisites

- Navigate the 3D AutoCAD environment.
- Create and edit 3D solid models.
- Navigate the drawing layout and paper space environment.

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Overview

Two-dimensional drawings are still needed to communicate ideas in industry. While designing in 3D offers significant advantages, designs may still have to be displayed in a 2D format for producing your products.

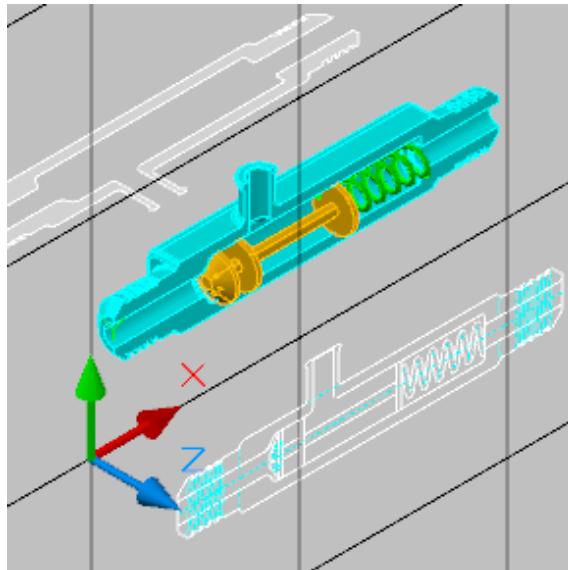
The following lessons teach you the methods, commands, and options for creating views of your 3D models. These methods include defining views based on orientation of 3D models, planes, and 2D geometry extracted from the 3D models. You also learn to create, edit, and manage layouts, and to combine defining views to create layouts that document your 3D designs.

Section a Solid Model and Generate 2D Geometry

This lesson describes how to graphically remove part of a 3D model and generate 2D geometry from the solid model.

As you create more detailed models, there will be times when you need to view an aspect of a model that is visually obstructed by other parts or features of the model. By using section planes, you can view the information you want in 3D or 2D form. You can also generate 2D cross sections based on the planes you define that can be used to generate mass property information or create 2D drawing views.

In the following image, a front view of the assembly was created for a 2D drawing to be provided to manufacturing. The other view is a cross section of the valve body to be used in strength and material analysis.

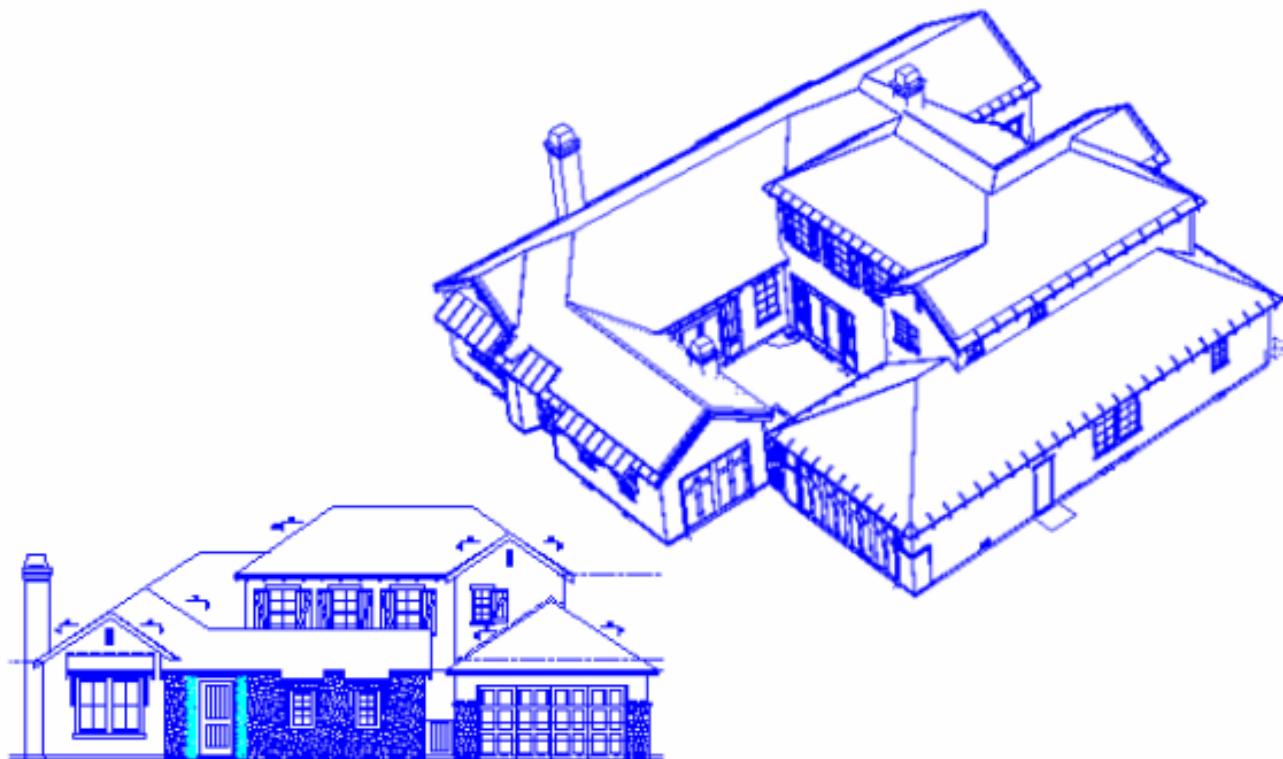


About Flattened Views

Flattened views are generally required when you need to create dimensioned drawings of 3D models. While the 3D model is the closest representation of the finished product, it does not work well for placing dimensions and other annotations for production drawings or construction documentation.

Regardless of the design discipline, 2D geometry is still relied upon heavily when it comes to final documentation and annotation. To make the most use out of your 3D models, you need to create flattened views from those models.

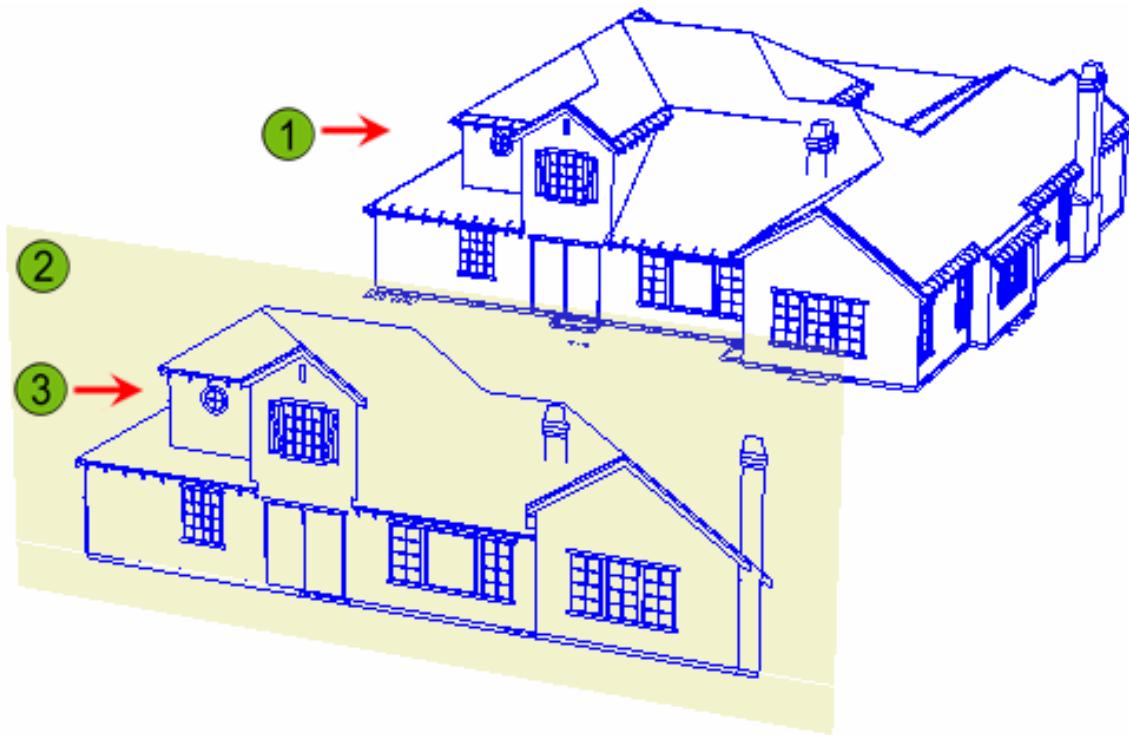
In the following illustration, while the 3D perspective image does a better job of conveying the overall design, the 2D elevation view is better suited for construction documentation



Definition of Flattened Views

A flattened view can be defined as a view created from a 3D model in which objects are projected in their current position, relative to the view, onto a plane that is parallel to the current view. Flattened views can be from any angle and are not limited to standard orthographic projections. In most cases, it is equally beneficial to include a flattened view of an isometric projection.

The following illustration shows how a 3D model is projected onto a viewing plane, resulting in a 2D elevation



- ① 3D model
- ② Plane representing 2D view
- ③ Resulting flattened view for the elevation

Example of Using Flattened Views

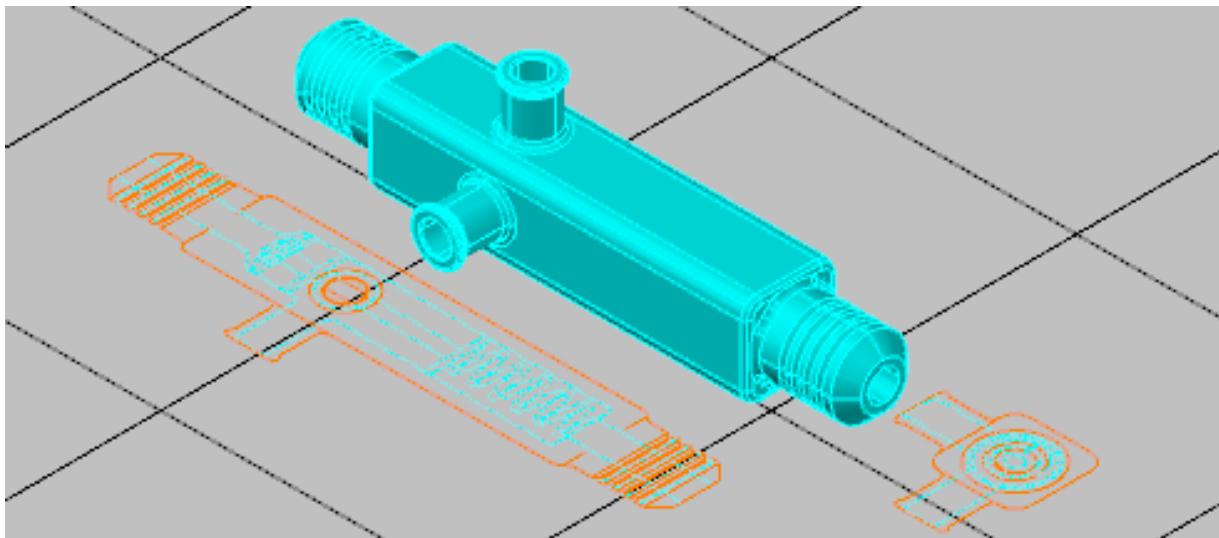
In an Architectural environment, flattened views are used to represent plan and elevation views to send to clients for review without having to send the entire drawing file. The client can view all elevations, including as many isometric projections as required.

Displaying 2D Geometry from a Model View

In this section of the lesson, you learn how to access the Flatshot dialog box and use the options within it to create 2D geometry based on your 3D models. The ability to create accurate 2D data efficiently is significant as the majority of today's industry still relies on 2D data as the primary means of communication between design and manufacturing.

In an Architectural environment, Flatshot view and drawing can be used to quickly create plan and elevation views to send to clients for review without having to send the entire drawing. DWFs of the Flatshot views can be generated for Web-based applications.

In the following illustration, the Flatshot command was used to create different 2D views of the 3D model. The display of the 2D geometry is controlled by settings in the Flatshot dialog box.





Flatshot Command Access

Command Line: **Flatshot, FSHOT**



Dashboard: **3D Make Control Panel**

Options for Creating 2D Geometry Using Flatshot

Following a typical workflow, you first need to set the viewing orientation of the 3D model so you are viewing it as a flat view in the direction you want. You then start the Flatshot command and specify a destination and display characteristics for the new geometry. When using the default Insert As New Block option, you insert the new geometry into a drawing using the same procedure and options as for inserting any block into a drawing.

Use the following options with the Flatshot command.

Option	Description
Basepoint	Use to specify the insertion point of the geometry.
Scale	Use to scale the geometry uniformly in all axes.
X	Use to scale the geometry in the X direction independently of the Y and Z axes.
Y	Use to scale the geometry in the Y direction independently of the X and Z axes.
Z	Use to scale the geometry in the Z direction independently of the X and Y axes.
Rotate	Use to rotate the geometry on the current XY plane.

Flatshot Dialog Box

- ① Insert as New Block: Use to create 2D geometry of the 3D model as a block.
- ② Replace Existing Block: Use to update an existing view to reflect changes in the solid model.
- ③ Export to a File: Export the 2D geometry to be available for use in other drawings.
- ④ Foreground Lines: Use to set the color and linetype of the visible lines.
- ⑤ Obscured Lines: Use to set the color and linetype of hidden lines.
- ⑥ Show: Use to toggle the display of hidden lines.



Procedure: Creating 2D Geometry from a Model View

The following steps give an overview of creating 2D geometry from 3D models.

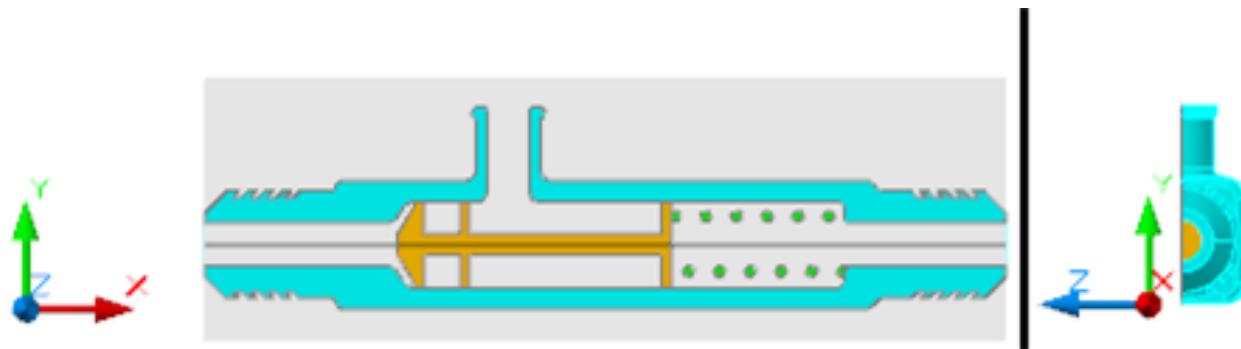
1. Display the model in the orientation of the view to be created.
2. Display the model as a parallel projection.
3. Start the Flatshot command.
4. If the view being created is new, decide whether the geometry created will reside in the current drawing file or be written out to a new drawing file.
5. Set the color and linetype for the visible foreground lines.
6. Create the Flatshot view.

Creating Section Planes

In this section of the lesson, you learn to define section planes based on 3D models. You can use these section planes to view internal sections of 3D models, create 2D cross sections of models, create 3D cross-sectional models, and generate 2D geometry containing mass property information. You can use mass property information in strength and area calculations, which are essential in determining items such as safety factors or material costs.

In an Architectural environment, you can use section planes to view into a structure. For example, you could place a section plane just above floor level to see the floor plan without the extraneous information. Or a section plane could remove a wall to reveal the contents of a room or floor as one would look into a doll house.

In the following image, an orthographic section was created on a model of a pressure relief valve assembly.



Section Plane Command Access



Section Plane

Command Line: **Sectionplane**

Menu: **Draw → Modeling → Section Plane**

Dashboard: **3D Make control panel**

Options for Creating Section Planes

Following the command prompts and a typical workflow, you determine the views required of your 3D model. You start the Sectionplanes command and choose whether to create an orthographic or segmented plane. An orthographic plane is aligned to a standard orthographic view. A segmented plane is based on a series of points that you define.



When you start the Sectionplane command, you are prompted to select a face or any point to locate the section line. You have the option to draw segments or align to an orthographic direction. You can use the Draw Section option to create offset sections and the Orthographic option to create a plane based on standard orthographic views.

Use the following options with the Sectionplane command.

Option	Description
Draw	Use to define the plane by selecting a series of points.
Orthographic	Use to create a plane based on one of six standard orthographic views: Front, Back, Top, Bottom, Left, and Right.

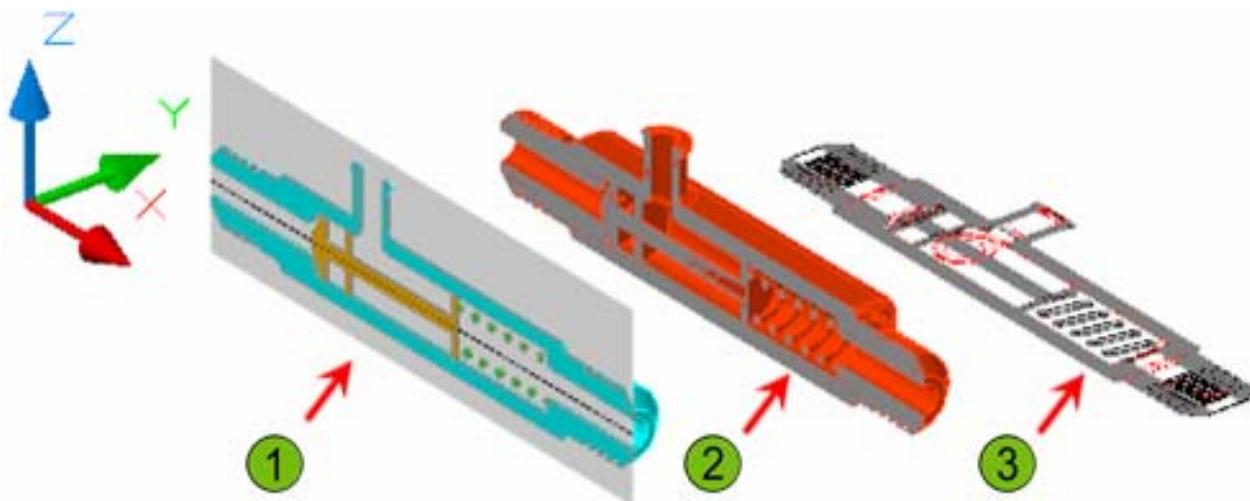
Procedure: Creating a Section Plane

The following steps give an overview of creating section planes.

1. Start the Sectionplane command.
2. Decide to draw a segmented or orthographic section plane.
3. If using the Draw section option, define the points to create the plane, then specify a point to determine the direction of the section view.
4. If using the Orthographic option, determine the orthographic direction.

Manipulating Section Planes

In this section of the lesson, you learn to manipulate section planes to activate live sectioning, generate 2D and 3D section models, and add a jog to an existing section plane. The ability to look inside assembly or complex parts is beneficial during the design process because associations between parts can be monitored while in their assembled state. Moving a section plane by specific intervals through a 3D model can reveal trends not seen in a typical section view. You can control the display of section planes by placing them on specific layers.



- ① The original 3D model with live sectioning enabled.
- ② A 3D model of the assembly based on the section plane.
- ③ A 2D cross section based on the section plane.

Command Access

Grips shortcut menu: **Activate Live Sectioning, Show Cut Away Geometry, Generate 2D/3D Section, Add Jog to Section.**

To access the commands to manipulate section planes, you must first select the section plane. Once selected, grips appear immediately. To access additional commands, right-click while the section plane is selected.

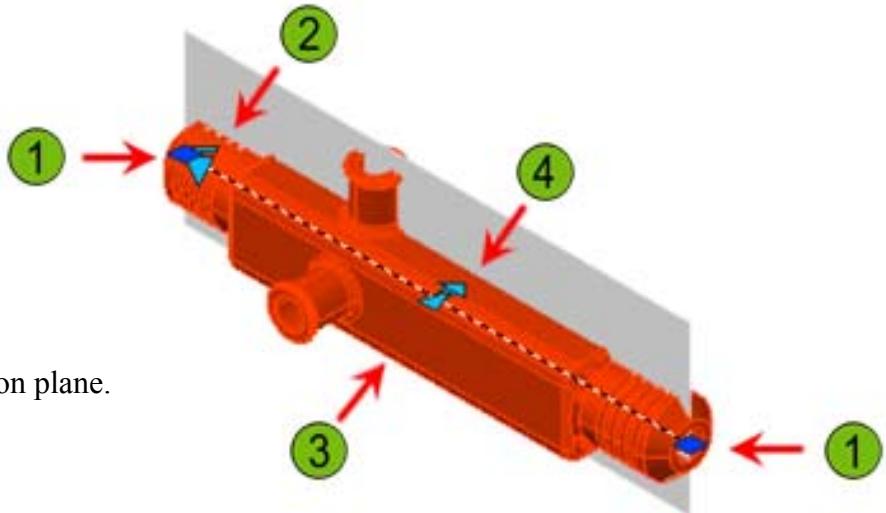
Options for Manipulating Section Planes

Following the command prompts and a typical workflow, you select the section plane and activate live sectioning to view the internal areas of the model. Depending on your design needs, you can then generate independent 2D or 3D models based on the current location of the section plane, or move the section plane to a new location. You can also flip the view of the section plane to view objects on the other side.

Use the following options with the Sectionplane command.

Option	Description
Activate Live Sectioning	Use to view internal features of the 3D model.
Show Cut Away Geometry	Use to generate the cut away portion of the 3D model.
Live Section Settings	Use to display the Section Settings dialog box.
Generate 2D/3D Section	Use to generate a 2D cross section or 3D model of the cut away geometry that is independent of the original model.
Add Jog to Section	Use to add segments to section planes created using the Draw Section option.
Grips	Use Grips to flip or relocate the section plane.

- ① Standard grips for editing the endpoint location of the section plane.
- ② Click to display shortcut menu.
- ③ Midpoint grip for changing the location of the section plane.
- ④ Flip the view direction of the section plane.



Note: When live sectioning is activated, it affects all solids in the drawing. Objects may disappear, depending on which side of the section plane they are located.

Section Planes States

When you create a section plane, the state it is in by default depends on how the plane was originally created. You can modify the section plane state at any time by selecting a different state from the grip menu.

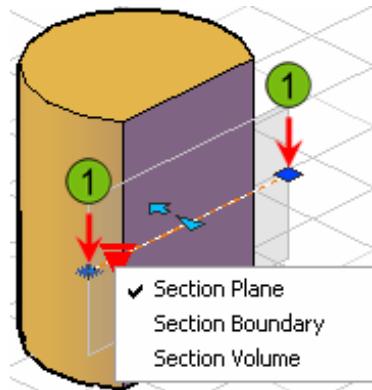
There are three different section plane states:

Section Plane: The section plane extends infinitely.

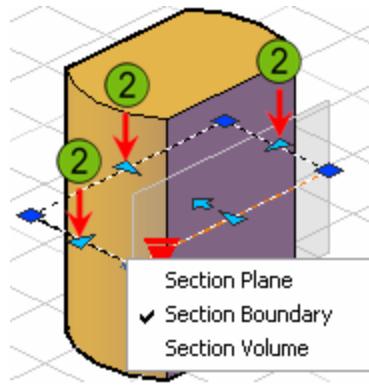
Section Boundary: The section plane object contains side planes and a back plane extending infinitely, and can section a model from all four sides.

Section Volume: The section plane contains side planes, a back plane, and top and bottom planes. The model can be sectioned on six sides.

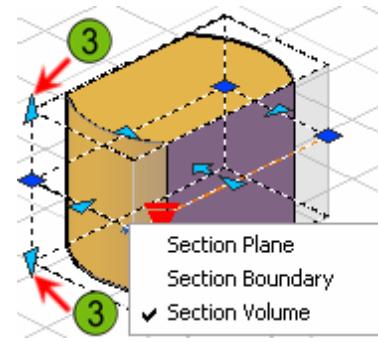
The following images illustrate the effect of changing the section plane state.



Section Plane



Section Boundary



Section Volume

① Plane grips: Drag to adjust the length of the section plane.

② Boundary grips: Drag to adjust the effective boundary area of the section.

③ Volume grips: Drag to adjust the effective volume of the section.

Procedure: Manipulating Section Planes

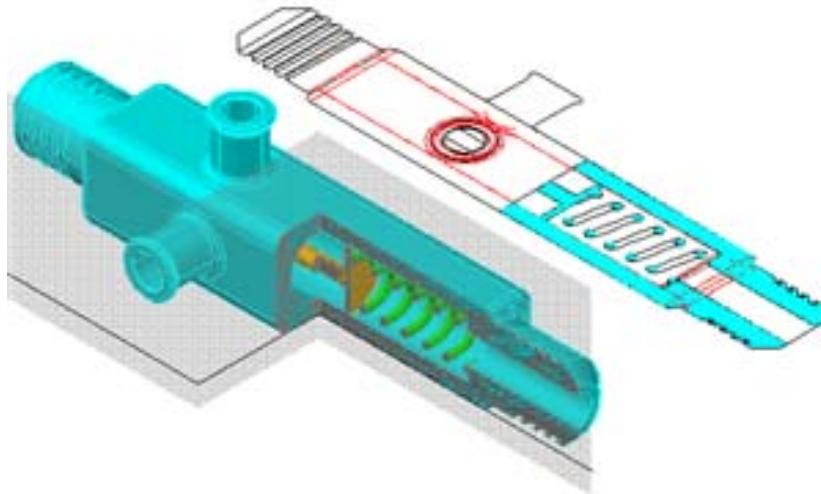
The following steps give an overview of manipulating section planes.

1. Select the section plane.
2. Use the grips to reposition the section plane or flip the view direction.
3. With the section plane selected, right-click.
4. Display the internal areas of the model by activating live sectioning.
5. Generate 2D and 3D models based on the section plane location.

Generating 2D/3D Sections

Once you have created your section plane, you can generate 2D sections or elevations and 3D sections of your model. This option is on the shortcut menu when you select an existing section plane.

In the following image, a 2D section has been updated to reflect the new section plane shape and settings.



Command Access

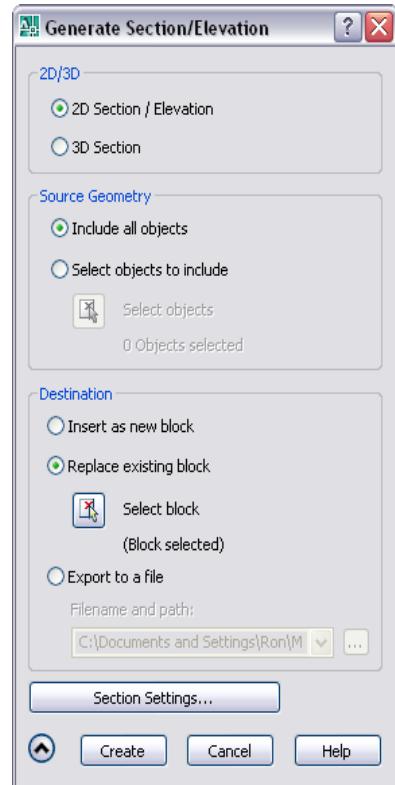
Grips shortcut menu: **Generate 2D/3D Section**, **Generate 2D/3D Section/Elevation**

When the Generate Section/Elevation dialog box is in a collapsed state as shown, select whether to create a 2D Section / Elevation or a 3D Section.

When the dialog box is in an expanded state as shown here, you can specify whether or not to use all objects in the drawing or select only the objects you want to include in the section.

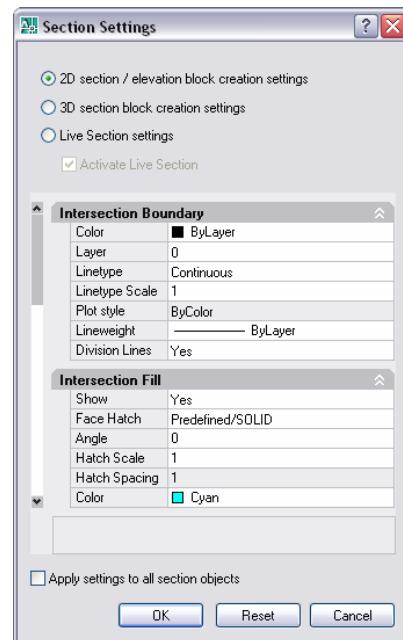
Under Destination, you specify how the resulting section should be handled. You can insert it as a new block, which is typically what you do the first time to create the section. Use the Replace Existing Block option to update a block of the section that already exists. You need to click Select Block and select the existing block. You can also choose to export the section to a separate drawing file by clicking the Export to a File option.

Click Section Settings to modify properties of your section such as hatch and fill pattern, line types, and colors.



Section Settings

Use the options in the Section Settings dialog box to control the appearance of objects within your section view. You must first select the appropriate option depending on your current section type. The properties available in the main area of the dialog box depend on the type of section settings you choose.



Procedure: Creating Section or Elevation Views

The following steps give an overview of creating section or elevation views after a section plane has been created.

1. Select the section plane.
2. Right-click anywhere in the drawing. Click Generate 2D/3D Section.
3. Select the type of section, 2D or 3D.
4. Expand the dialog box to adjust additional options and click Create.

Procedure: Updating Section or Elevation Views

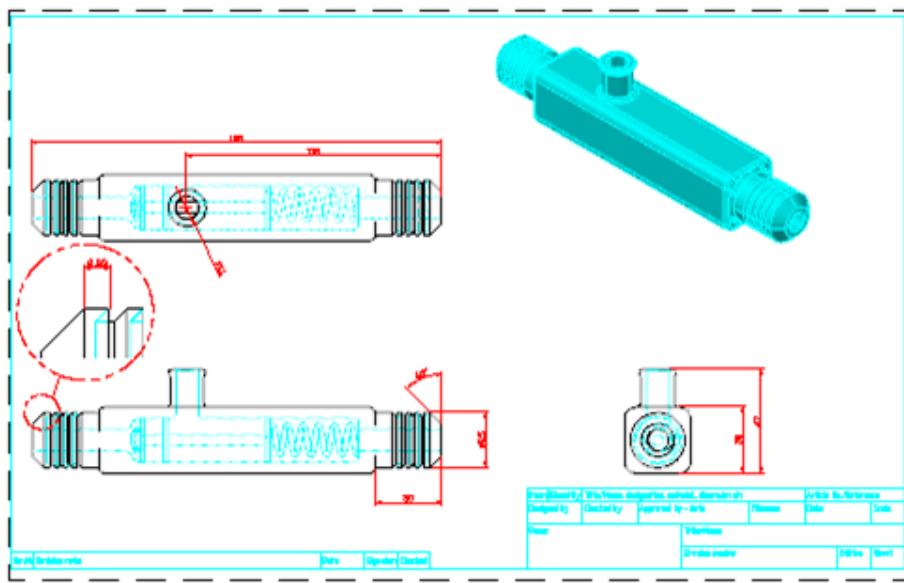
The following steps give an overview of updating an existing section or elevation view.

1. Select the section plane.
2. Right-click anywhere in the drawing. Click Generate 2D/3D Section.
3. Expand the Generate 2D/3D Section/Elevation dialog box.
4. Under Destination, select Replace Existing Block. Click Select Block and select the block of the section or elevation.
5. Click Create. The existing block is updated with the current section geometry, parameters, and settings.

Creating Drawings from 3D Models

This lesson describes how to display geometry from 3D models, and geometry generated from 3D models in layouts.

In the following image, layout views have been created from the 3D model. The isometric view is a Realistic view of the 3D model, while the other views are 2D geometry generated from the solid model.

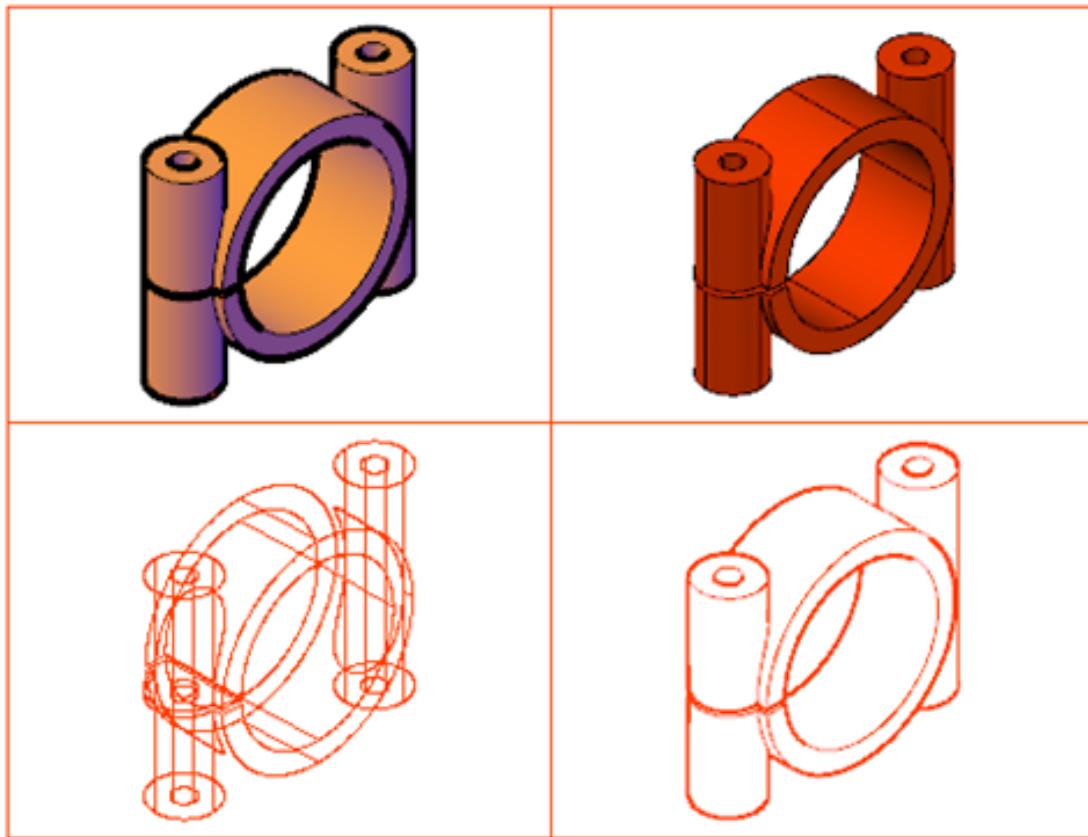


Visualization, interference checking, and mass property information are a few of the benefits of creating designs with 3D models. As you design in 3D, you still need to create 2D documents of your models. Using layouts, you can create all the views necessary to document your models.

Types of Views from 3D Models

One of the benefits of designing with 3D models is the ability to visualize during the design process. You can continue this practice when you publish your drawings. You use layouts to create different types of output files for your 3D model space designs. Depending on the intended audience, you can create views in a shaded, hidden, or wireframe mode. You can also create 2D prints based on the geometry created with the Flatshot and Sectionplane commands. The views created in layouts can contain a combination of solid, surface, and wireframe geometry.

In the following image, identical views are created using the different visual styles. The bottom-left view is a wireframe display of a solid model. The bottom-right view is 3D hidden display. The top-left is conceptual, and the top-right is realistic.

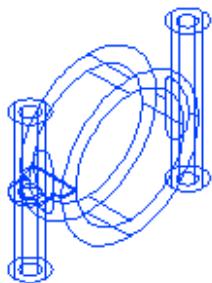
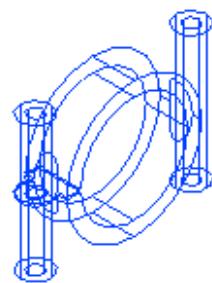


Types of Views

From 3D models you can generate different types of views depending on your requirements. Using visual styles, you can create views that display as wireframe, hidden, or shaded. You set the display options from the 3D Navigate panel of the dashboard or the Visual Styles toolbar. Display options are based on the current viewport.

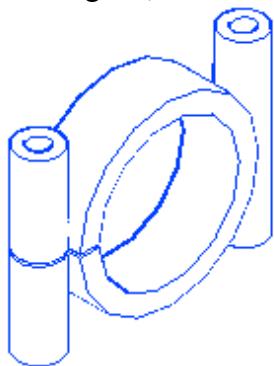
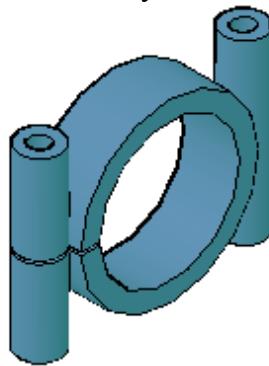
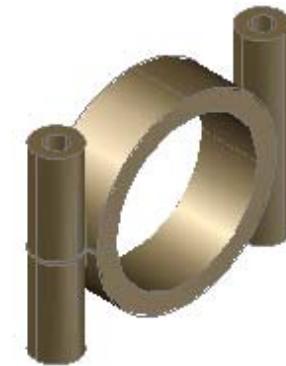
Wireframe Views

There are two options for wireframe display: 2D Wireframe and 3D Wireframe. Both options display 3D models as 2D lines and arcs and can be virtually identical. The difference is that 3D Wireframe visual style offers properties and settings that are not available in the 2D Wireframe visual style. As a rule of thumb, if your viewport consists of 3D geometry, and you require a wireframe view, use 3D Wireframe visual style.

**2D Wireframe****3D Wireframe**

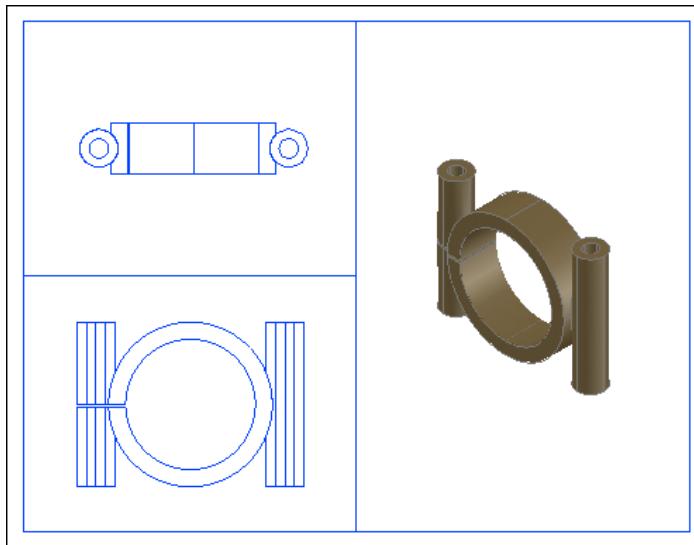
Views with Hidden Lines Removed

There are three options that do not display lines that would be considered hidden. They are: 3D Hidden, Conceptual, and Realistic. 3D Hidden appears as a wireframe silhouette of a 3D model. Although it appears to be wireframe geometry, lines that would not be visible are hidden from view. Conceptual and Realistic visual styles both apply color to faces of models and hide hidden lines. Conceptual shading uses a transition between colors. Realistic shading displays 3D models in the colors assigned, and also displays materials if they are attached.

**3D Hidden****Conceptual****Realistic**

Example of 3D Model Views in Drawing

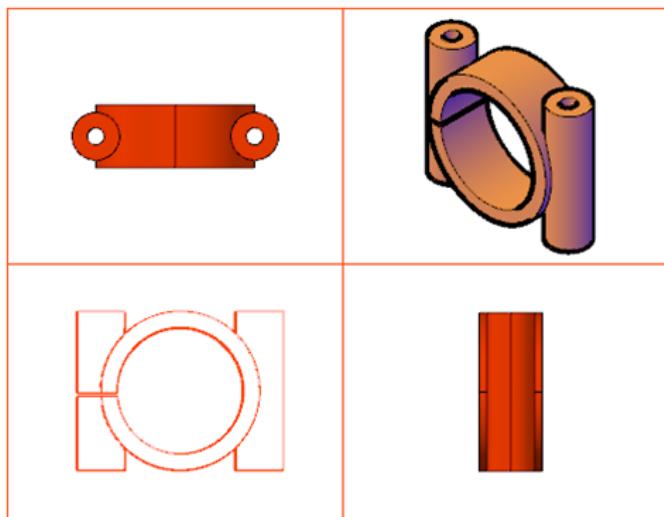
In the following illustration, a layout sheet is set up with different types of views from the 3D model.



Shaded and Hidden Views

To create a hidden or shaded view, you must first have a 3D model or 2D region. You then determine the number of viewports required to display your design. With the viewport active, select the visual style for the view.

In the following image, four shaded standard orthographic view are created. The isometric view is Conceptual. The front view is 3D Hidden. The other two views are Realistic.



System Variables That Affect Display

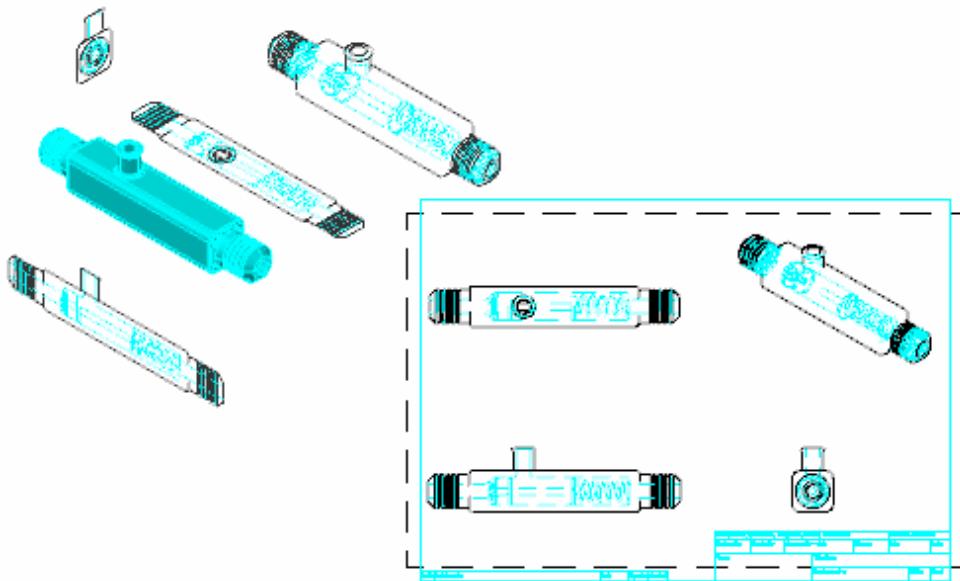
The display quality of your views can be affected by certain system variables. These system variables constitute a trade-off between display quality and performance: increasing the values can decrease the performance of drawings. The following table explains these system variables.

System Variable	Definition
Viewres	Controls the smoothness of arcs and circles. Values range from 1 to 20,000. The VIEWRES setting is saved in the drawing.
Facetres	Controls the smoothness of shaded and rendered objects. Values range from .01 to 10. The FACETRES setting is saved in the drawing.
Isolines	Controls the number of contour lines on a curved surface. Values range from 0 to 2047. The ISOLINES setting is saved in the drawing.
Perspective Projection	Controls the viewport display representing depth in the view.
Parallel Projection	Turns off Perspective Projection.

Creating Views from Flatshots and Sectionplanes

The process for creating layout views of geometry created with the Flatshot and Sectionplanes commands is the same as that for creating views of any other geometry. You generate the geometry needed to convey the design using the Flatshot and Sectionplanes commands in model space, and create a viewport for each view in Layout mode. You determine the geometry that will be displayed in each viewport and adjust the viewport scale, alignment, and visual style as needed.

On the left in the following image, 2D views of the 3D model are created in model space using the Flatshot command. On the right is shown the resulting layout of those 2D views.



Description

Upon completion of a design created with 3D models, you generate different views using these commands. View types such as plan, elevation, orthographic, section, and offset views are generated in model space. In Layout mode, you create viewports to display these views. You create a viewport



and display the geometry to represent the view. You remove any unwanted geometry from that view by freezing the layers in the viewport where the unwanted geometry resides. You then set the viewport scale and lock it.

Process: Creating Views from Flatshots and Sectionplanes

The following steps give an overview of the steps required for creating views from the Flatshot and Sectionplanes commands.

1. Create or access a drawing with 3D models.
2. Generate 2D geometry using the Flatshot and Sectionplanes commands.
3. Place geometry for each view on a layer independent of other views.
4. Create viewports for each view in Layout mode.
5. Adjust the orientation of each view created.
6. Freeze the layers of unwanted geometry in each viewport.
7. Set and lock the viewport scale.
8. In the case of orthographic or other related views, align the views.

Summary

In this lesson, you learned the commands and methods to create layouts of 3D Models. After creating 3D Models, you decide the best method to document your designs based on the intended audience. You then execute the commands and processes to create production drawings or shaded views for visual representation.