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The Ins & Outs of Representations in Autodesk Inventor®

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MA115-3P Mechanical systems often have moving parts that designers and engineers must show in multiple positions. With Positional representations in Inventor, you can illustrate your assemblies in multiple, predefined positions. In this session, learn how Positional representations, in conjunction with View representations and Level of Detail (LOD) representations can be used to create complex representations of machinery processes and movement. Then learn how to show these assemblies in a drawing with overlays to illustrate the range of motion of the model.

Key Topics:

- What are Positional, View and LOD representations?
- How to create Positional, View and LOD representations.
- How to nest these representations to create configurable positions of your assemblies.
- How to use Positional representations to create overlays in IDWs.
- How to use adaptivity and flexibility in assemblies with Positional representations

About the Speaker:

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Based in Lake Oswego, Oregon, Paul is currently a Subject Matter Expert/Technical Writer working on Autodesk Inventor. As a Subject Matter Expert, he brings a wealth of experience and practical knowledge about Inventor to the Technical Publications team. Prior to joining Autodesk, Paul designed high voltage electrical substation equipment, and then moved on to designing high tech laboratory equipment. He left the design arena and became an applications engineer for an Autodesk reseller and spent the next sixteen years demonstrating, training, and supporting Autodesk manufacturing software. Prior to joining Autodesk Paul was an Inventor Certified Expert, Data Management Certified Expert, and an Implementation Certified Expert. In his spare time, Paul teaches Inventor at local community colleges in the Portland, Oregon area and participates in local Inventor user groups.



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Introduction

With the introduction of Positional representations (PosReps) in Autodesk Inventor 9, assemblies could be shown in multiple positions. Inventor 11 enhanced these capabilities through nested views of the alternate positions (overlay views) in a drafting document.

Inventor 11 also introduced the concept of Level of Detail (LOD) representations. LODs control how components are loaded into memory. LODs are especially useful when working with large assemblies.

Combine these two tools with View representations (formerly known as Design Views) and you have three powerful tools to help control the display of components in your assemblies and drawings.

More about PosReps

 The principle behind PosReps is to allow the components in an assembly to be shown in various positions and appearance states by using overrides. PosReps can control the:

- Numeric value of a constraint
- Suppressed state of a constraint
- Value of the number of occurrences in a component pattern
- Grounded state of a component
- Position offset of a component (in ordinate and polar coordinates)
- Positional representation of a subassembly component
- Flexible status of a component

 The right-hand assistant to Positional Reps is View Representations (ViewReps) which were formerly known as Design Views. ViewReps can control:

- Component visibility
- Sketch and work feature visibility
- Component-enabled status
- Color and style characteristics applied in the assembly
- Zoom magnification
- Viewing angle

 Rounding out the Representation trio is Level of Detail Representations (LODReps). LODReps are used to:

- Control the suppressed or unsuppressed state of parts and assemblies
- Lower the memory overhead of large assemblies
- Lower the memory overhead in large detail drawings
- Create bounding box representations of complex models

Representations				
Tool	 View	 Position	 Level of Detail	 iAssemblies
Purpose	Control component visibility, enabled state, camera position and work feature visibility	Display assemblies in different physical positions or states	Control visibility and manage memory consumption by suppressing components	Create table driven assemblies for product families
Used to Manage	Visibility (and other attributes listed above)	Constraint value, grounding status, component offset values	Component suppression (load/unload from memory)	Component exclusion (and other configuration properties)
Browser representation	Grayed out (unavailable)	Bold text	Strike through	Table folder
Effect on graphics window	Visible/Not Visible Enabled/Not Enabled (opaque/transparent)	Modifies position of assembly components	Suppressed components are not displayed although bounding box is visible on mouse over	Model display changes to reflect active iAssembly table row
Effect on Assembly BOM and Drawing Manager Parts List	No	No	No	Yes
Effects system memory consumption	No (can lower graphics card memory consumption)	No	Yes	Yes (impact determined by configuration)
Drawing Manger command access	Base View Edit View	Base View Edit View (for base view only)	Base View Edit View (for base view only)	Base View Edit View (view can display any of the defined configurations)
Usage in Drawing Manager	Creating custom, or specialty views without reorganizing the assembly (include/exclude)	Showing assemblies in different positions	Suppressing detail, such as internal parts and/or standard components to speed up view generation	Documenting assembly families and variants

Note: iAssemblies are not covered in this class.

Figure 1 illustrates the location of the Representations folder in the browser. Both ViewReps and PosReps are included in the folder. By default, every assembly has a few default representations.

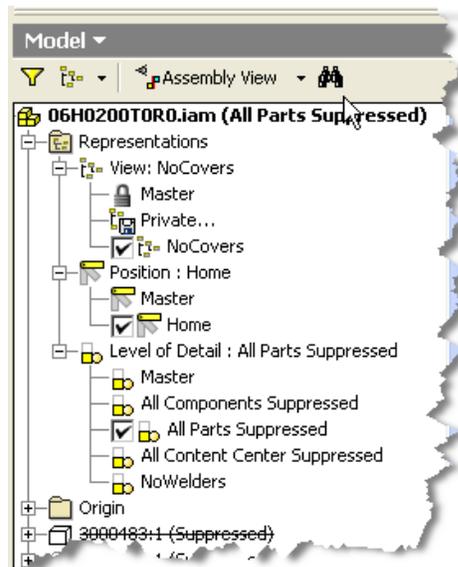


Figure 1 - Location of Representations in Browser

In older releases of Inventor (pre-2008) the View folder contained a default ViewRep named None. It was also “locked” and thus was the cause of an annoying error message in Inventor (see Figure 2). The default view rep is now called Default and is unlocked. It is still possible to get this error if you have attempted to save an assembly with the active ViewRep in a locked ViewRep state when you:

- Turned off the visibility of a part
- Changed the state of a part to disabled
- Turned on the visibility of a sketch
- Changed a color of a part at the assembly level



Figure 2 - ViewRep Error Message

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If you are comfortable with ViewReps you can turn off this error message. Be aware that if you make changes to the assembly in one of the manners described previously, and then save and close the document in a locked ViewRep state you will not be prompted to save and your changes to the view will be discarded.

The PosRep folder, by default, contains the Master PosRep. This is the “default” or “current” view of the assembly. All edits to the assembly must be done in the context of this PosRep. The document must also be saved in this Master PosRep (Figure 3). Under the Master PosRep in the browser, are the user-created PosReps.



Figure 3 - Saving the assembly in a non-master ViewRep

There are four default LODReps that are included with every model. These are:

- Master – the default, nothing suppressed LODRep
- All Components Suppressed – everything is suppressed
- All Parts Suppressed – parts but not assemblies are suppressed
- All Content Center Suppressed – all CC standard parts are suppressed

All representations can be activated with the model open or before the model is opened by selecting the file and clicking Options and selecting the desired reps.

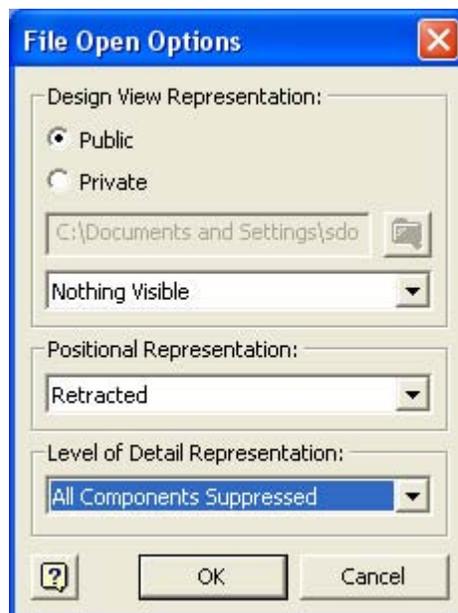


Figure 4 - File Open Options

Creating Positional Representations

The most common use of a PosRep is to override a constraint value. In this example we'll focus on that workflow. Later we'll examine the other ways to use PosReps. To create a PosRep in an assembly follow these steps:

1. Expand the Representations folder in the browser. Right click the Positional icon and select New.
2. Expand the Position icon. A Master and a new PosRep were created. Rename the new PosRep by "lazy double-clicking" the icon label.

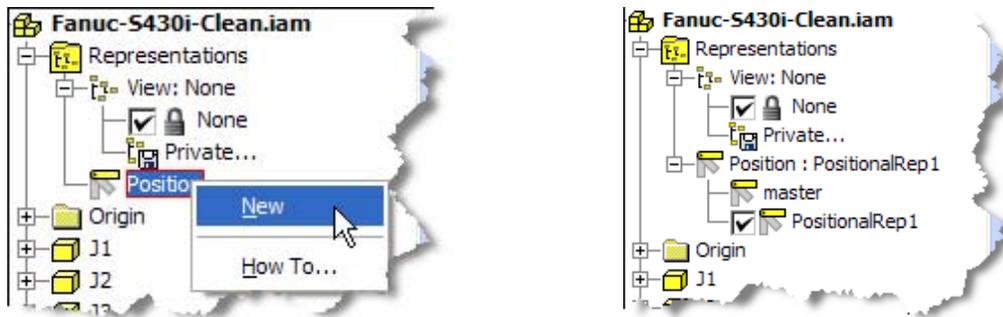


Figure 5 - Creating a new PosRep

The new PosRep is shown active by the checkmark next to it. The active PosRep is also shown in text next to the "Position:" icon at the top of the PosRep tree.

3. To create the first override, find a constraint in the browser tree to override, right-click on the icon, and select Override.
4. In the PosRep dialog box there are four tabs. Each changes a different aspect of a PosRep. Depending on what you selected (a constraint, component, pattern and so on) some tabs are unavailable and are grayed out. (Figure 5)

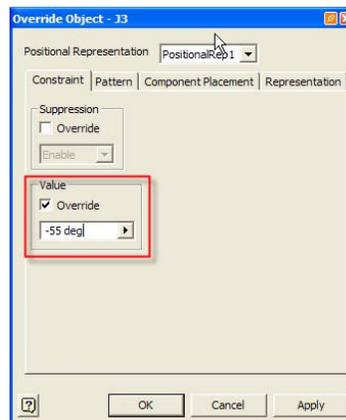


Figure 6 - PosRep Dialogue

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In this case we selected a constraint to override. Select the Override checkbox in the Value frame and enter a new value for the constraint. Click Apply or OK. The model updates.

Notice the constraint in the browser (or the part name itself in the case of a component placement or representation override) displays in bold. You can easily identify which parts or constraints were overridden. (Figure 6).

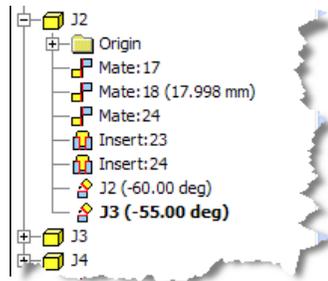


Figure 7 - Overridden constraint shown in bold

To remove an override, right-click the constraint or component, and select Remove Override.

You can continue to add overrides for other constraints or components. Double-click the Master PosRep to return to the original position. Double-click the new PosRep and it snaps back into the alternate shape.

Repeat this process to create new PosReps.

Positional Representation Dialog Box

The previous steps explain how to override a constraint but that is only one of the features of PosReps. Lets' examine all four tabs.

Constraint Tab

The first selection overrides the suppressed state of a constraint. For example, use it to free (or lock) the movement of a part when the machine is in a particular state. In a machine a tooling pallet might be locked into position in the load and unload states but is free to move during the time between these two states. By suppressing the constraint that locates the pallet you can freely move it in the assembly. We previously illustrated the usefulness of the constraint override feature.

Pattern Tab

Use this tab to adjust the row and column offset of a pattern, or the angular offset of a circular pattern. For example use it to show a set of circular products nested in a loose pattern. After a pusher arms pushes them into place, the pattern tightens (the distance between the rows is reduced) and the objects are closer to one another.

Component Tab

Use this tab to change the grounded status of a component as well as the position offset of a component. Changing the grounded state of a component allows other constraints to reposition the component in space. To alter the position of a component without changing constraints, select the Offset>Override checkbox and then drag the part in the model window.

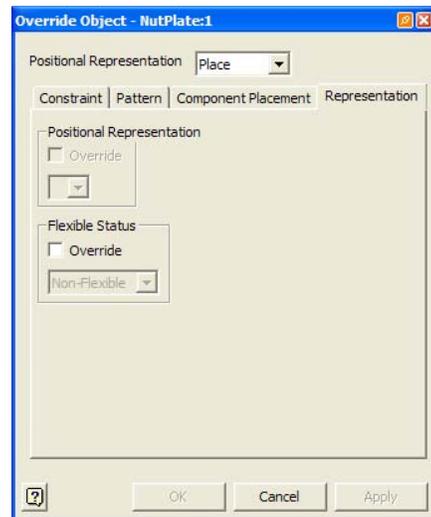
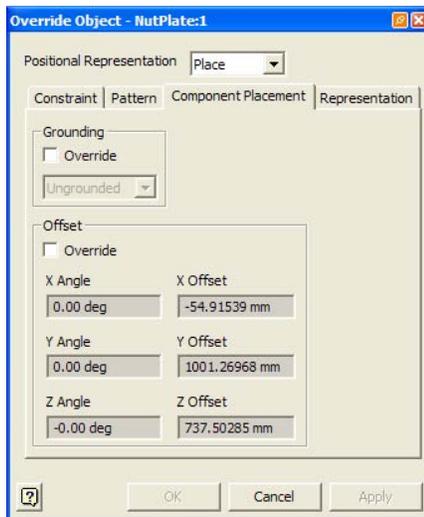
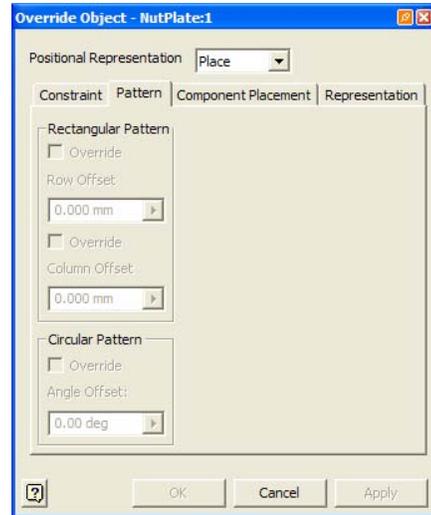
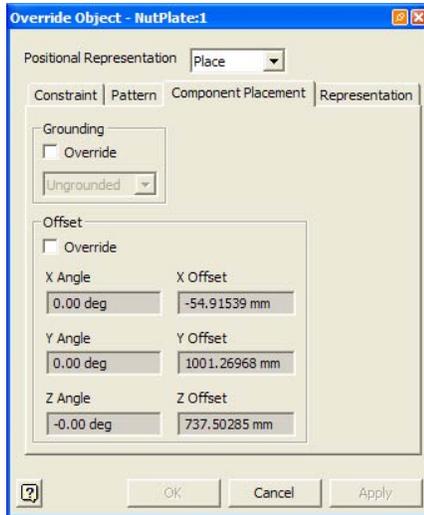
Note: The values cannot be changed numerically.

Representation Tab

Use this tab to create nested associative representations and control the flexible status of a subassembly. The flexible state can be turned on or off. This is important if there is motion contained in the subassembly that you want to control from the top level.

You can also cause a subassembly to display in one of its PosRep states by referring to them in the dialog box. For example, if you have a subassembly of an air cylinder, create both Extended and Retracted PosReps in the cylinder assembly. Then in the upper level assembly, create a Load and Unload PosRep. The Load PosRep activates the Extended PosRep in the cylinder assembly while the Unload PosRep activates the Retracted PosRep.

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Nesting Positional Representations

You can nest PosReps and make them associative. By nesting PosReps you have a tool to show a design in various stages and positions.

1. First create the PosReps in the lowest level assembly (A).
2. In the next higher assembly (B), create a PosRep, right-click the lower level assembly (A) and select Override.
3. On the Representations tab, select the PosRep in the lower level assembly (A).

When you activate the PosRep in the higher level assembly, the lower level assembly also activates its associated PosRep. Through these tools you can create complex states in your machinery.

In the case of a subassembly nested several layers deep, you do not have to have PosReps in every subassembly. For our example, imagine that the subassembly E is the one with the PosRep. In the top-level assembly A, you want to control this PosRep. Try this:

1. Make assembly B Flexible in the context of assembly A.
2. Make C Flexible in the context of assembly B.
3. Make D Flexible in the context of assembly D.
4. Make E Flexible in the context of assembly D.

Now you can control the PosRep in assembly E directly from assembly A.

Creating View Representations

1. Expand the Representations folder in the browser. Right-click the ViewRep icon  and select New.
2. The new ViewRep will be active.
3. Adjust the visibility, color, enabled state and so on, of components for this ViewRep.

To prevent new parts inserted into the assembly from showing up in this new ViewRep, right-click the ViewRep in the browser and select Lock. This prevents any changes to be made to this ViewRep. Be sure to save the assembly after locking to save the ViewRep state.

Creating LOD Representations

Creating LOD Reps is similar to ViewReps.

1. Select components to be unloaded from memory in the model window or browser and suppress them.
2. When all the required components are suppressed, browse to the Representations folder and expand it.
3. Right-click the LODRep icon  and select New. This creates a new LOD Rep with components captured in the current suppressed or unsuppressed state.
4. Save the file to capture the LODRep before activating another LOD.

Note: ViewReps unload the VISUAL information from memory, but do nothing to reduce RAM consumption. With LOD Reps, the parts are actually unloaded from memory so overall system memory consumption is reduced.

Tip: In my experience, applying an LOD Rep after opening the complete model does not reduce the system memory consumption as much as opening a model with an LOD Rep applied. Your results may vary.

Many users mistakenly used ViewReps to try to unload parts from memory. Autodesk included a useful tool to convert existing ViewReps to LOD Reps. Right-click on an existing ViewRep and select **Copy to LODRep** to create an LOD Rep with the “invisible” ViewRep components Suppressed.

Likewise, LODReps can be converted to ViewReps. Select an LODRep, right-click and select **Copy to ViewRep**.

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You can also use of the LOD tools to create bounding box representations of assemblies using the Derived part tool. This is useful when you want to send an assembly to a customer or vendor but do not want to show intricate details of some aspects of the model. See Figure 9.

1. Start a new part model and click the Derived component tool.
2. Select the components to display as a bounding box and change them to the green box icon.
3. Click OK when finished. A derived part model is created with the selected components displayed in a bounded box state as shown in the following figures.

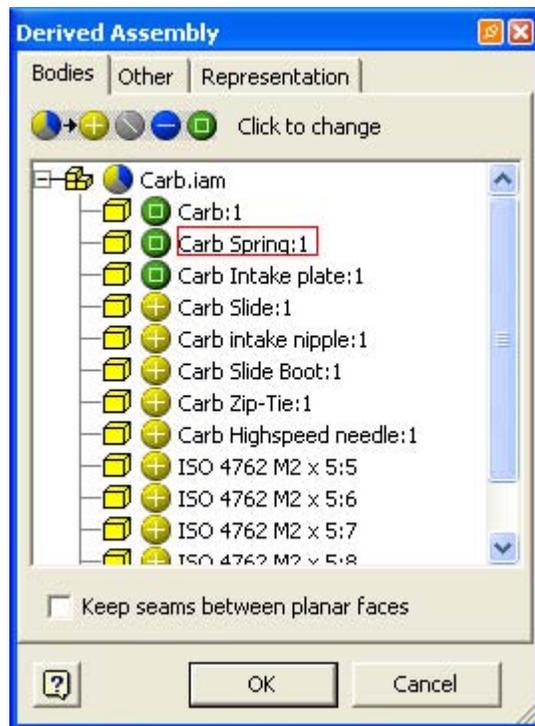


Figure 8 - Bounding Box Derived Parts

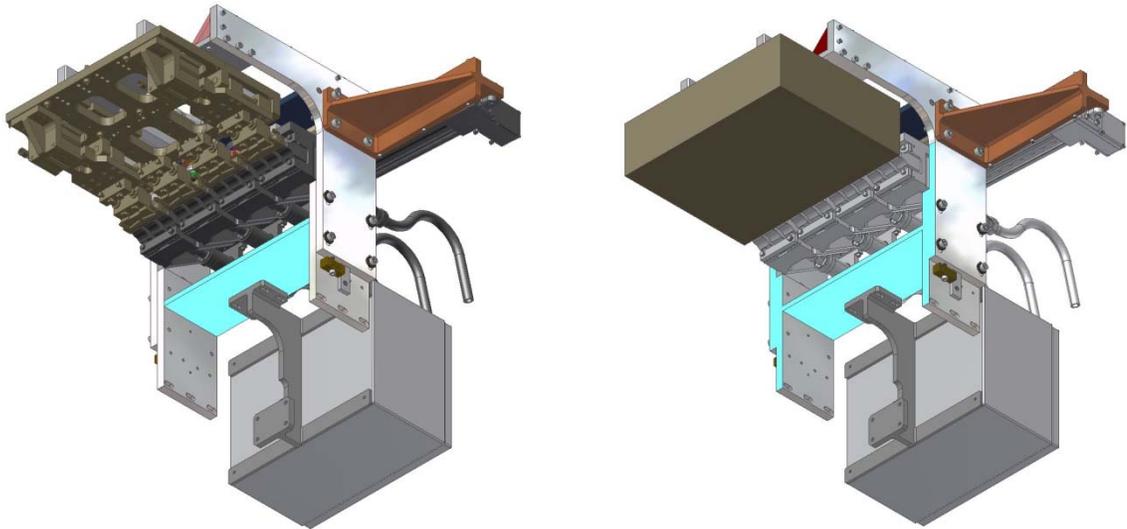


Figure 9 - Bounding Box Derived Example

Tying it all Together: LOD & PosRep Overlays in Drawings

Now that the model contains multiple states, we can show these states in a drawing. Many times a machine is shown in the load or unload positions, guarding door are shown in the fully open and closed positions to determine layout position or an air cylinder is shown in the retracted and extended positions. It is useful to show these positions on the drawing of the assembly.

While a ViewRep shows the entire model in the alternate position, many times you want to show only the portion of the machine that is in the alternate position. This is where PosReps and ViewReps work hand-in-hand. Once you create your PosReps, create a ViewRep and turn off the visibility of all objects not featured in the PosRep. This will significantly clean up your drawing.

To create a ViewRep overlay:

1. Create the base view. It can be of the master PosRep or a user-created PosRep.
2. Click the Overlay View icon in the Drawing Views panel bar.



Figure 10 – Overlay View Tool

3. Select the base view that contains a PosRep. In the Overlay View dialog box select the PosRep to display. You are also able to select a View Representation (ViewRep) to use with this PosRep overlay.

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4. Check the Associative checkbox to associate this ViewRep with this overlay and any changes to the ViewRep in the model will be reflected in the overlay.
5. You are also presented with the options to display a view label, tangent edges and the style of the overlay. If you choose a shaded display, the overlays always have a “dotted line quality” to distinguish them from a base view. You can continue this process on a view as long as there are unused PosReps in the model.

Notice in Figure 12 and 13 how a use of ViewReps (Design Views) displays only the parts of interest in each Overlay View.

There are a few caveats to PosRep overlays. You cannot put a PosRep overlay on a broken or a detail view. Also, an Overlay View in a base view does not carry over to a projected view. For the Overlay to be visible in the projected view, you must place it there manually.

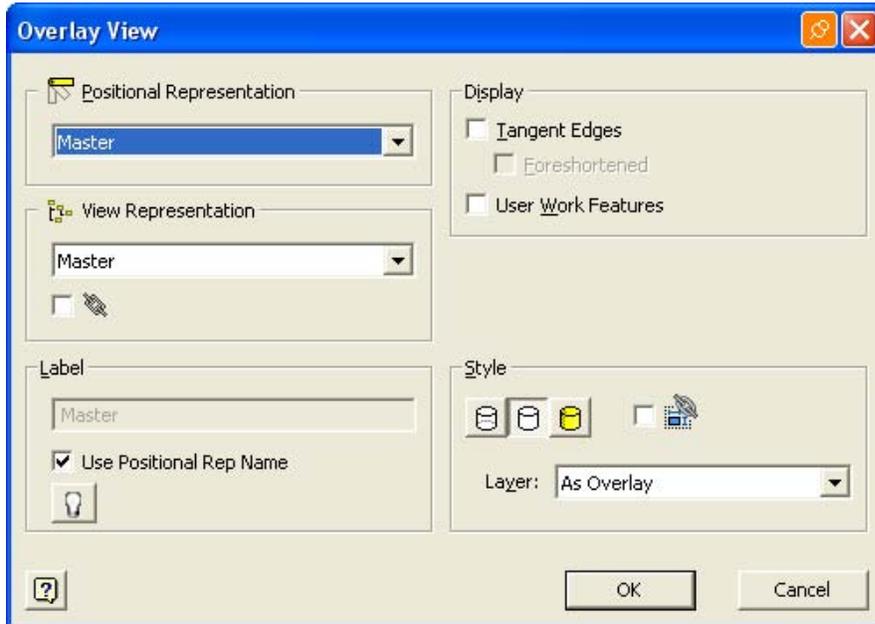


Figure 11 - Overlay View Dialogue Box

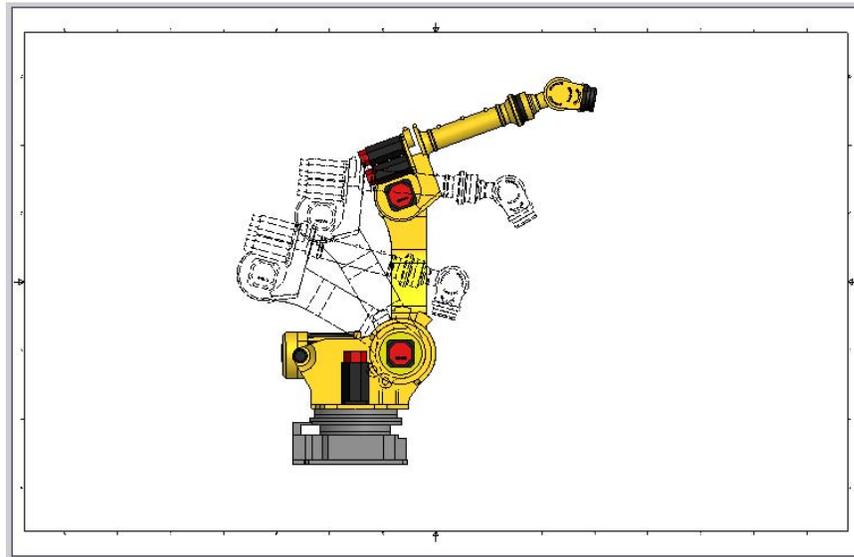


Figure 12 - Assembly with Multiple Overlay Views

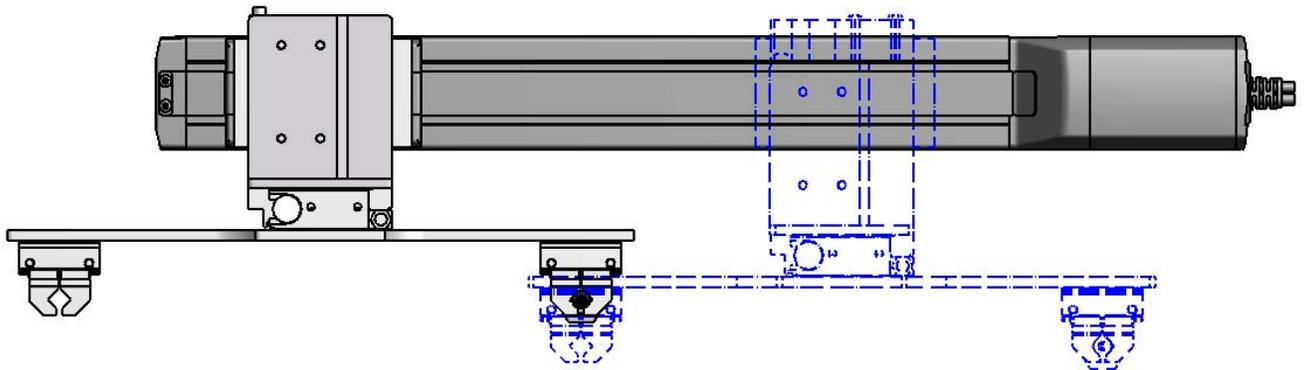


Figure 13 - Assembly with Overlay View

Creating LOD Rep views in drawings is very similar. When placing the view, select the LOD Rep from the view placement. The drawing view is produced with the suppressed components not visible. You can create drawing views of complex models, leaving out unimportant features and parts.

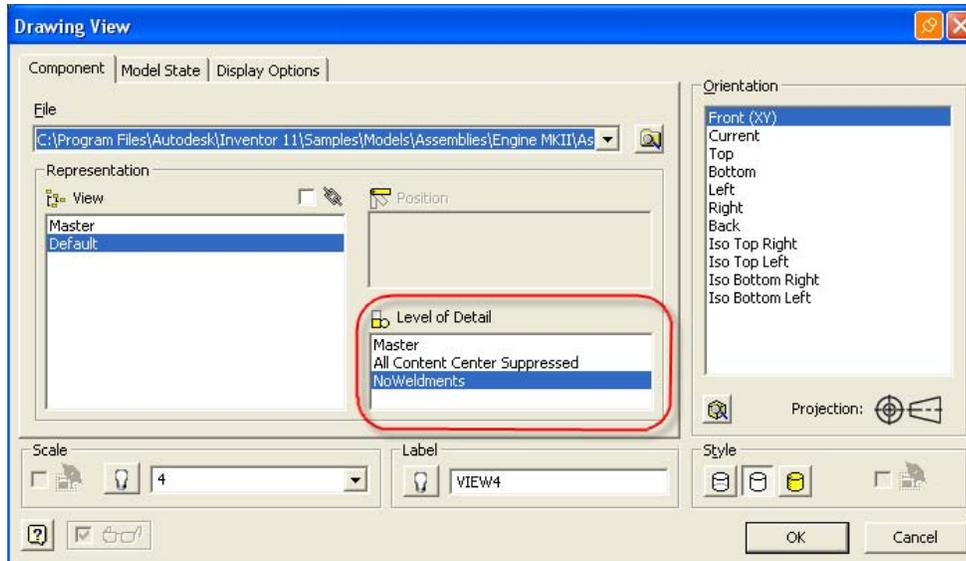


Figure 14 - LOD Rep Selection when Placing View

Final Tips

- When I create PosReps in things like air cylinders or grippers or other devices that typically have two or three positions I also create an additional PosRep named Free. In this PosRep I suppress the constraint that controls the position of the device. In the next higher-level assembly I override the air cylinder assembly. On the Representation tab, I select the PosRep checkbox and choose the Free PosRep in the air cylinder sub. Next, I check the Flexible Status Override checkbox and select Flexible. This allows me to move the air cylinder into any position. Using this method I can show the devices in the fully open, fully closed and free positions.
- Instead of using angle constraints, consider using PosReps. Create workplanes at the appropriate angles. Mate parts to the workplanes and then suppress the constraint. Do this for each angle as needed. Create a PosRep for each angle where that specific constraint is enabled (the others are suppressed). Now you can switch back and forth quickly using these PosReps.
- If you find that you cannot make parts adaptive, invisible, add parts to an assembly or many other commands, make sure you are not in an active PosRep. You cannot do many of these things to an assembly unless you are in the Master PosRep.
- Be sure to check AU Online for a copy of this document, example assemblies and more AU related information.