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40 Thousand What? How to Create Large Assembly Models in Inventor

IM500685

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Tyler Mejia
Herzog: CAD Manager |
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Meet Your Speaker… Melissa Thomas

- Founder and Solution Architect at Nfluencr, Inc.
- Have wonderful husband, 2 dogs and 3 horses.
- Have worked in consulting for 11+ years.
- 22 years experience in Inventor Professional
- 20 years experience in Vault Professional
- Work with Coolorange products
- Love being a bridge between technology and customer needs

- Who we are
    - Nfluencr is a consulting company that works with engineering and IT departments on workflow and data security using the Autodesk and coolOrange products.

- Who we serve
    - Nfluencr serves many different industries that use these software products.

Meet Your Co-Speaker… Tyler Mejia

- CAD Manager at Herzog Railroad Services
- Have a beautiful wife, 3 lovely kids, and 1 on the way
- Have been with Herzog for 13 years and going.
- 17 years experience in Inventor Professional
- 13 years experience in Vault Professional
- Recently started using Coolorange Powerjobs and PowerEvents
- Love being a problem solver and looking for new ways to automate workflow.

HERZOG

- Who we are
  - Herzog is a leading rail and heavy/highway contractor across North America. We efficiently solve complex transportation problems in challenging operating environments thanks to 50 years of experience and our highly qualified team of professionals.

- Who we serve
  - Herzog provides state-of-the-art equipment, technology, construction, and maintenance services to owners of Class 1 railroads, transit agencies, state transportation authorities, and prime contractors

Solving the problem

Large assemblies are always going to use computing power but how to you work better with these large assemblies?

- There is pages of information on large modeling techniques for Autodesk Inventor and this is information that you need.
- You need to change the way you model inside of Inventor even for parts so that when put into the assembly, it gets easier to optimize.
- You need to understand the tools that Autodesk Inventor gives to you and how to best use it for your assembly.
- There are two things to consider when building a large assembly:
    - How will the assembly be modified in the future?
    - How will the assembly be detailed in the drawing?

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Introduction to large model optimization steps: Acronym

Memory technique

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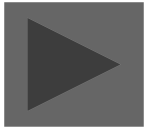
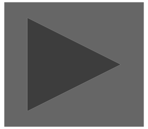
Examples of Acronyms

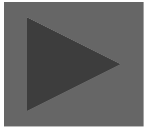
Helps you recall information



KISS



SMART Goals



SOHCAHTOA

Introduction to large model optimization steps: SUPERCALIFRAGISTICEXPOALODOCIOUS

Memory technique

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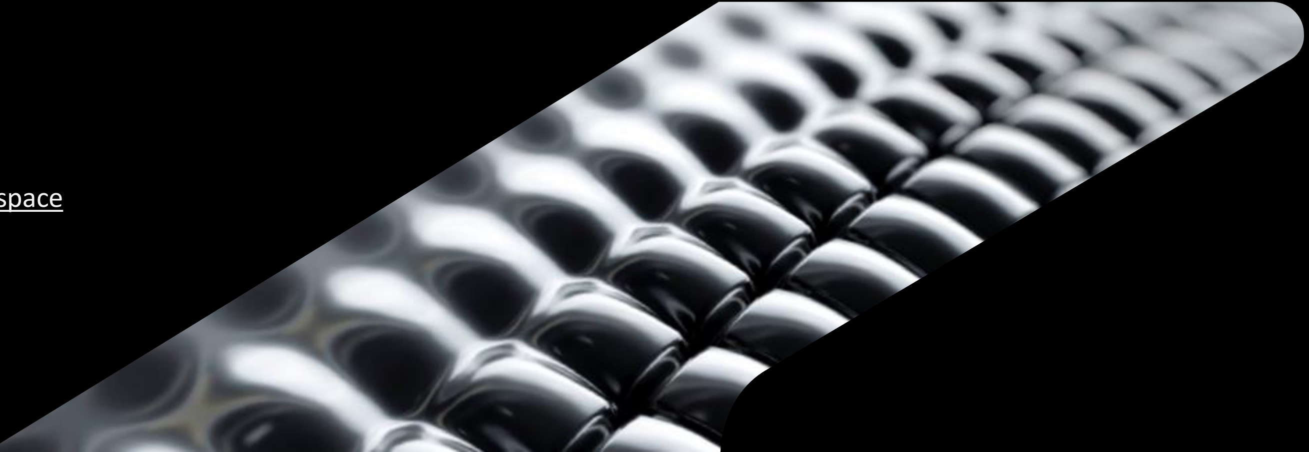


Autodesk Inventor Large Model Acronym

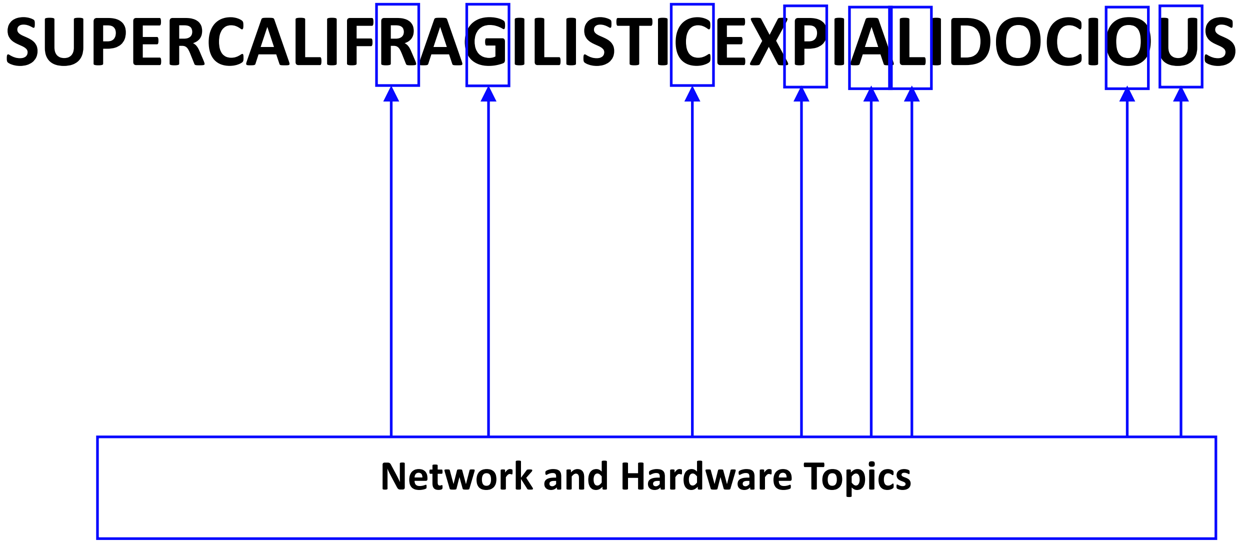
SUPERCALIFRAGILISTICEXPIALIDOCIOUS

- Simplified Model
- Under constrained Assembly
- Phantom Assemblies (Skeletal Modeling)
- Express Mode
- Representation Views
- Custom Content Center
- Appearances
- Library Files

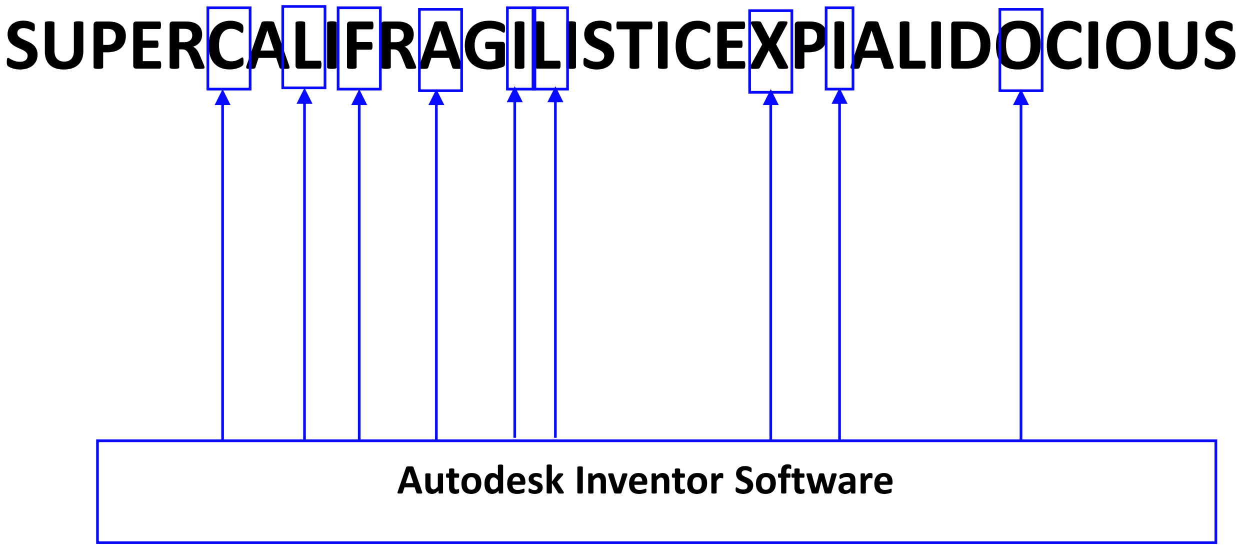
- Inventor Model States
- File Management
- RAM
- Assembly Hierarchy Efficiency
- Graphics Card
- Inventor Projects
- Leaving Contact Solver Running
- Inventor Projected Geometry

- STEP Files
- Texture vs. Feature
- Incompatible Versions
- Computer System Requirements
- Excessive Occurrences
- XML
- Process Running on Machine
- Inventor Add-Ins

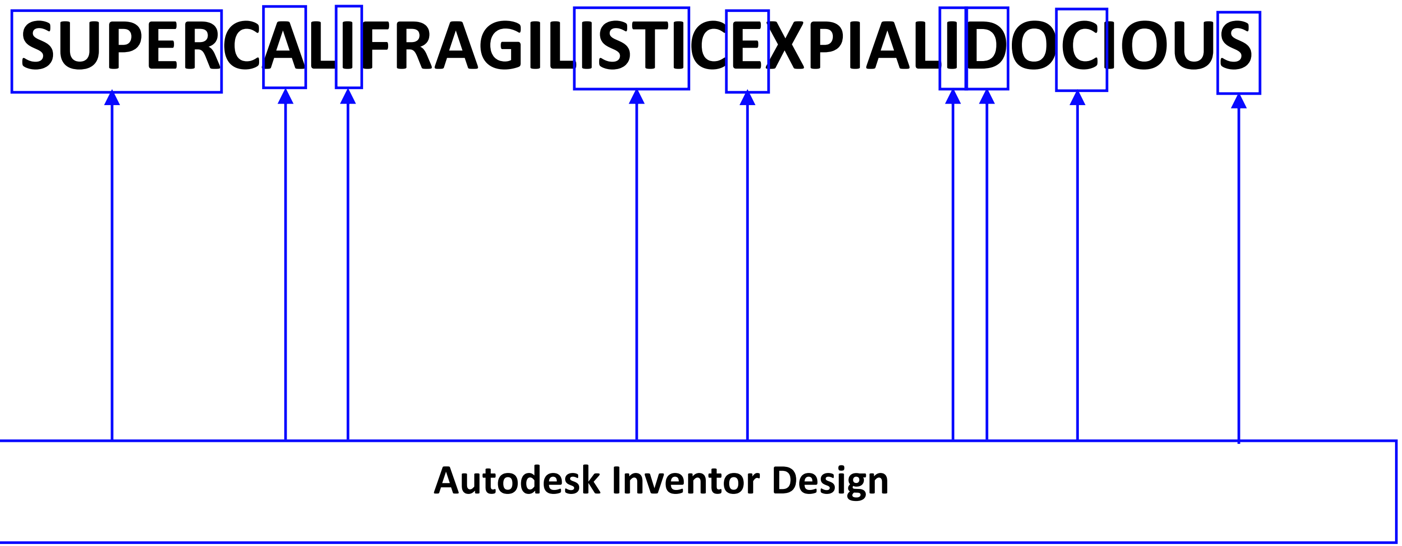
- Anti Virus Software
- Low System Memory
- Inventor Adaptivity
- Drawing View Strategy
- Options (Inventor)
- Correct Errors
- Inventor Diagnostics
- Operating Services
- Usage (Network)
- Selection Filters



- RAM
- Graphics Card
- Computer System Requirements
- Process Running on Machine
- Anti Virus Software
- Low System Memory
- Operating Services
- Usage (Network)



- Custom Content Center
- Library Files
- File Management
- Assembly Hierarchy Efficiency
- Inventor Projects
- Leaving Contact Solver Running
- XML
- Inventor Add-Ins
- Options (Inventor)



- Simplified Model
- Under constrained Assembly
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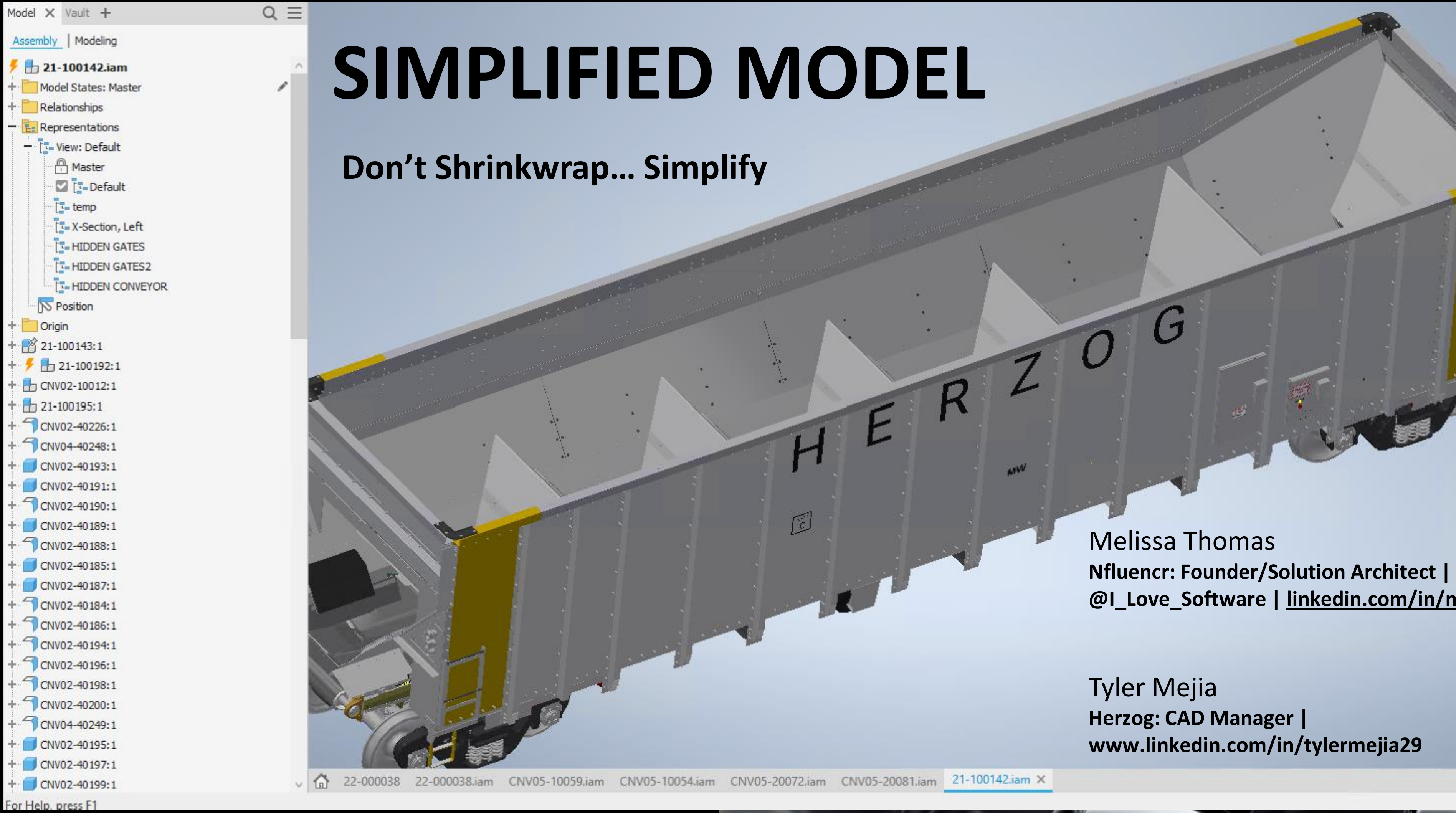
- Express Mode
- Representation Views

- Appearances
- Inventor Model States
- Inventor Projected Geometry
- STEP Files
- Texture vs. Feature

- Incompatible Versions
- Excessive Occurrences
- Inventor Adaptivity
- Drawing View Strategy
- Correct Errors
- Selection Filters

SIMPLIFIED MODEL

Don’t Shrinkwrap… Simplify



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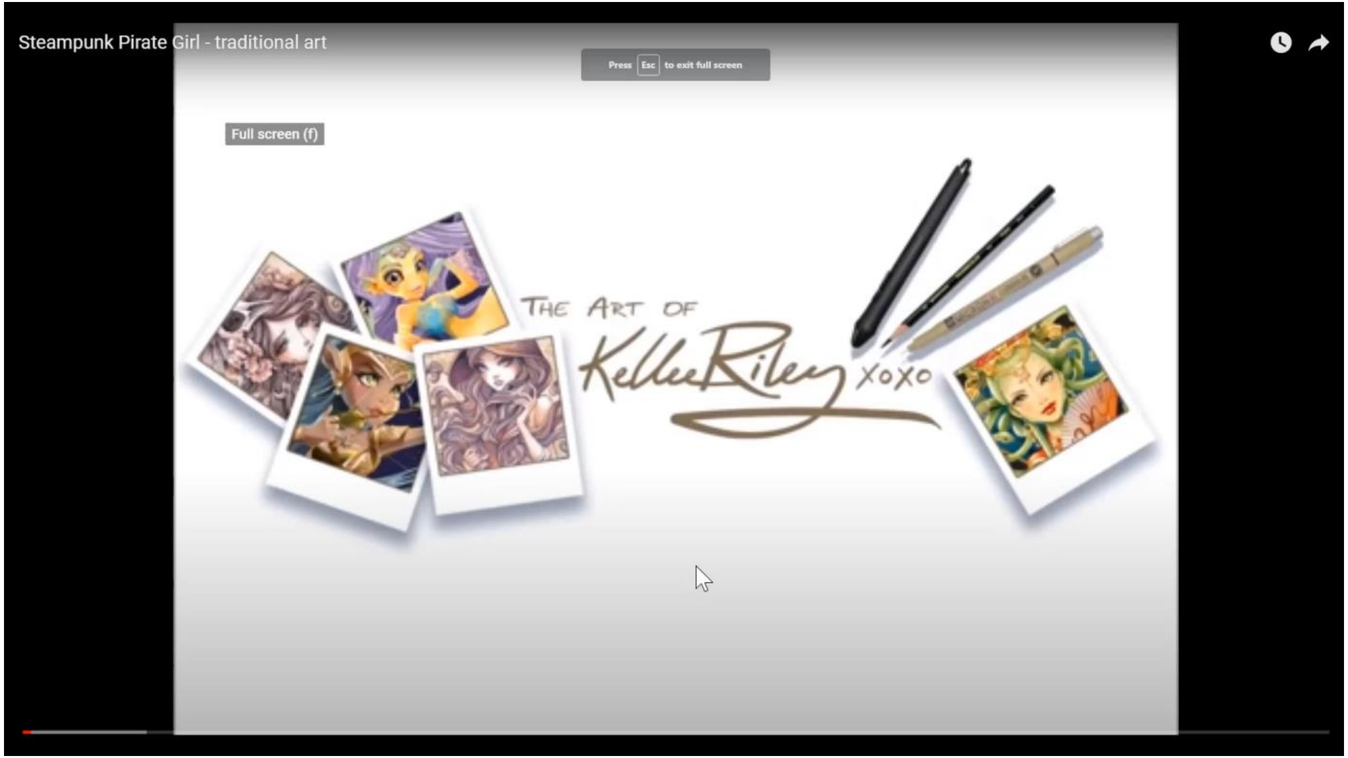
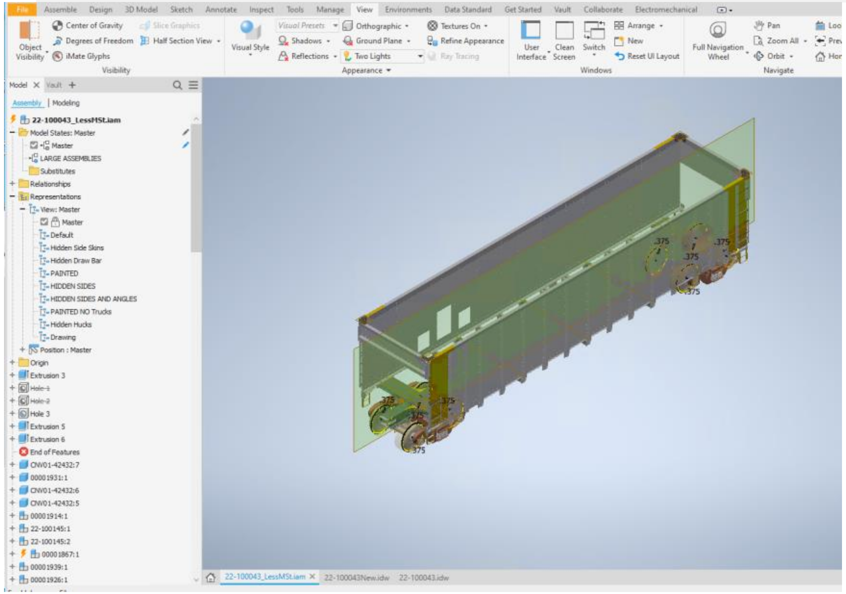
Think about what the computer calculates

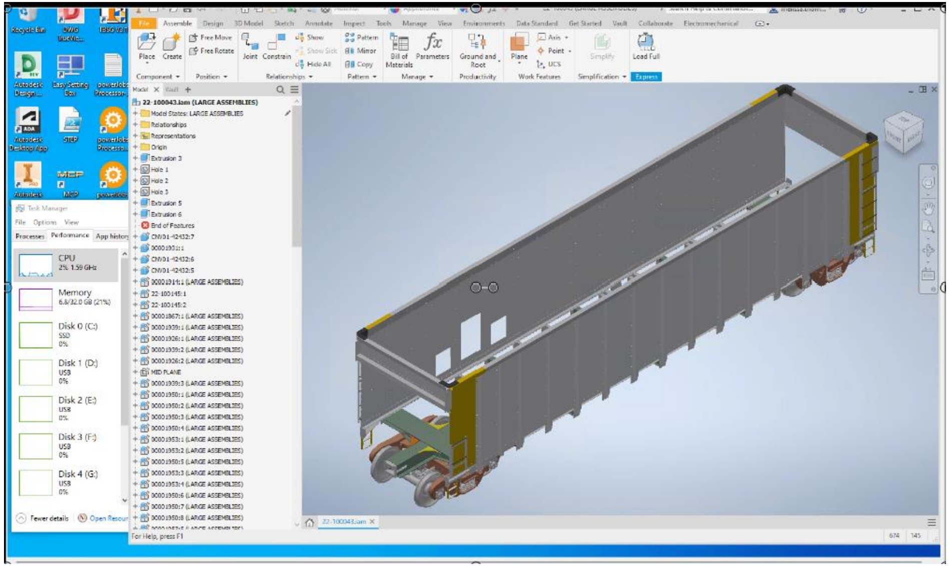


Initial Times to load

Before Simplified

Full Mode:	Express Mode:
1:30:70 (Min:Sec:mSec)	0:43:11





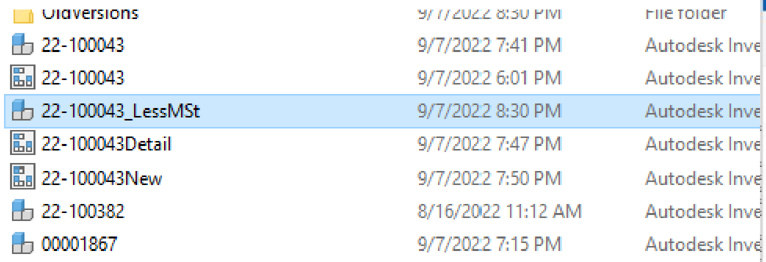
Initial Times to load

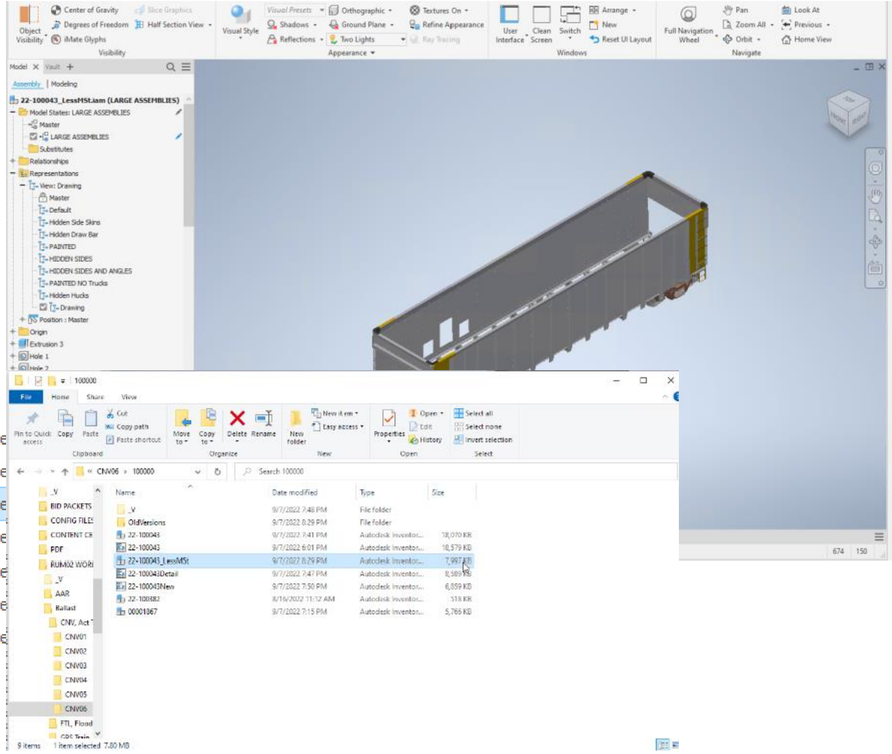
After Simplified

Model State = LARGE ASSEMBLIES

View Representation = Drawing

0:24:17 (Min:Sec:mSec)





Start with the end in mind.

- There are two things to consider when building a large assembly:
  - Potentially, how many users may need to work on parts of it at the same time?
  - How will the pieces (parts and sub-assemblies) be purchased or built?

There are two considerations when starting a new top-level assembly

How will the pieces (parts and sub-assemblies) be purchased and/or built?

And

Potentially, how many users may need to work on parts of it at the same time?

Every Company has a unique product and therefore a unique workflow when using software to create, modify, and expand their designs. When you have more than 3k or 4k parts in an assembly, it is good practice to build a framework for designing models before you start.

There are two considerations when starting a new top-level assembly

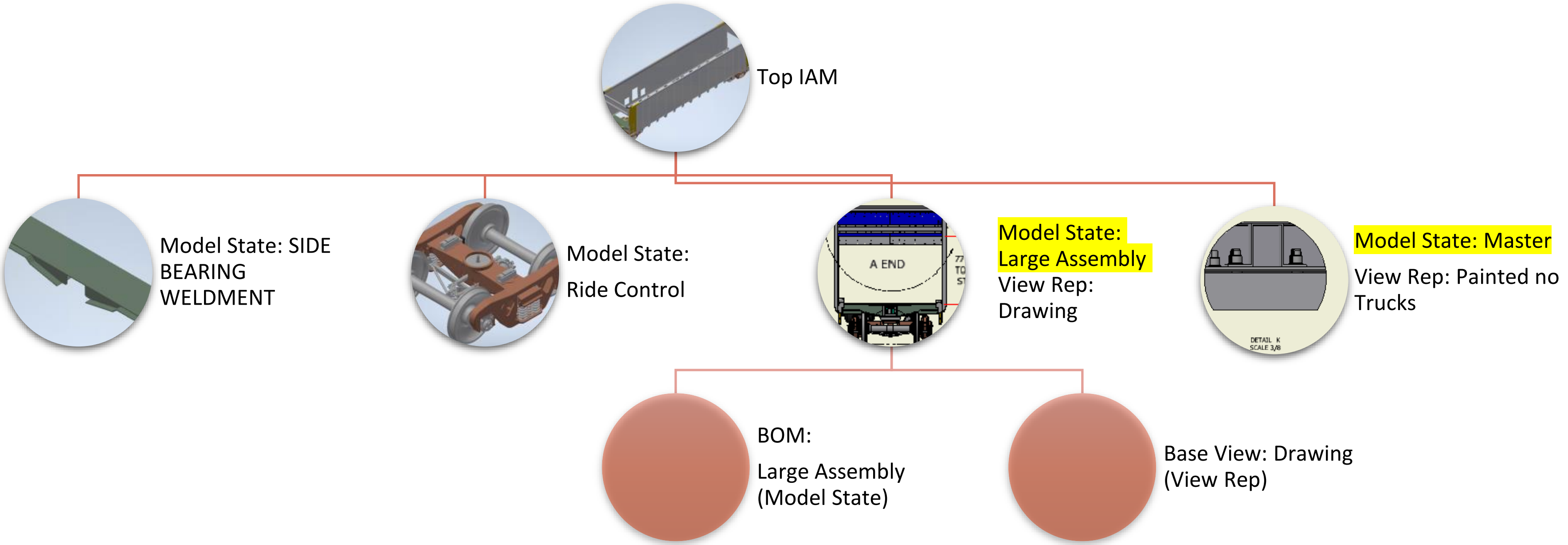
How will the pieces (parts and sub-assemblies) be purchased or built?

The first consideration is how the BOM will be purchased or built.

- Does the sales order have multiple assemblies on one or is it an individual assembly?
- Is the order built with individual components or are sub-assemblies build in the manufacturing process?
- Are there different manufacturing segments in the company?

How will the assembly be used in the future

Think about what you will change in the future and build your assembly with this in mind



Representations

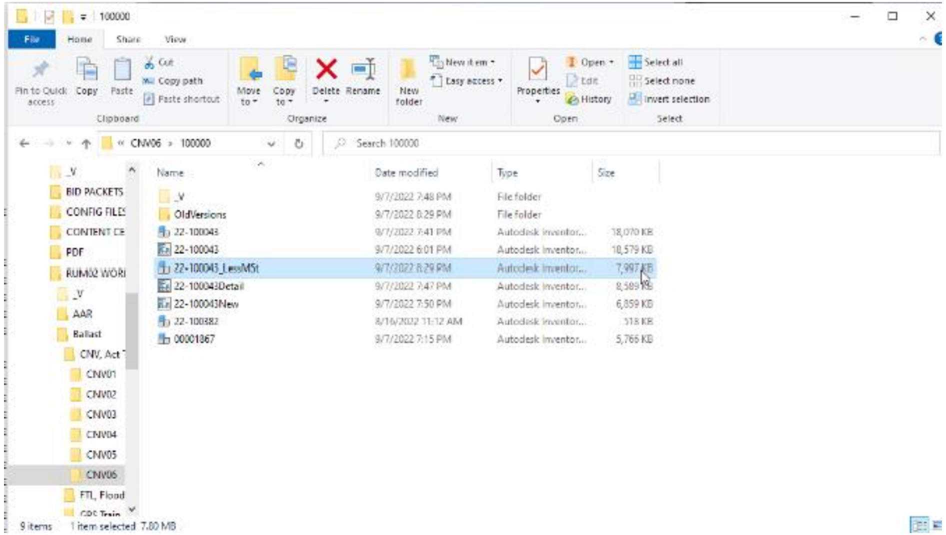
Aka View Representations

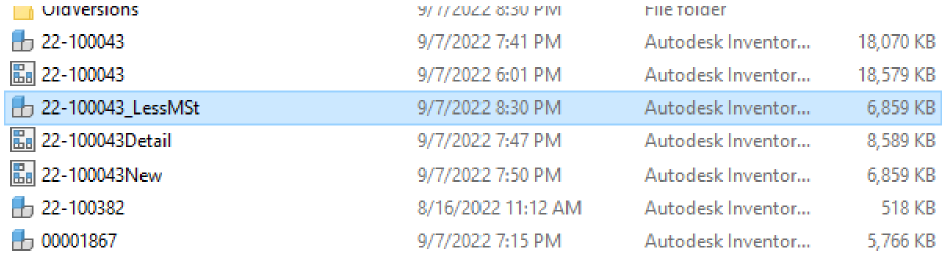
- They store a component's current state when the view is created, edited, and saved
- Note: Must save after creation for your changes to show
- It saves the component visibility, work feature visibility, selection status, camera state, viewing angle and subpart and subassembly view representations
- Only loads parts needed for the view
- Caution: If you move from one representation to another, Inventor will load more based on the views to the point that you negate the time saved not doing a full load
- Tip: to unload unnecessary components, close the document and reopen it with the specific view representation

Model States

New for Inventor but does not replace LOD

- Model State is like saving a document within a document.
- It adds the cache information to the model state for quick opening
- Note: Must save after creation for your changes to show
- Caution: It adds to the size of the file.
- Tip: Express add size to your iam file and is a “look” don’t touch solution.





Initial Times to Open Drawing

Model State = Master

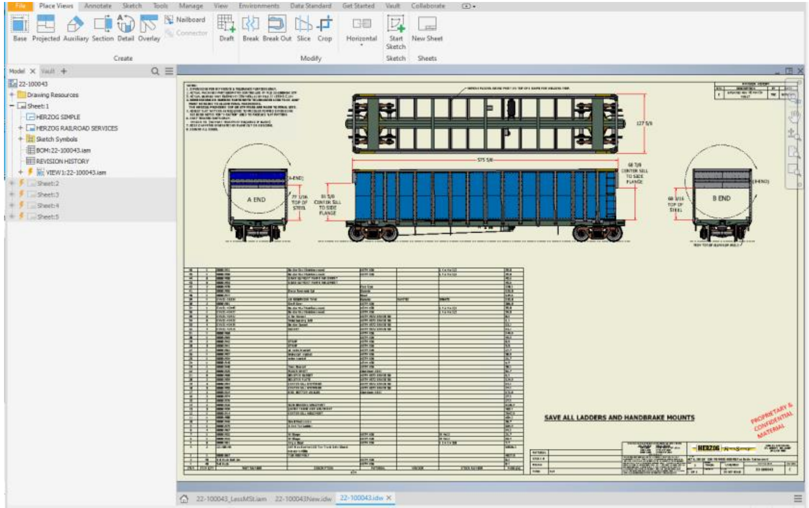
View Representation = Master and ‘Painted no TRUCKS’

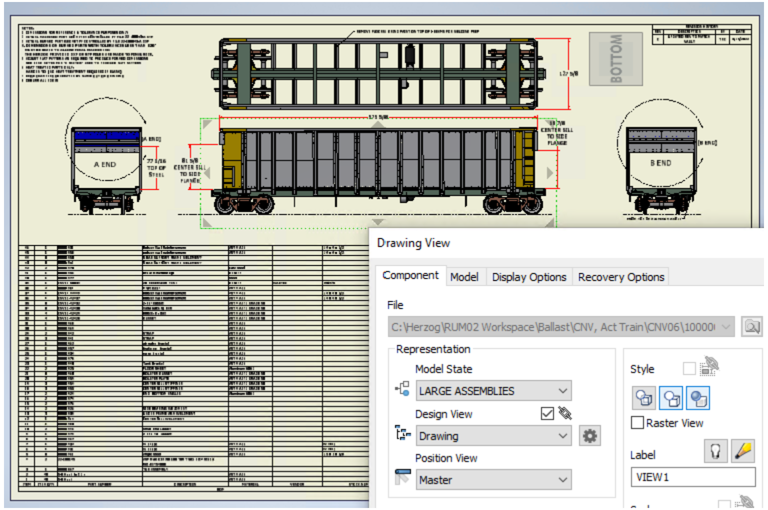
1:21:09 (Min:Sec:mSec)

Model State = LARGE ASSEMBLIES AND Master

View Representation = Master and ‘Painted no TRUCKS’

1:08:67 (Min:Sec:mSec)





Initial Times to Open Drawing

Split the Drawing into two files: One for each needed Model State

Model State = LARGE ASSEMBLIES

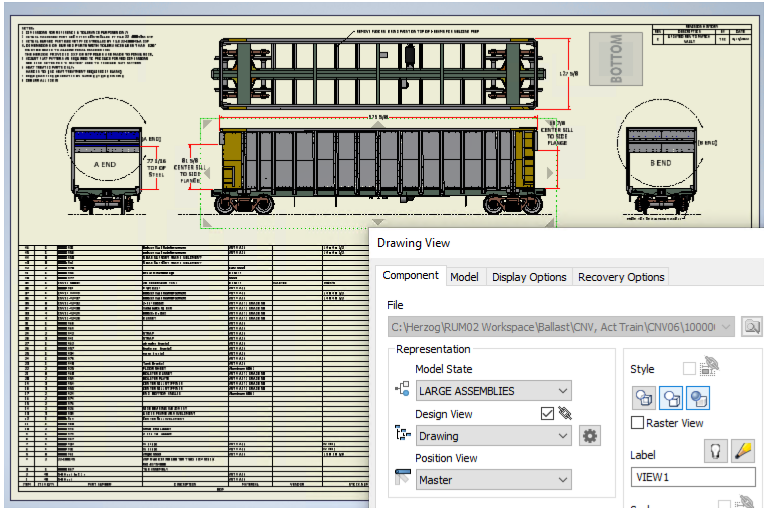
View Representation = Drawing and ‘Painted no TRUCKS’

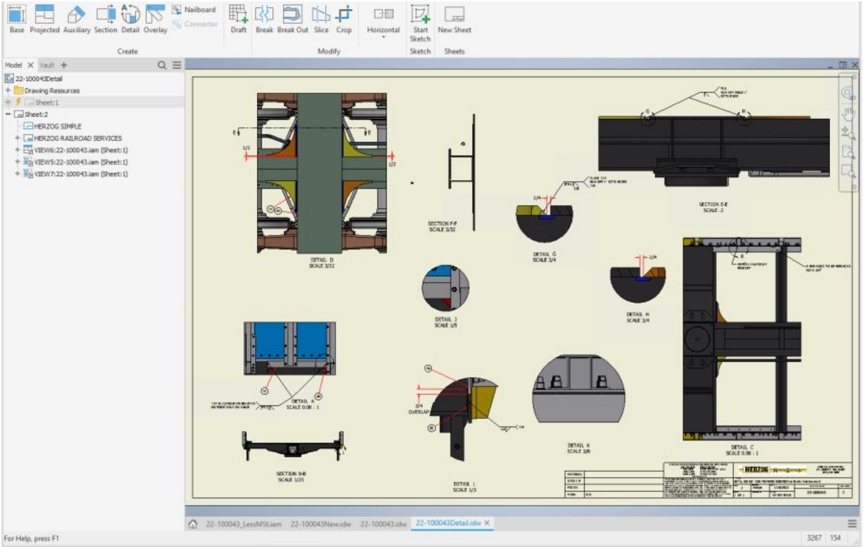
0:33:84 (Min:Sec:mSec)

Model State = Master

View Representation = Master and ‘Painted no TRUCKS’

0:35:61 (Min:Sec:mSec)

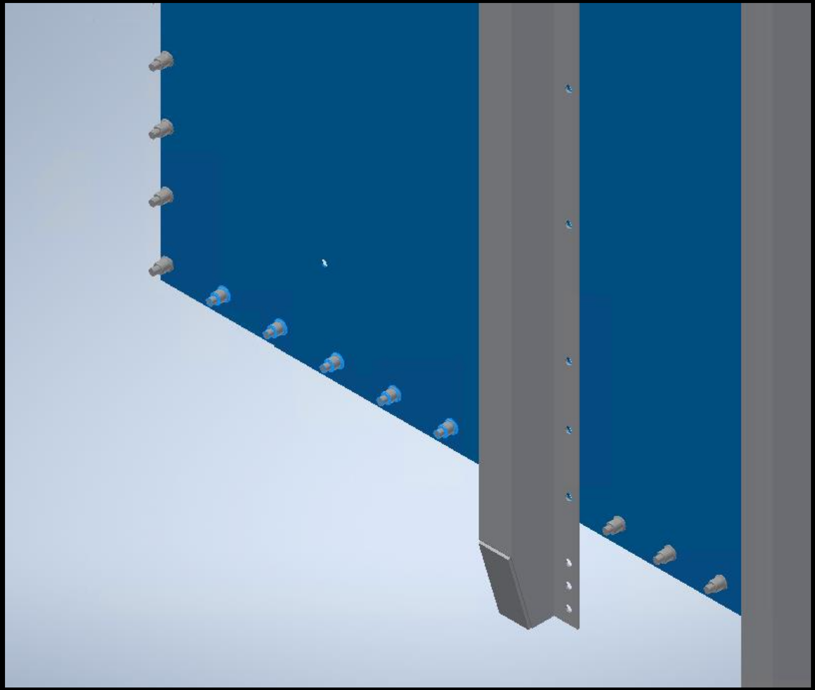




Simplify steps

- First step to Simplify is to first remove the small parts that won't be needed for the Model State or View Representation.
- TIP: use selection filter to quickly identify these parts.
- TIP: % does not work with patterned components.
- Use the Simplify tool to create a smaller model for use in the upstream iam

Used 18% or less but these patterns did not highlight



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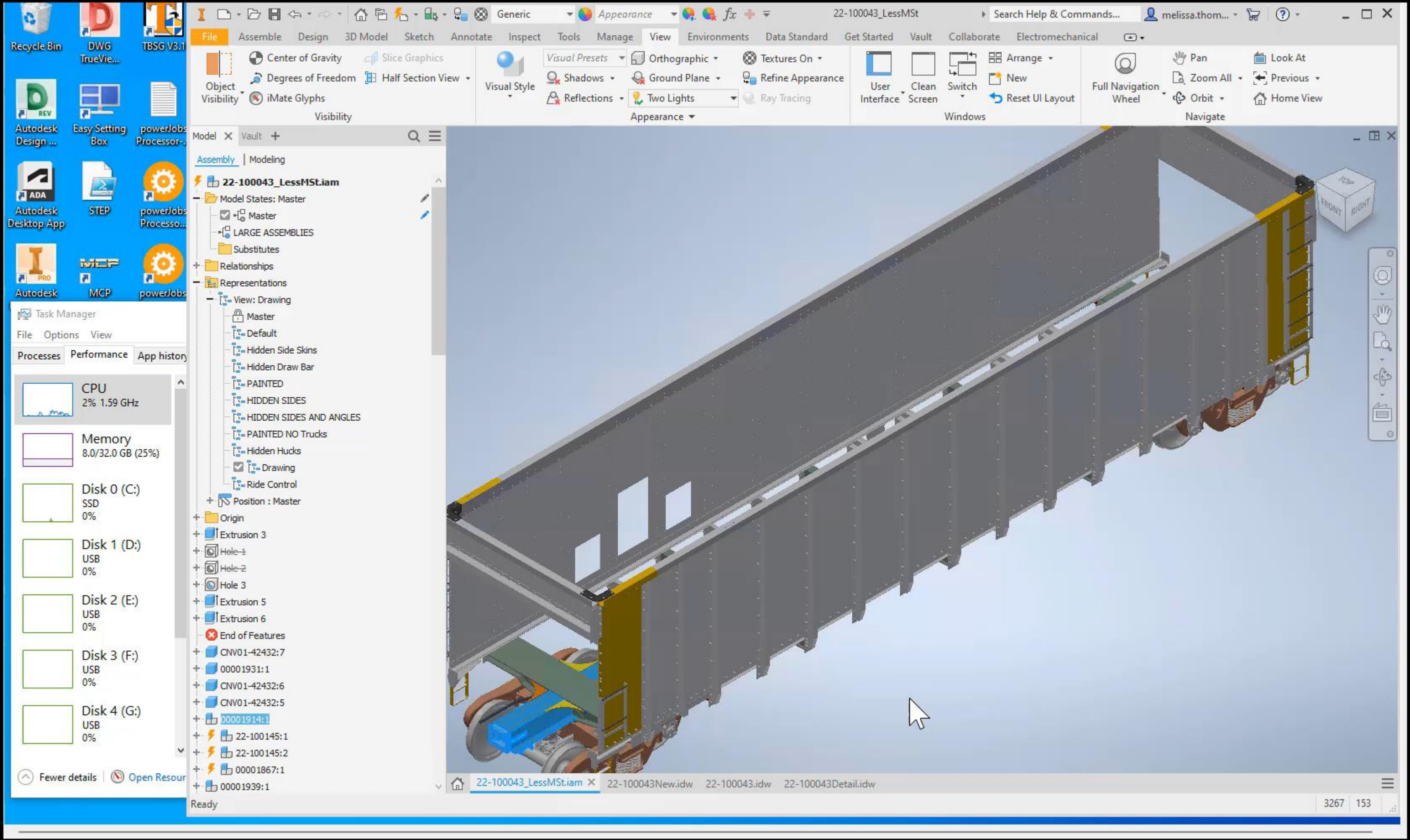
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Reflections
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Ground Plane
Two Lights
Textures On
Refine Appearance
Ray Tracing
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Hole 3
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End of Features
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153

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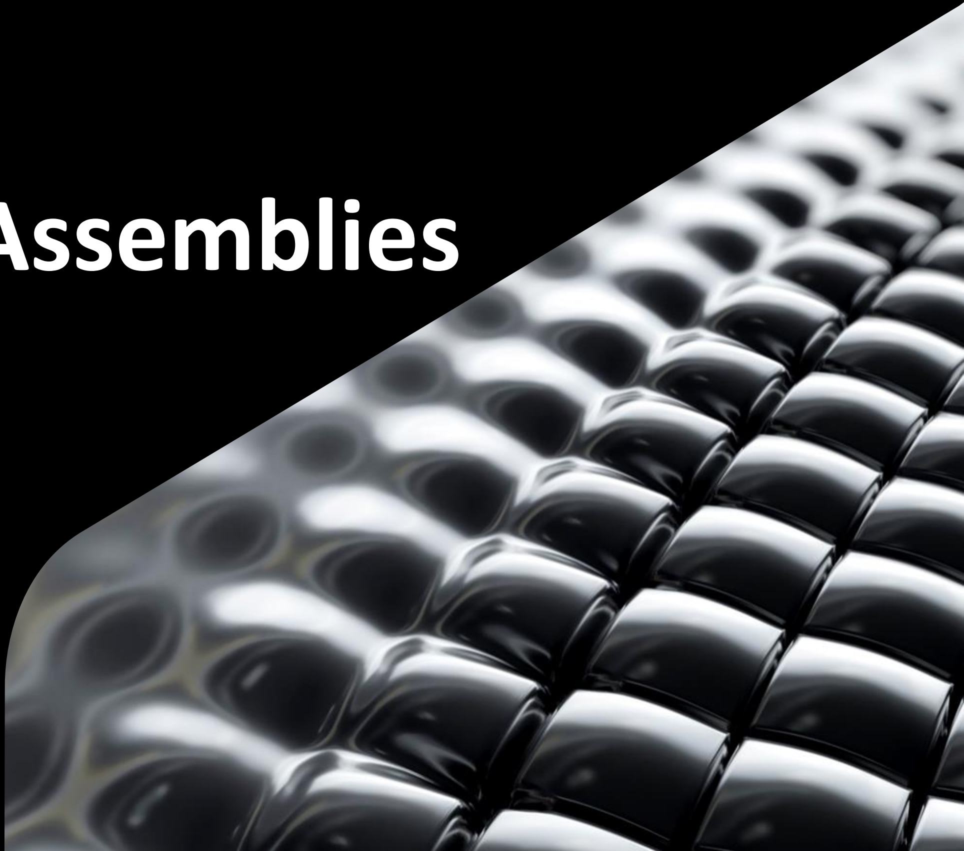
Under constrained Assemblies



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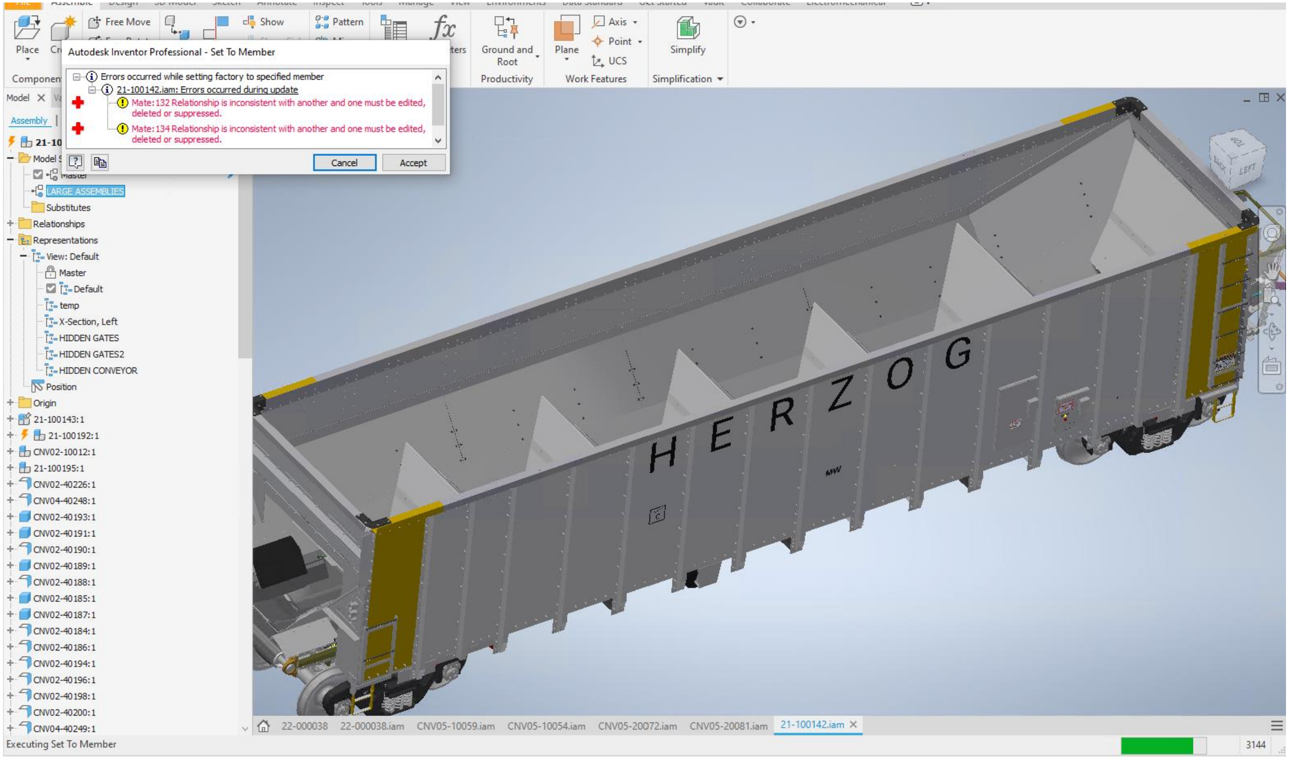
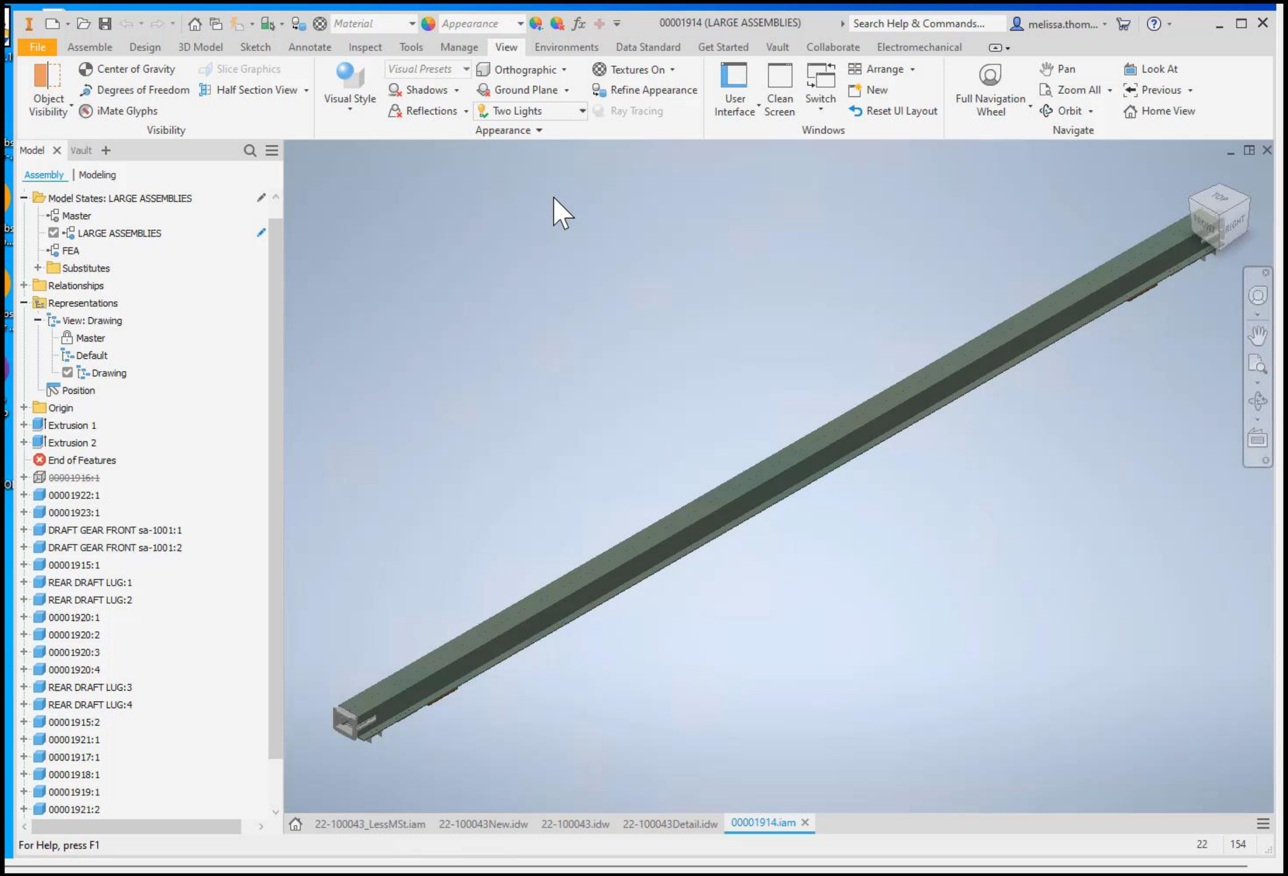
Assembly Joint and Constraint Relationships

- Fully constrain components or ground components that are not designed to move in your assembly.
- Avoid redundant constraints. For assistance in locating these, use the Application Options Assembly tab Enable constraint redundancy analysis. Remove redundant constraints, then turn off the option.
- Use a common constraint reference if possible.
- Constrain symmetrical assemblies to the mid-planes or center axes.
- Resolve relationship errors as they occur.

Avoid errors in Assembly and Subassembly





00001914 (LARGE ASSEMBLIES)
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Environments
Data Standard
Get Started
Vault
Collaborate
Electromechanical
Object Visibility
Center of Gravity
Degrees of Freedom
iMate Glyphs
Slice Graphics
Half Section View
Visibility
Visual Style
Visual Presets
Shadows
Reflections
Orthographic
Ground Plane
Two Lights
Textures On
Refine Appearance
Ray Tracing
Appearance
User Interface
Clean Screen
Switch
Arrange
New
Reset UI Layout
Windows
Full Navigation Wheel
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Zoom All
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Representations
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22-100043.idw
22-100043Detail.idw
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For Help, press F1
22
154

Phantom Assemblies

And Skeletal Modeling

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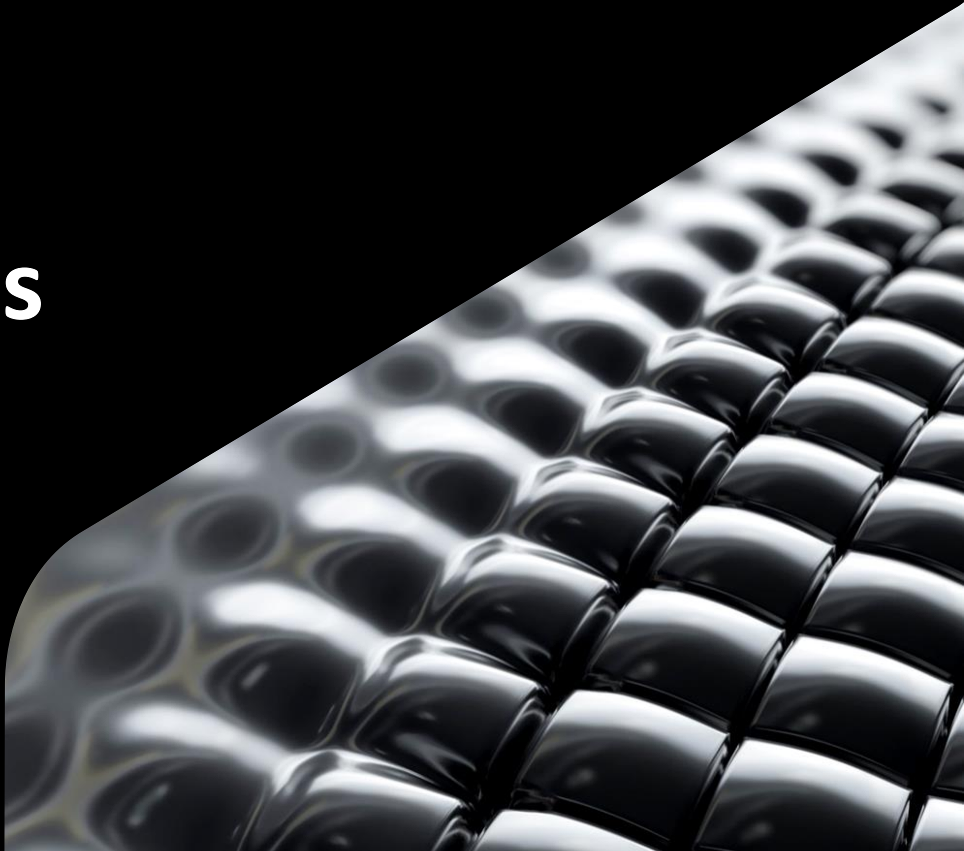


Skeletal Modeling

Skeletal Modeling, top-down design, is a method of working with large assemblies. The benefits of using the skeletal technique include:

- A much more stable Inventor model
- Faster updates
- More available resources for handling larger data sets
- An easier way of working in a collaborative environment

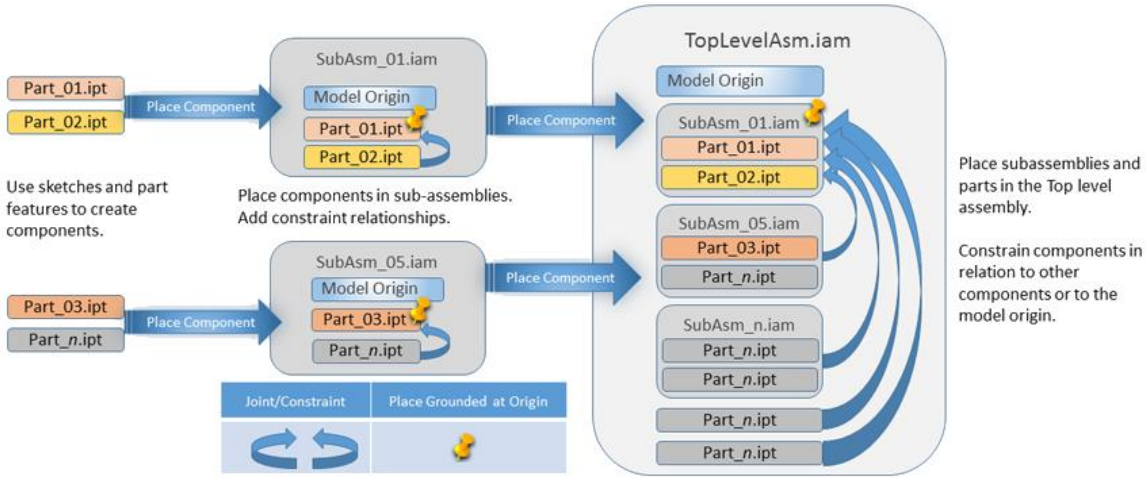
Note: Legacy Data
To take full advantage of skeletal modeling workflows in Express Mode your legacy data must migrated to the latest release. Migration ensures that the legacy data is updated to work with the current commands and their options.

Not Recommended for large models…

***It can consume system resources and slow down performance**.

*Model changes ripple through the design due to a lot of cross references and/or referenced geometry that are affected.

Assembly Modeling: Bottom Up



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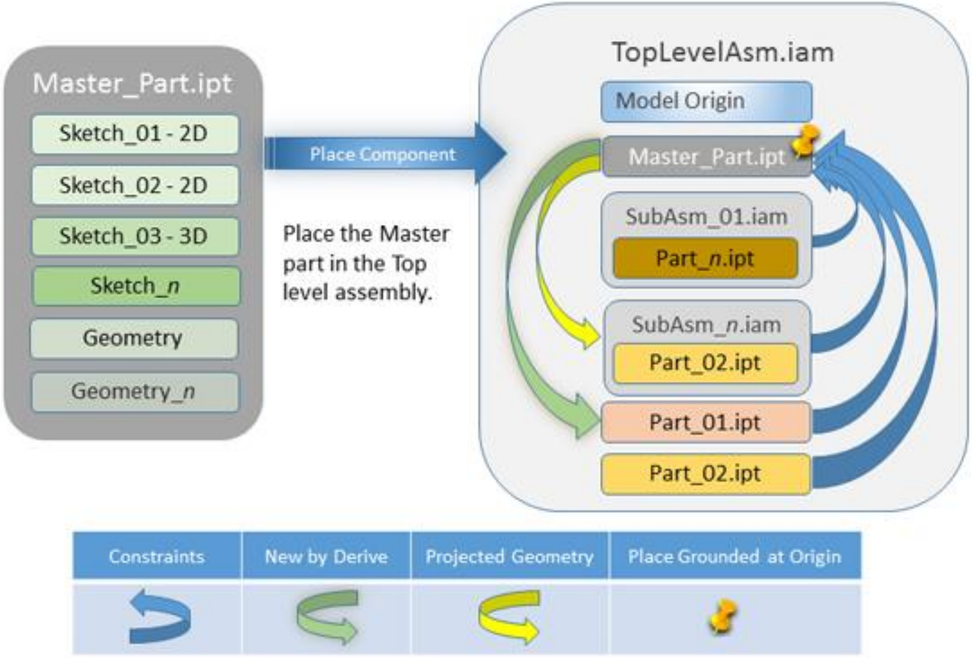
Skeletal Modeling: Single-Part

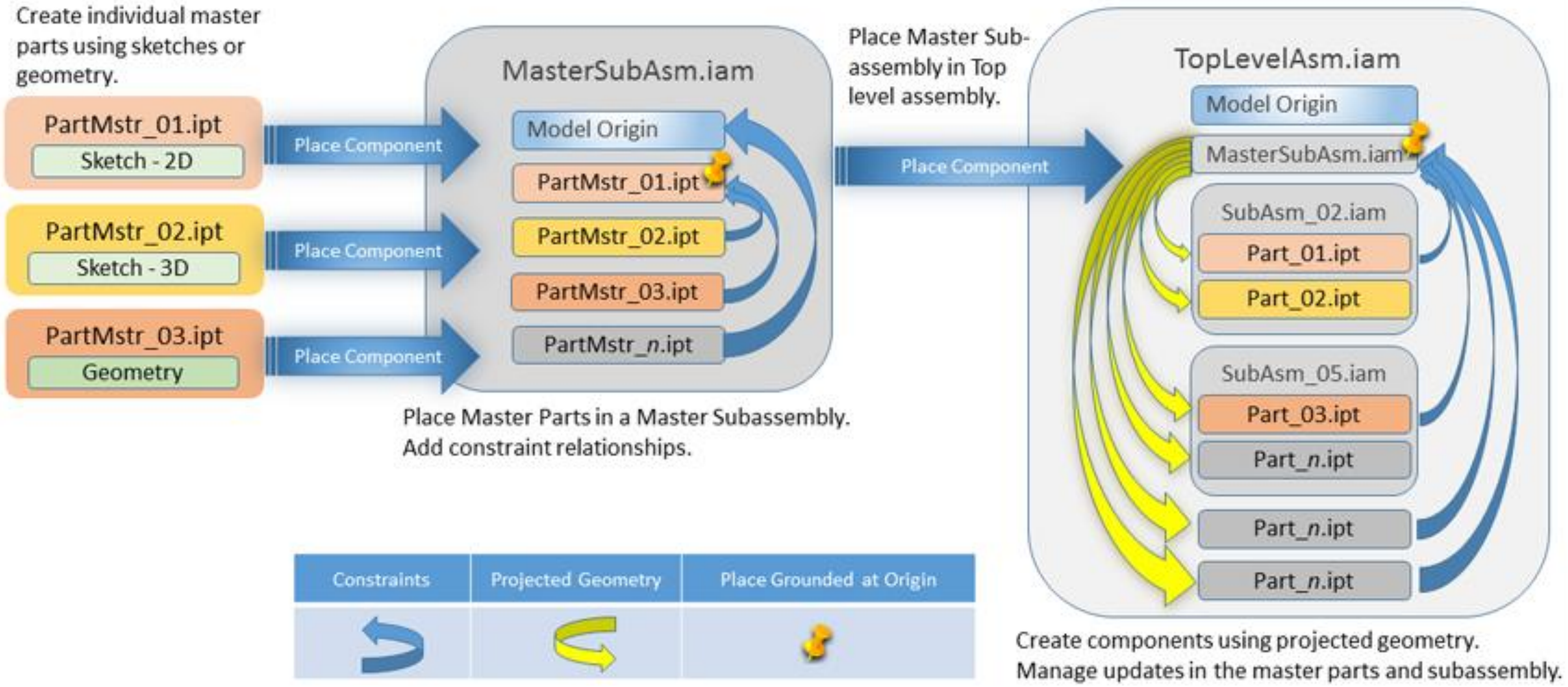
Use sketches and geometry to create a Master part of your design.



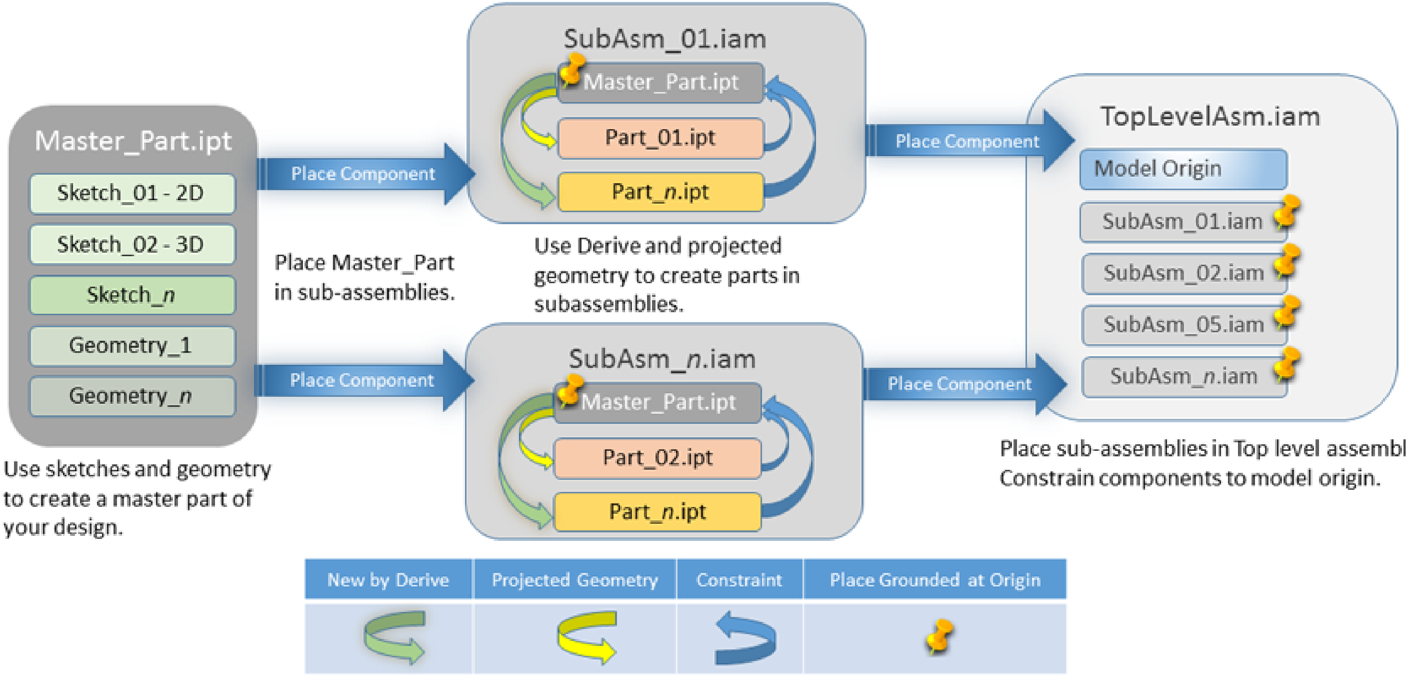
Use Derive and projected geometry to create parts and subassemblies.

Components retain association with the Master_Part and update with edits to the master.

Skeletal Modeling: Multi-Part



Skeletal Modeling: Distributed Master



Use sketches and geometry to create a master part of your design.

Place sub-assemblies in Top level assembly. Constrain components to model origin.

Linking Part Model Parameters

- If you share parameters between parts, do not link them by an Excel spreadsheet. When the Excel file changes the software does not distinguish which files are affected, so an update is required for all parts. The performance of large assemblies slows down.

- If you use global parameters, those used across designs, establish these parameters in your master parts and then link them one by one from the Parameters dialog box. This is the 'lightest' reference. Alternatively, use the Derive command in connection with the master part and select the parameters to use in the derived part. The software detects and updates only those files that a change affected.

How will the pieces (parts and sub-assemblies) be purchased or built?

The first consideration is how the BOM will be purchased or built.

- Does the sales order have multiple assemblies on one or is it an individual assembly?
- Is the order built with individual components or are sub-assemblies build in the manufacturing process?
- Are there different manufacturing segments in the company?

Consider BOM

The BOM Structure property defines the status of the component in the BOM. BOM Structure has five basic options: Normal, Phantom, Reference, Purchased, and Inseparable.

Normal

Normal is the default BOM Structure for most components.

Normal components have the following characteristics:

- Their placement/participation in the BOM is determined by their parent assembly.
- They are numbered and included in quantity calculations.
- They have no direct influence on their child components participation in the BOM.

Purchased

Purchased components are components that are not fabricated.

Examples of Purchased Assemblies include:

- Cylinders, pistons, or shock absorbers
- Swing arms for LCD monitors
- Hinges

Purchased components have the following characteristics:

- **The component is considered a single BOM line item, whether it is a part or an assembly. For example, an assembly marked as purchased is listed as a part in parts-only parts list.**
- **If the purchased component is an assembly, its children are not included in the BOM. Children are also excluded from quantity calculations in the BOM.**
- **Normal child components of a purchased assembly are included in structured parts list, and numbered, but are hidden in parts-only parts lists.**

Reference

Reference Components are components that are used for construction geometry or add context to a design.

Examples of Reference Components are:

Construction elements such as a skeleton part or assembly for skeleton modeling.
Visual enhancements, such as a tote filled with parts sitting on a desk, where the tote is added for technical drawing/publication purposes. It is not a part of the actual design.
Reference components have the following characteristics:

- They are ignored in the BOM.
- They are excluded from the mass calculations.
- They are not numbered and are not directly included in quantity calculations.
- Child components of the reference component are ignored in the BOM.
- They are shown with a hidden line style in drawing views.

Note: Use View Representations to control the display of reference components in the assembly and in drawing views. The display of reference components in drawing views is controlled in the Model State tab of the Drawing View dialog box.
When a component has a BOM Structure of Reference, the BOM treats the component and all its direct and indirect children as if they do not exist. **All components, that are a part of a Reference component, are excluded from quantity, mass, or volume calculations, regardless of their own BOM Structure value**.

Inseparable

Inseparable components are generally assemblies where a component or multiple components must be physically damaged to disassemble the assembly. Many manufacturing processes consider inseparable assemblies to be a single line item like purchased components, but Inseparable assemblies are fabricated, not purchased.

Examples of inseparable assemblies are:

- Weldments including assemblies that are glued or bonded.
- Riveted components fastened together with semi-permanent fasteners that must be destroyed to separate the components.
- Assemblies where components have been press fit together, such as dowel pins pressed into a part.

Inseparable components have the following characteristics:

- To separate the assembly, some component or multiple components must be physically damaged.
- One or more child components are considered part of the parent and are never tracked or revised separately.
- In a parts-only parts list, the inseparable assembly is treated as a part, just like a purchased assembly.
- An inseparable assembly is treated as a standard assembly when it is documented in its own context.

Inseparable assembly with purchased children components

Inseparable components and purchased components have one difference in their behavior. In a parts-only parts list of BOM, all children of a purchased assembly are hidden. The assembly itself shows up as a line item in the BOM. For Inseparable assemblies, child components with a BOM structure of normal or inseparable are hidden. Purchased child components that are inside an inseparable assembly are still displayed in the parts-only parts List.

Phantom

Phantom components are used to simplify the design process. They exist in the design but are not distinct line items in a bill of materials.

Examples of phantom components are:

- Sets of hardware where the components are purchased and assembled separately, but are commonly used together (for instance screws, nuts, and washers).
- Installation Assemblies. For instance, when you want to focus on a certain section of an assembly, you can set other subassemblies as Phantom. Use Phantom to avoid working with a large assembly file.

Phantom components have the following characteristics:

- They are ignored by the BOM.
- They are included in assembly mass calculations.
- They are not numbered and are not directly included in quantity calculations.
- They influence the participation of their children in the BOM by promoting them in Structured BOM views. The children of a Phantom component are treated as siblings to the phantom component siblings, even though from a model structure standpoint, they are not.

When a parent component is phantom, and it has children that are normal, purchased, or inseparable, then:

- The BOM promotes the children in structured views to a higher level than their model structure dictates.
- The quantity of promoted child components is multiplied by the quantity of phantom parent components.
- The promoted child components are combined with any other matching components at that same assembly level.
- The order, sorting, and numbering of promoted child components is determined as if they were at the promoted level.
- If multiple phantom parent components exist, children are promoted until they reach a level where the parent is not phantom.
- Note: If a parent component has the BOM Structure set to Normal, and all its children are phantom (or reference), then the parent is not displayed in a parts-only parts list.

Excessive Components

Strategy for reducing them

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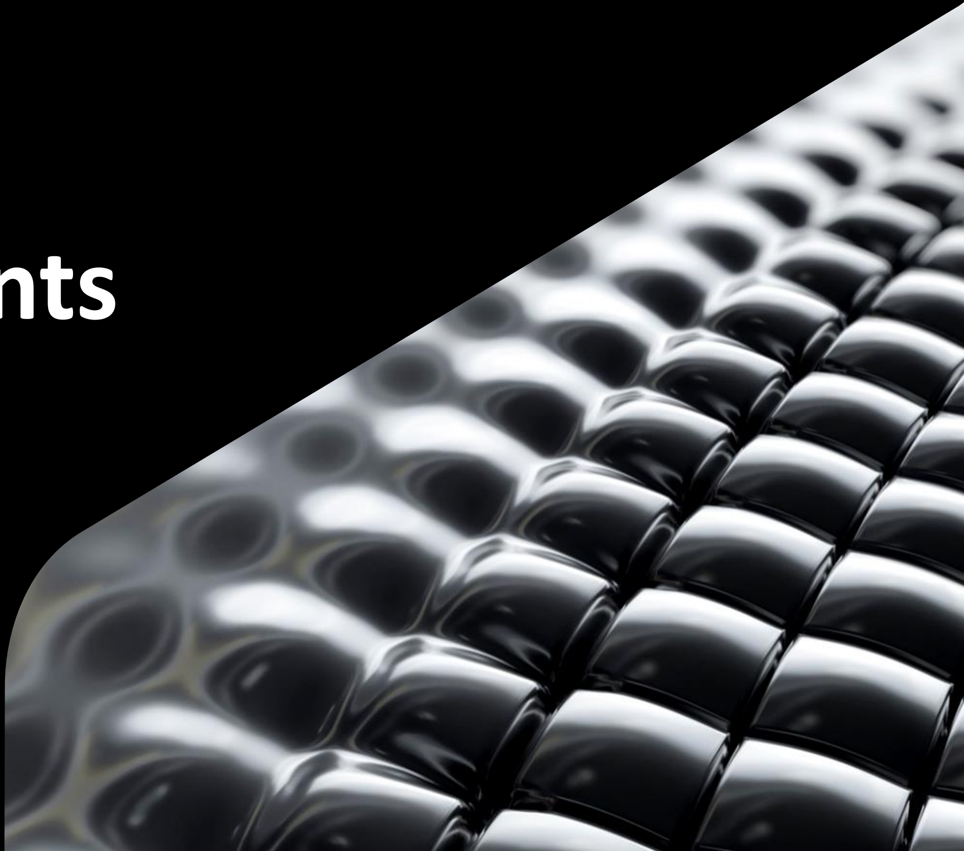
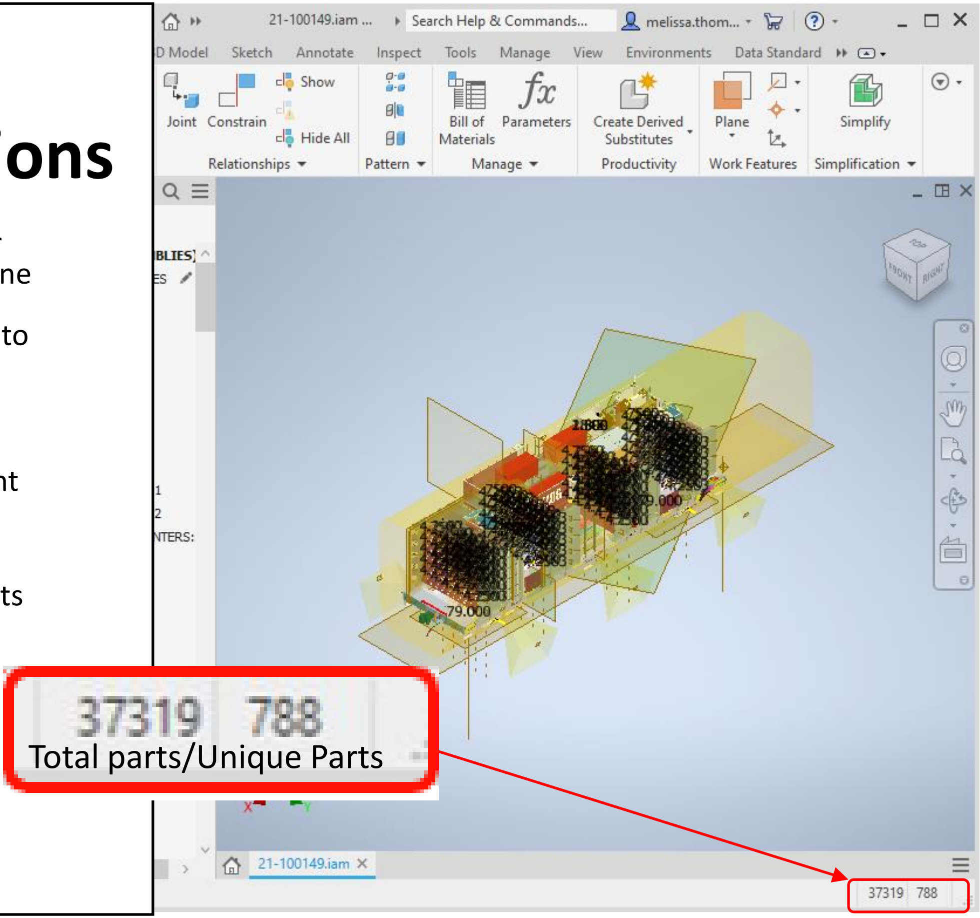
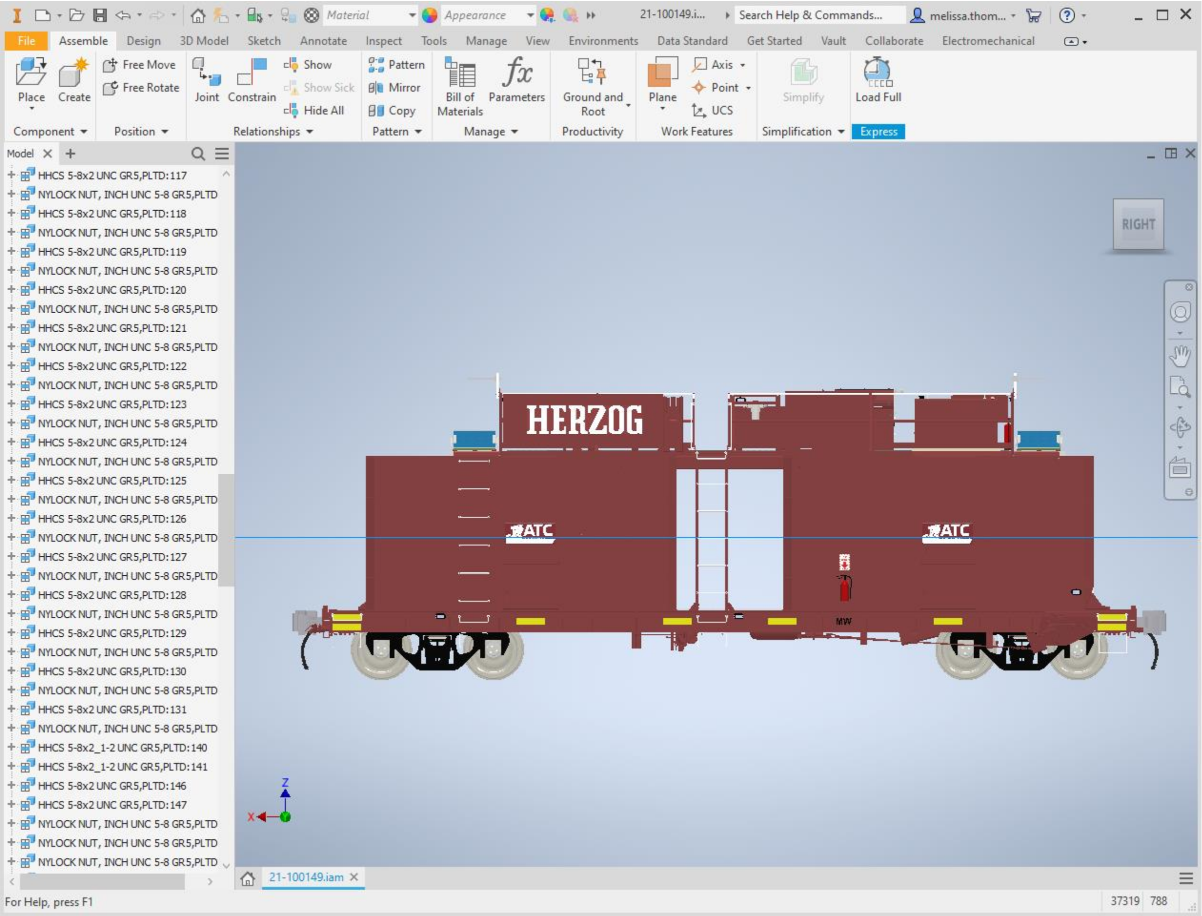


Hardware Considerations

- For purchased or standard components consider not placing hardware parts at all, or only place one instead of many. Quantity overrides can be performed on the Bill of Materials and Parts List to accurately capture the required number of fasteners and other hardware in a design.
- If you need component presence, use component patterns to reduce component count.
- You can reduce the number of visible components with the use of View Representations.
- You can create a Model View with the Hardware Suppressed.





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Get Started
Vault
Collaborate
Electromechanical
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Hide All
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Mirror
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Bill of Materials
Parameters
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UCS
Simplify
Load Full
Component
Position
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Pattern
Manage
Productivity
Work Features
Simplification
Express
Model
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NYLOCK NUT, INCH UNC 5-8 GR5,PLTD
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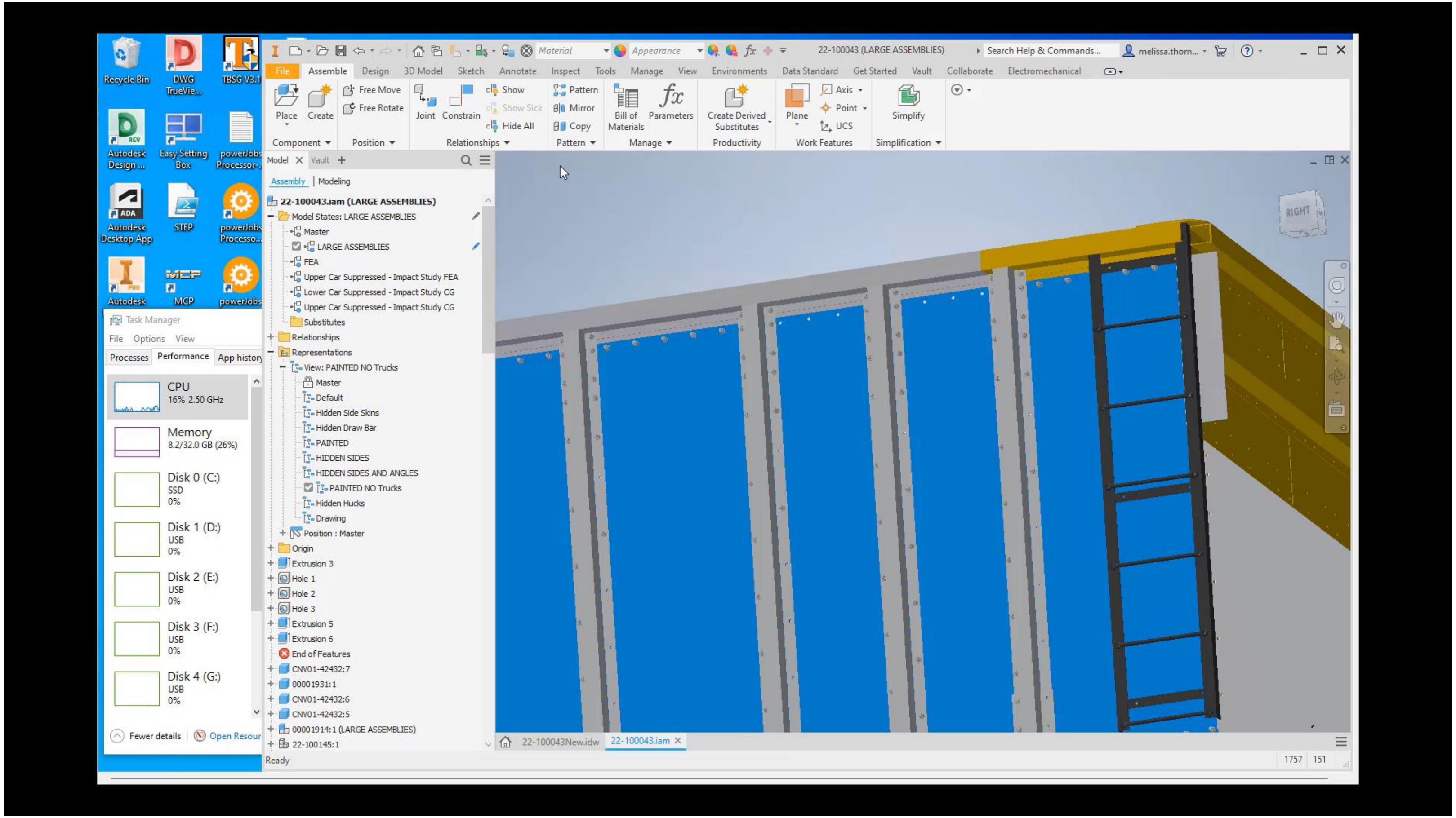
Using Selection Filter to Suppress Components



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Representations

Strategy for using View and Position Representations

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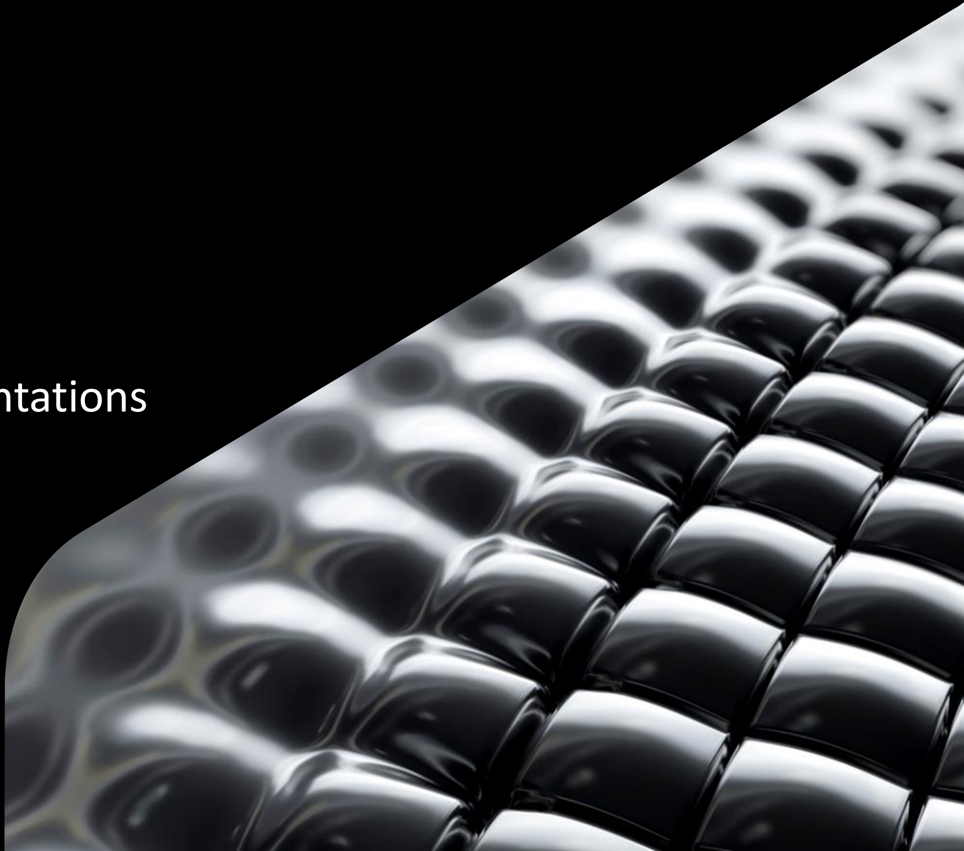
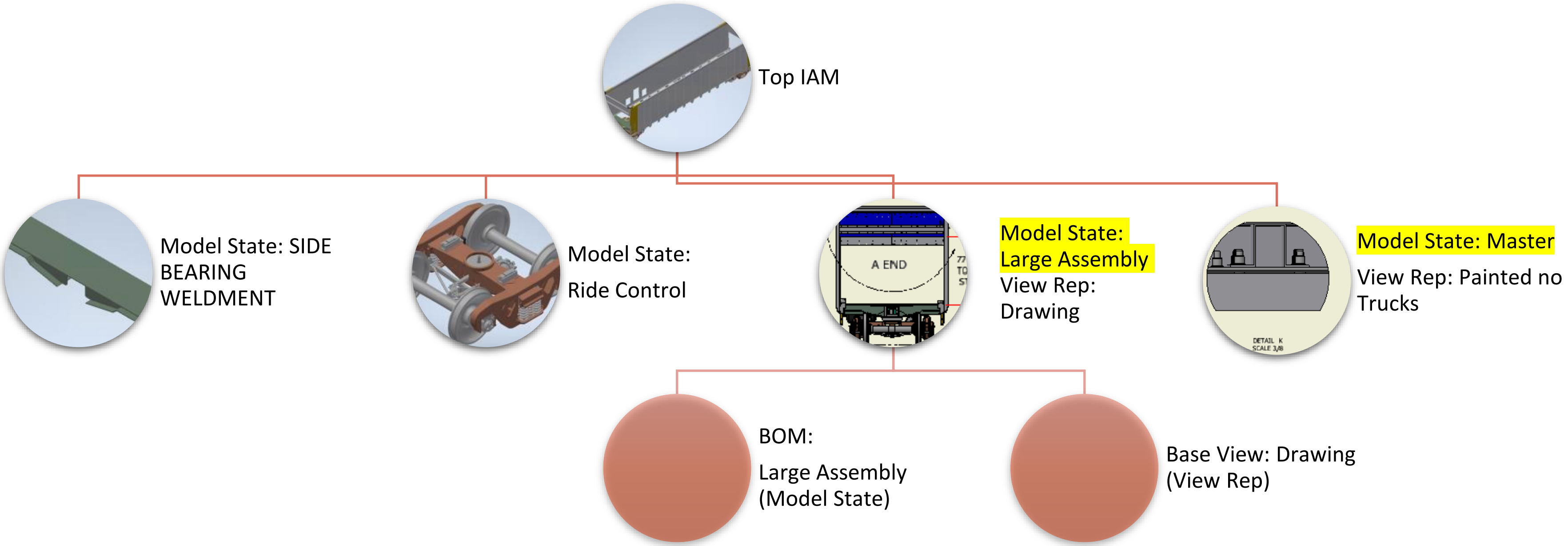


How will the assembly be used in the future

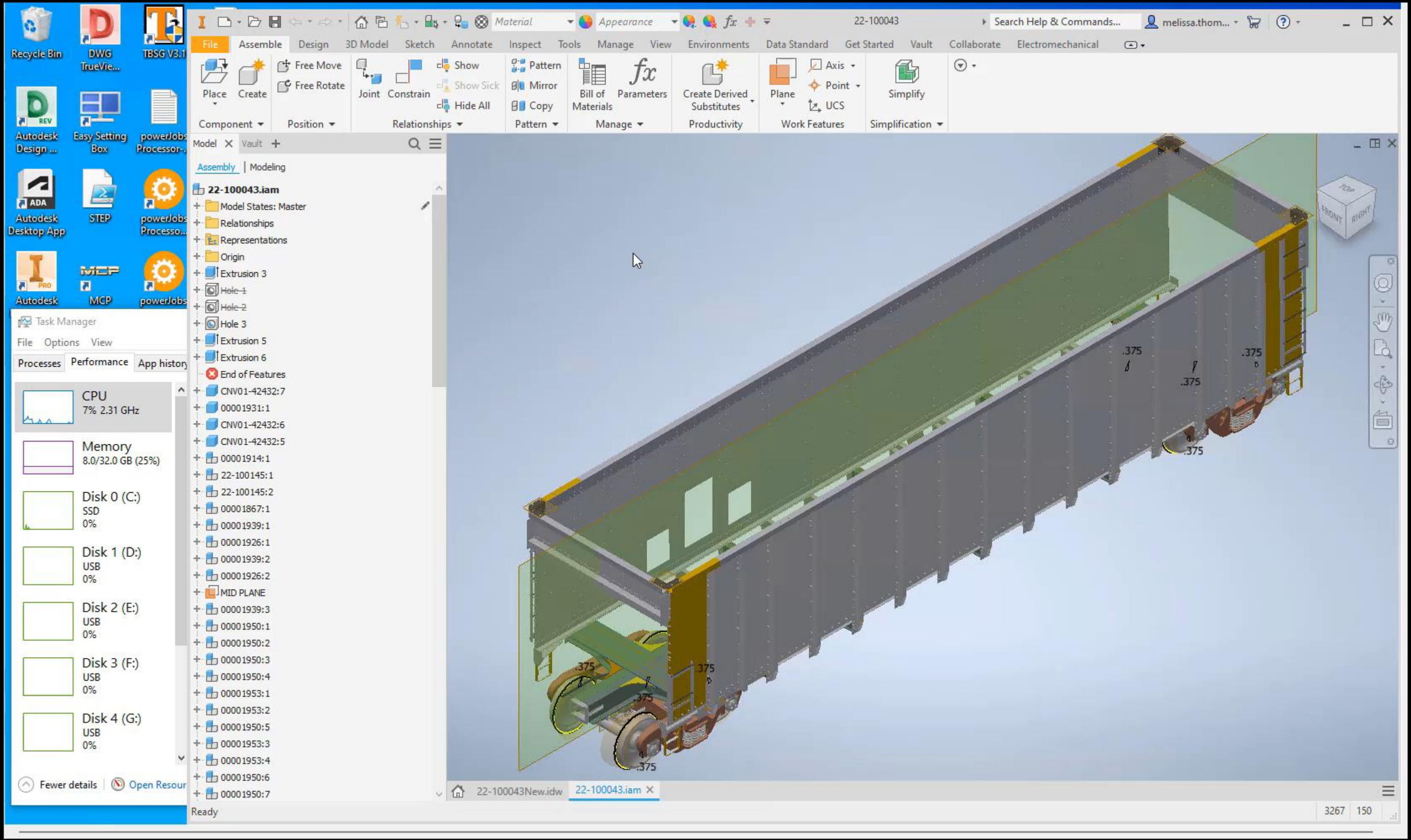
Think about what you will change in the future and build your assembly with this in mind



Representations

Aka View Representations

- They store a component's current state when the view is created, edited, and saved
- Note: Must save after creation for your changes to show
- It saves the **component visibility**, **work feature visibility**, selection status, camera state, viewing angle and subpart and subassembly view representations
- Only loads parts needed for the view
- Caution: If you move from one representation to another, Inventor will load more based on the views to the point that you negate the time saved not doing a full load
- Tip: to unload unnecessary components, close the document and reopen it with the specific view representation



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Data Standard
Get Started
Vault
Collaborate
Electromechanical
Place
Create
Free Move
Free Rotate
Joint
Constrain
Show
Show Sick
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Pattern
Mirror
Copy
Bill of Materials
Parameters
Create Derived Substitutes
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Axis
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UCS
Simplify
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Hole 1
Hole 2
Hole 3
Extrusion 5
Extrusion 6
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22-100145:1
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MID PLANE
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Memory
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SSD
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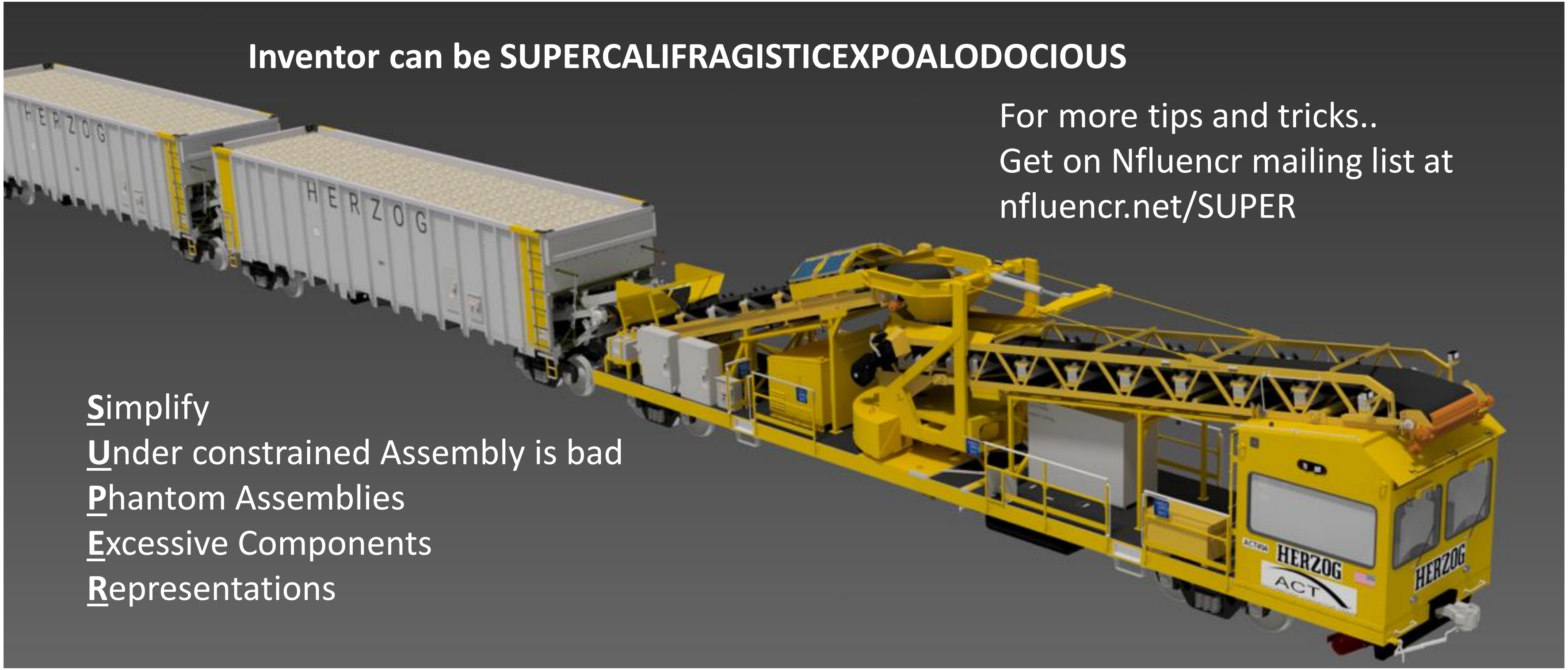
SUMMARY



Inventor can be SUPERCALIFRAGISTICEXPOALODOCIOUS

For more tips and tricks..
Get on Nfluencr mailing list at
nfluencr.net/SUPER

Simplify
Under constrained Assembly is bad
Phantom Assemblies
Excessive Components
Representations

Keep it Simple Stupid

Specific

Measurable

Achievable

Relevant

Time Specific

Sin = Opp/Hyp

Cos = Adj/Hyp

Tan = Opp/Adj