

MA1577 - It's All in the (Level of) Details: Simplification Strategies for Autodesk® Inventor®

Matt Bussey

Sr. Business Consultant – Autodesk® Global Services

Class summary

Keep it simple. Easy to say, harder to do. In the exacting world of manufacturing, complete detail in a model is an absolute. However, details come with a price—performance, protection of intellectual property, and more. Can a mechanical designer have it all? This class shows you how to get all the detail you need and all the detail you don't. Starting with the concept of visual fidelity versus visual identity, we demonstrate the tools attendees need to successfully create a simplification strategy for detailed Inventor software models with minimum investment and maximum return. From advanced techniques for level of detail (LOD) use to incorporating construction geometry in your Content Center files to easily create shrink-wrapped models, this class gives you advanced tools to manage your models. If you deal with massive-sized assemblies, create BIM-ready content, or need to control intellectual property through managing the details you disclose, this class is for you.

Key learning objectives

At the end of this class, you will be able to:

- Use the principals of visual fidelity and visual identity to create a simplification strategy
- Use construction geometry in your simplification process
- Use advanced Level of Detail techniques to enable your simplification strategy
- Incorporate your simplification strategy directly into Inventor Library and Content Center files for reuse

Starting Thoughts: Assumptions for This Class

- You Know Inventor
- You Know how to create LOD's
 - Standard LOD
 - Substitute LOD (Derive & Shrinkwrap)
 - Link LOD's together
- This does not cover everything about Large Assembly Management, only simplification

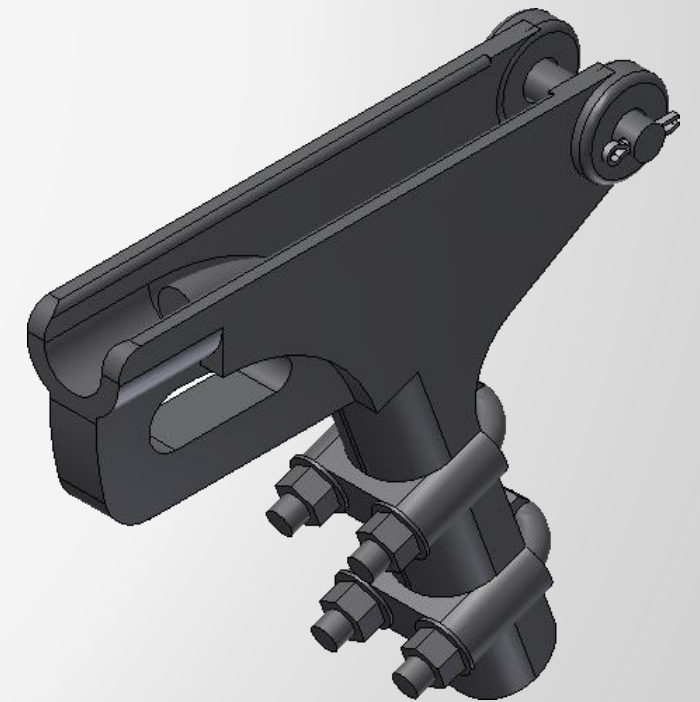
Let's see, 90 minutes,
2 minutes/slide, 473 slides...
Are you sure I only have 90
minutes?



Why Simplify?

Engineering is Exacting Detail

- You can't leave a detail out! Can you?
- It's easy to make a model "Accurate"
- But does that mean you need all of the details all the time?



There is no such thing as a fast enough computer!

So Mr. Data, I hear this new Holodeck program is a sight to behold.



Yes Captain. I have included every conceivable detail; down to the chamfer on every thread of every screw.

And exactly how long will it take to finish loading?



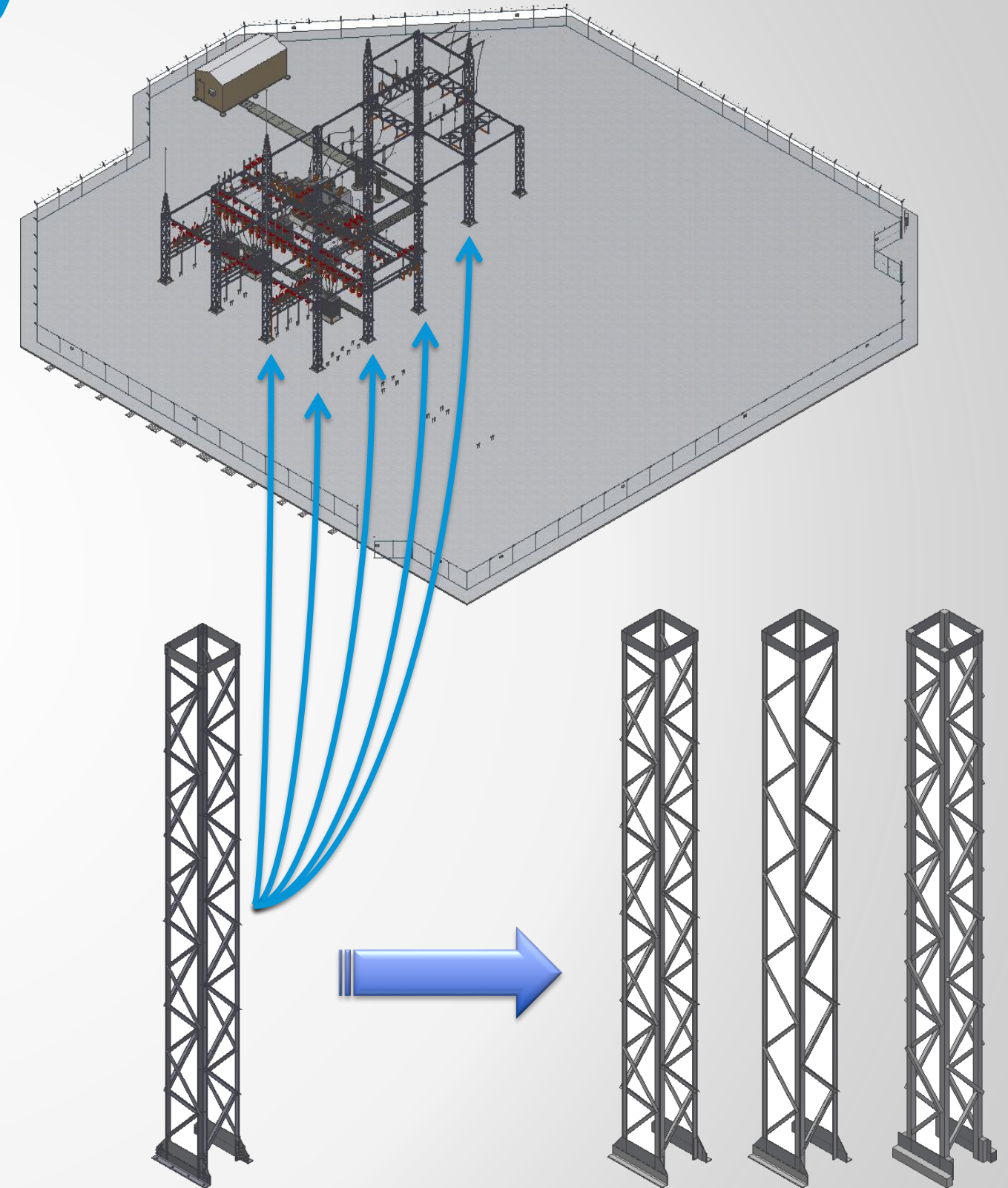
*It is currently at 17.426%...
17.427%...
17.428%...*

Maybe if we add more RAM....



Real Life Example: Duke Energy

- Substation Design Model
 - 30% Design Complete
 - 1347 Unique Parts
 - 54,428 Total Parts
 - 987,740 Faces (Avg. 18 Faces/Part)
- With No Simplification:
 - Create 6 Drawing Views
 - Very good workstation
 - 23 minutes to complete! (Before Raster Views)
- Applying the techniques in this class
 - Only columns and a few other elements
 - Reduced time by almost 50%!
- ❖ Images courtesy of Duke Energy



Understanding Simplification

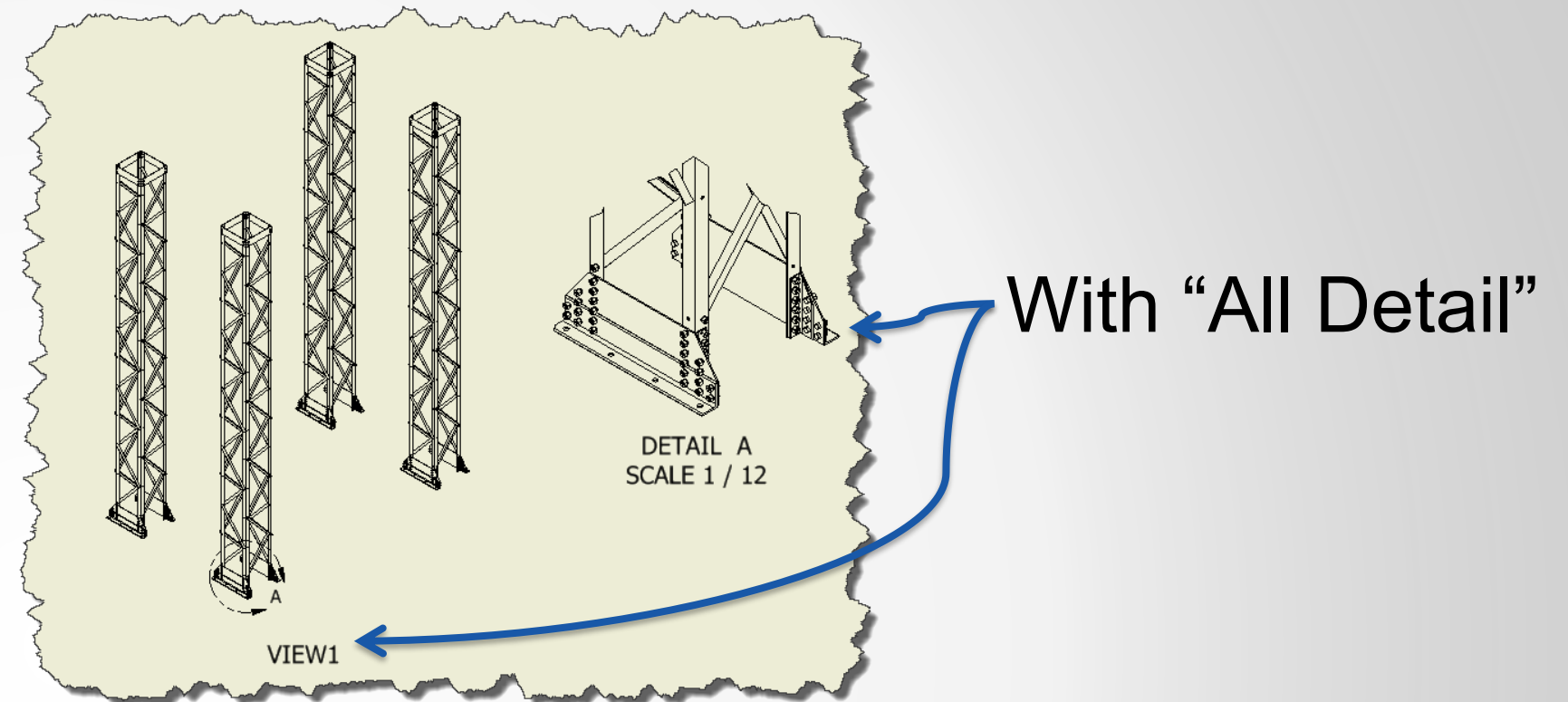
Visual Fidelity & Visual Identity

- Fidelity? – How Detailed is your model
- Identity? – Is the model understood correctly and fully?
- Successful Simplification balances Fidelity & Identity

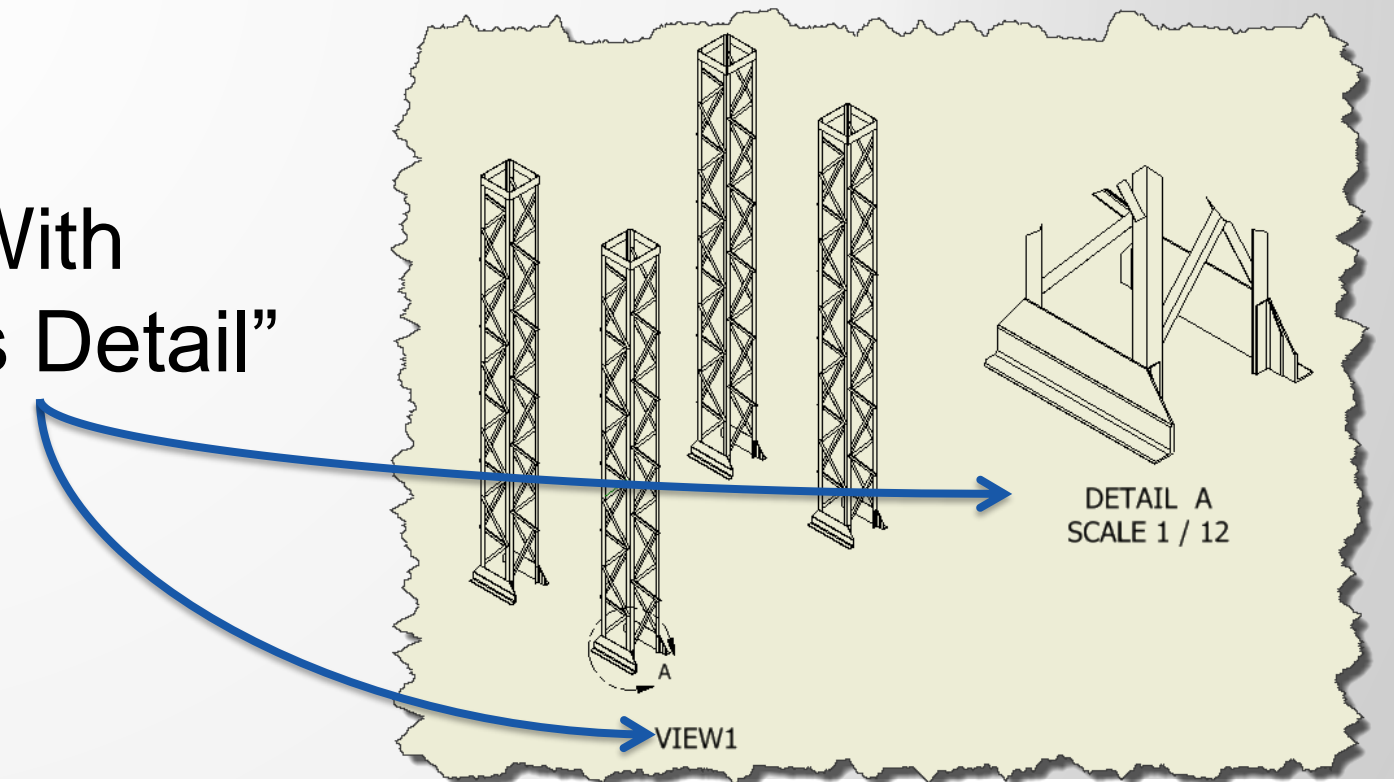


Balancing Fidelity and Identity

- Example: Drawing of a bolted column
- View 1: Full Detail is Lost
- Detail A: Missing detail is noticed

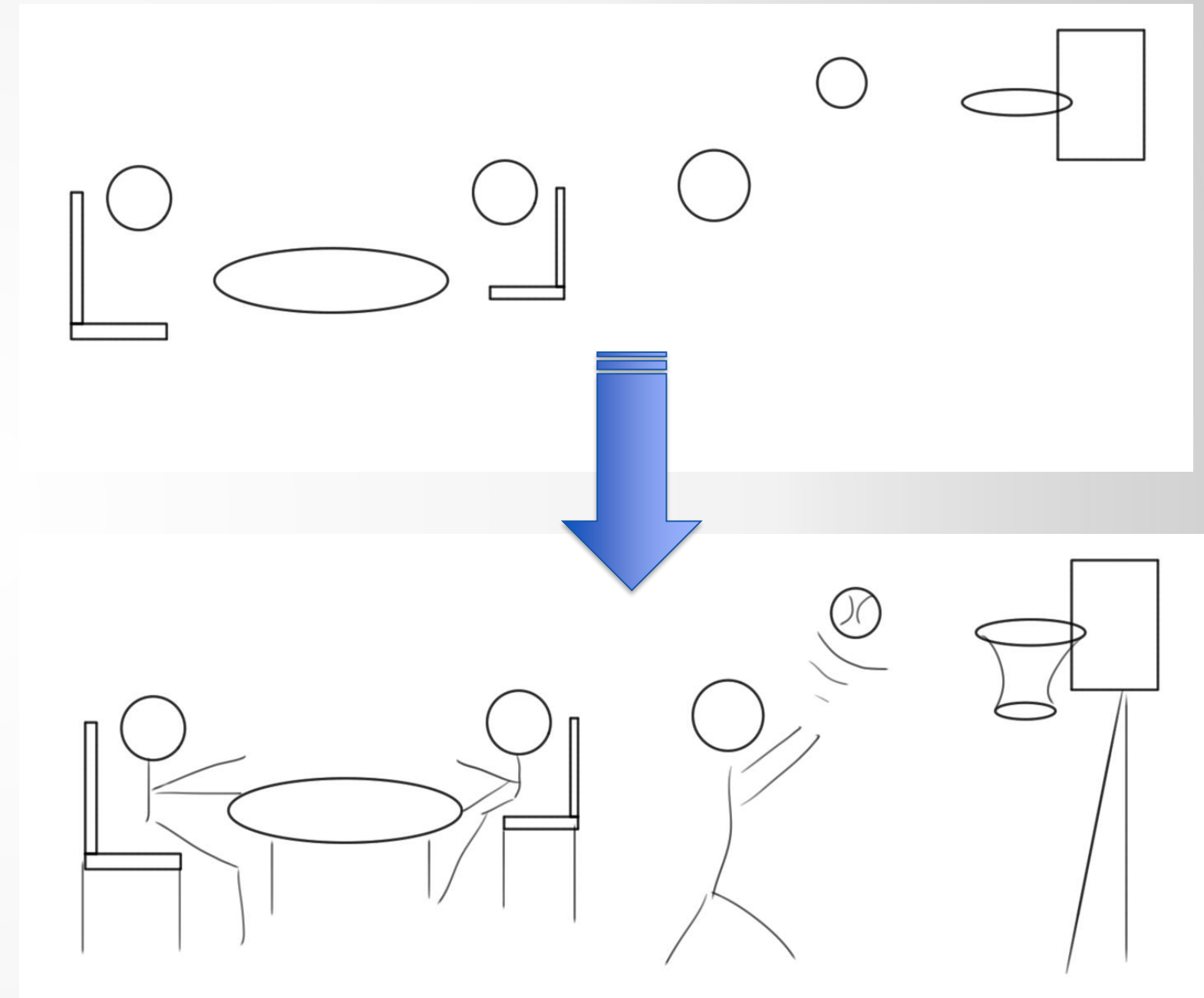


With
"Less Detail"



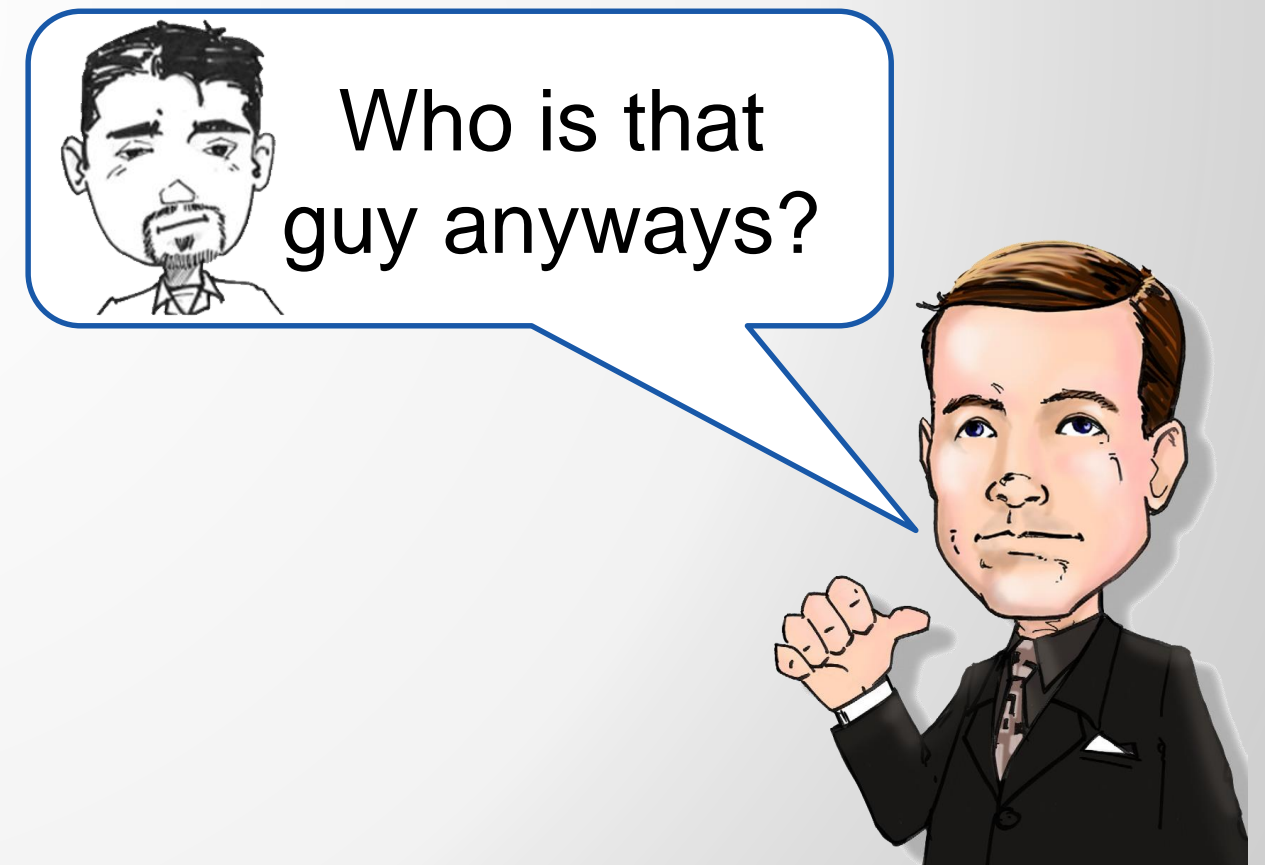
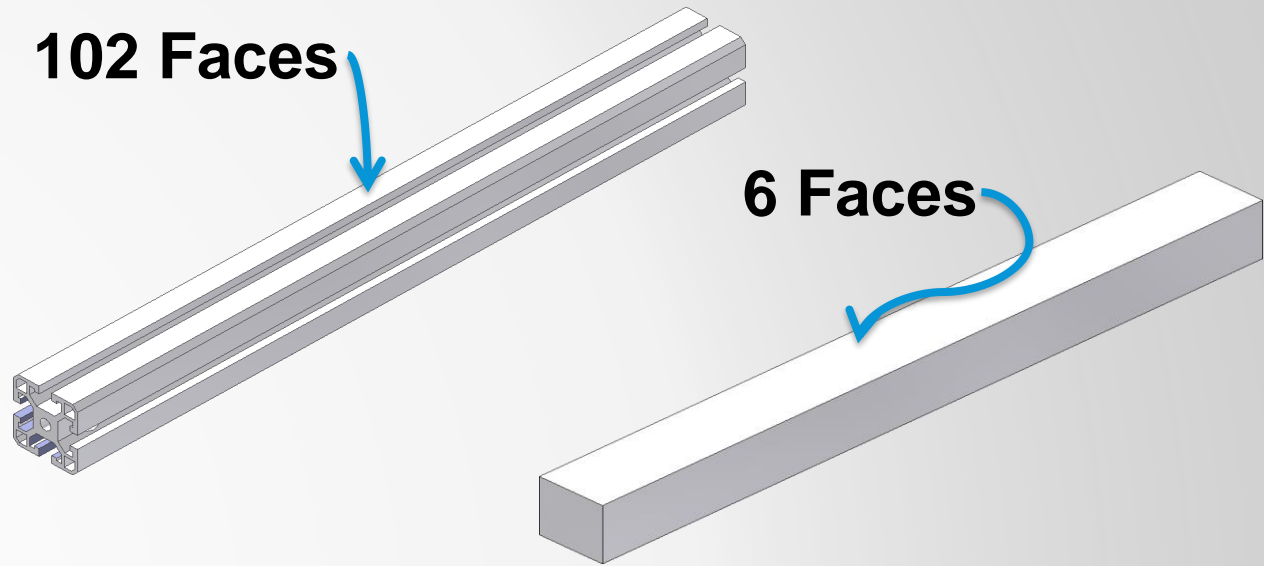
Balancing Simplification: Context & Audience Matter

- Simple geometry needs context
- Context can be Audience Dependent
- Set context based rules to help your strategy



Quick Thoughts: Faces are the Real Battlefield

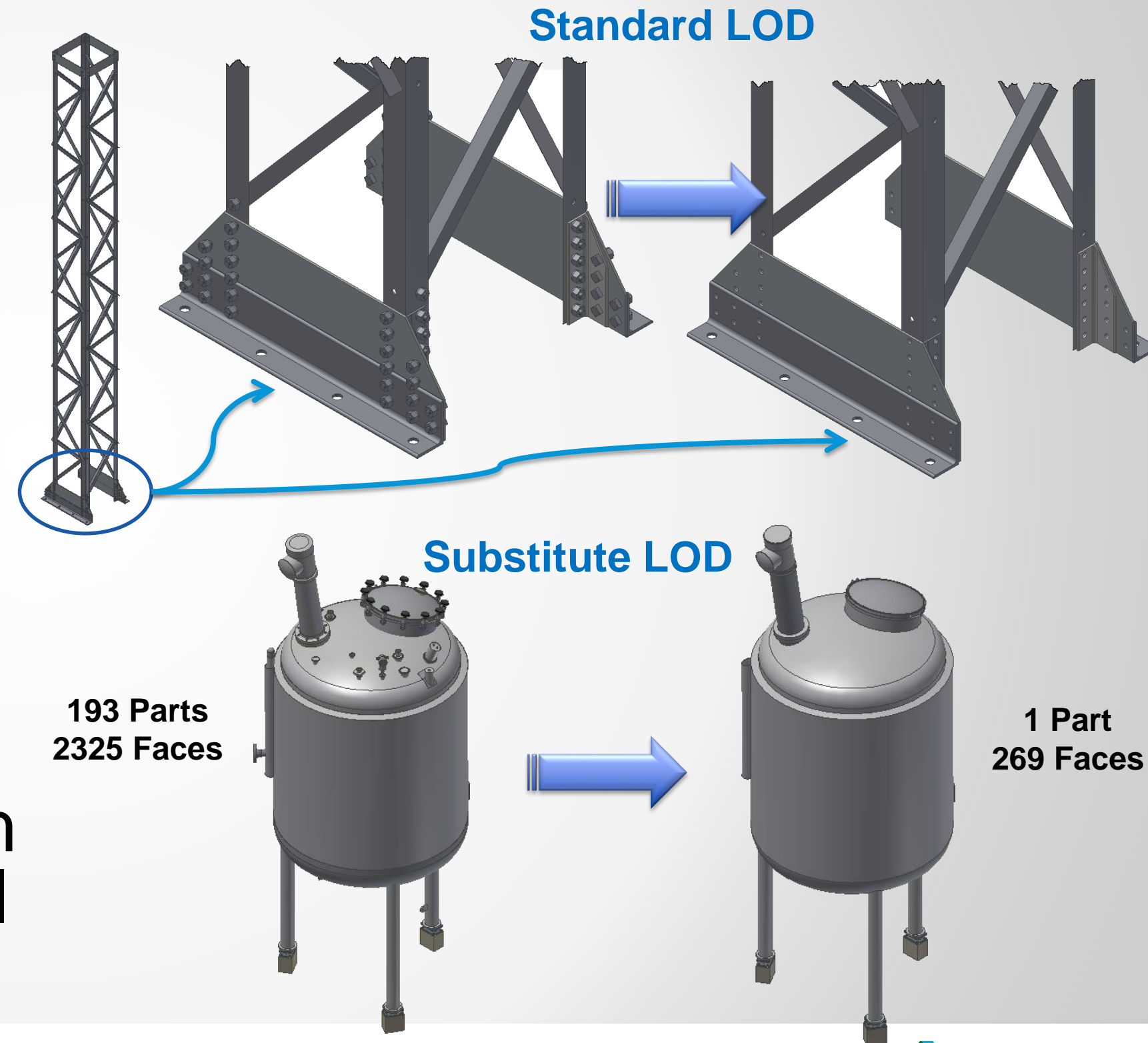
- More Geometry = More Memory
- Geometry = Faces and Edges
- Simplification = Reduce(Faces)



Inventor Simplification Paradigms

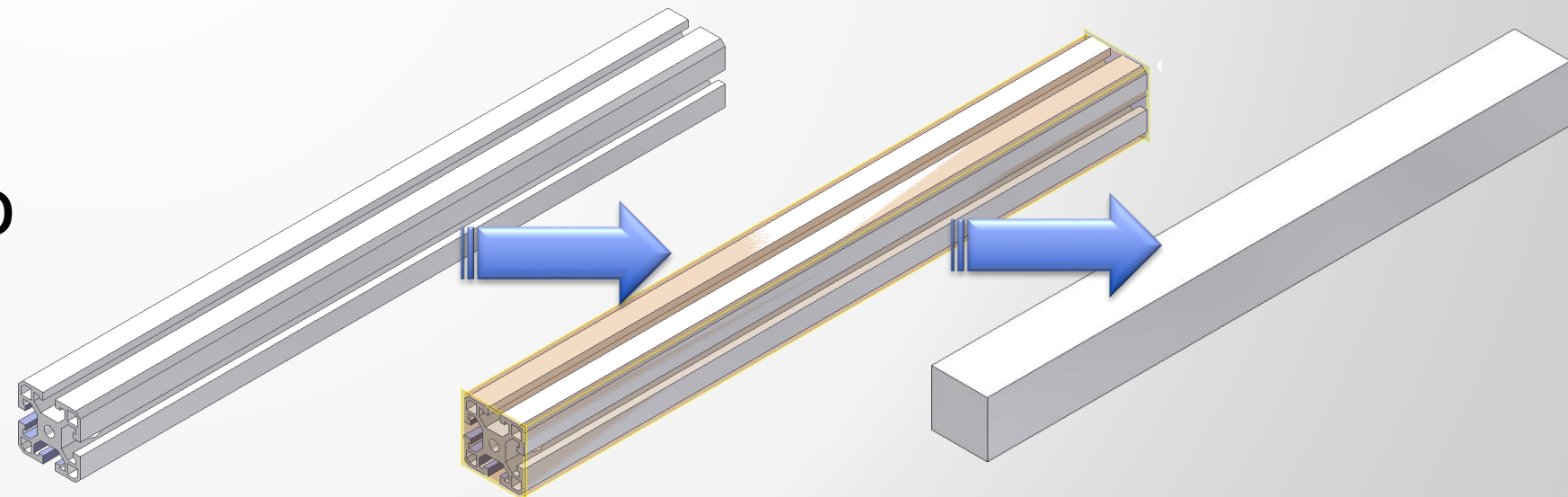
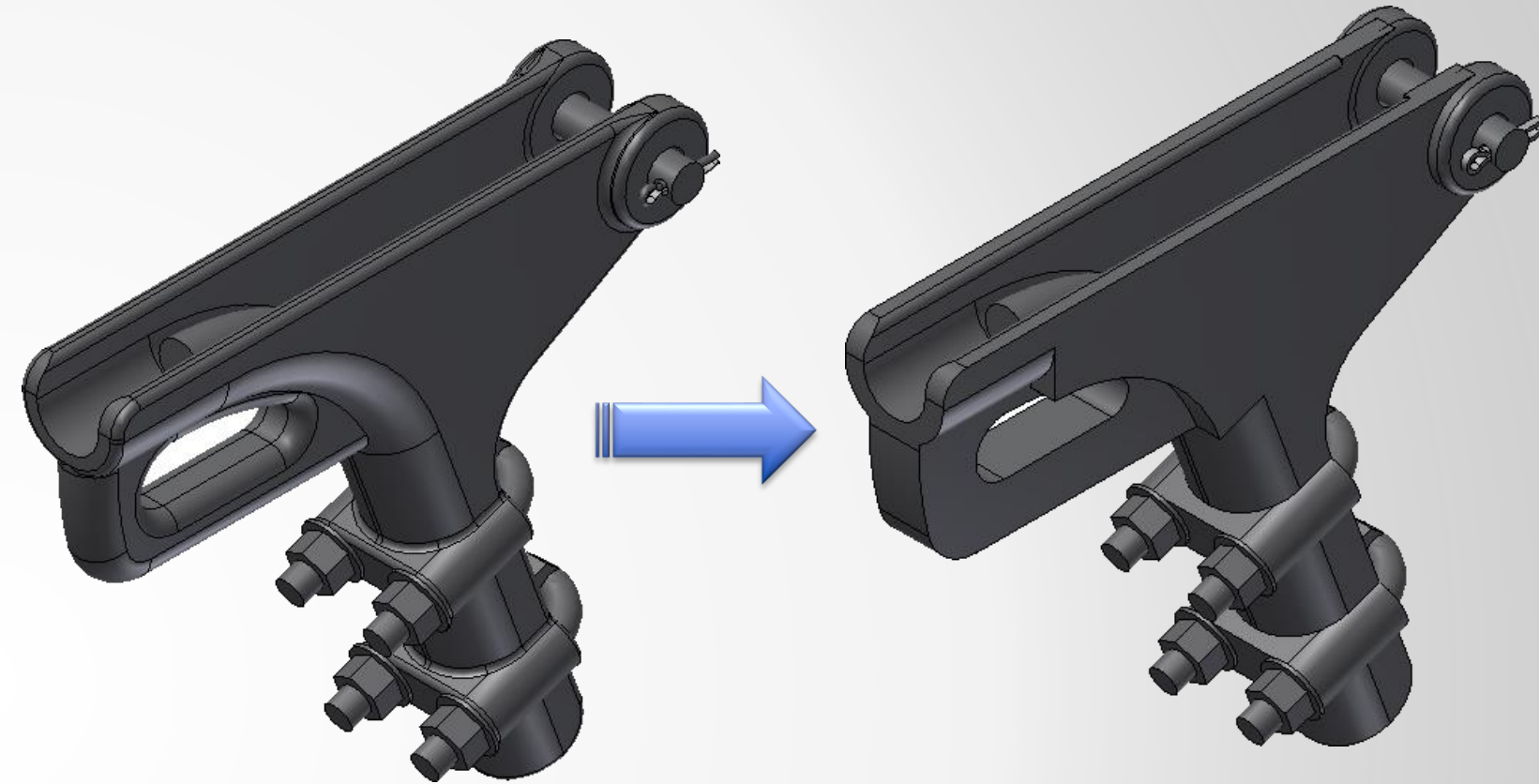
Assemblies: Level of Detail Representations (LOD)

- LOD's manage memory by removing detail
- Option 1: Standard LOD - Remove components from memory
- Option 2: Substitute – replace all components with a single, simpler part model



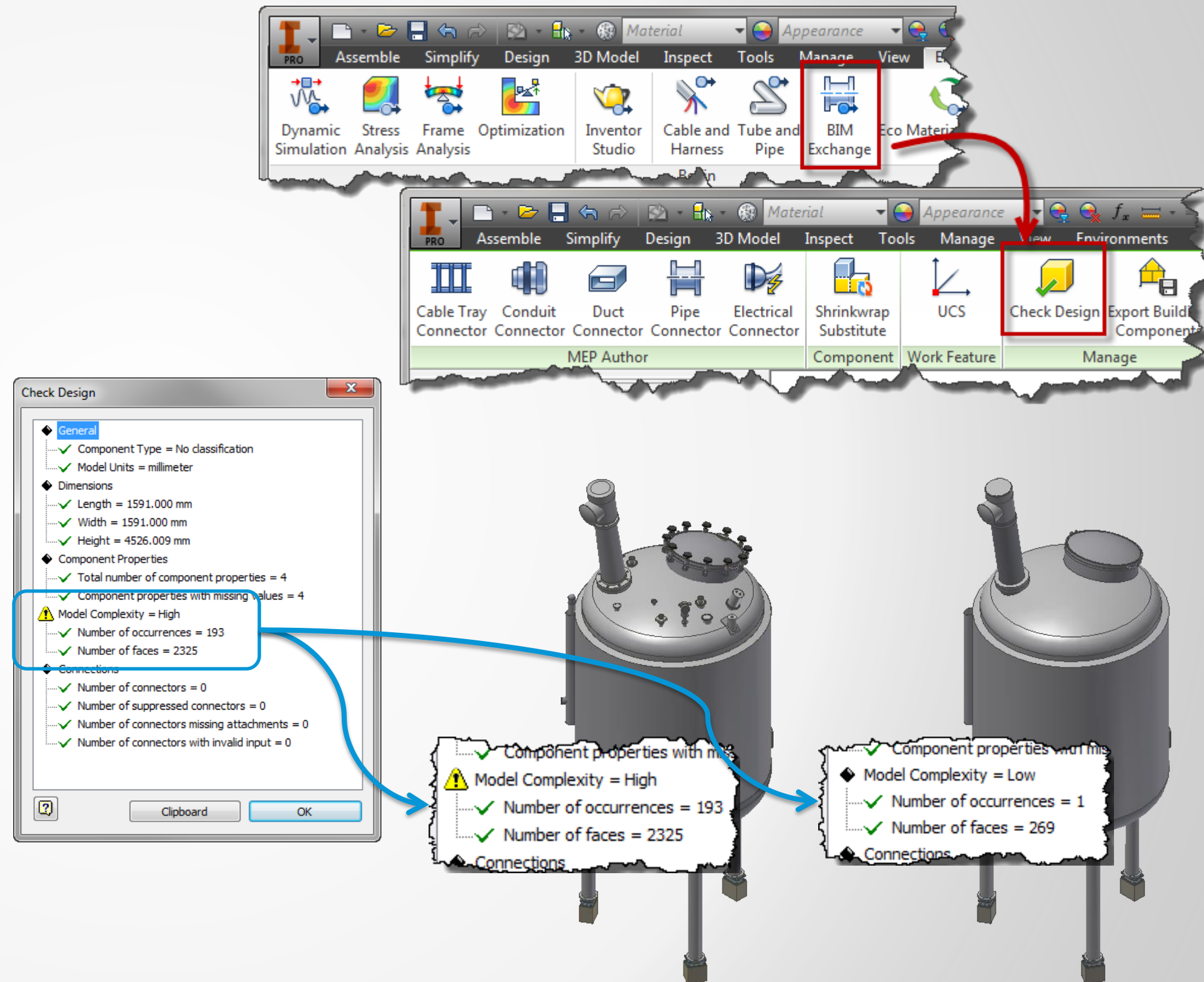
Parts: You add the details, or not

- Part files do not have formal simplification tools
- Library Parts are the best place to make an impact
- If you don't make it, don't detail it
- Use “Construction Geometry” to assist with Substitute creation (more on that later)



You be the Judge

- BIM Exchange Check Design Tool
- Use to see how well you are removing faces



Large Thoughts: The Other LAM Stuff...

- Inventor has a lot of tools for Large Assembly Management (LAM)
 - Express Mode
 - Raster Views
 - Etc.
- Don't ignore them, Explore them as well

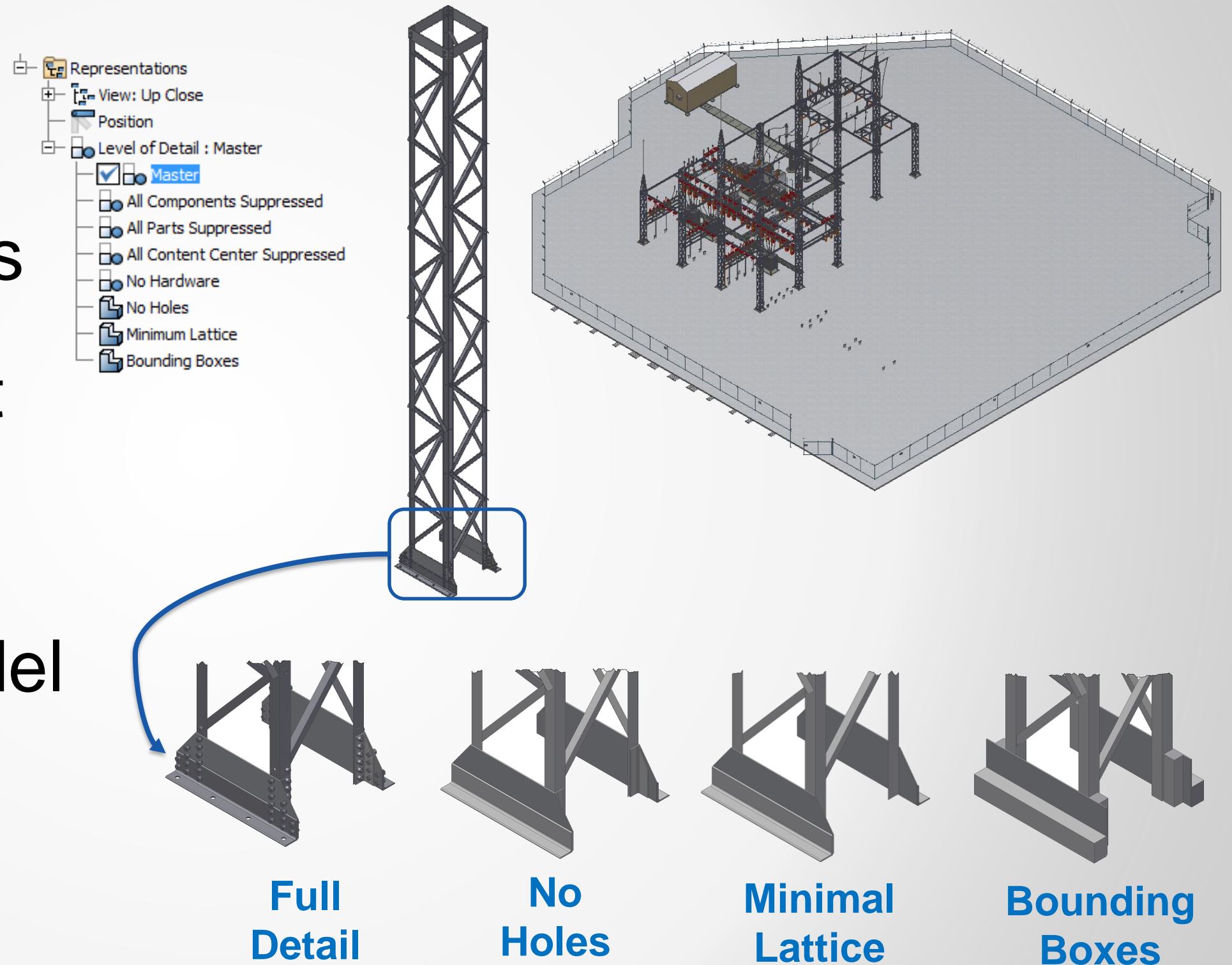
What do you mean I **only** have 90 minutes?



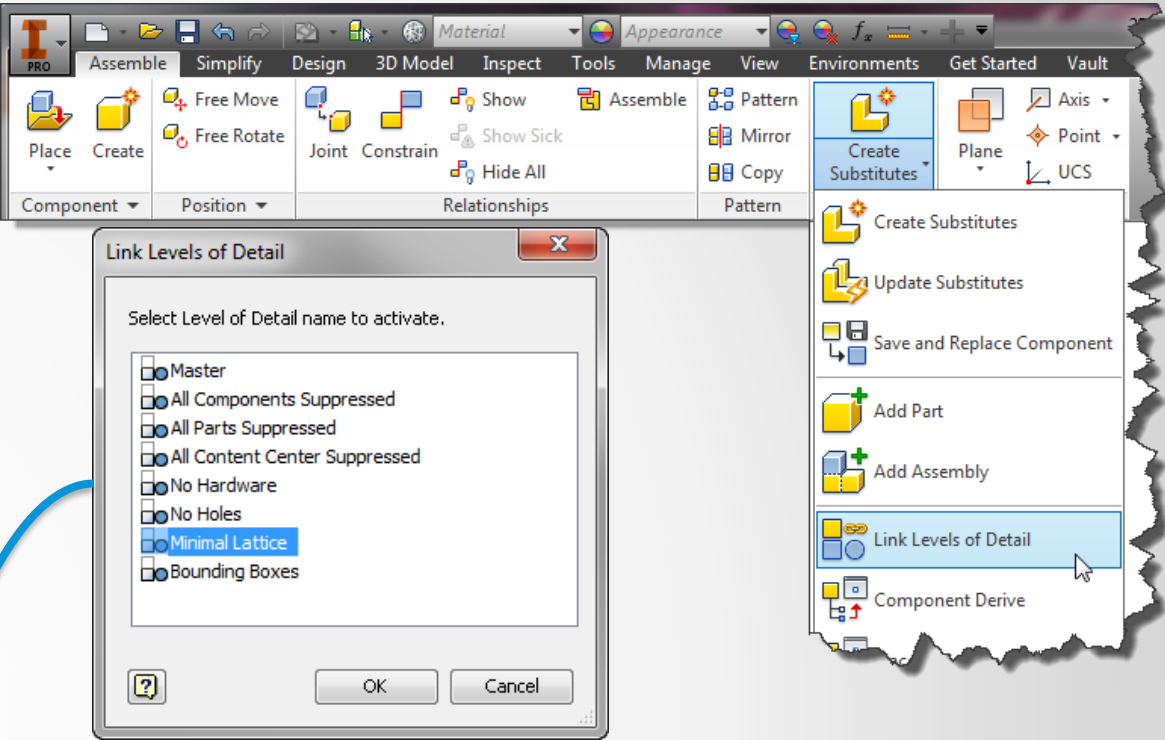
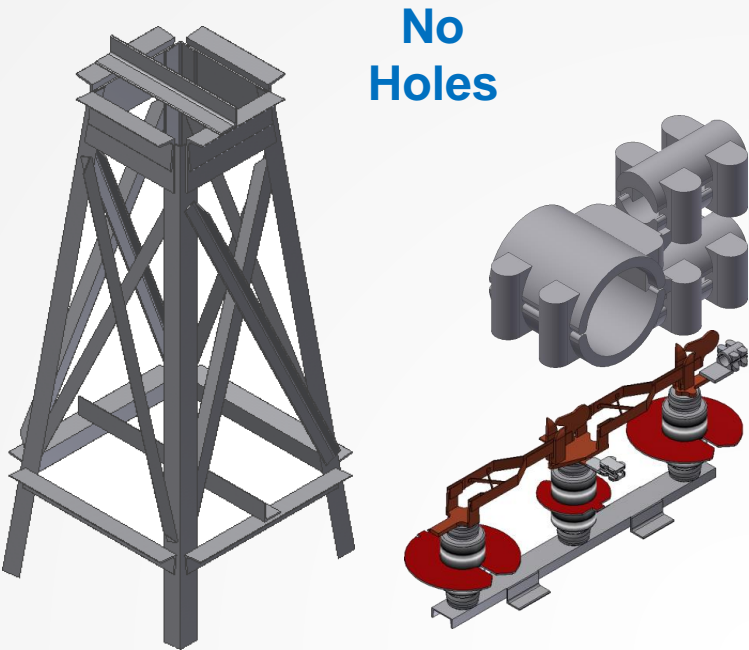
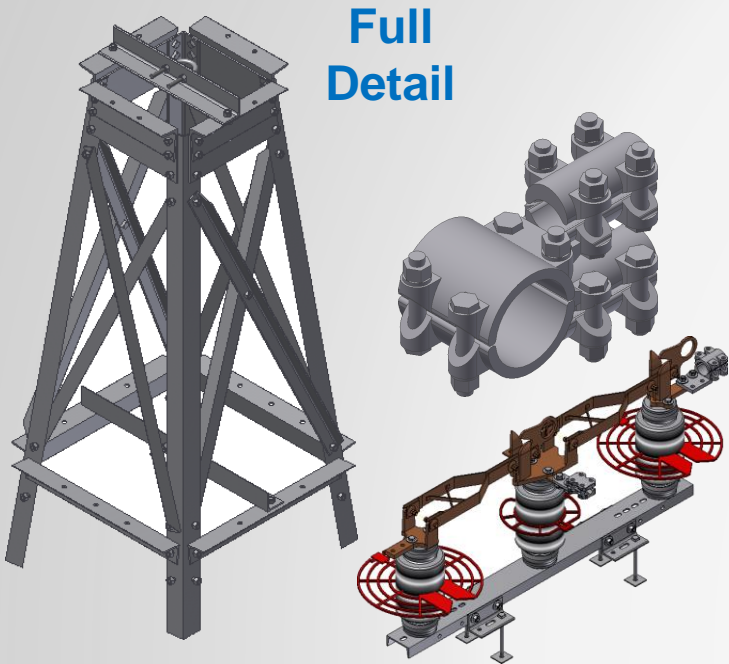
Approaches to Simplification

Bottom Up Approach: Build into Everything

- Define common Simplifications that fit your design process
- Build them into lowest reasonable level
- Tie them together at every level of the model
- Example: Substation Design

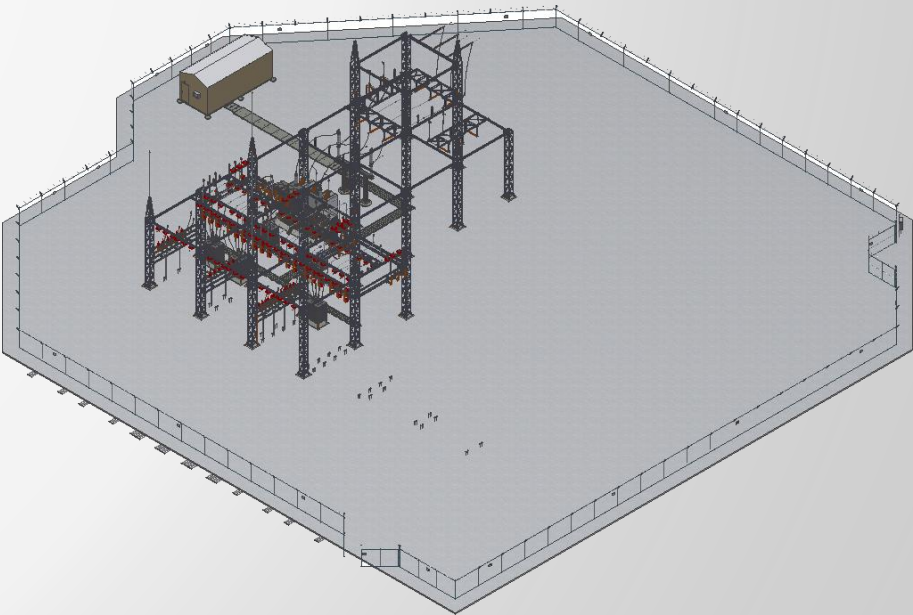
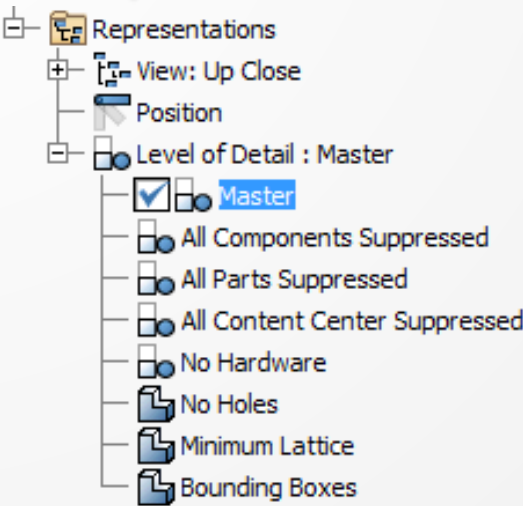
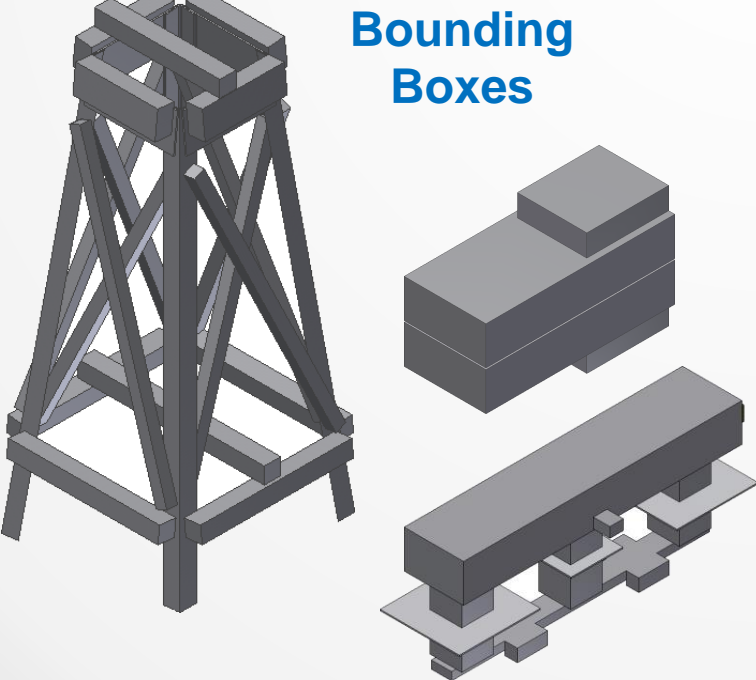


Bottom Up Approach: Typical Process



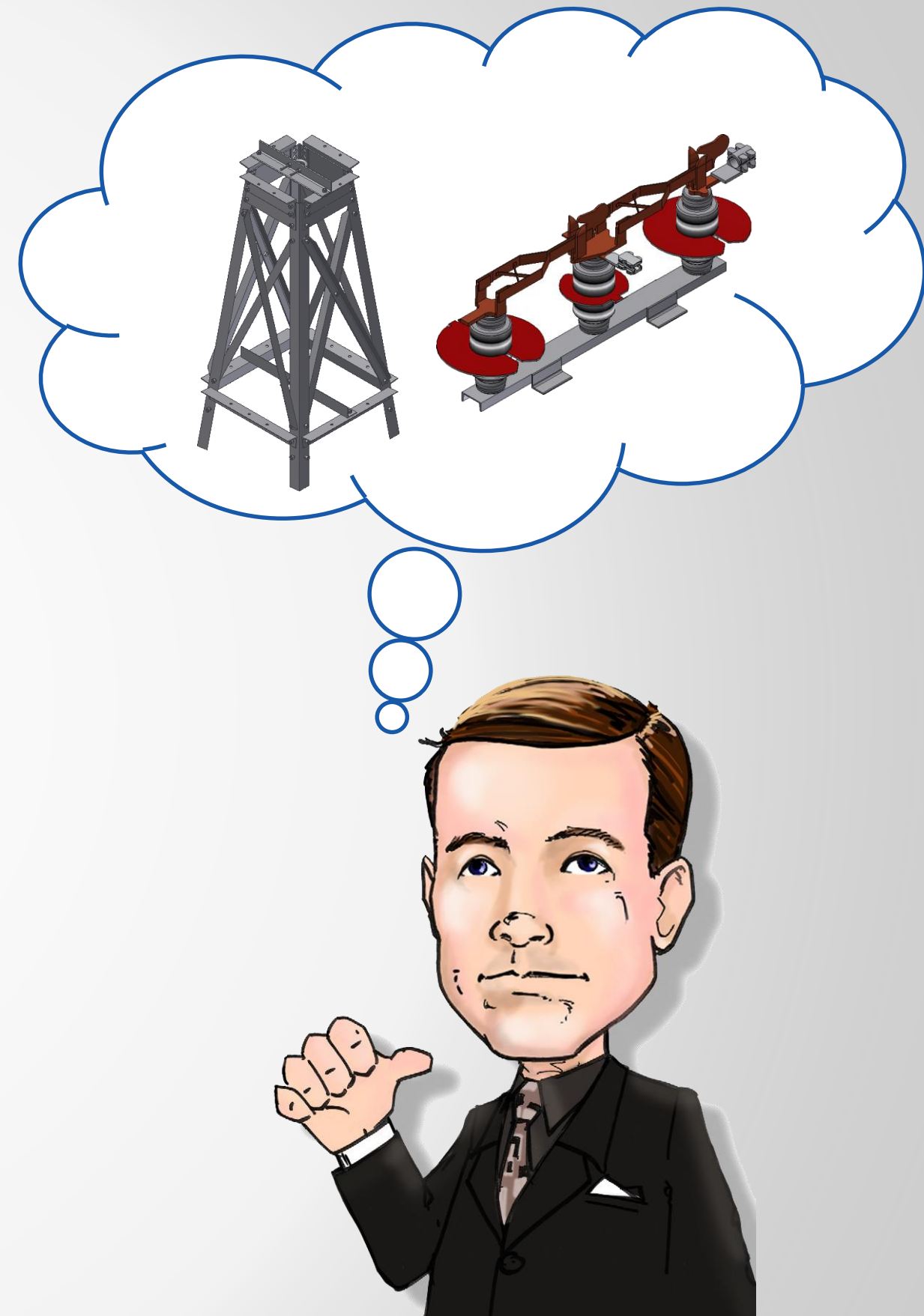
Build the Same Simplification into every Element

Tie Them Together from Bottom to Top



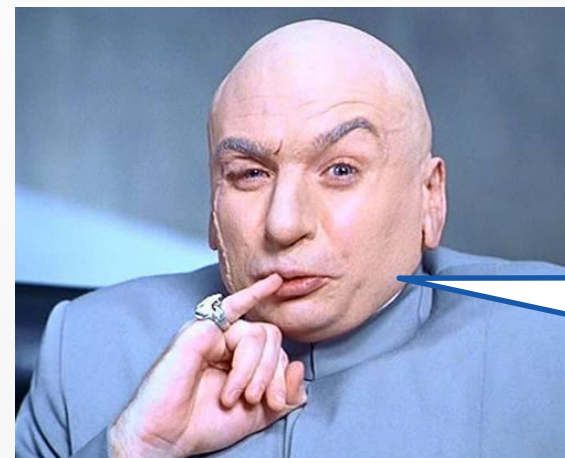
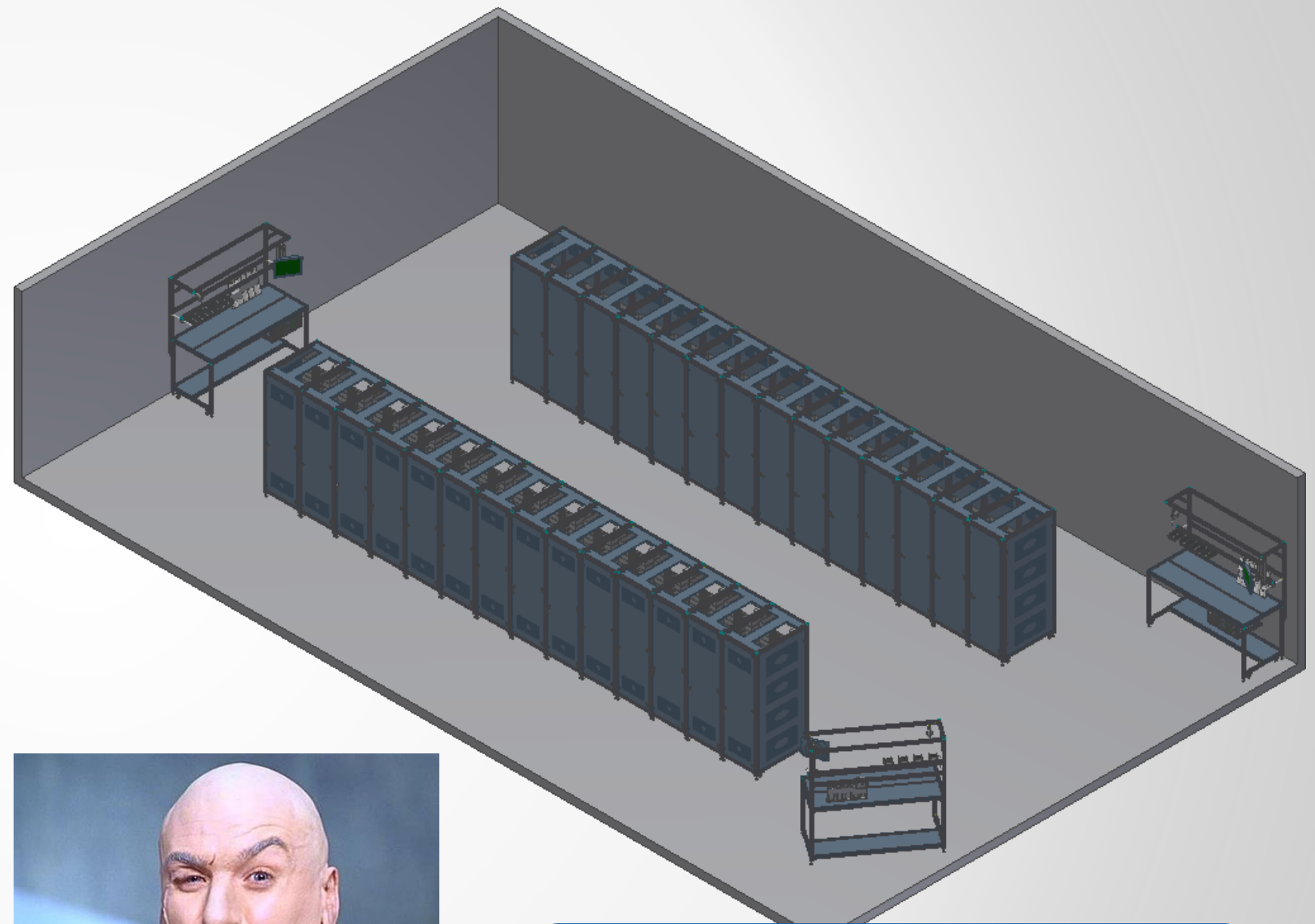
Bottom Up Approach: Thoughts

- When to take this approach?
 - Always have large assemblies
 - Work with large “library” of reusable design elements (Build once, use a lot)
 - Design work is collaborative
- Considerations for this approach
 - “Upfront” investment to plan and execute
 - Consistency: make sure everyone has a plan to create and manage the same way



Top Down Approach: Only When “It’s A Problem”

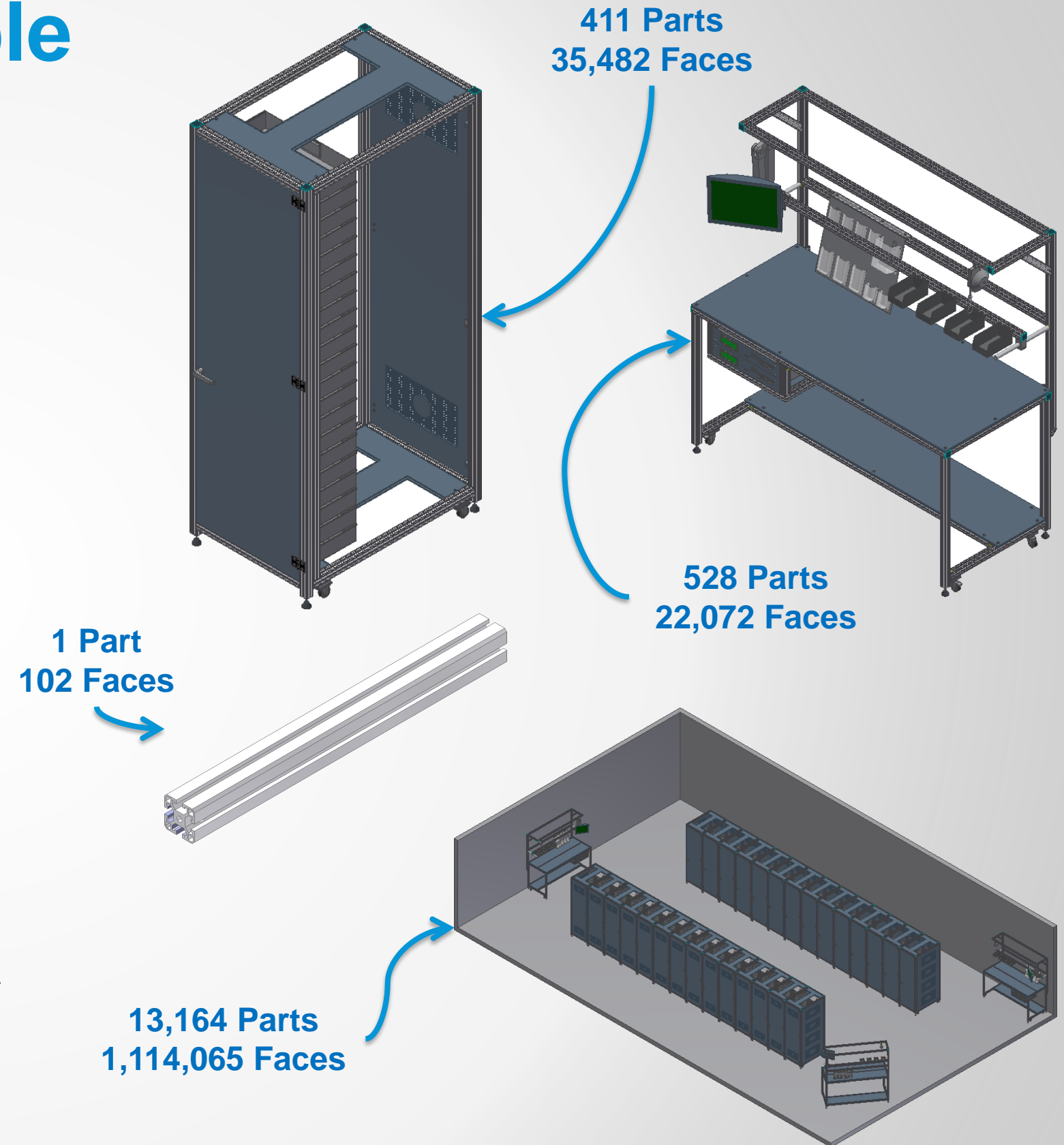
- Minimum to no up front setup in lower level assemblies
- Start tackling only when you get to the point that you “have a problem”
- Use “Fast Tricks” like select all small stuff and suppress



My Design has
One...MILLION Faces!!

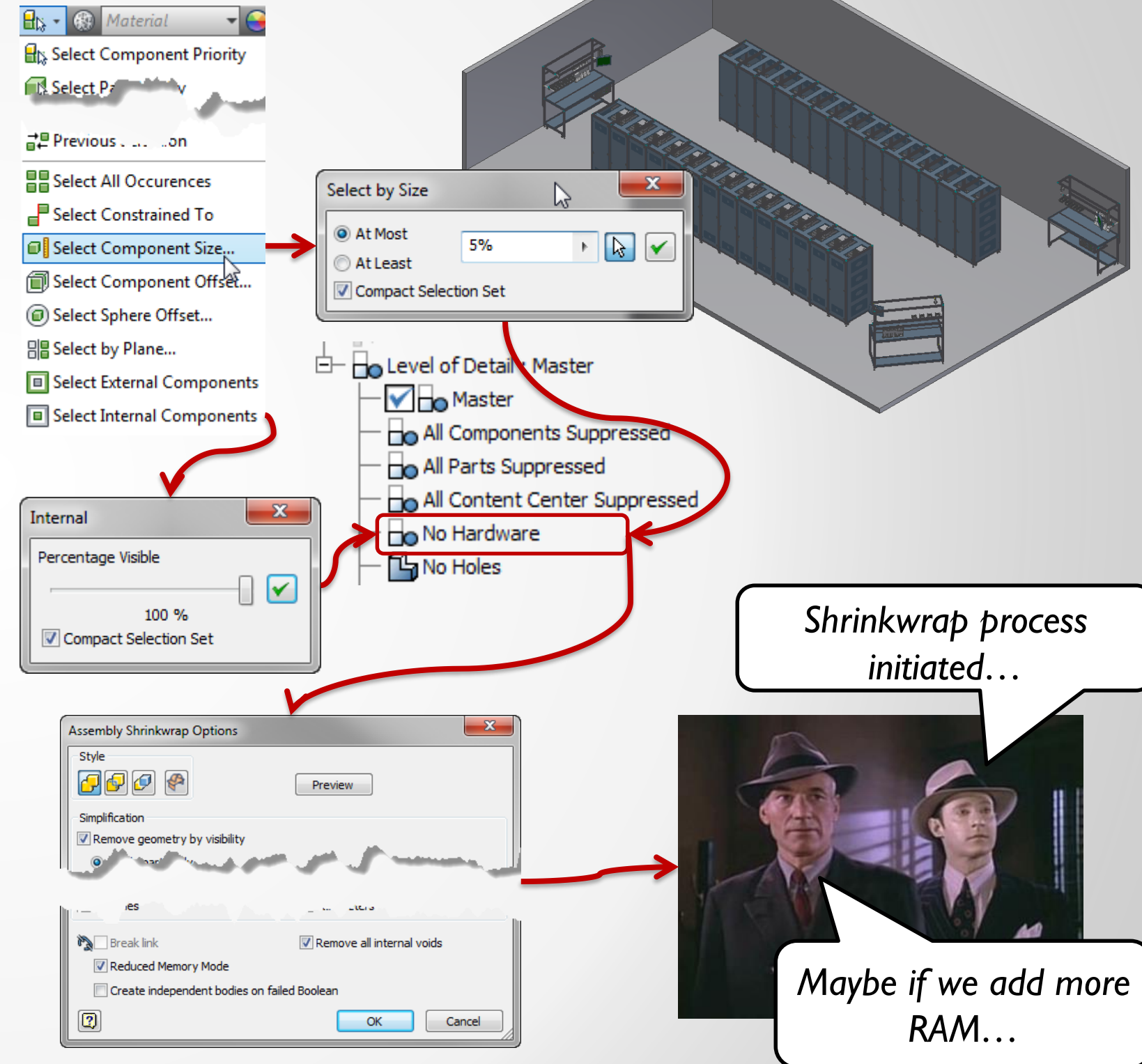
Top Down Approach: Example

- Company makes Rack Mount Enclosures and Test Benches
 - Has 1000's of catalog items (Unit Level)
 - Use T-Slot Extrusions for Flexibility (Complex Part – Lots of Faces)
- 90% of time only “Unit level” assembly design
 - Single Rack, Single Test Bench
 - ROI to build in LOD's for every unit level not there
- 10%: Room layout and CFD/Thermal Analysis for Customer (Requires simplified model)



Top Down Approach: Typical Process

- Start at “Top Level” Assembly
- “Get Rid” of “stuff” via Standard LOD
 - Small Hardware, Internal Parts, Etc.
 - Use Assembly Selection tools (Select Size, Select Internal Camera, etc.)
- Create a Shrinkwrap and cross your fingers
- Go to “Lower Levels” if process at top has issues and repeat



Top Down Approach: Other Thoughts

- Top-Down is where most people start and have issues
 - Easy to “Boil the Ocean” this way
 - Can lead to frustration...
 - This doesn't mean it's a bad approach!!!
- When to take this Approach?
 - “Large Assemblies” are not the norm (“<10%” rule of thumb)
 - Well Defined Internal/External in design
 - A lot of components are “Library” and Content Center
 - Components are easy to rapidly “select” and “suppress”
- Considerations for this Approach?
 - Lower chance of reusing the work put into it
 - End results might not be as “efficient” as Bottom Up



Some Practical Simplification Techniques

My Approach: Thoughts on how I tackle LOD's

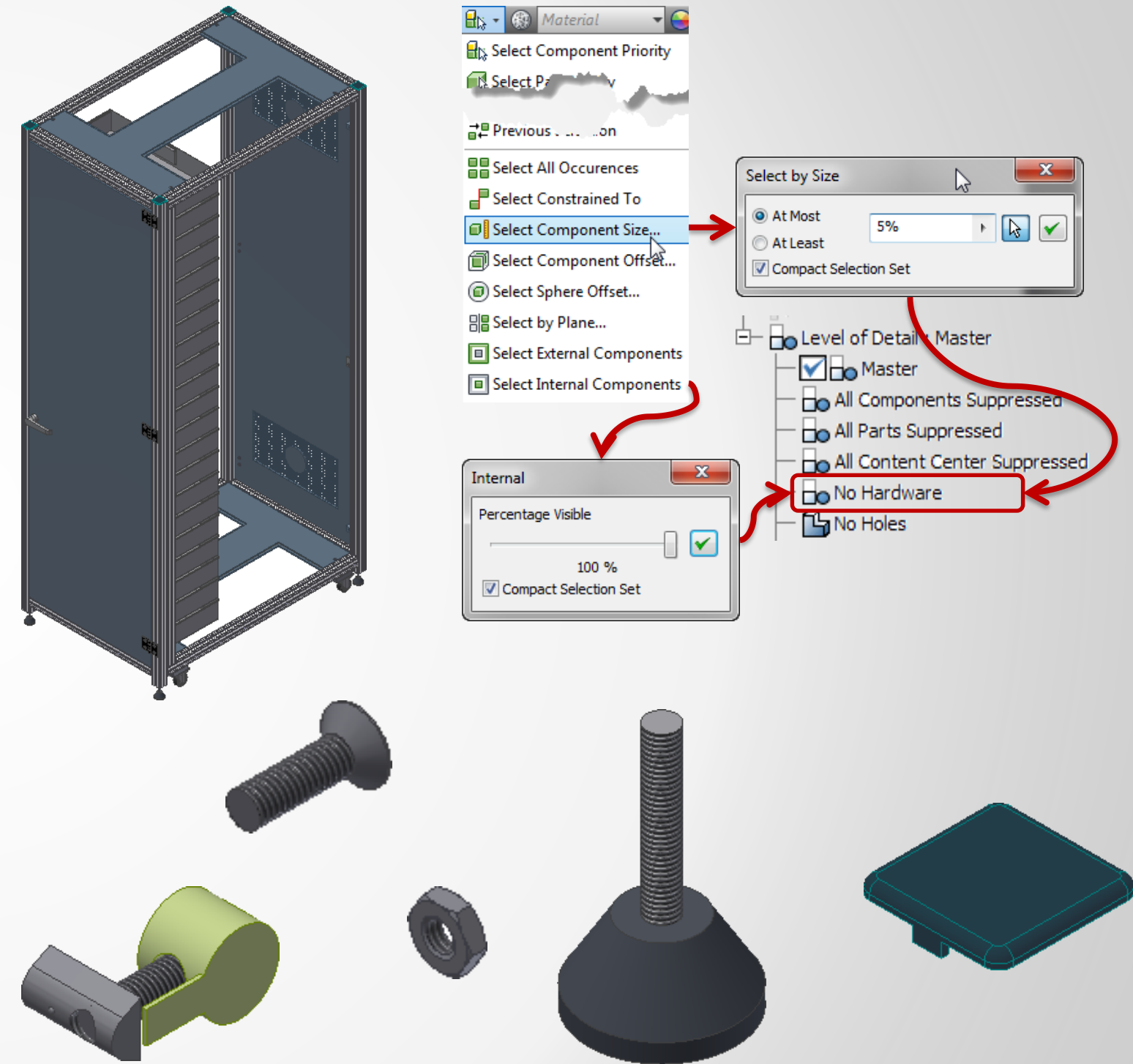
- Tag-It: make things simple to select
- Build an Easy Button: Setup elements to make my life simple later on
- Cheat: When all else fails...
- Reuse LOD's: Create ones that make sense and save them for later

This is how I tackle
Simplification



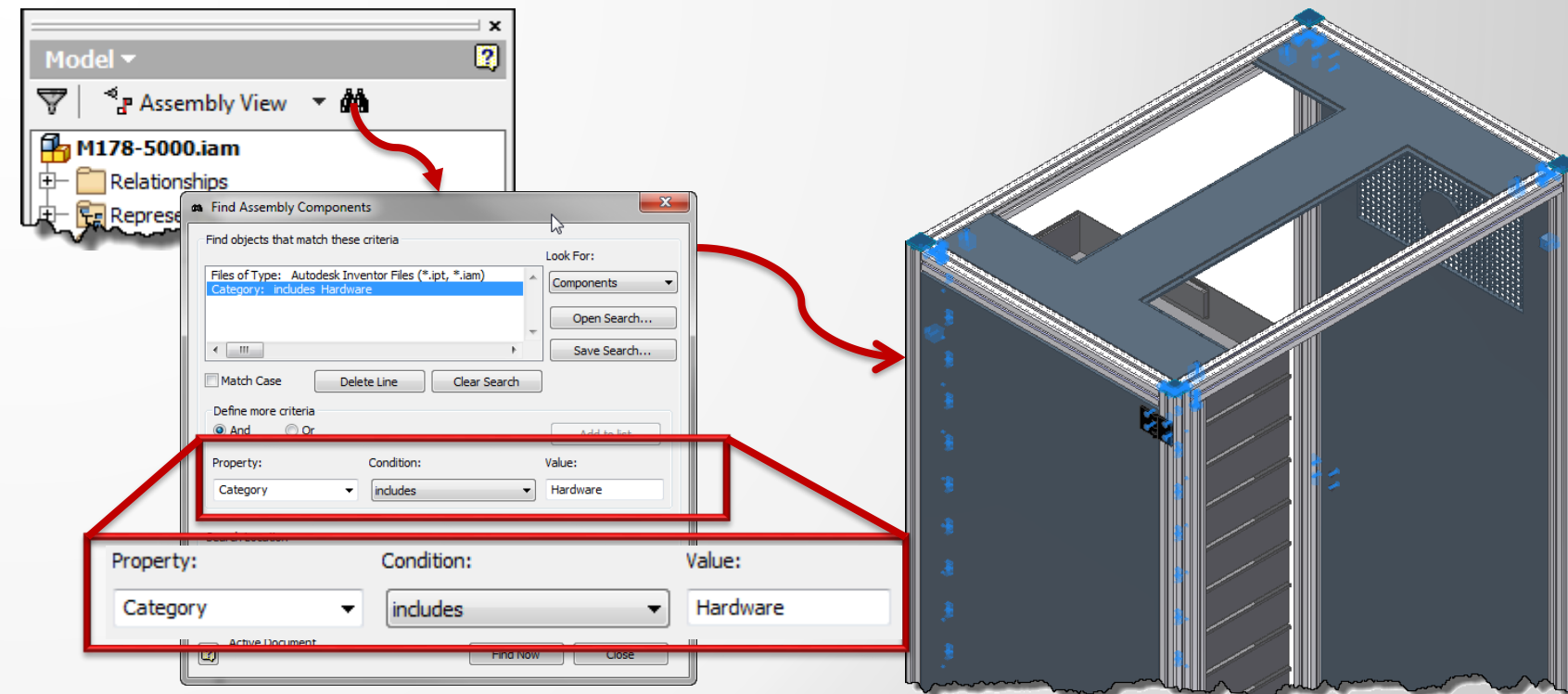
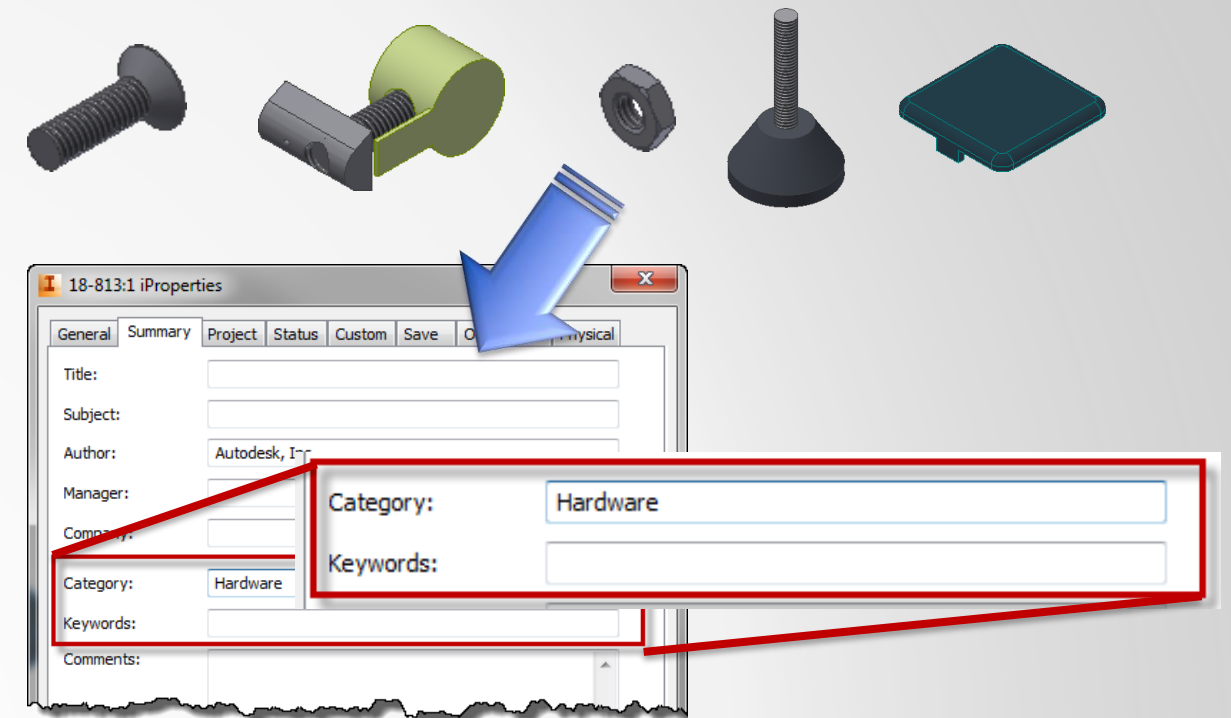
Tag It: Quick Select Techniques

- Best use of Standard LOD's
 - Get rid of “parts that don't matter”
 - Small Hardware, Internal components, etc.
- Content Center is easy
- Your Library Parts?
 - Can use Assembly Selection Tools
 - Not always efficient
- Why not Tag your Library?



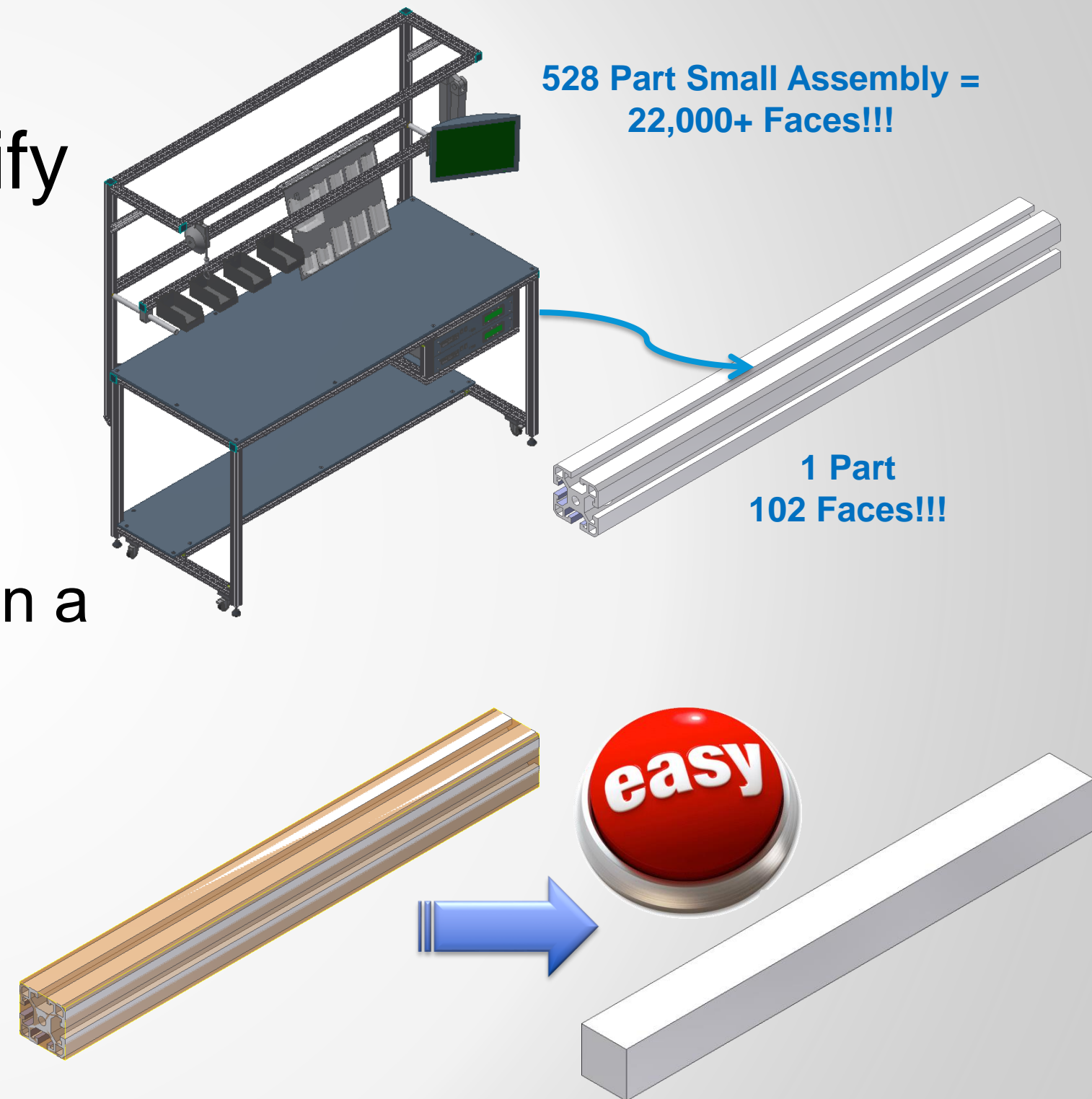
Tag It: How-To

- Setup all “Library” Parts
 - Use an iProperty (“Category”, “Keywords”)
 - Set to common value (“Hardware”, “Fastener”)
- Perform an Assembly search on the iProperty
 - Can save and reuse the search
- Right Click and Suppress... Easy!



Build an Easy Button: Sculpt and Surfaces

- Some geometry is hard to simplify
- Example: T-Slot Extrusions
 - Shrinkwrap barely touches it
 - Hard to “extrude out” all those faces in a substitute
- Build “Easy Button” Shrinkwrap with Construction Surfaces!

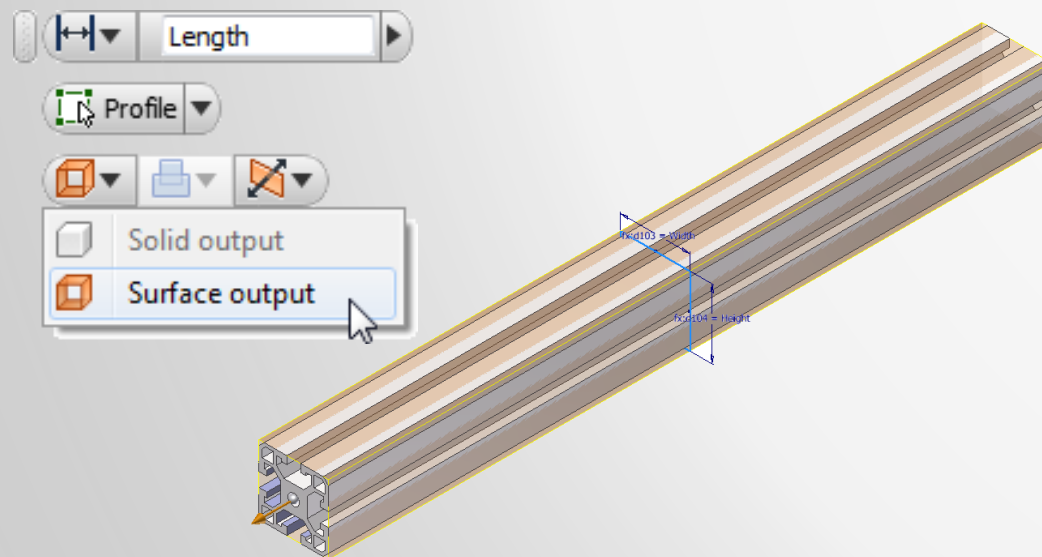


Build an Easy Button: The Setup...

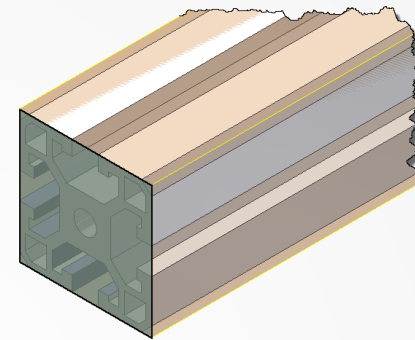
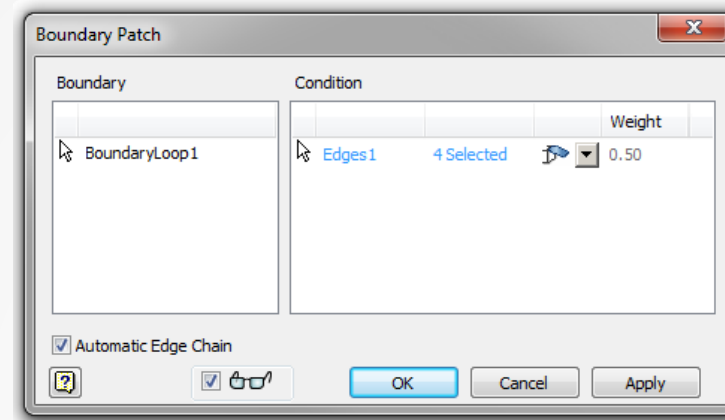
1. Start with Template for the extrusion (Custom iPart, CC Family Template, or plain old part)



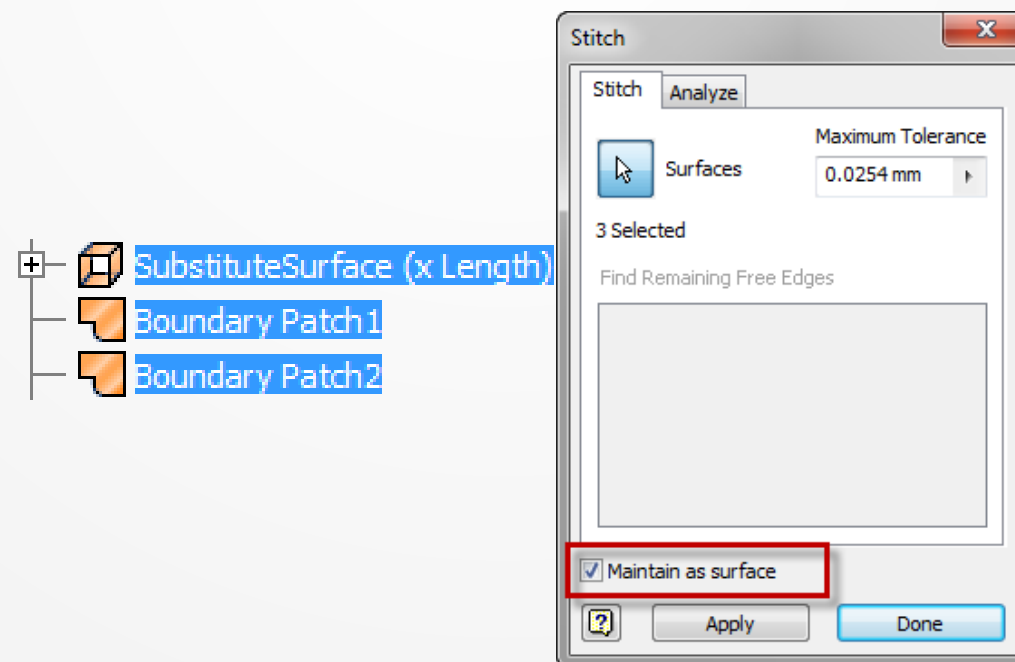
2. Extrude an encompassing surface to the Length (use Parameters)



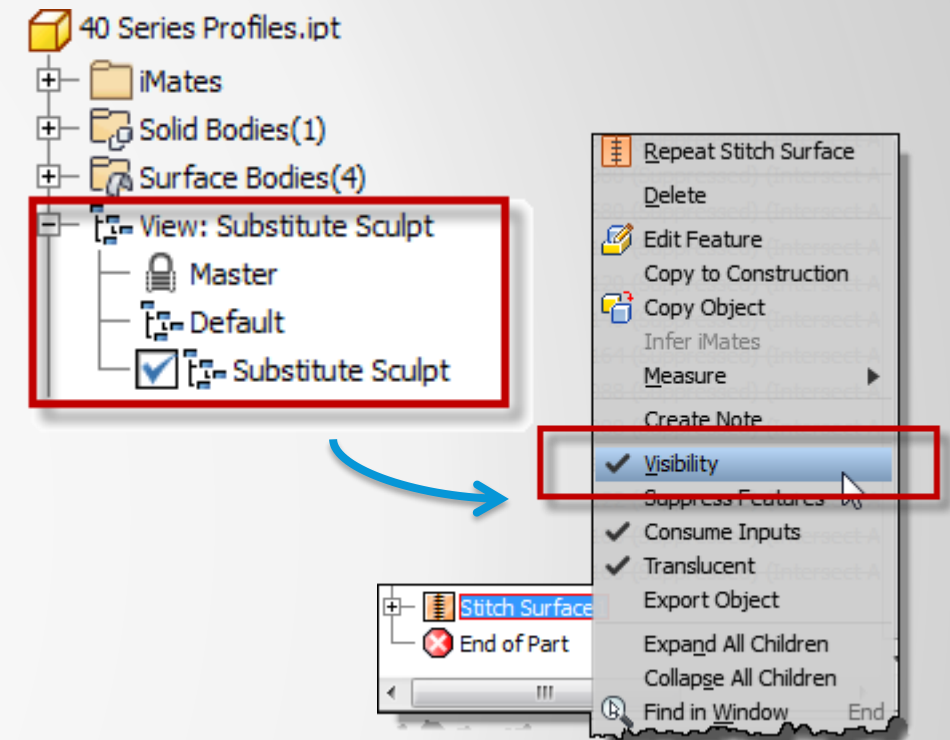
3. Boundary Patch the ends of the



4. Stich surfaces together as single surface



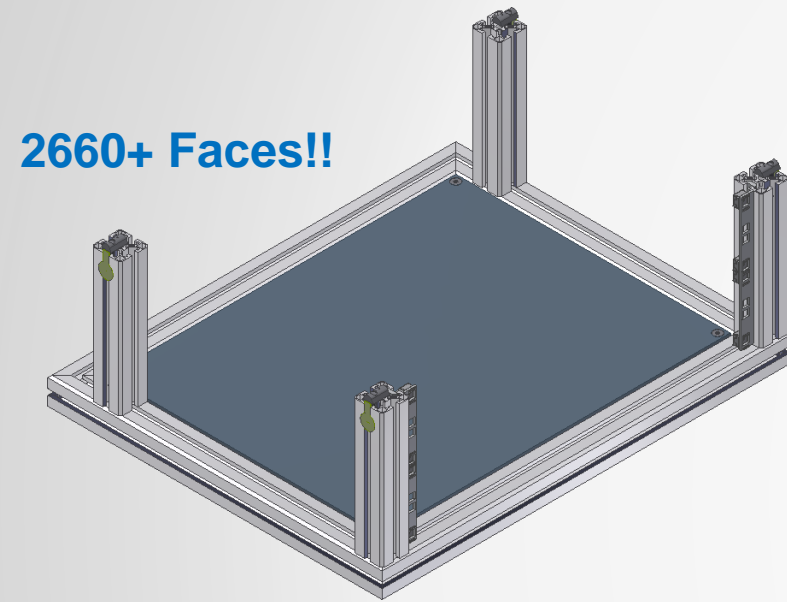
5. Create a common named View Rep with the stitched surface turned on



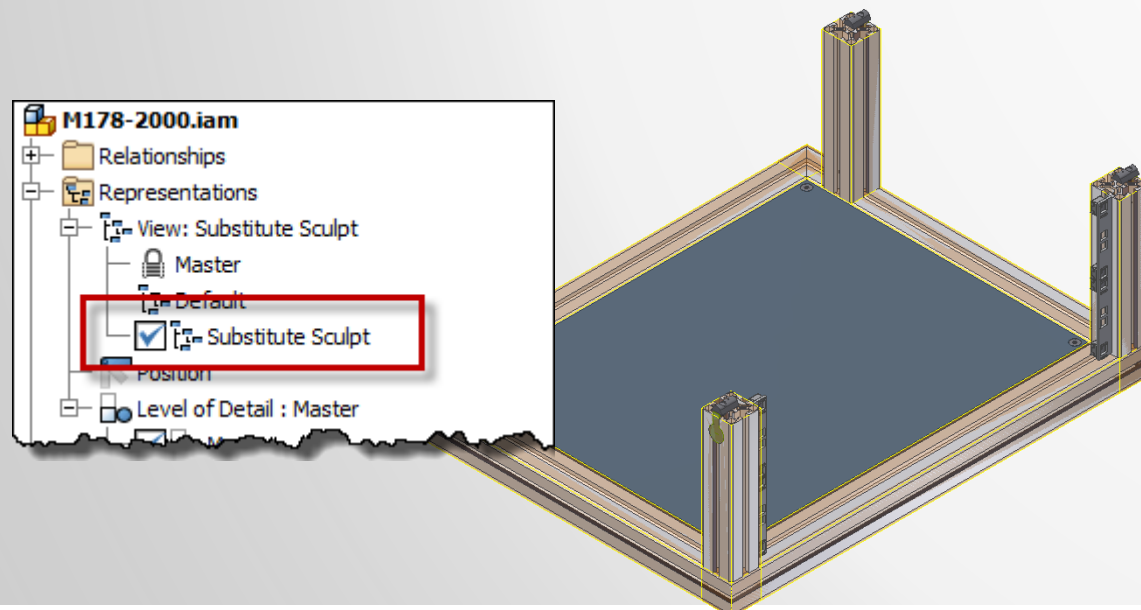
6. Save the "Template" appropriately
❖ Step-by-step Handout will detail how to do this

Build an Easy Button: Push the Button...

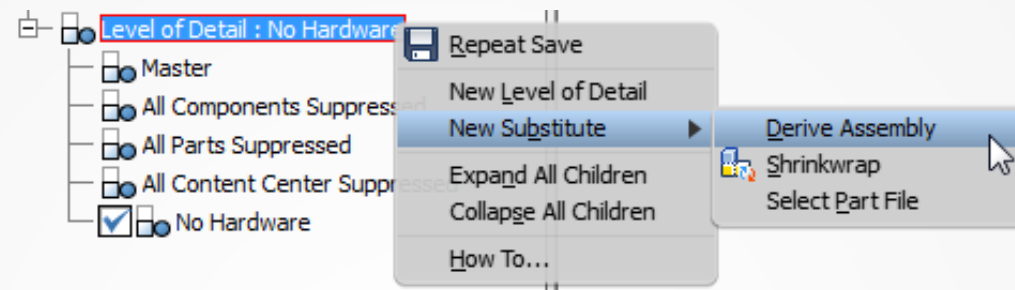
1. Make an Assembly with the “Template” parts containing the Construction Surfaces



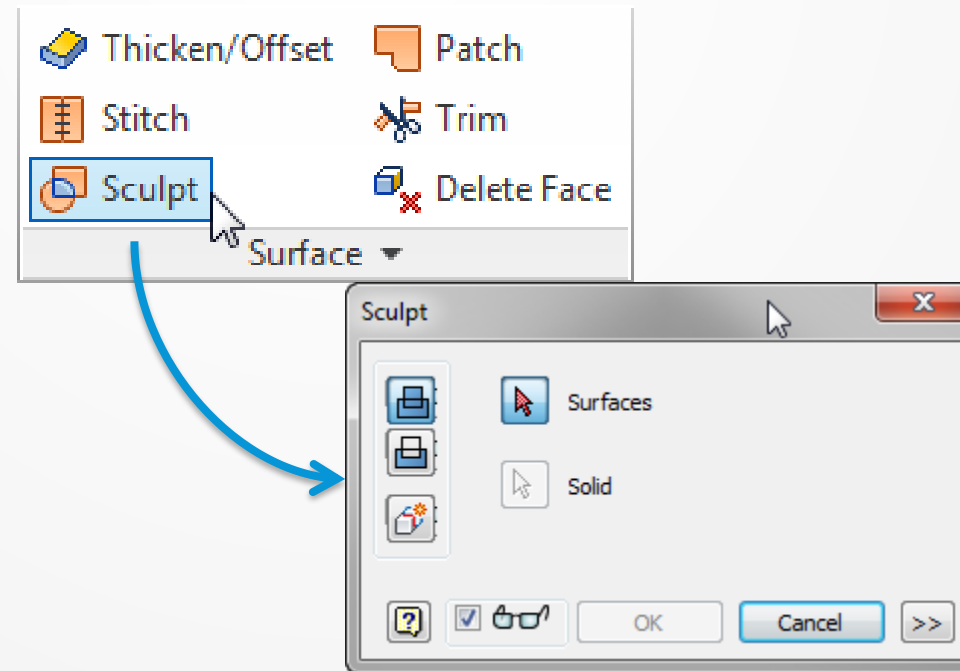
2. Make a View Rep with All the surfaces turned on (Part View Reps can help)



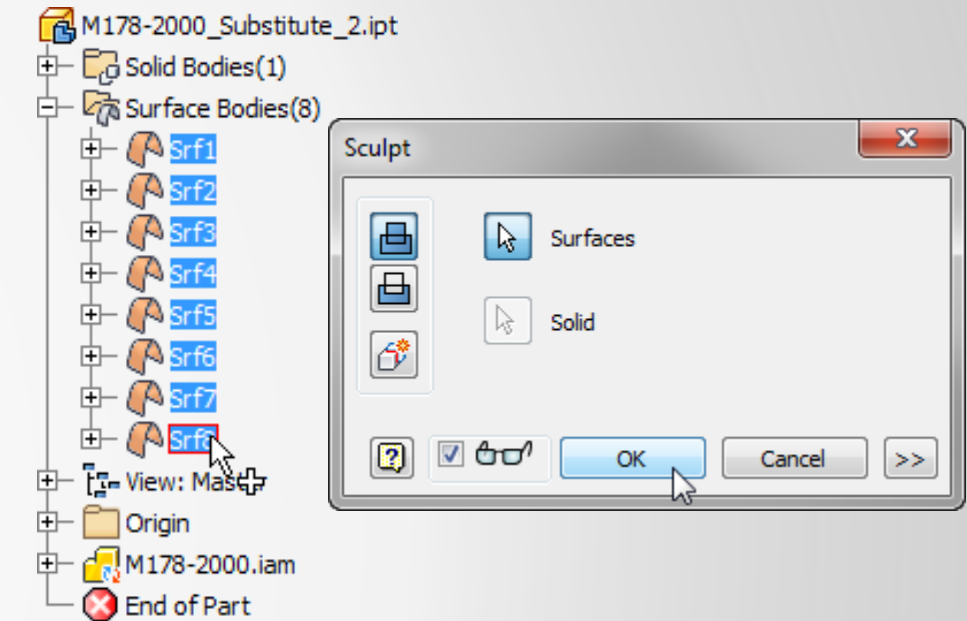
3. With the View Rep active, create a Substitute LOD (Derive Assembly)



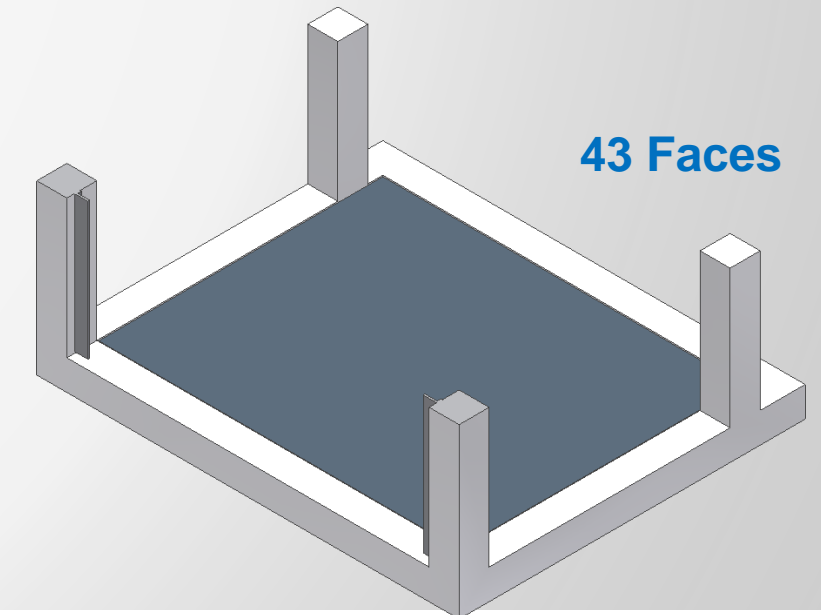
4. Edit the Substitute Part after creation. Start the Sculpt command.



5. In browser, multi-select the surface bodies then click OK

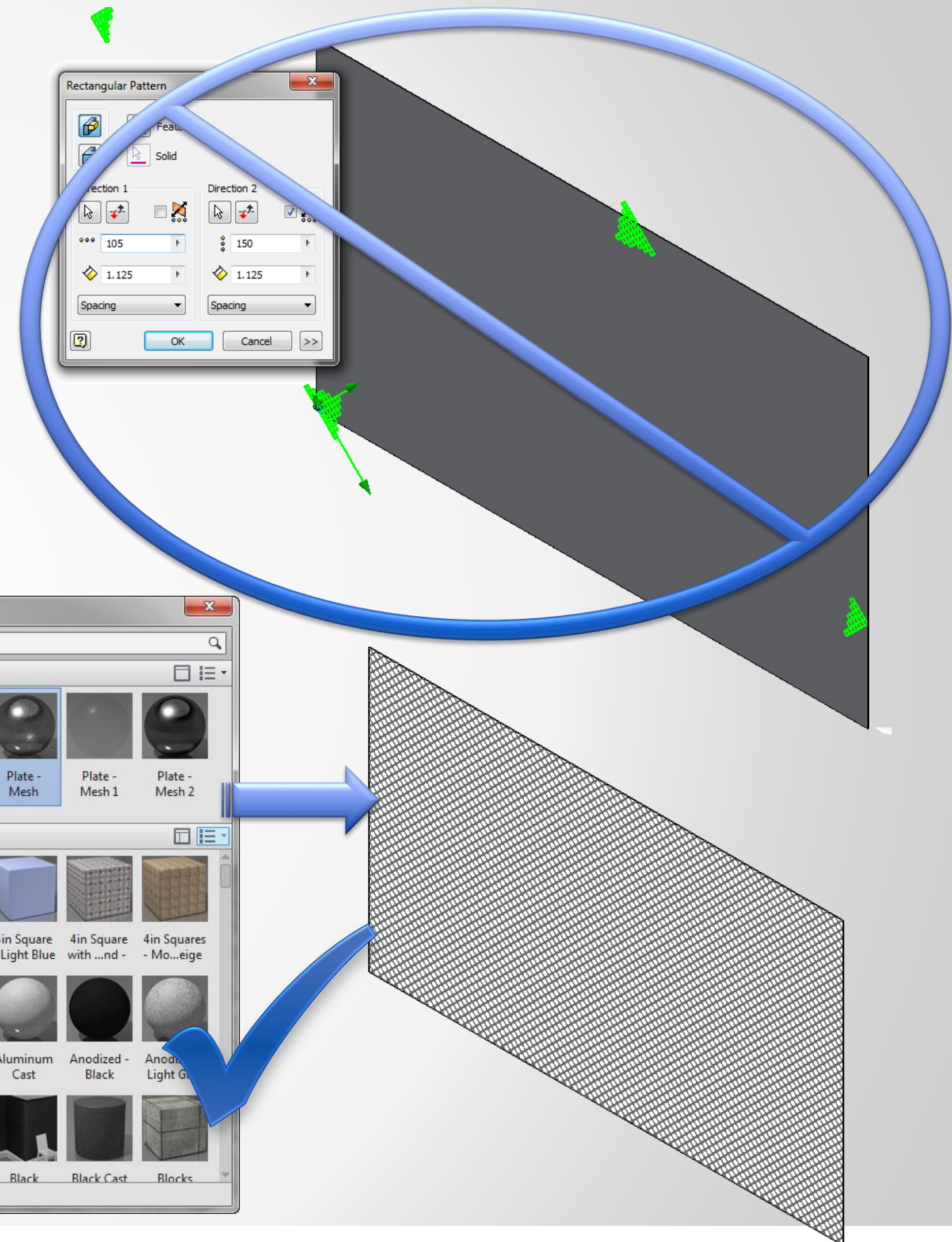


6. Save the substitute... Voila!!!



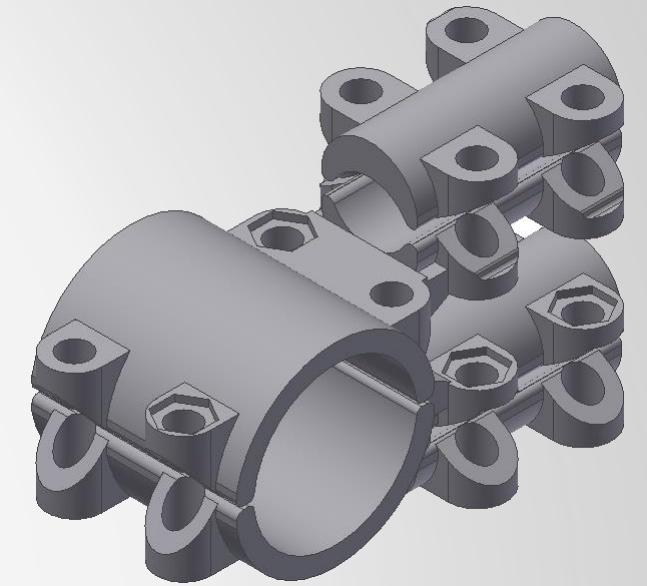
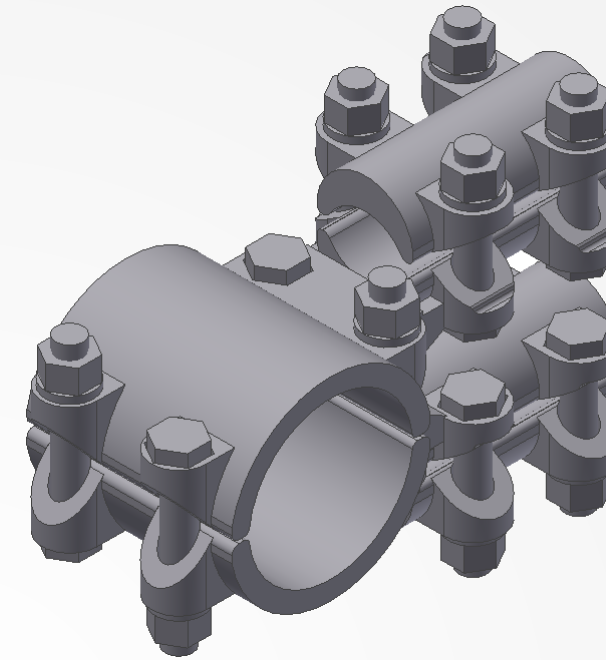
Cheat Example: Appearances

- For Fences/Cutout flooring etc., don't pattern "bazzillions" of cuts
- Apply an Appearance with texture map & cutouts
- Note: Appearances will only "look real" on drawings in rendered views

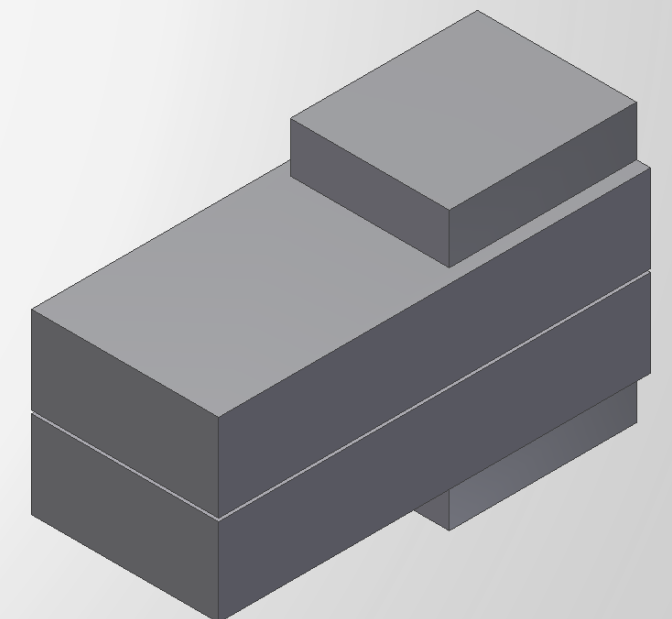
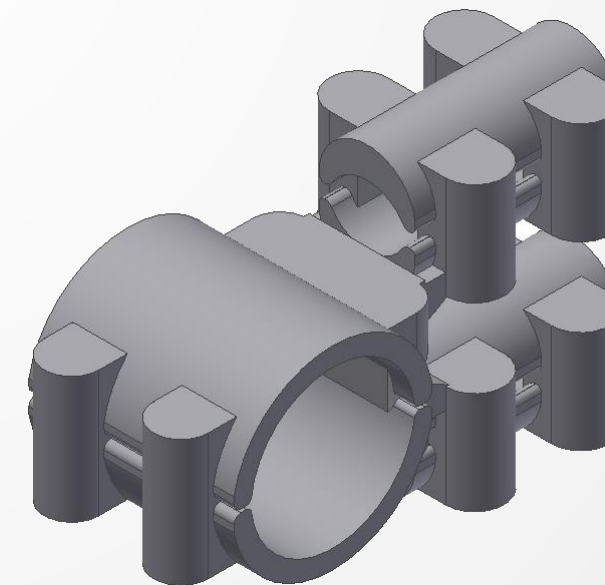


Cheat Example: Not a Part

- Not all Library “Parts” should be parts
- Clamp can be made a part file
 - Typical if it's purchased
 - Looks good up close
- If it's an assembly can build LOD's for reuse

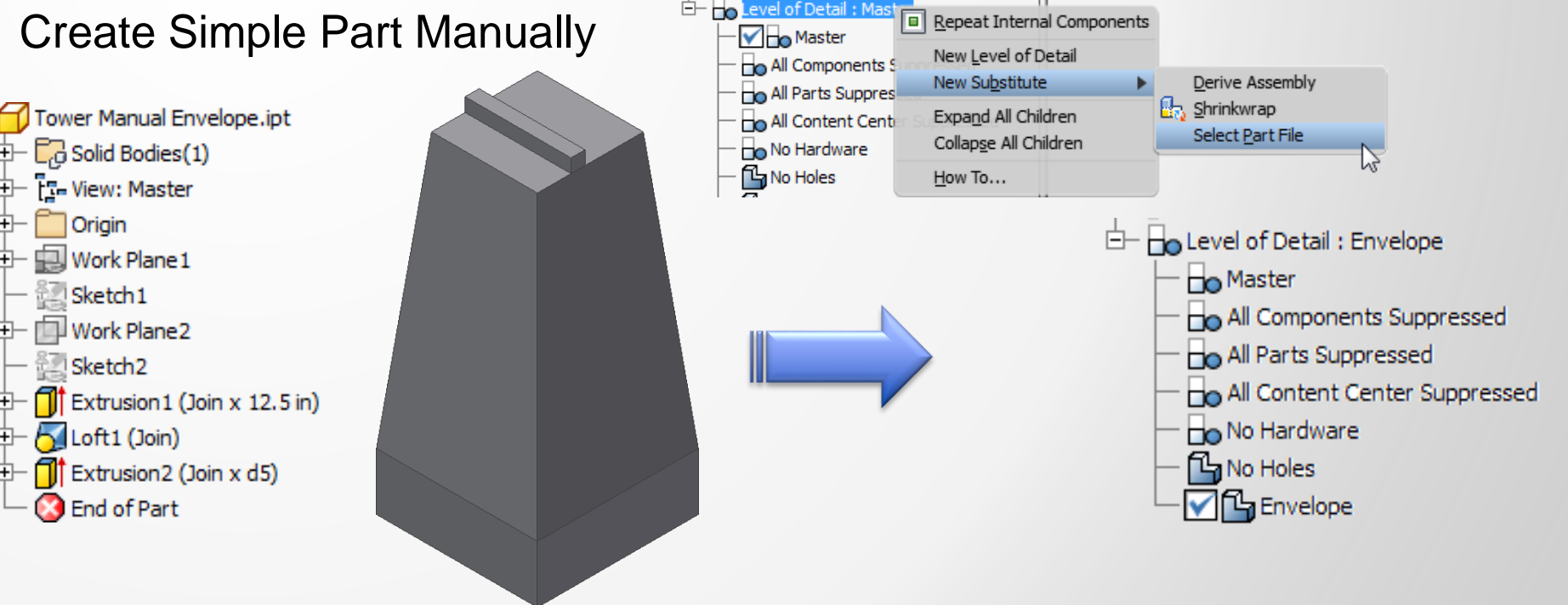
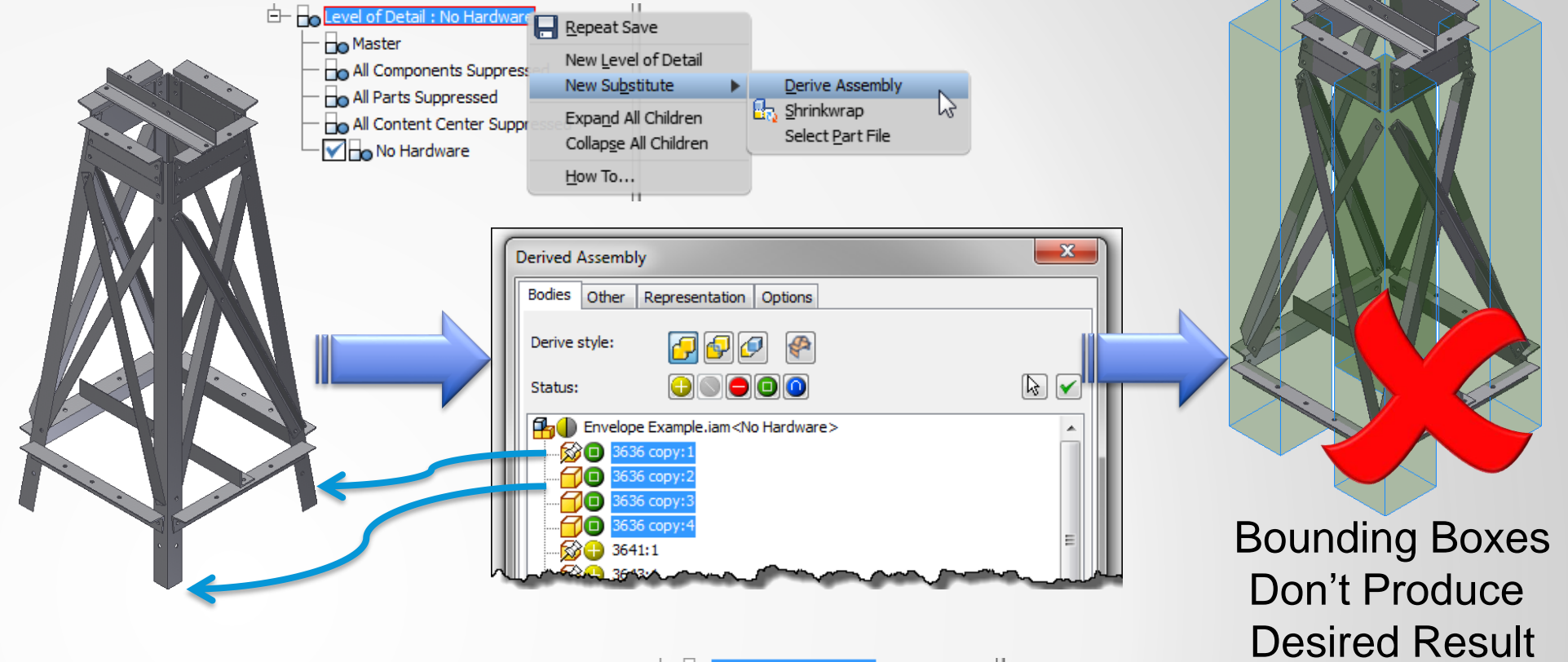


Hard to do this with a single Part file ☺



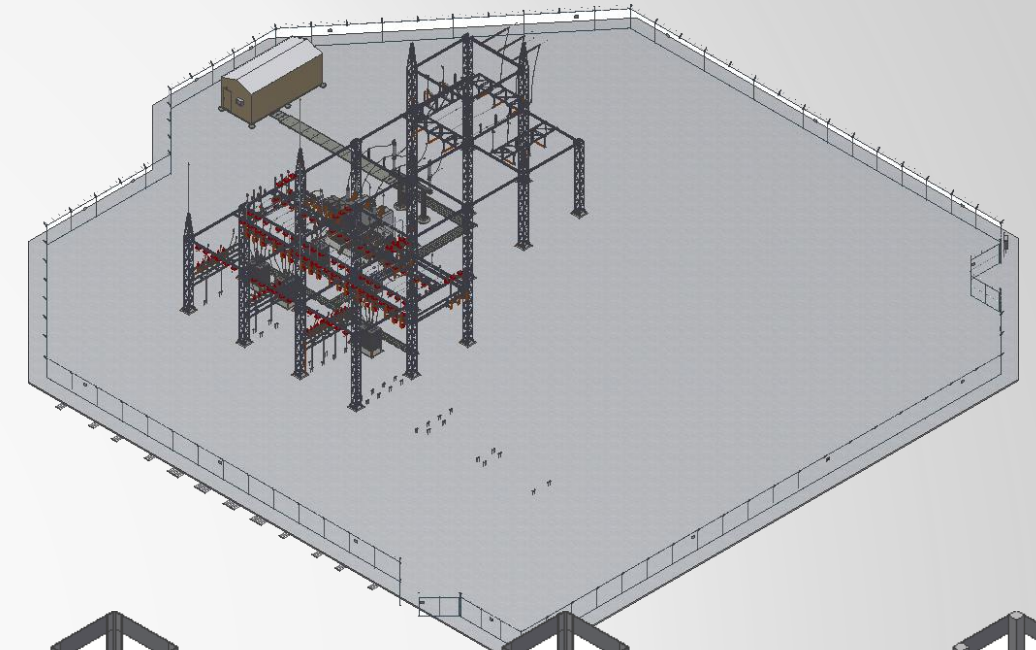
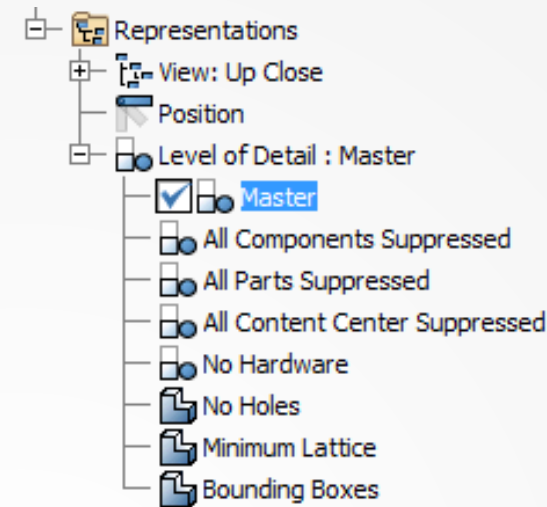
Cheat Example: Make Your Own Substitute Part

- Sometimes Shrinkwrap, etc. doesn't give you the results you want
- If all else fails: Make your own "Part" manually
- Make it a substitute with New Substitute > Select Part File



Reusable LOD's: Making Life Easier

- Best use of any design elements is reusing them
- LOD's can be the same way
- Plan out the LOD's you need
- Start with the most “Prominent” elements to guide you
- Build the “same” LOD's into everything, even if they duplicate results



Full
Detail



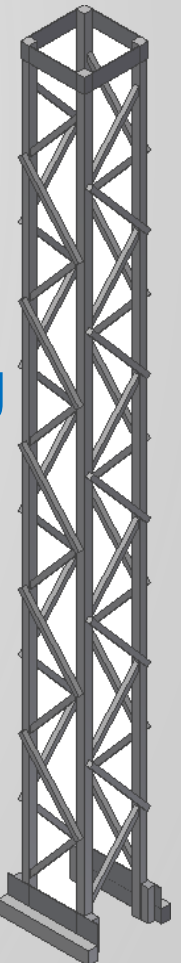
No
Holes



Minimal
Lattice

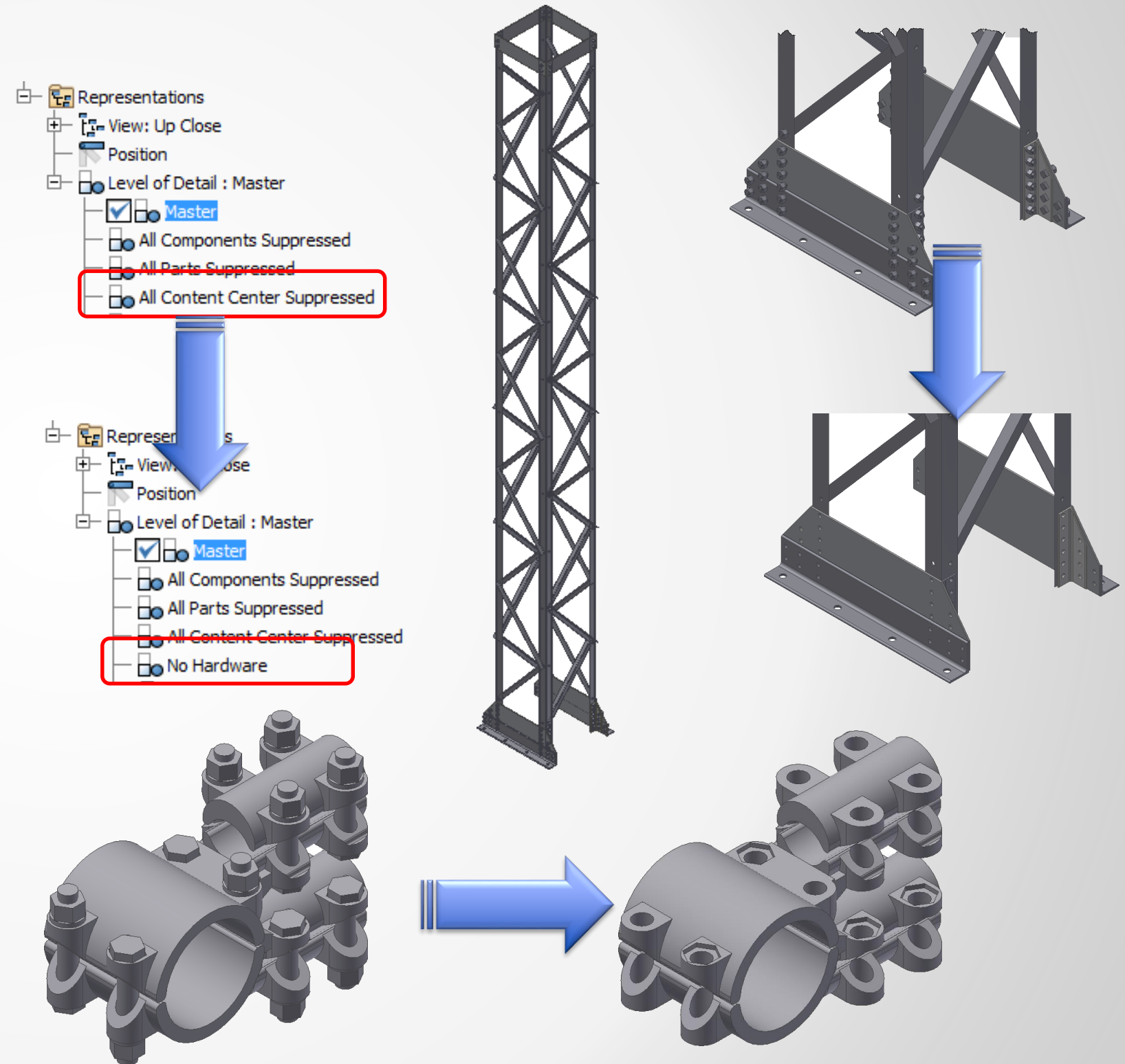


Bounding
Boxes



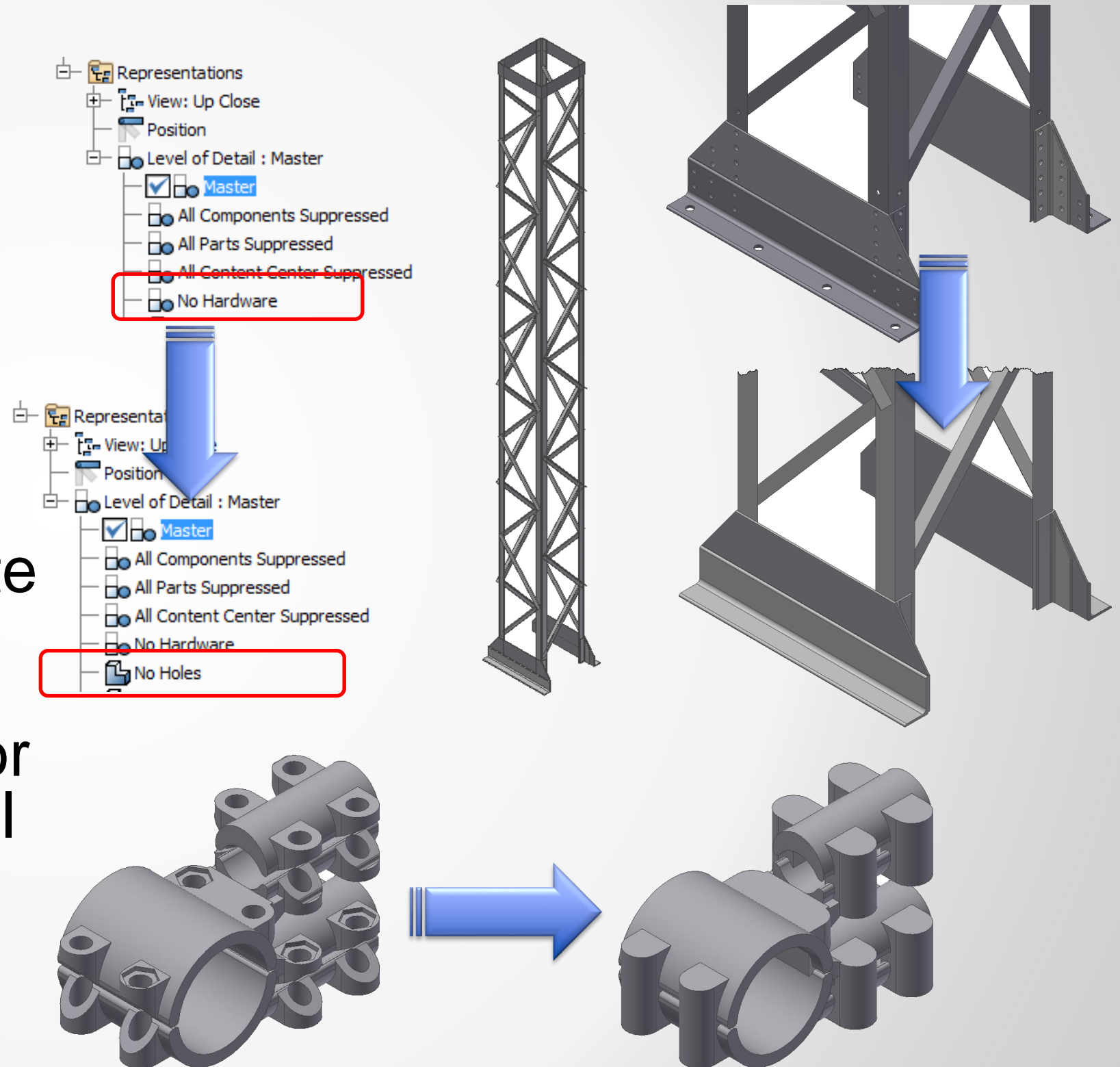
Reusable LOD's: Walkthrough a Substation

- LOD #1: No Hardware
- Simple place to start: I always create this!
- Step 1: Suppress All Content Center
- Step 2: Create “No Hardware” from Step 1 and use Tag-It
- Use it as the Basis for all other LOD's



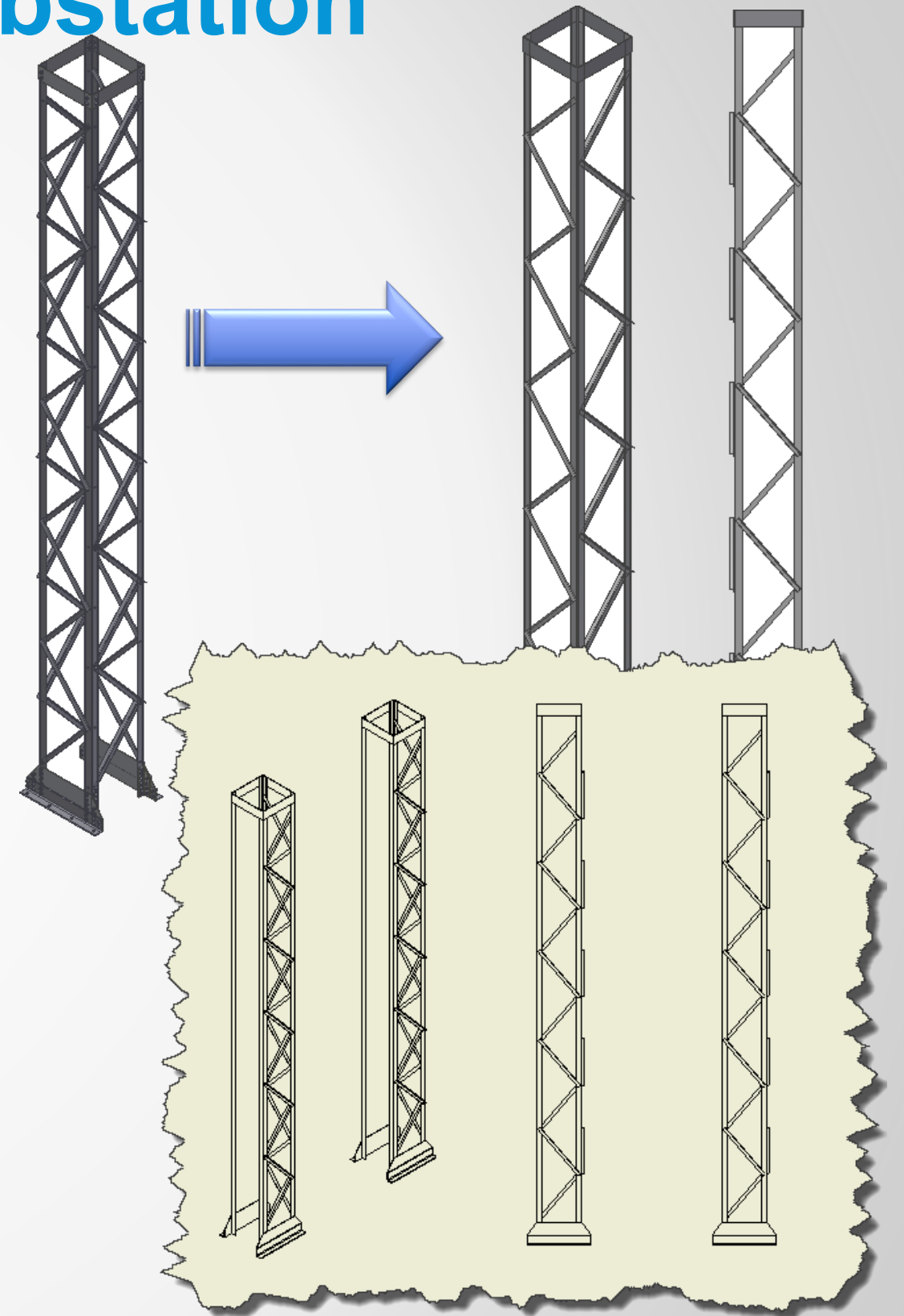
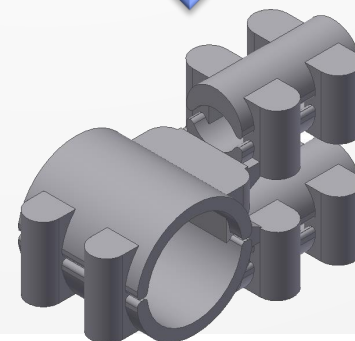
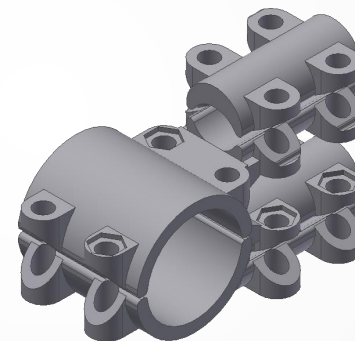
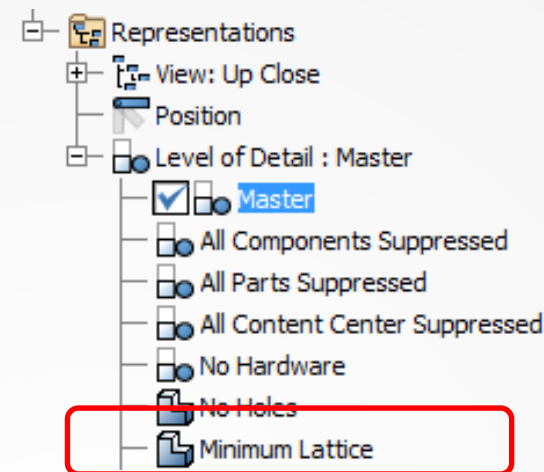
Reusable LOD's: Walkthrough a Substation

- LOD #2: No Holes
- Start with No Hardware
- Create Shrinkwrap, Fill in all Holes
- May require editing the substitute part to get results you want
- Use in Assembly environment for balancing performance vs. detail



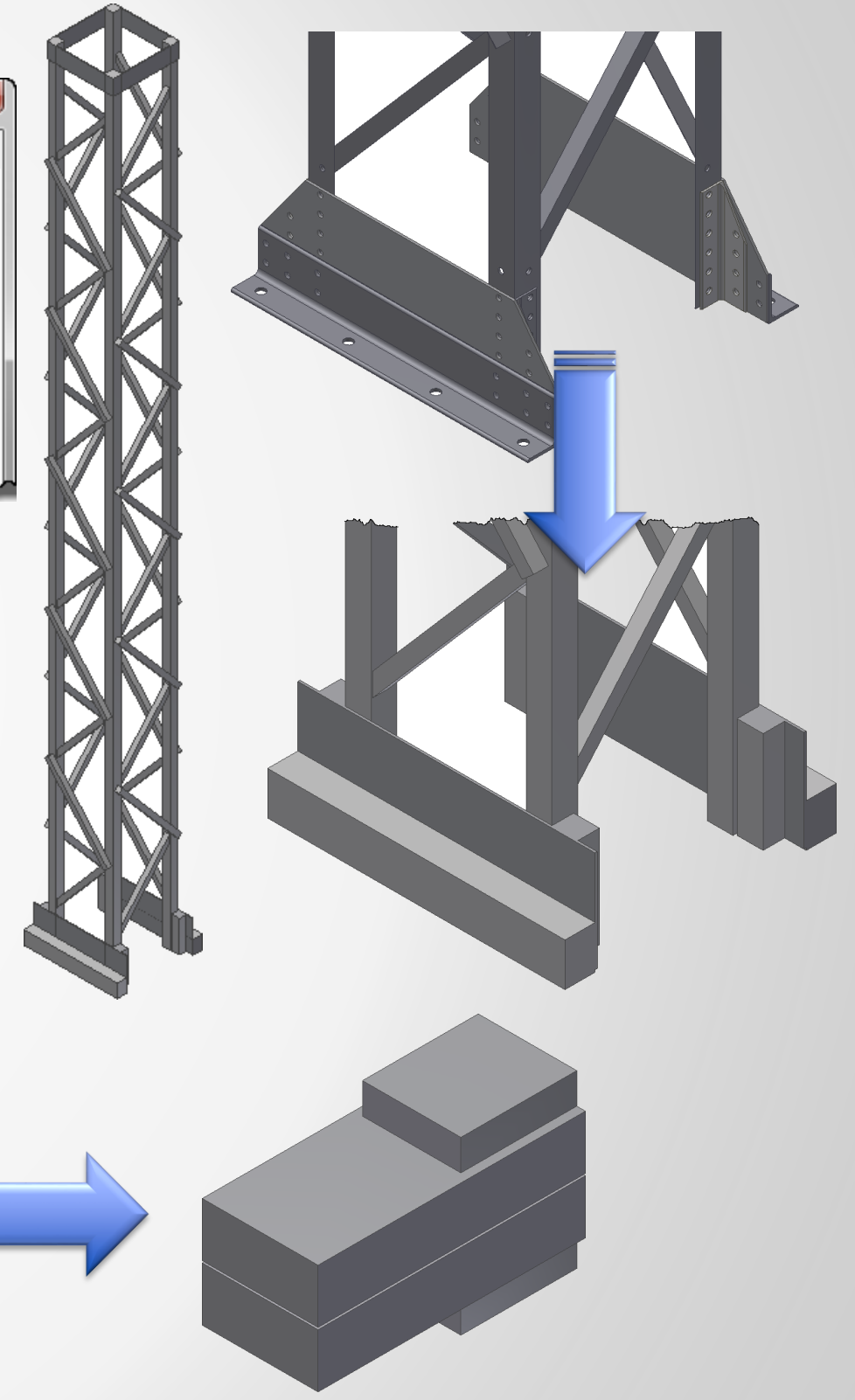
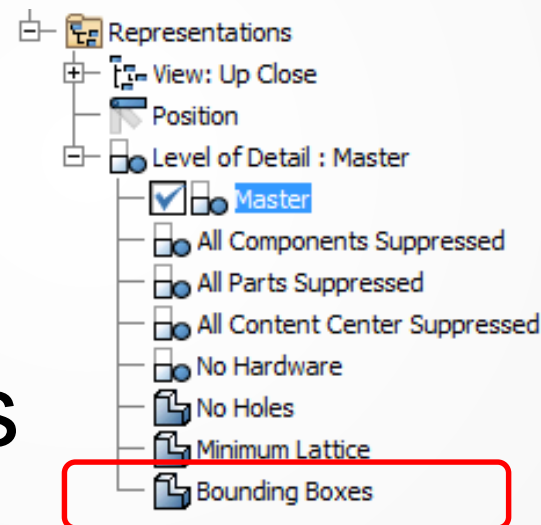
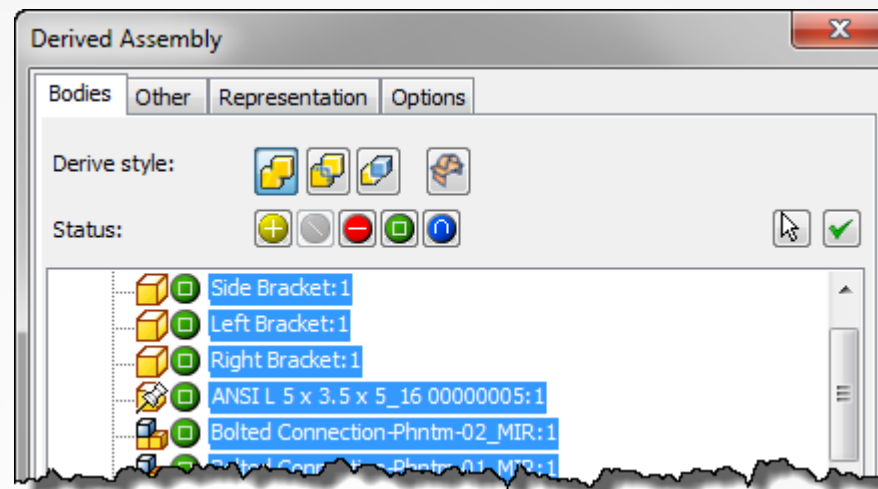
Reusable LOD's: Walkthrough a Substation

- LOD #3: Minimum Lattice
- Unique to this design: Hide Lattice on opposing Sides
- Comes from AutoCAD world – drawing views only show Lattice in Front, not back
- In Assemblies where this “makes no sense”, reuse the “No-Holes” Substitute part using “Select Part”
- Use: In Drawings of side views



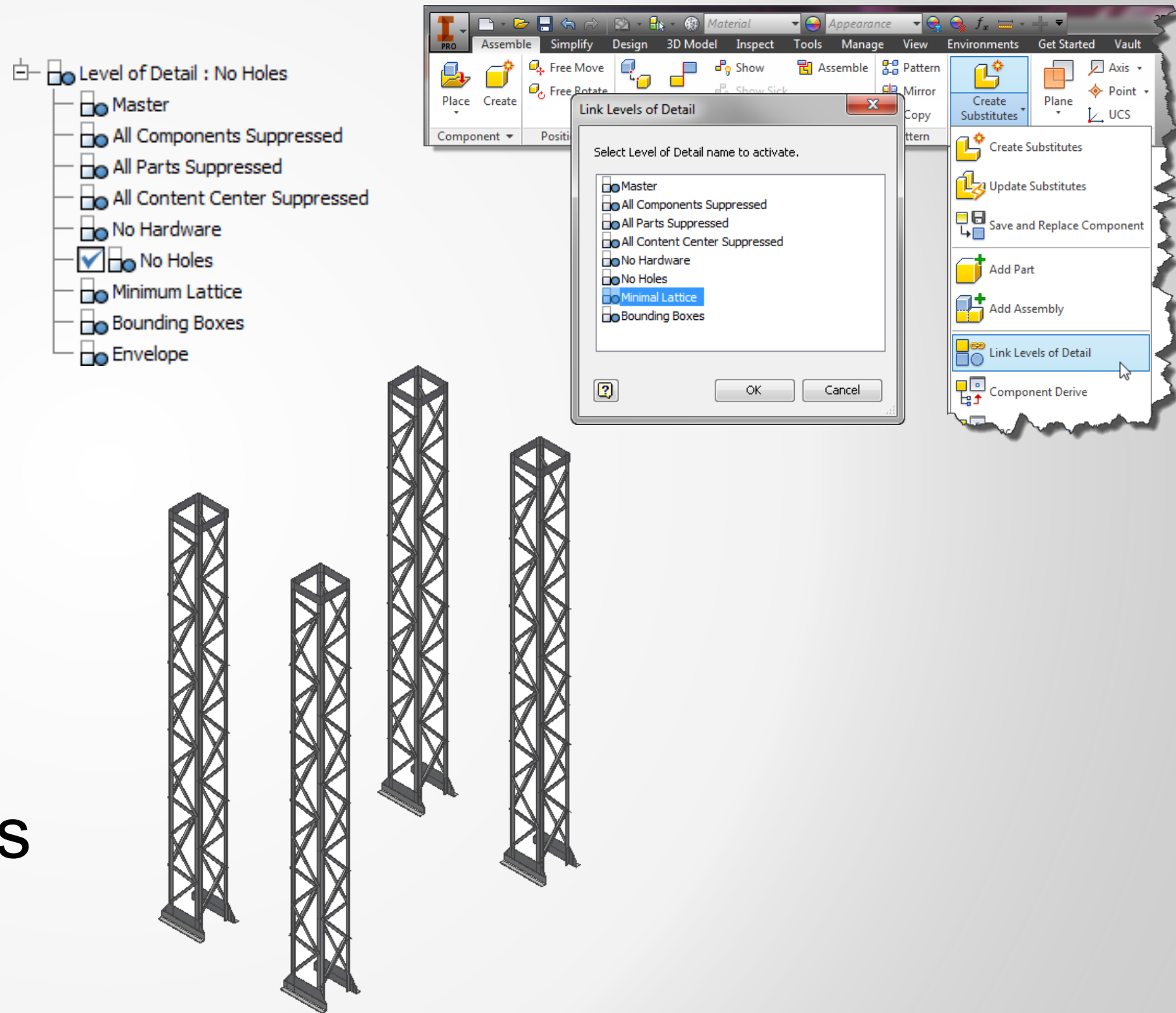
Reusable LOD's: Walkthrough a Substation

- LOD #4: Bounding Boxes
- Easy to Make: I usually make this
- Substitute: Derive Part
- Select Individual Components and Change to “Bounding Box”
- Use: “Long Views” in Drawings



Reusable LOD's: Tie It Together

- Once all of the elements have these consistent named LOD's, you can reuse them easily
- Create the named LOD's as Standard LOD's in your Assembly template
- In every new Assembly, simply use the Link LOD's to tie them together



More & More Thoughts: There's More!!

- These are great tools, but there is more...
 - Simplifying Constraints systems
 - Optimizing Substitutes for Mechanisms
 - Using Express Mode & Raster Views
 - Understanding how to Annotate Substitutes
 - Etc.
- Autodesk and your Reseller can help you explore these more

Are you sure I only have **90** minutes...

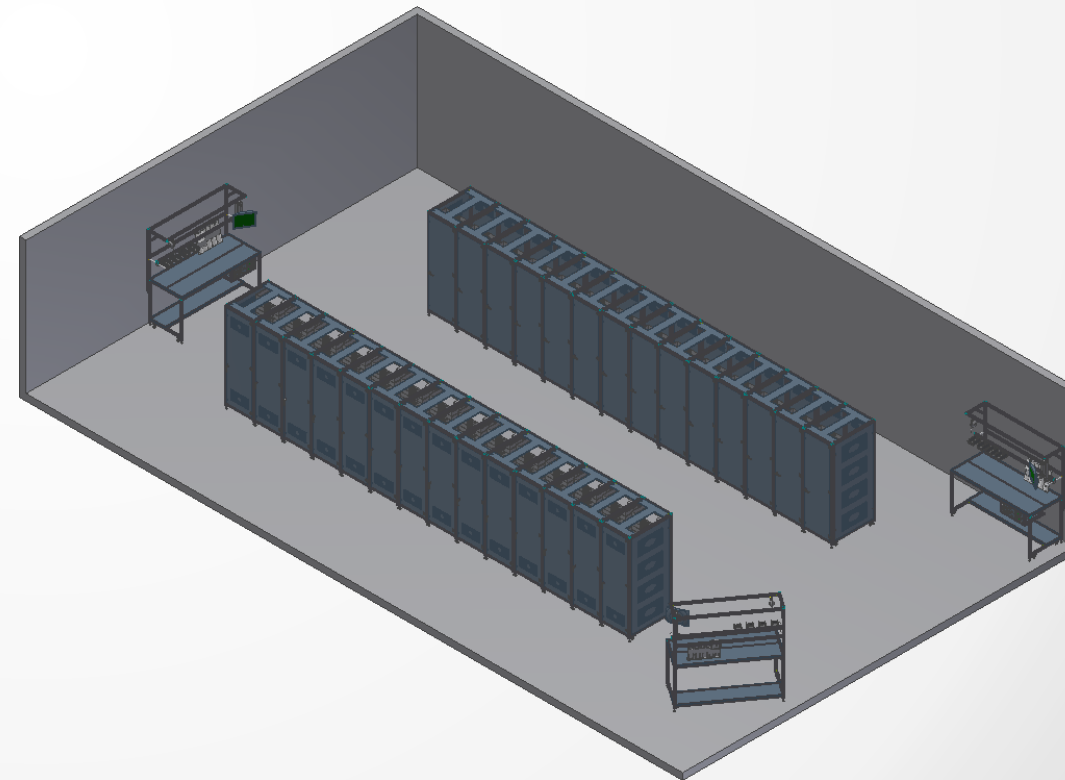


Simple Conclusions

Final Thoughts

- Being Successful requires work
 - Don't just press "Shrinkwrap" and expect an "Easy Button"
- Think through and plan accordingly
 - Best approach to take for you
 - Best techniques to get results
- Don't be afraid to experiment
 - This takes practice!!!
- Ask for Help!
 - User Groups/Forums
 - Resellers
 - Autodesk

One Million
Faces... Wow!
Maybe if I add
more RAM?...
Nah!!



Summary

- Understand the balance between Fidelity and Identity
- Develop your strategy and approach in a deliberate manner to find the path to that balance
- You have a wealth of tools, and help available...
explore them!

