Skeleton Process

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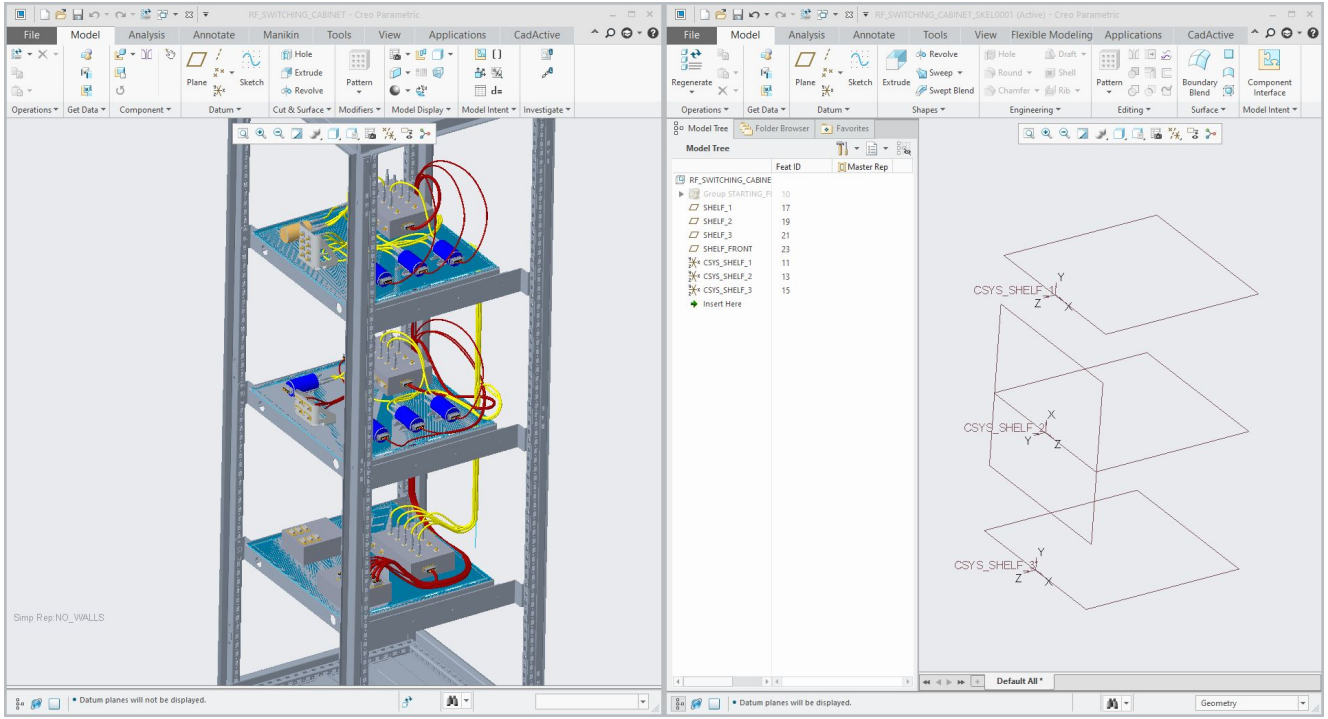
Overview

Today, managing large assemblies in Creo Parametric is a difficult and nuanced task. There are many ways to do this - one of the ways this document will explore are skeleton models. PTC defines a standard skeleton model as:

A model that captures and defines design intent and product structure. Skeletons allow designers to pass along essential design information from one subsystem or assembly to another. This essential design information is either master definitions of geometry or copied geometry from designs defined elsewhere. Any changes made to a skeleton change its components as well.



(Left) 3-shelf large ASM, (Right) 3-shelf skeleton model using only datums

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Why Use Skeletons?

- Communicate design intent
  - Update downstream systems from the top-level, “top-down design”
- Lightweight
  - Only show the needed surfaces/datums
- Help avoid external references
  - Well-defined skeleton features can and should be referenced
  - Standardized references vs. ad-hoc references

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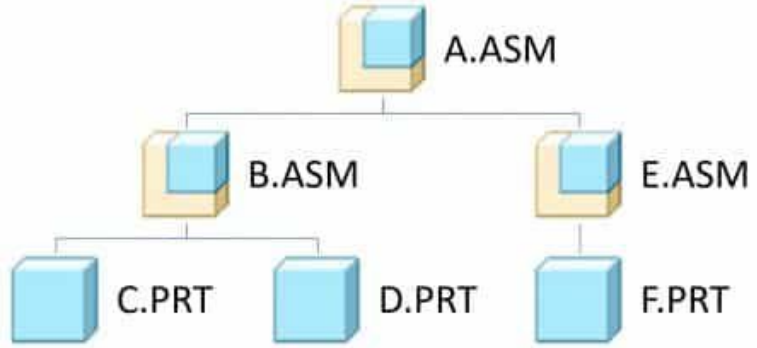
What are External References?

An external reference is when a feature or definition to is dependent on a component outside of its current assembly context.

For example, let's imagine that we have a top-level assembly, called "A.ASM", as shown in the graphic below. Inside of that, we create two other assemblies, "B.ASM" and "E.ASM". Inside of "B.ASM", we have part models "C.PRT" and "D.PRT", and inside of "E.ASM", we place "F.PRT" (shown below).

In this example, if the position and orientation of "D.PRT" directly referenced a feature, surface, edge, or other detail from "F.PRT" – that would be considered an external reference.



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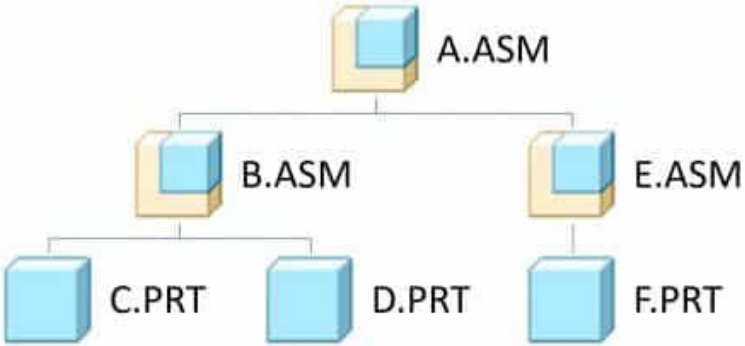
Why are External References Bad?

In the prior example, “D.PRT” contains an external reference to “F.PRT”.

Depending on Creo’s configuration settings, when loading “B.ASM” on its own, Creo can sometimes load the **entire** “E.ASM” into memory as well in order to properly load the correct reference.

This is generally not a problem for small assemblies like this example, but it can become a **major** performance issue for larger assemblies.



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Skeleton Feature Types

Skeleton models are <u>usually</u> comprised of two types of features:

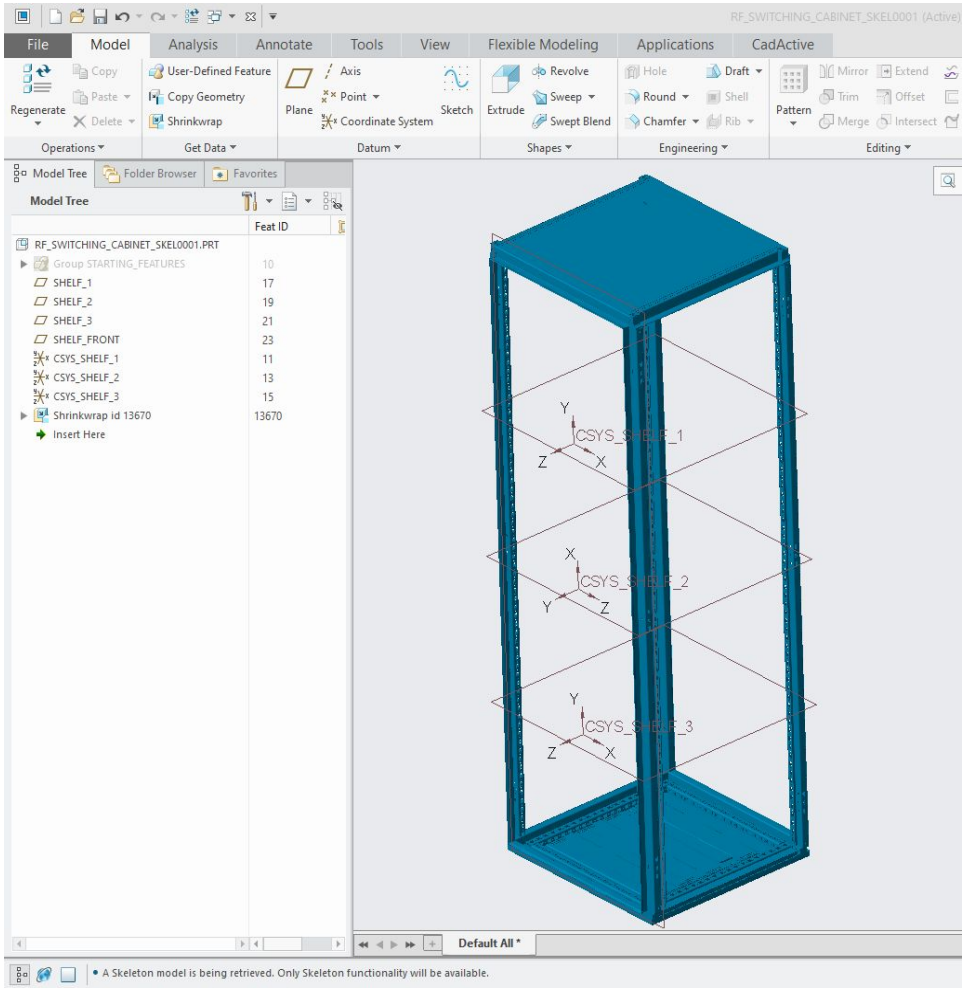
Datums:

- Coordinate systems (csys)
- Points
- Axes
- Planes
- Curves/Sketches

Surfaces:

- Surface boundaries of solid geometry - aka metal surfaces of a steel frame

NOTE: Skeletons can contain solid geometry but will not show up in mass property reports.



3-shelf skeleton using datums AND surfaces (shown in blue)

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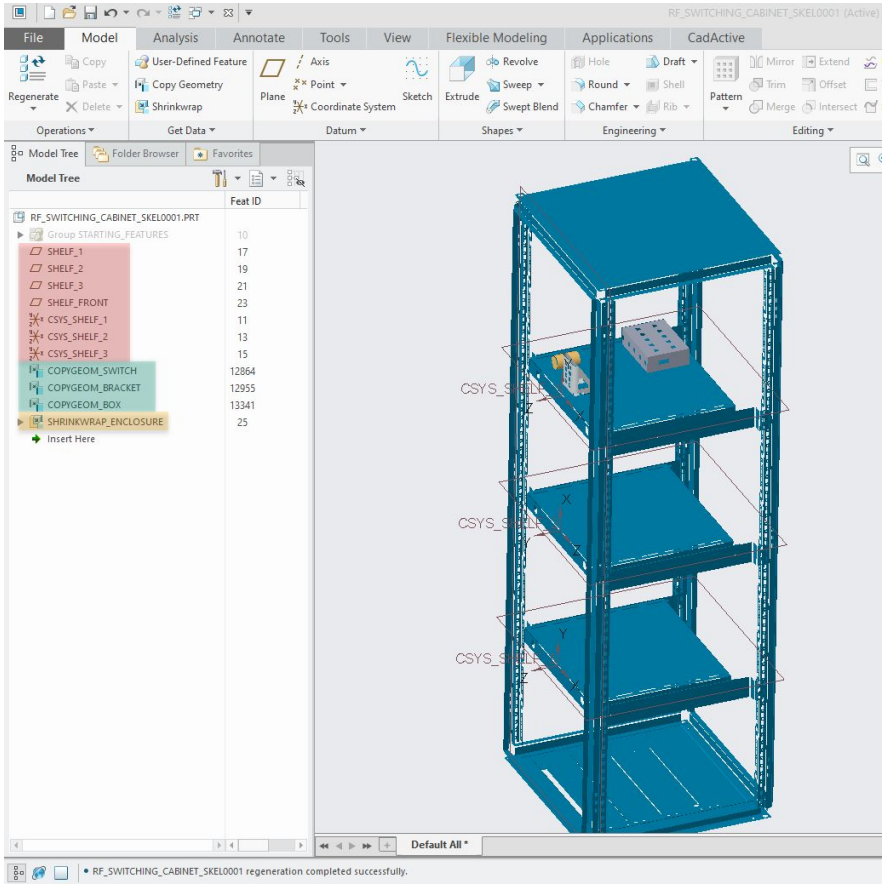
Skeleton Feature Types, continued

Skeleton Datum and Surface Features can be populated two ways:

1. Standalone Geometry - geometry created and defined inside the skeleton, “regular” geometry

2. Copy Geometry (CG) - copied representations from outside models
   a. Individual
      i. Internal
      ii. External
   b. Shrinkwrap
      i. Internal
      ii. External



3-shelf skeleton containing standalone geometry (planes and coordinate systems); individual copy geometries of the Switch, Bracket, and Box; and a shrinkwrap of the enclosure

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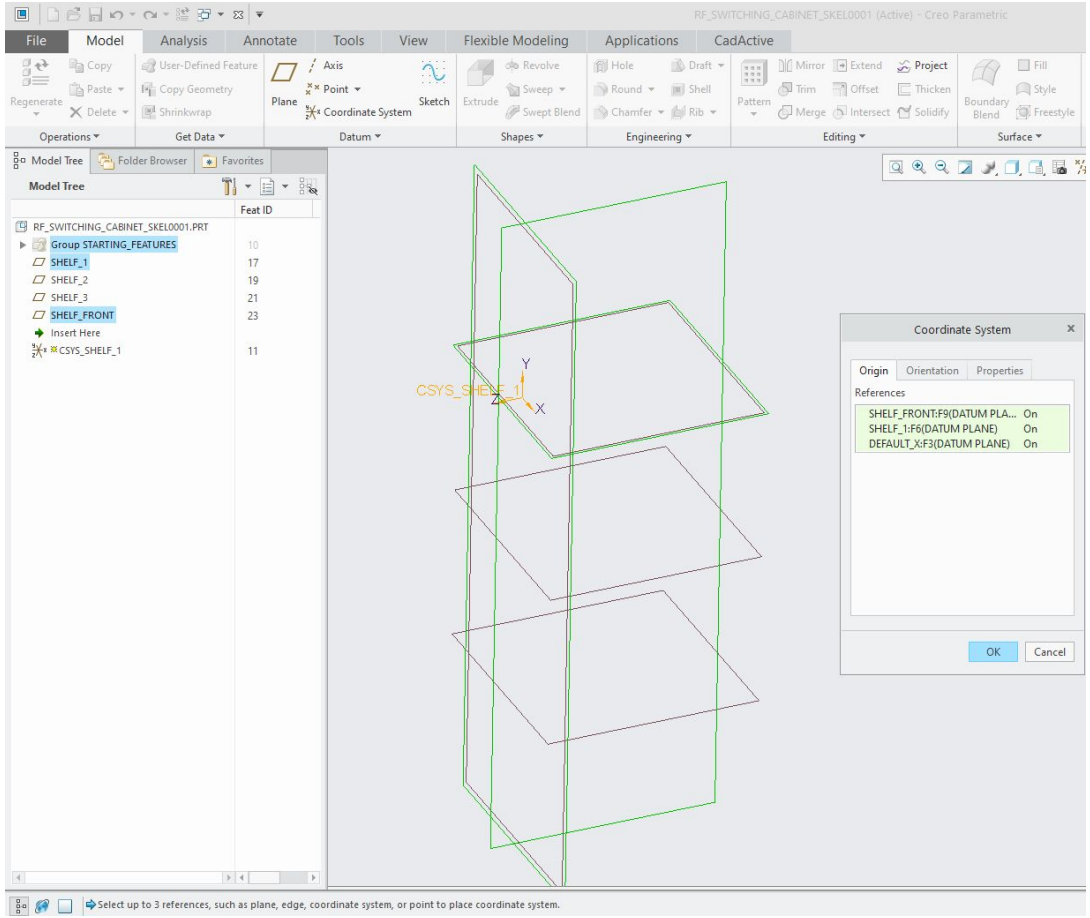
Standalone Geometry

- Just like in standard PRTs, standalone geometry can be created and defined in the skeleton.

- This is helpful in defining top-level design decisions where changing the geometry in the skeleton will cascade downwards.



3-shelf skeleton, with SHELF planes and SHELF coordinate systems created and defined within the skeleton PRT

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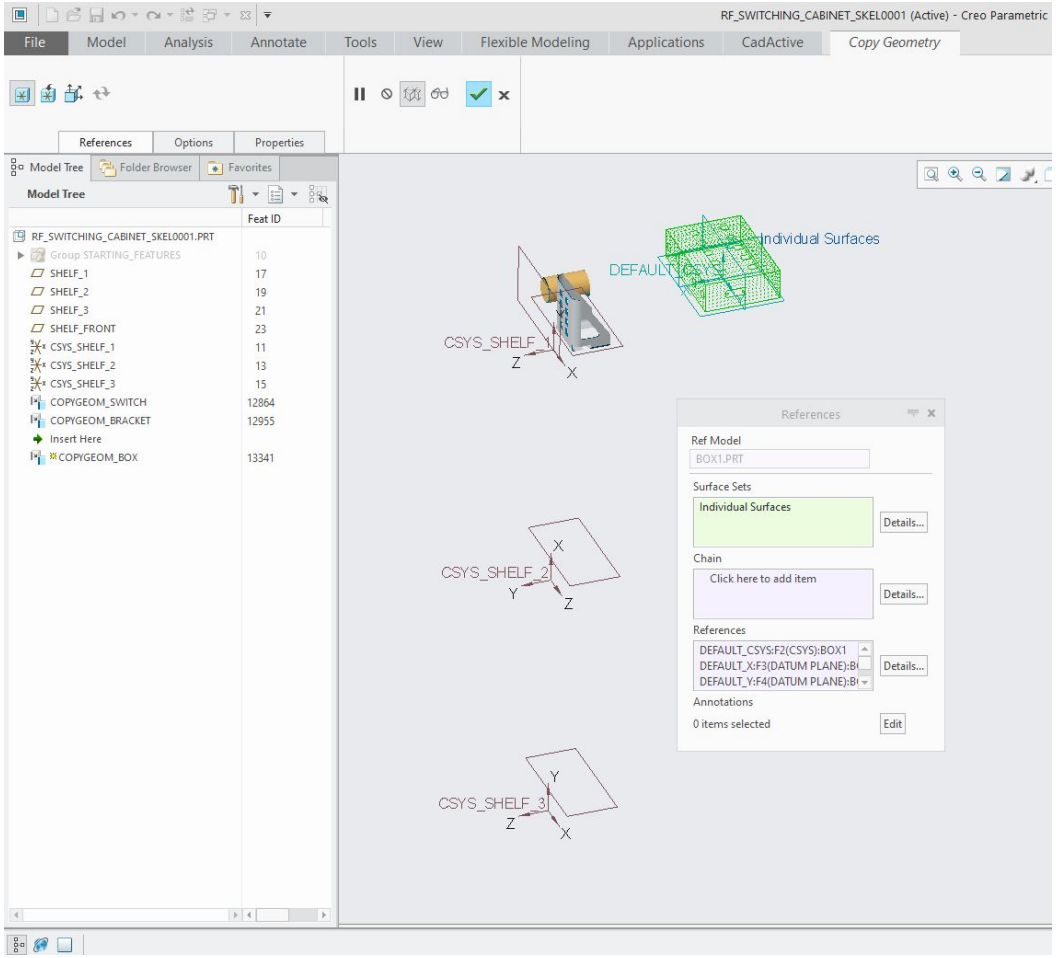
Individual Copy Geometry Features

- Copied Datums and/or Surfaces from a model outside the skeleton
- Users can only select features to CGs from a single PRT at a time
- Can be created on-the-fly or use Publish Geometries
- Can be either internal or external type (see next page)



3-shelf skeleton, the copy geometry features from the BOX include both surfaces and datums (default coordinate system and default starting planes)

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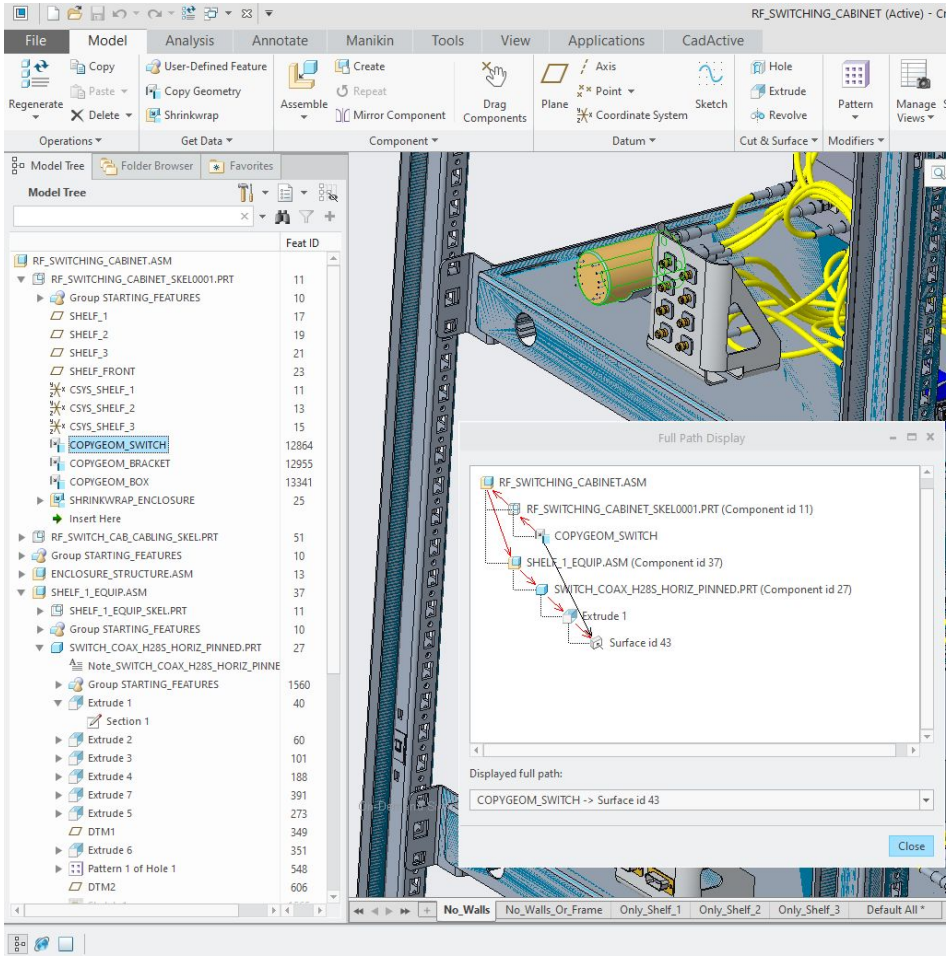
Internal CG Reference Path

The graphic shows the reference path of the internal copy geometry feature COPYGEOM_SWITCH.

For Creo to load COPYGEOM_SWITCH into memory, Creo must traceback up the Skeleton hierarchy (**red** arrows up) until it reaches the top-level RF_SWITCHING_CABINET.ASM. Then it must navigate down the ASM hierarchy (**red** arrows down) until it finds the original feature Surface id 43. Then it can create the parametric link (**black** arrow) from the copy geometry to the original feature.

This creates a dependency, which will update the copy geometry feature if the original feature changes. However, it **takes processing power** for Creo to link these - leading to longer model load and regeneration times.



Full Reference Path of internal COPYGEOM_SWITCH copy geometry

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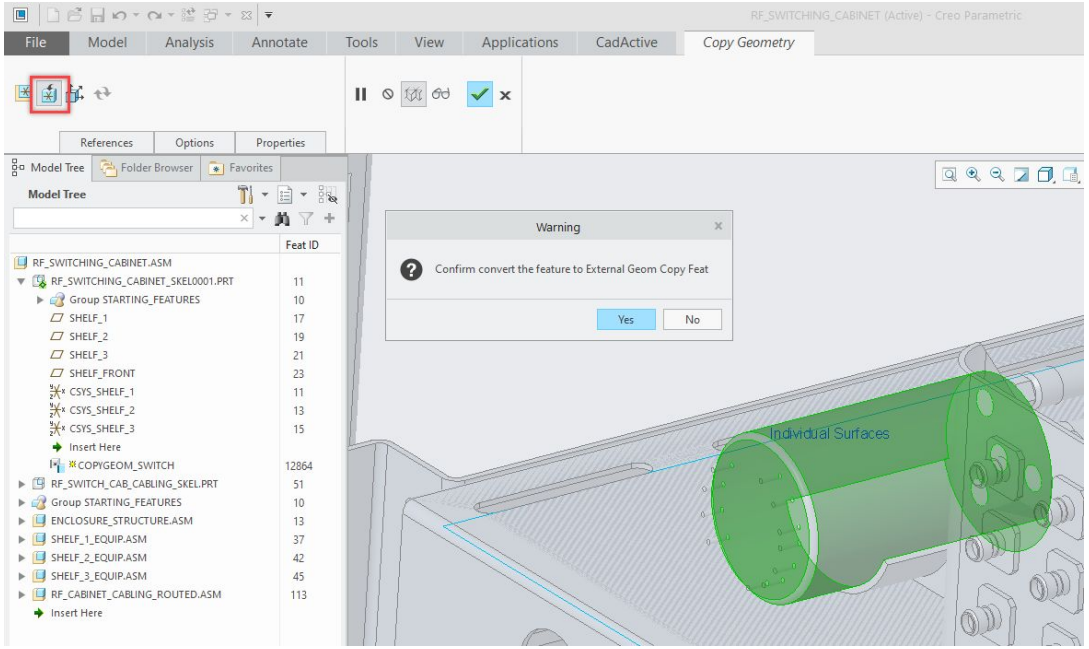
Internal vs. External Copy Geometry

- Default copy geometry is internal
- Internal can be changed to an external type, which is irreversible
- Internal references the ASM hierarchy structure to obtain the global feature location of the copy geometry (not very lightweight)
- External uses one of three methods to determine global feature location, breaking the original parametric link (lightweight)



Externalizing an Internal Copy Geometry

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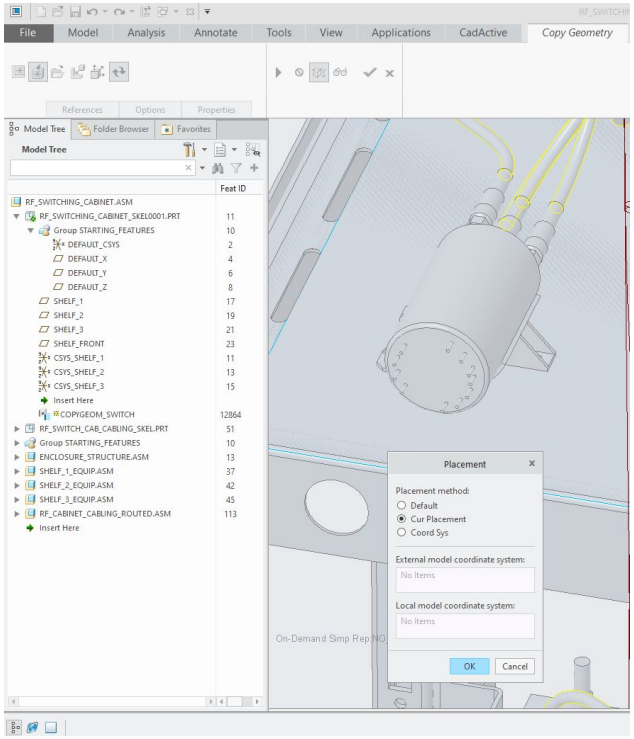
Externalizing Internal Copy Geometry

- External CGs place the copied geometry based on the global location of the reference PRT via three options:
  - **Default** - places the copied geometry in the current skeleton model using the default location. The PRT's local csys gets constrained to the default csys.
    - Probably never want to select this.
  - **Current Placement** - places the copied geometry in the current model using the current relative placement - the transformation from the default to the PRT's local.
    - Needs to be saved as internal CG first to get position, then redefined and externalized.
  - **Coordinate System** - places the copied geometry in the current model by aligning coordinate systems.
    - Difficult to do, need a placement csys!



Default vs. Current Placement vs. Coordinate System Placement

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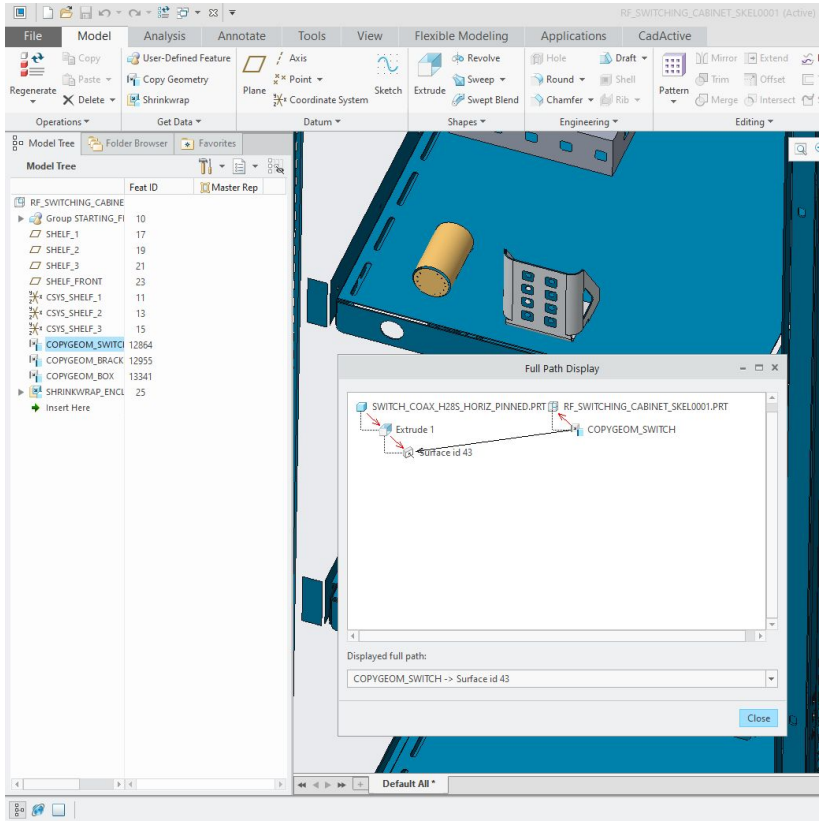
Externalizing Copy Geometry

- Once the placement location is chosen, Creo only needs to calculate the transformation between the feature being copied and the chosen local coordinate system.

- As shown (right), this is a very simple reference path compared to the internal CG. This would take Creo **much less time** to load into session.

NOTE: Since the reference to the original model has been broken, the external CG is frozen in place. If the location of the original model moves, the external CG will not update. Likewise, if the original model fails, the external CG will still show.



Full Reference Path of external COPYGEOM_SWITCH copy geometry

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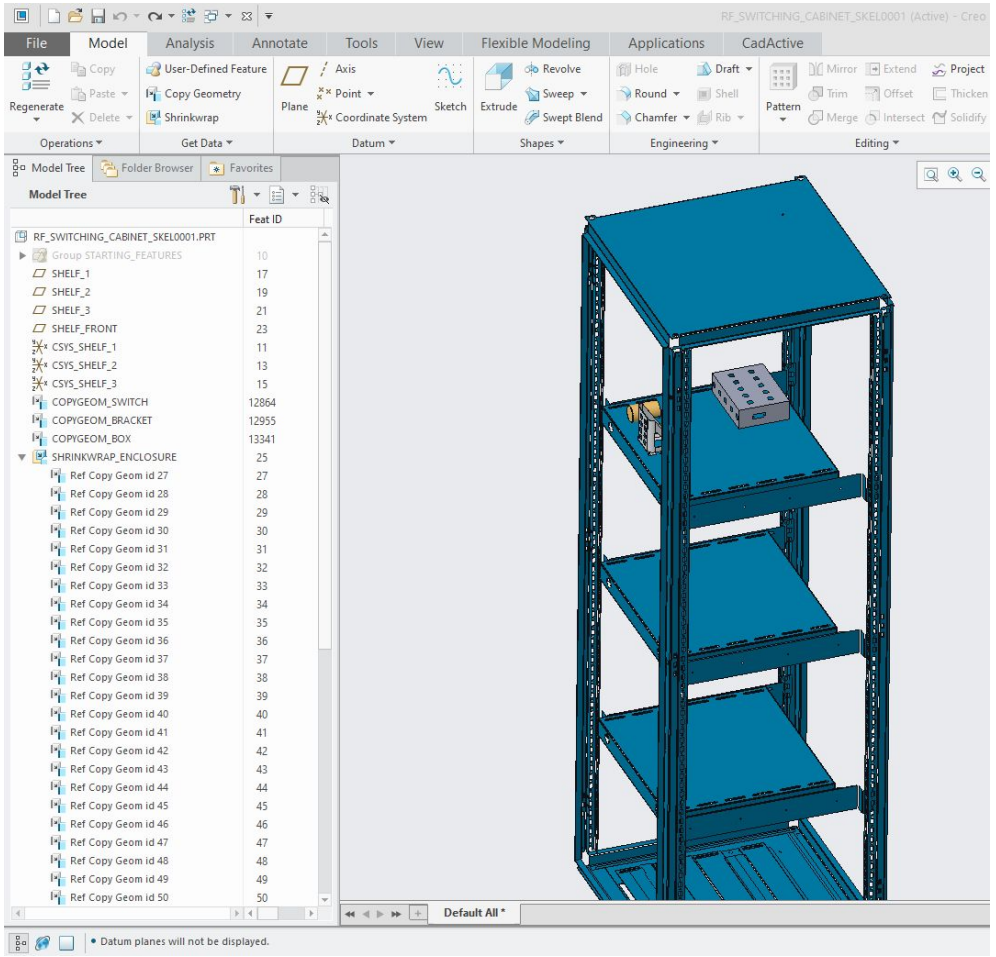
Shrinkwrap Features

- When doing an individual copy geometry, users can only create copy geometry features from a single PRT.
- Shrinkwraps allow users to create copy geometry features from multiple PRTs in an ASM.
- Shrinkwraps are a collection of copy geometry references from children PRTs from the defining parent ASM.

Note: Shrinkwrap feature should not be confused with a Shrinkwrap PRT!



3-shelf skeleton, showing the shrinkwrap of the enclosure and the numerous copy geometries contained within it from the child enclosure PRTs

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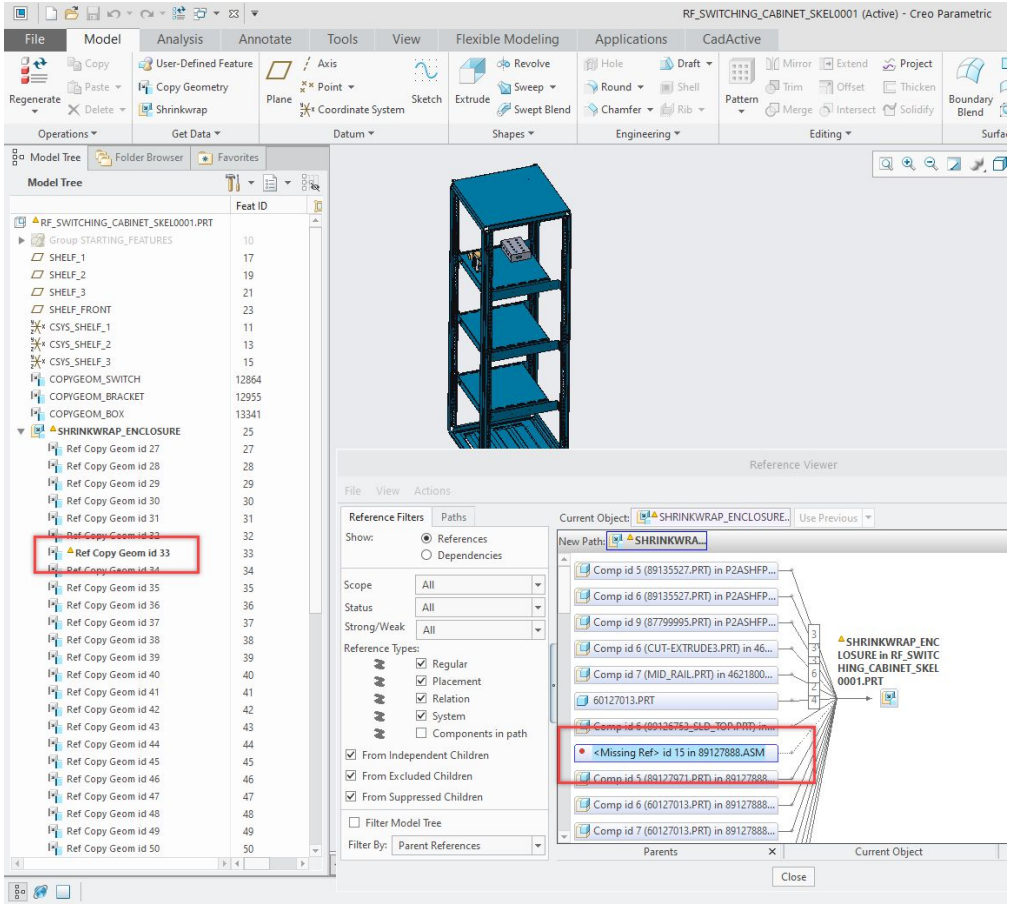
Shrinkwrap Pitfalls

While shrinkwraps are powerful as blunt objects for creating copy geometry references, we generally recommend that organizations **do not** rely on them for two main reasons:

1. If a **single** reference is deleted/missing, it causes the entire shrinkwrap to **fail**
   a. All or nothing, can't re-reference or fix a single copy geometry inside a shrinkwrap

2. Users will often include **too** many things to reference, which hurts model performance



3-shelf skeleton showing the broken shrinkwrap and the missing individual copy geometry reference

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Recommended Best Practices

We recommend organizations follow the best practices highlighted below for handling skeleton references in large assemblies. Our platform expedites this manual process. In summary:

1. When defining CGs, organizations should try to reference well-defined Publish Geometry
   a. Config.Pro setting: *copy_geometry_method* **publish_geometry**

2. When you can use them, external CGs are more efficient for Creo load times than internal CGs

3. “Current Placement” is the easiest option for externalizing CGs when doing them manually

4. Try to avoid large, unruly shrinkwraps when individual CGs will do

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3-shelf skeleton using datums AND surfaces