Fusion 360 - Assemblies Masters Class

Kevin Schneider

Fusion 360 | Autodesk

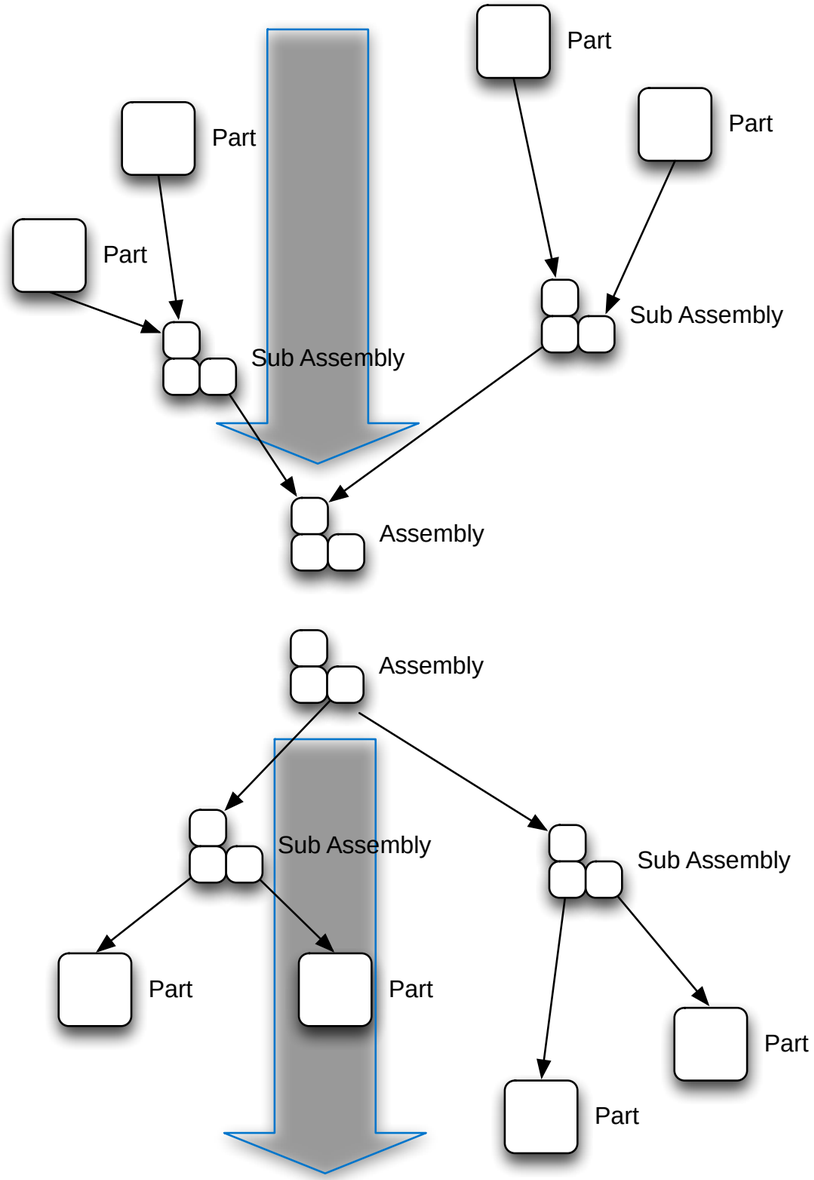
Topics

Fusion 360 design methodology
Bodies vs Components
Managing References
Degrees of Freedom
Positioning Components

Fusion 360 design methodology

Assembly Design Methods

- Bottom Up
  - Build piece parts, assemble them into sub assemblies
  - Assemble sub assemblies into a final assembly
- Top Down
  - Start with the assembly and work down to detail parts

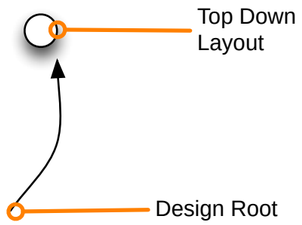


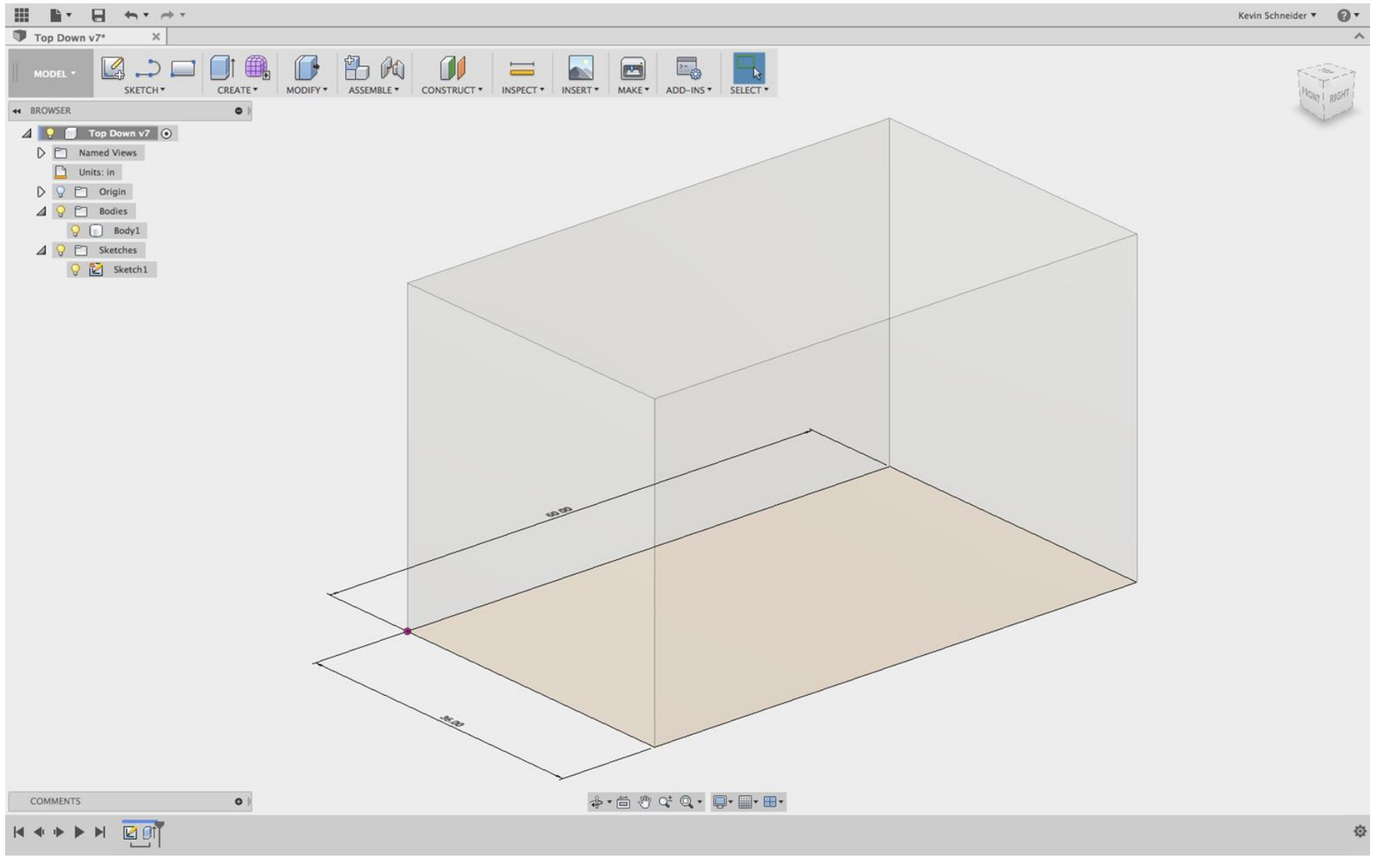
Top-down design methodology

- Top Down “Layout driven” or “Skeleton”
  - Sketch/Work Geometry and parameters makeup a layout”
- Not “In context” from SolidWorks
- Not Adaptive from Inventor

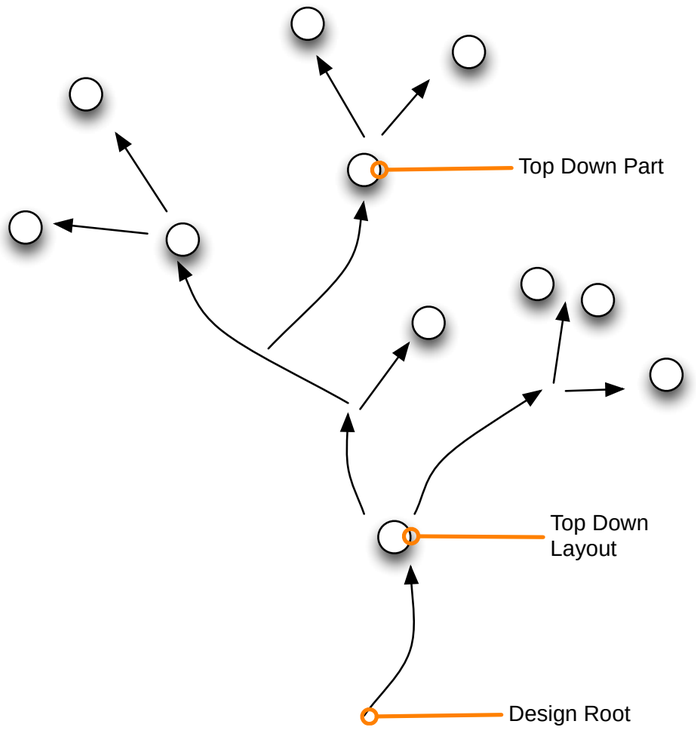
- **Fusion 360 was designed to be a layout, top down design environment**

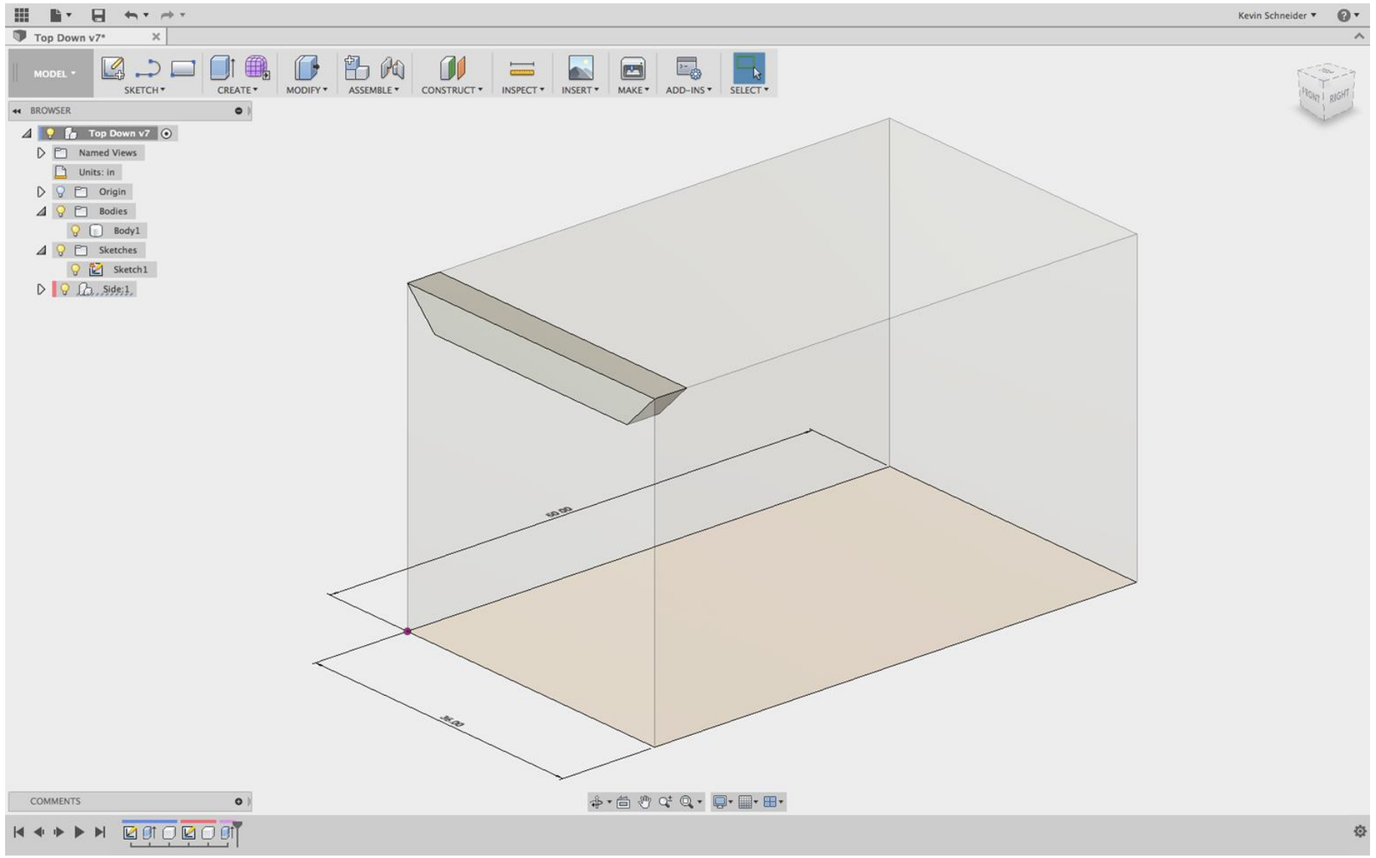
Tree Mental Model



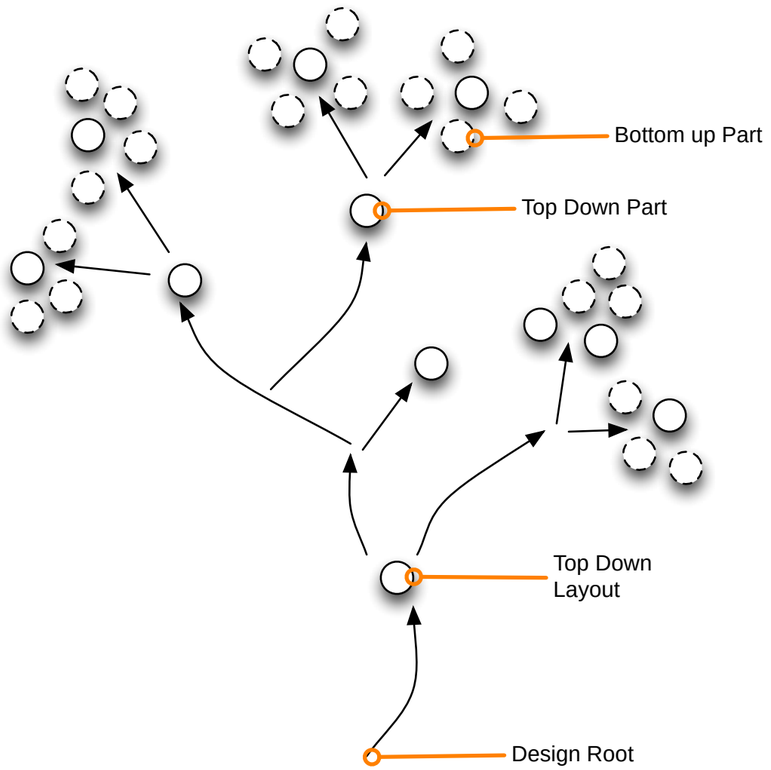


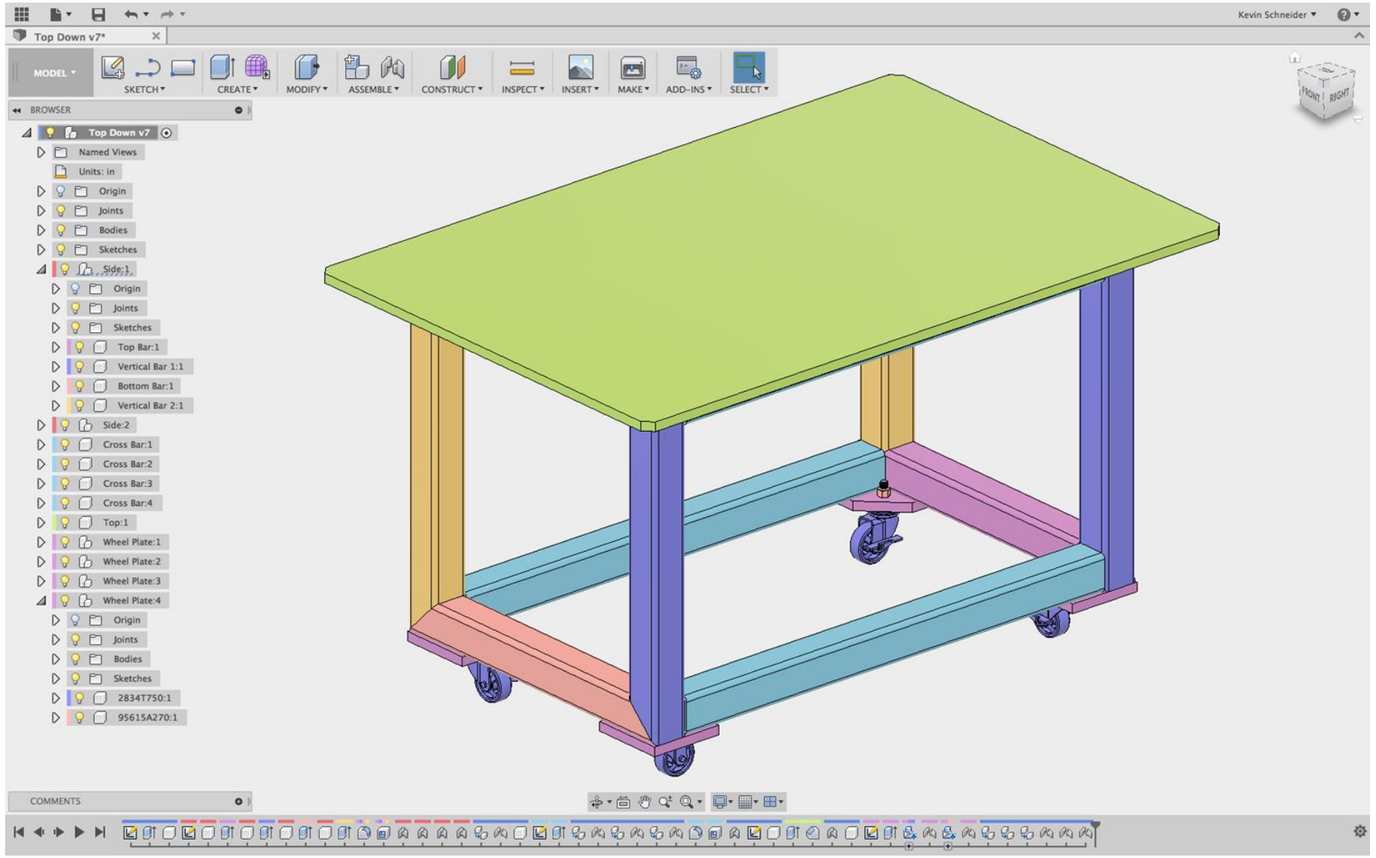
Tree Mental Model



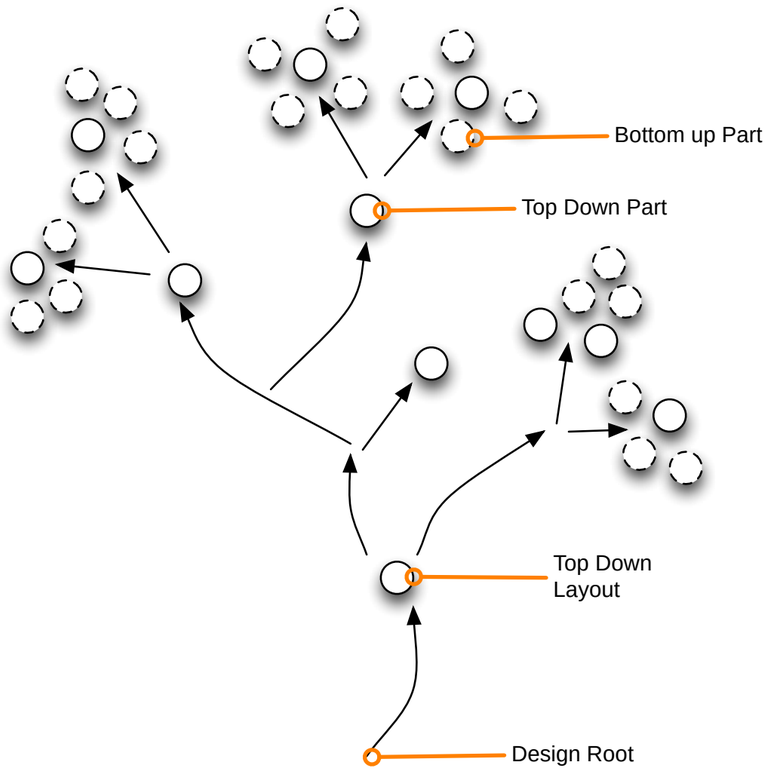


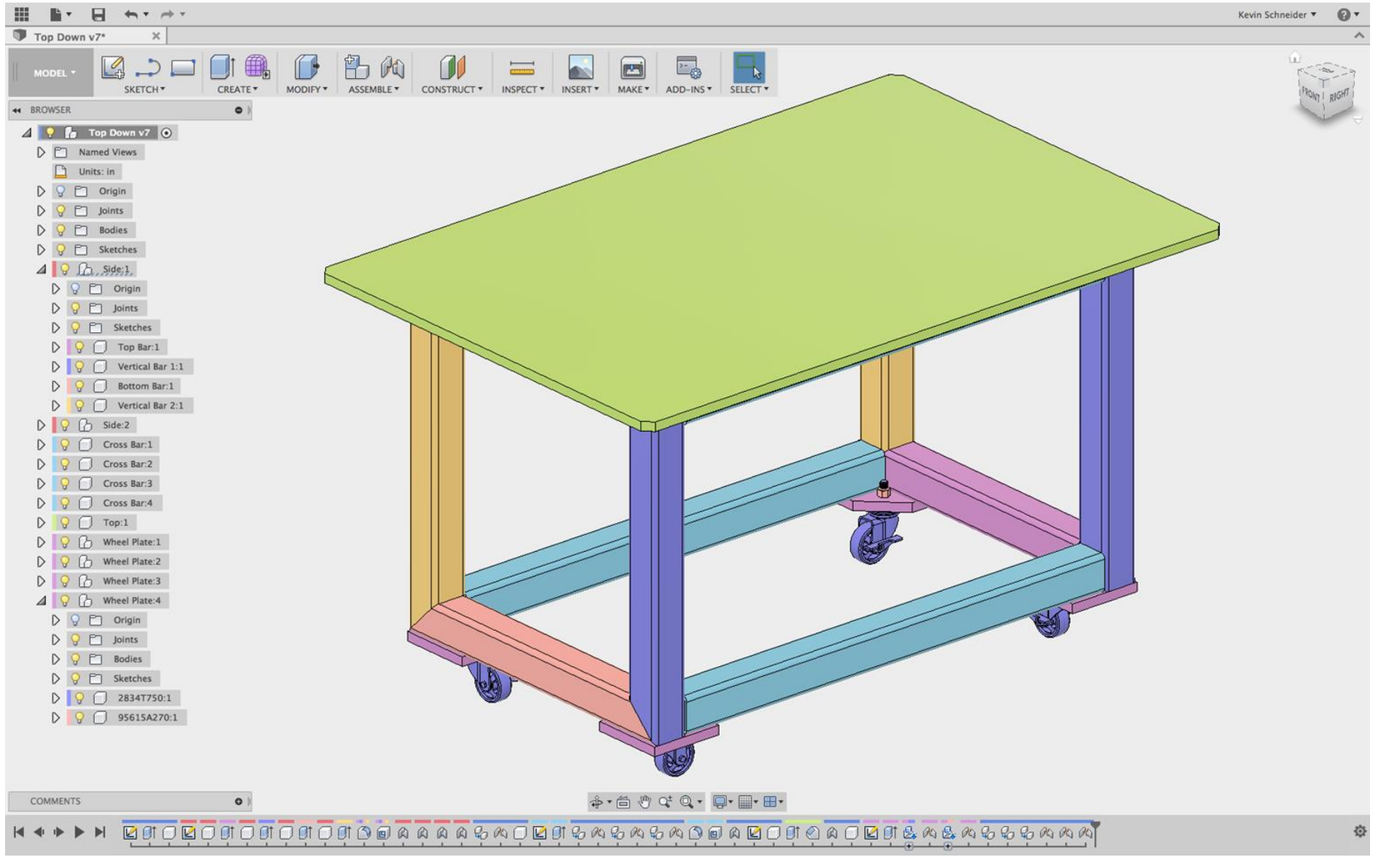
Tree Mental Model





Tree Mental Model – Top Down Only

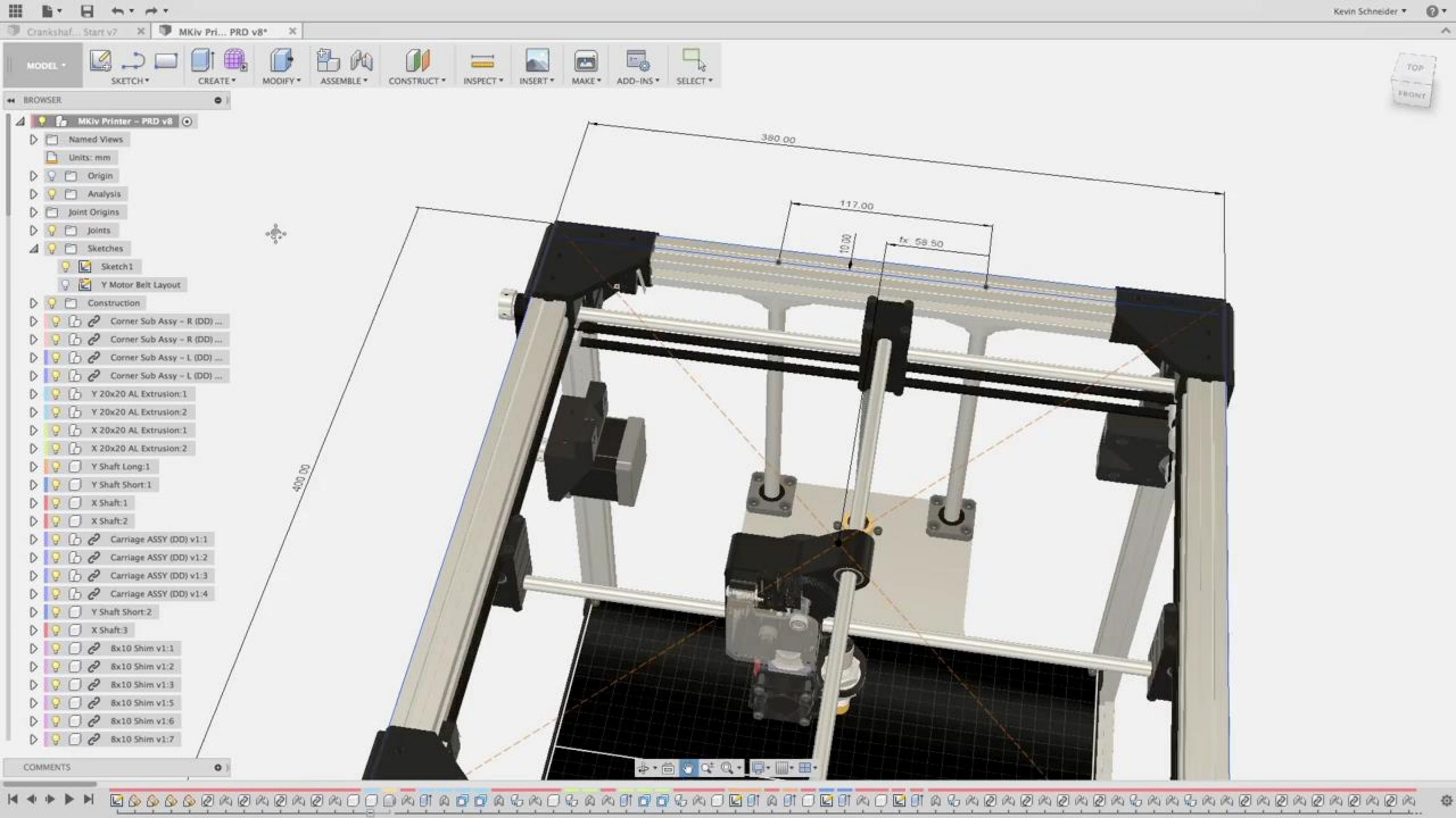




Demo

Top Down – Finished.f3d

Fusion 360 File Edit View Window Share Help
Tue 8:55 AM schneik
Autodesk Fusion 360
Kevin Schneider
Top Down v9*
MODEL
SKETCH
CREATE
MODIFY
ASSEMBLE
CONSTRUCT
INSPECT
INSERT
MAKE
ADD-INS
SELECT
BROWSER
Top Down v9
Named Views
Units: in
Origin
Joints
Bodies
Body1
Sketches
Sketch1
Sketch2
Side:1
Side:2
Cross Bar:1
Cross Bar:2
Cross Bar:3
Cross Bar:4
Top:1
Wheel Plate:1
Wheel Plate:2
Wheel Plate:3
Wheel Plate:4
FRONT
RIGHT
COMMENTS


Kevin Schneider
Crankshaf... Start v7
MKiv Pri... PRD v8*
MODEL
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ADD-INS
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MKiv Printer - PRD v8
Named Views
Units: mm
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Joint Origins
Joints
Sketches
Sketch1
Y Motor Belt Layout
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Corner Sub Assy - R (DD) ...
Corner Sub Assy - L (DD) ...
Corner Sub Assy - L (DD) ...
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Y 20x20 AL Extrusion:2
X 20x20 AL Extrusion:1
X 20x20 AL Extrusion:2
Y Shaft Long:1
Y Shaft Short:1
X Shaft:1
X Shaft:2
Carriage ASSY (DD) v1:1
Carriage ASSY (DD) v1:2
Carriage ASSY (DD) v1:3
Carriage ASSY (DD) v1:4
Y Shaft Short:2
X Shaft:3
8x10 Shim v1:1
8x10 Shim v1:2
8x10 Shim v1:3
8x10 Shim v1:5
8x10 Shim v1:6
8x10 Shim v1:7
COMMENTS
380.00
117.00
10.00
fx 58.50
400.00
TOP
FRONT

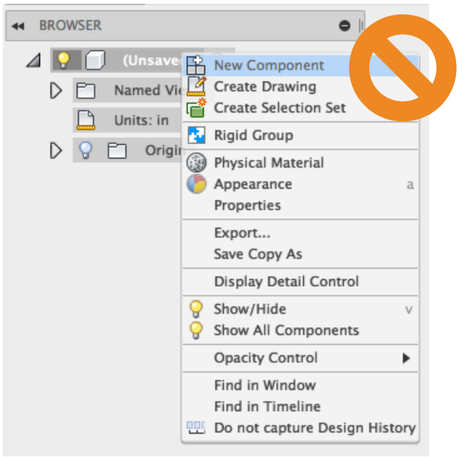
Top Down Benefits

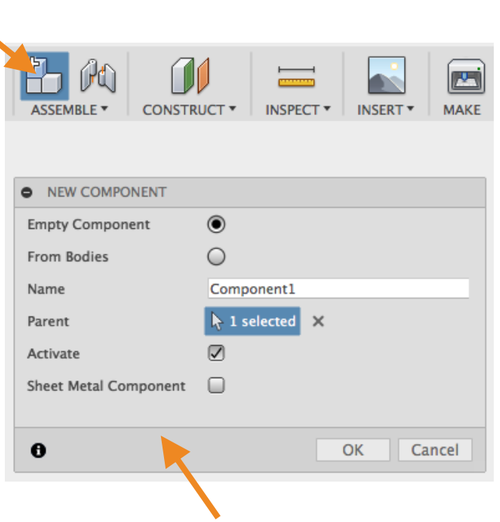
- **Simpler to learn**
  - Multi part modeling and assembly modeling behave the same
- **Promotes design creativity**
  - Designs start simple and add detail as the design evolves
  - Change is easy to make
- **Cross-component relationships are self contained in one design**
  - Makes edits and management easier
  - Reduces errors from out of context changes
  - Components are designed in place, reusing intent and reducing work positioning

Bodies and Components

Bodies and Components

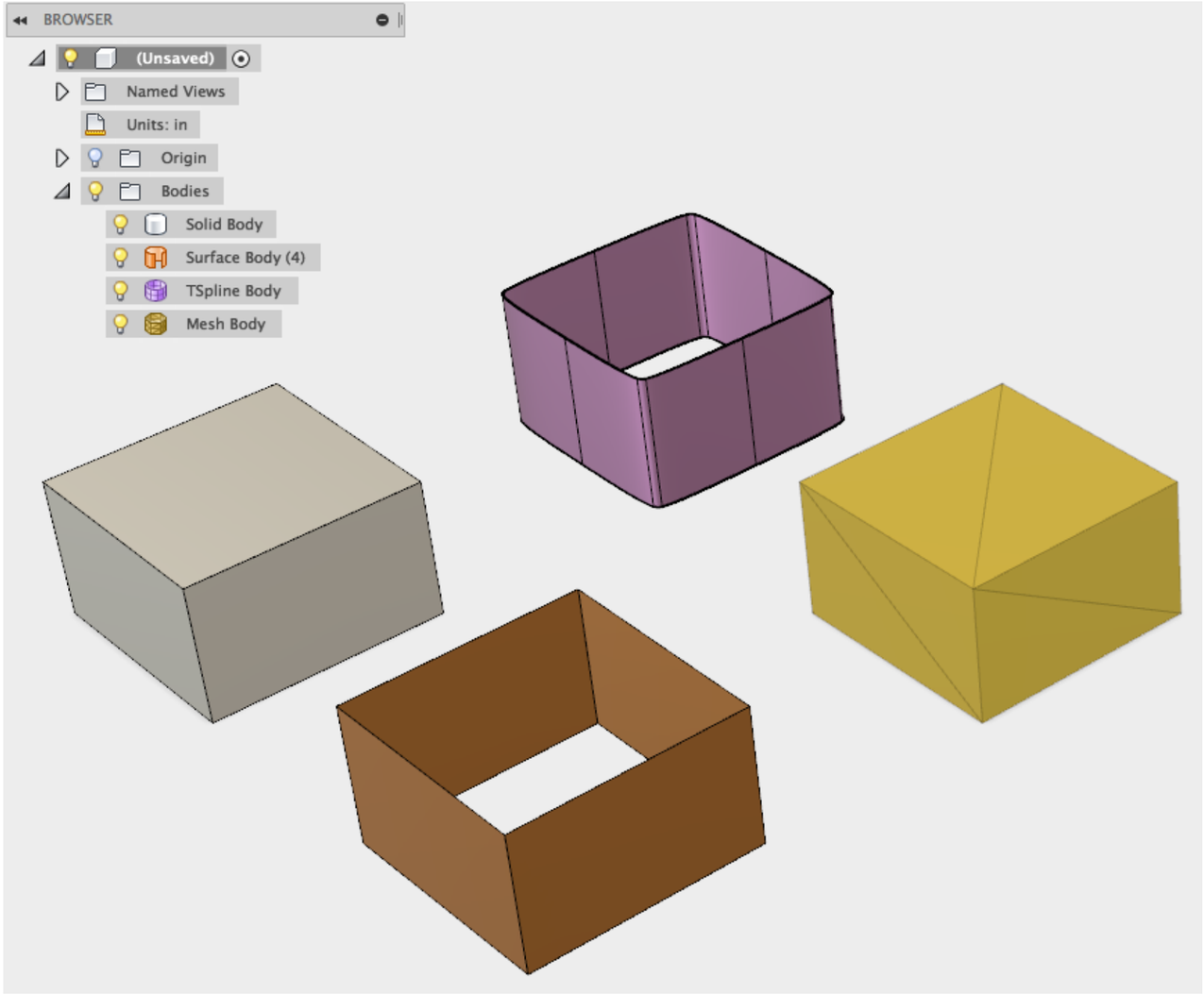
- Any Design can be a part, or an assembly
- Fusion 360 calls both parts and assemblies components
  - Any component can have child components
  - Any component can have 0, 1 or more bodies
  - Components can have both bodies and child components
- General rule: always create a component as soon as you know you need one.
- Use the **Create Component** command for more options





Noteworthy Body Benefits:

- Bodies have a type
  - Solid
  - Surface
  - TSpline
  - Mesh
- Bodies can be organized in folders
- Bodies do not move with respect to their parent origin
- Bodies have materials



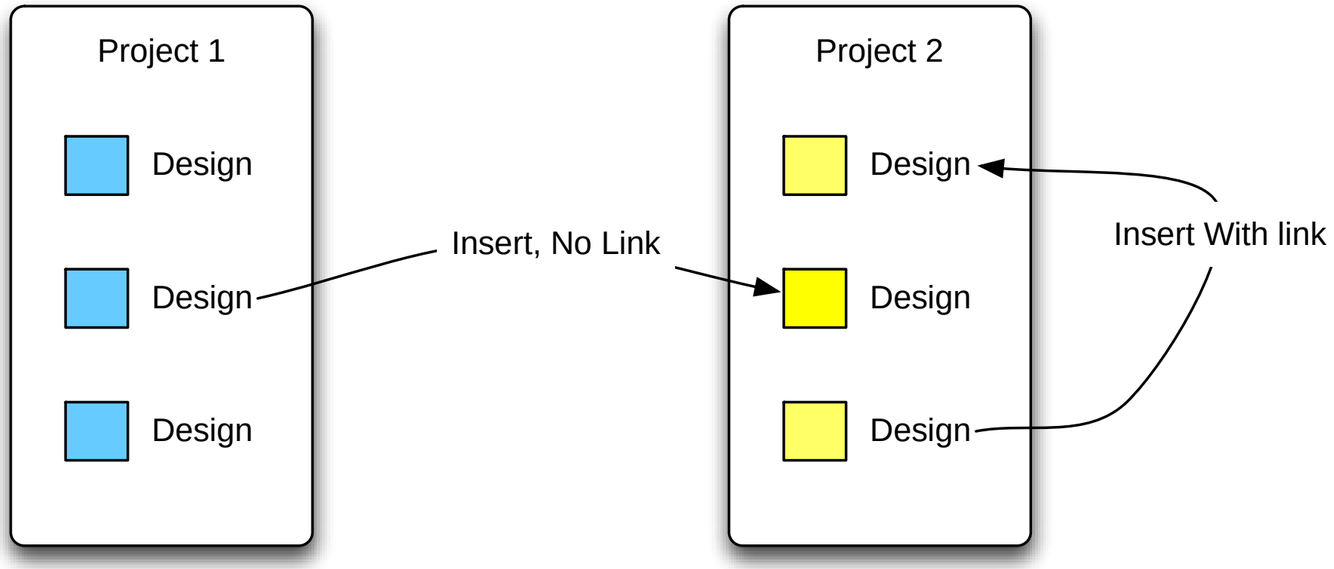
Noteworthy Component Benefits:

- Joints only work with components
- Drawings can be made of individual components
- Components have part numbers and other properties
- BOM is based off components and their properties
- Components can have occurences
- Components can be save out to a new file
- Components can be inserted
- Components have an origin
- Activating components can help manage your timeline

Managing References

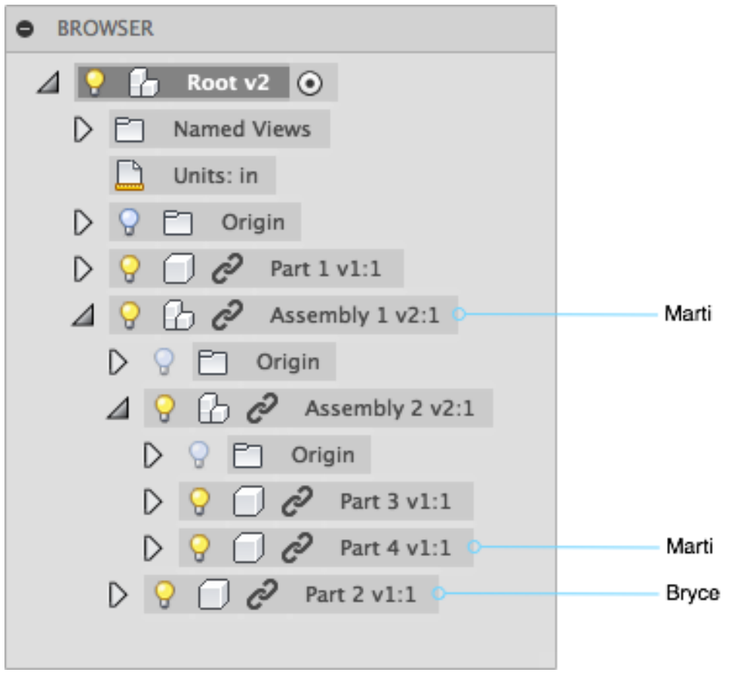
Inserting linked Components

- You can only insert (with link) components in the same project
  - This will change this fall
  - You can break link for any linked inserted design
  - You can move and rename without breaking references

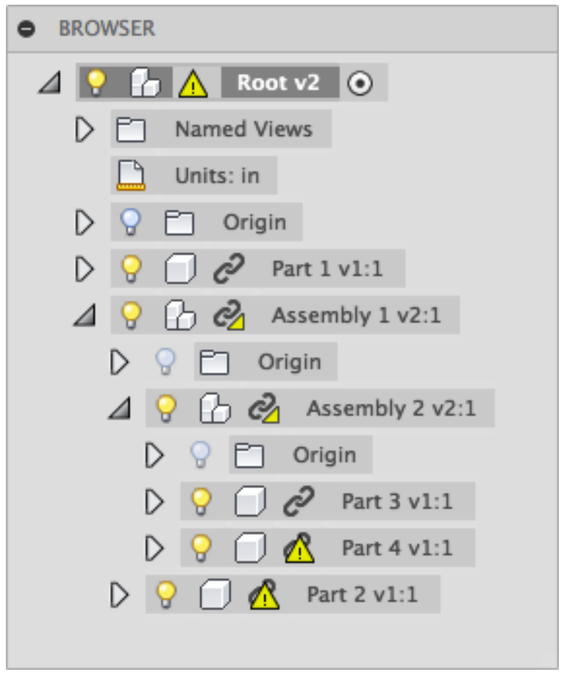


References and versions

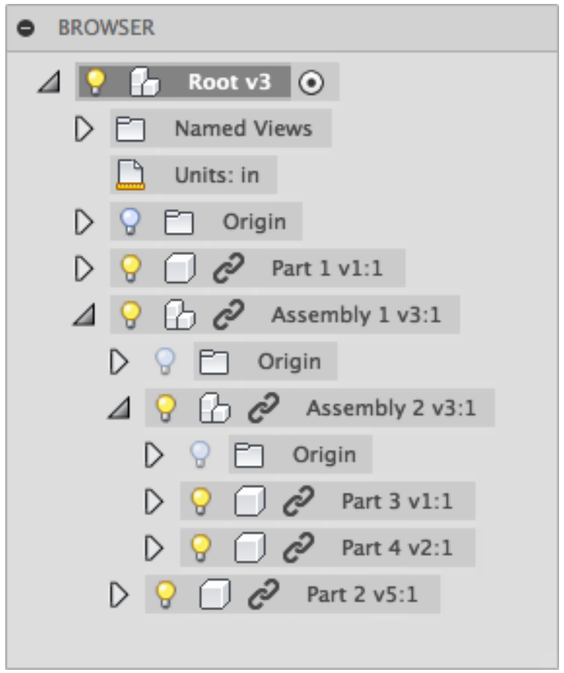
- References are versions specific
  - The parent stores the version reference
  - Get latest will load latest versions
  - This does not create versions unless you save



Start



Edit

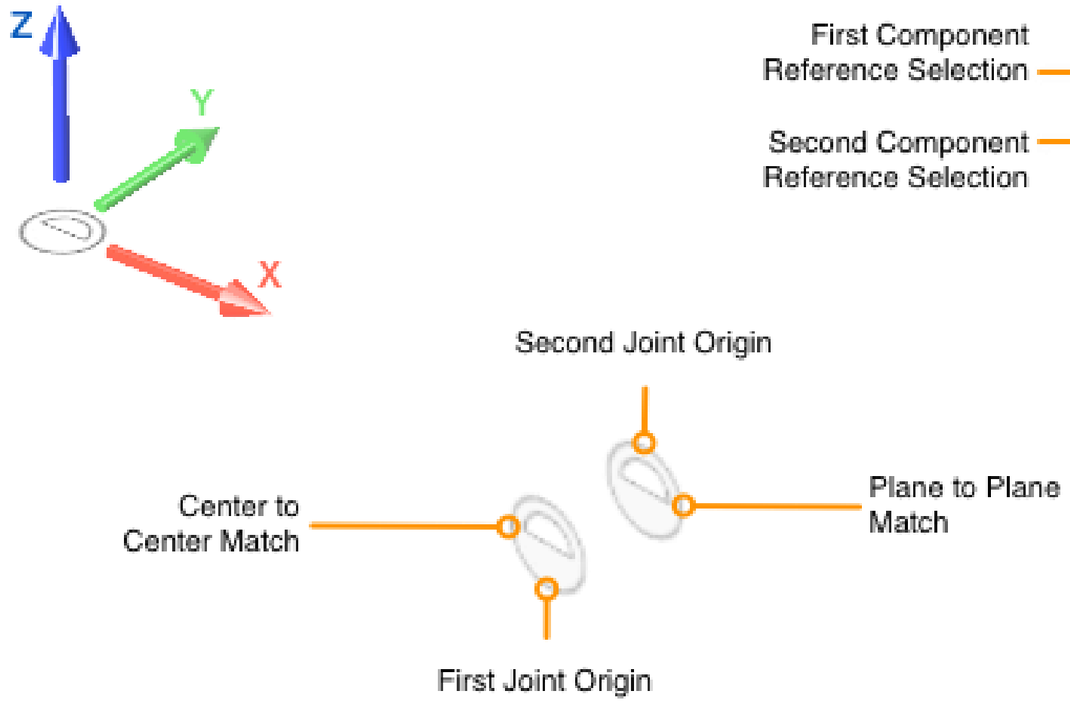


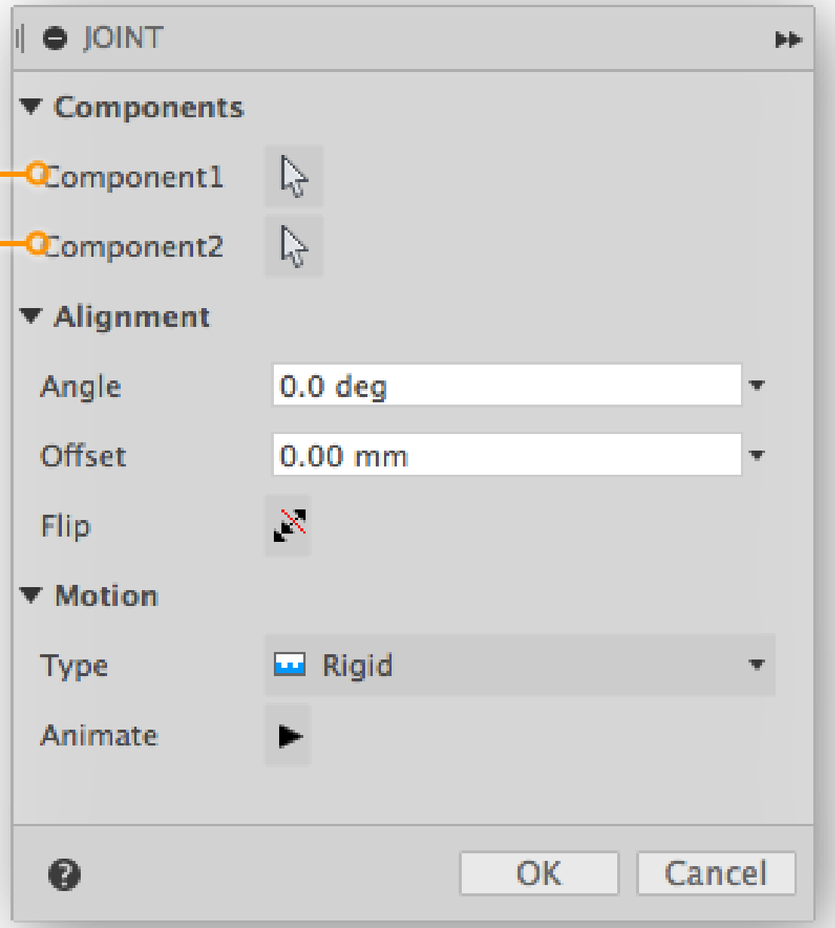
Save

Positioning Components

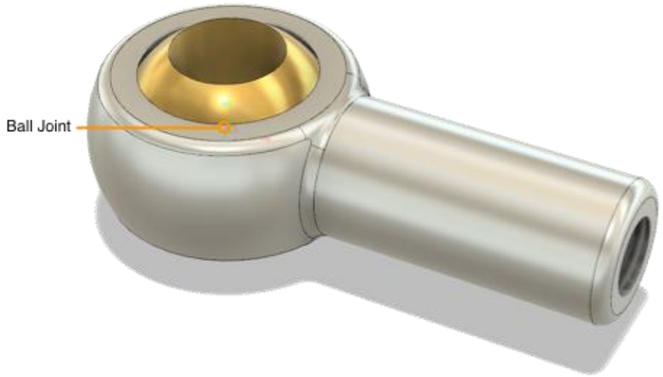
Creating Joints

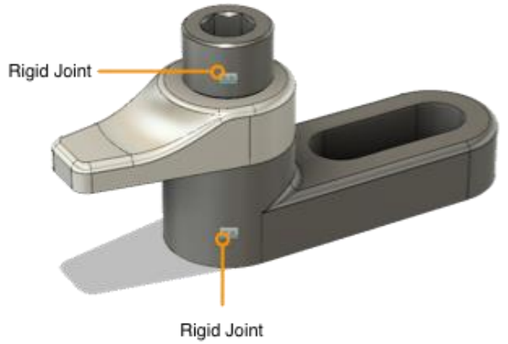
Define how components move in relation to each other rather than locking down degrees of freedom.

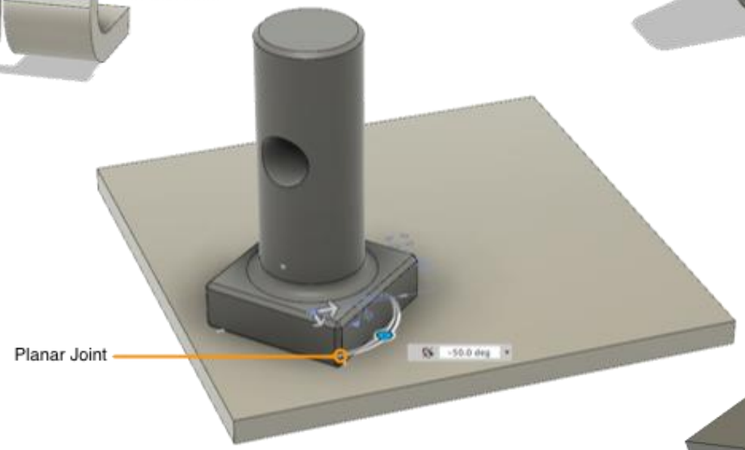


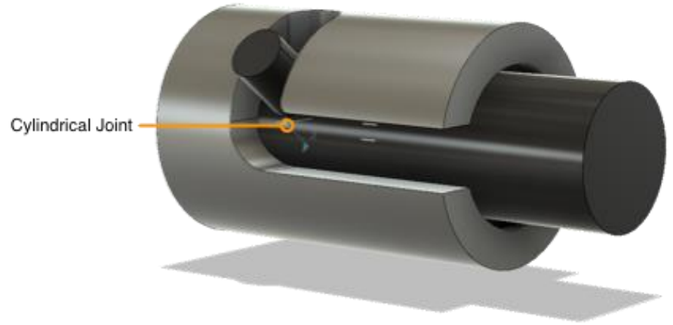


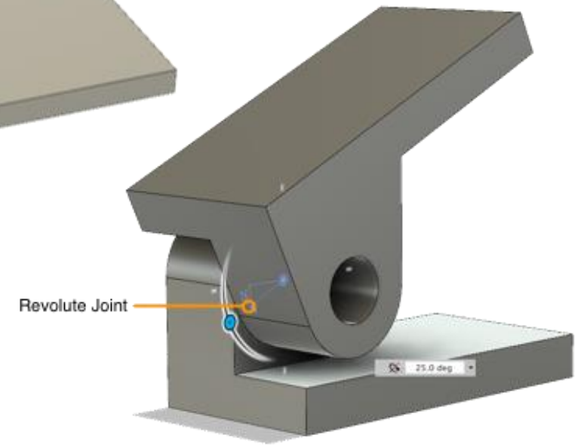
Understanding Joint Types





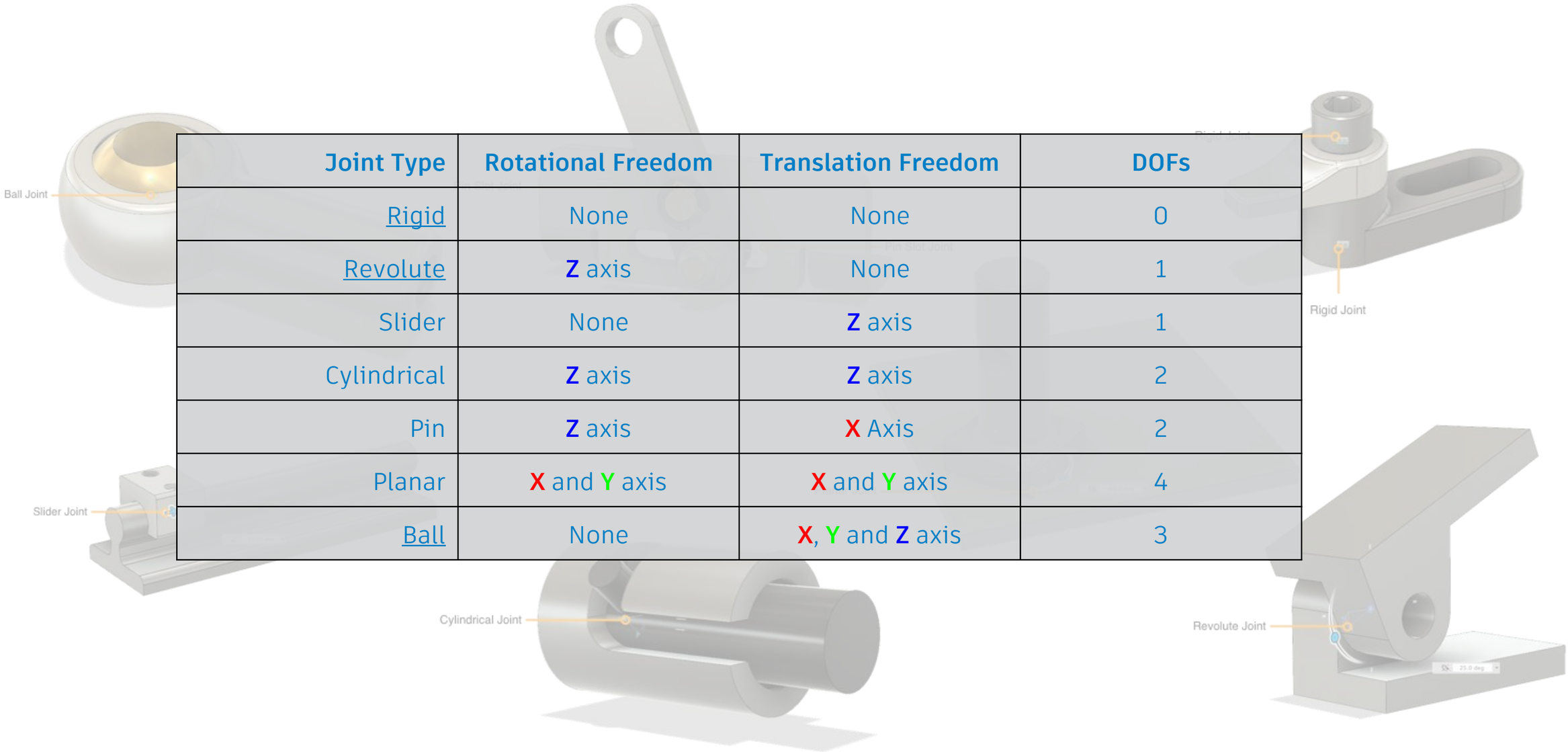




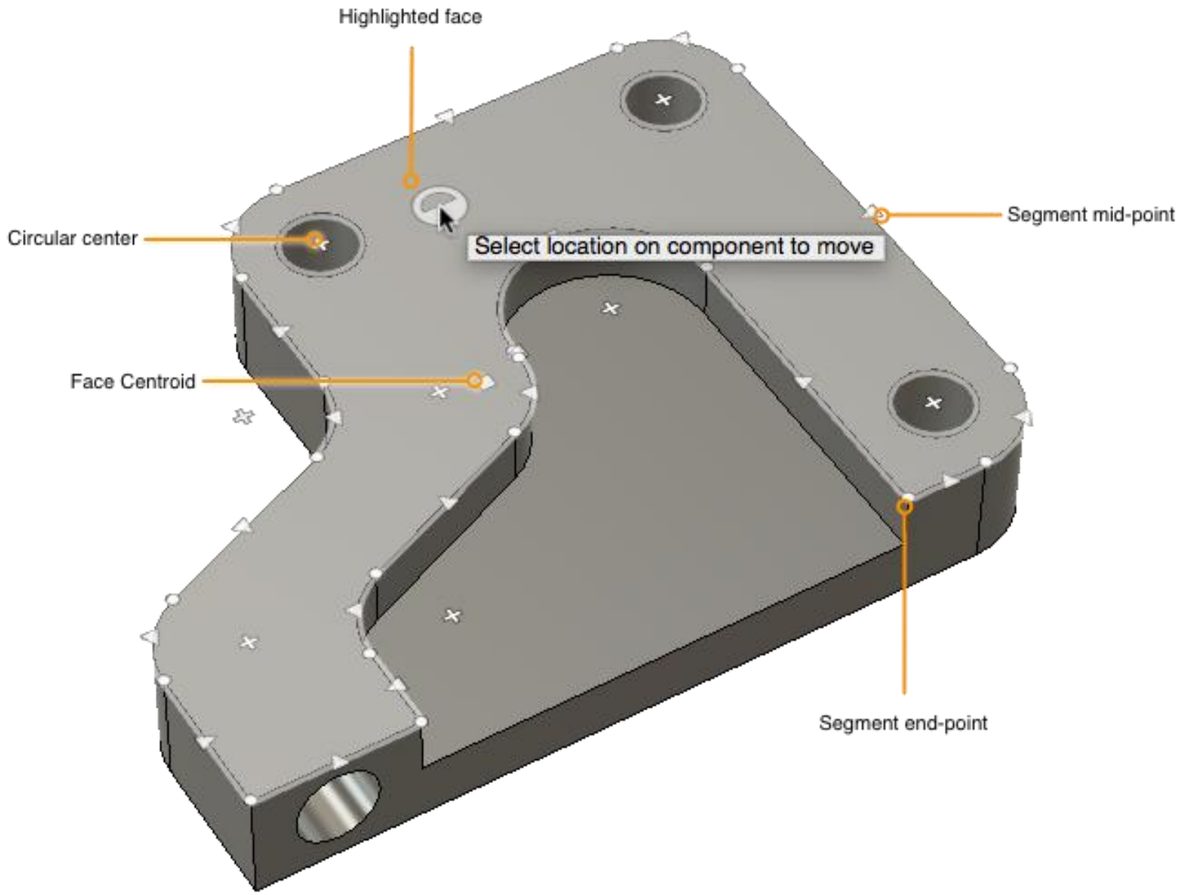


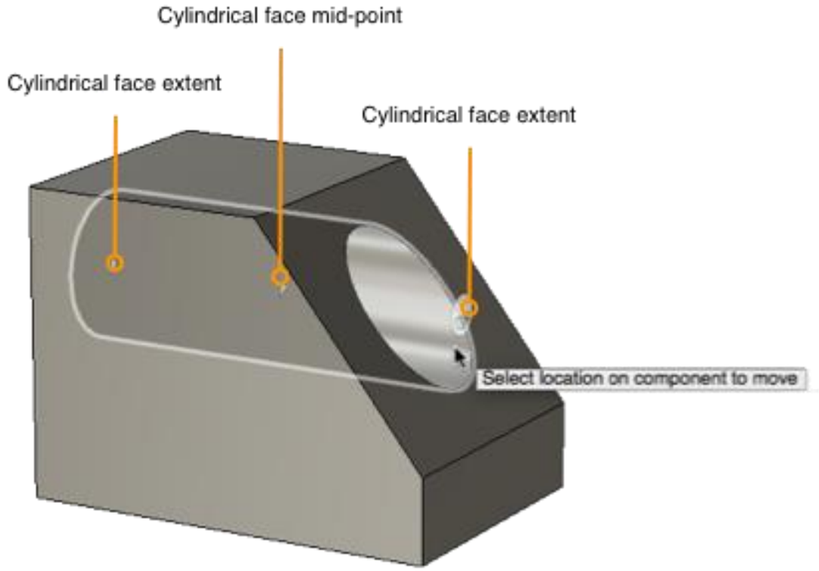
Joint Degrees of Freedom

Joint Type	Rotational Freedom	Translation Freedom	DOFs
Rigid	None	None	0
Revolute	**Z** axis	None	1
Slider	None	**Z** axis	1
Cylindrical	**Z** axis	**Z** axis	2
Pin	**Z** axis	**X** Axis	2
Planar	**X** and **Y** axis	**X** and **Y** axis	4
Ball	None	**X**, **Y** and **Z** axis	3

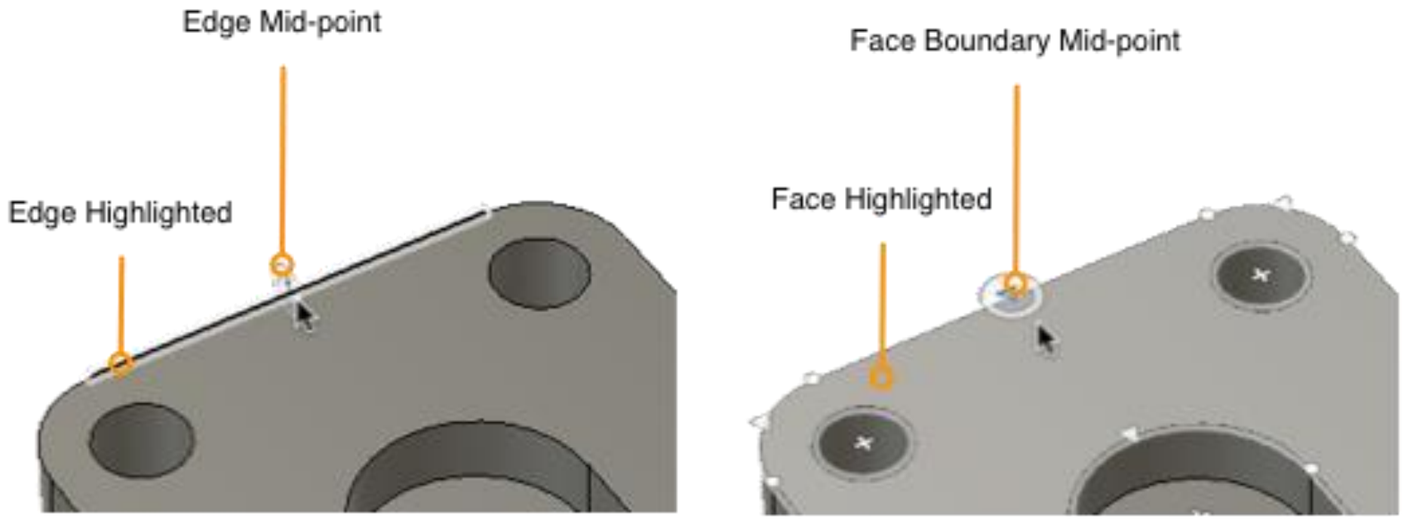


Joint Snap Points



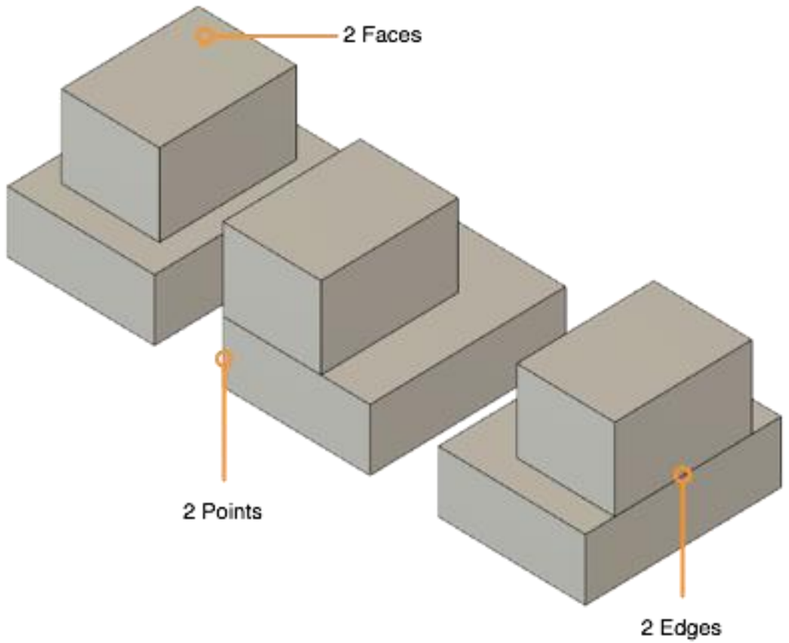


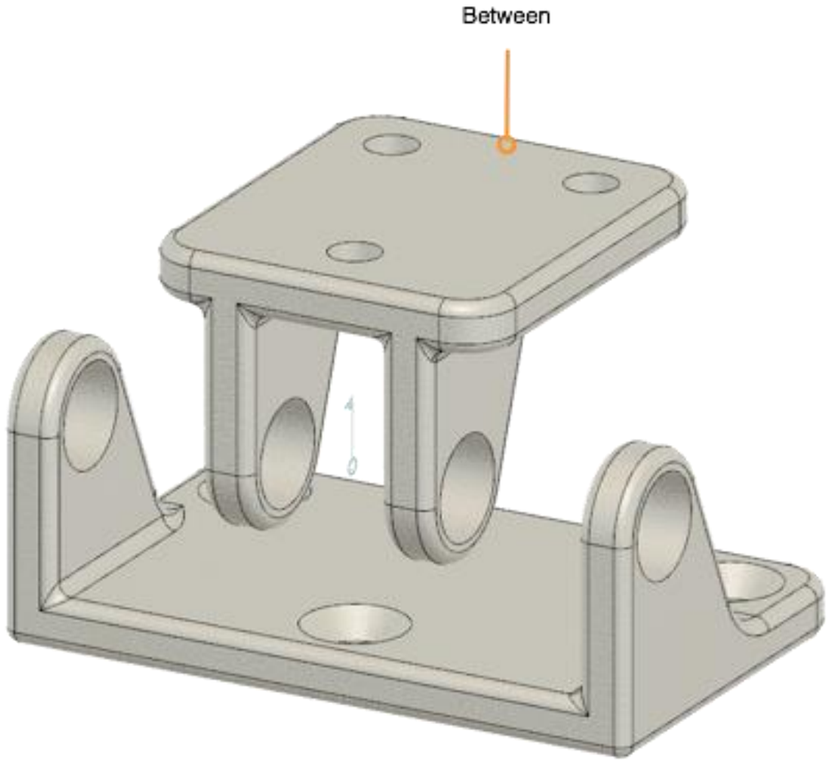
Face Snap Points vs Edge Snap Points



To lock the selection to an entity hold down Command (OS X) or Control (Win).

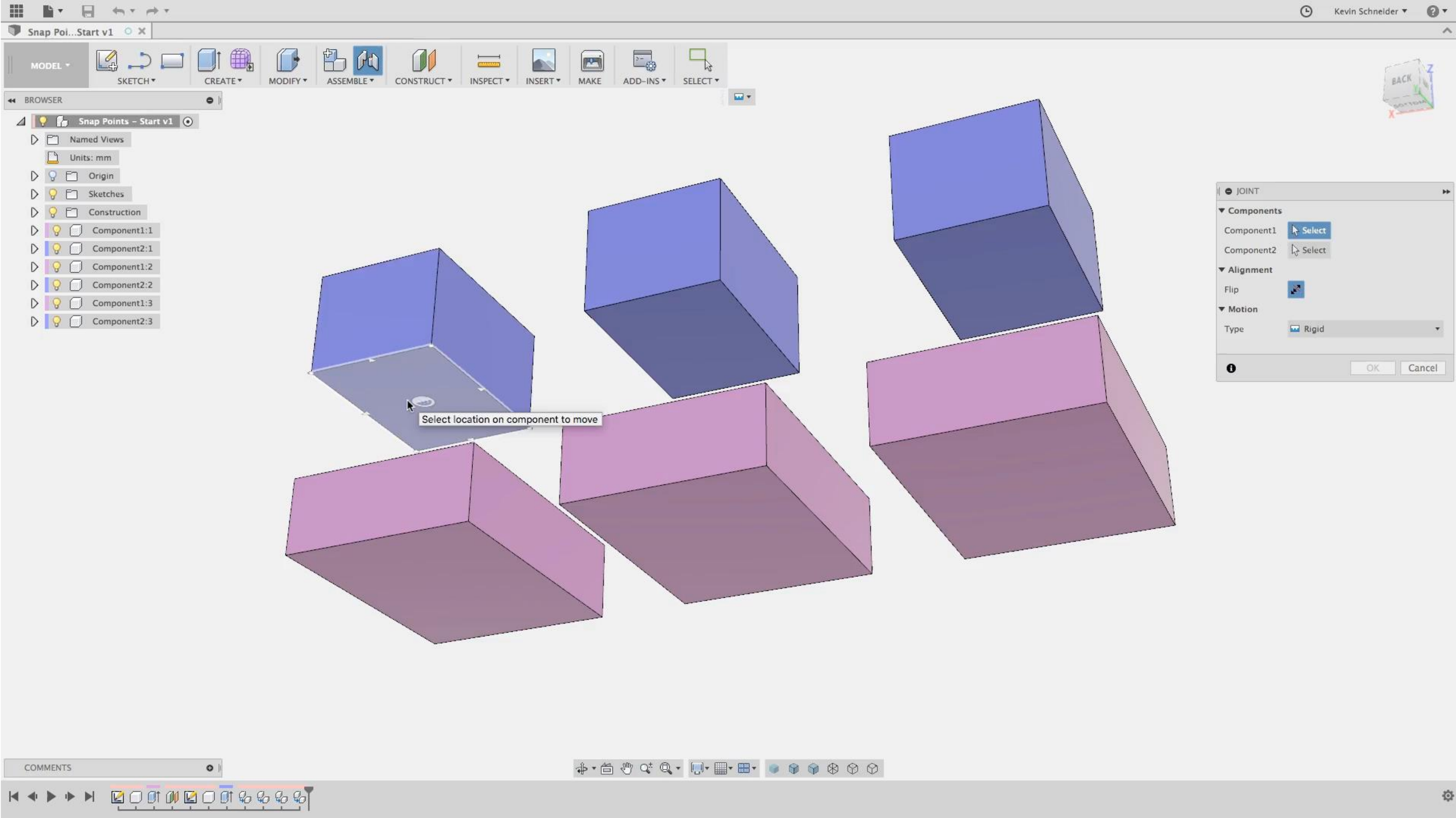
A few common tips





Demos

Snap Part – Start.f3d
Between – Start.f3d


Snap Poi...Start v1
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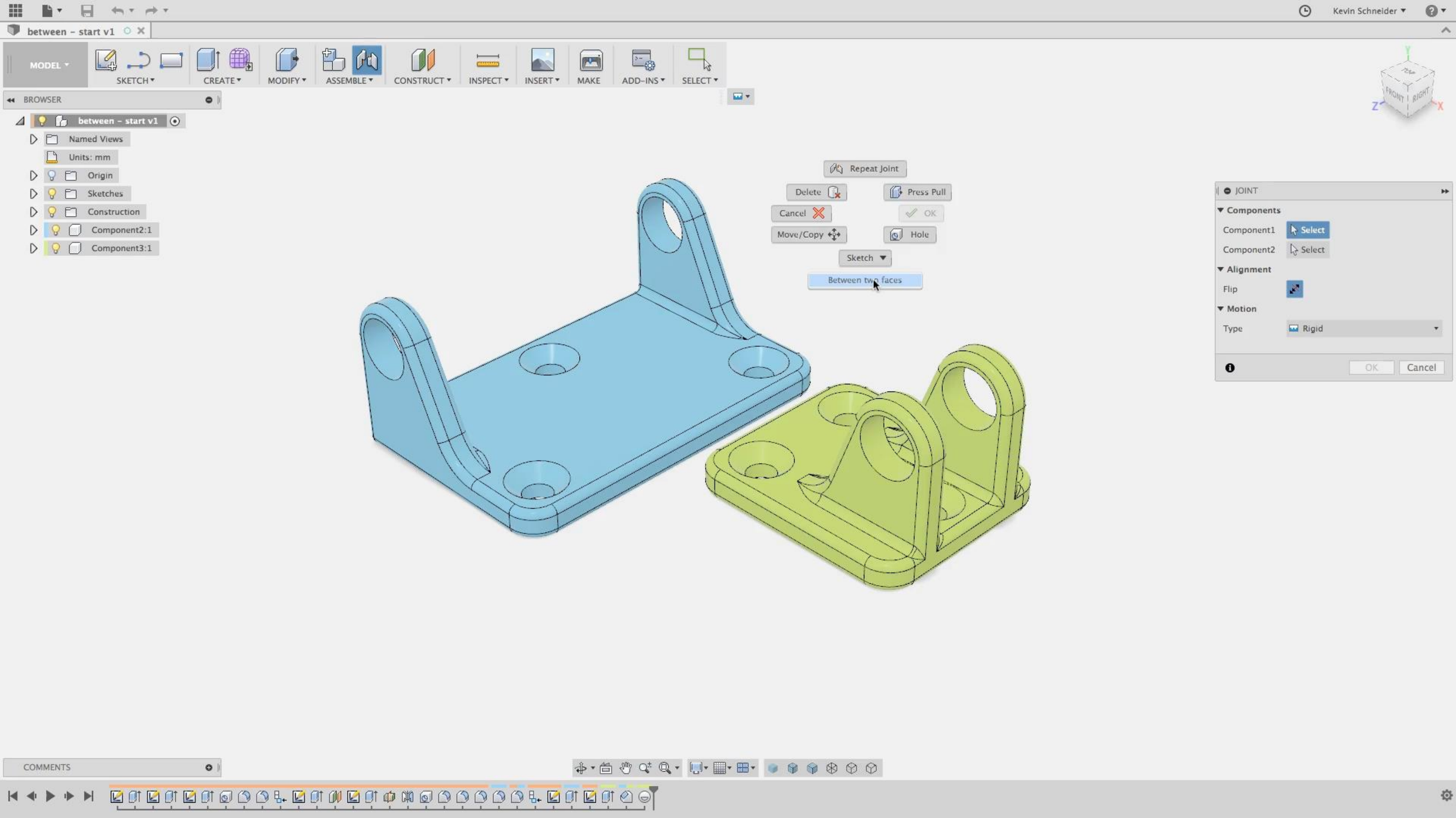
BROWSER
Snap Points - Start v1
Named Views
Units: mm
Origin
Sketches
Construction
Component1:1
Component2:1
Component1:2
Component2:2
Component1:3
Component2:3
Select location on component to move
JOINT
Components
Component1
Select
Component2
Select
Alignment
Flip
Motion
Type
Rigid
OK
Cancel
COMMENTS


between – start v1
Kevin Schneider
MODEL
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CREATE
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INSPECT
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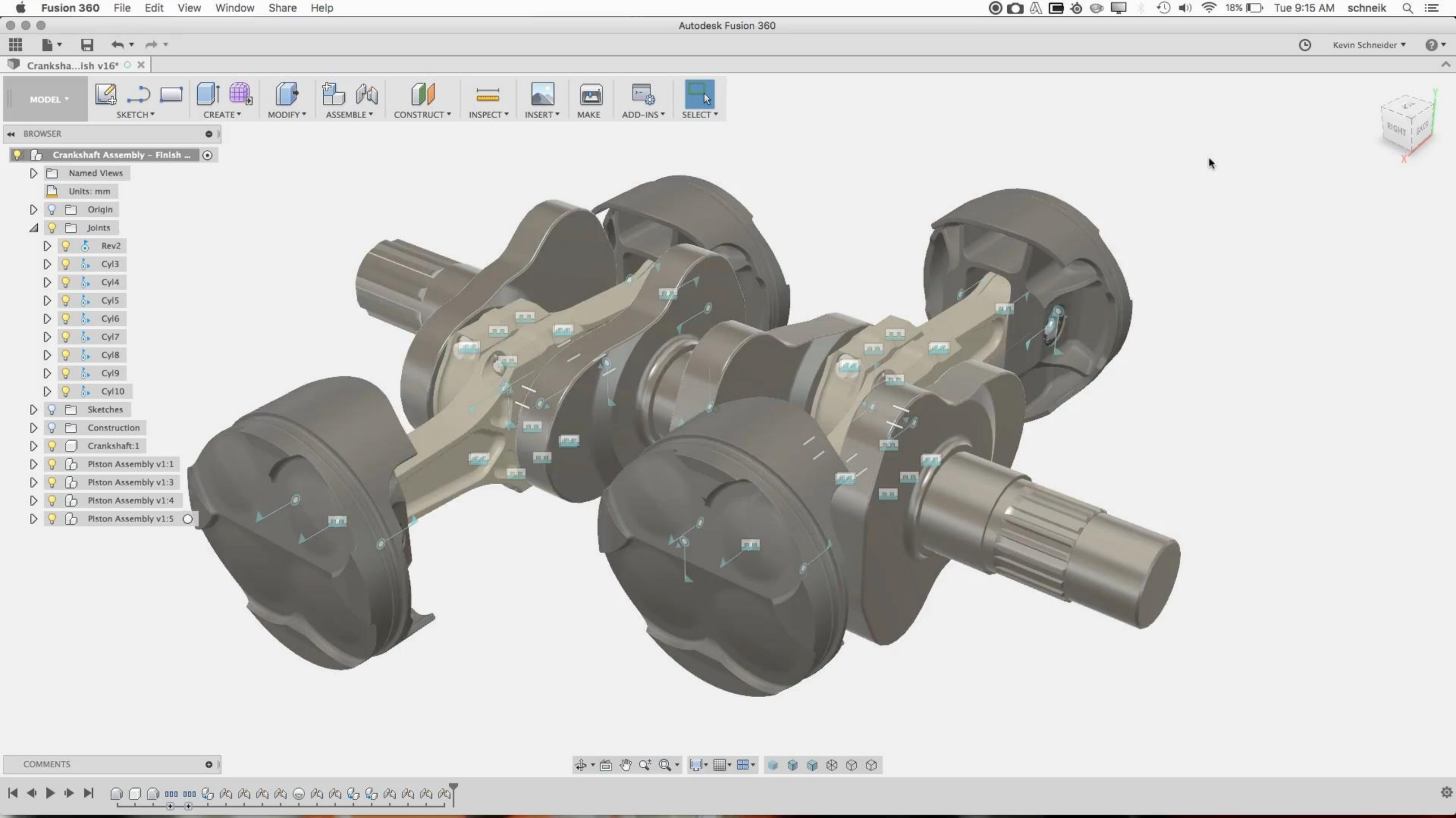
MAKE
ADD-INS
SELECT
BROWSER
between – start v1
Named Views
Units: mm
Origin
Sketches
Construction
Component2:1
Component3:1
Repeat Joint
Delete
Press Pull
Cancel
OK
Move/Copy
Hole
Sketch
Between two faces
JOINT
Components
Component1
Select
Component2
Select
Alignment
Flip
Motion
Type
Rigid
OK
Cancel
COMMENTS

Troubleshooting Joints

- Selection issues
  - Select component(s) from joint
  - Select joint(s) from component
  - Turn on color swatches
- Managing joint visibility
  - Session Option
  - Filter and window select
- Joint solve failures
  - Joints are in time, roll back to triage

Demos

Crankshaft - Assembly Finished.f3d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Cranksha...ish v16*
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Crankshaft Assembly - Finish ...
Named Views
Units: mm
Origin
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Rev2
Cyl3
Cyl4
Cyl5
Cyl6
Cyl7
Cyl8
Cyl9
Cyl10
Sketches
Construction
Crankshaft:1
Piston Assembly v1:1
Piston Assembly v1:3
Piston Assembly v1:4
Piston Assembly v1:5
COMMENTS

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Joints
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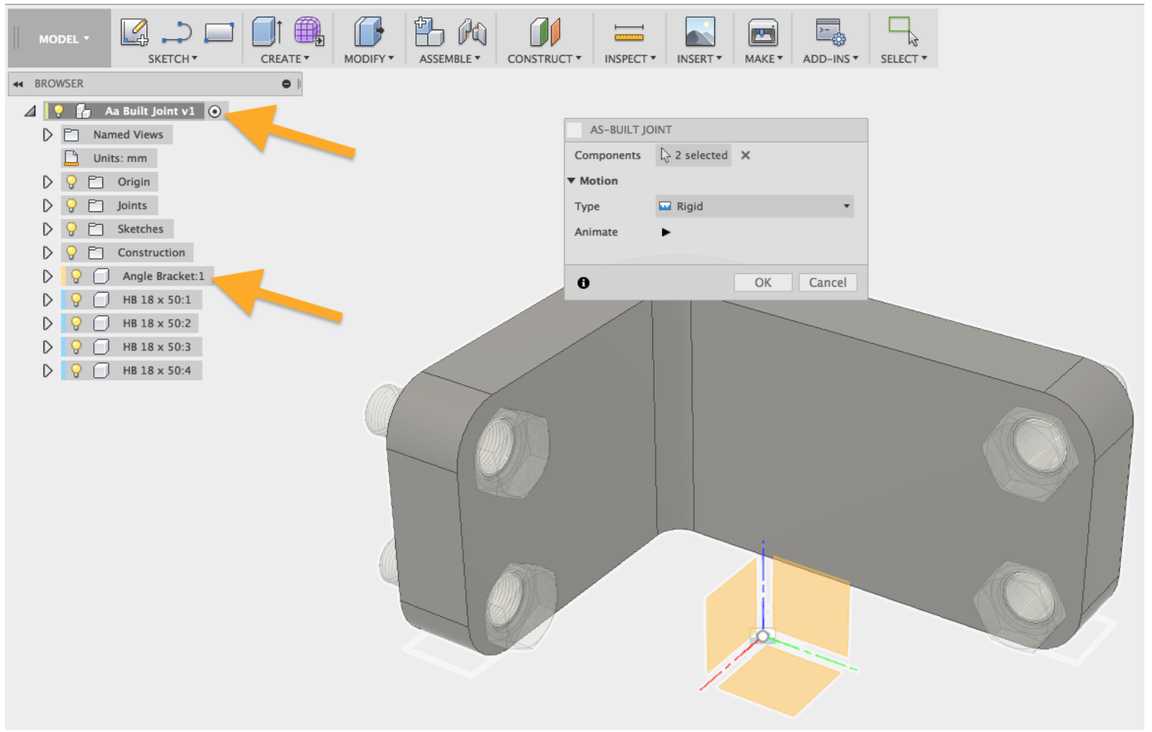
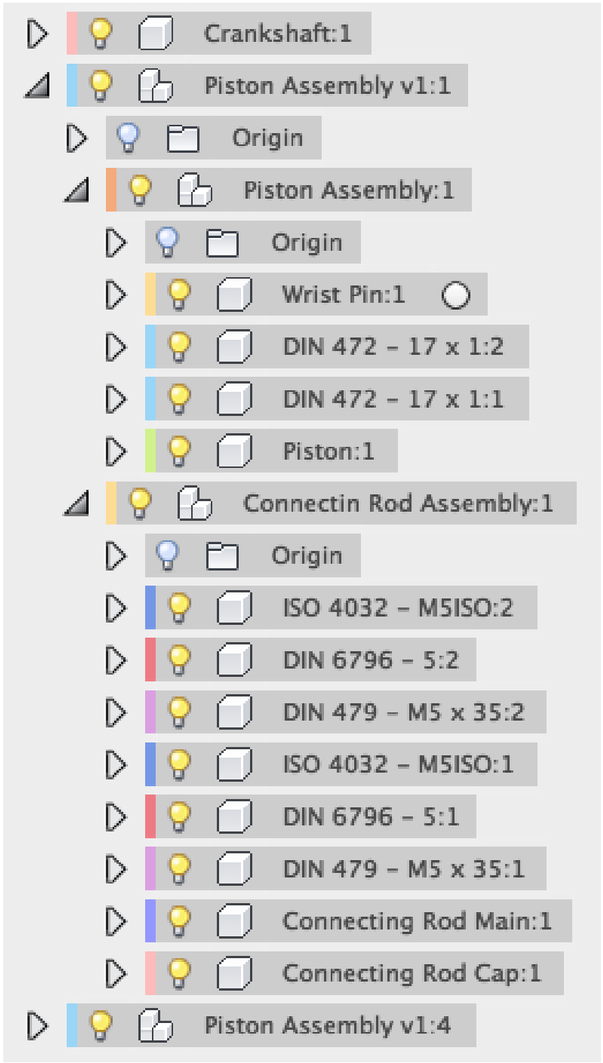
Cyl9
Cyl10
Sketches
Construction
Crankshaft:1
Piston Assembly v1:1
Piston Assembly v1:3
Piston Assembly v1:4
Piston Assembly v1:5
COMMENTS
TEXT COMMANDS

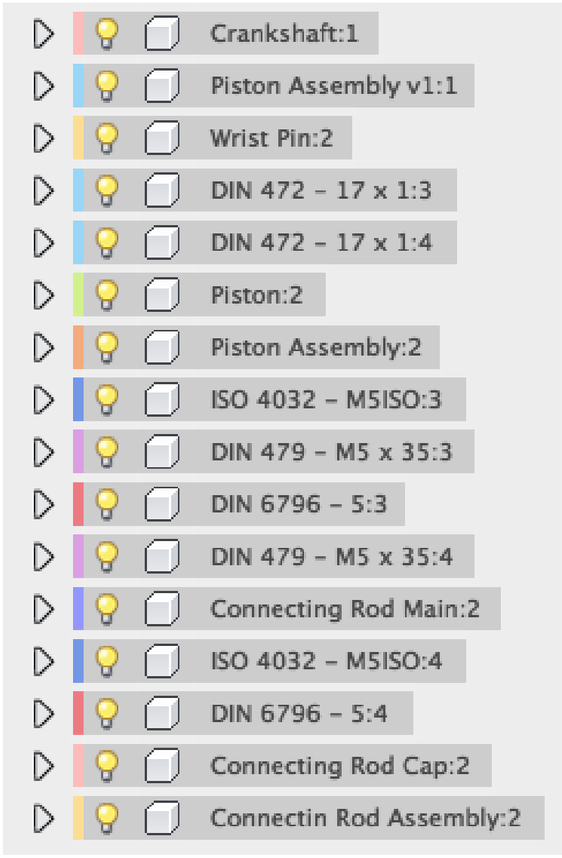
Degrees of Freedom

- All parts are free to move (6 degrees of freedom)
- Joints remove degrees of freedom
- Features or Insert defines the components starting position
- The document and sub assemblies can be used for “As built” joints



Degrees of freedom





All documents are Kinematically flat until joints are added

Parametric Position and Kinematic Position

- Modeling Features or Insert Feature defines the components starting position
  - This is explicit and is a parametric position
  - The Component will want to return to this position on rebuild
- Kinematic position is a position that results from movement that degrees of freedom allow
  - This is a transient position
  - A components kinematic position can be made parametric by creating a capture position feature.

Kinematic Position – An Occurrence override

- Instances and Occurrences
  - Instance – A Unique Component
  - Occurrence – One of multiple inserts of an Instance
- Fusion allows Occurrences to override some instance properties

	Top Down	Linked (Referenced)
Component Visibility	Yes	Yes
Body Visibility	Yes	No
Sketch Visibility	Yes	No
Construction Visibility	Yes	No
Origin Visibility	Yes	No
Kinematic Position	Yes	Yes

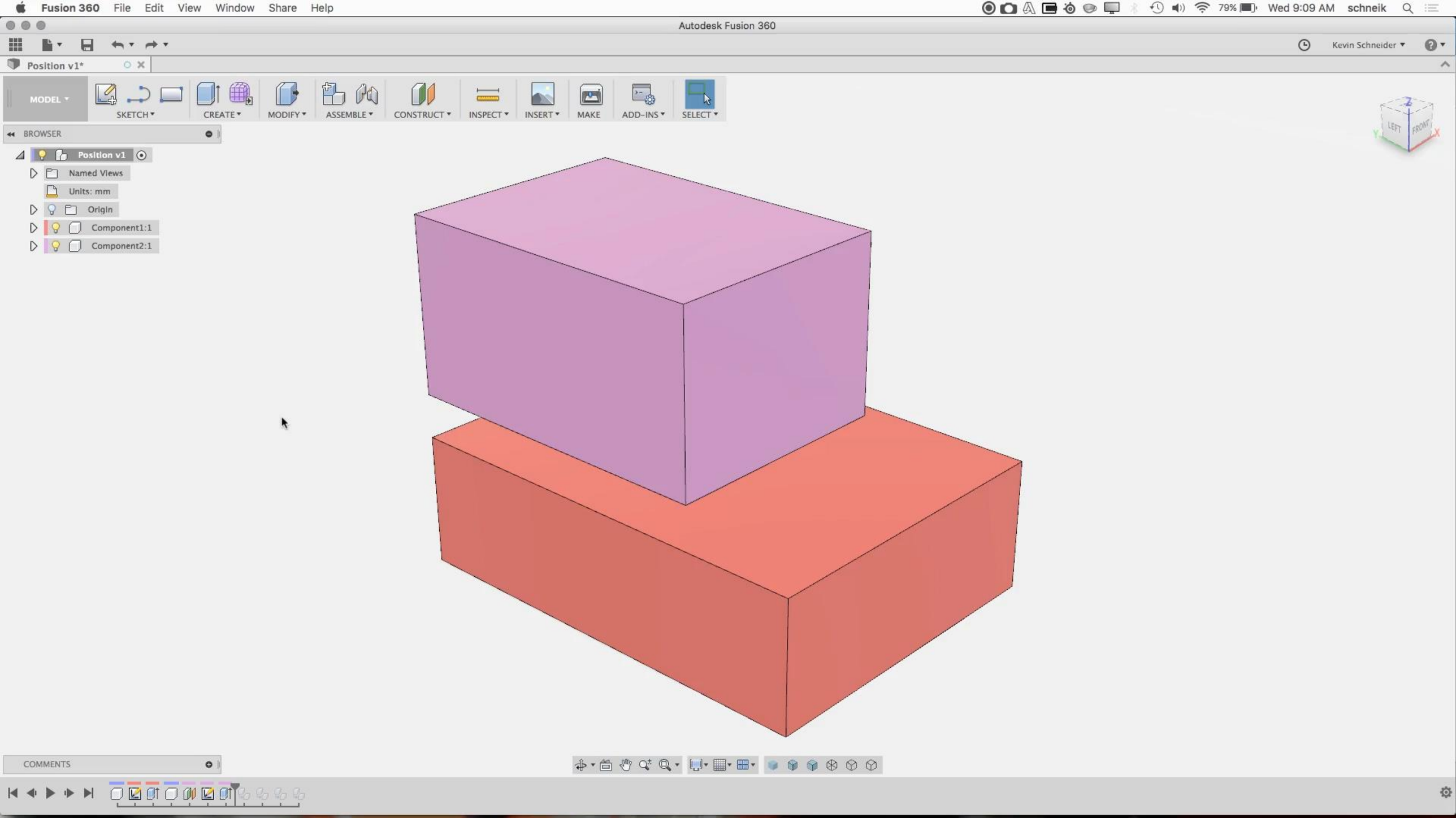
Degrees of Freedom - Ground

- Ground is a timeline feature
- Un-Ground is a timeline feature
- Grounding only affects the document in which it is applied
  - Therefor grounds do not apply across linked component refrences
- Grounding only affects the component it is applied to. NOT it's children.

- If you use Fix in SolidWorks, or Ground in Inventor… Do not use ground in Fusion 360 the same way.
- Use As built joints

Demos

Position.f3d
Crankshaft - Assembly Start.f3d


Fusion 360 File Edit View Window Share Help
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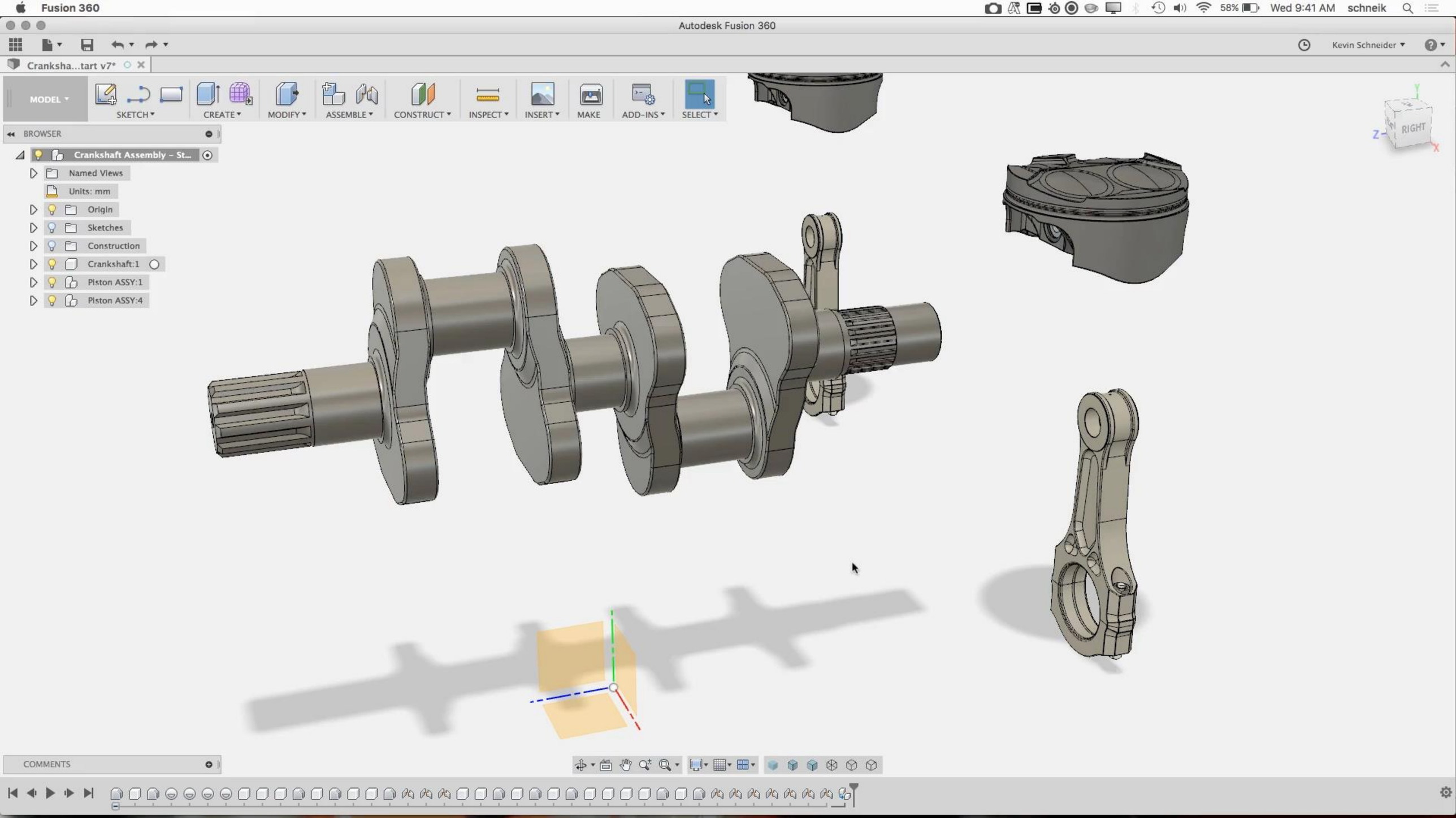
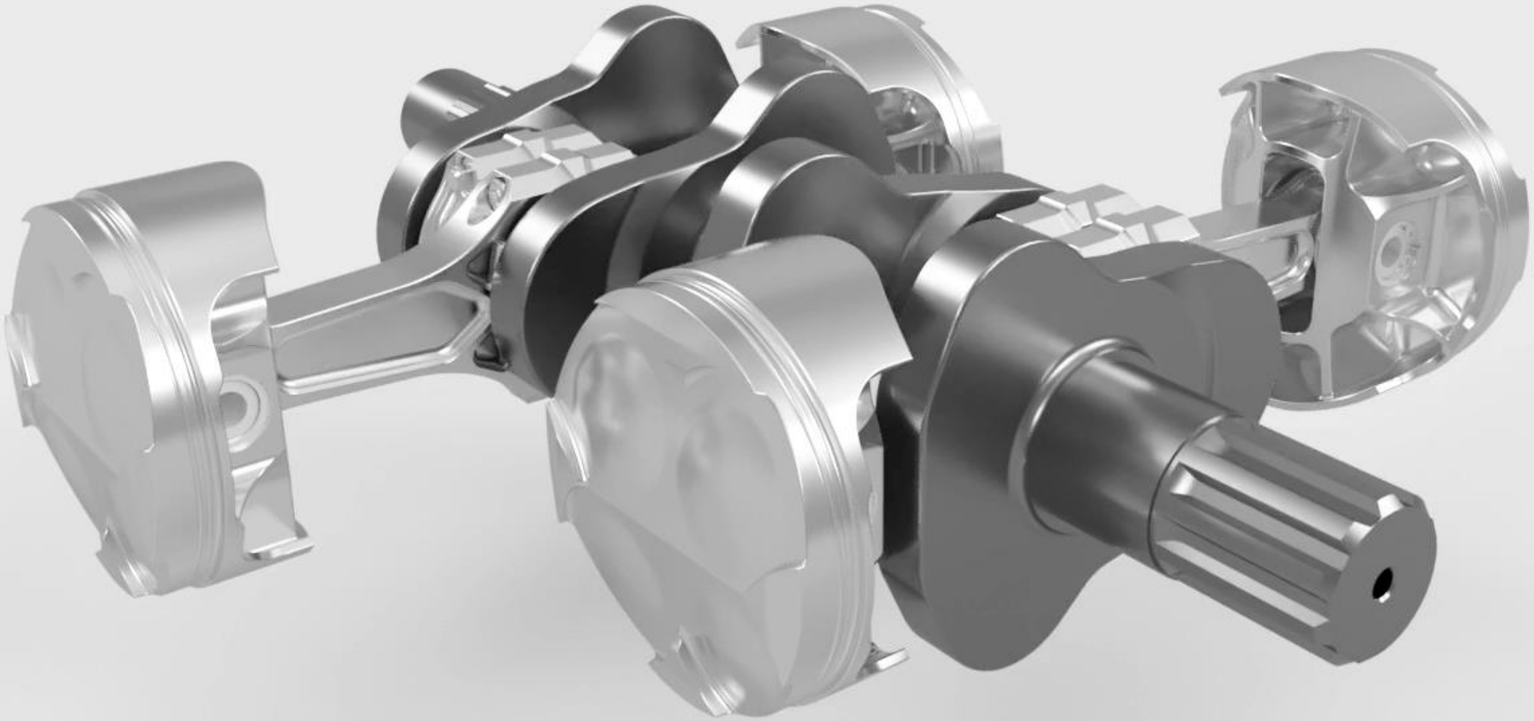
Autodesk Fusion 360
Kevin Schneider
Position v1*
MODEL
SKETCH
CREATE
MODIFY
ASSEMBLE
CONSTRUCT
INSPECT
INSERT
MAKE
ADD-INS
SELECT
BROWSER
Position v1
Named Views
Units: mm
Origin
Component1:1
Component2:1
LEFT
FRONT
COMMENTS


Fusion 360
Autodesk Fusion 360
Kevin Schneider
Crankshaft Assembly – St...
Named Views
Units: mm
Origin
Sketches
Construction
Crankshaft:1
Piston ASSY:1
Piston ASSY:4
MODEL
SKETCH
CREATE
MODIFY
ASSEMBLE
CONSTRUCT
INSPECT
INSERT
MAKE
ADD-INS
SELECT
BROWSER
COMMENTS
RIGHT

Review

Fusion 360 design methodology
Bodies vs Components
Managing References
Degrees of Freedom
Positioning Components



AUTODESK®

Make anything.