EP1000

Computer Controlled Cutting

Computer Controlled Cutting

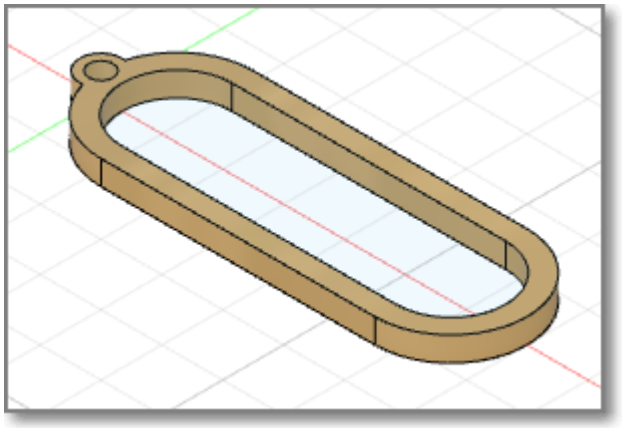
- Perform Cutting operations based on digital data.
- Also known as CNC (Computer Numerical Control)
- Data is provided from:
    - CADD operations
    - Digital 2D drawings
- Provides accurate and precise cutting operations
- Used in:
    - Laser cutting & engraving
    - Flatbed cutters & 2D routers
    - Milling machines

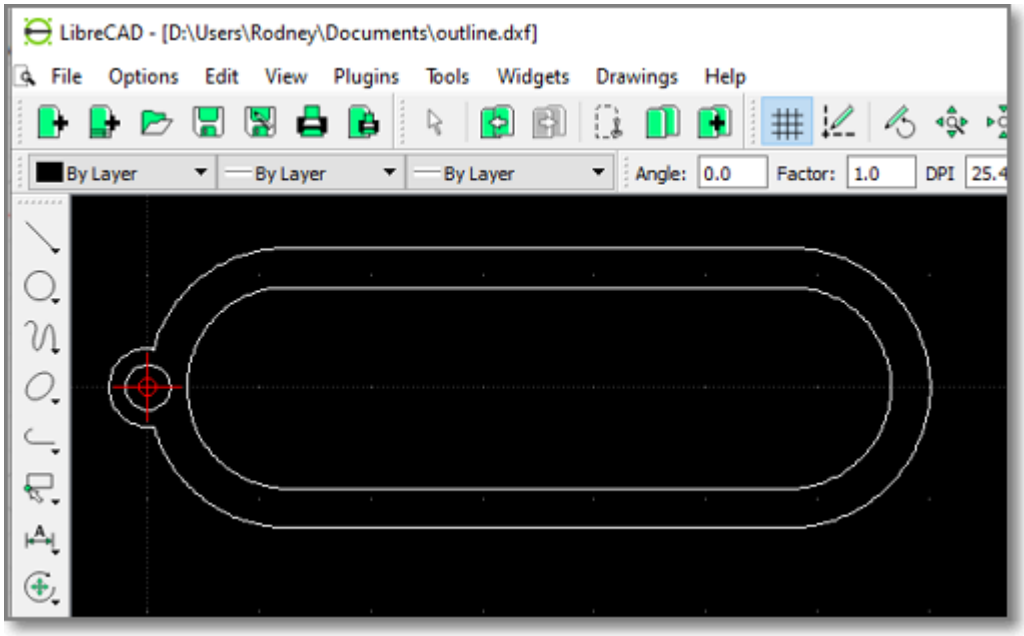
2D profile

- All cutting systems work on a 2D profile which provides an outline of the cut.
- Advantages:
  - The cut is precise with little wastage of material.
  - Allows positioning to prevent wastage.
  - Repeatability
- Vector File formats:
  - DXF (Data eXchange Format)
  - PDF (Portable Document Format)
  - SVG (Scalable Vector Graphics)

Vector Software

- 2D Vector drawing programs: Inkscape, AutoCAD, Adobe Illustrator, CorelDraw
- CAD Software – Fusion 360, Rhino3D





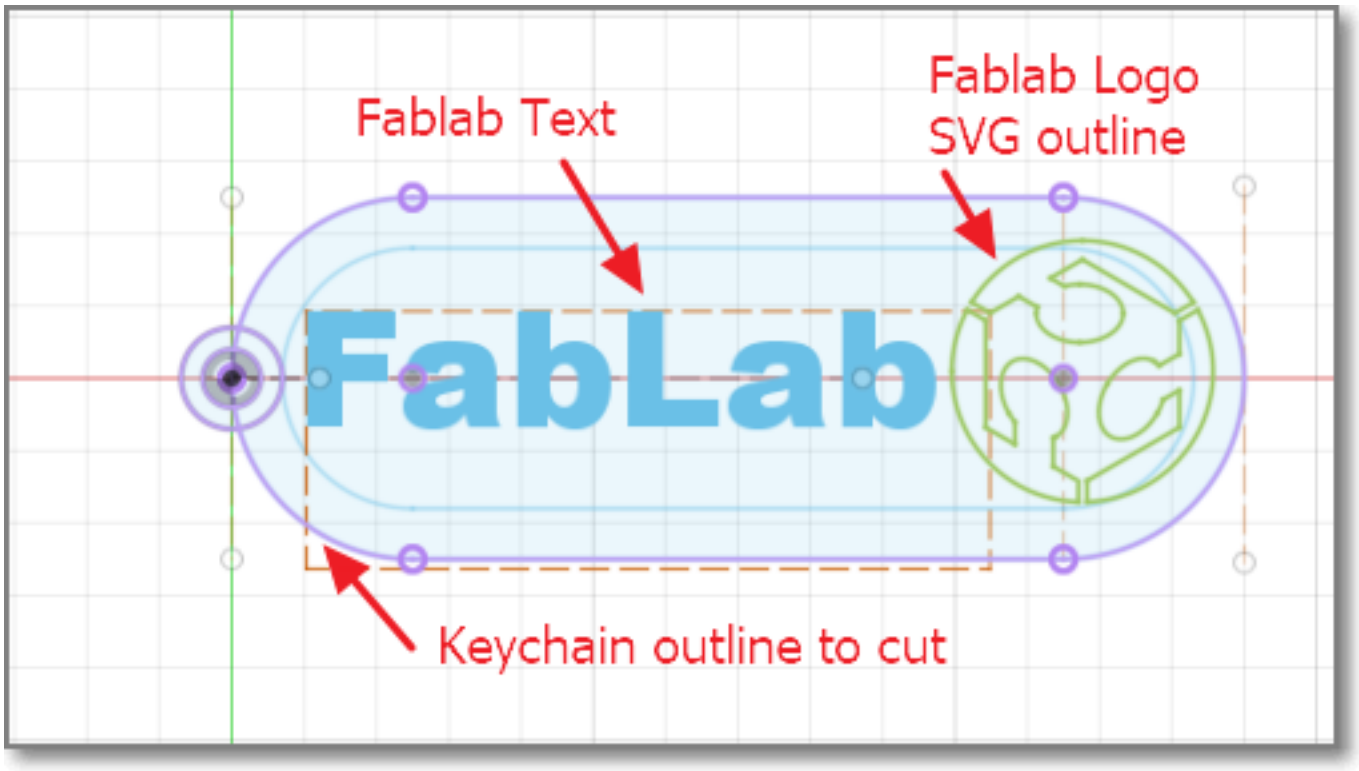
Don't forget InkScape !

Software Tools

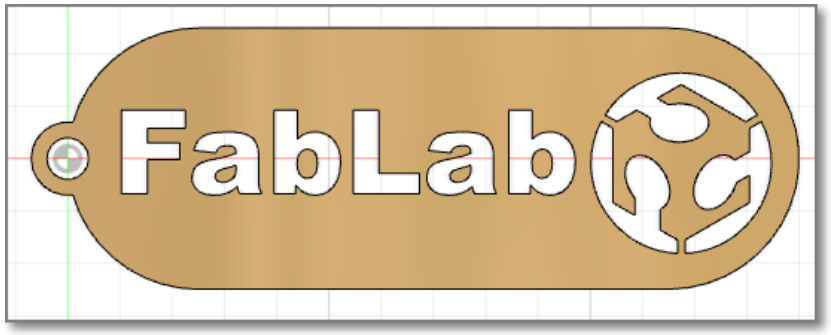
- Fusion 360
  - Full CAD/CAM software to obtain profiles
  - Lots of modelling tools to help
- Vector Drawing software
  - Inkscape
  - LibreCAD (for DXF files)
  - CorelDraw (licensed software)
  - Illustrator (licensed software)
- Output Vector formats
  - DXF (outdated, but still used, text editable)
  - PDF, EPS
  - SVG (may have different variants)
  - AI (Adobe Illustrator format)

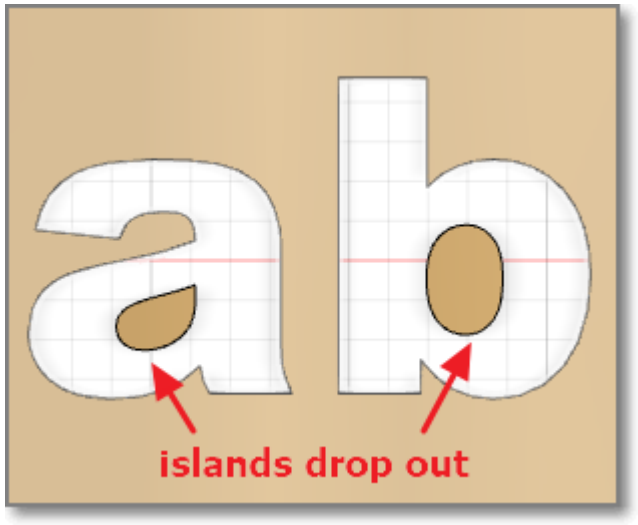
Exercise 1: Keychain for cutting

- Let's make a keychain for the fablab with logo
- Size: 30mm x 70mm x Thickness (dependent on material)



What happens when cut

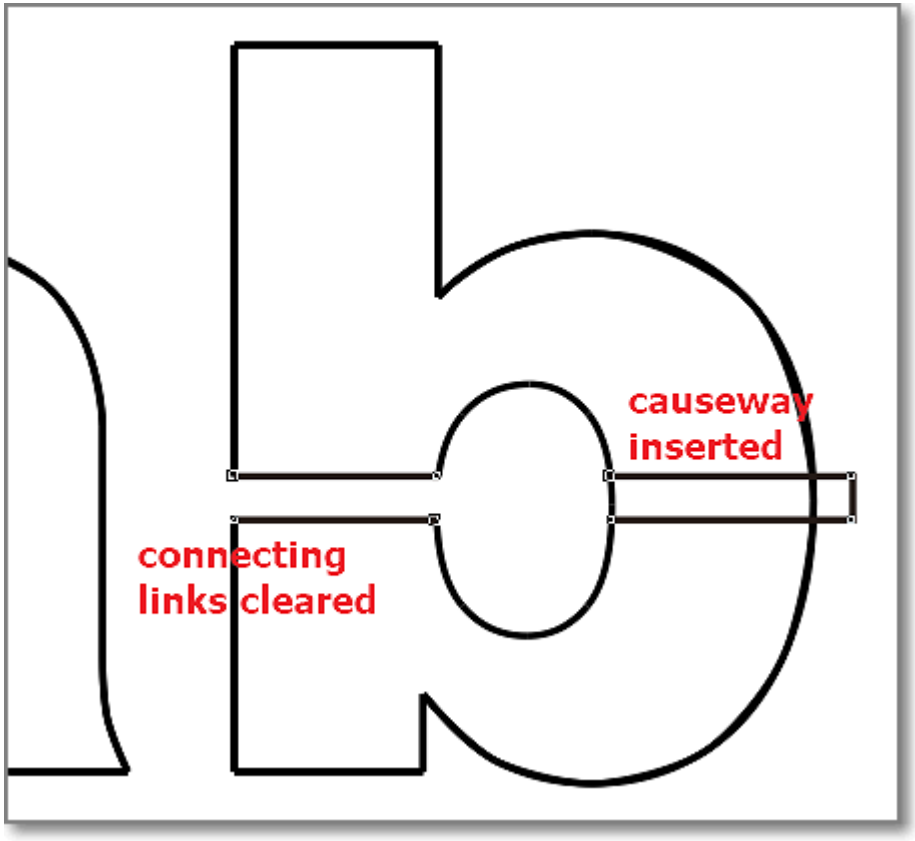




- Islands may form, these drop out after cutting
- Need to edit the Vector file before cutting
- Placement of causeways to prevent drop-outs
- Post production (i.e. edit DXF exported file)

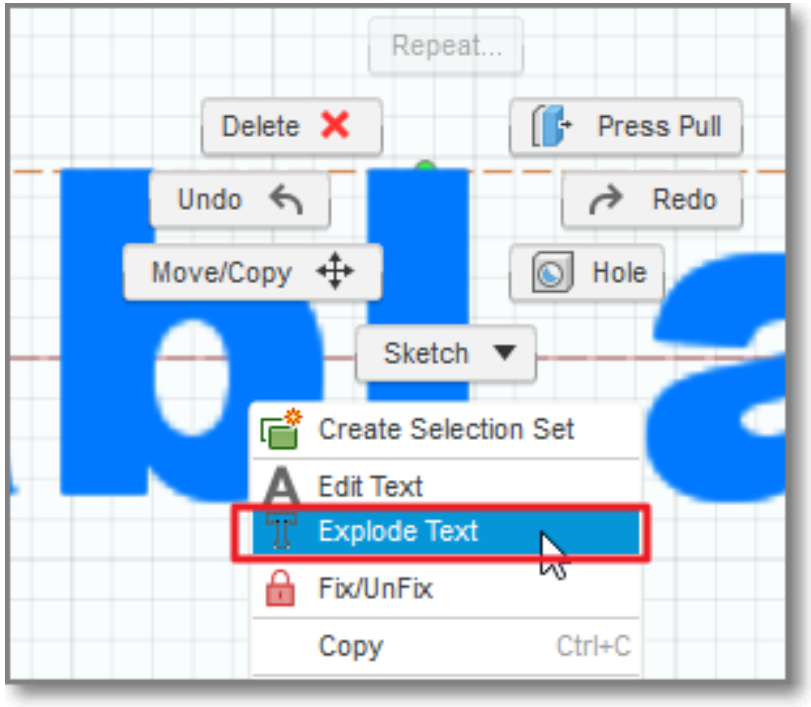
Post Production Editing

- Use a Vector Drawing program to create the causeways
- May need knowledge of vector drawing program
- Suggest CorelDraw

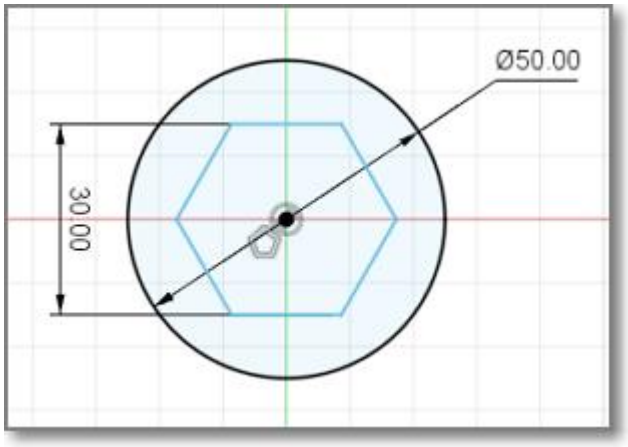


Fusion 360 Explode Text

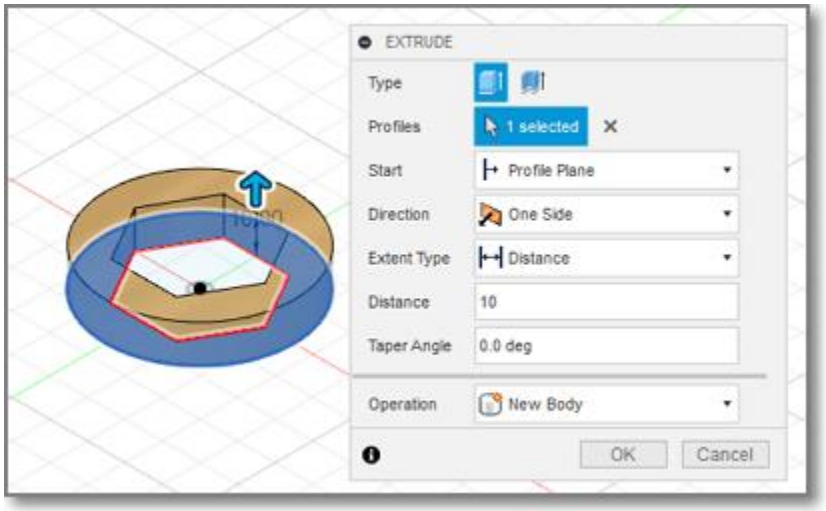
- Use the Explode Text function to separate each letter in the word.
- Add causeways in Fusion 360 before extrusion for cut surface



Fusion 360: Export Cut Profile -1

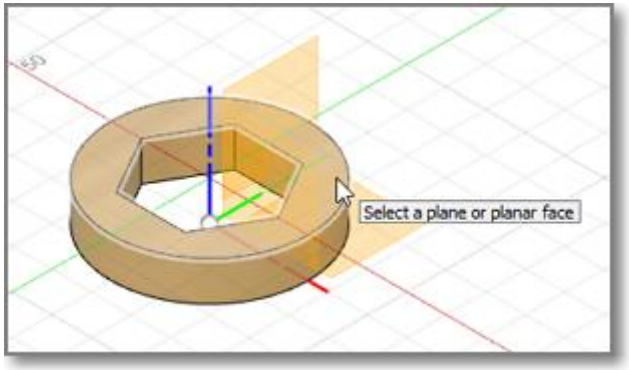


- Create your design

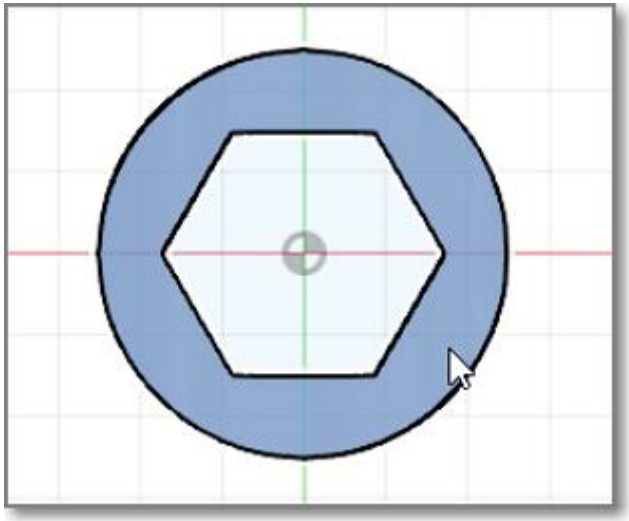


- Extrude surfaces to create object

Fusion 360: Export Cut Profile -2

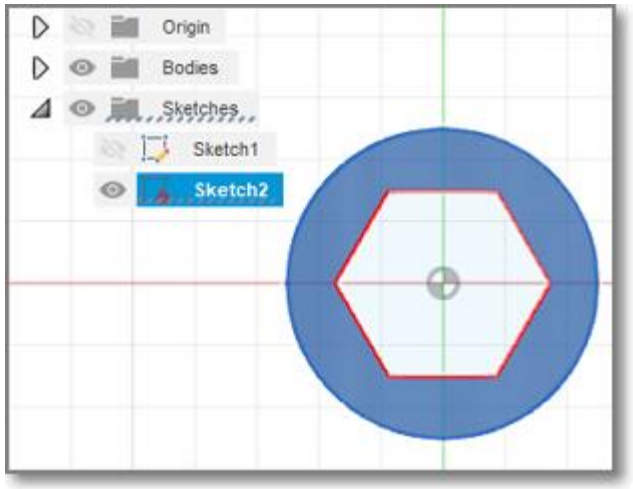


- New sketch on object profile to cut

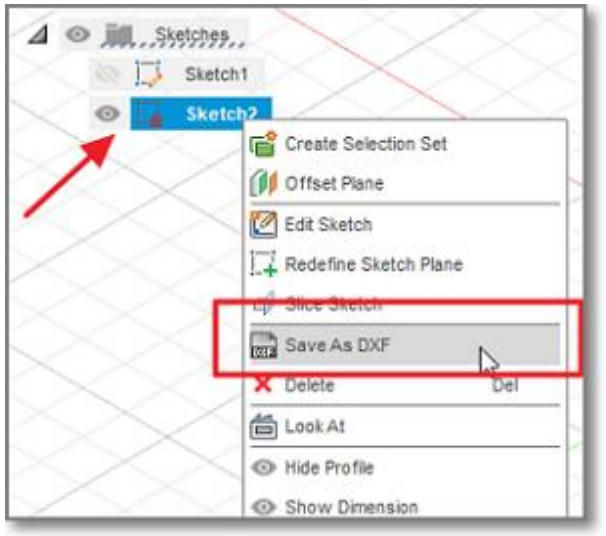


- Click again on profile to verify/ select

Fusion 360: Export Cut Profile -3



- New sketch created
- Should rename to avoid confusion (design_dxf)



- R-Click on sketch name
- Save As DXF

DXF format

washer.dxf

```
262   AcDbEntity
263   8
264   0
265   100
266   AcDbPolyline
267   90
268   6
269   70
270   1
271   43
272   0.0
273   10
274   -8.6602540378443997
275   20
276   -14.999999999999991
277   10
278   8.6602540378443802
279   20
280   -15.000000000000007
281   10
282   17.320508075688771
283   20
284   -4.4408920985006262e-15
285   10
286   8.6602540378443944
287   20
288   14.999999999999993
289   10
290   -8.6602540378443802
291   20
292   15.000000000000011
293   10
294   -17.320508075688778
295   20
296   1.9984014443252818e-14
297   0
298   CIRCLE
299   5
300   101
301   100
302   AcDbEntity
```

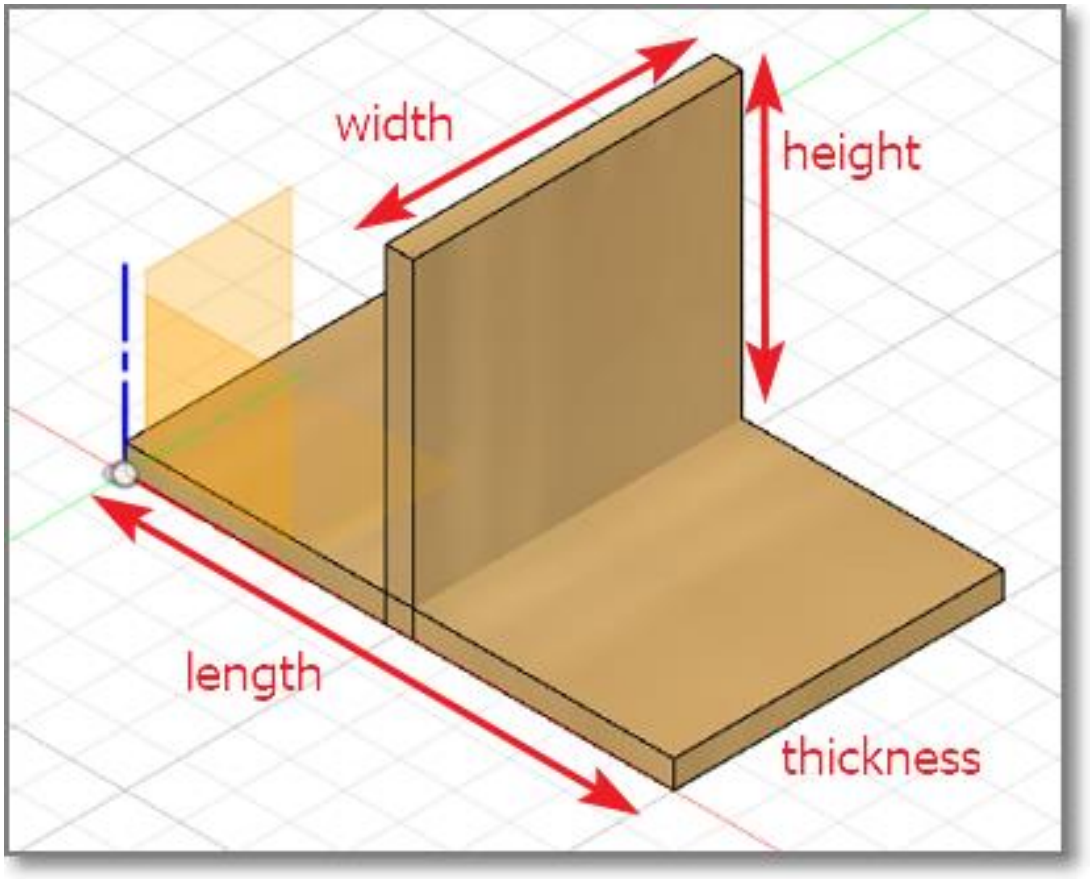
- A simple text format that defines the coordinates of the profile.
- Can come in different versions
- Backward compatible only

Fusion 360: Modelling

- Modelling allows us to simulate the actual object using CAD
- We can use CAD tools to help us in the design
- Most common tools are:
    - Combine
    - Joints
    - Cross-sectional views
    - Clearances

Let's make a joint

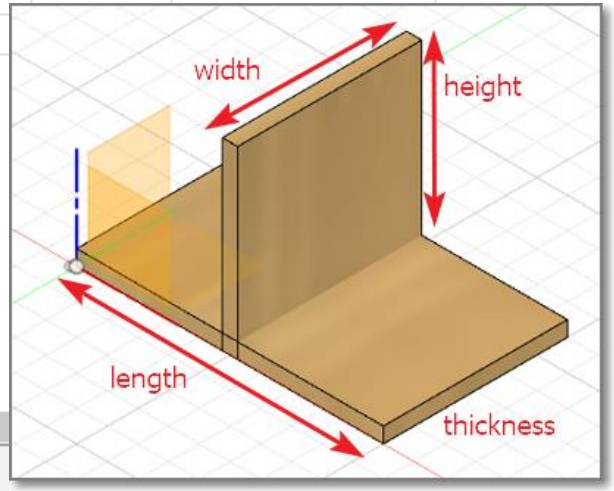
- We will use the CADD features to assist us
- We would like to join 2 pieces of wood



Drawing Parameters

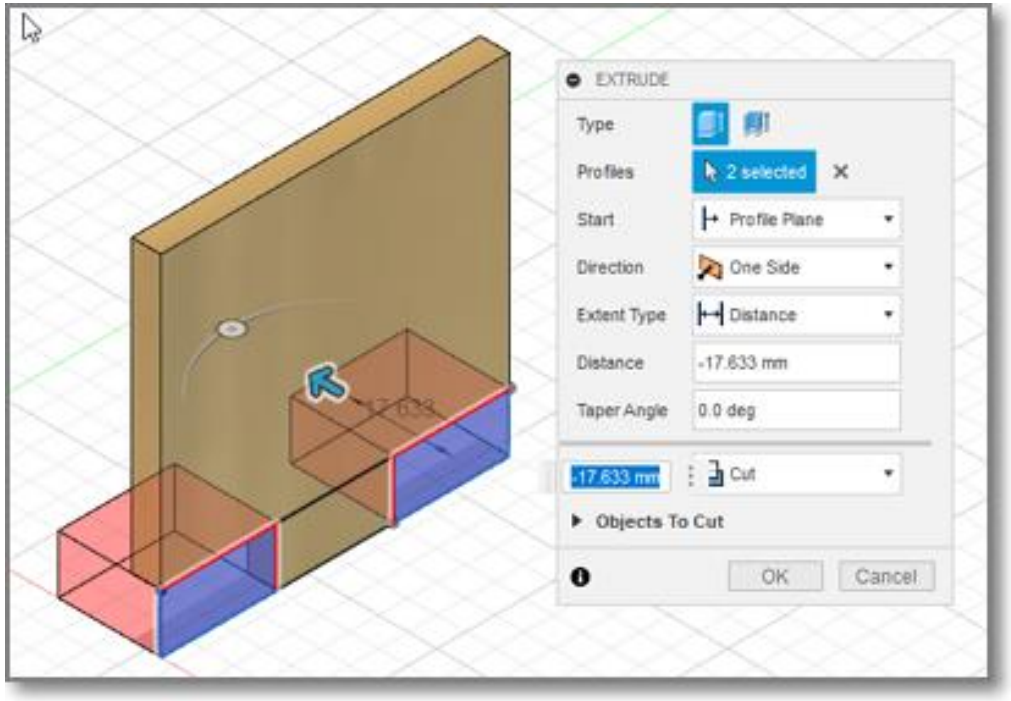
Parameters

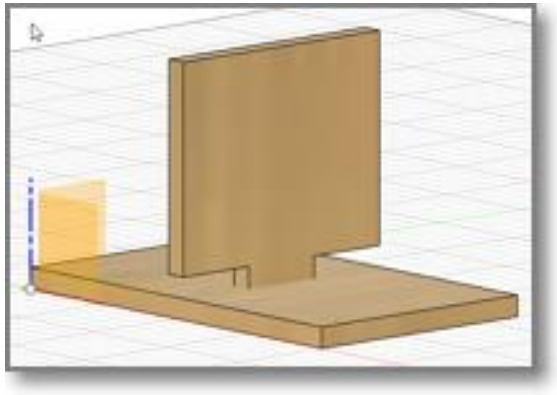
Parameter	Name	Unit	Expression	Value	Comments
Favorites					
User Parameters					
User Param...	length	mm	100 mm	100.00	
User Param...	width	mm	60 mm	60.00	
User Param...	height	mm	60 mm	60.00	
User Param...	thickness	mm	5 mm	5.00	
Model Parameters					
base					
vertical					

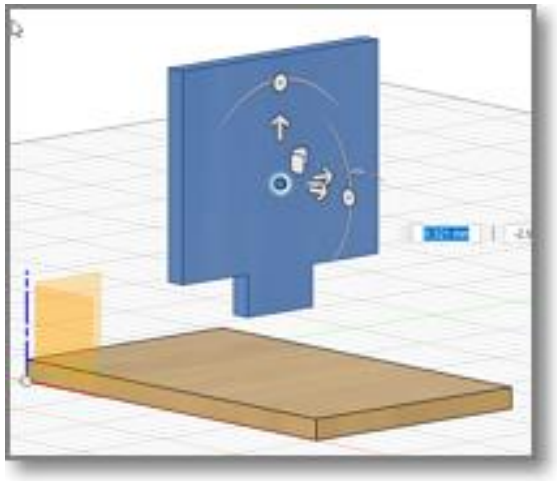


OK

Draw the 2 components

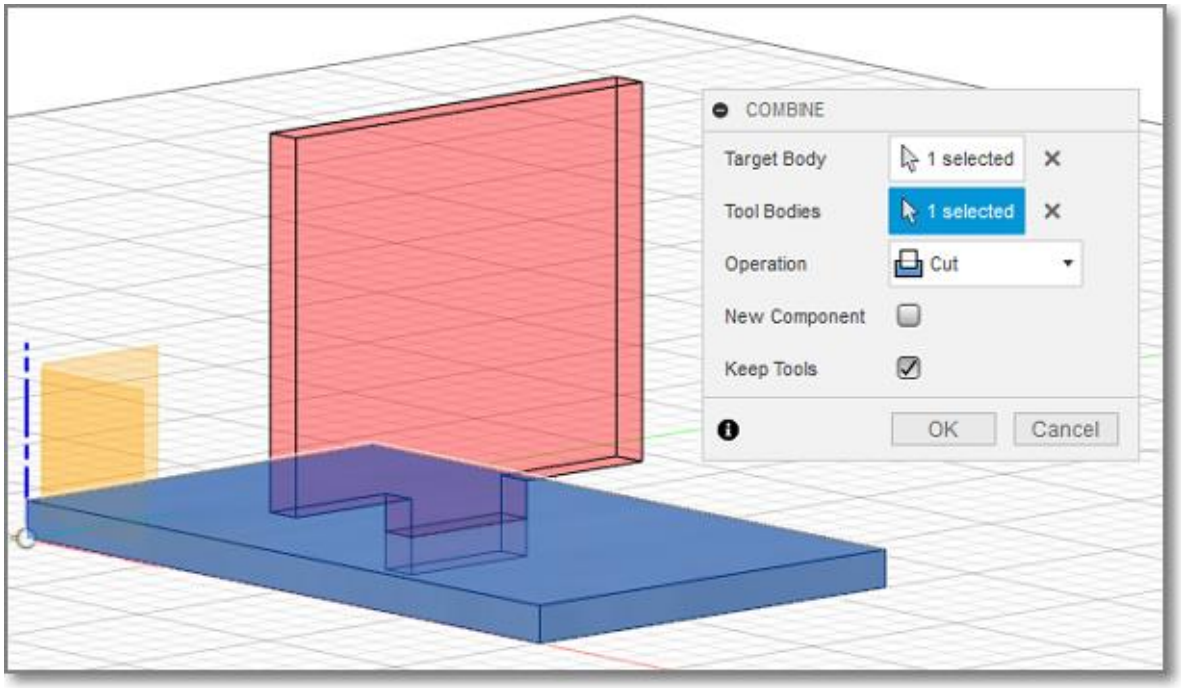




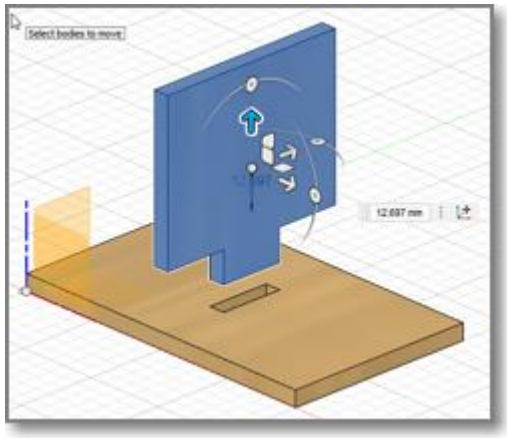


We would like a “tight” fit, since we are going to CCC the wood.
The cuts will be very precise. (The joint is exaggerated to show the effect)

Use CADD to effect the joint



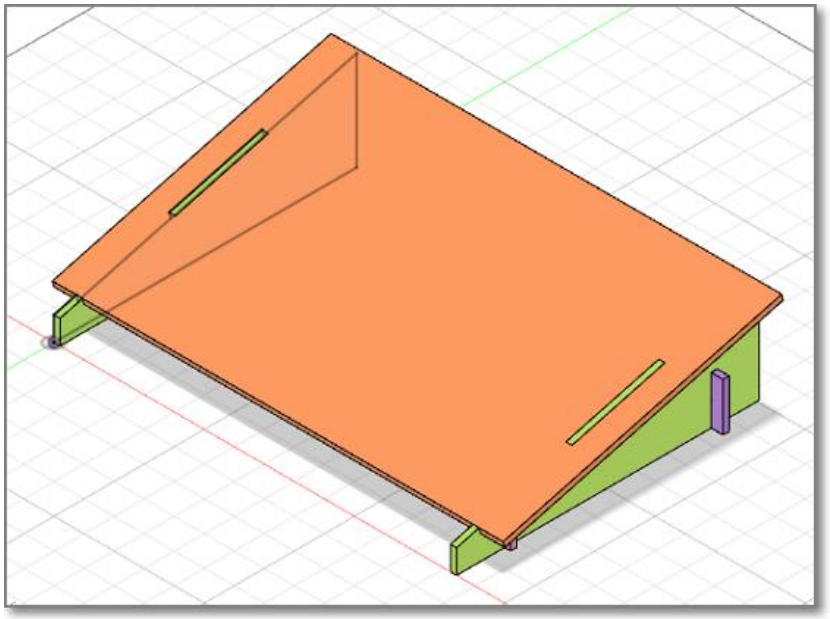
Blue = Target Body Red = Tool Body Operation = Cut Keep tools

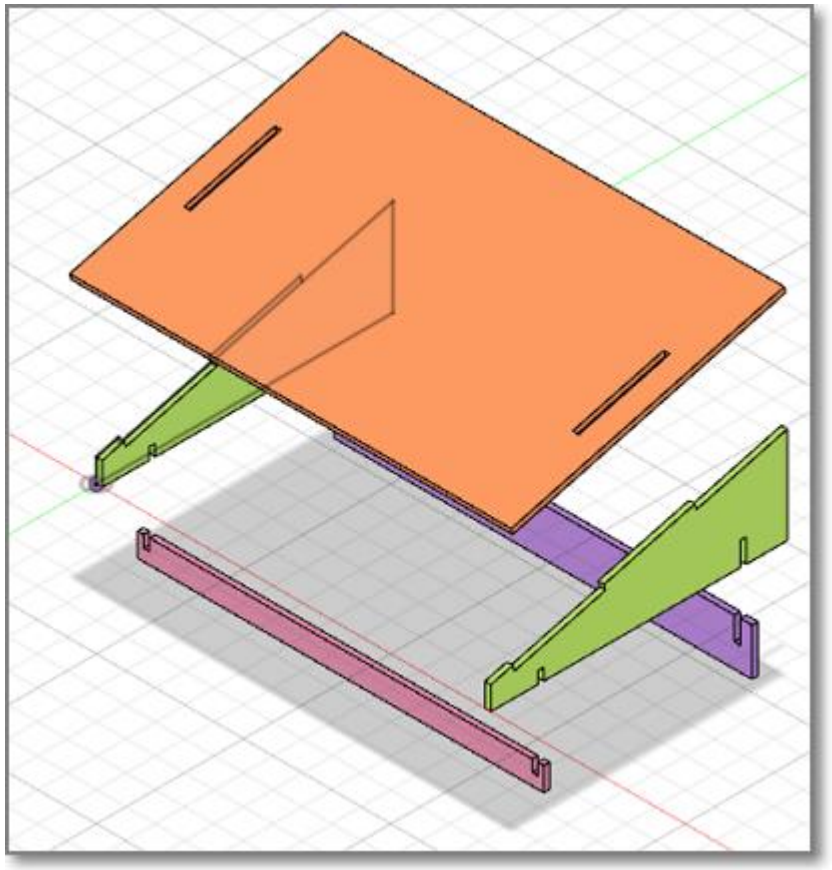


- Modify > **Combine**
- Creates the joint and necessary cuts without further drawing

Laptop Stand

- Let's quickly design a laptop stand that can be lasercut.



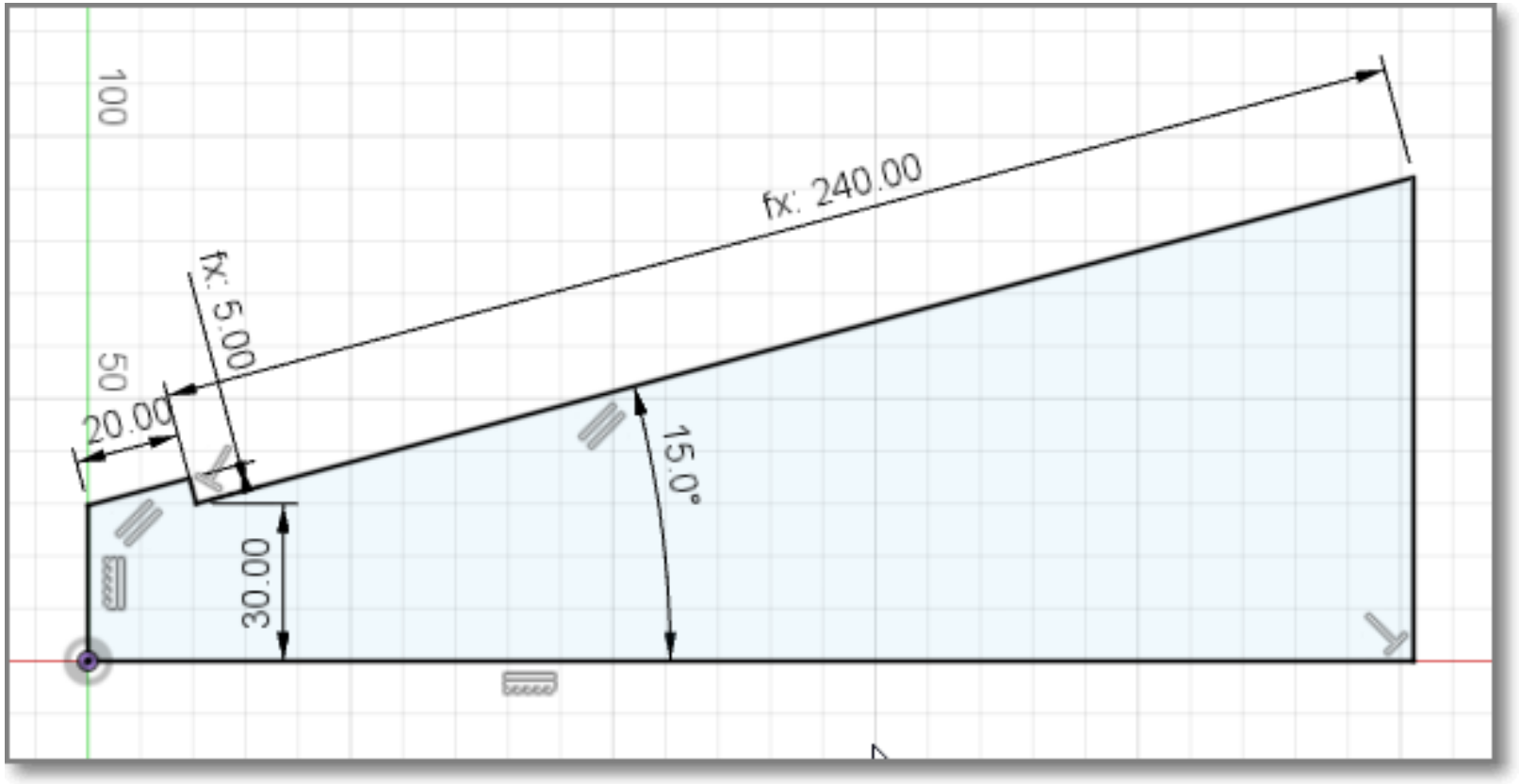


4 components

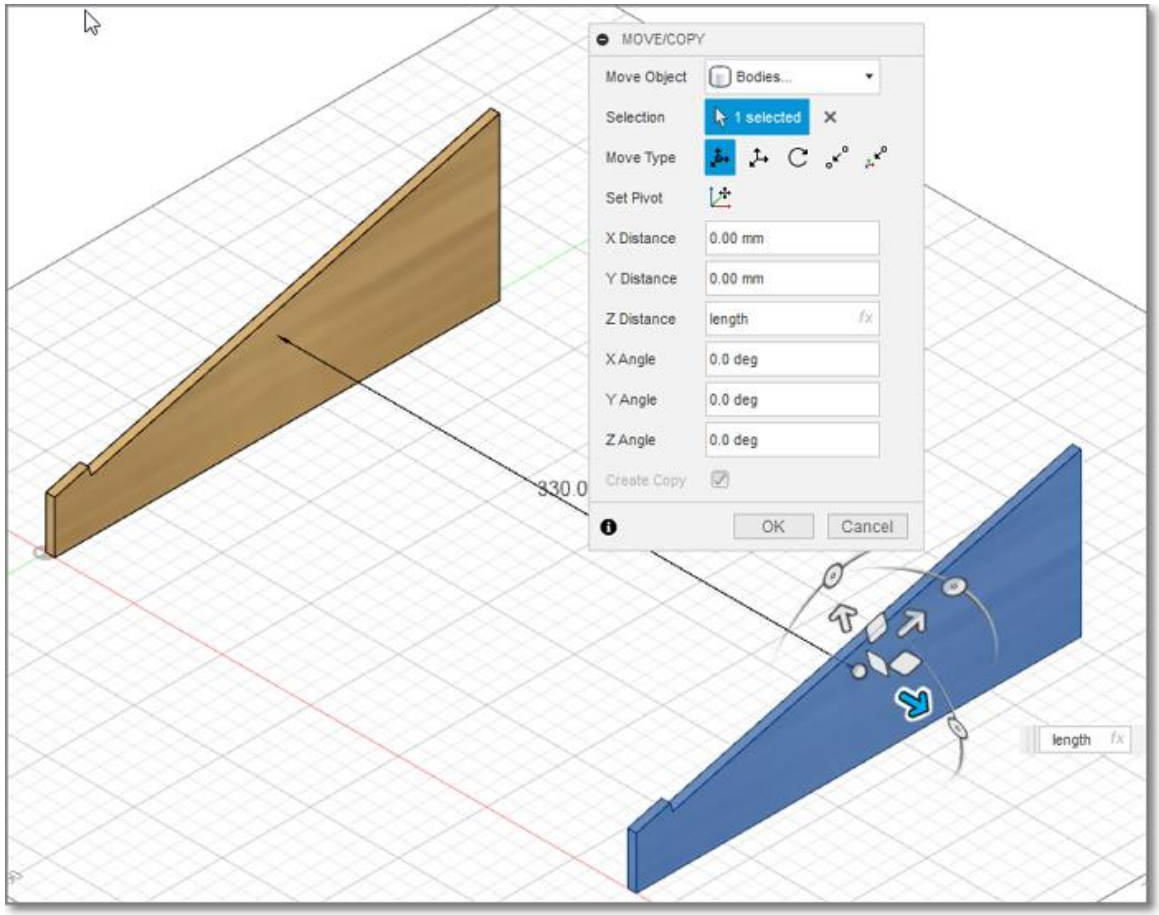
- legs (x2)
- top
- front support
- rear support

Legs

- Set your own parameters



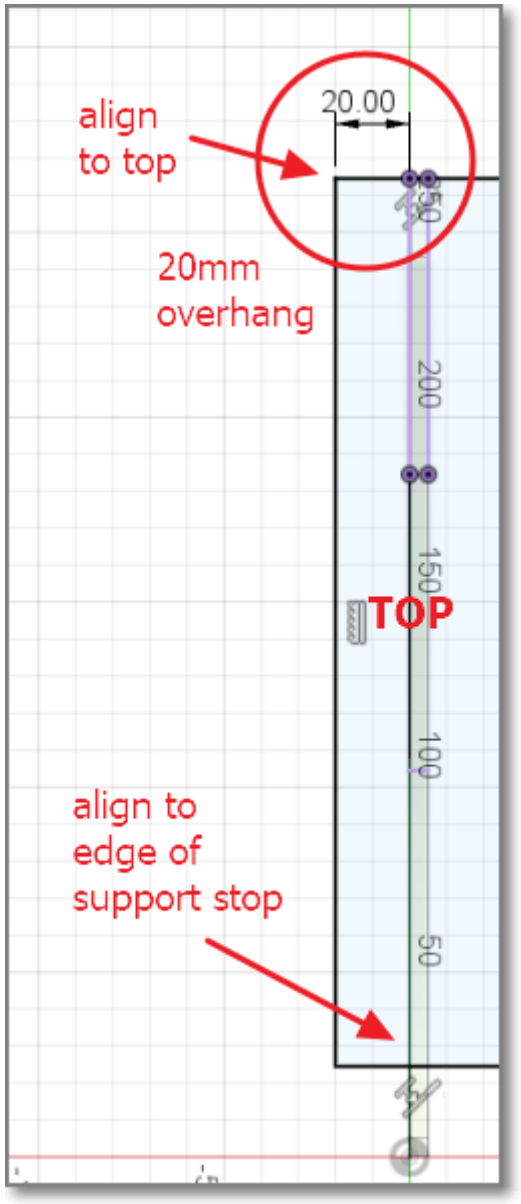
Create the body and a copy of the leg



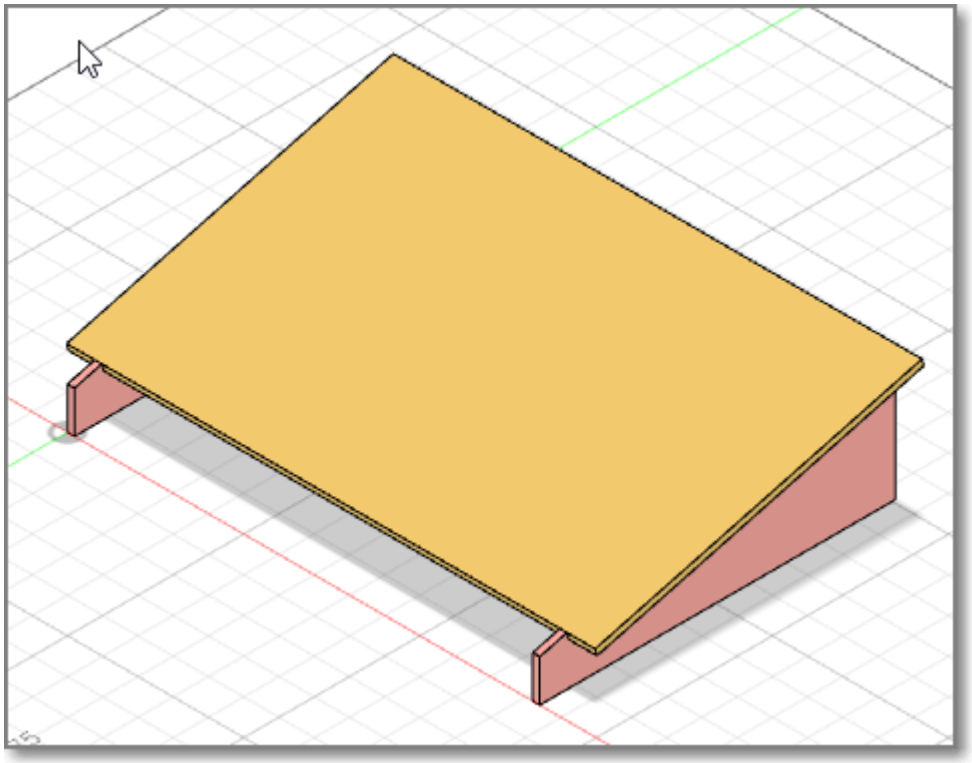
- Extrude the profile using thickness
- Move/Copy the body
- Length of laptop

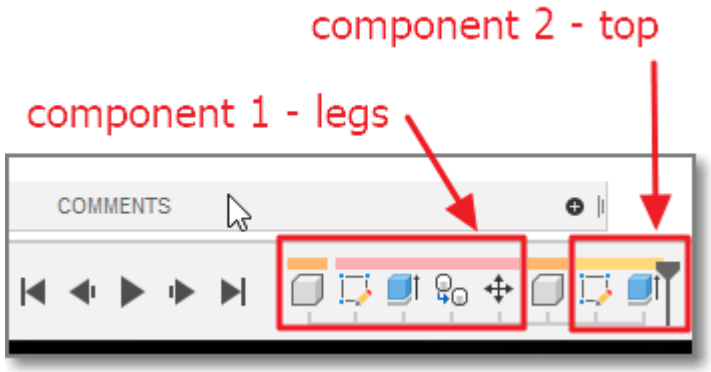
Add Component – Top

- Create component **Top**
- **Enable the component!**
- Create new sketch, select slope surface
- Top should line up with the top edge of the legs
- Bottom should line up with the slip support stop
- Sides extend 20mm on each side
- Extrude the top



..so far .. so good!

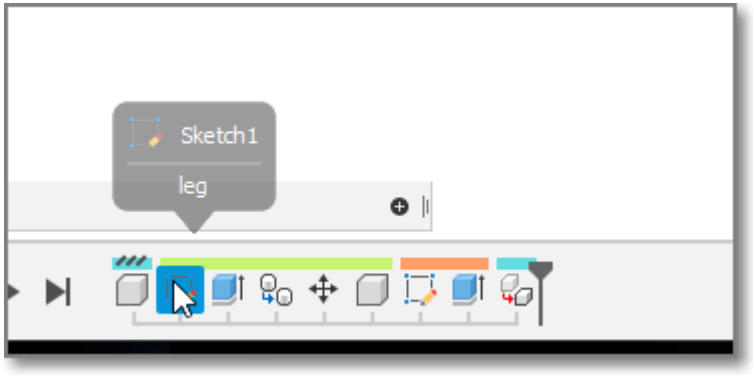


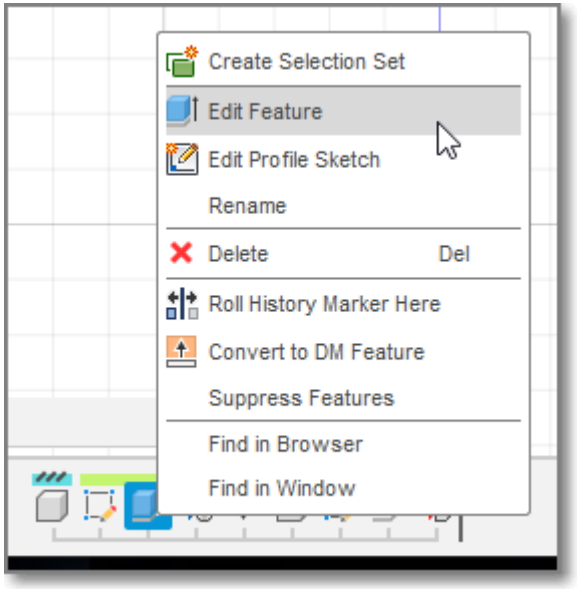


- You should have 2 components.
- Use Inspect > Component Color Cycling

Fusion 360 History / Timeline bar

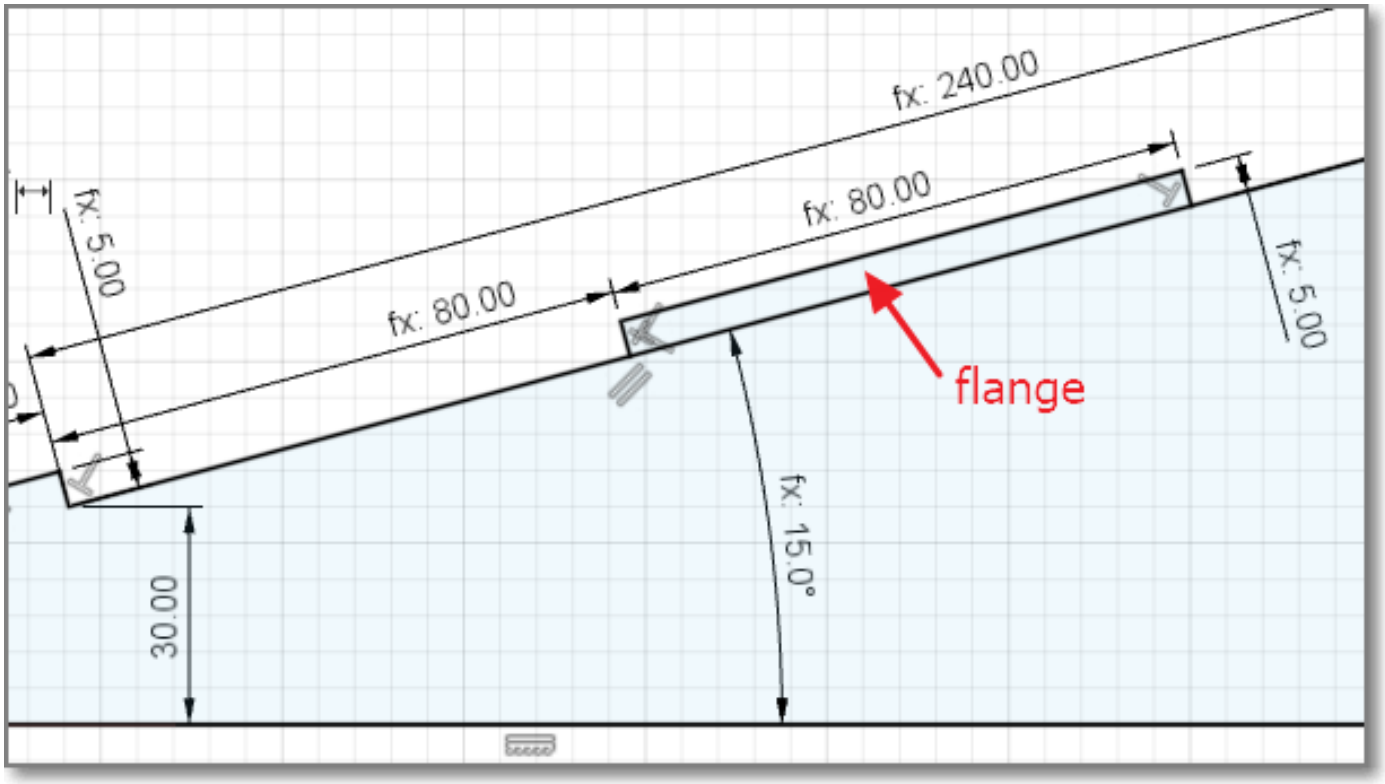
- We can use the History/Playback bar to walk through and edit (sometimes) changes





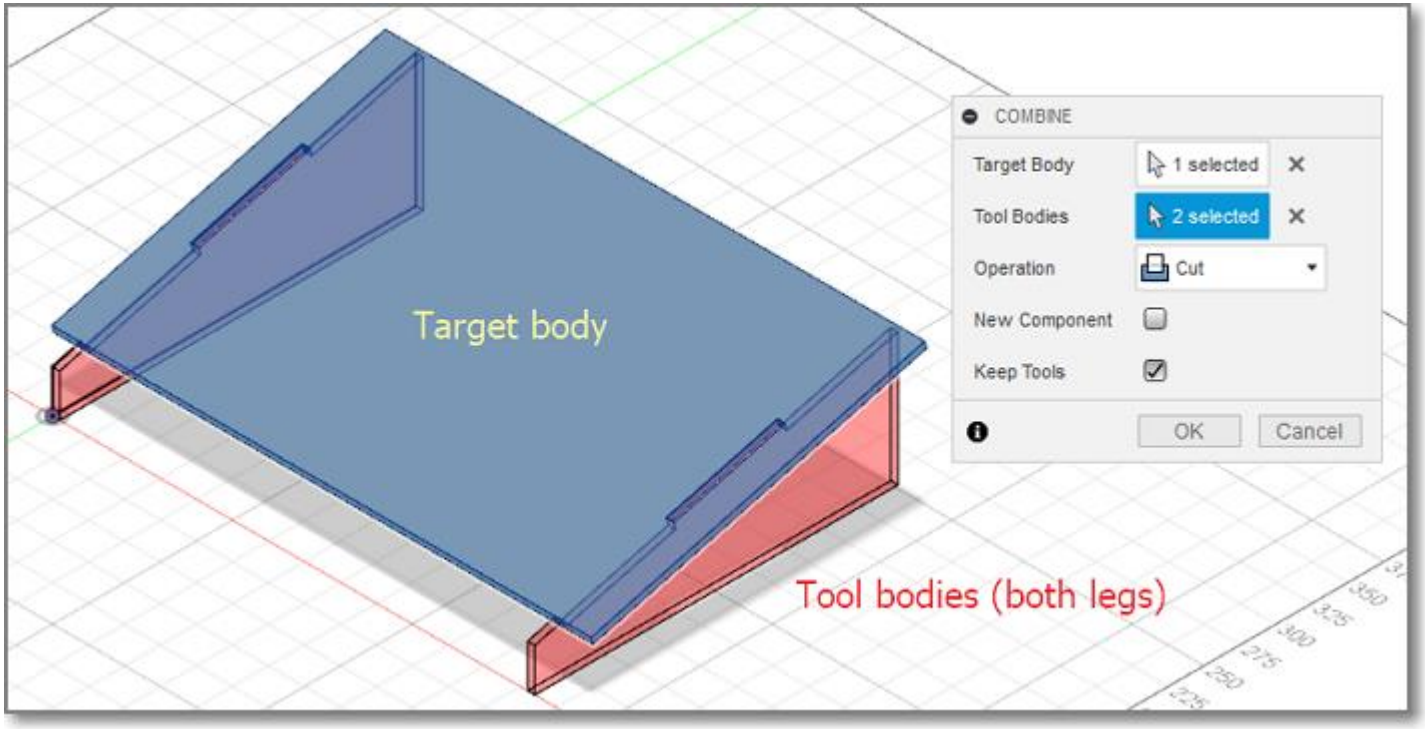
Let's add supports for our top so that it does not move while we use it

Edit/Add flanges to the legs



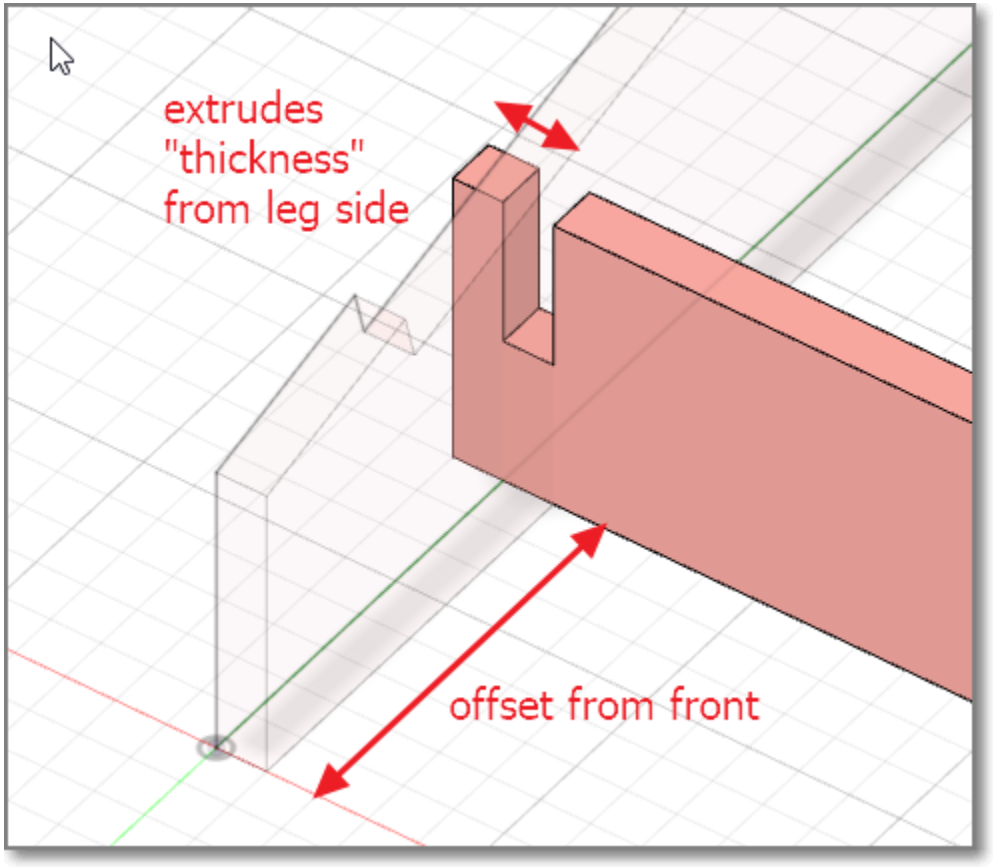
- Use the history bar to add the flange
- The rest of the design will auto-correct itself to accommodate the change

Modify > Combine



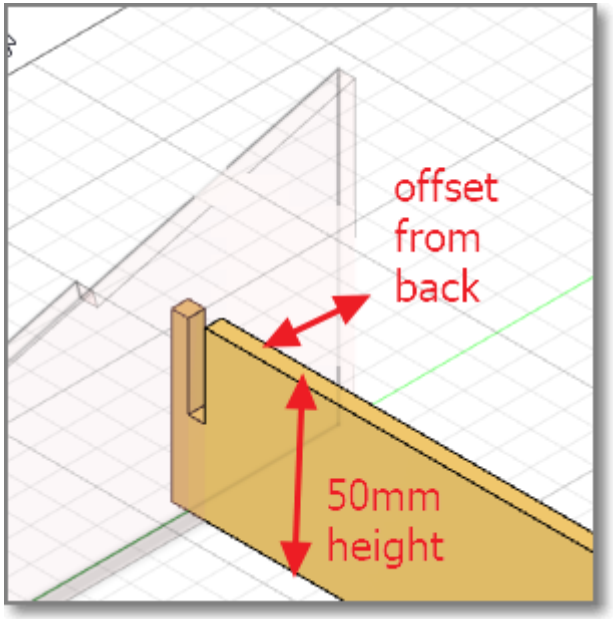
- Use the combine function to cut the slots into the top
- Remember to “keep tools” after cutting

Add front support



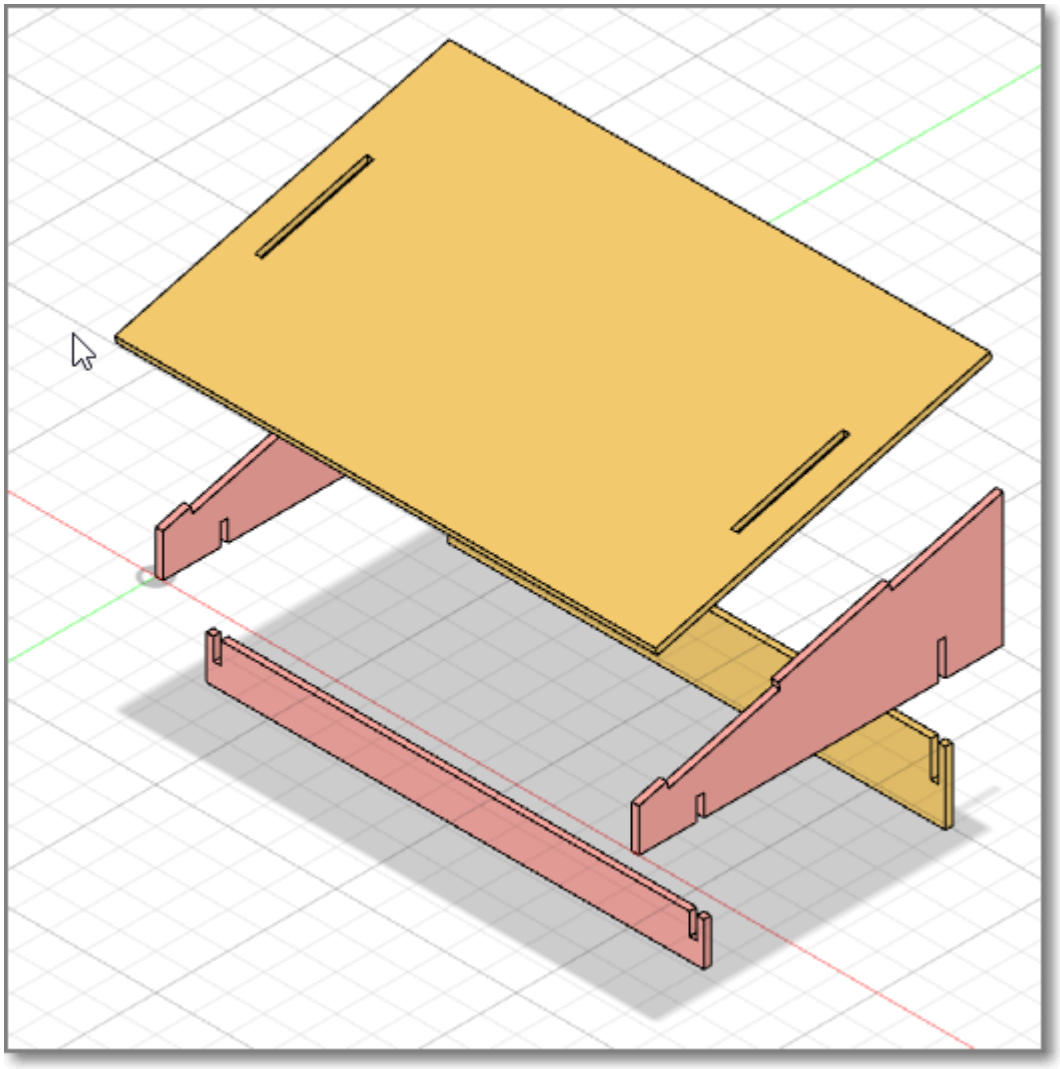
- The front support adds strength to the frame
- Offset the spar from the front e.g. 40mm
- Protrude the side for support
- Use Combine to cut the slots on the legs

Add back support



- Create new component
- Create offset plane from back leg
- Create new sketch
- Draw structure, ensure constraints
- Modify > Combine to cut out the slots

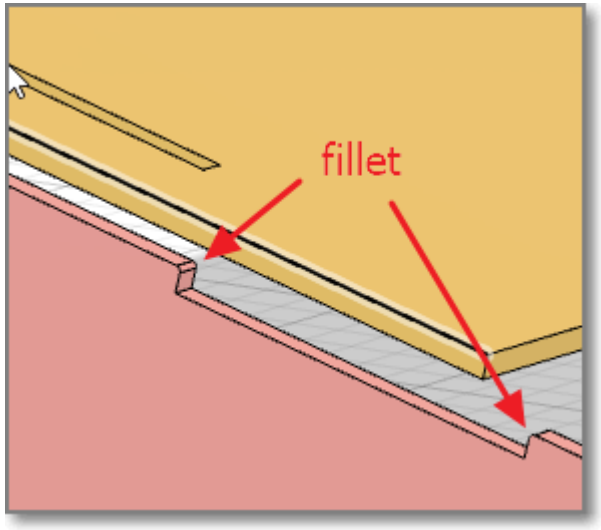
Completed Model



- Move the bodies and examine the result
- Check for clearances and cuts

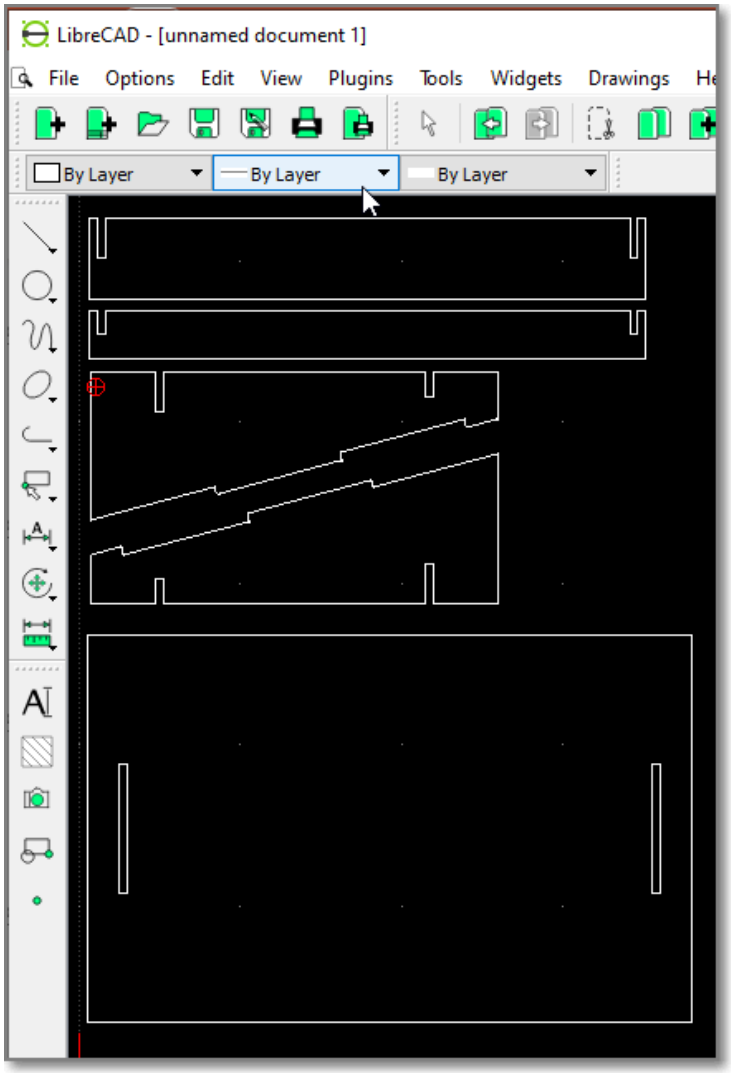
Finishing touches

- Fillet (smooth) the edges
- Fillet/Chamfer the joints for easy insertion



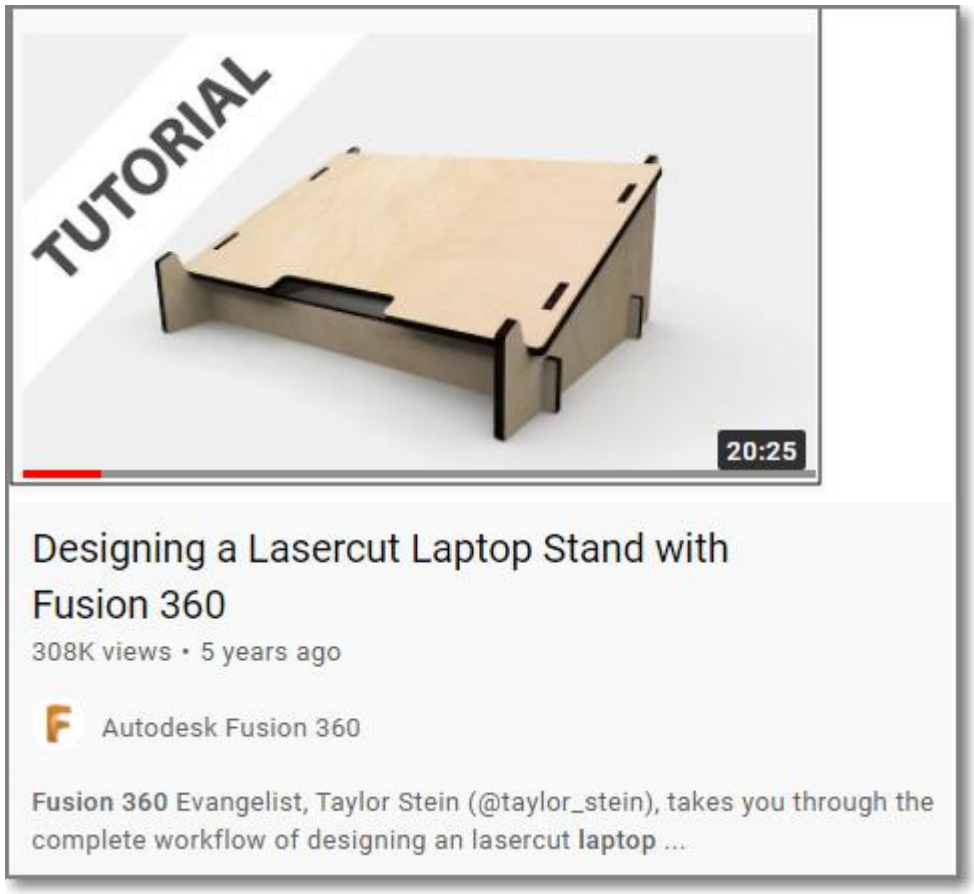
Export & check the DXF for cutting

- For each body
  - Turn off other components/bodies
  - Create new sketch for cut profile
  - Rename the sketch for reference
  - Export to DXF
- Use LibreCAD to check or layout the cuts
- Or use CorelDraw to check your files



Task: Draw your laptop stand

- Draw your own laptop stand (measure your laptop)
- Add features (i.e ventilation holes, slots for cable?)
- Ref: https://youtu.be/7riGolu7BpA



EP1000
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End