

Using Fusion for Education

John Middendorf

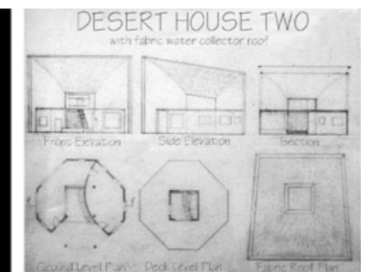
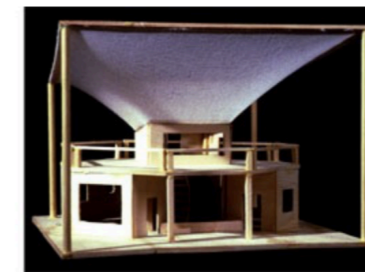
My Background:

- **Engineering Degree (Stanford, 1983)**
- **30 years of product development, including tension fabric structures.**
- **Experience with CAD/CAE programs (Solidworks, ProEngineer, Catia, Patran/Nastran, CFD) since 2001 in the Master of Engineering program, UNSW.**



John Middendorf is a designer and mechanical engineer with 15 years of experience in fabric and structure projects. In 1987 John began A5 Adventures, Inc. which produced world renown suspended camping tents that revolutionized climbers ability to live on vertical walls in remote, stormy places. After selling the successful design company in 1997, John completed a Master's of Design from Harvard Design School, where he studied architecture and tension fabric structures.

**John
Middendorf
Design**



JMDesign

Climbing Gear

Engineering

Architecture

GIS Mapping

Robotics

Engineering Design : FEA, CFD, CAD. Finite Element Analysis (FEA) is the art of modeling a structure into finite elements that can be mathematically analysed using computers (click on the links for PDF downloads).

9.47-001

By far, Autodesk Fusion merges all the design tools (CAD, CAE, CAM) into the easiest, most flexible unified tool ever.
(and the most powerful!)

What we will discuss:

- What is Parametric Modelling?**
- Some real world Fusion examples.**

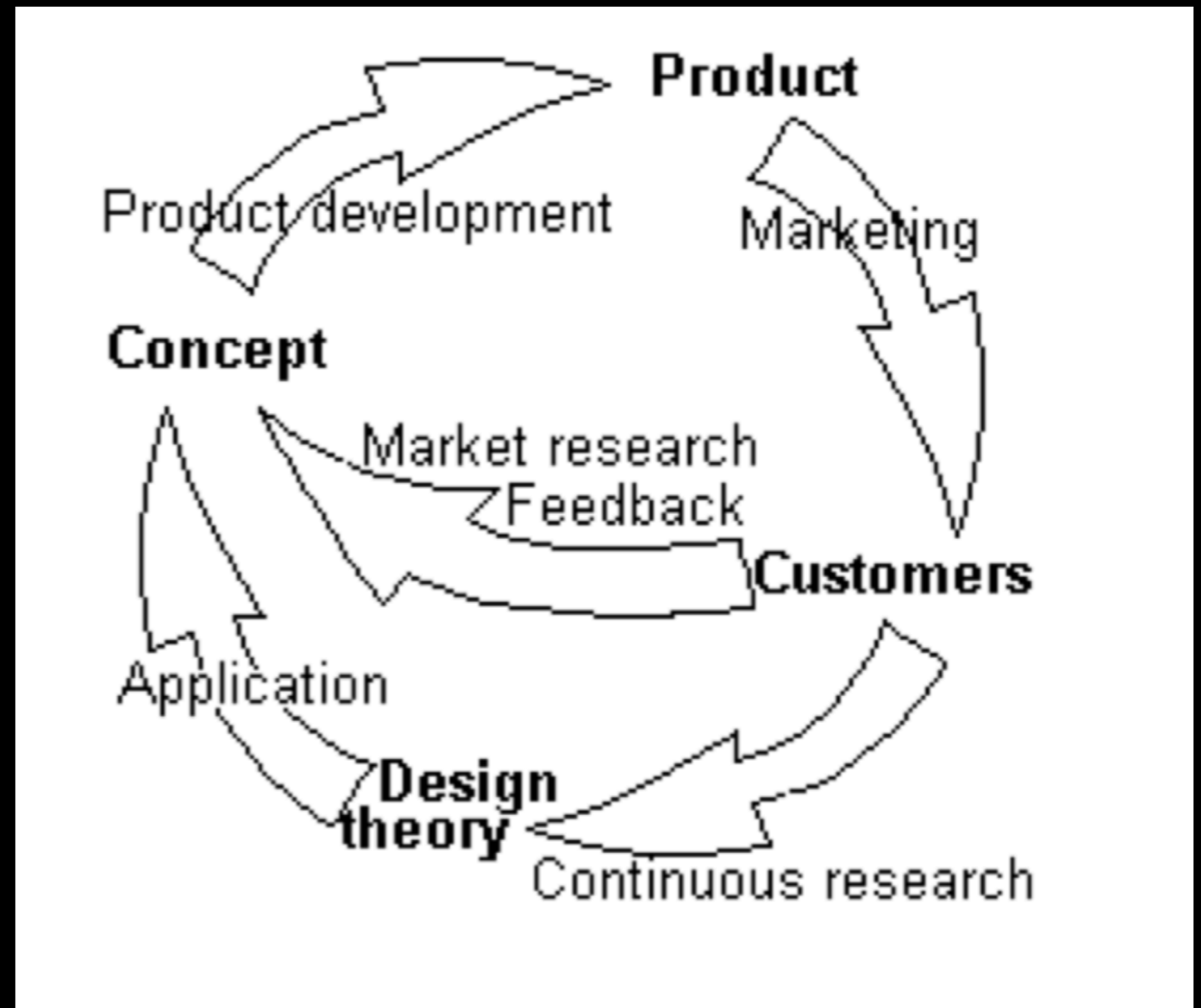
- Basic Fusion Concepts and the interface**
- Making stuff: starting with a 2D sketch vs. 3D solid**
- Export formats for 2D and 3D for CAM
(i.e. 3d Printing, CNC Router, Online Job Shops)**
- Advanced topics (Assembly and CAE)**

- Fusion in Education:**
- Alignment with Curriculum (Engineering Design 2)**
- Collaboration and student design review/feedback/grading**

HANDS ON SESSION

**Design is a very
Iterative
Process!**

**Revisions to
interdependent
parts needs to
be built into the
design process.**



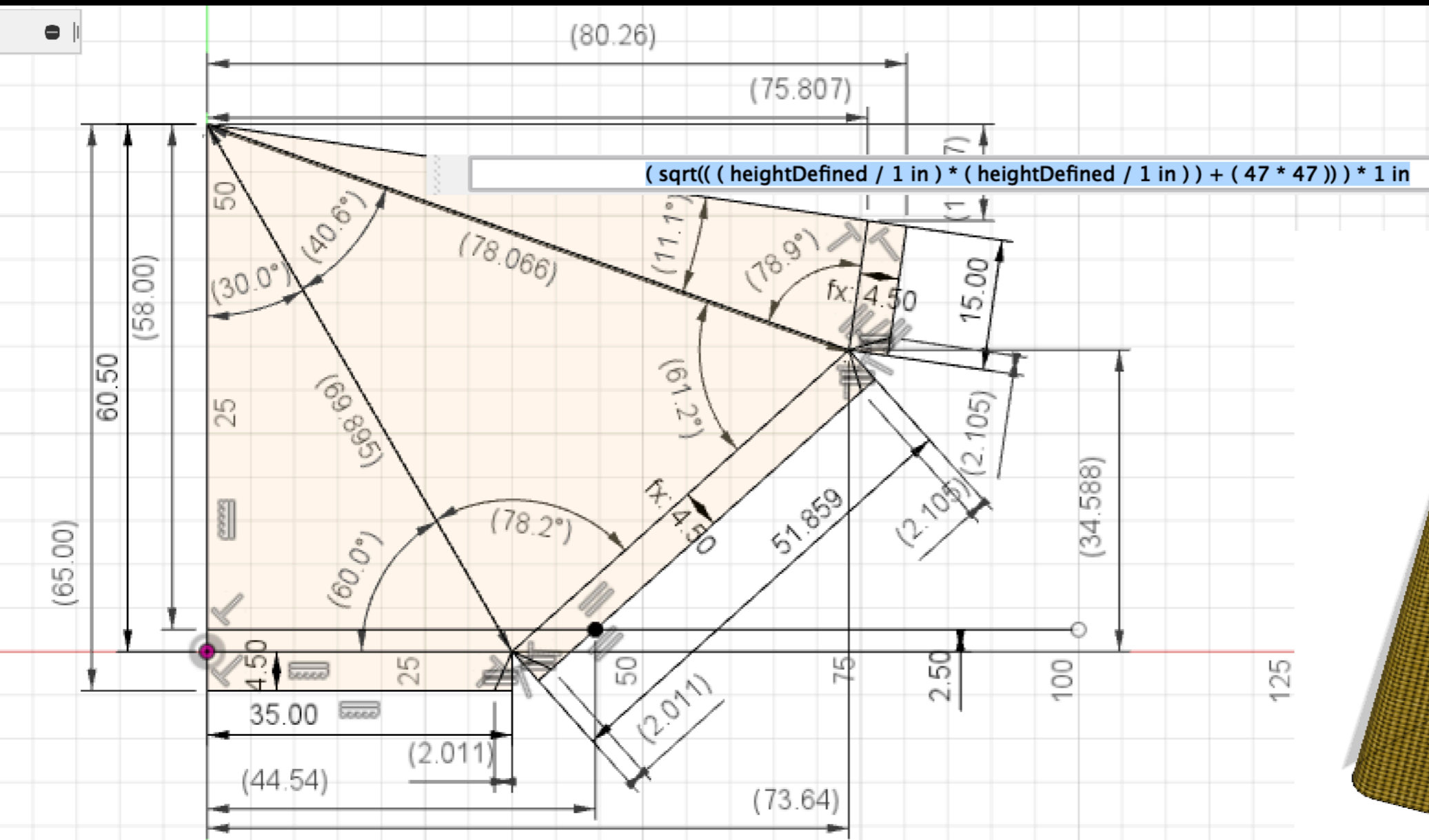
Parametric Modelling makes revisions easy.

What is Parametric Modelling?

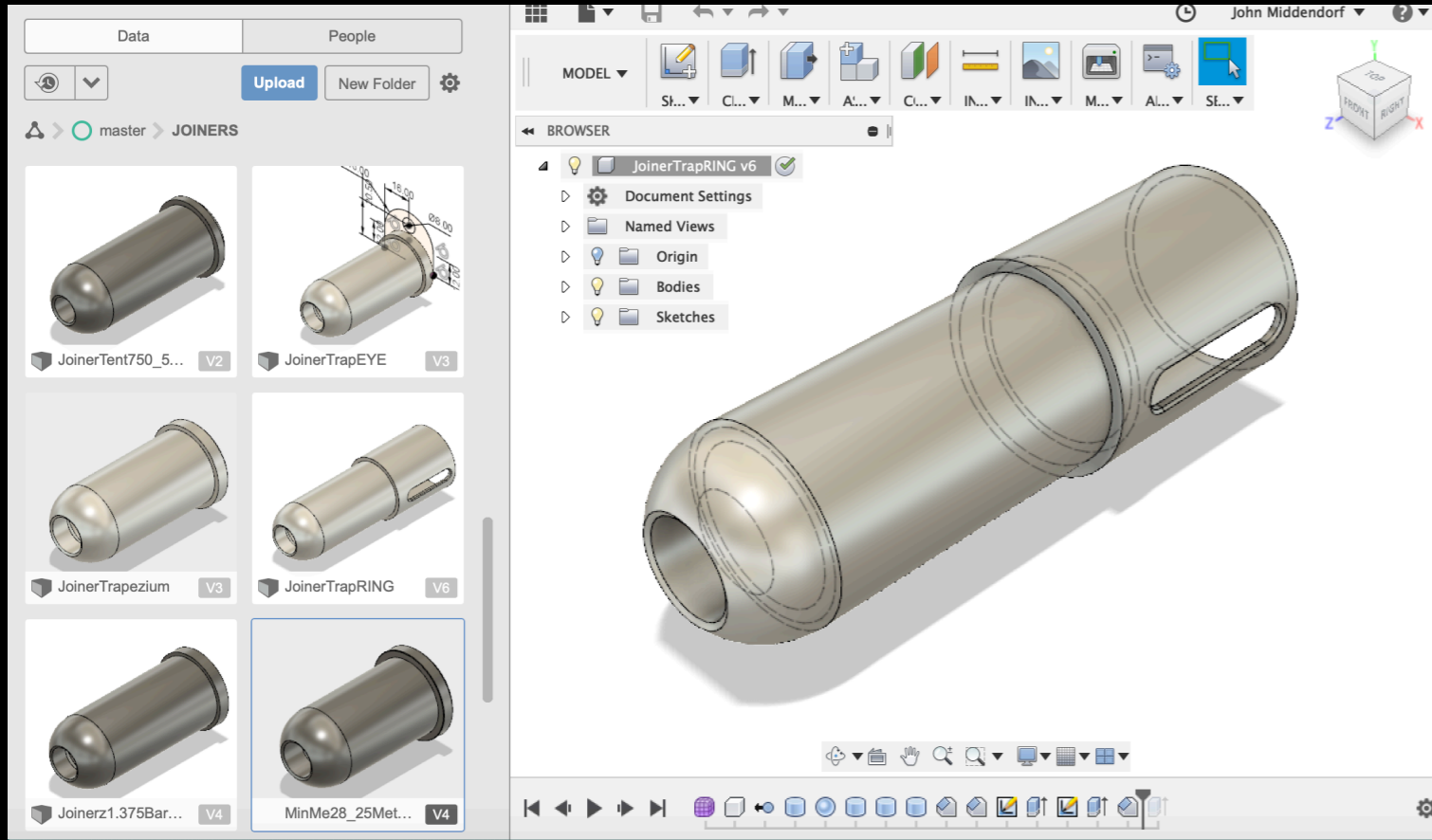
Parametric:

1. Modifying a single dimension updates entire model.

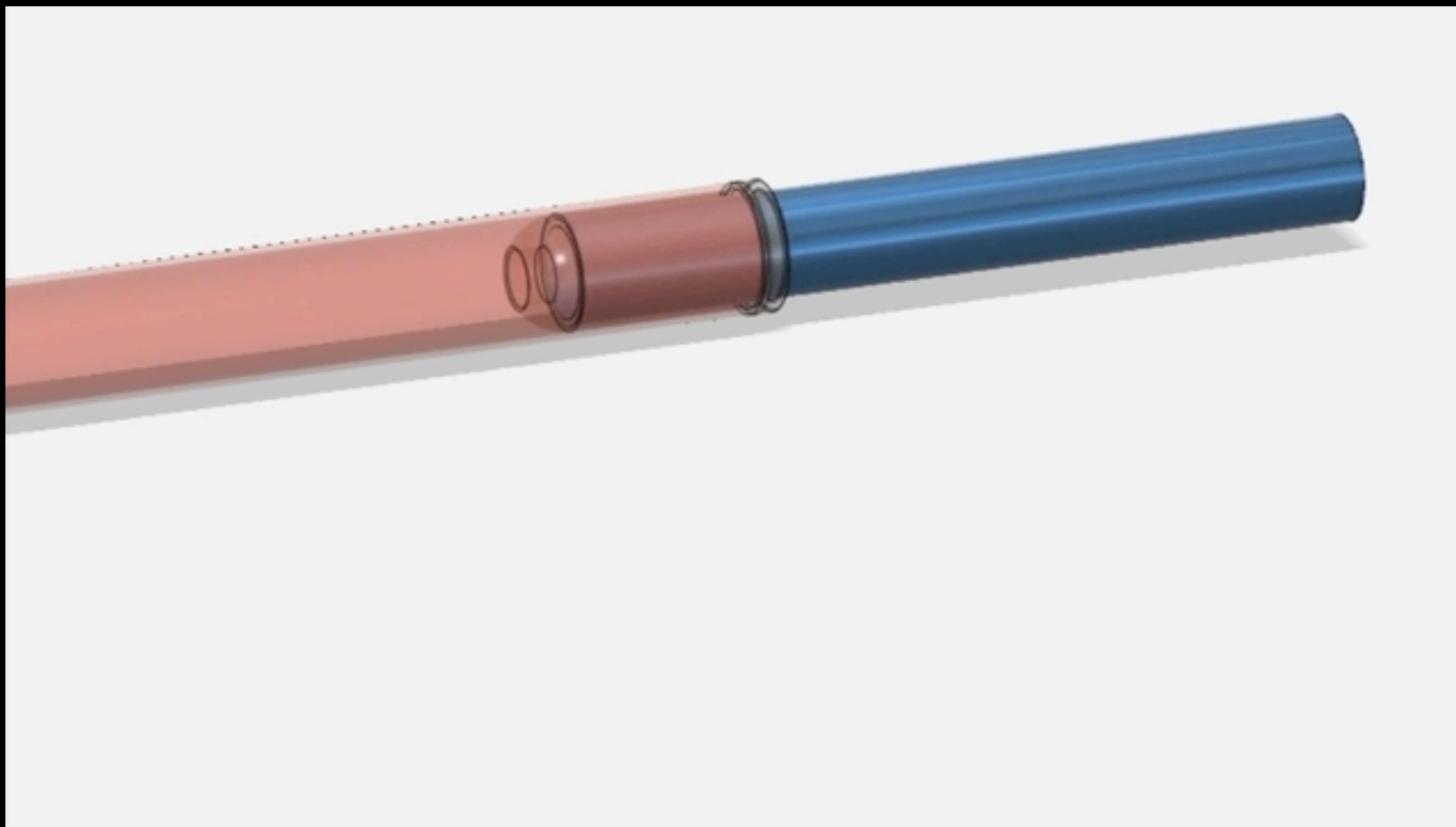
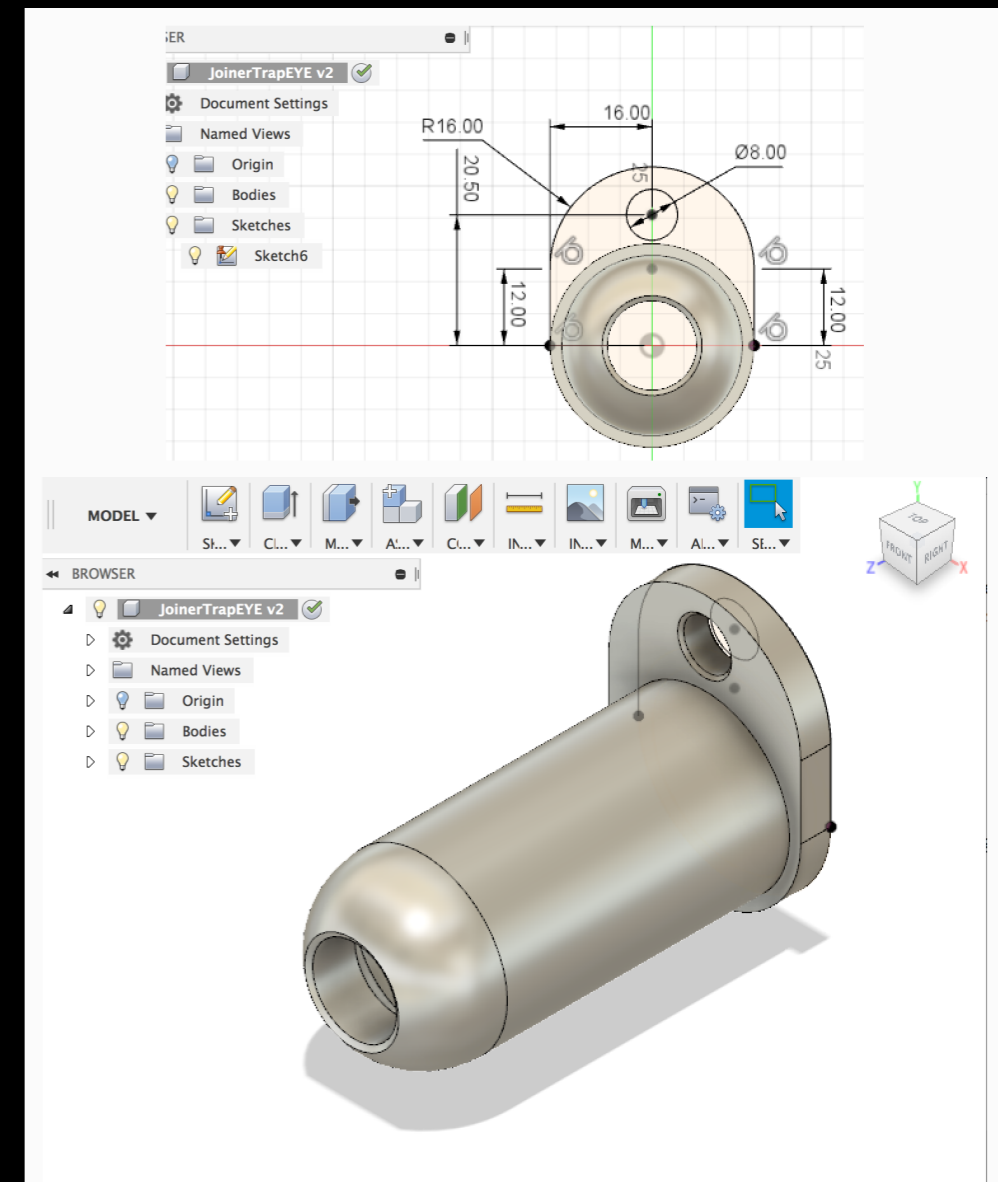
2. *Relative Dimensions*—dimensions can be specified in terms of other measurements so, revisions of parts with many dimensions is simple.



Parametric CAD makes it easy to generate a lot of study models quickly.



Parameter	Name	Unit	Expression
▼ JoinerTrapRING v6			
▼ CylinderPrimitive1			
☆ Height	length	mm	52 mm
☆ Diameter	ODforTubeID	mm	28.30 mm
▼ SpherePrimitive1			
☆ Diameter	SameAsAbove	mm	28.30 mm
▼ CylinderPrimitive2			
☆ Height	RimWidth	mm	-5.00 mm
☆ Diameter	RimOD	mm	32 mm
▼ CylinderPrimitive3			
☆ Height	InsideLength	mm	-52 mm
☆ Diameter	IDforTubeOD	mm	26.20 mm
▼ CylinderPrimitive4			
☆ Height	ShockCordCut	mm	100 mm
☆ Diameter	ShockCordDiam	mm	14.00 mm
▼ Chamfer1			
☆ LeftDistance	ShockCordCham	mm	1 mm



So how do we use Fusion?



RESOURCES ONLINE

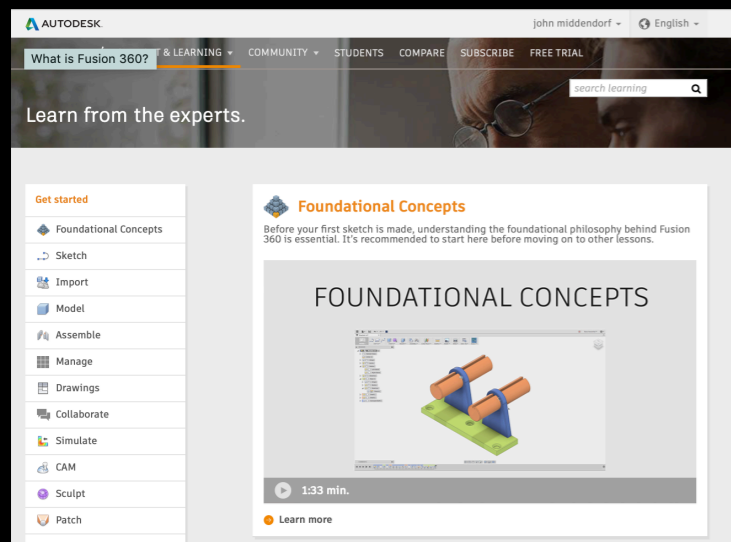
Best Overview of Fusion:

<https://www.autodesk.com/products/fusion-360/get-started>

(many lessons with short videos covering each topic, and step-by-step PDF for hands-on learning)

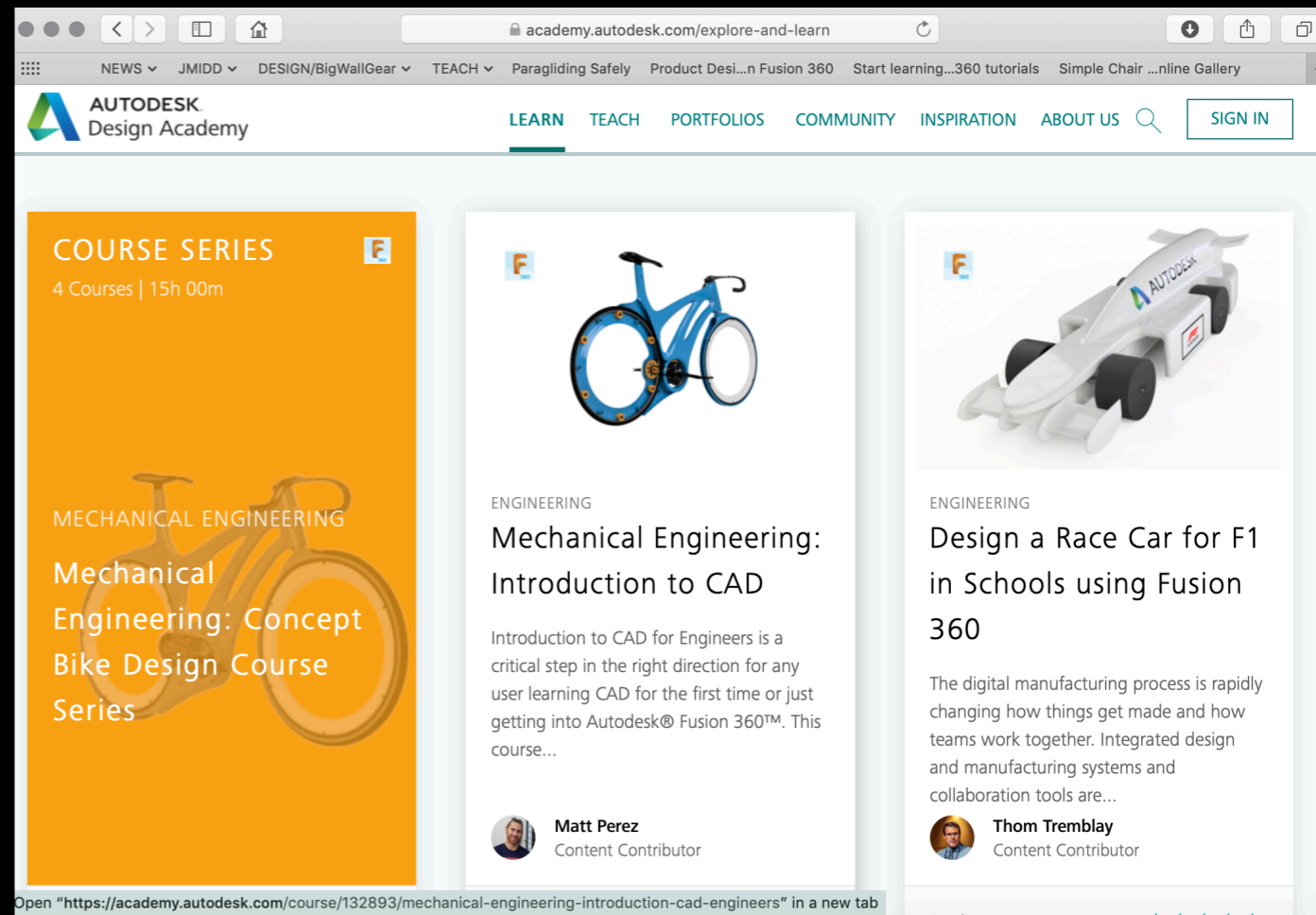
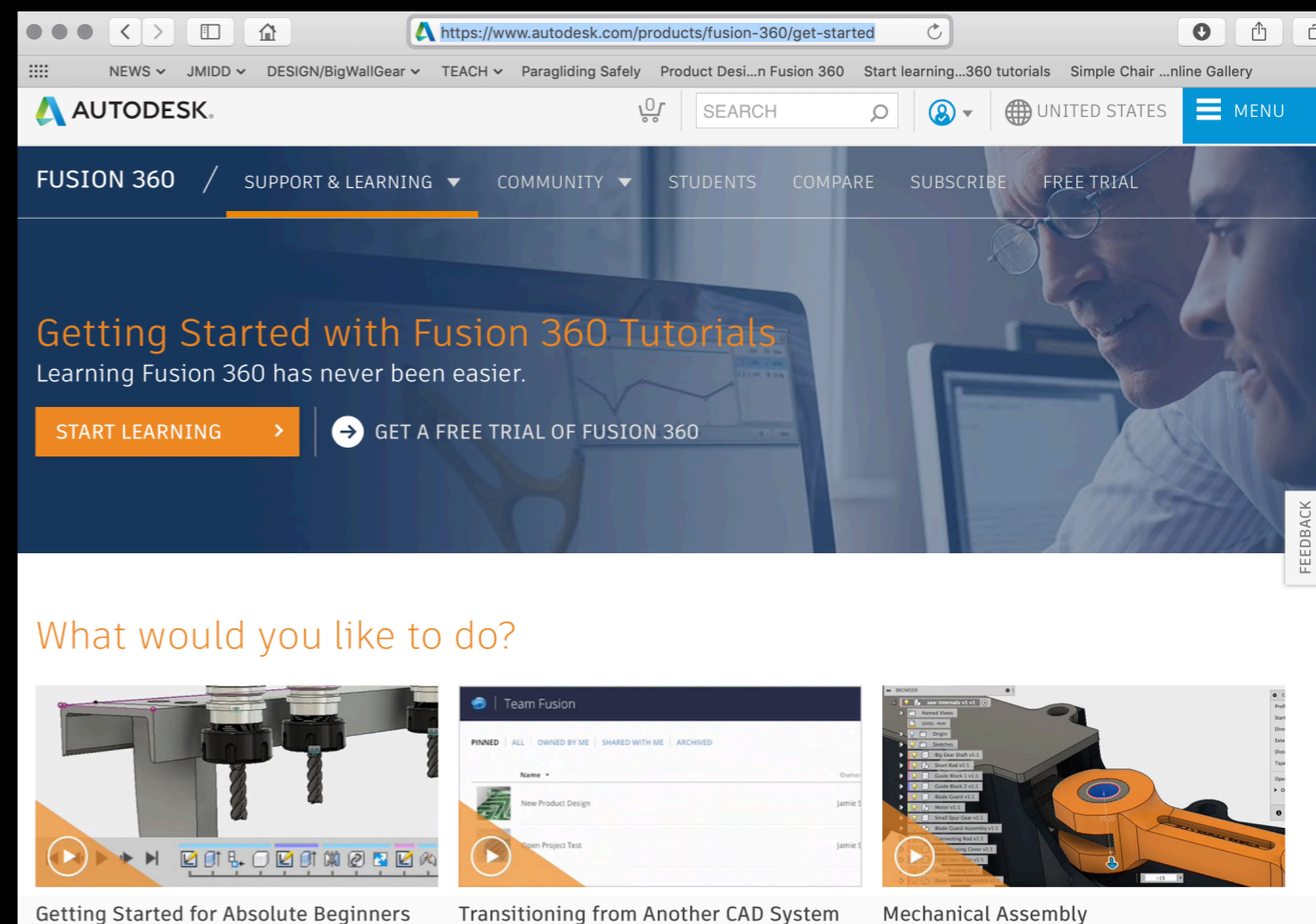
Design Academy—complete educators resources and lesson plans:

<https://academy.autodesk.com/explore-and-learn>

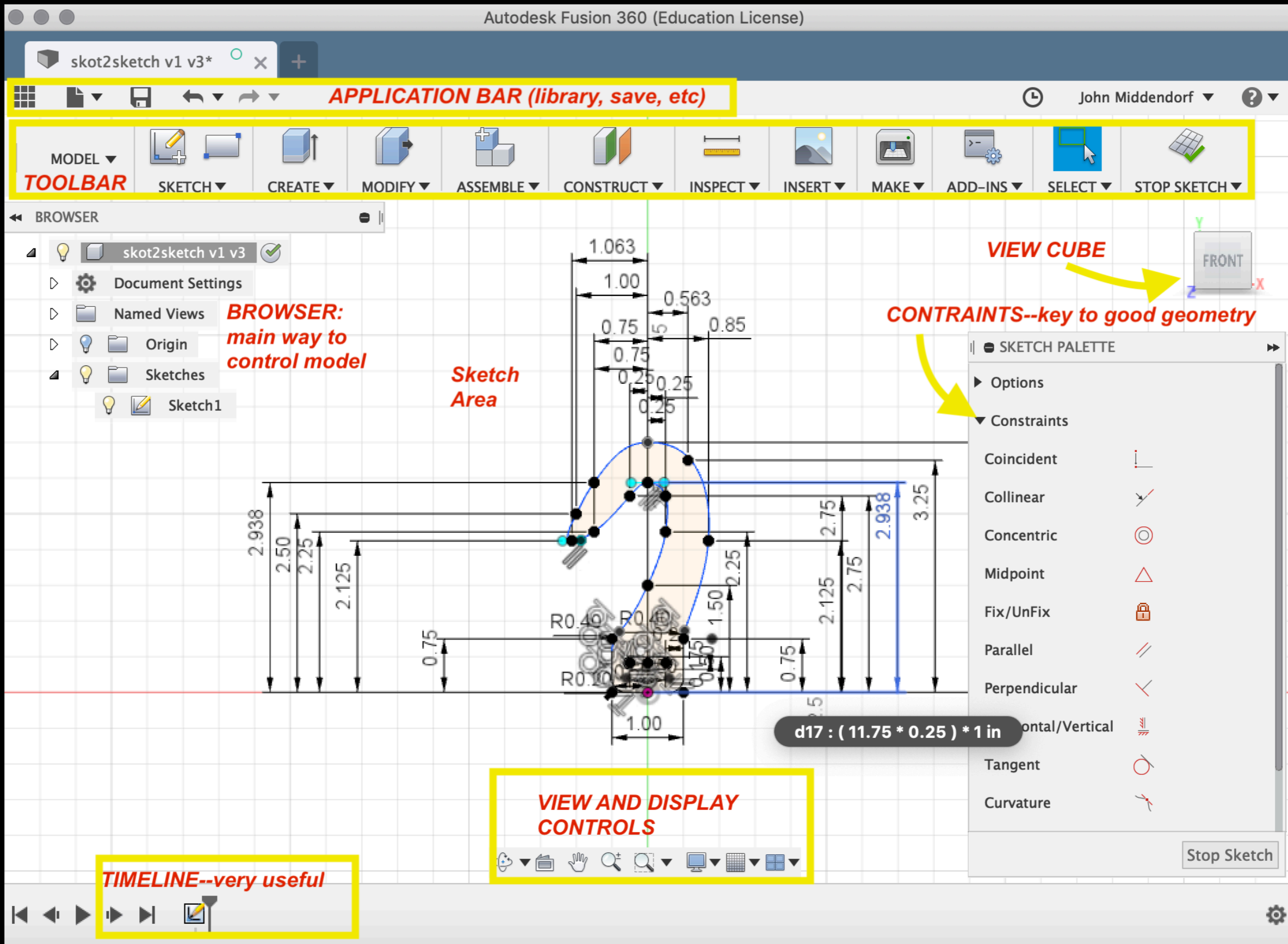


Many more learning sites!

Or just start playing!



Interface. Best to use a three button mouse with scroll wheel!



Toolbar menu:

- MODEL
- PATCH
- SHEET METAL
- RENDER
- ANIMATION
- CAM
- DRAWING

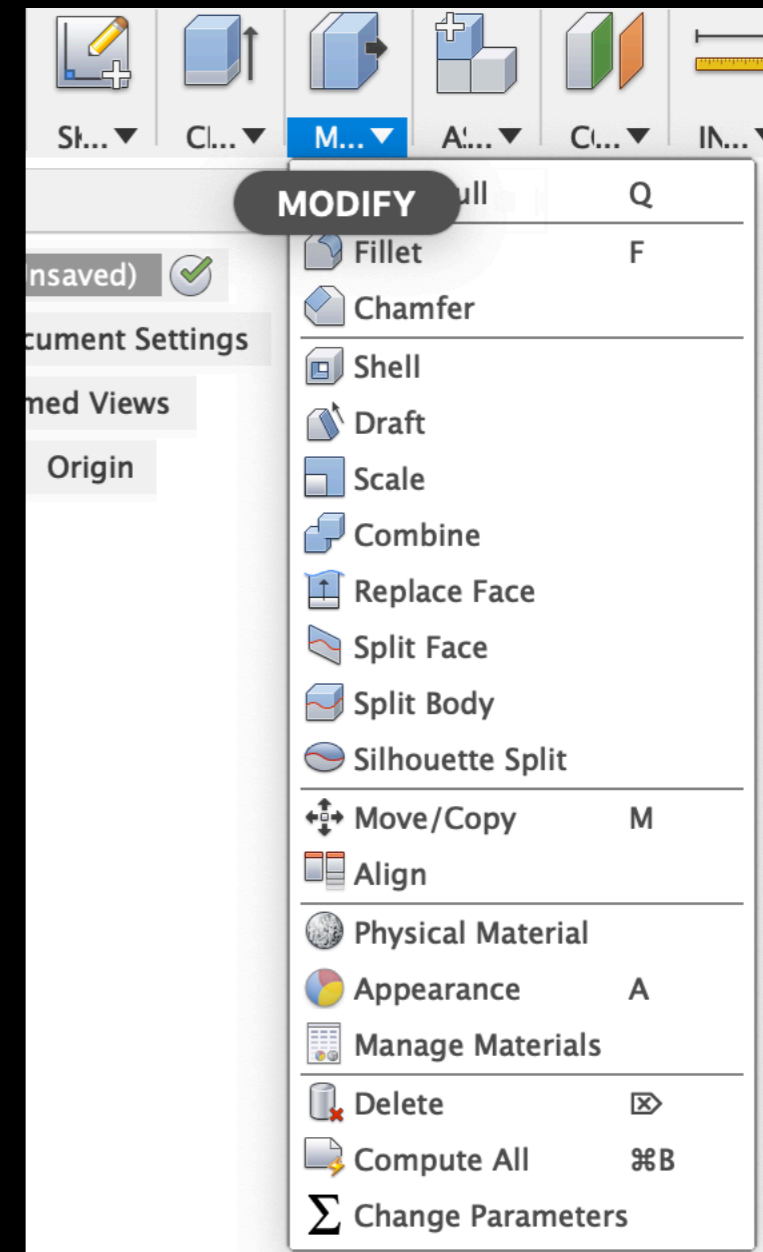
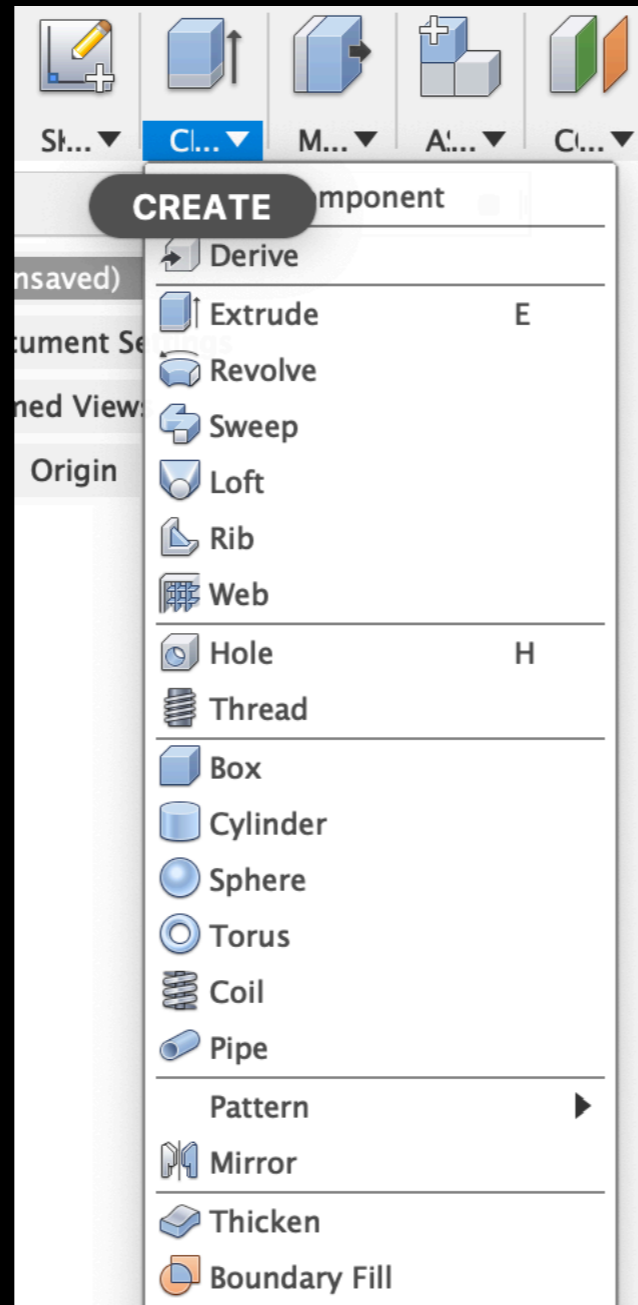
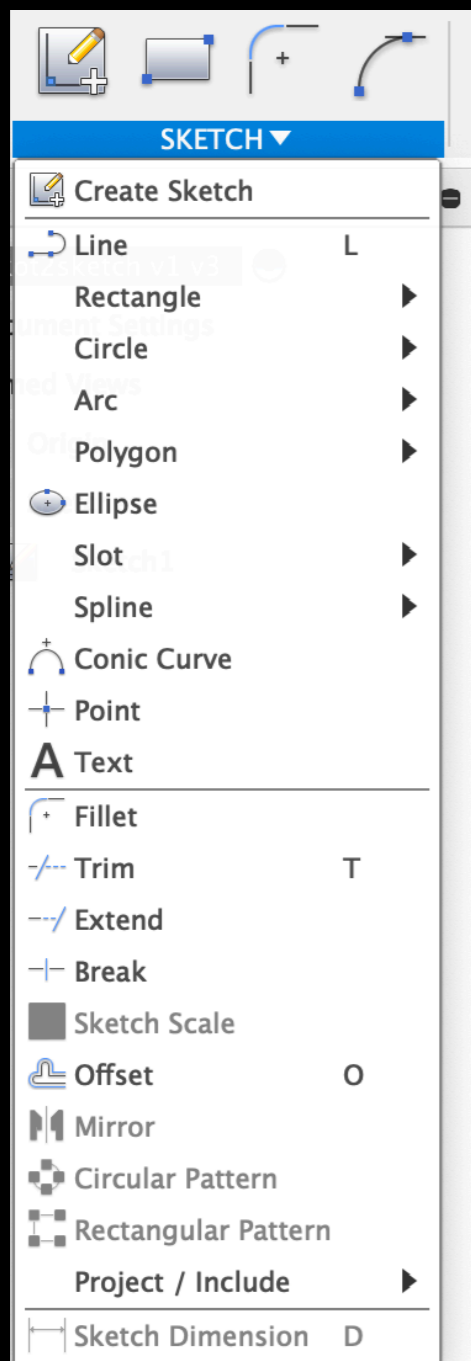
Sketch Menu:

- SKETCH
- Create Sketch
- Line
- Rectangle
- Circle
- Arc
- Polygon
- Ellipse
- Slot
- Spline
- Conic Curve
- Point
- Text
- Fillet
- Trim
- Extend
- Break
- Sketch Scale
- Offset
- Mirror
- Circular Pattern
- Rectangular Pattern
- Project / Include
- Sketch Dimension

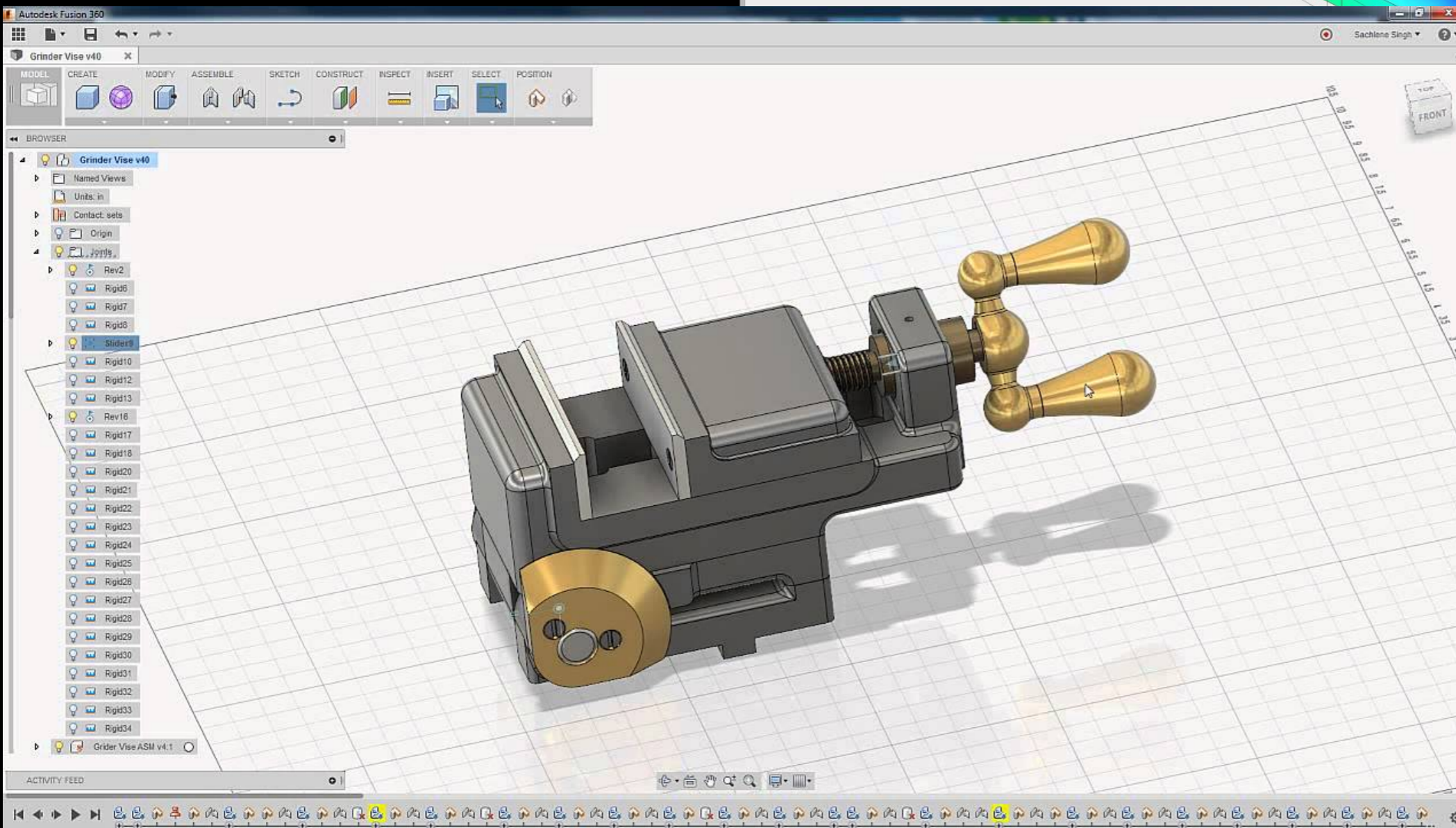
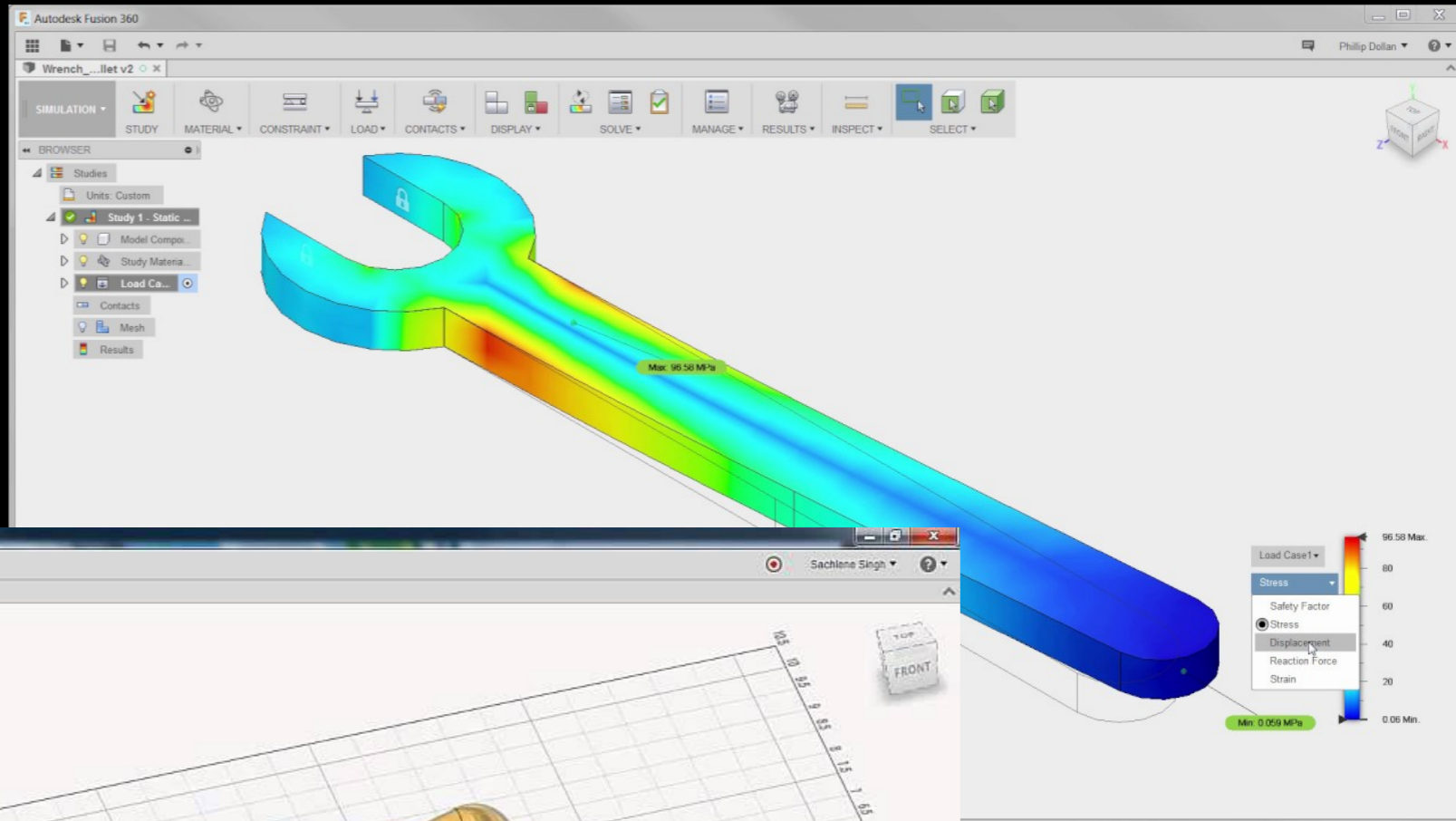
Two Schools of Thought for CAD:

1. Started with fully dimensioned parametric sketch, then build 3D model.
2. Start with solid, then sculpt model to shape.

Good News is, Fusion allows both methods, but best practice is to begin with a fully dimensioned sketch, create 3D part, then “sculpt” additional features using create and modify menus.



Advanced Topics: Assemblies and CAE

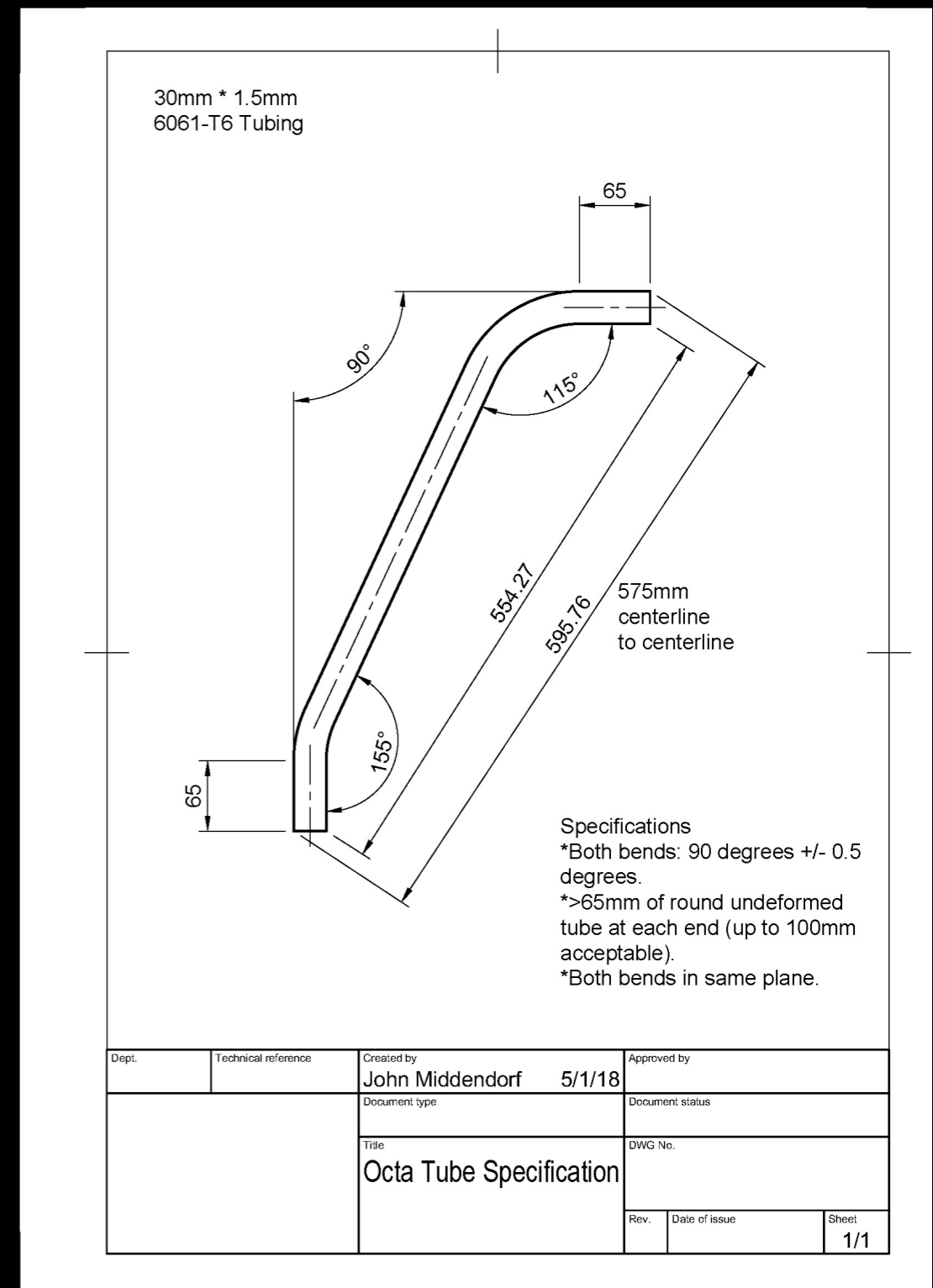
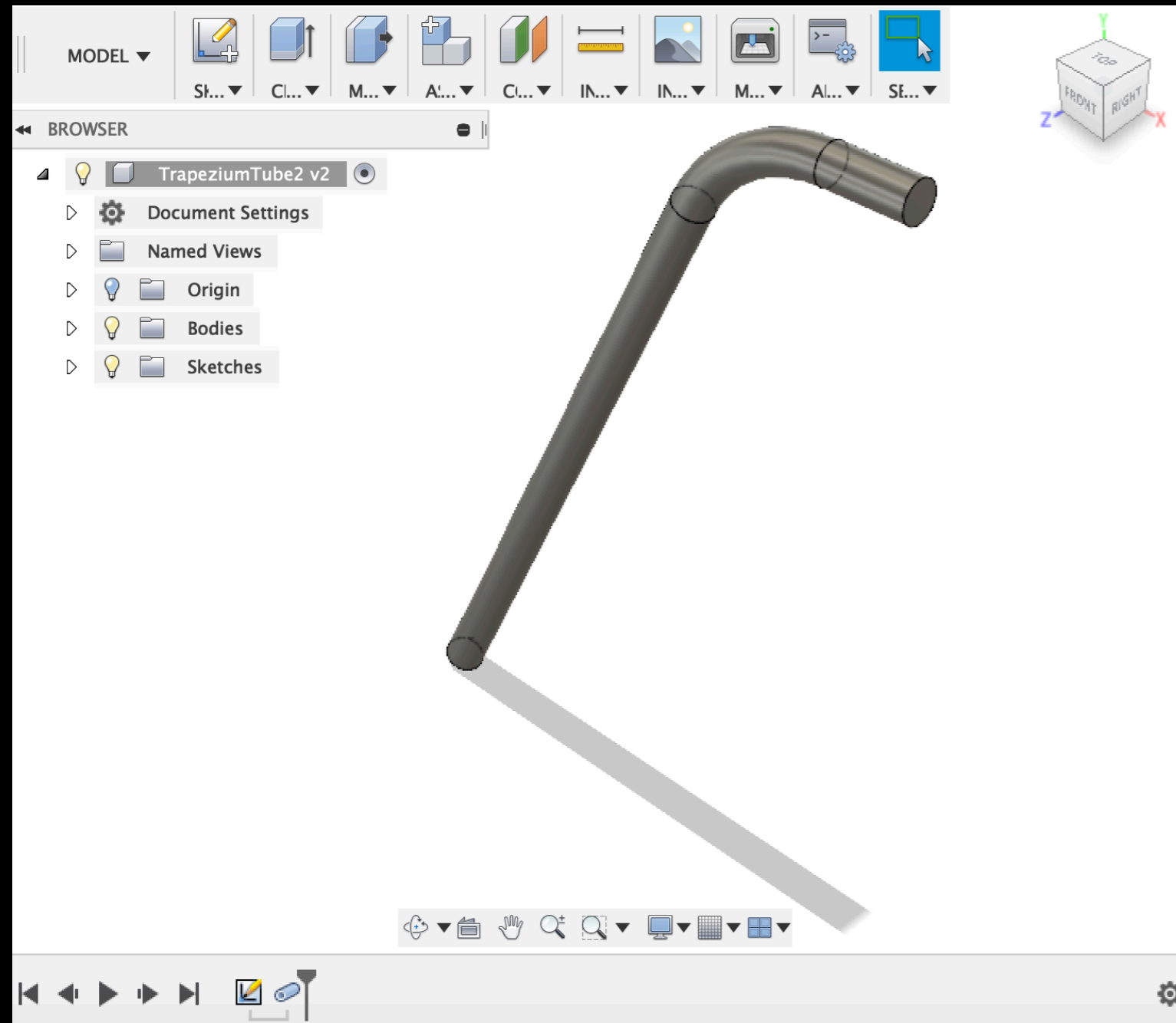


Export Formats

links our learning with real world opportunities...

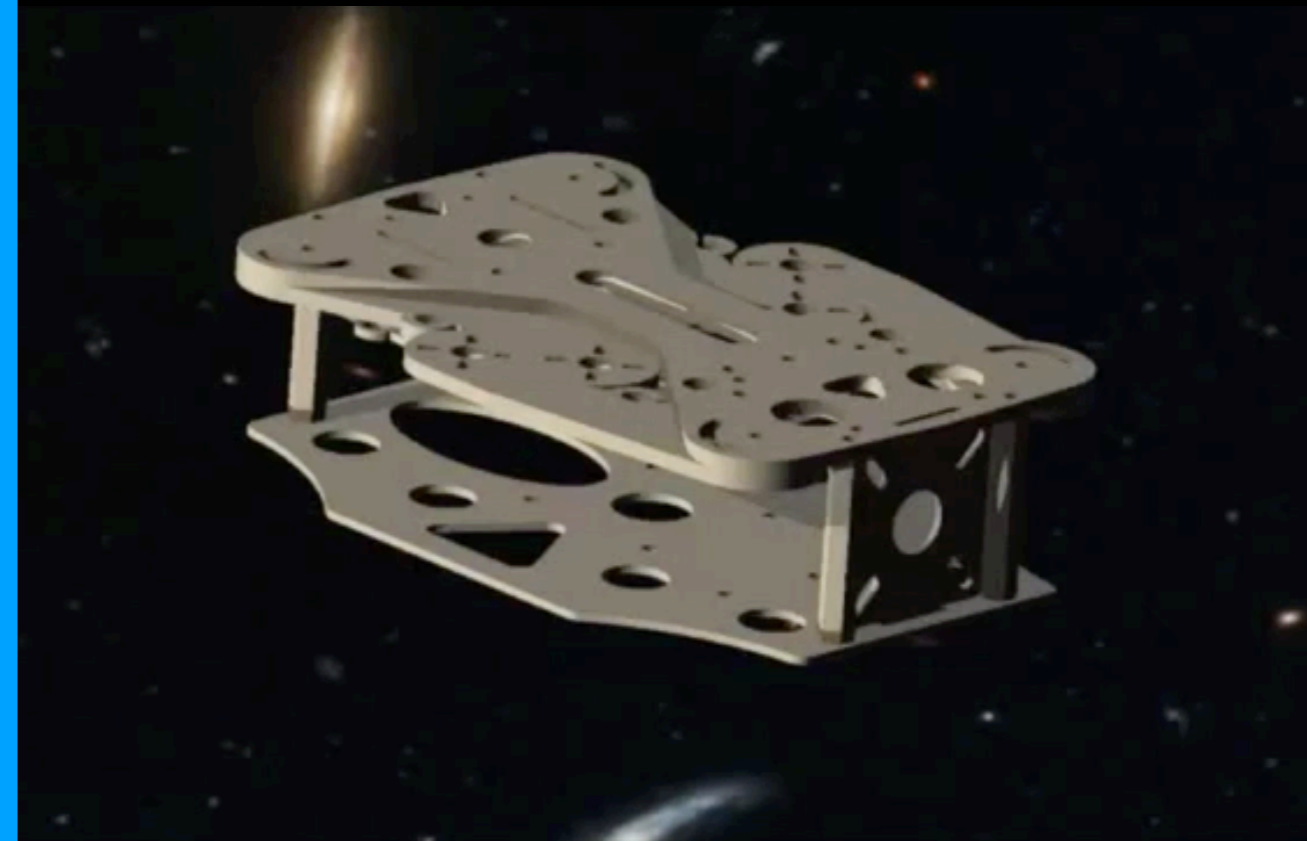
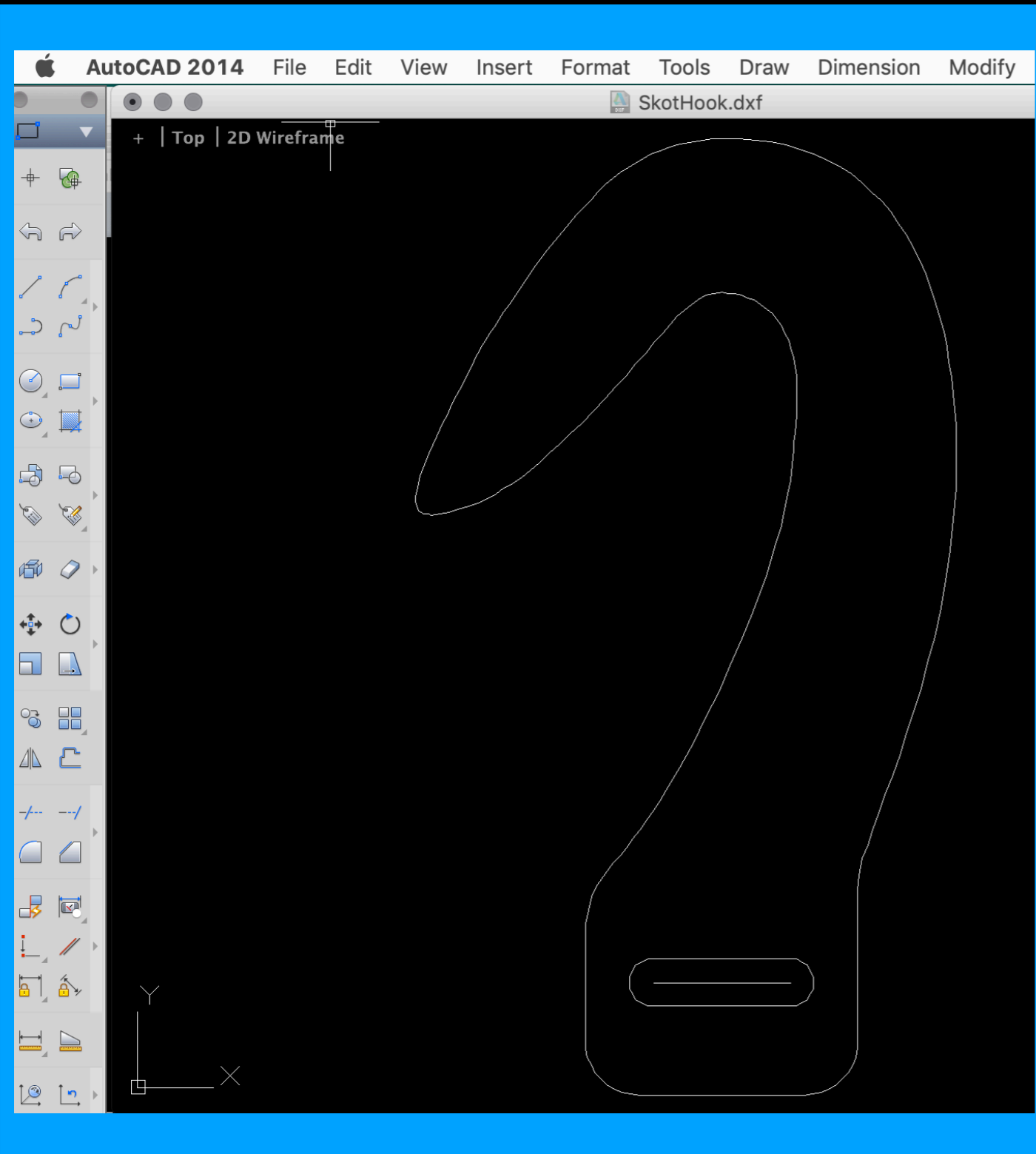
Key Export Format 1: Drawings

Some manufacturing shops still need drawings—very easy in Fusion.



Key Export Format 2: DXF

– DXF best for 2D parts, can be processed for CNC router.

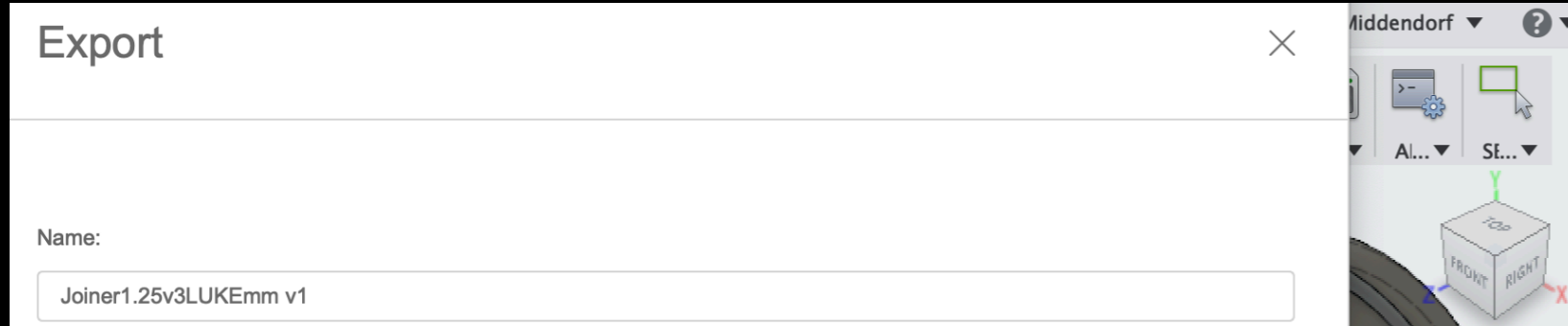


Parts all sourced in carbon fibre as 2D DXF parts.

DXF originally created in Fusion

Key Export Format 3: 3D formats—for 3D printer or for CAM quotes

.STEP and .IGS seem to be most used in industry



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Injection Molding

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Brass 260★

Brass 360★

Steel 12L14★

Steel 4130

Steel 4140

Steel A36★

Steel D2

Steel O1

Titanium Grade 2

ABS★

Acetal★

Nylon

PVC

Polycarbonate

Polypropylene

Polystyrene

Compression Molding

Alignment with Curriculum (TASC Engineering Design 2)

In addition to the learning of parametric modelling tools as a practical lifelong skill, the development of Fusion skills are well aligned with the curriculum:

“Through practical experiences, learners will learn to use technology to design, test and appraise products, systems and solutions and have the opportunity to identify and articulate further improvements and developments.”

Specifically, projects can be designed to focus on Areas 1 and 4:

Area 1: Design thinking (50 hours)

Design underpins all engineering solutions. In this area of study, learners develop an understanding of an engineering design process known as *design thinking*, and how this is applied to create solutions.

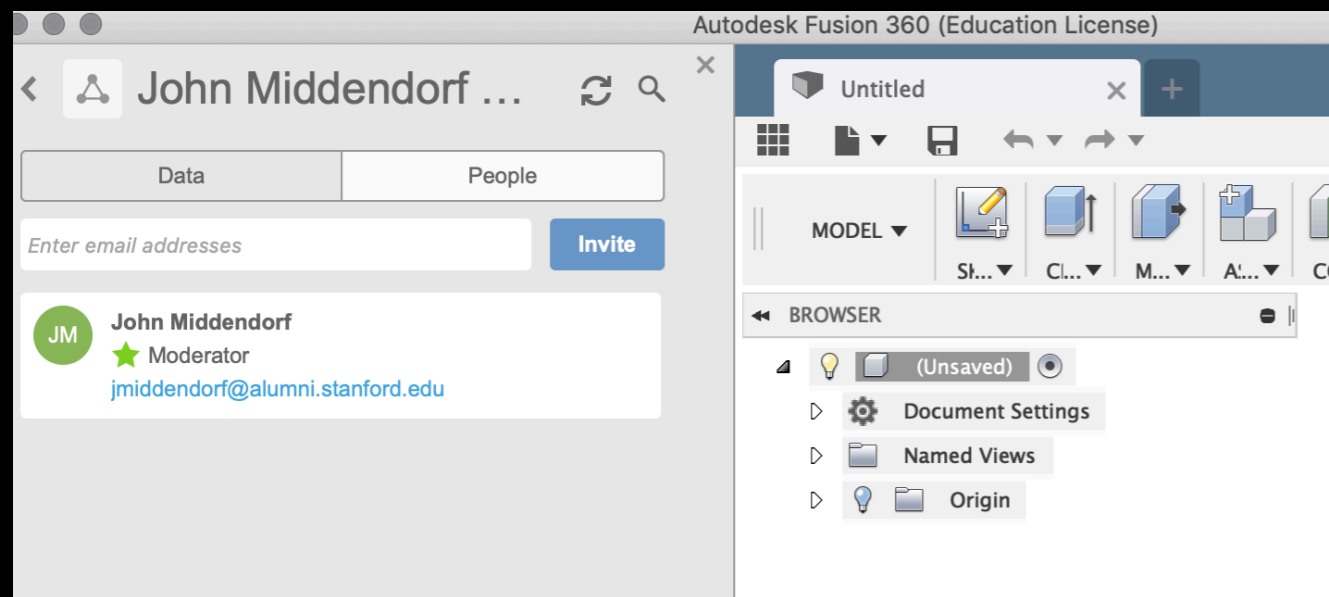
Area 4 – Major Project (40 hours)

In this area of study, learners will build on the skills gained in *Engineering Design* to propose and develop their own engineering project. They will follow an engineering design process to conduct their own research, ideation, design, development, and then perform an evaluation of their final product.

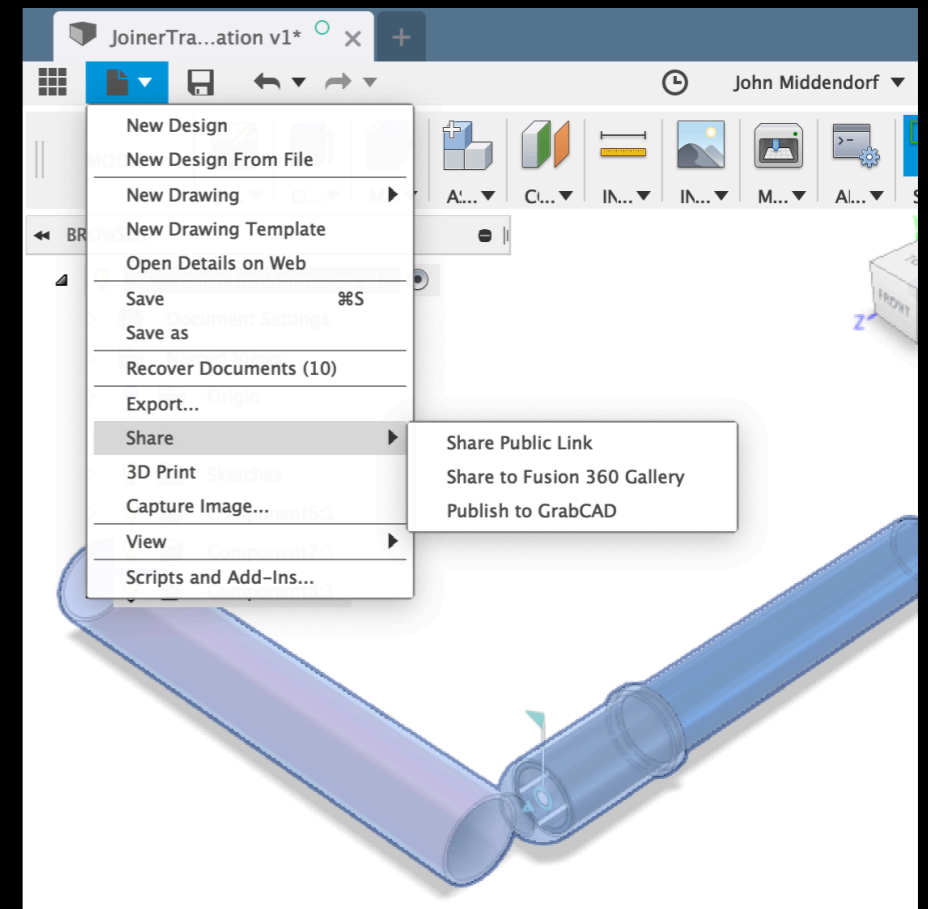
And the Criteria:

1. describe and apply engineering concepts
2. apply design thinking to generate engineering solutions
3. create engineering solutions using appropriate resources
4. evaluate prototypes through user and technical testing
5. describe the application and impact of engineering on society
6. collect, represent, and interpret data
7. plan, organise, and complete activities
8. communicate technological information

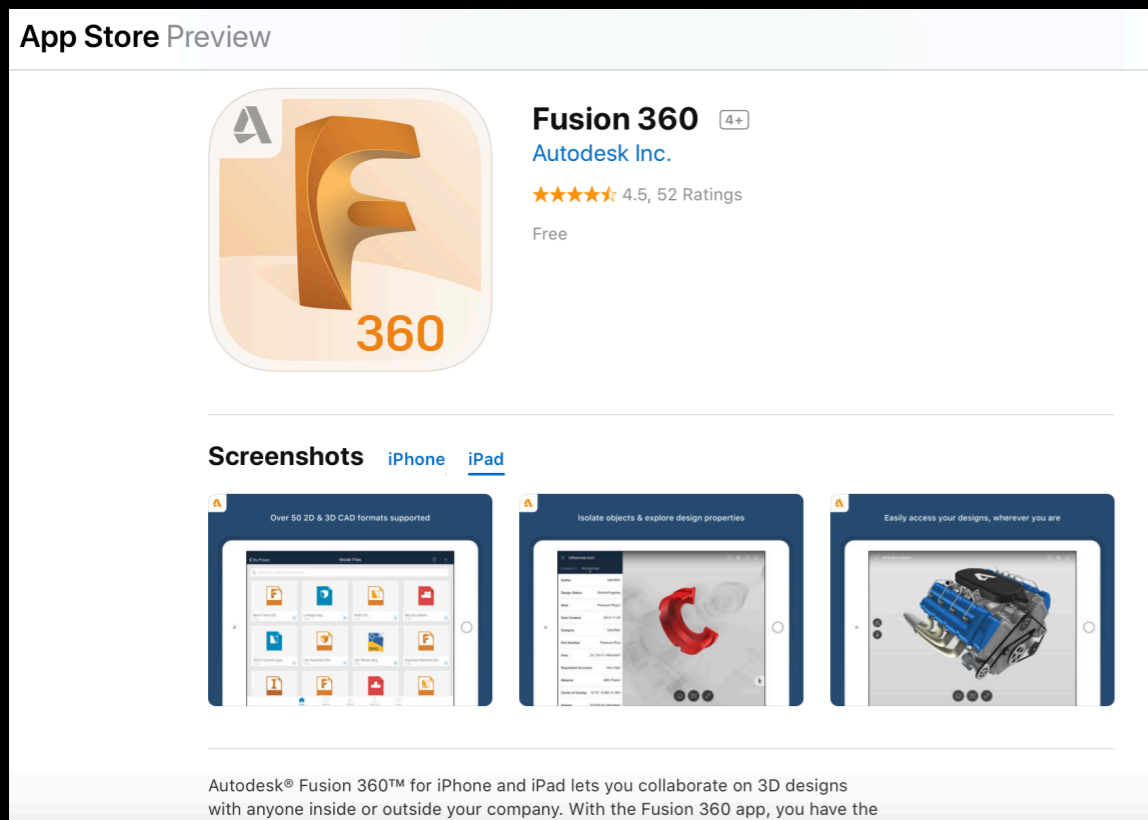
Collaboration Tools:



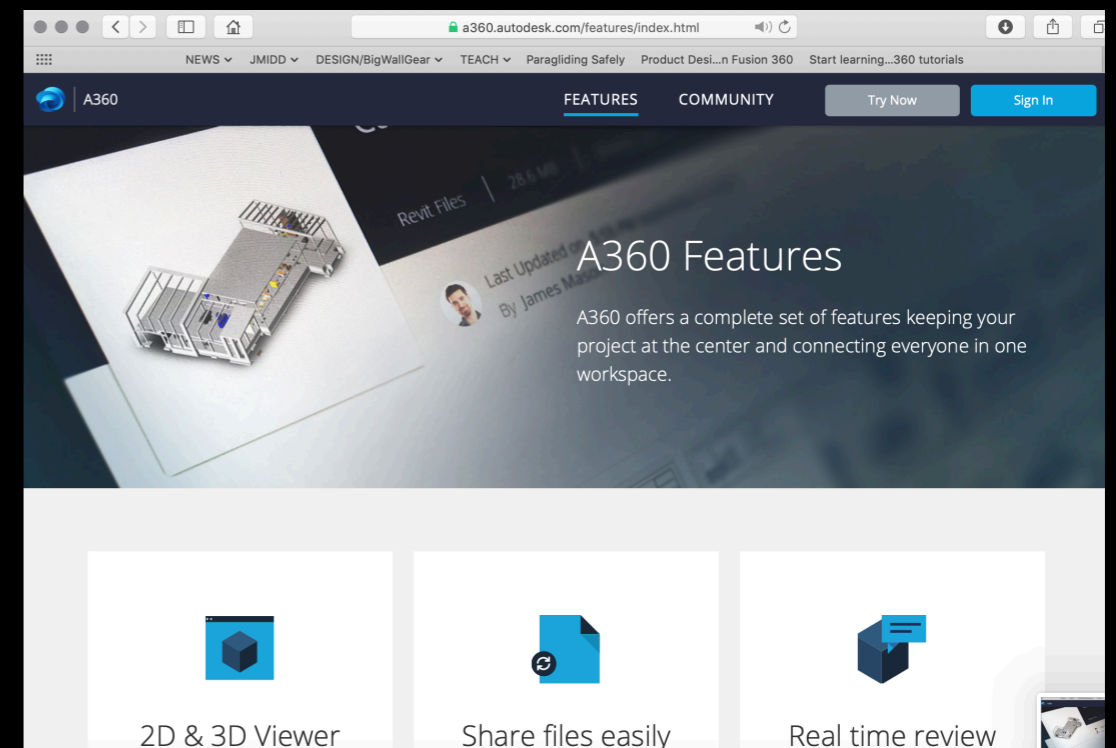
Add People to your projects



Share public link or add to 360 gallery



View and comment on models on iPad



View on web based cloud browser

Best of all, free Educational access!

Some customers are experiencing difficulty obtaining education license details for Autodesk software; we appreciate your patience as we work to resolve this as quickly as possible. In the meantime, please try [these steps](#), which should fix this problem.

Get a free 3-year education license

Fusion 360 is available for Mac and PC.

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