

Generative Design to Build an Optimum Model for Autodesk CFD Heat-Sink Modelling

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About the speaker

Gilberto Fernandez

Gilberto Fernandez is a Designated Support Specialist within the Autodesk Customer Services organization. Having an engineering background, he has vast experience in the field of Simulation and Computational Fluid Dynamics. Mainly Gilberto's role is to lead the way technically with Autodesk Premium Customers, in terms of Simulation solutions. He is based in Barcelona, and is heavily focused now in Design Optimization through Simulation



Summary

This demo will show how to generate a model for a heat sink to be simulated in Autodesk CFD, optimizing the model with Fusion 360 software and Generative Design.

Generative design is a process of iterative design that uses the power of computing to give a large number of permutations and possibilities that we can fine-tune to get an optimum-performing design.

This demo will apply this to a real-world model of a heat sink, where we can vary the layout and the geometry of our item quite a lot, based on different constraints.

We will go through the decision-making process to achieve the best-performing design.

Agenda

SUMMARY

INTRODUCTION TO GENERATIVE DESIGN

- Why do we care?
- What makes it different?

HEAT SINK MODELLING DETAILS

- Fusion initial model
- CFD model
- Comparison in CFD

GENERATIVE DESIGN WORKFLOW DEMO

RUNNING ALTERNATIVES IN CFD

CHALLENGES AND LIMITATIONS

LOOKING INTO THE FUTURE

ADDITIONAL RESOURCES

Q&A





Design is thinking made visual | SAUL BASS (1920-1996)

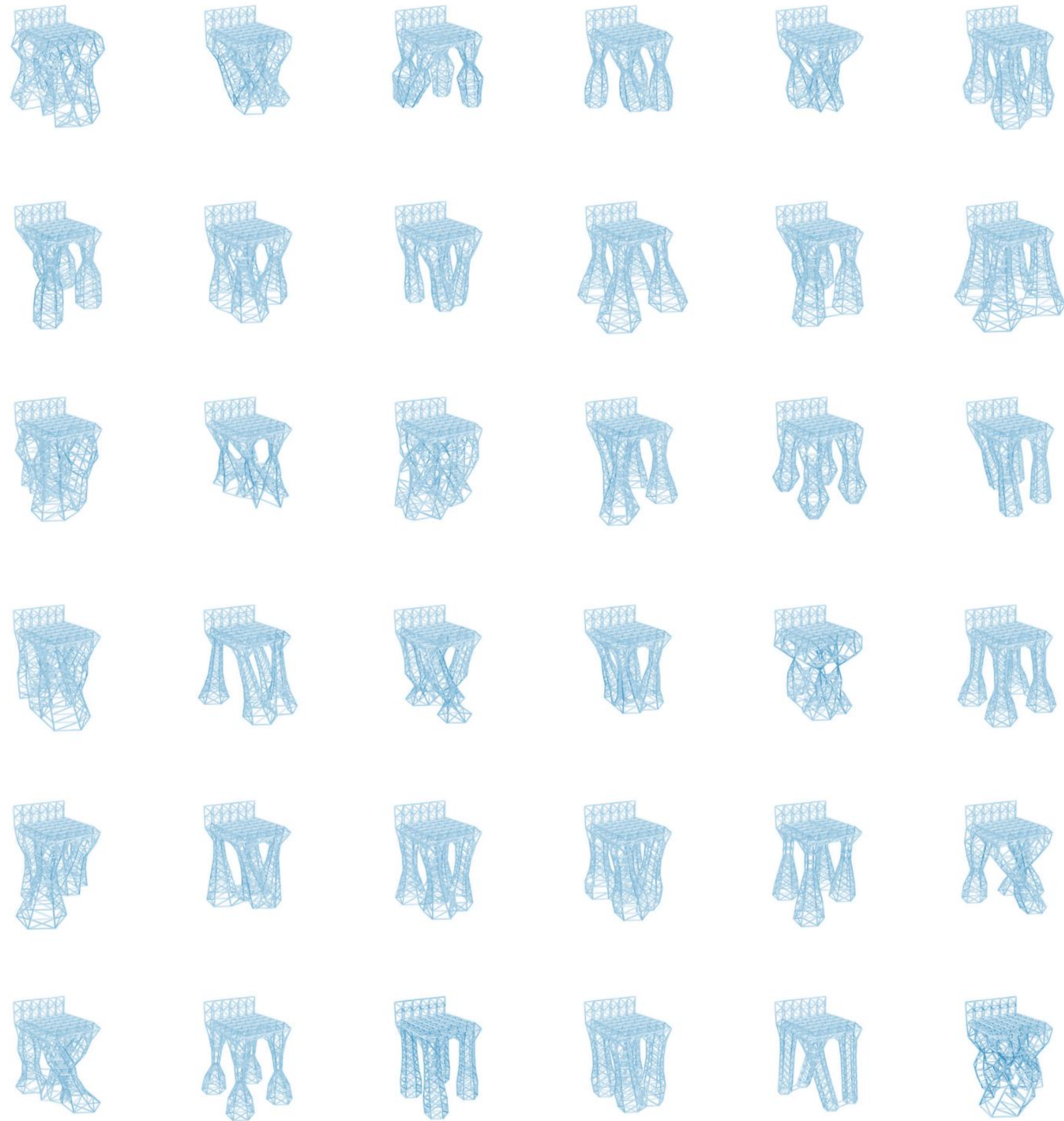
Introduction to Generative Design



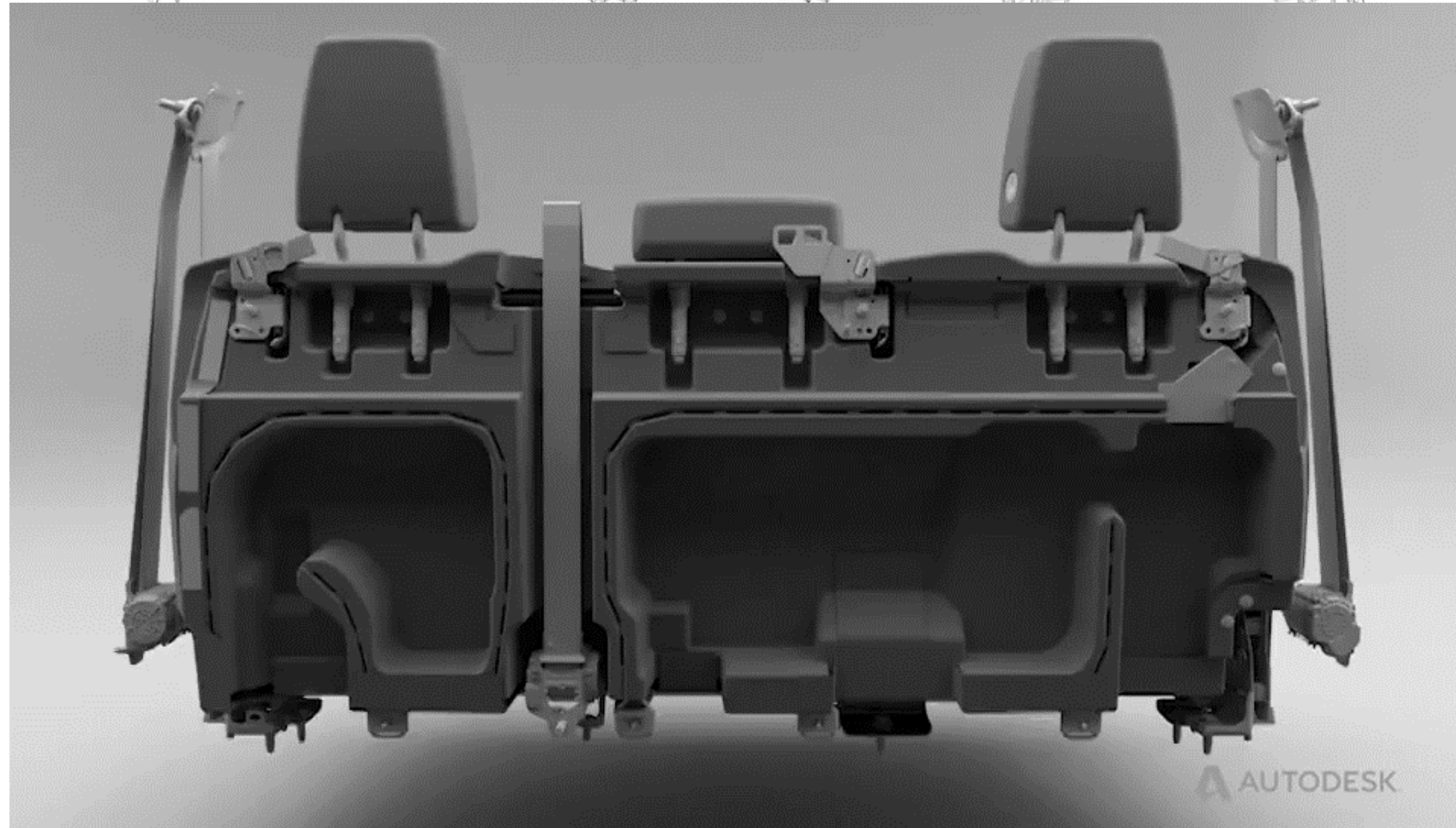
What is Autodesk Generative Design?

Autodesk generative design is a **design exploration** technology.

Simultaneously generate multiple CAD-ready solutions based on real-world manufacturing constraints and product performance requirements.



Why do we care?



Part consolidation is a twofold motivator

Optimize for mass

Reduce supply-chain costs associated with each part and its unique supplier



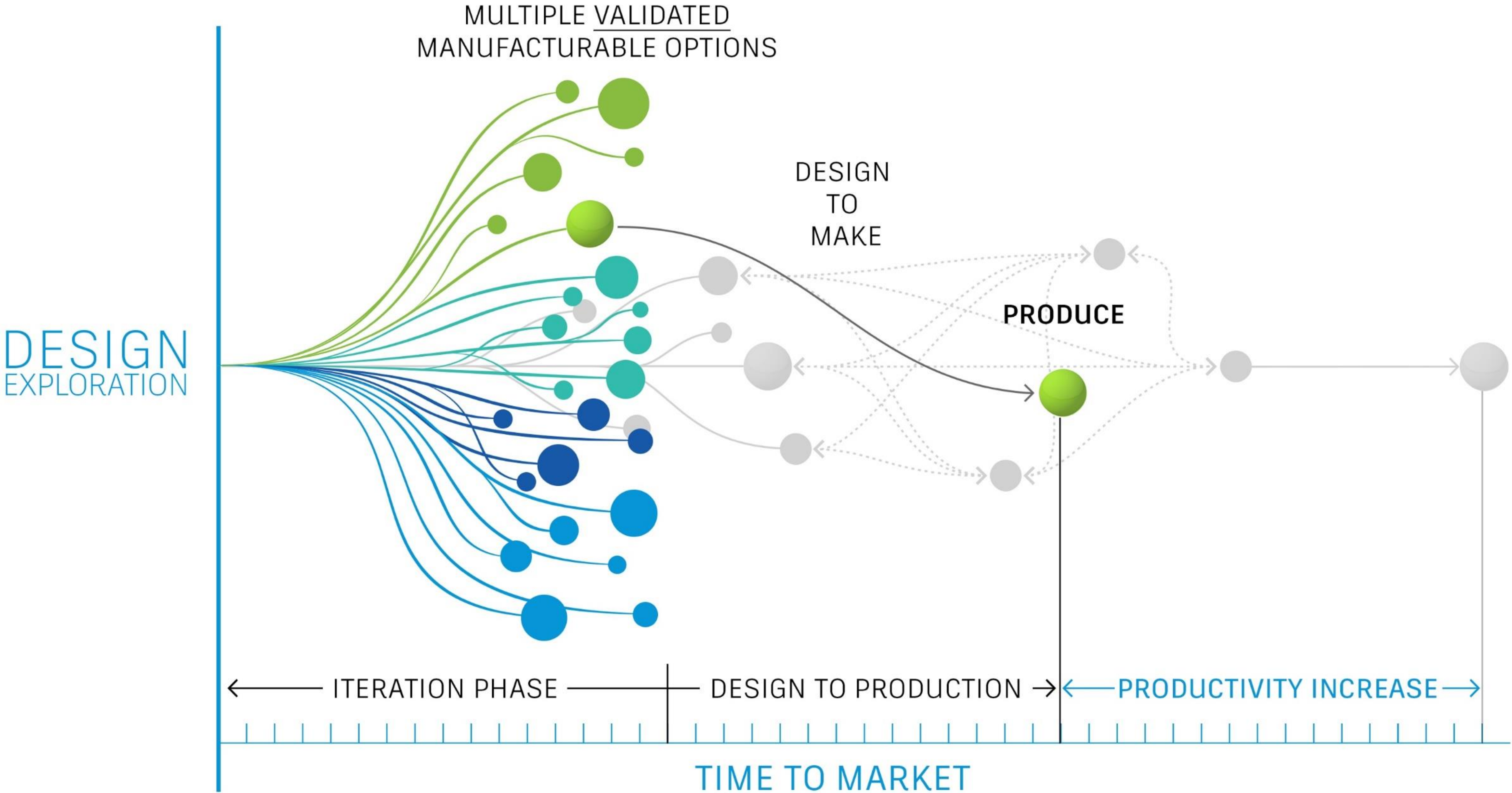
Making wheelchairs more versatile, customizable and a fashion item

Tailored to unique persons measurements

Interchangeable parts based on needs

How does Generative Design help the product development process?

GENERATIVE DESIGN

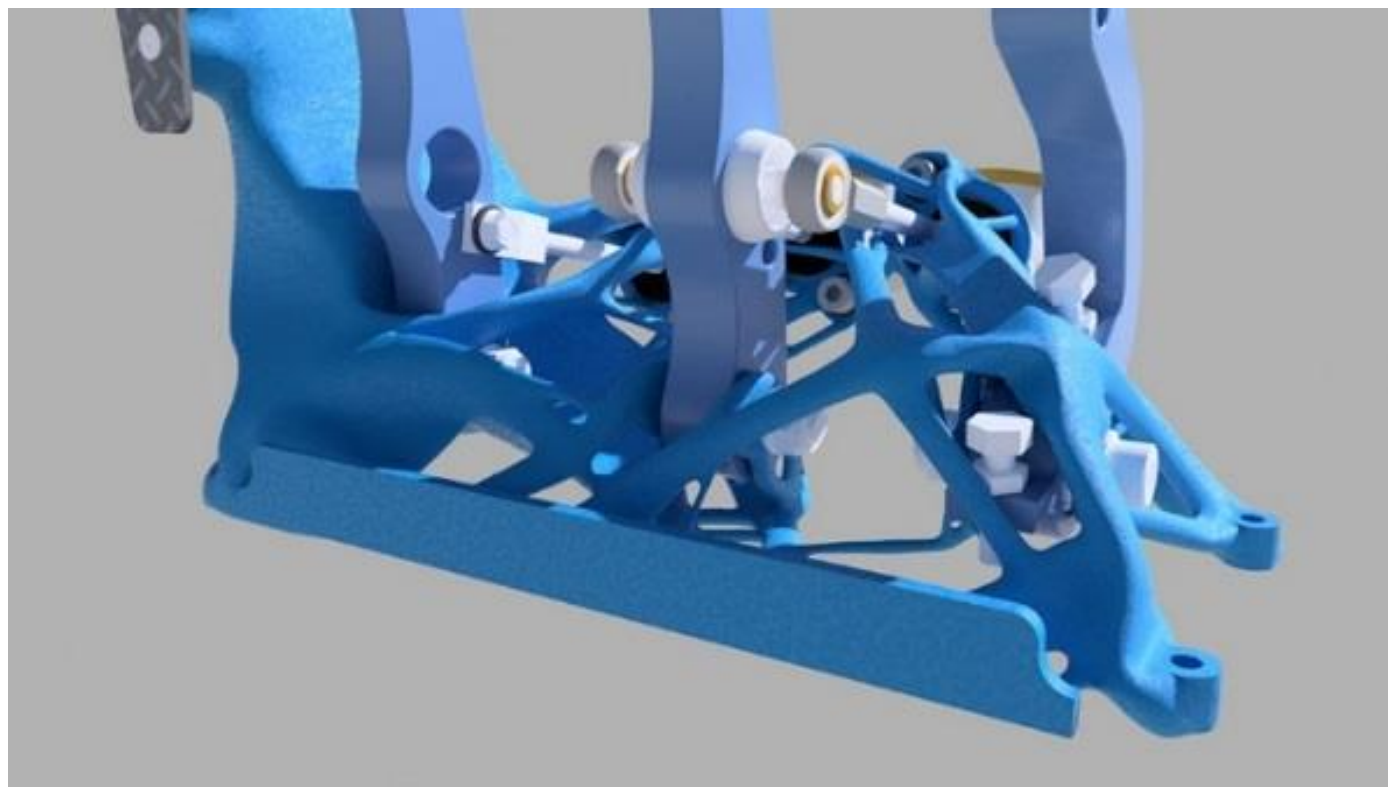


Where does Generative Design apply?



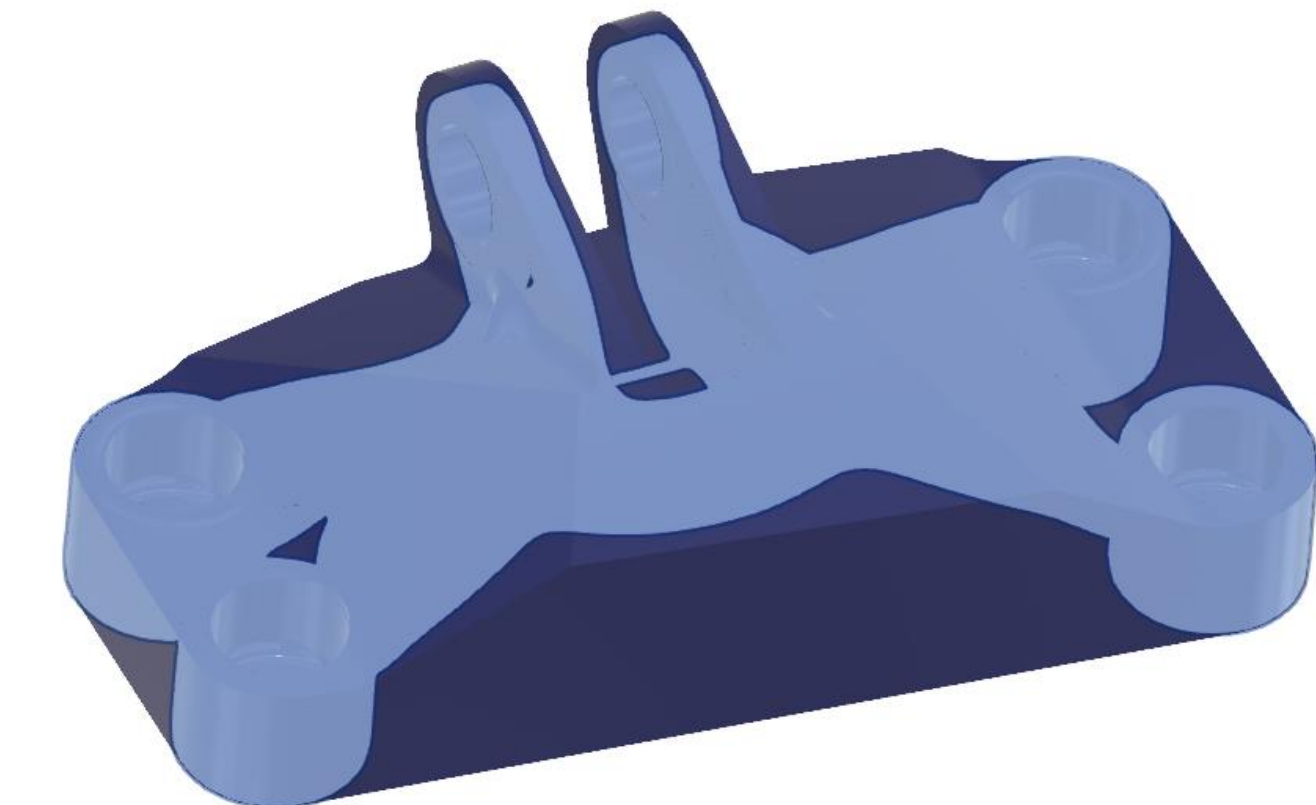
1 | New Product Design Creation

- Use Generative result as design guide. *Where is material needed?*
- *What type of material and how much?*
- Use Generative result, manipulate for production



2 | Part Consolidation

- Explore costly, or hard to manufacture assemblies – *how can multiple parts be consolidated to one?*

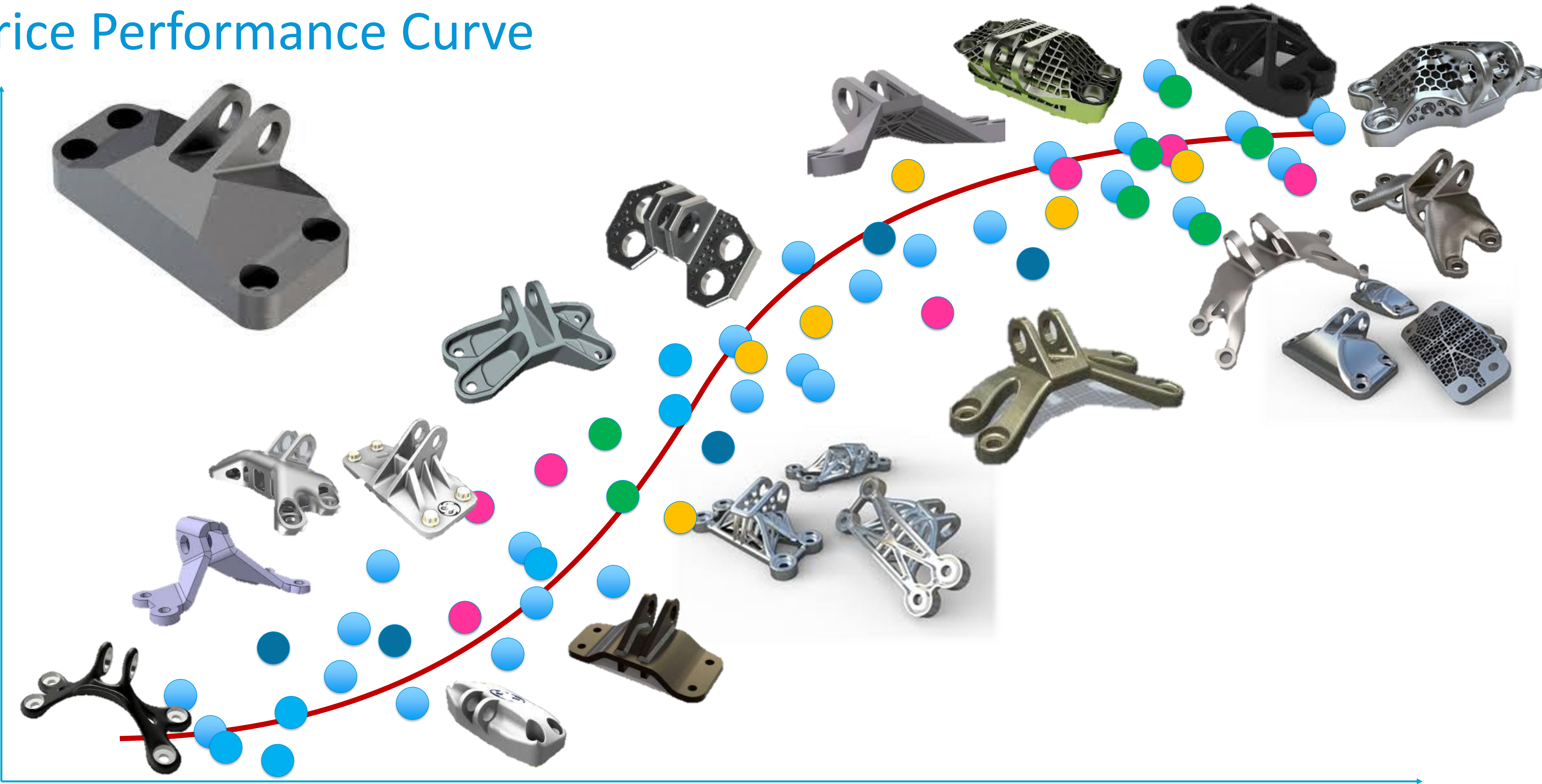


3 | Part Enhancement

- Enhance existing parts to improve strength-to-weight ratio, reduce material cost, improve manufacturability
- *Am I using the correct material?*

Price Performance Curve

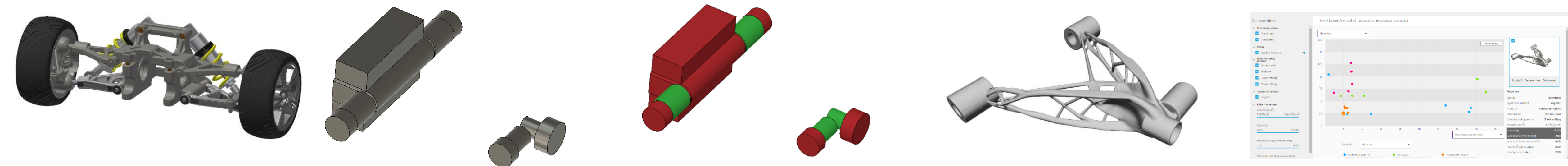
Performance



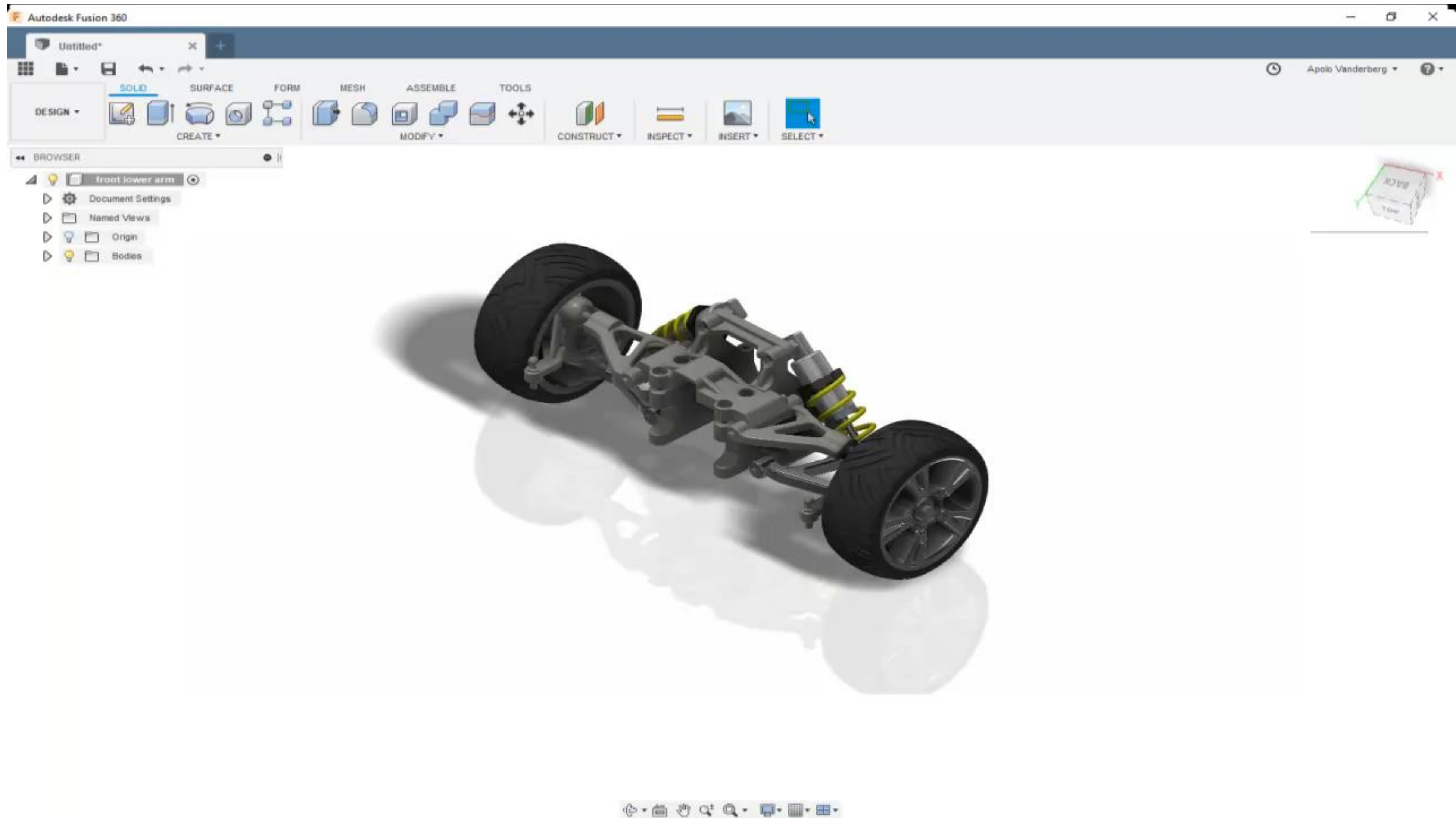
Cost to Produce

Autodesk Generative Design - Workflow

1. In CAD model appropriate Preserve and Avoidance Regions
2. Start Project in Generative Design
3. Import Geometry
4. Setup Study - Geometry, Constraints, Loads, etc
5. Generate Outcomes
6. Explore Outcomes
7. Export desired outcomes for use



Demo



A pair of hands holds a white rectangular sign with the words "FREE STUFF" printed in large, bold, dark red capital letters. The background is a soft-focus bokeh of warm, glowing lights in shades of red, orange, and yellow, with a few cooler green and blue tones visible on the right side. The hands are positioned at the bottom corners of the sign, with fingers gripping the edges. The overall composition is centered and visually appealing, emphasizing the message of the sign.

**FREE
STUFF**

Free Generative Design Until 2020

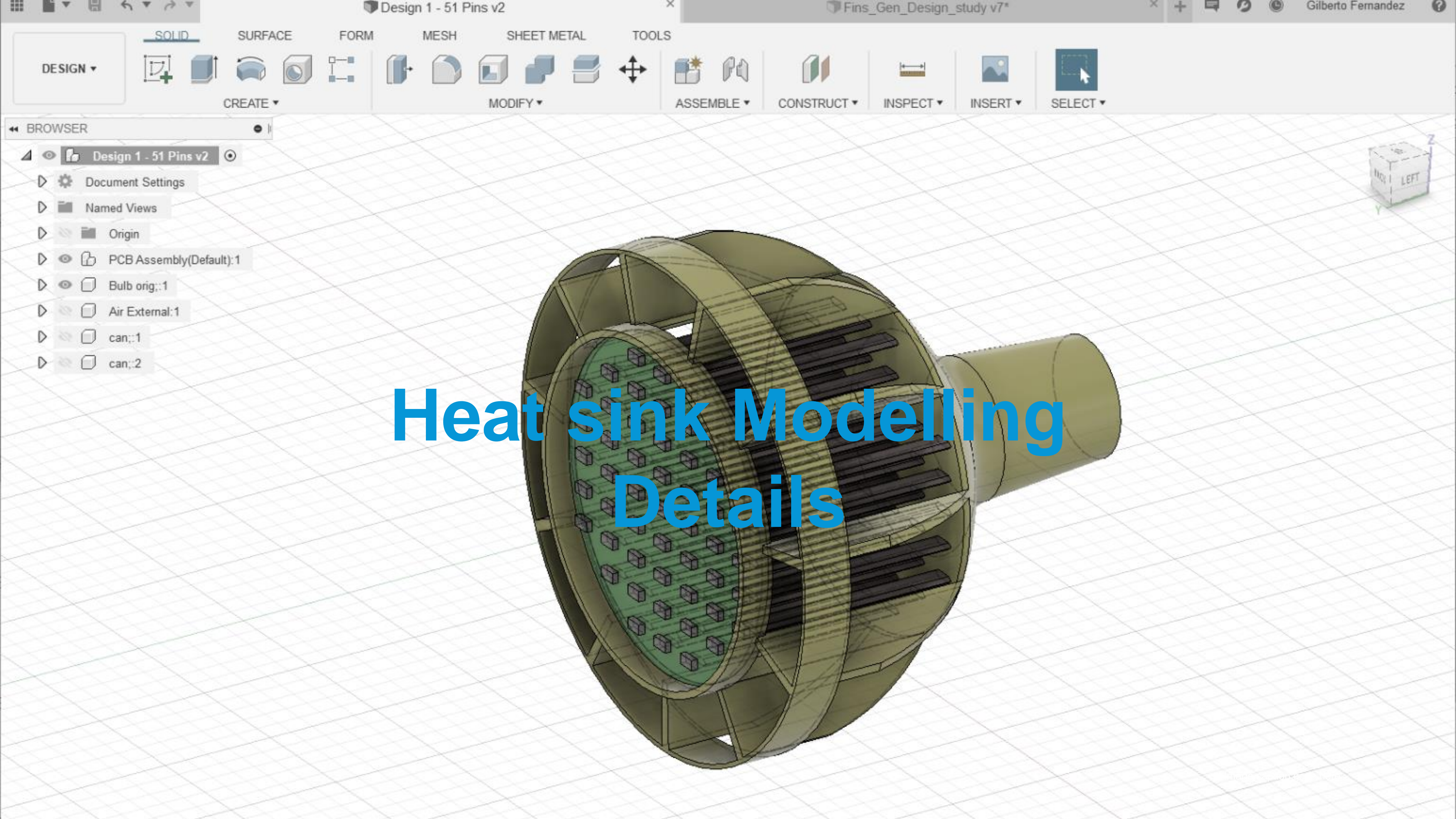
Autodesk has teamed up with AWS and NVIDIA to offer unlimited generative design in Fusion 360 from November 18th through December 31, 2019.

Learn more

autodesk.com/free-generative-design

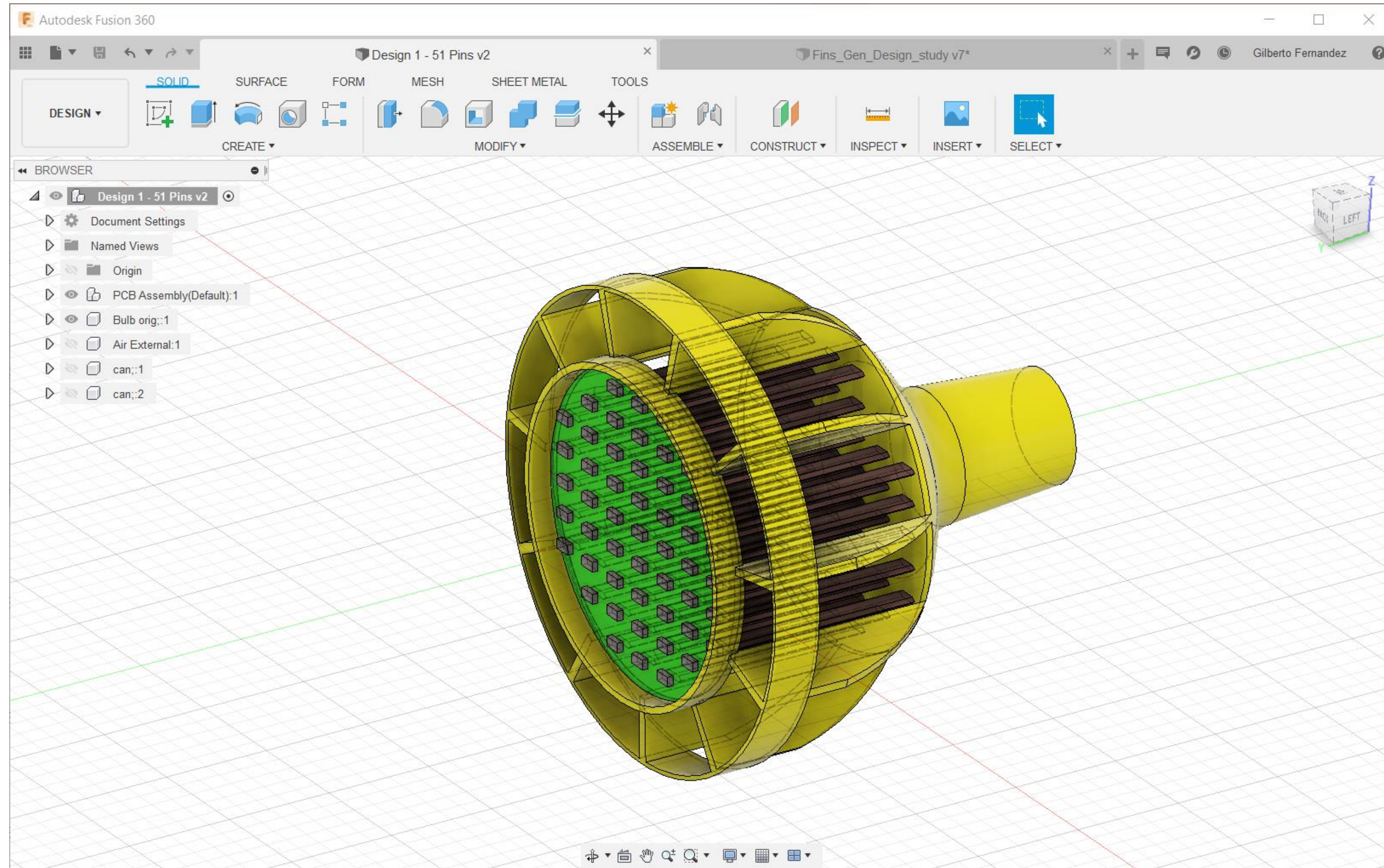
Sponsors





Heat sink Modelling Details

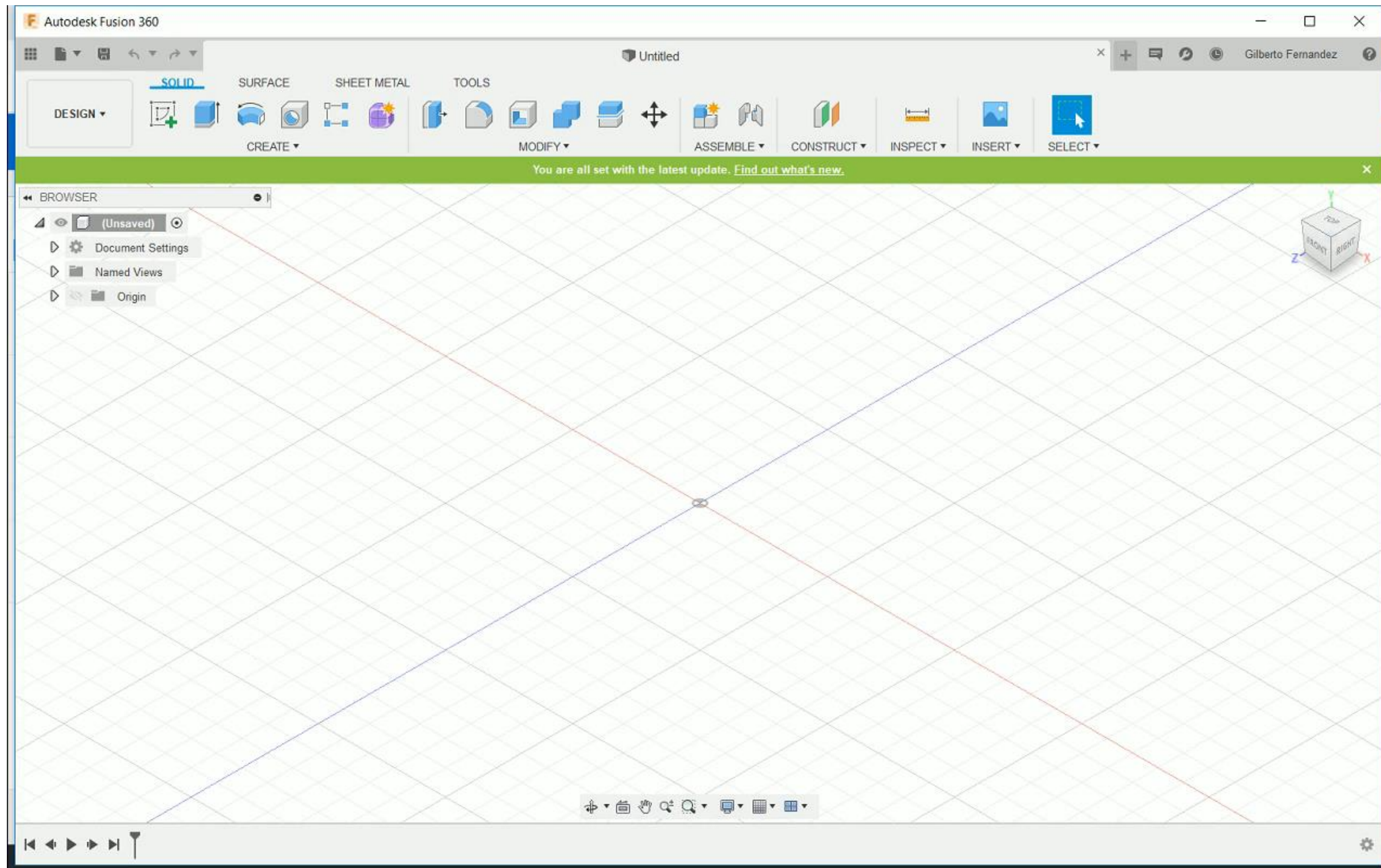
Fusion initial model



Generative Design Workflow DEMO

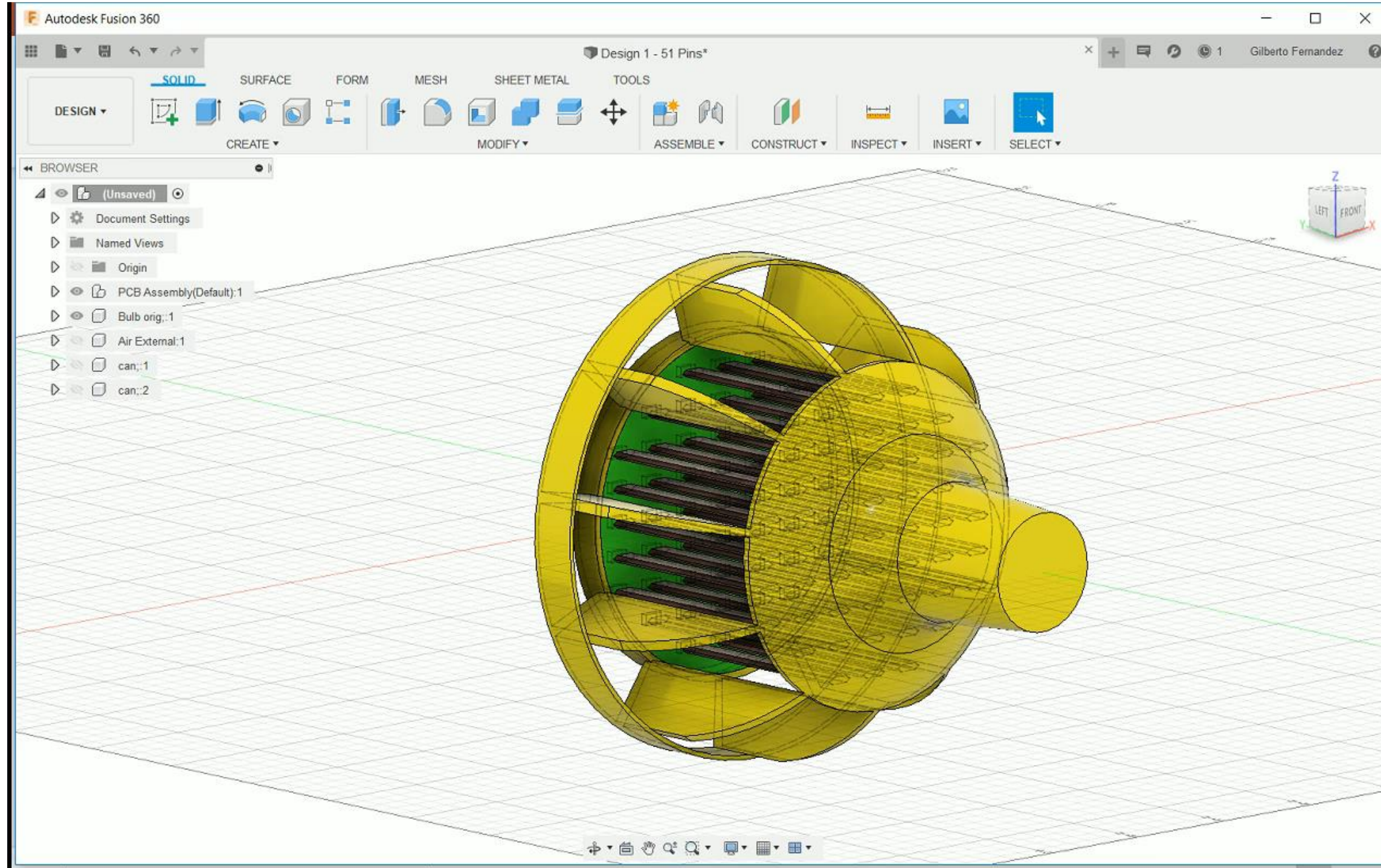


Step 1 – Opening the model



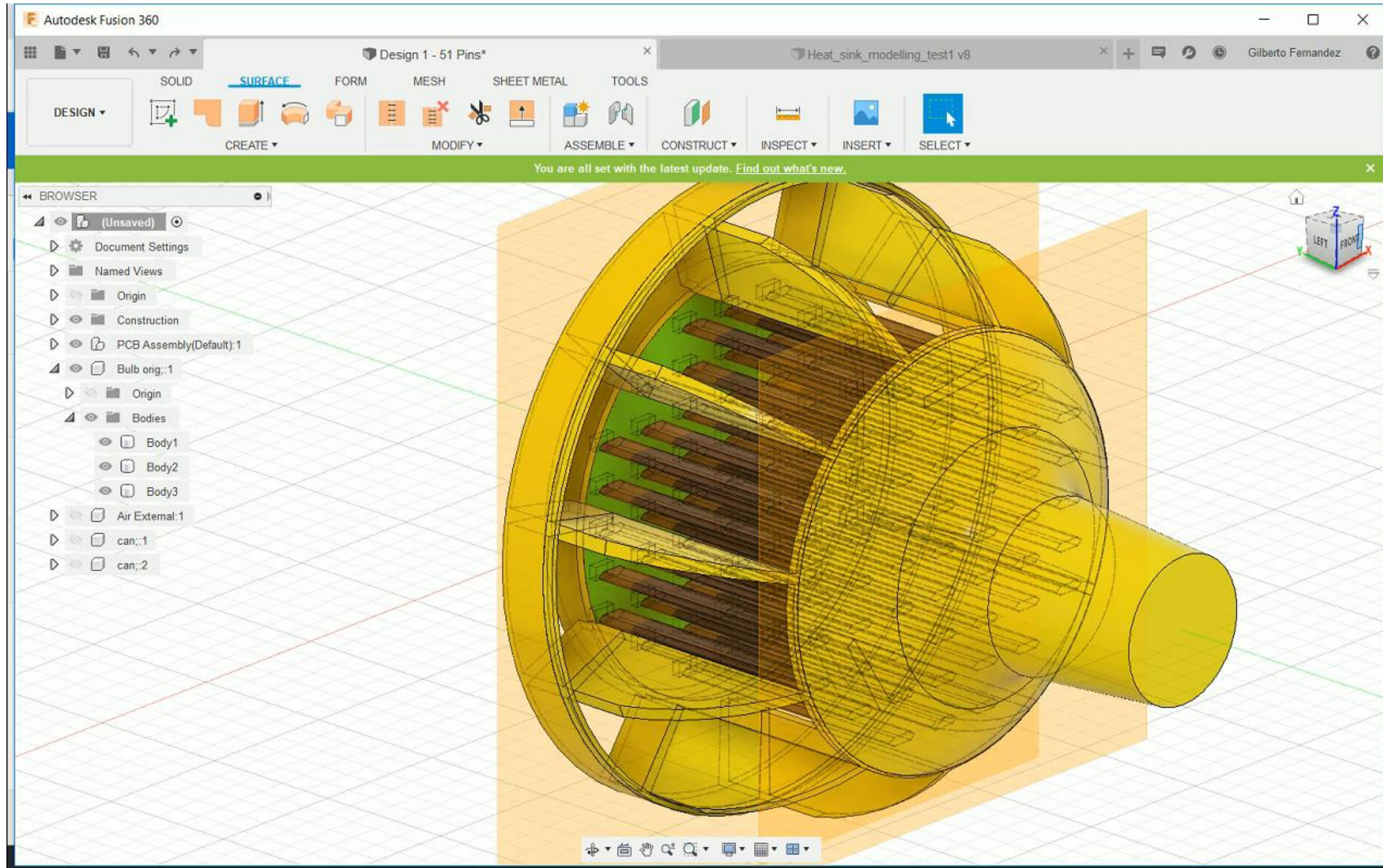
<https://autode.sk/36XCjA2>

Step 2- Geometry preparation in Fusion



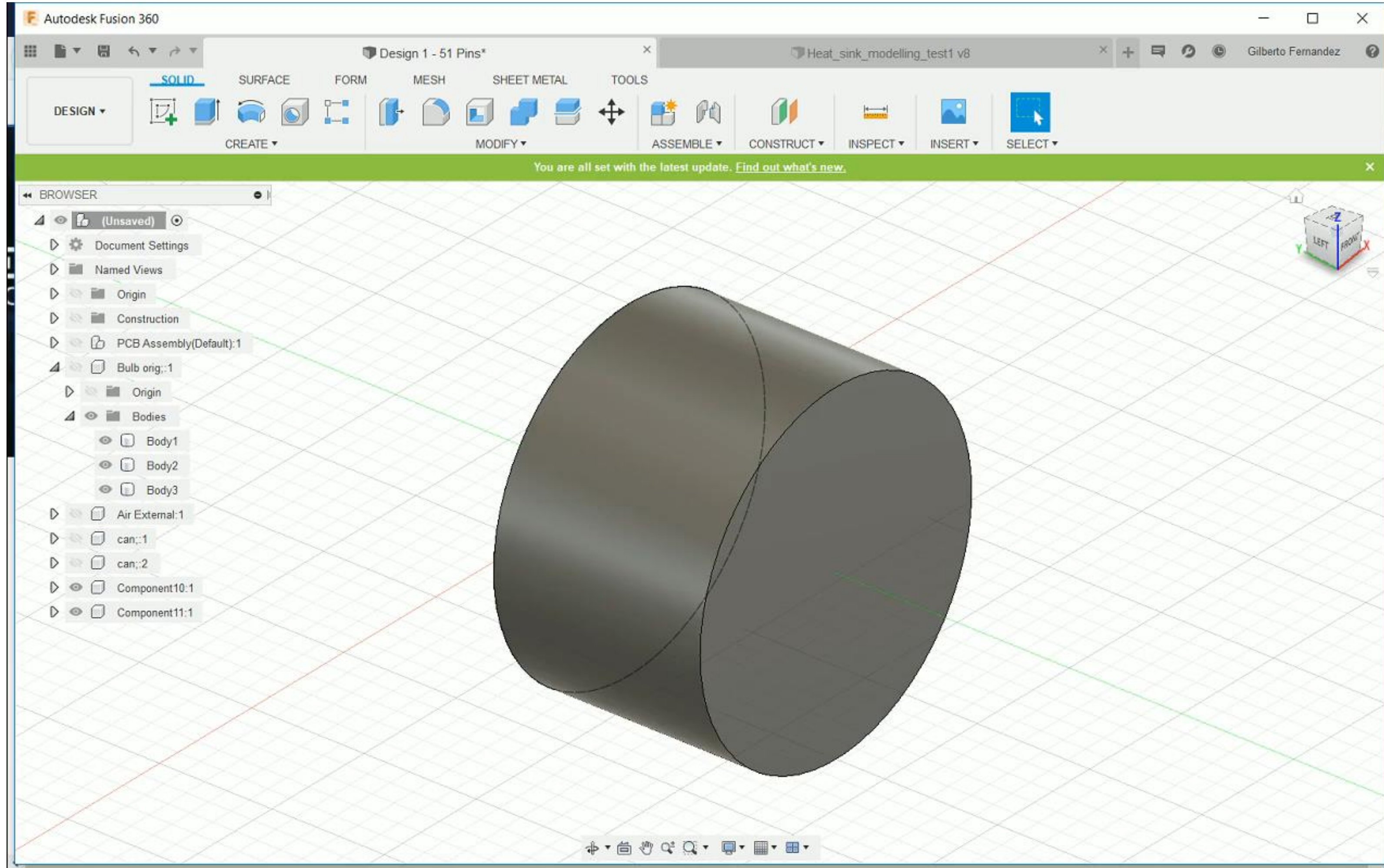
<https://autode.sk/2Xh0rcn>

Step 3- Geometry preparation – Obstacle Geometry



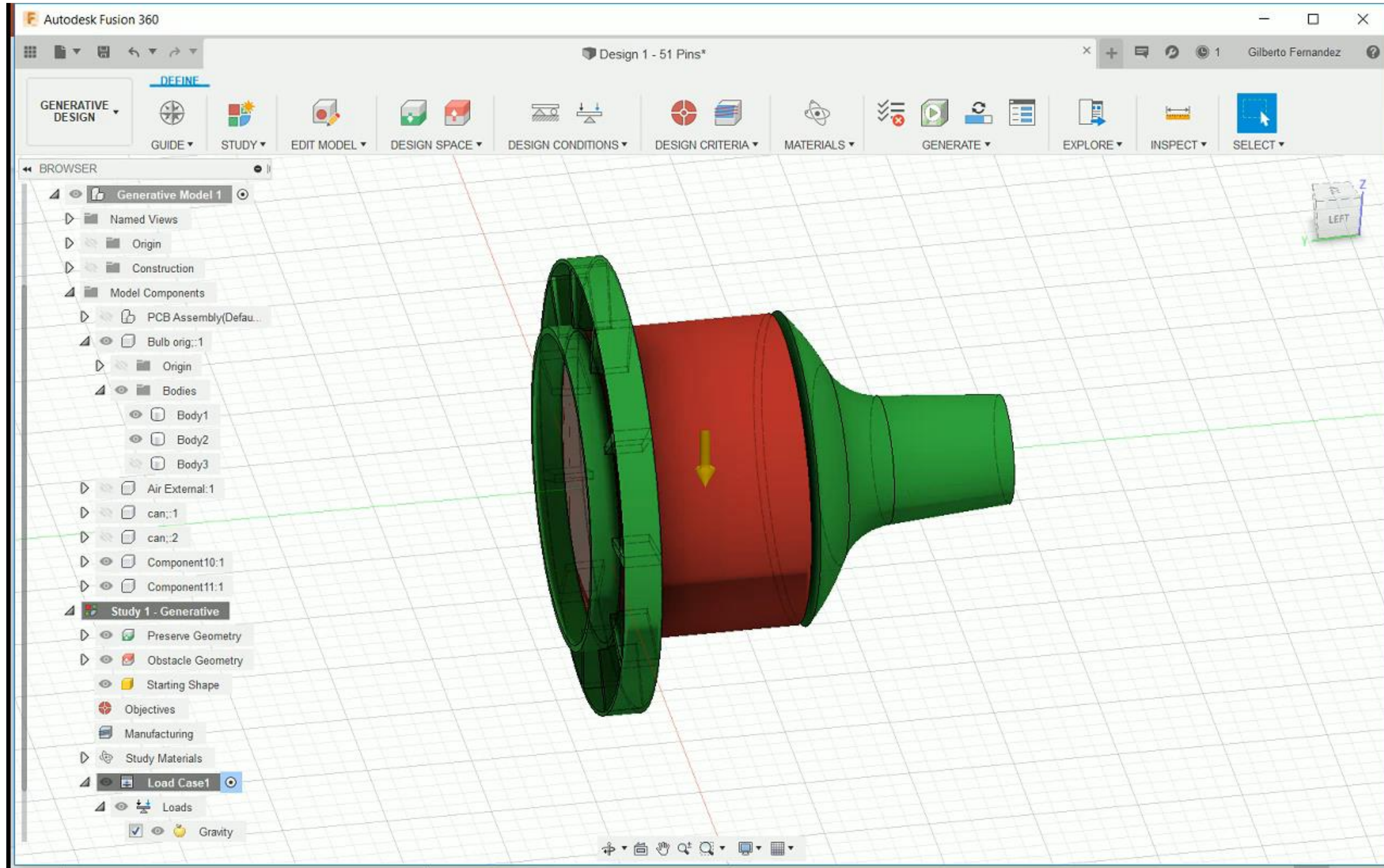
<https://autode.sk/2XaKTXQ>

Step 4 – Generative Design – Design Space



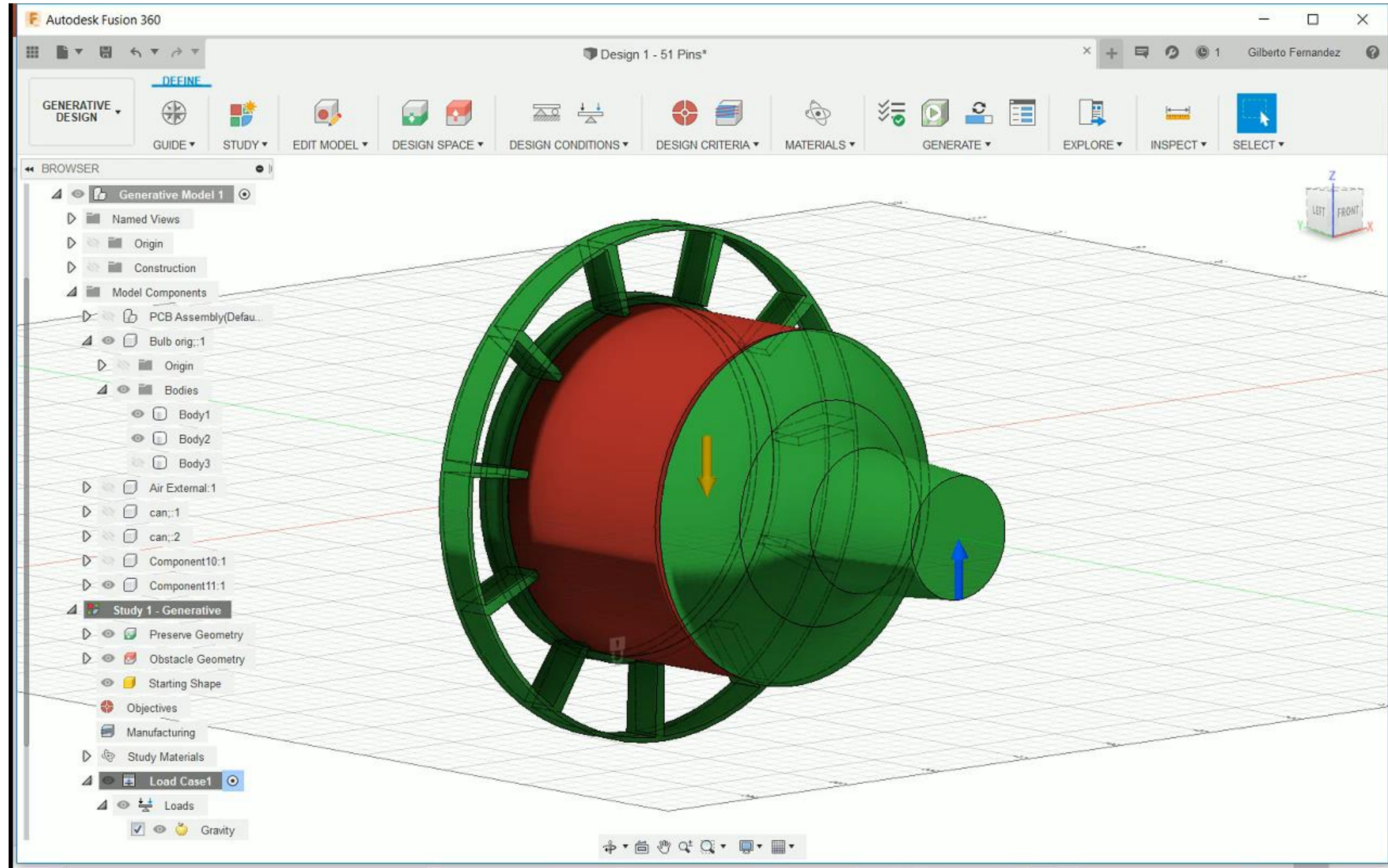
<https://autode.sk/33IbduN>

Step 5 – Generative Design Set up II



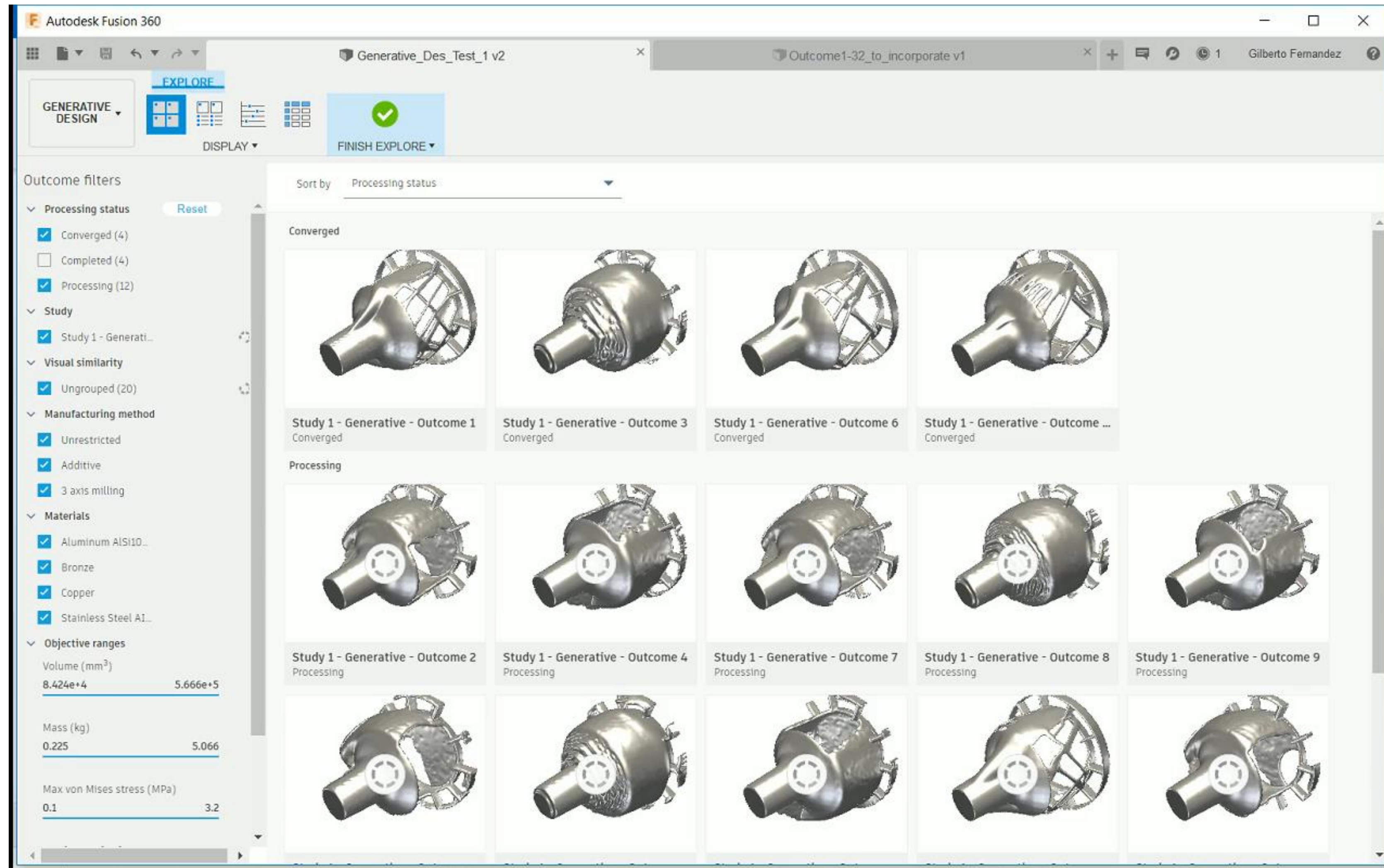
<https://autode.sk/20g2gST>

Step 6 – Generation – Choice and Export



<https://autode.sk/2rL9tTn>

Step 7 – Generation – Further exploration - Results

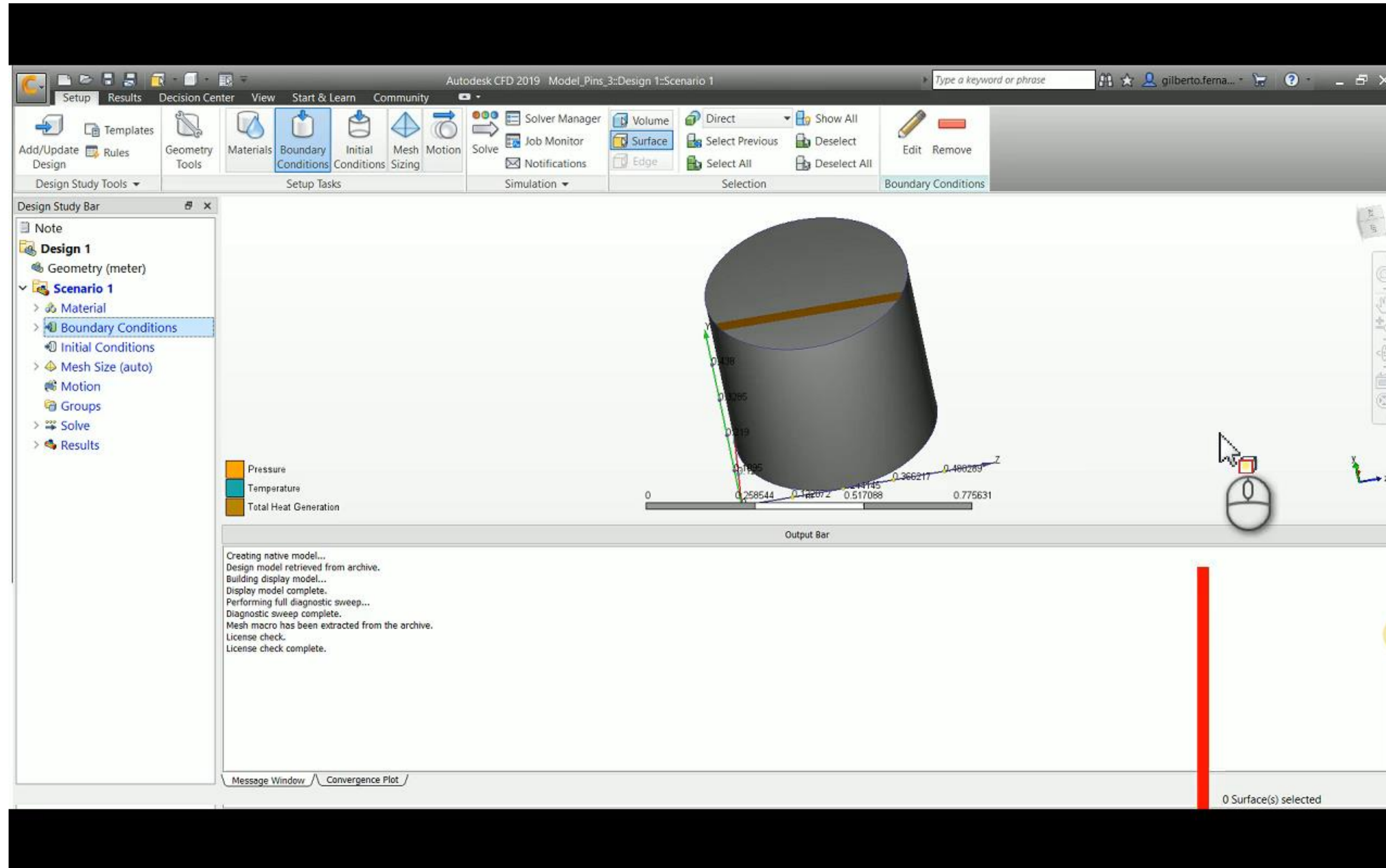


<https://autode.sk/2KmJc47>

Running Alternatives in CFD

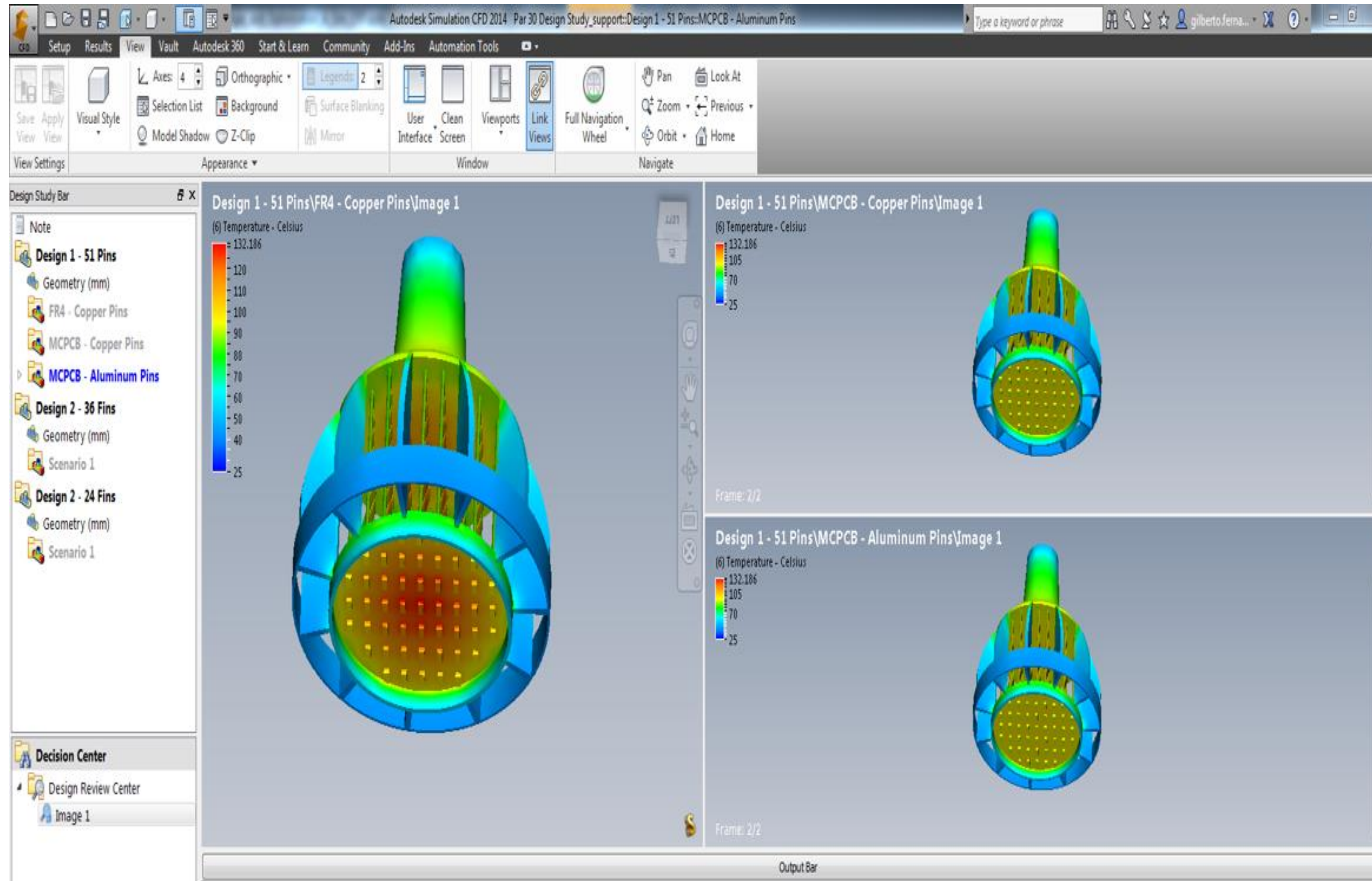


CFD Model – Lighting set up description

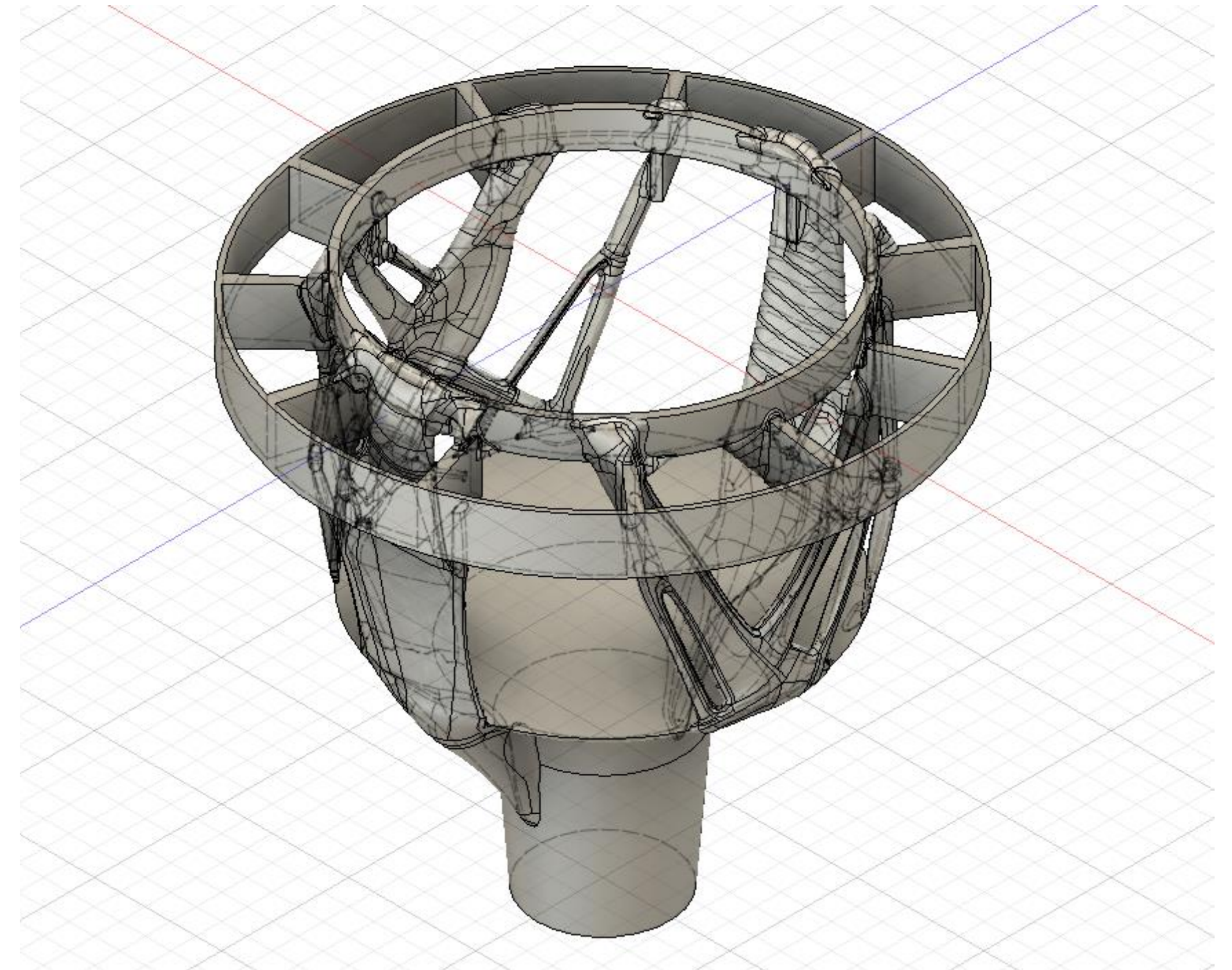
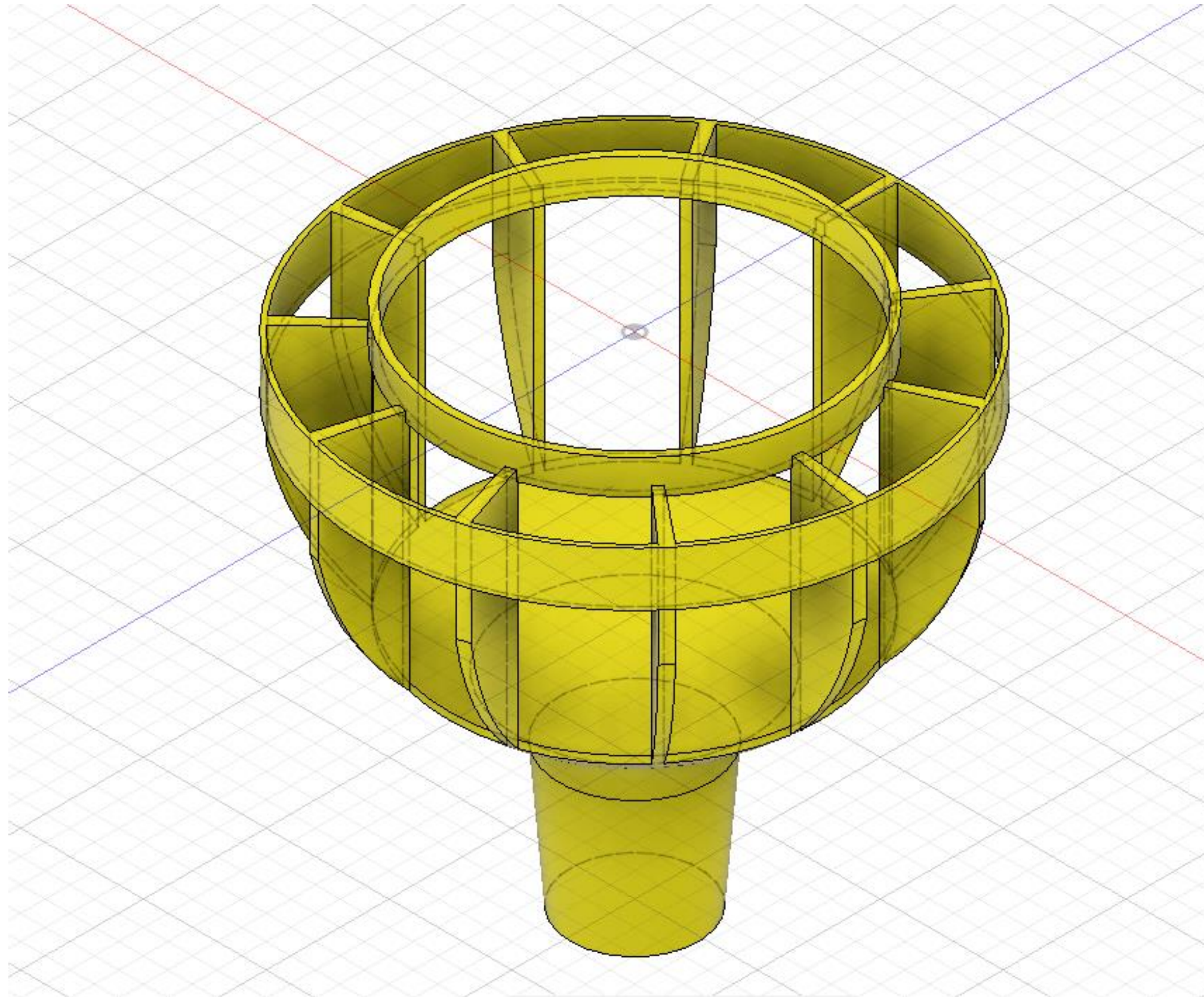


<https://autode.sk/2pkqW4c>

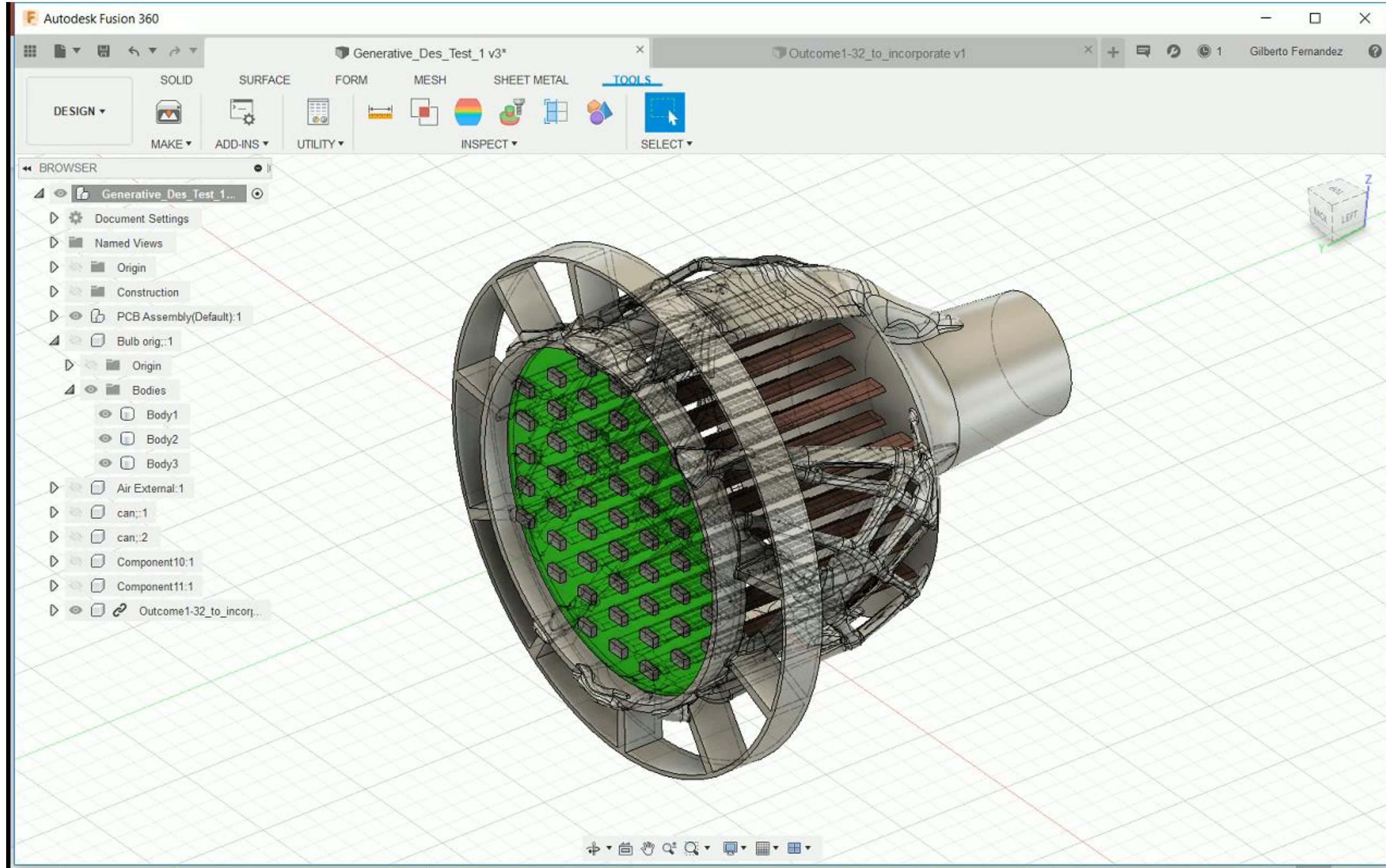
Comparison in original CFD- Possibilities



Alternatives for housing



CFD Model – Launching new geometry



<https://autode.sk/2plkwlo>

Comparison of performance – Multiple designs

The screenshot displays the Autodesk CFD 2019 software interface. The main window shows a 3D model of a mechanical part, likely a fan or turbine component, with a green mesh applied to its top surface. The model is set within a red fluid domain. The interface includes a top toolbar with tabs for Setup, Results, Decision Center, View, Start & Learn, and Community. Below the toolbar is a ribbon with various tool groups: Design Study Tools, Setup Tasks, Simulation, Selection, and Materials. The left sidebar shows the Design Study Bar with a tree view of the model hierarchy, including Design 1, Scenario 1, Design 3, and Scenario 1. The bottom of the interface features a Message Window and an Output Bar. The Message Window displays a log of the simulation process, including meshing steps and solver initialization. The Output Bar shows the current location and value of the selected element.

Autodesk CFD 2019 Model_Pins_2::Design 3::Scenario 1

Design Study Bar

- Note
- Design 1
 - Geometry (meter)
- Scenario 1
- Design 3
 - Geometry (meter)
- Scenario 1
 - Material
 - Boundary Conditions
 - Initial Conditions
 - Mesh Size (auto)
 - Motion
 - Groups
 - Solve
 - Results

Materials

- Stainless Steel (304)
- PCB 12-Layer(Y)
- Copper
- Bridgelux LS
- Air
- ABS (Molded)

Output Bar

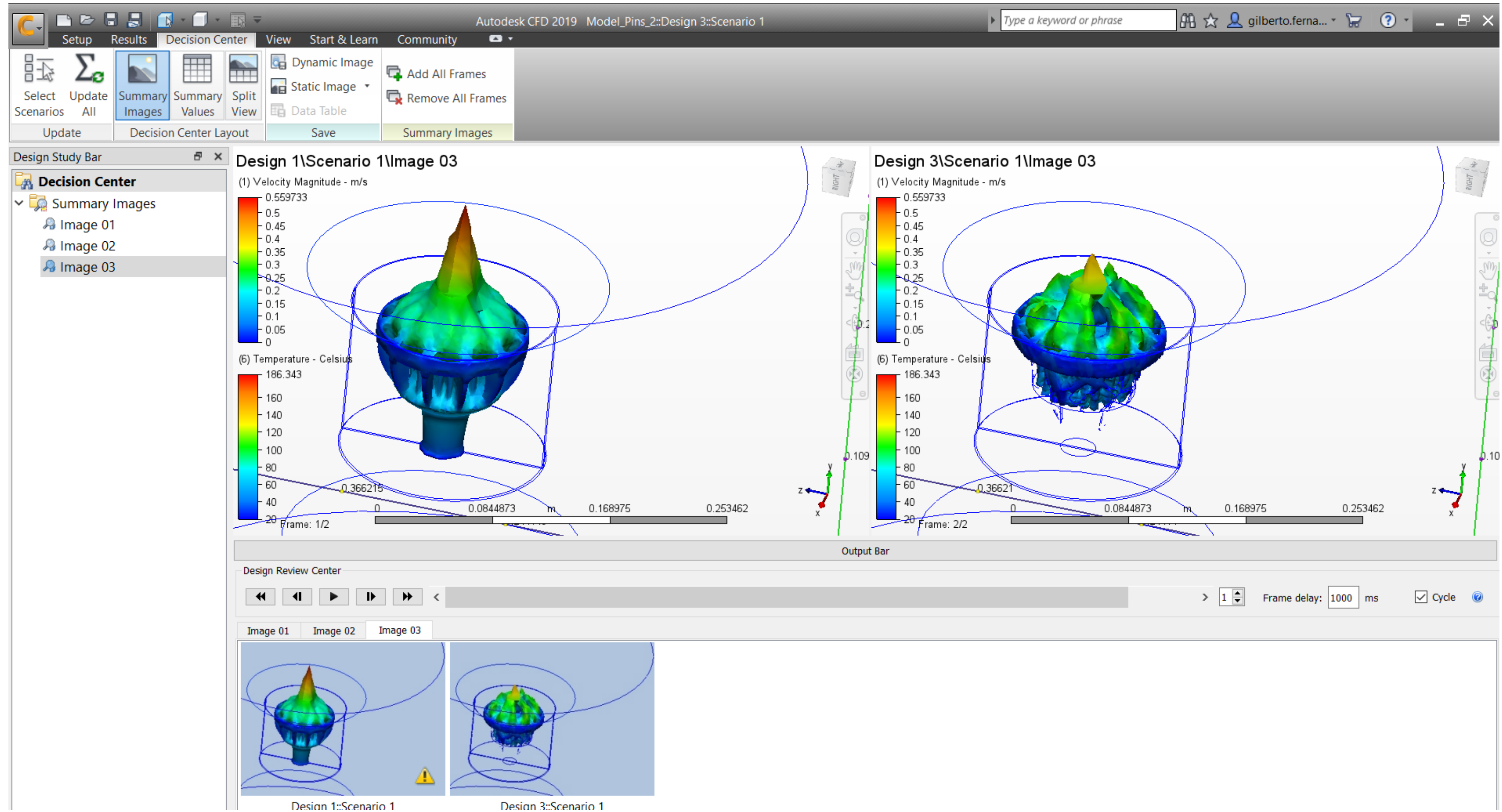
Loading mesh sizes and constraints...
Meshing...
Surface meshing... generating surface mesh
Surface meshing... smoothing surface mesh
Volume meshing... creating volume mesh
Volume meshing... optimizing volume mesh
Volume meshing... smoothing volume mesh
Mesh contains 170040 nodes and 712582 elements.
Performing mesh quality check...
Saving mesh...
Meshing completed.
Updating model database...
Model database updated.
Updating mesh database...
Mesh database updated.
Building solver model file...
Solver file written.
Initializing ...
Control file processing complete
Check Out motion License: Successful
Authorization verified

Message Window / Convergence Plot

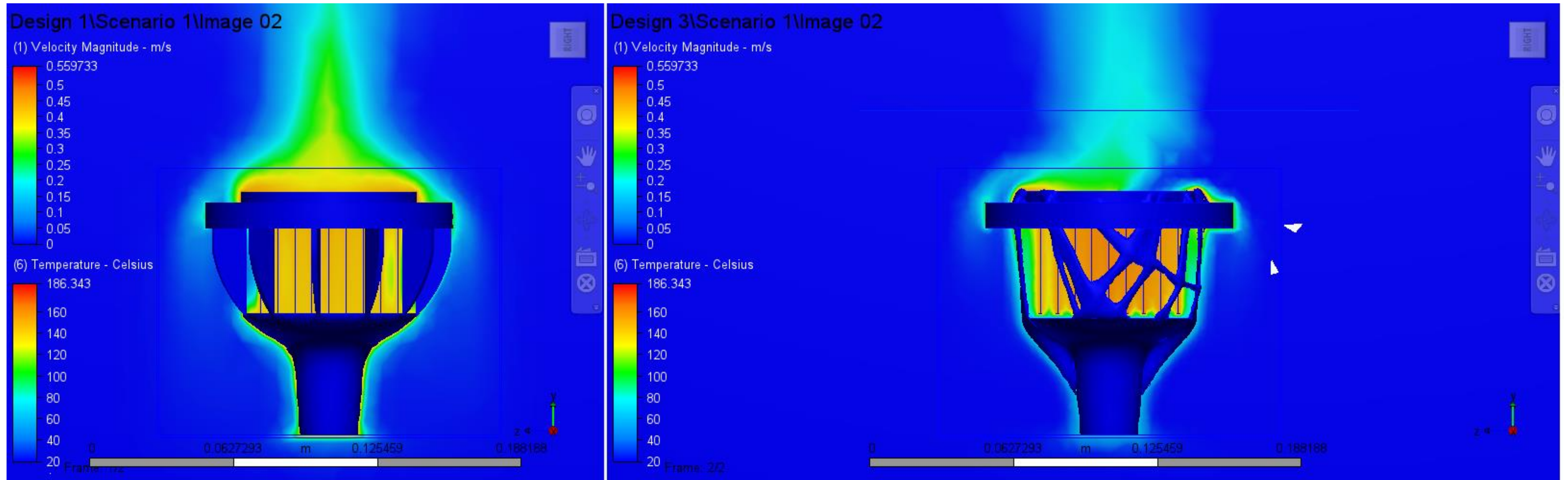
On Surface 3- Location(X=0.0783412,Y=0.0623675,Z=0.230848) PartID = 1 Element ID = 1015 - Value -8.93522e-12 m/s

0 Volume(s) selected

Comparison of performance – Decision Centre



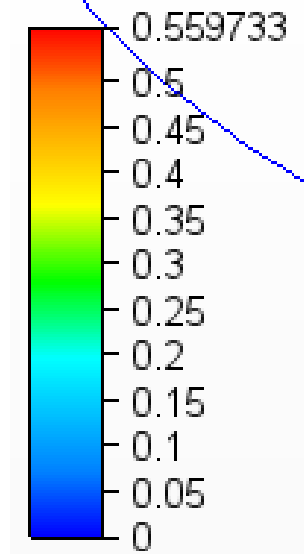
Comparison of performance



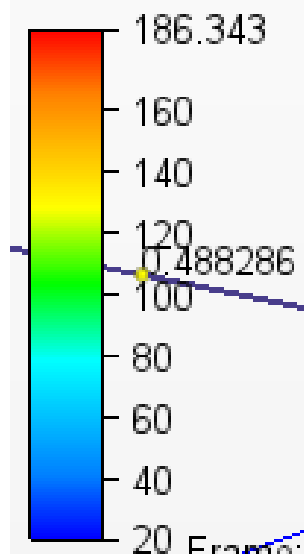
Comparison of performance

Design 1\Scenario 1\Image 03

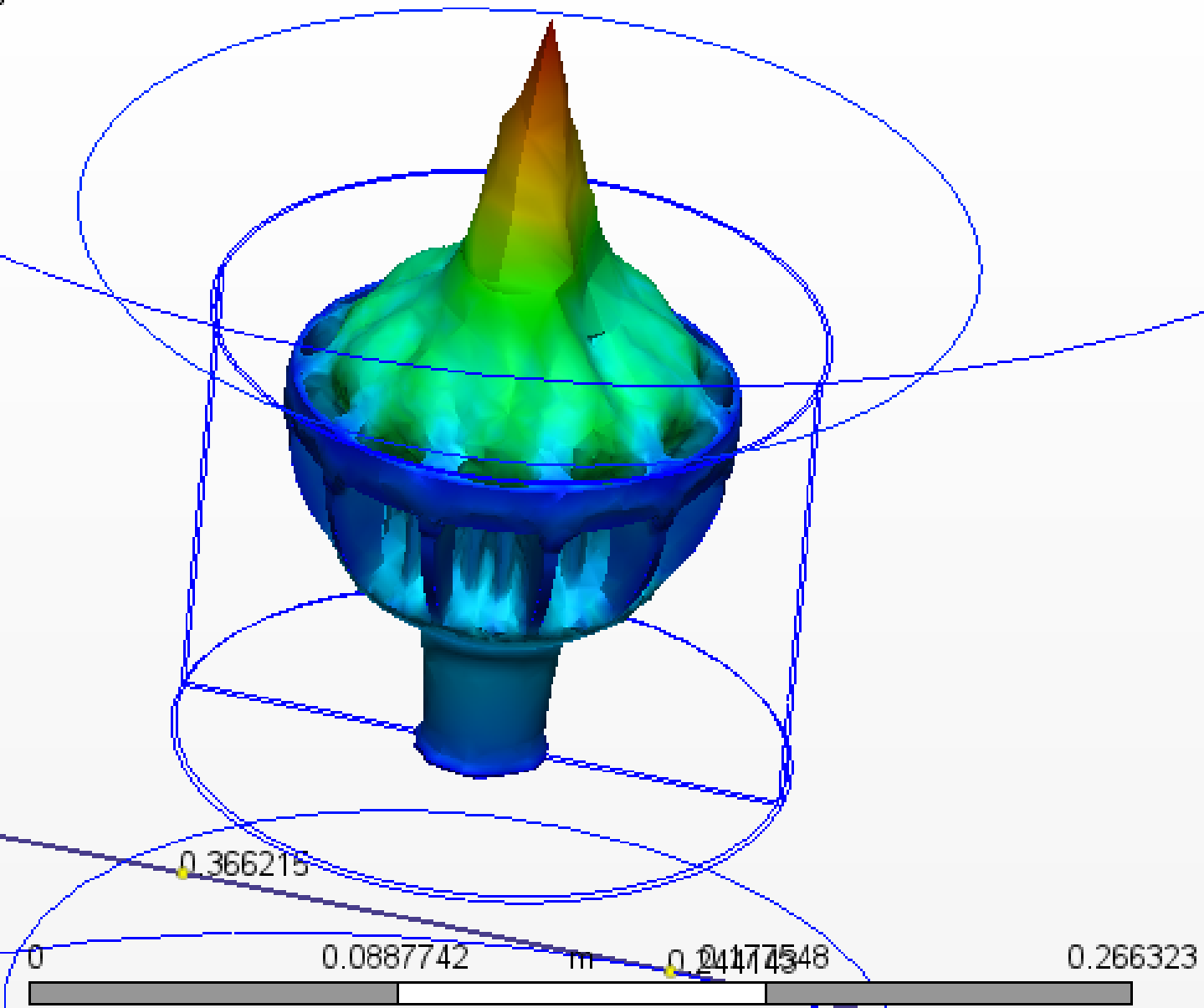
(1) Velocity Magnitude - m/s



(6) Temperature - Celsius

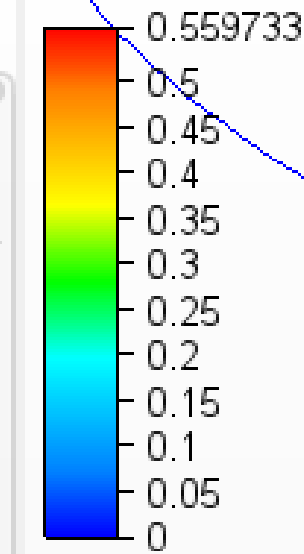


Frame: 1/2

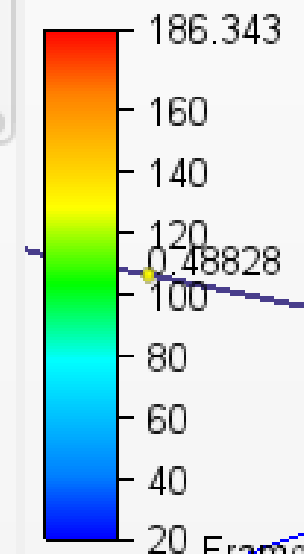


Design 3\Scenario 1\Image 03

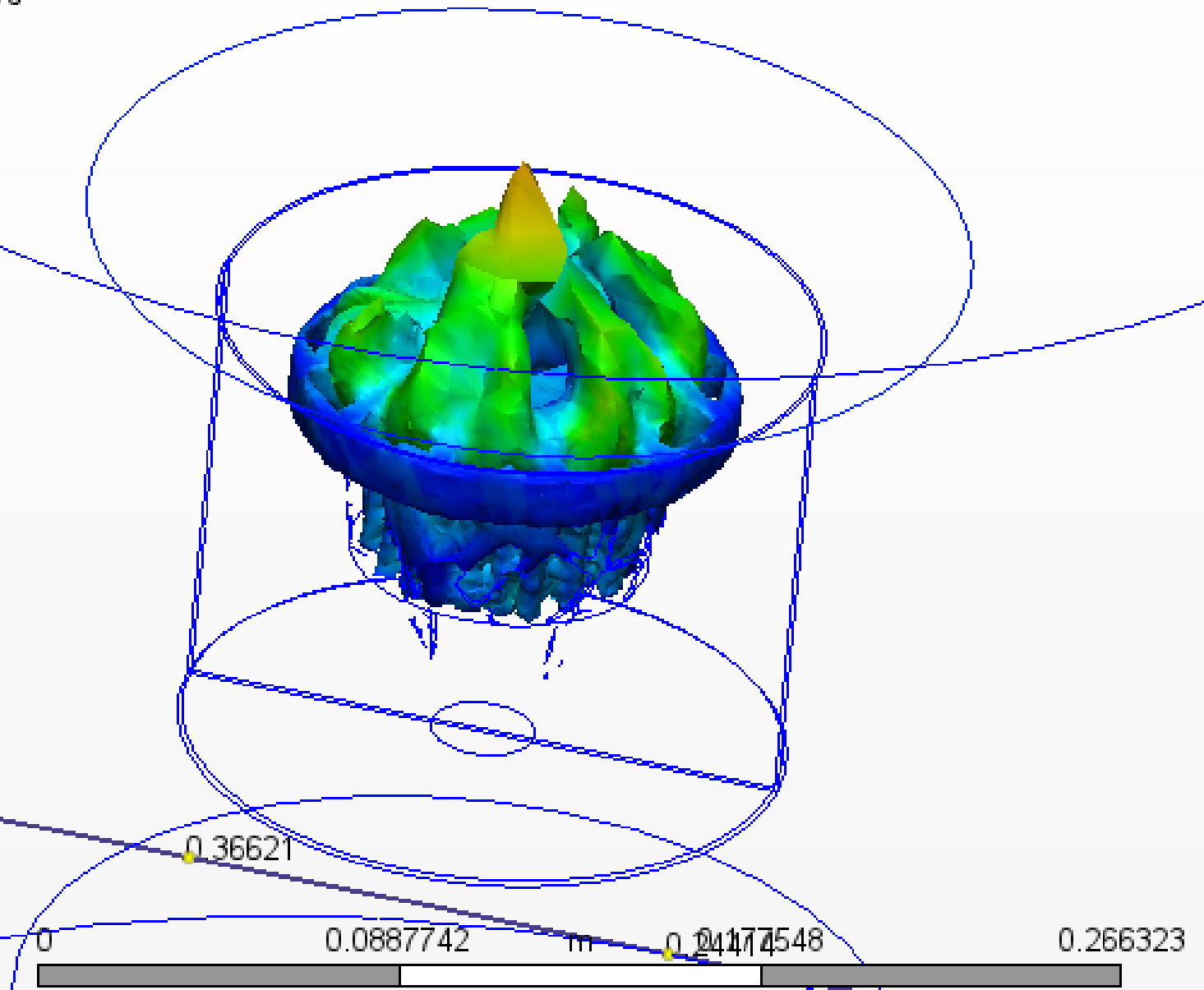
(1) Velocity Magnitude - m/s



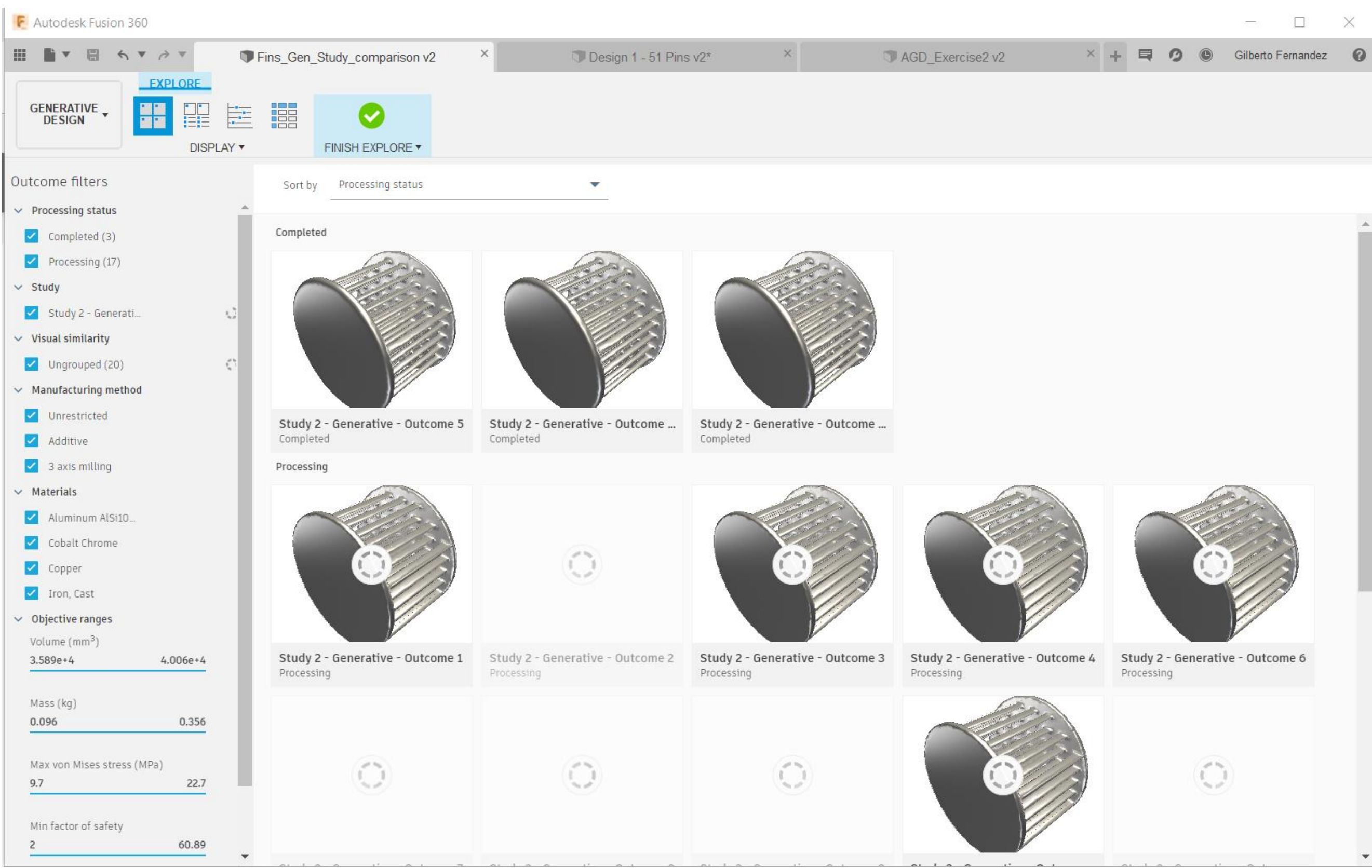
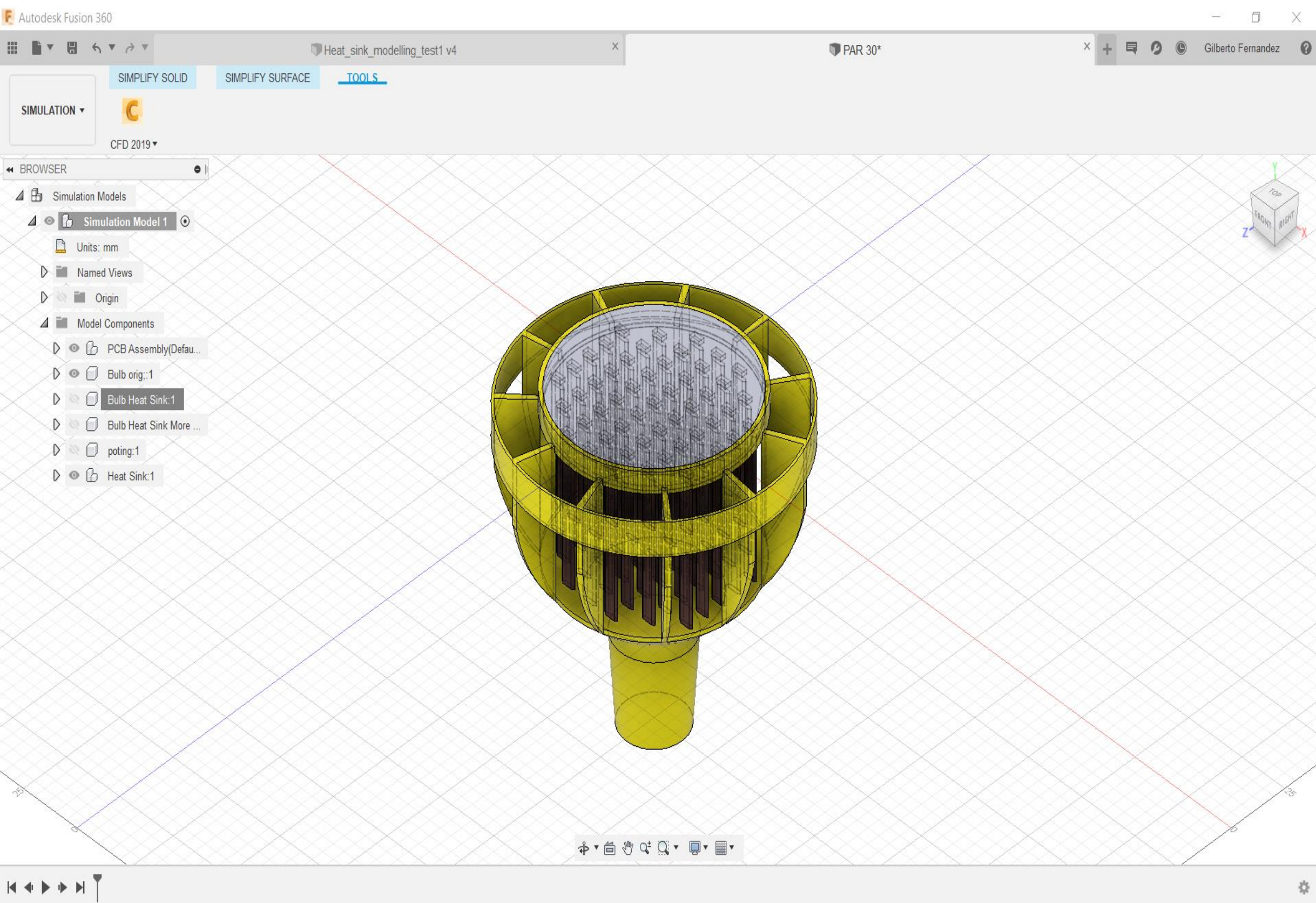
(6) Temperature - Celsius



Frame: 2/2



Alternatives for pins



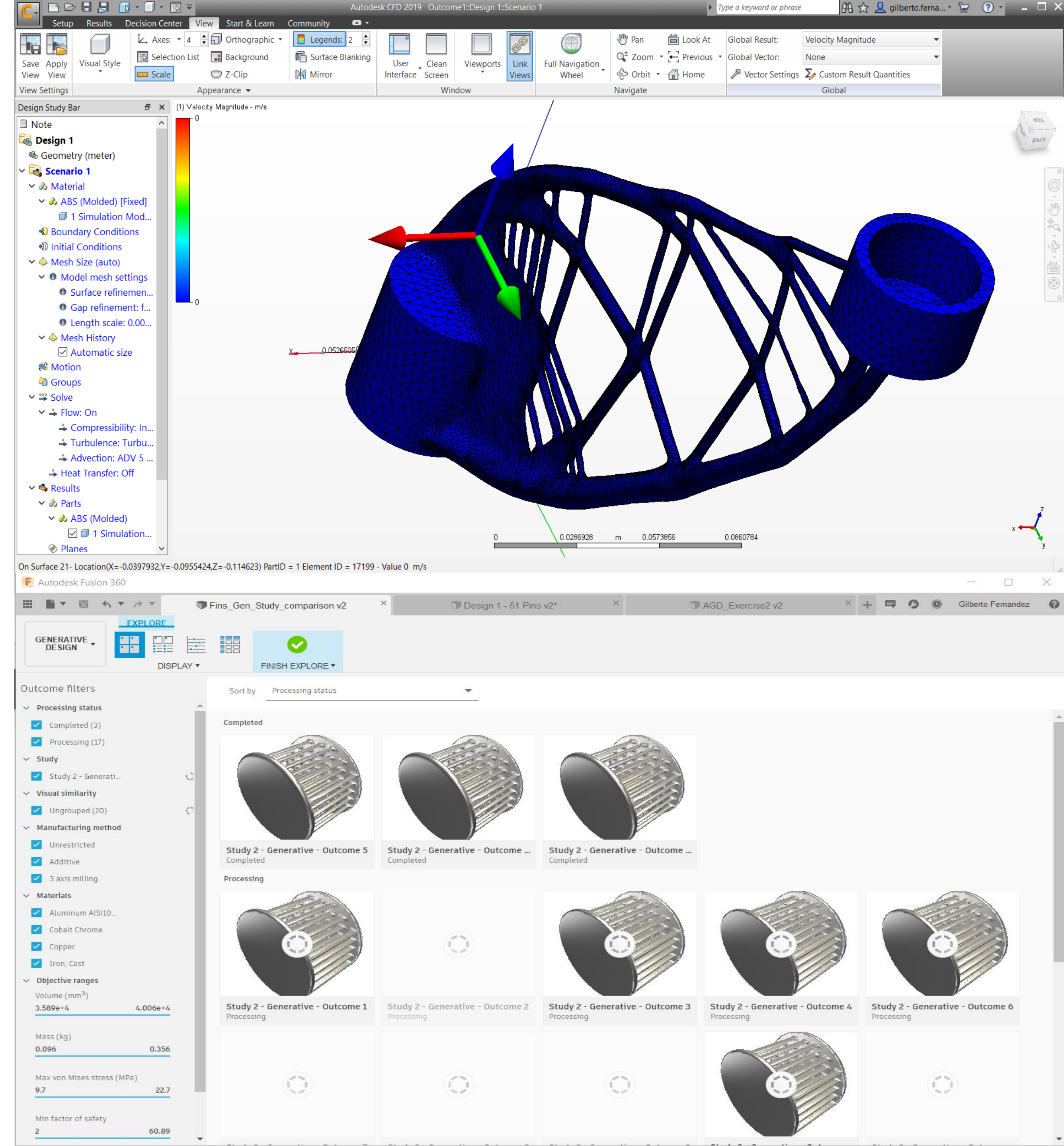
Video link to follow here -

Challenges and Limitations



Challenges and limitations

- Optimization vs Simplicity?
- Meshing challenges
- Generating Obstacle Geometry can be a difficult task
- Enveloping starting shapes
- Time to load geometry – long
- Fixing a “skeleton” guide – pins
- Objectives – mass – stiffness

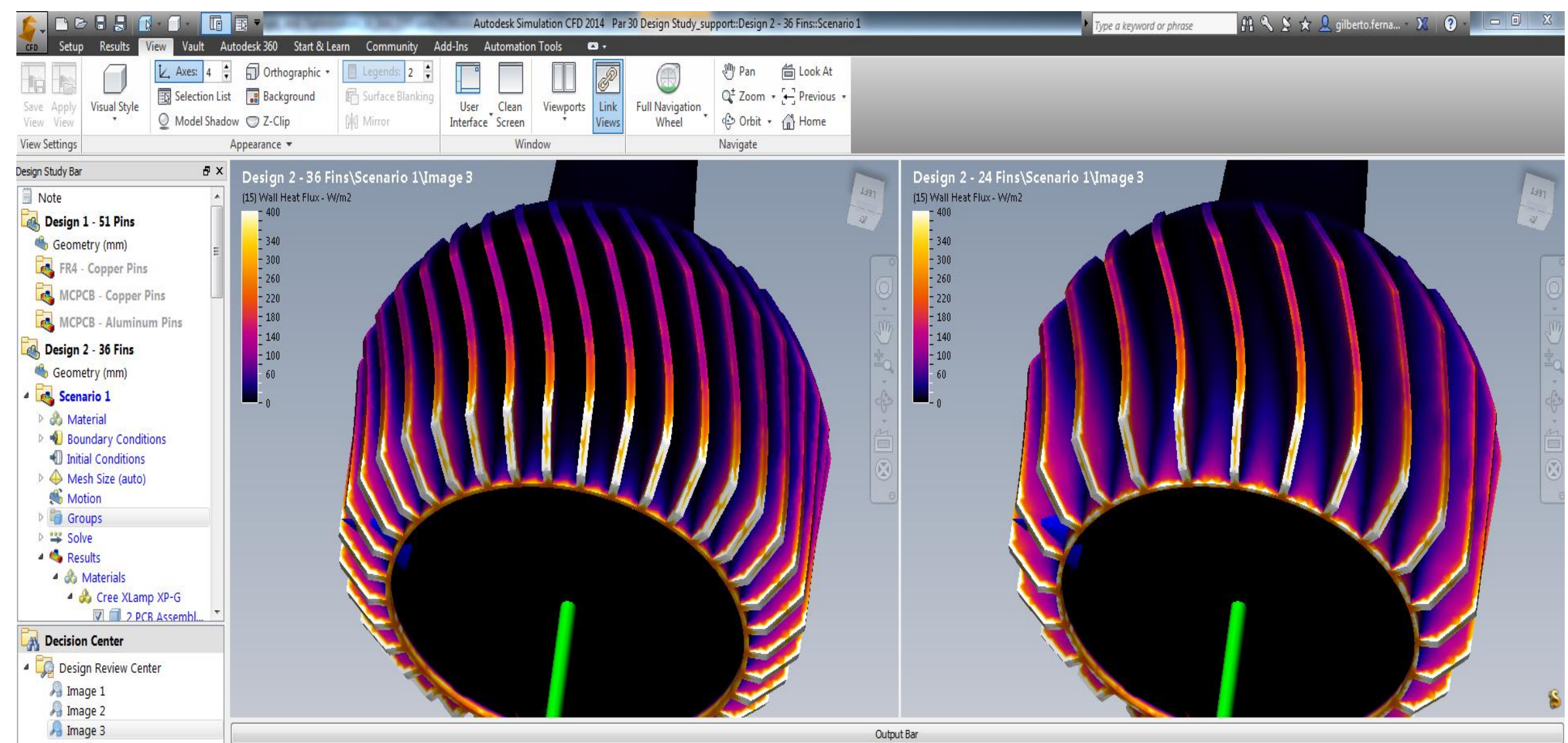
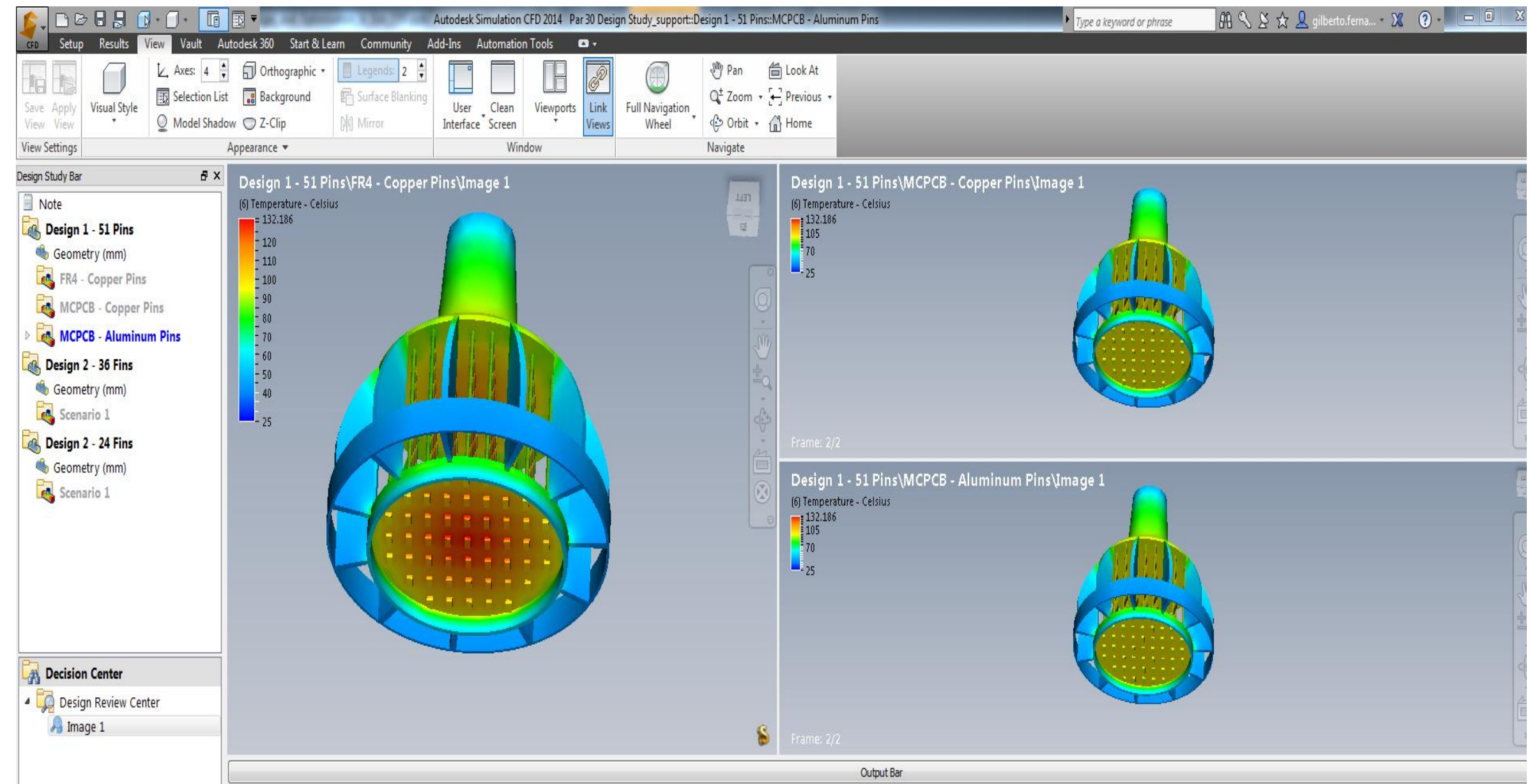


Looking Into the Future



Looking into the future – Better integration of CFD

- CFD Integration:
 - Integration so does not need launching
 - Key: CONDITIONS and constraints. Operating conditions such as maximise area exposure to heat, number of blades, etc.....
 - Flexibility in terms of shapes, and starting shapes- Error on intersections

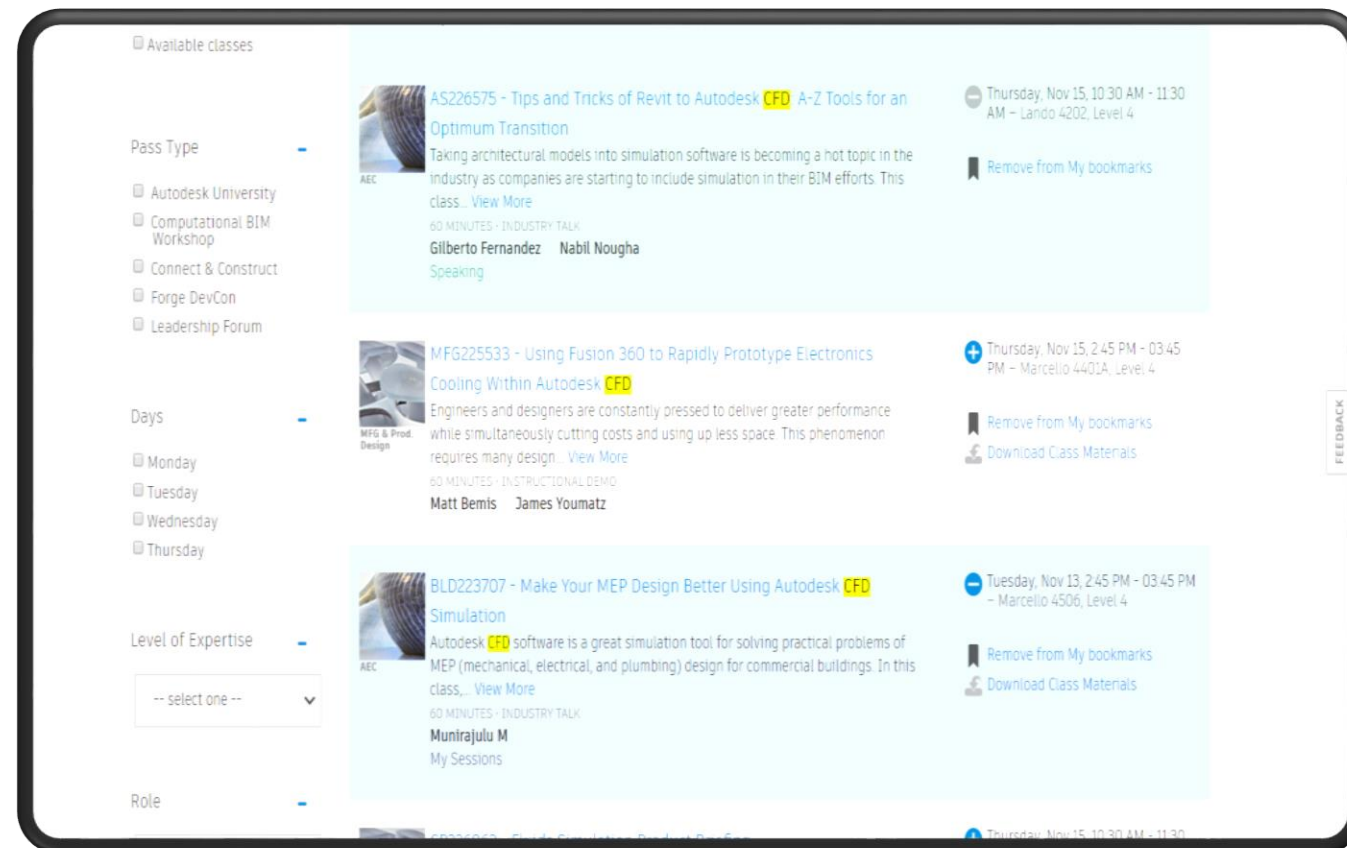


Additional Resources



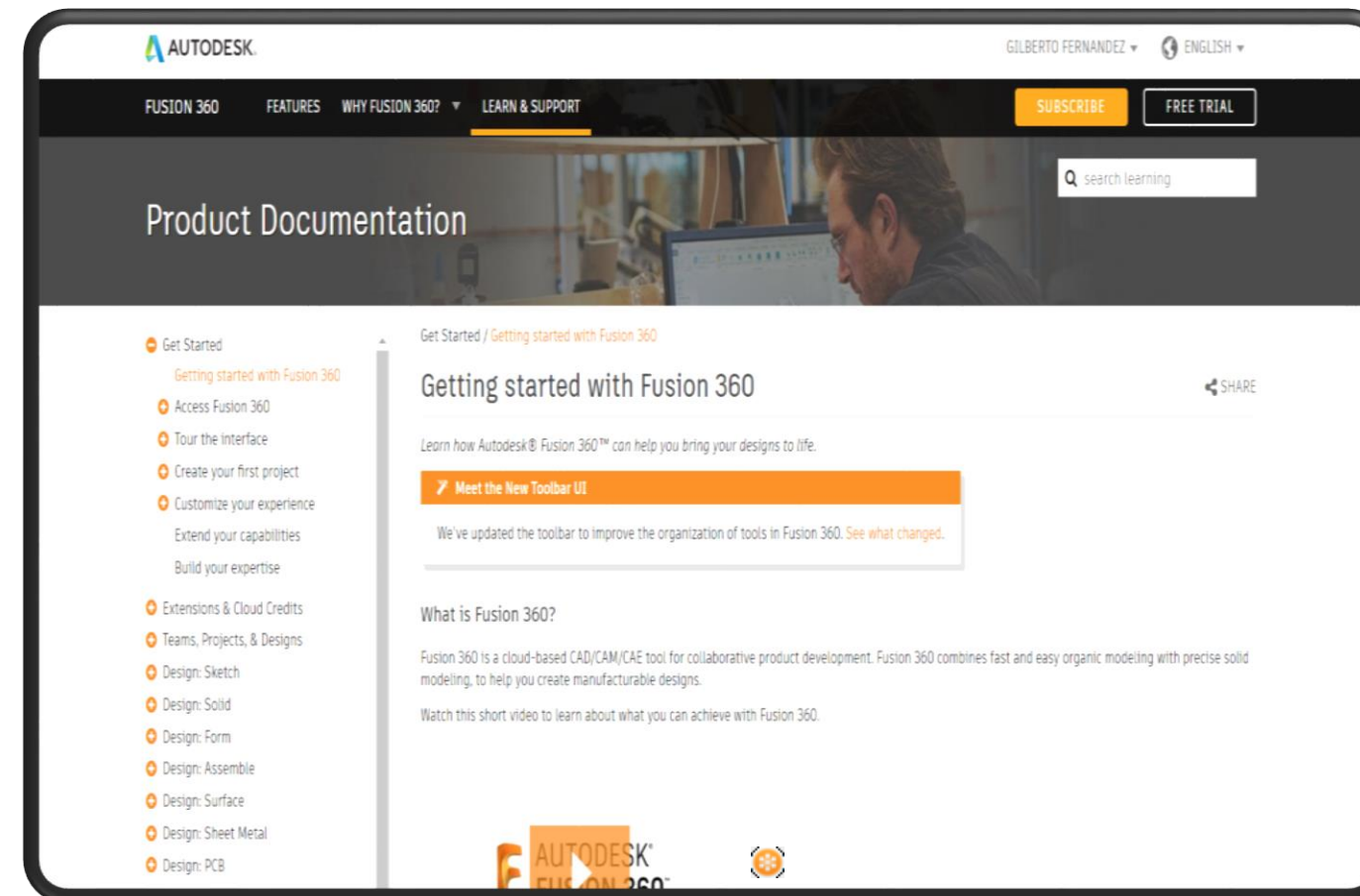
Further information

CLASS HANDOUT



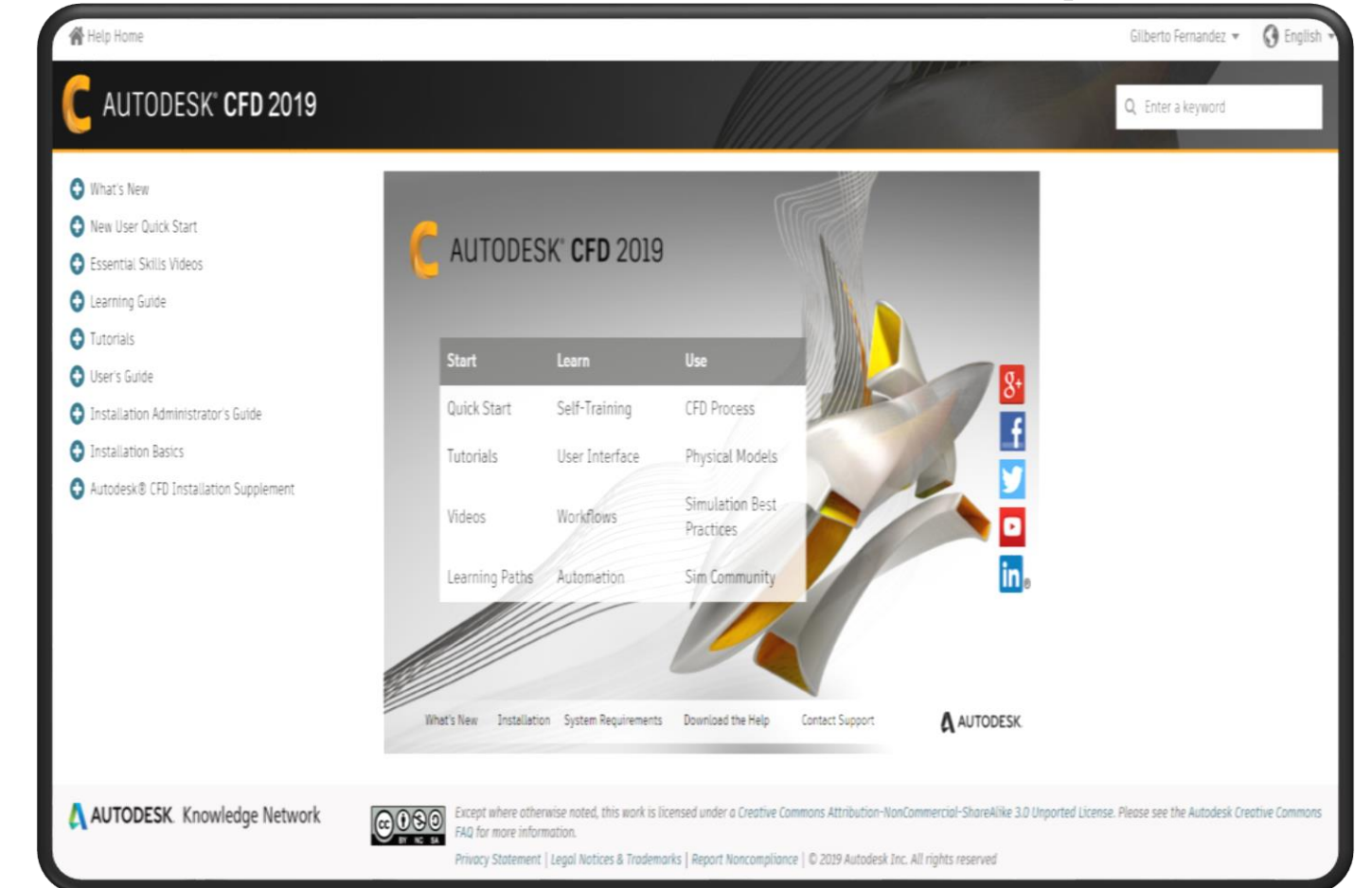
[Class Handout](#)

Fusion 360 Online Help



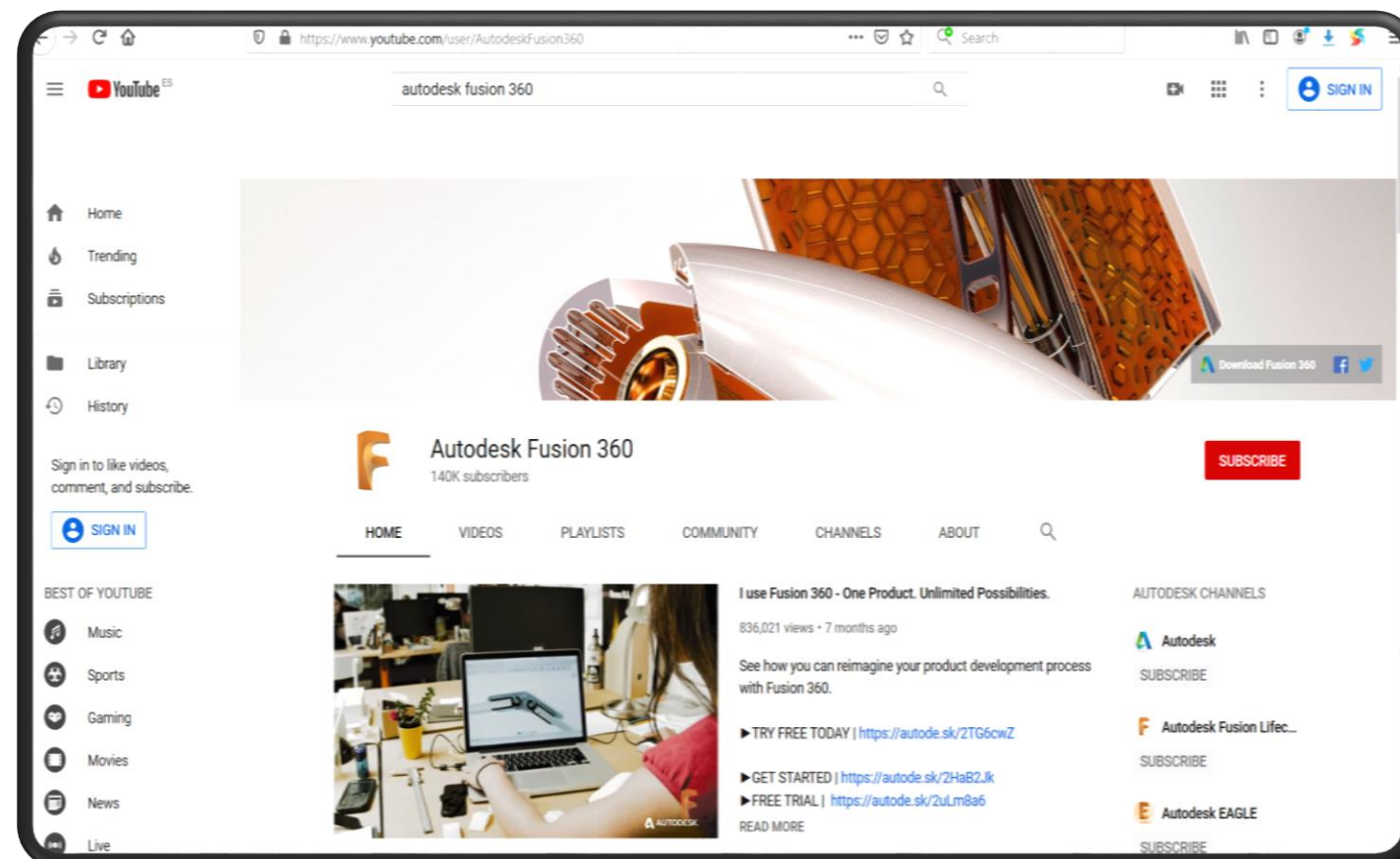
<http://help.autodesk.com/view/fusion360/ENU/>

CFD Online Help



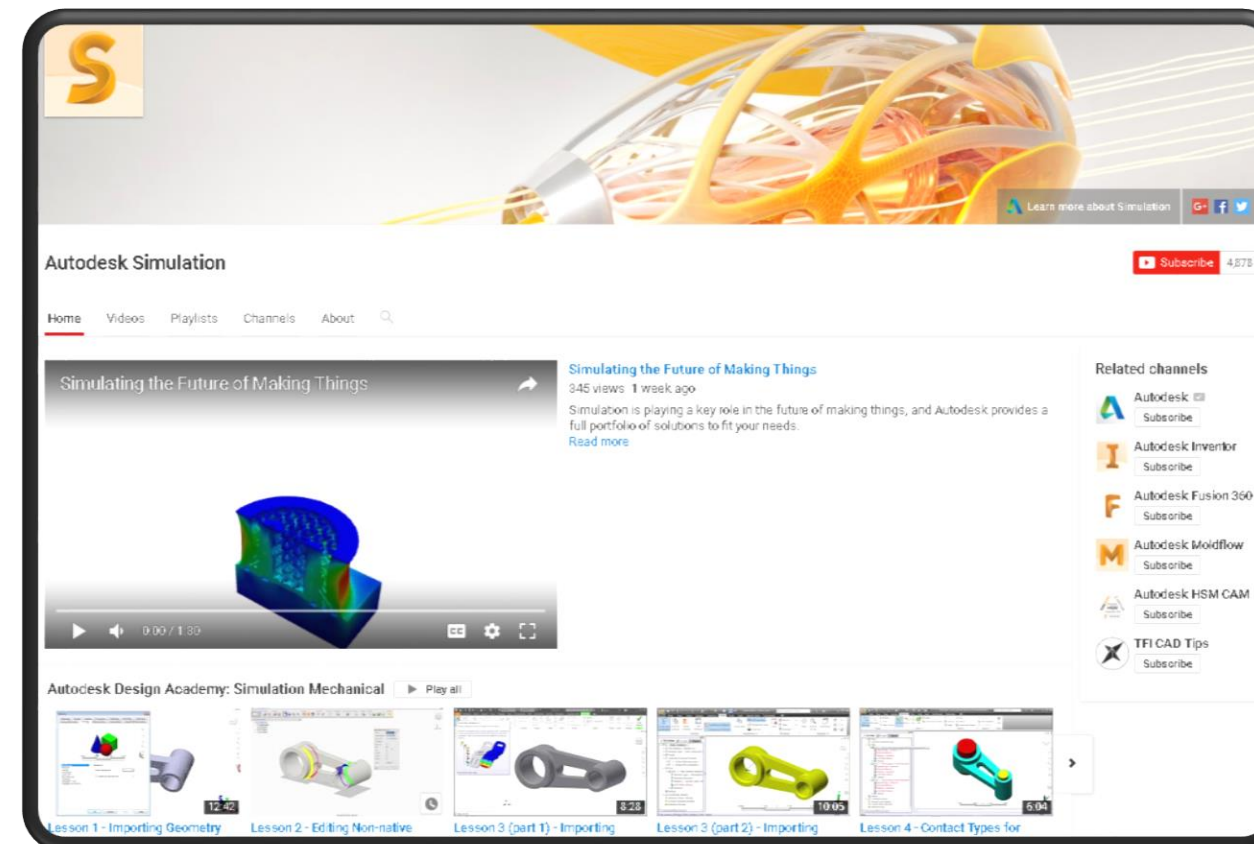
<http://help.autodesk.com/view/SCDSE/2019/ENU>

Fusion 360 YouTube



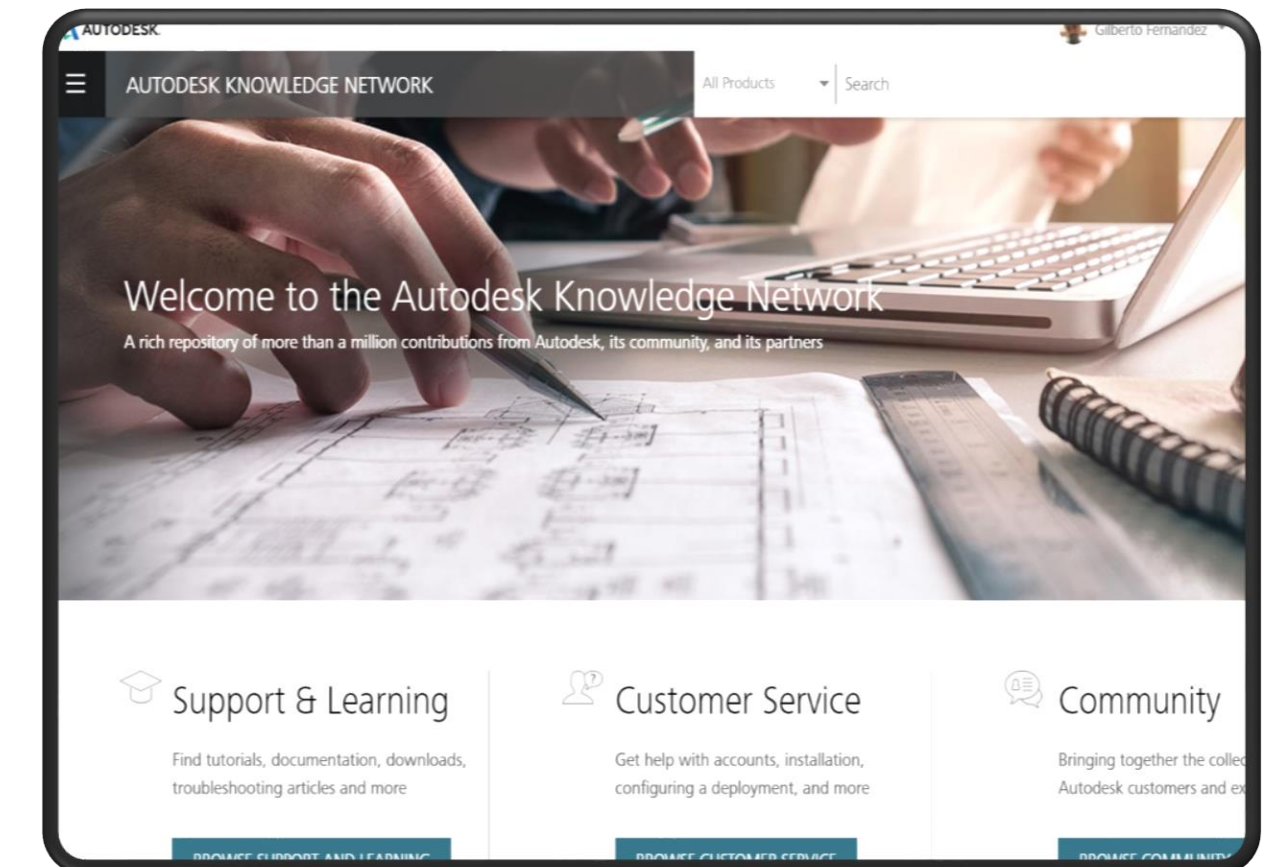
<https://www.youtube.com/user/AutodeskFusion360>

Simulation YouTube



<https://www.youtube.com/user/AutodeskSim360>

Knowledge Network



<https://knowledge.autodesk.com/>







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