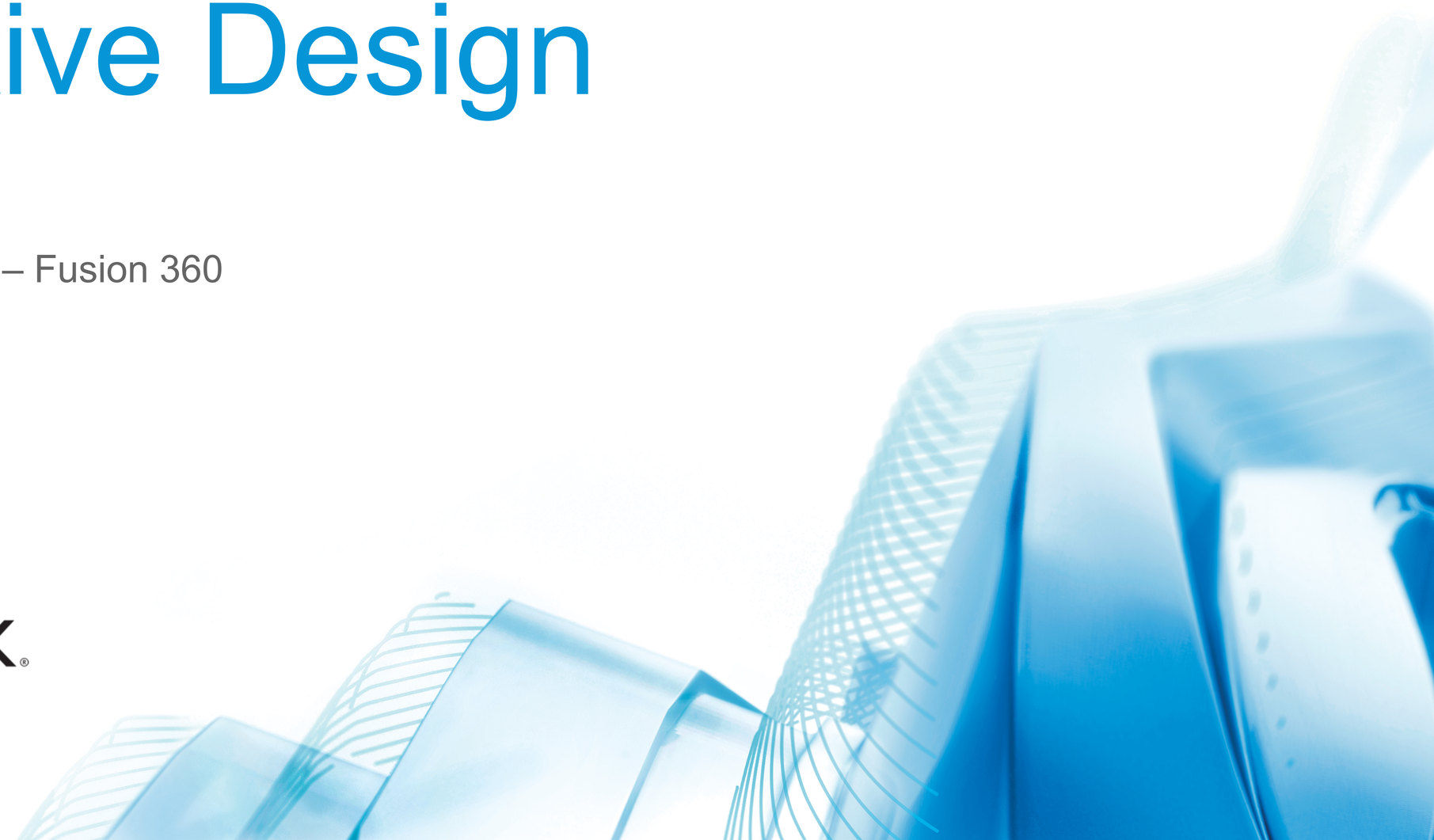
Breaking Boundaries with Generative Design

Harv Saund

Technical Sales Specialist – Fusion 360

AUTODESK. UNIVERSITY





About the Speaker

Harv Saund

Technical Specialist – Fusion 360, Autodesk UK

harv.saund@autodesk.com | @harv_saund

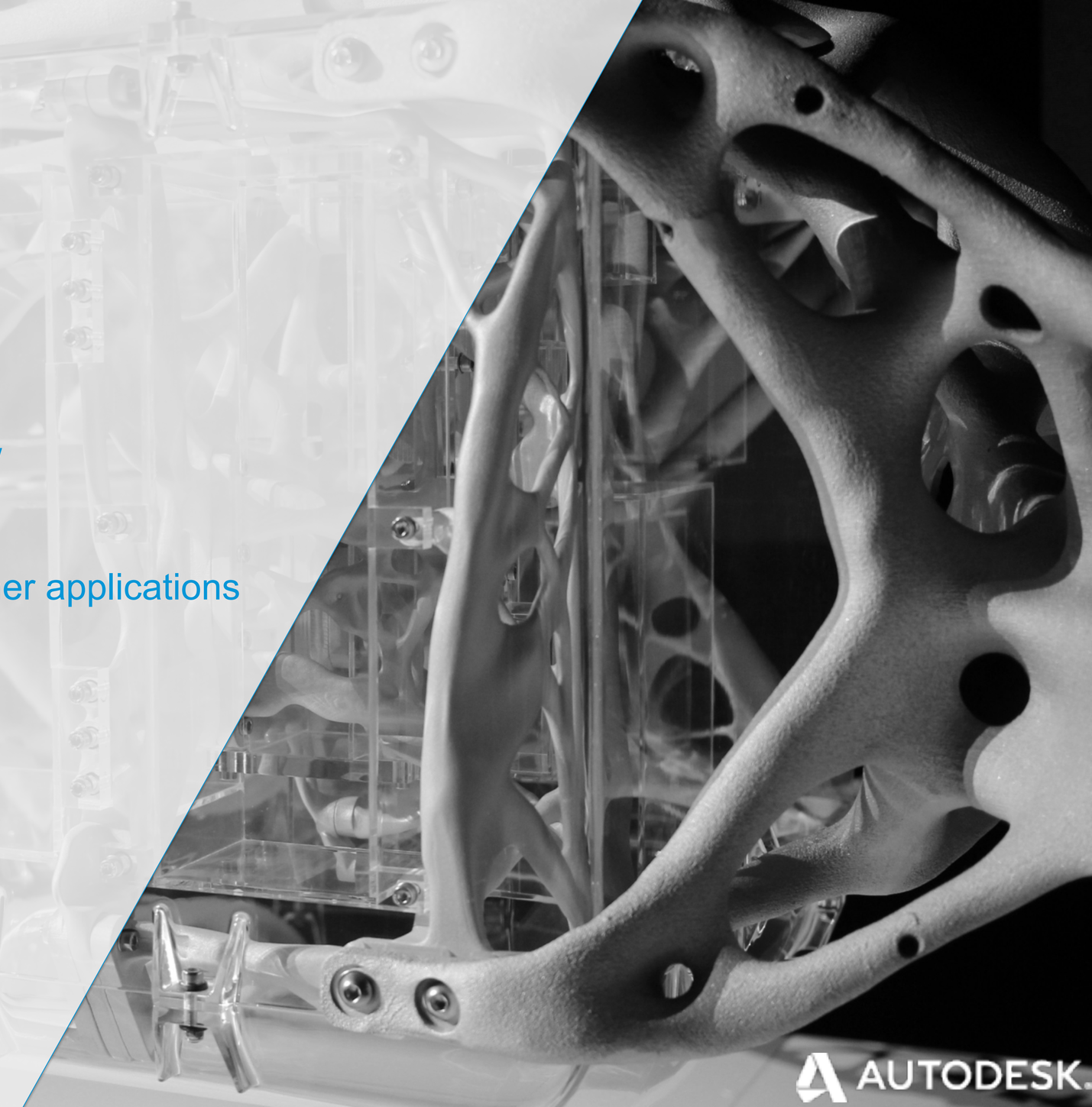
Joined Autodesk in 2016.

Prior to Autodesk, 5 years as a Solidworks technical consultant, 2 years spent in Race Engine Development & a degree in Motorsport Engineering

Product focus is the Fusion 360 platform incl. CAM, Eagle, FEA, Generative Design & Library.IO

Key Takeaways

- Introduction to Generative Design and Workflow
- How an industry leader uses Generative Design
- What could Generative Design be applied to other applications



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Safe Harbour

We may make statements regarding planned or future development efforts for our existing or new products and services. These statements are not intended to be a promise or guarantee of future availability of products, services or features but merely reflect our current plans and based on factors currently known to us. These planned and future development efforts may change without notice. Purchasing decisions should not be made based upon reliance on these statements.

These statements are being made as of 19th June 2019 and we assume no obligation to update these forward-looking statements to reflect events that occur or circumstances that exist or change after the date on which they were made. If this presentation is reviewed after 19th June 2019, these statements may no longer contain current or accurate information.

Exploration is the act of searching for the purpose of discovery of information or resources.



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Quote from google

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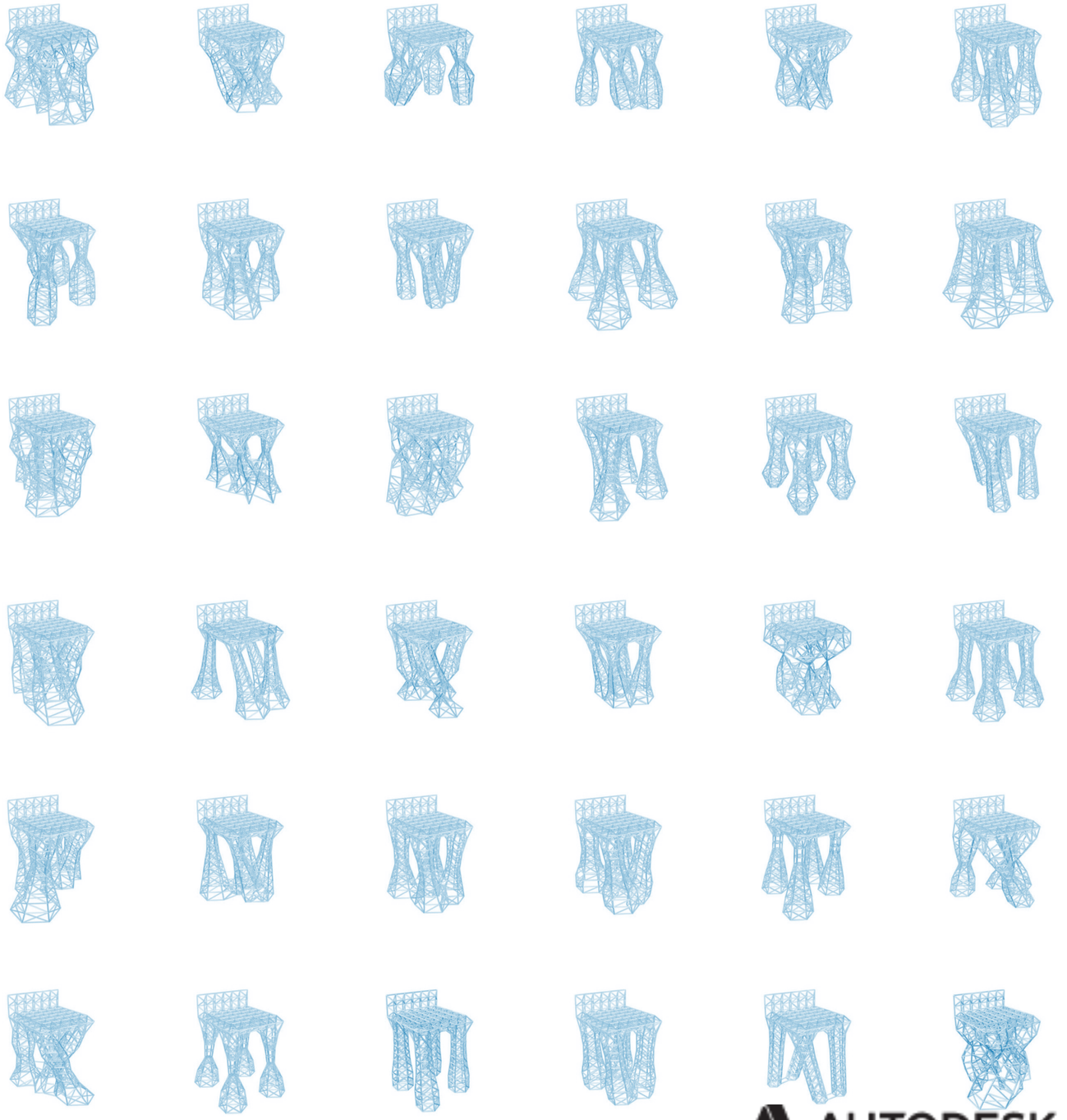
WHAT IS AUTODESK GENERATIVE DESIGN?



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

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

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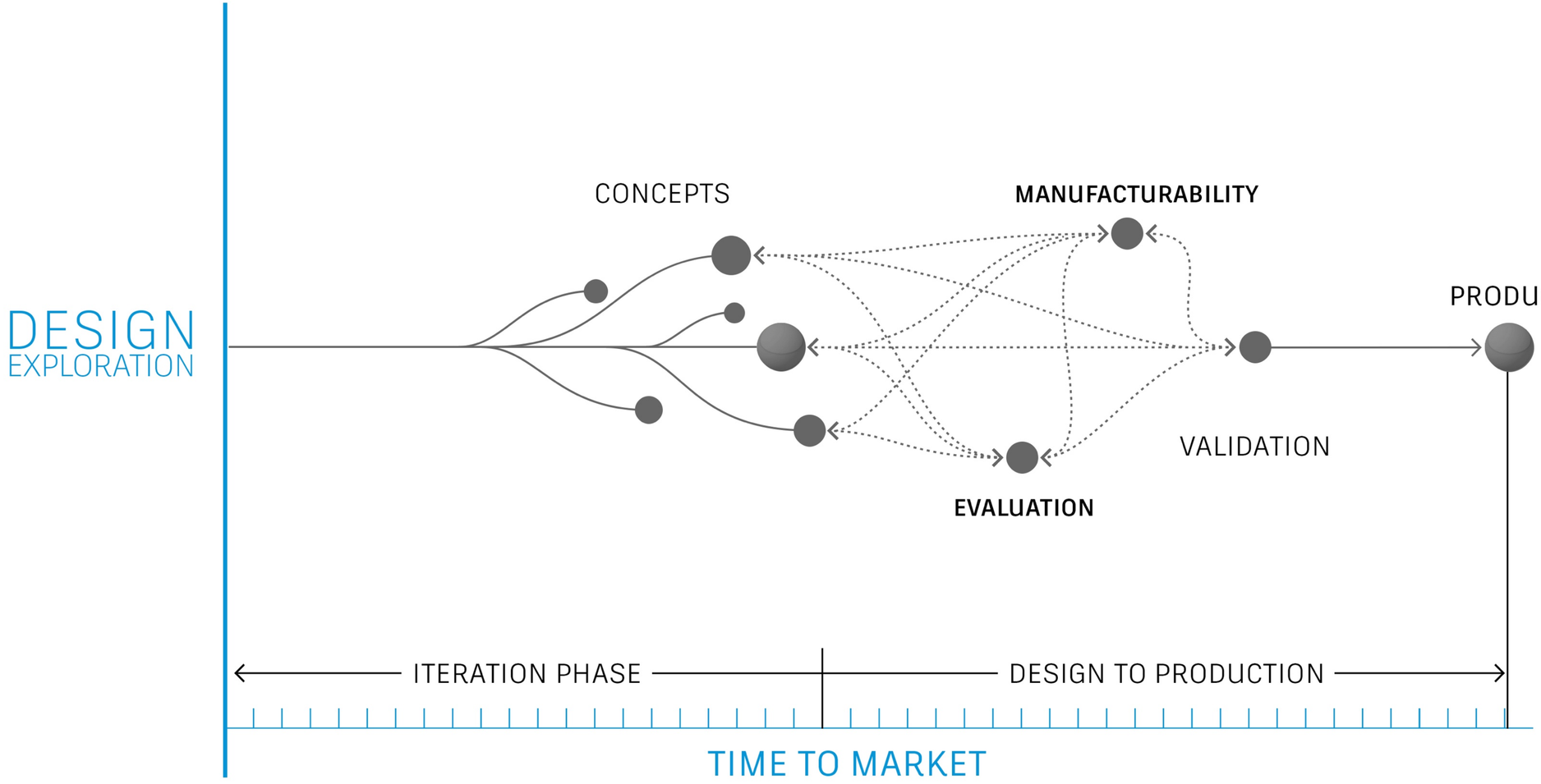
HOW DOES AUTODESK GENERATIVE DESIGN HELP THE PRODUCT DEVELOPMENT PROCESS

TRADITIONAL





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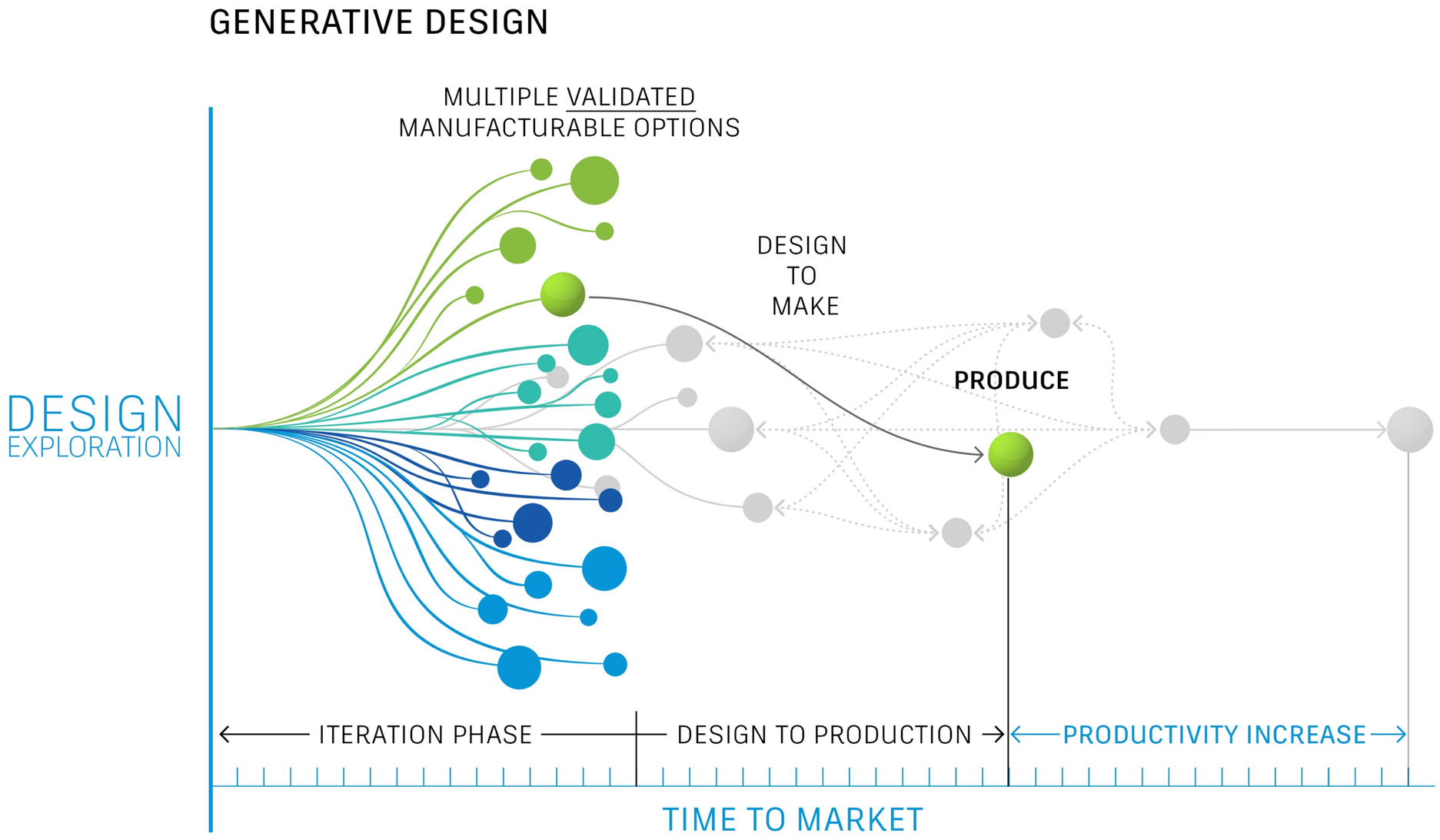
HOW DOES AUTODESK GENERATIVE DESIGN HELP THE PRODUCT DEVELOPMENT PROCESS





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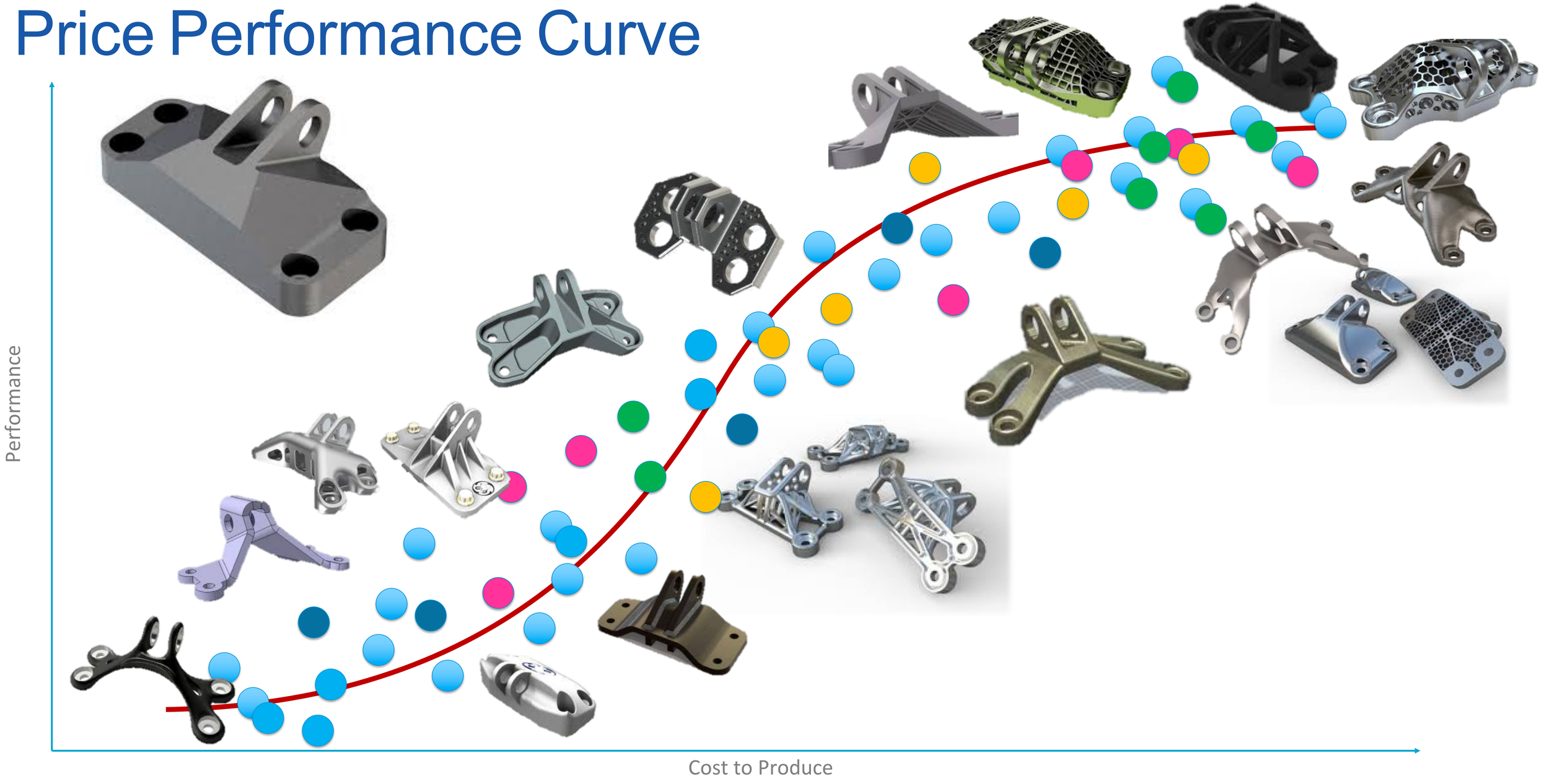
Price Performance Curve



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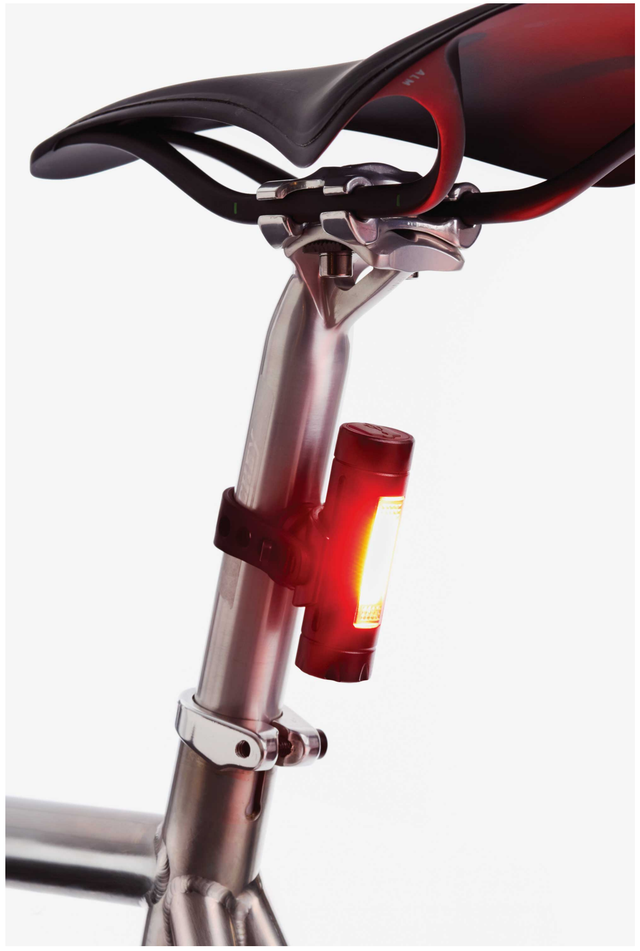
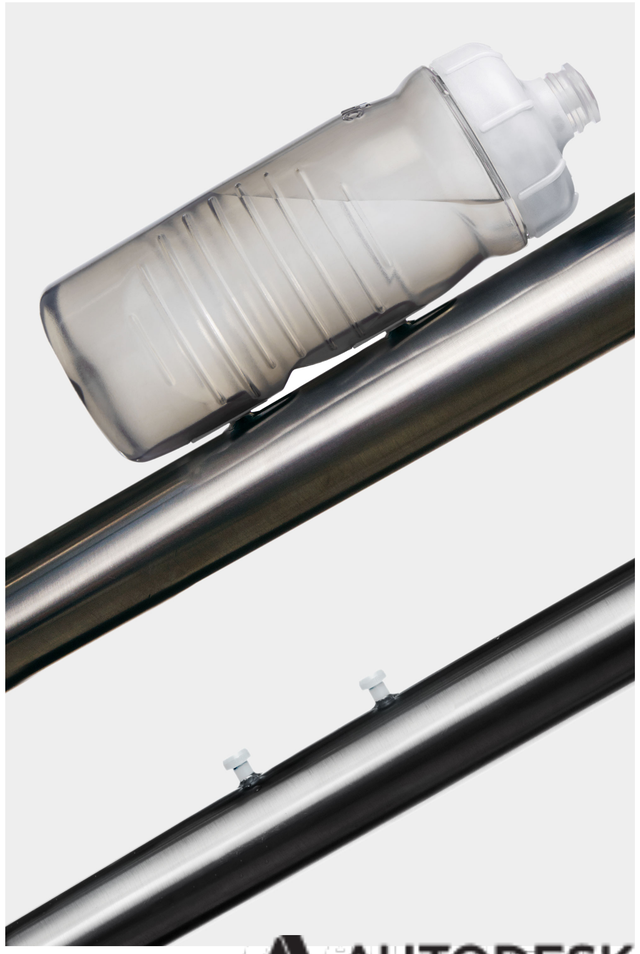
CANYON
SMITH
GMBN
mtbr
AUTODESK

fabric®









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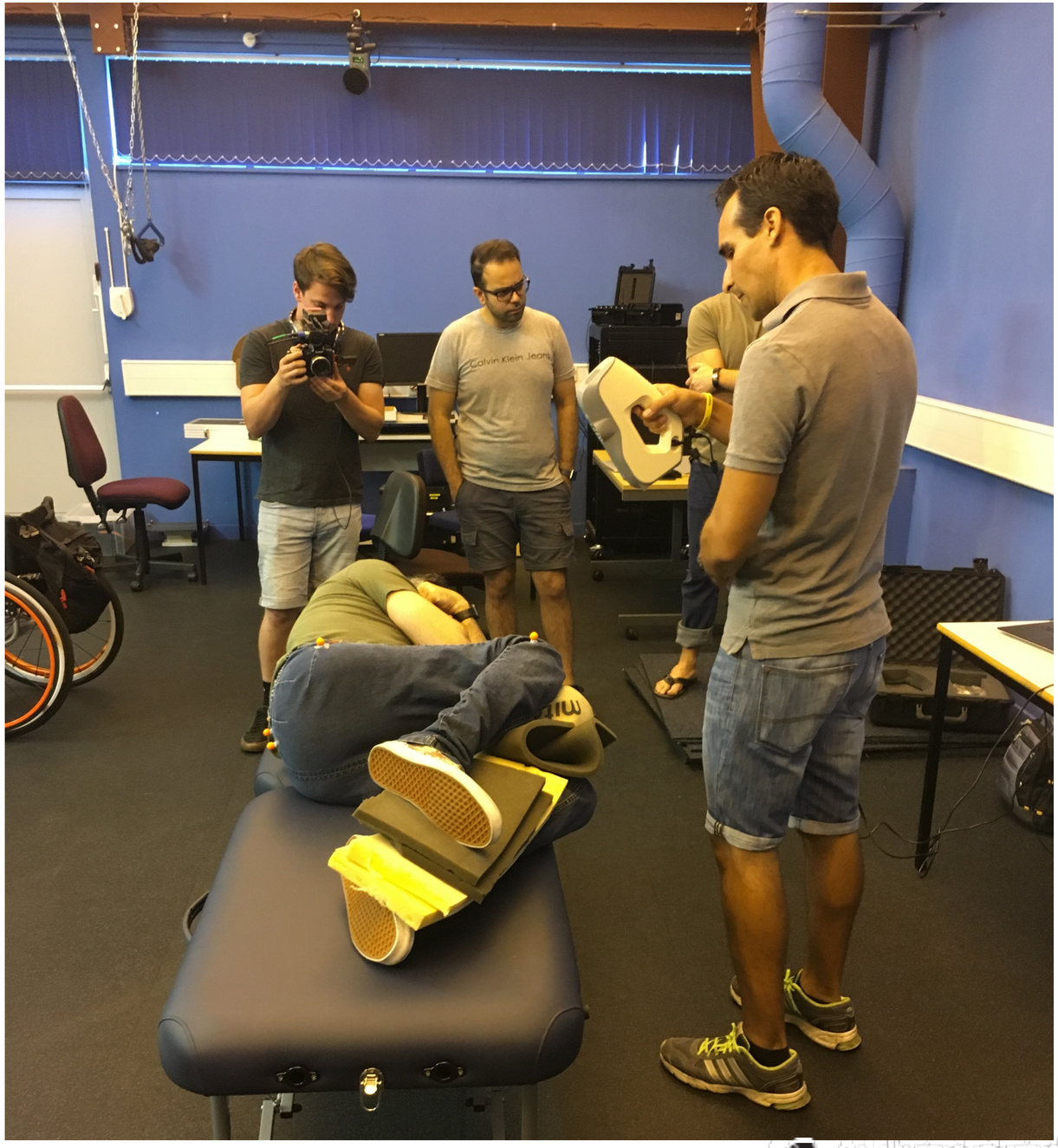
AUTODESK


suspension
CANYON
FOX
hope
GMBN
BROKEN
AUTODESK


6


15





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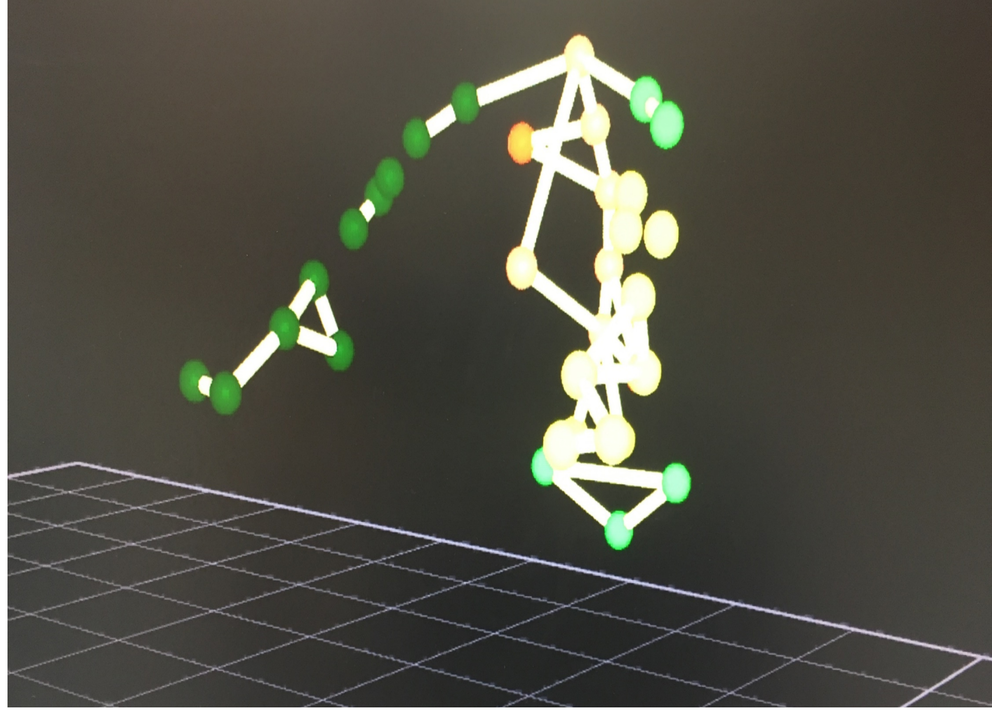


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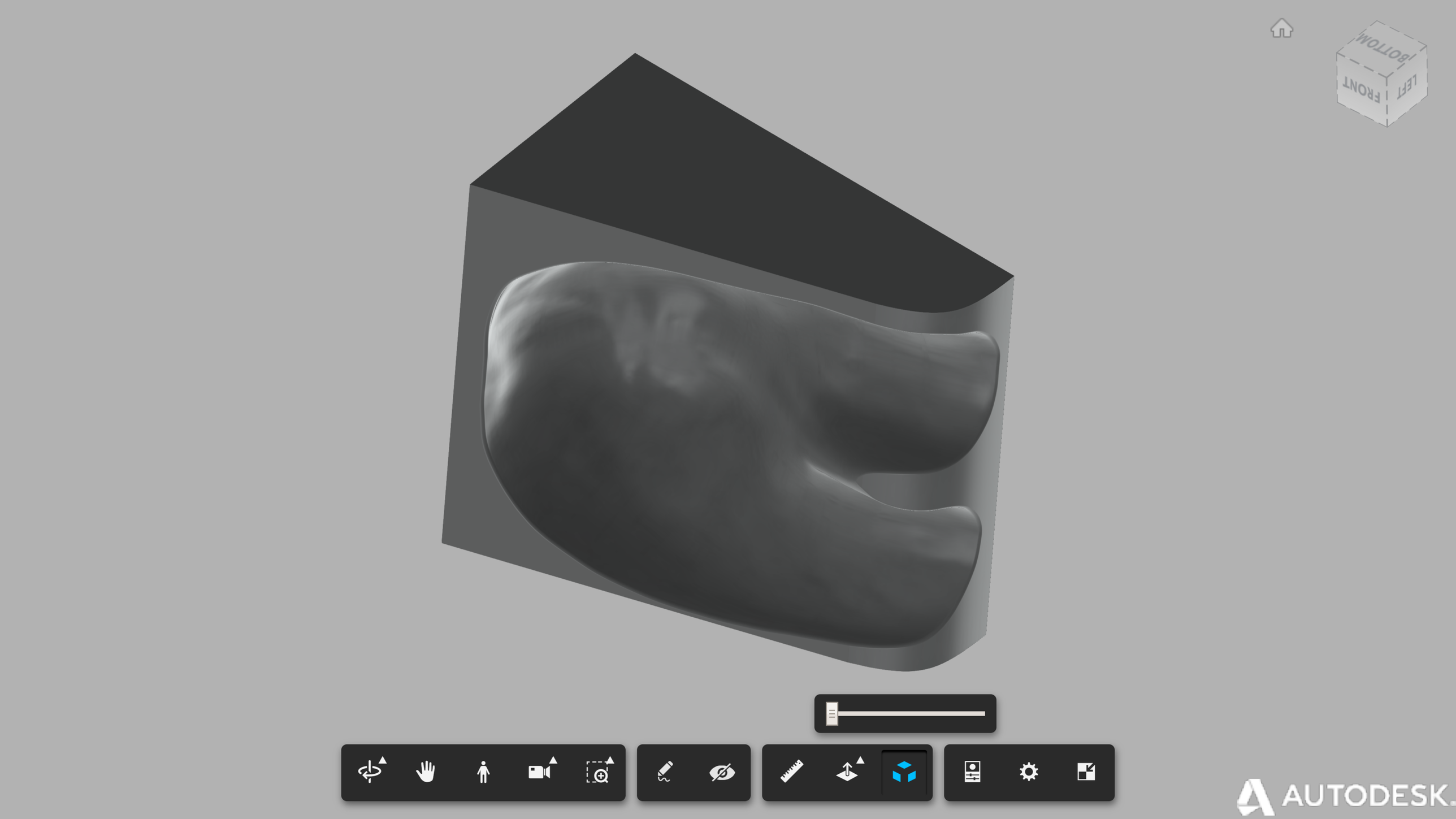
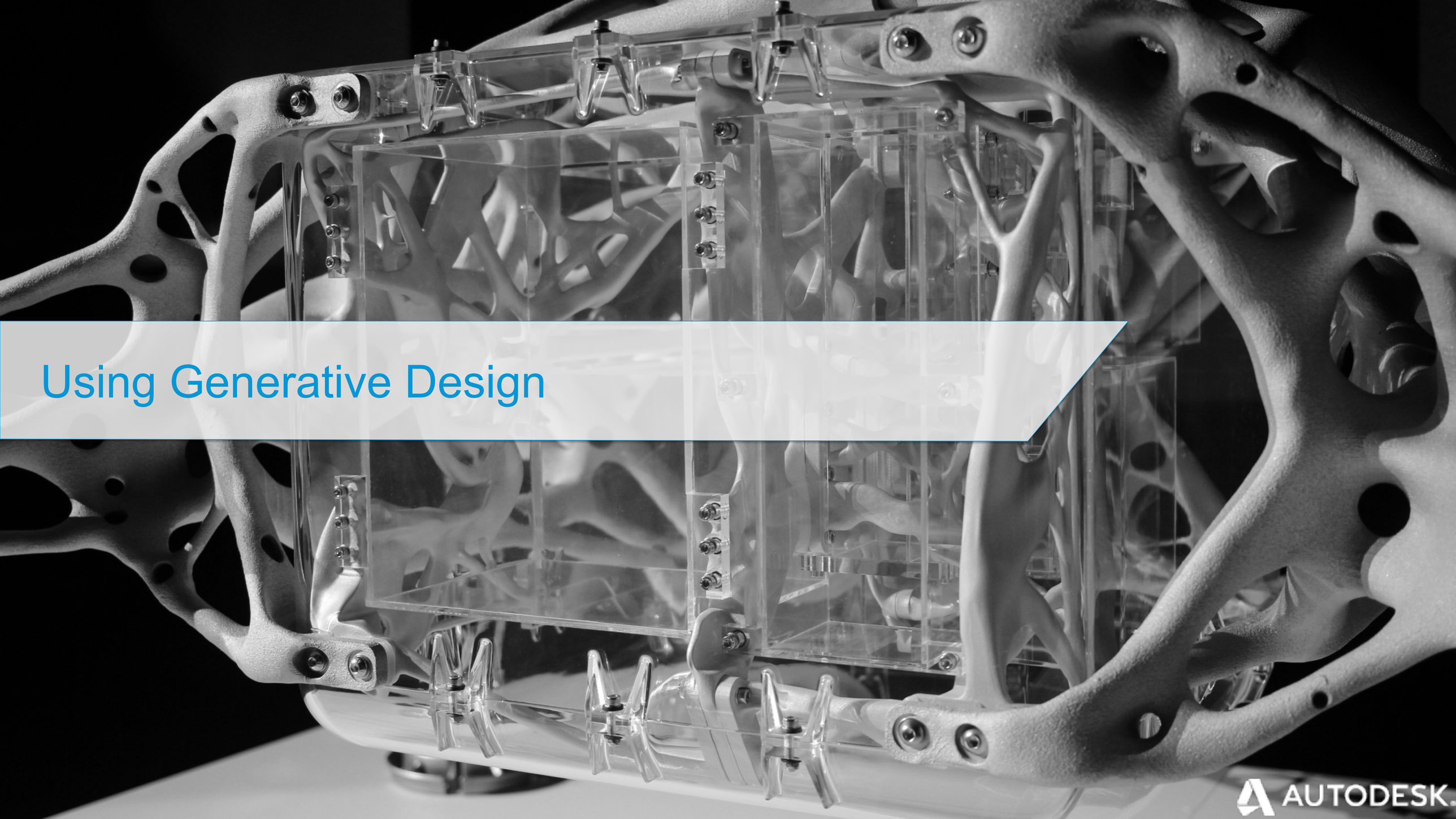

BOTTOM
LEFT
FRONT
AUTODESK.


fabric
SENDER
CANYON
NOTBROKEN
CONTINENTAL
CATAPULT
AUTODESK.


IRWIN
VELCRO
SENDER
NOTBROKEN
CONTINENTAL
KAISER
AUTODESK



Using Generative Design

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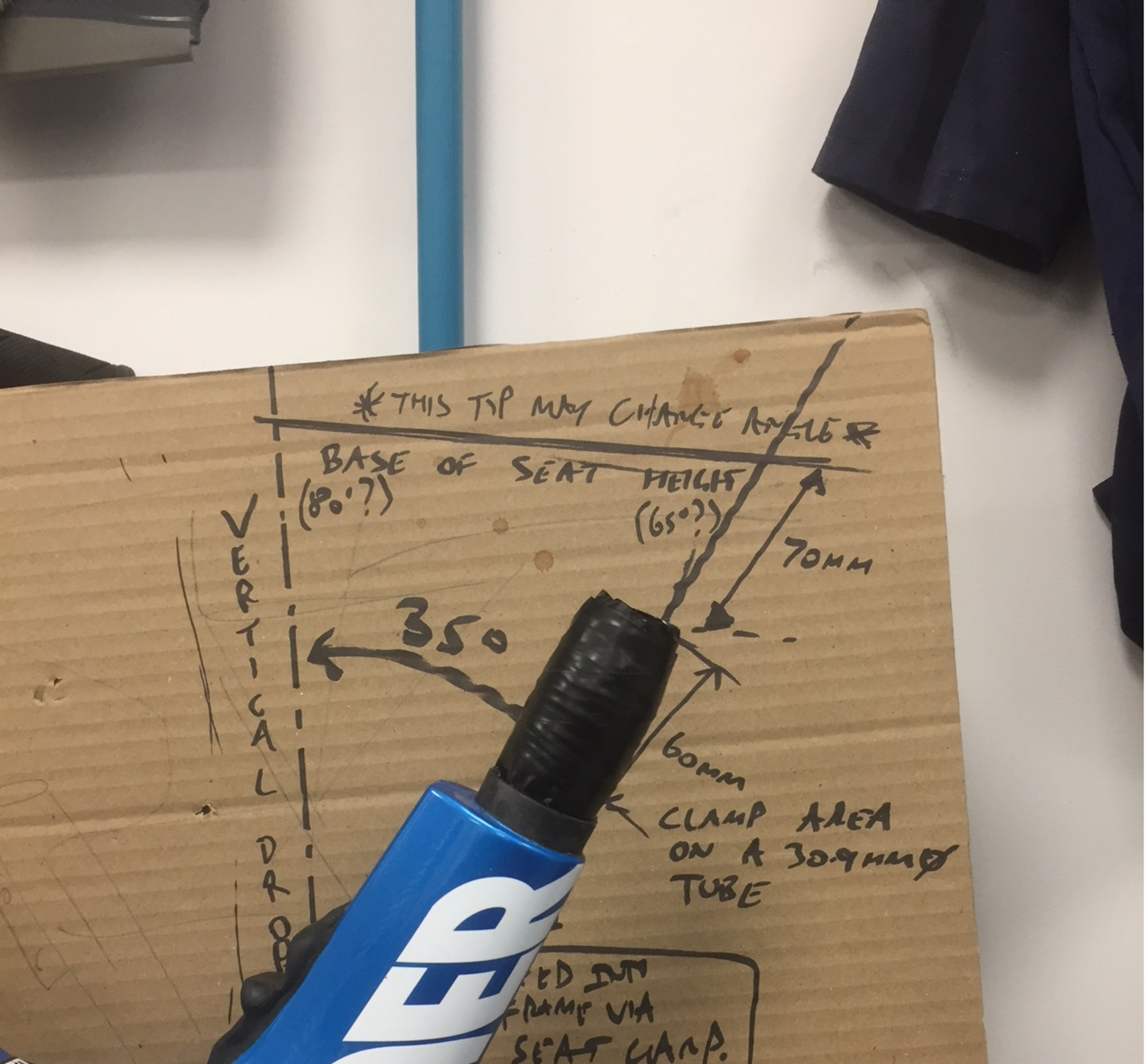
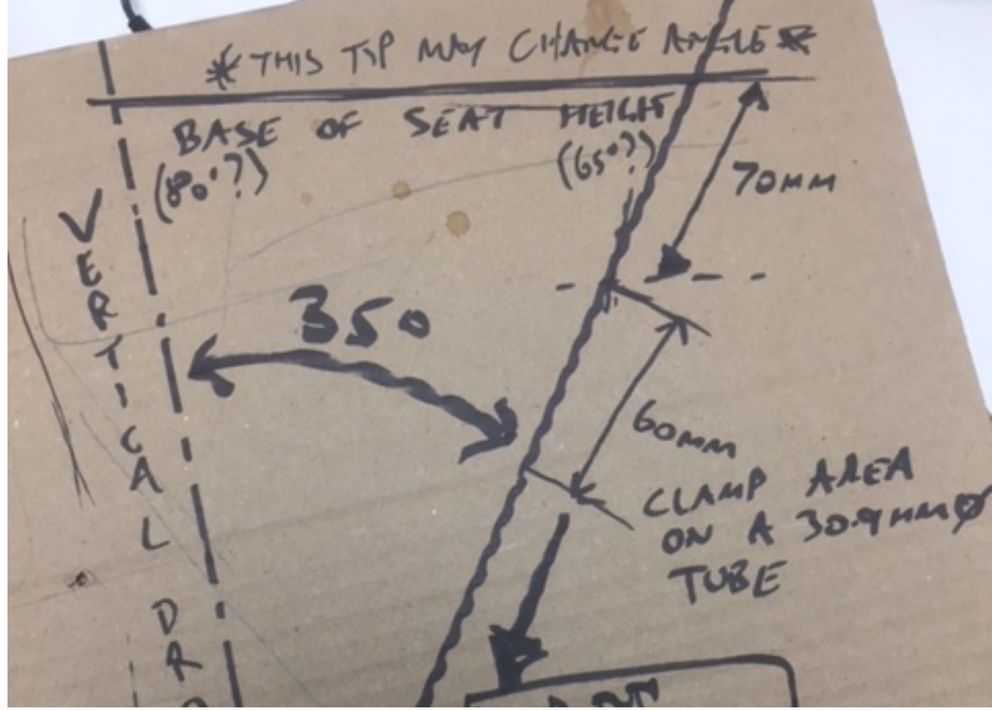

THIS TIP MAY CHANGE ANGLE
BASE OF SEAT
(80°?)
HEIGHT
(65°?)
70MM
VERTICAL
DR
350
60MM
CLAMP AREA
ON A 30.9MM Ø
TUBE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VERTICAL
DR
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60MM
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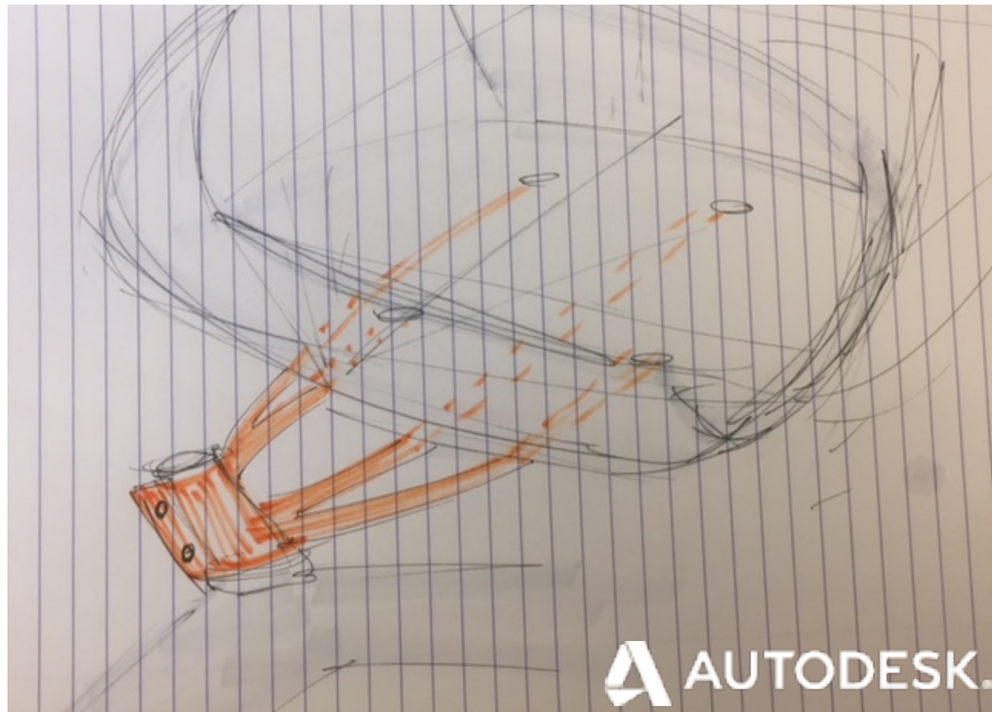
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Autodesk Fusion 360

ma_base_...ive v15*

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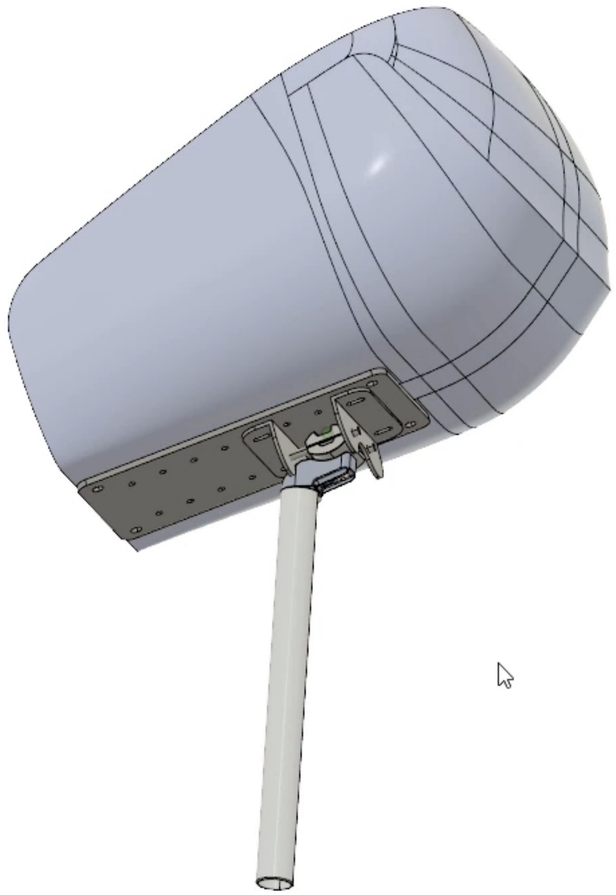
DESIGN

SOLID | SURFACE | SHEET METAL | ASSEMBLE | TOOLS

CREATE | MODIFY | CONSTRUCT | INSPECT | INSERT | SELECT

BROWSER

- ma_base_and_post Generat...
  - Document Settings
  - Named Views
  - Selection Sets
    - Preserve [5]
    - Obs [226]
    - Selection Set7 [1]
    - Selection Set8 [1]
  - Origin
  - Bodies
  - Sketches
  - Construction
  - ma_base_and_post:1
    - Origin
    - l_bracket_02:1
    - l_bracket_01:1
    - saddle_pin_01:1
    - saddle_inner_plate:1
    - saddle_pin_02:1
    - ma_base_v01 v86:1
    - Martyn Seat CAD:1
    - Zadelpen_308_350_metstrop:1
    - Zadelpen_272_350_metstrop_...
  - Initial Generative Bracket:1
  - ma_base_and_post v31:1
  - CNC Machined V2 Latest v1...



FRONT

COMMENTS

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Autodesk Fusion 360

ma_base_...ive v15*

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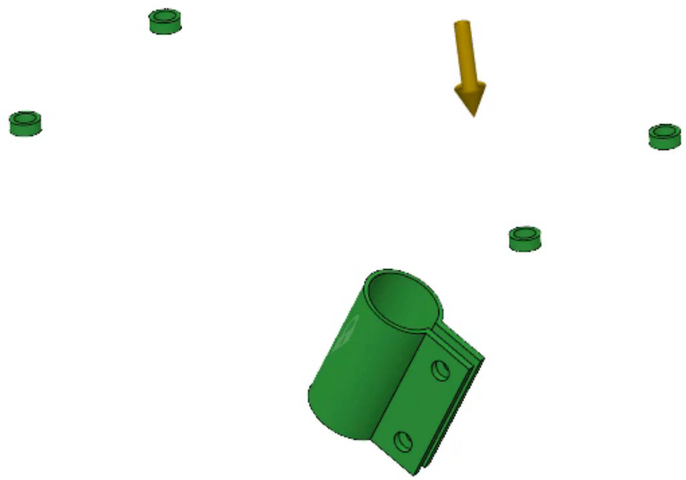
GENERATIVE DESIGN | DEFINE | STUDY | MODEL | DESIGN SPACE | DESIGN CONDITIONS | OBJECTIVES | MANUFACTURING | MATERIALS | GENERATE | MANAGE | EXPLORE | INSPECT | SELECT

BROWSER

- Generative Studies
  - Units: Custom
  - Generative Model 1
    - Named Views
    - Selection Sets
    - Origin
    - Construction
    - Model Components
    - Study 1 - Generative
    - Study 2 - No side load
    - Study 3 - Lower load
    - Study 4 - Smaller tooling
    - Smaller tooling with side load
    - Adjusted seat post and angle of seat
    - Adj Seat no side load
    - Adj seat extra obs
    - Study 4 - Generative
      - Preserve Geometry
      - Obstacle Geometry
      - Starting Shape
      - Objectives
      - Manufacturing
      - Study Materials
      - Load Case1





COMMENTS

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GENERATIVE DESIGN

DEFINE

STUDY | MODEL | DESIGN SPACE | DESIGN CONDITIONS | OBJECTIVES | MANUFACTURING | MATERIALS | GENERATE | MANAGE | EXPLORE | INSPECT | SELECT

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- Generative Studies
  - Units: Custom
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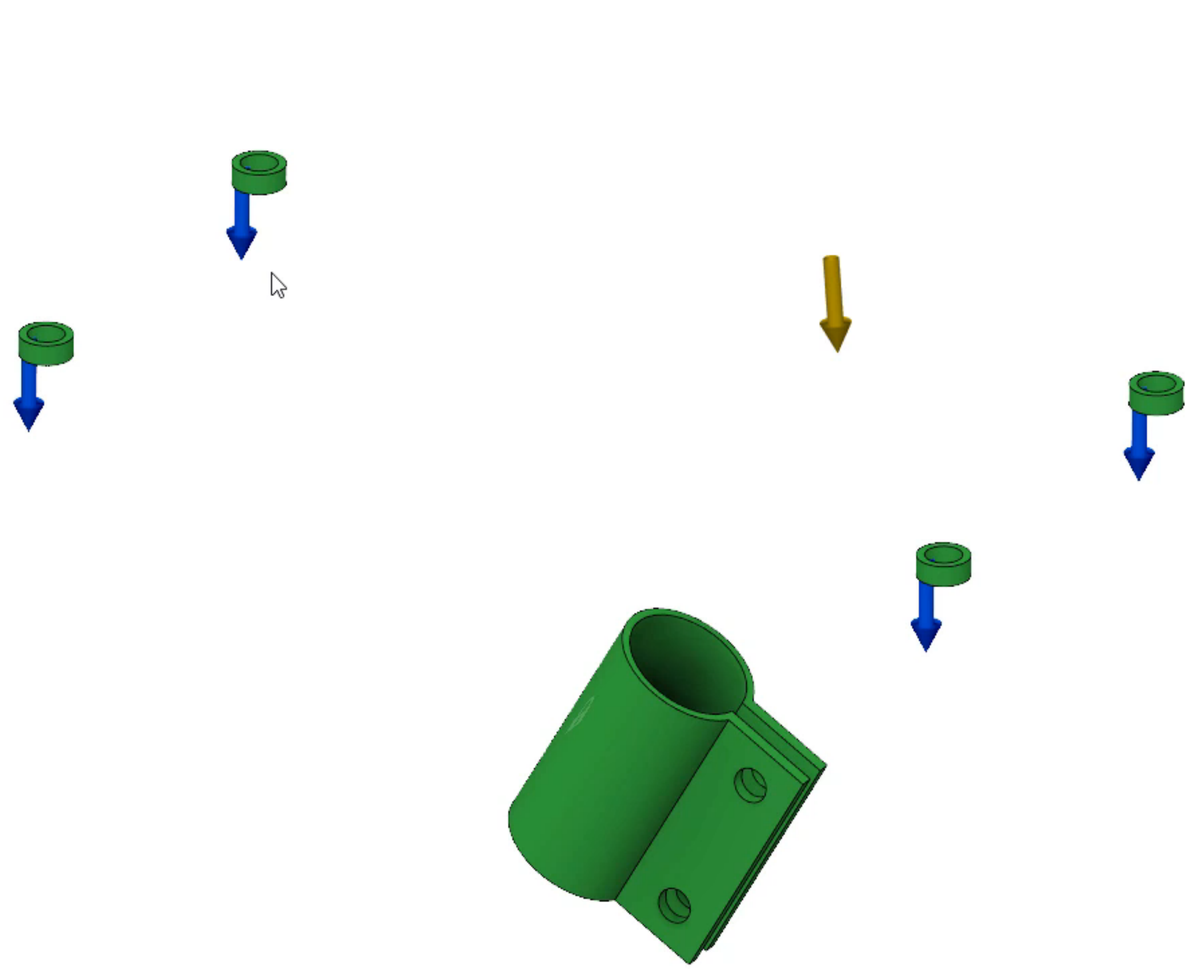
    - Study 3 - Lower load
    - Study 4 - Smaller tooling
    - Smaller tooling with side load
    - Adjusted seat post and angle of seat
    - Adj Seat no side load
    - Adj seat extra obs
    - Study 4 - Generative
      - Preserve Geometry
      - Obstacle Geometry
      - Starting Shape
      - Objectives
      - Manufacturing
      - Study Materials
      - Load Case1



COMMENTS

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ma_base_...ive v15*

GENERATIVE DESIGN

EXPLORE

DISPLAY

FINISH EXPLORE

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Outcome filters

Processing status
- [x] Converged
- [x] Completed

Study
- [x] Adj seat extra obs
- [x] Adj Seat no side ...
- [x] Adjusted seat po...
- [x] Smaller tooling ...
- [x] Study 1 - Genera...
- [x] Study 2 - No sid...
- [x] Study 3 - Lower ...
- [x] Study 4 - Smalle...

Design file
- [x] Created from outcome
- [x] Not created from outcome

Manufacturing method
- [x] Unrestricted
- [x] Additive
- [x] 3 axis milling
- [x] 5 axis milling

Synthesis method
- [x] Organic

Objective ranges

Volume (mm^3)

3.25 6,173,694.40

ma_base_and_post Generative v13

480 outcomes **345** converged **135** completed

Sort by: Processing status

Converged



Adj seat extra obs - Outcome 1
Converged



Adj seat extra obs - Outcome 2
Converged



Adj seat extra obs - Outcome 3
Converged



Adj seat extra obs - Outcome 4
Converged



Adj seat extra obs - Outcome 5
Converged



Adj seat extra obs - Outcome 6
Converged



Adj seat extra obs - Outcome 7
Converged



Adj seat extra obs - Outcome 8
Converged



Adj seat extra obs - Outcome 9
Converged



Adj seat extra obs - Outcome 10
Converged



Adj seat extra obs - Outcome 11
Converged



Adj seat extra obs - Outcome 12
Converged













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ma_base_...ive v15*

CNC Mach...test v10

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DESIGN

SOLID | SURFACE | SHEET METAL | ASSEMBLE | TOOLS

CREATE | MODIFY | CONSTRUCT | INSPECT | INSERT | SELECT

BROWSER

- CNC Machined V2 Latest v10
  - Document Settings
  - Named Views
  - Origin
  - Bodies
  - Sketches
  - Construction



FRONT RIGHT

COMMENTS

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CNC Mach...est v12*

3D printe...atest v4*

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SOLID SURFACE SHEET METAL ASSEMBLE TOOLS

DESIGN

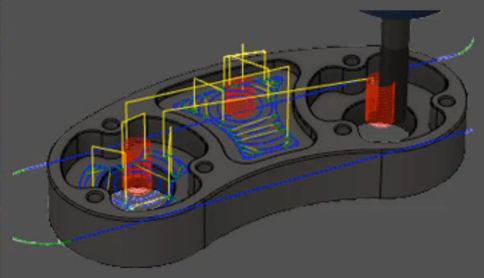
CREATE MODIFY CONSTRUCT INSPECT INSERT SELECT

DESIGN
GENERATIVE DESIGN
RENDER
ANIMATION
SIMULATION
MANUFACTURE
DRAWING

achined V2 Latest v12
Settings

Manufacture Workspace

Generates tool-path strategies for the design to be fabricated.



Bodies
Sketch
Constr

COMMENTS

ORANGE VISE COMPANY

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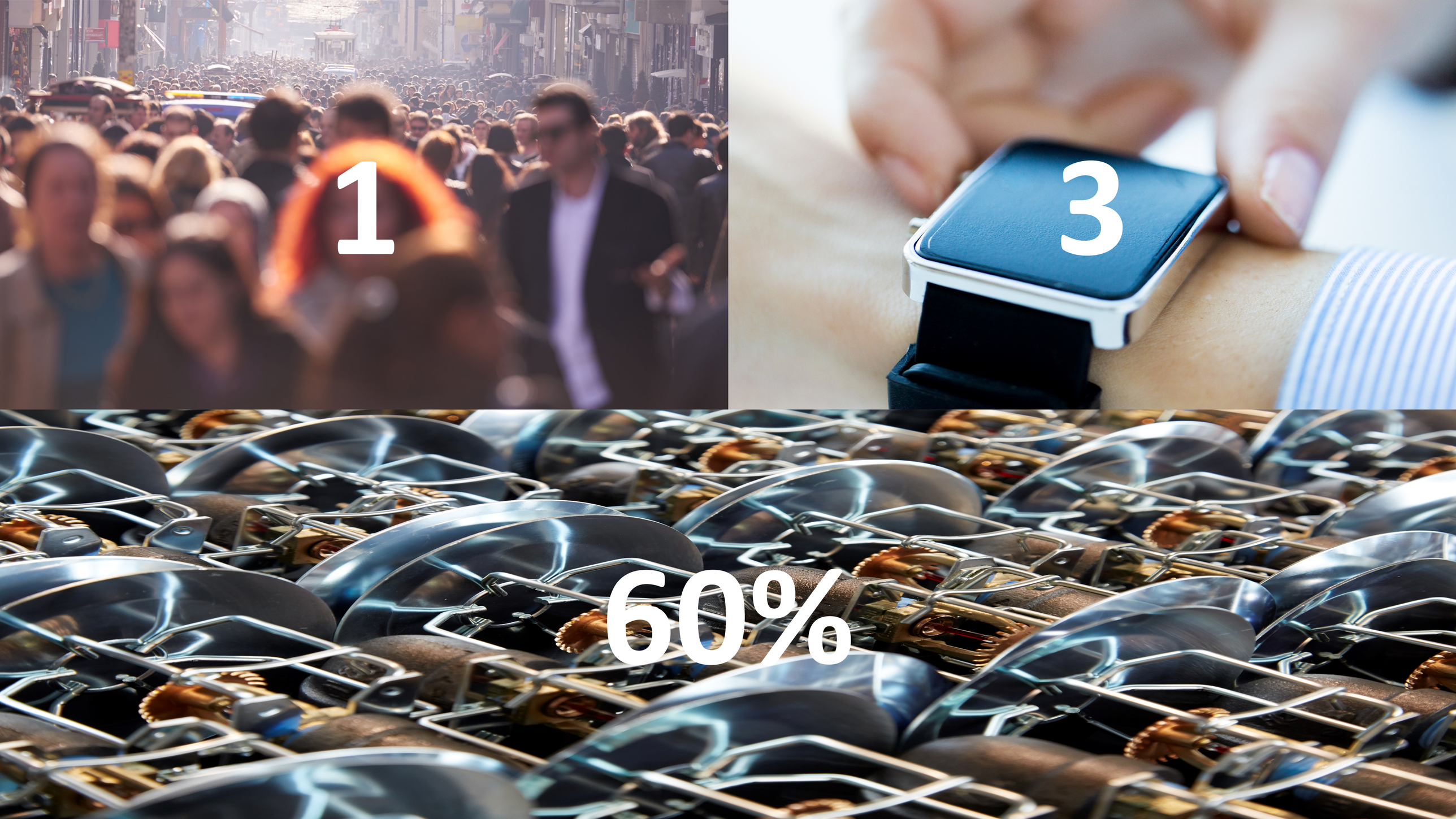
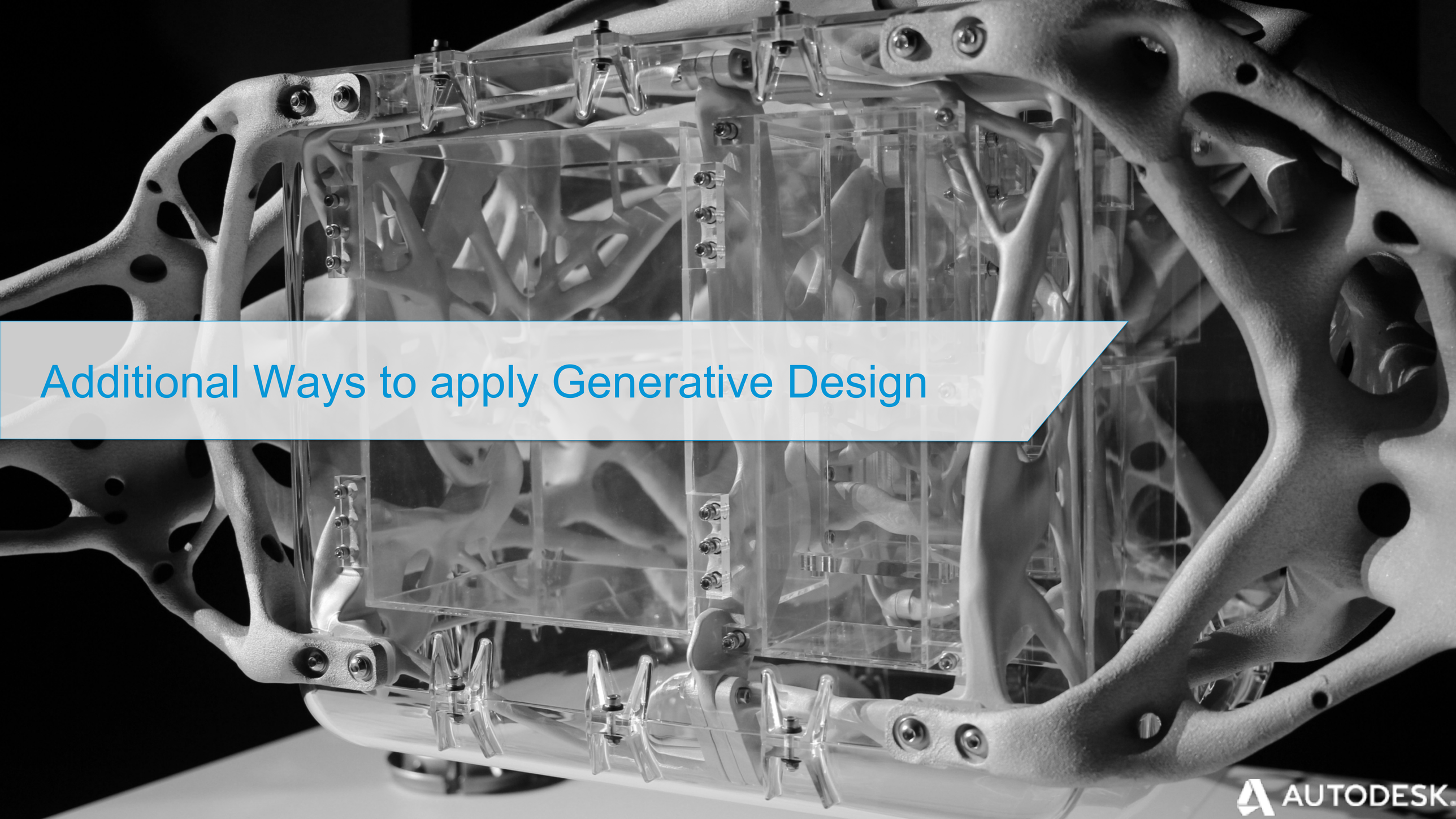
NOTBROKEN
CANYON
fabric
AUTODESK


1
3
60%



Additional Ways to apply Generative Design

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Autodesk Fusion 360

Equitus_Dropout_GD v3 | Generative bottom bracket v6* | BMX_Generative v10 | Session Frame Assembly v2 | Session Frame Assembly v21*

Harv Saund

DESIGN

SOLID | SURFACE | FORM | MESH | TOOLS

CREATE | MODIFY | ASSEMBLE | CONSTRUCT | INSPECT | INSERT | SELECT

BROWSER

- Session Frame Assembly v2
  - Document Settings
  - Named Views
  - Origin
  - Session Front Triangle (True to Sci...
  - Session Chain Stay (Rounded)_ac...
  - Session Seat Stay_accurate:1
  - Session Rocker_accurate:1
  - Seatpost Clamp Assembly_accurat...
  - Trek Session ABP Assembly_accu...
  - Truvatuv GXP Bottom Bracket_acc...
  - FSA Orbit ZS-1 (57-E-1)_accurate:1
  - Seat Stay Nut_accurate:1
  - Seat Stay Nut_accurate:2
  - Chain Stay Bearing_accurate:1
  - Chain Stay Bearing_accurate:2
  - Top Shock Nut_accurate:1
  - Top Shock Sleeve_accurate:1
  - McMaster - M8x60_accurate:1
  - Rocker Sleeve_accurate:1
  - McMaster - M12x80_accurate:1
  - Rocker Nut_accurate:1
  - McMaster - M8x60_accurate:2
  - Main Pivot Nut_accurate:1
  - Main Pivot Bolt_accurate:1





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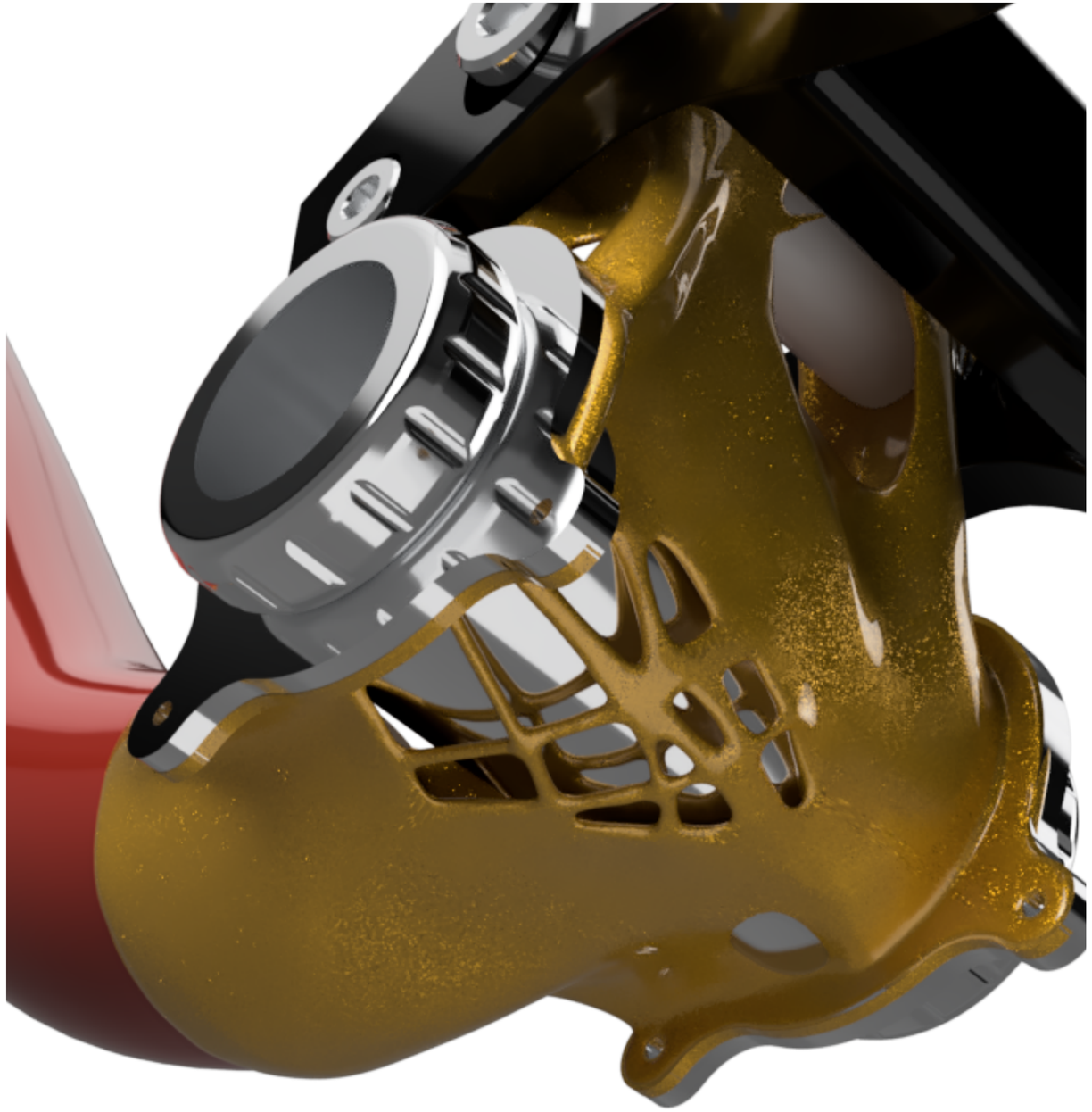

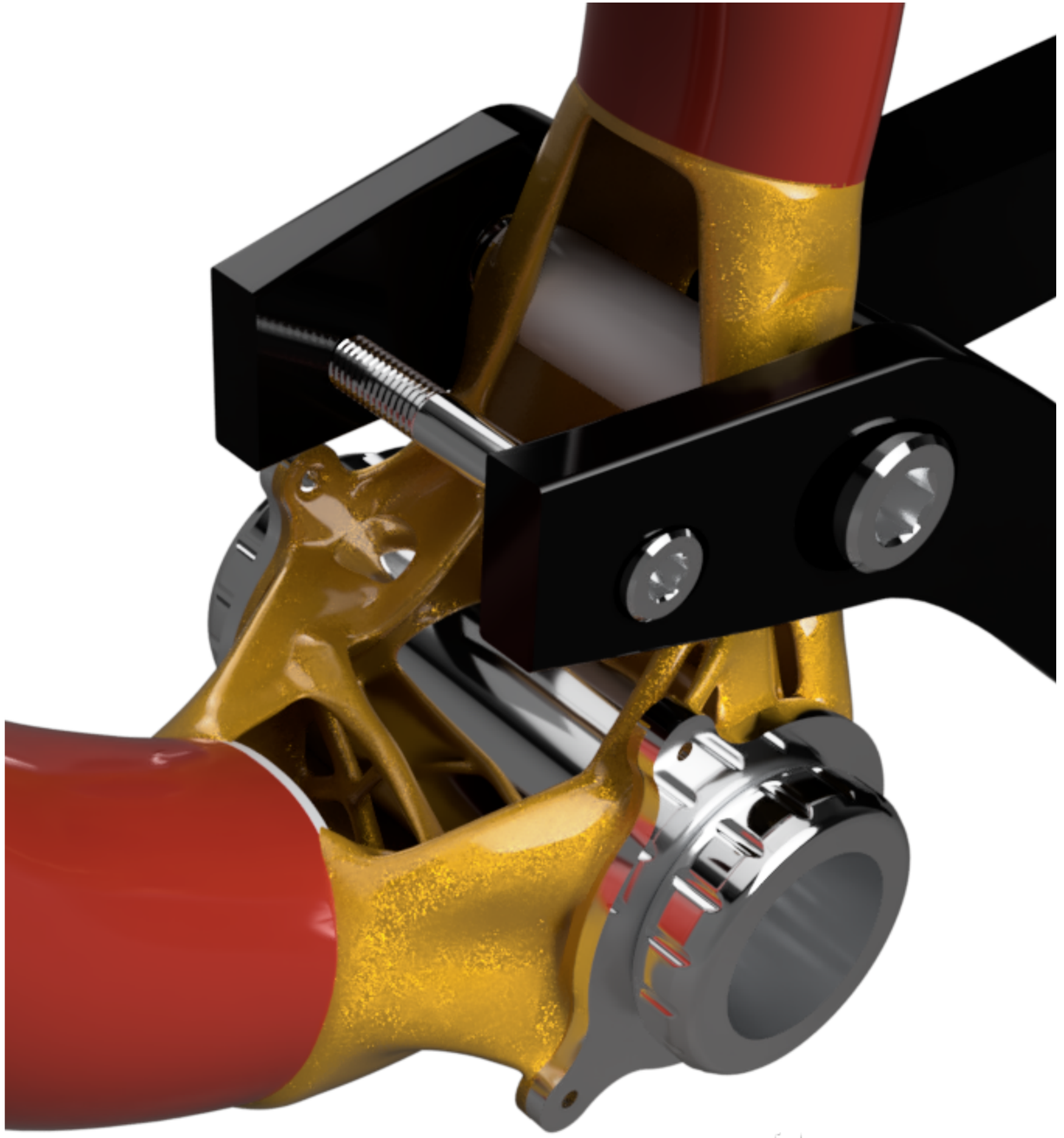

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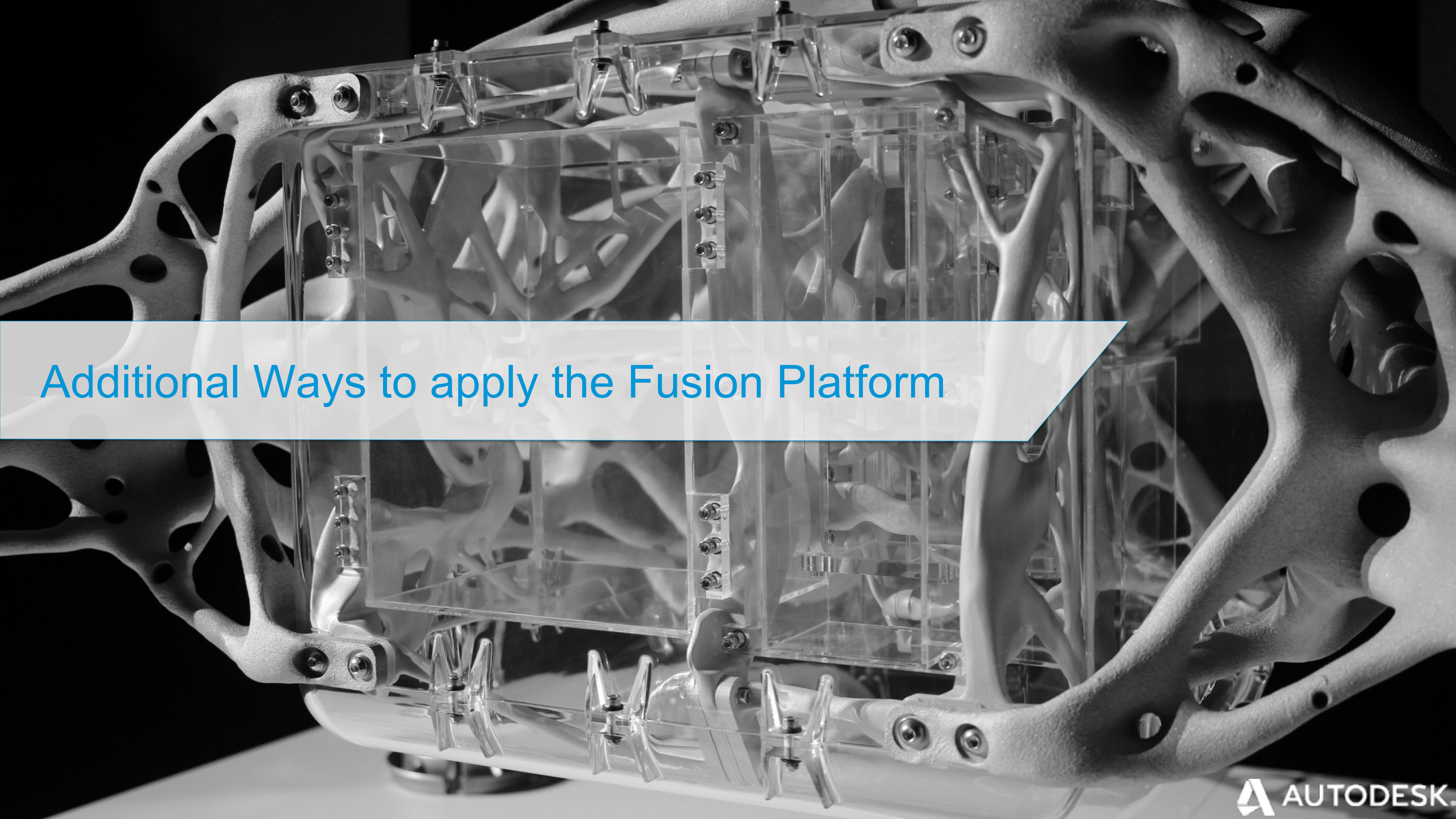

Additional Ways to apply the Fusion Platform

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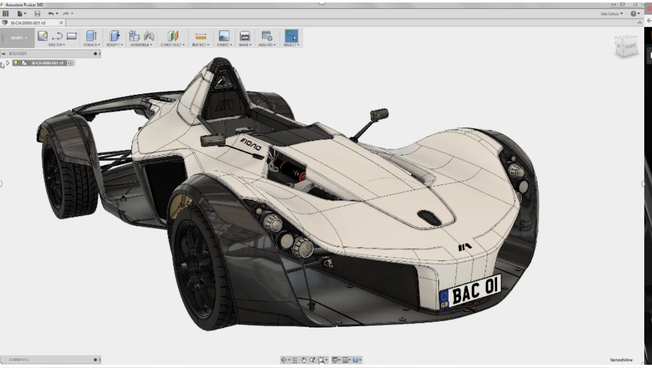
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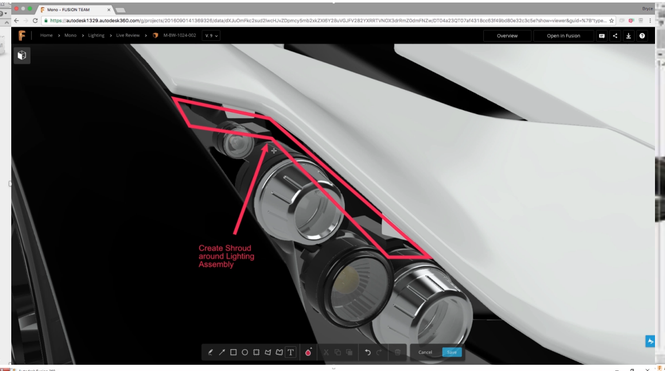
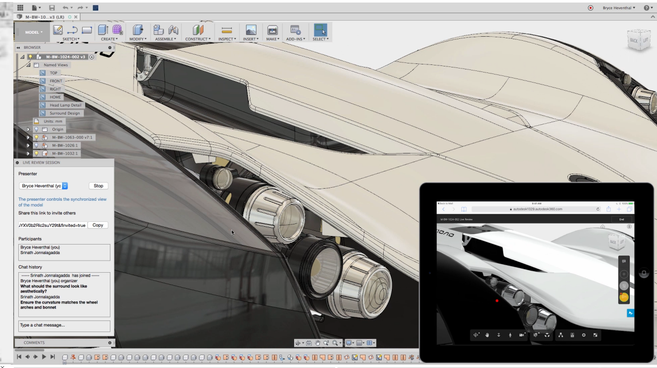
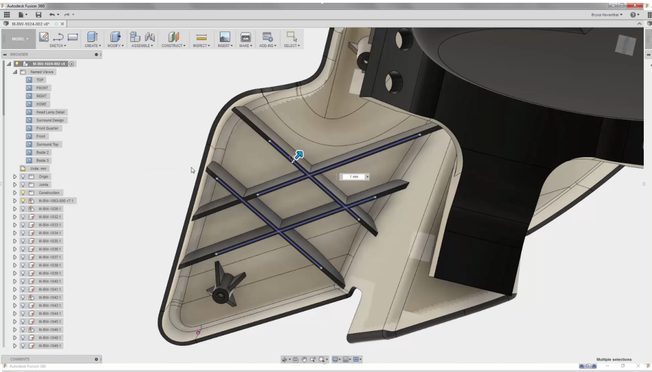
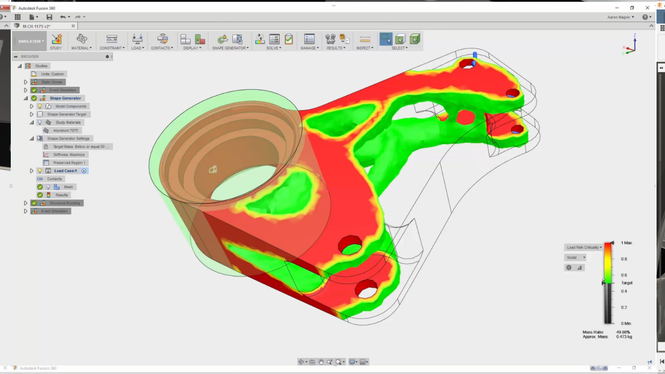
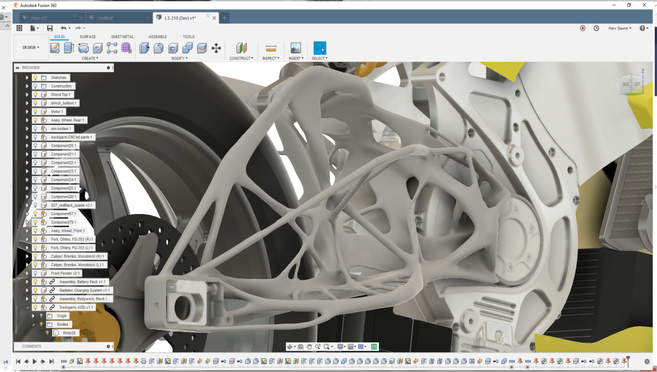

Create Shroud
around Lighting
Assembly

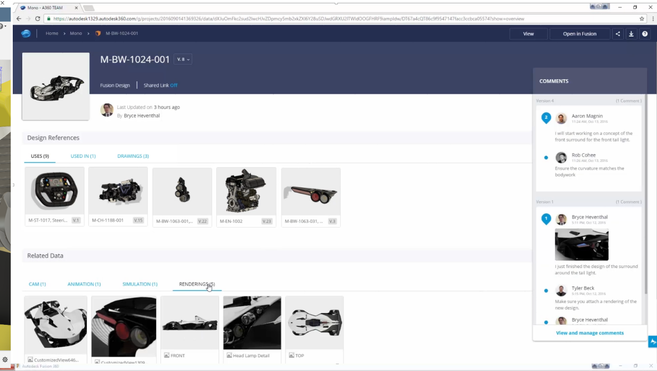








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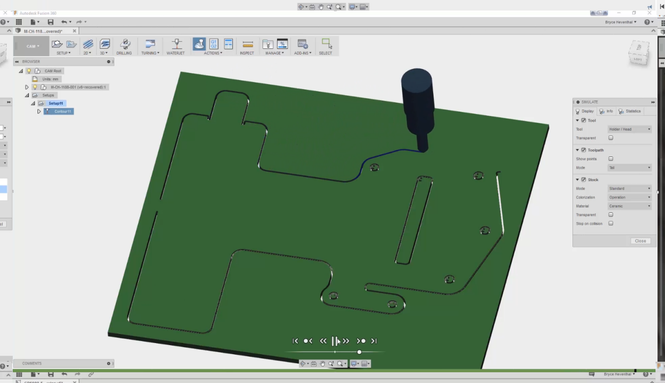
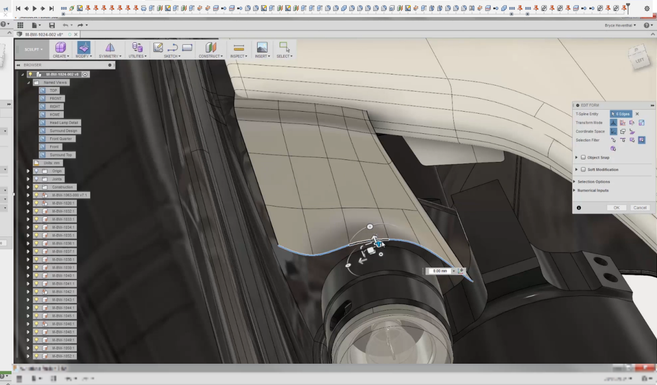
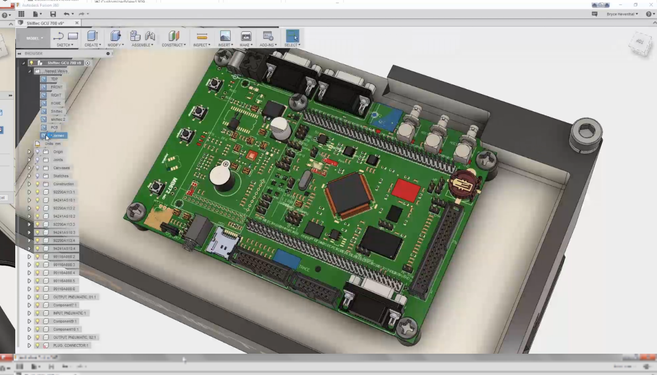
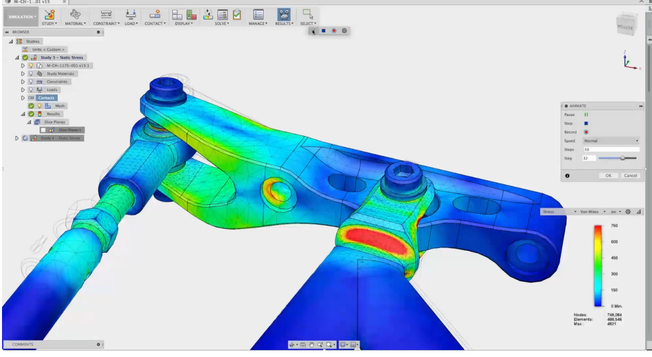
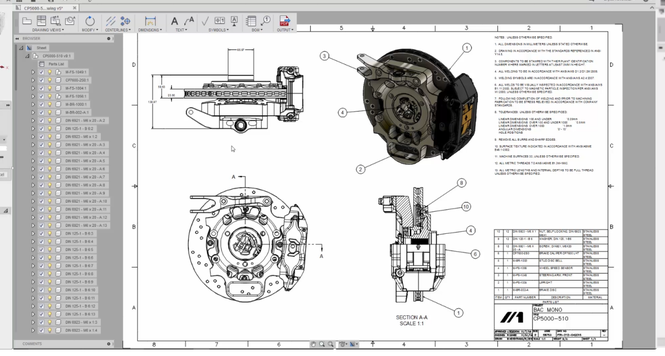
SHIFTEC







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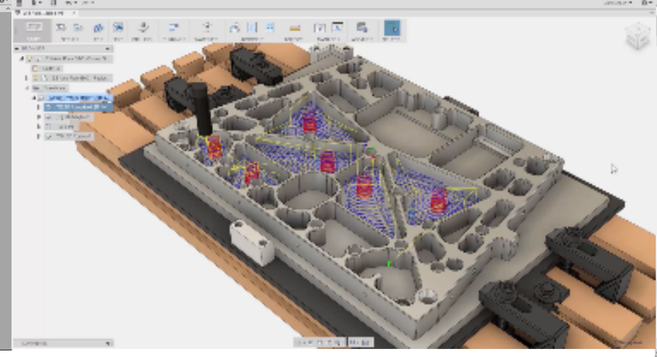
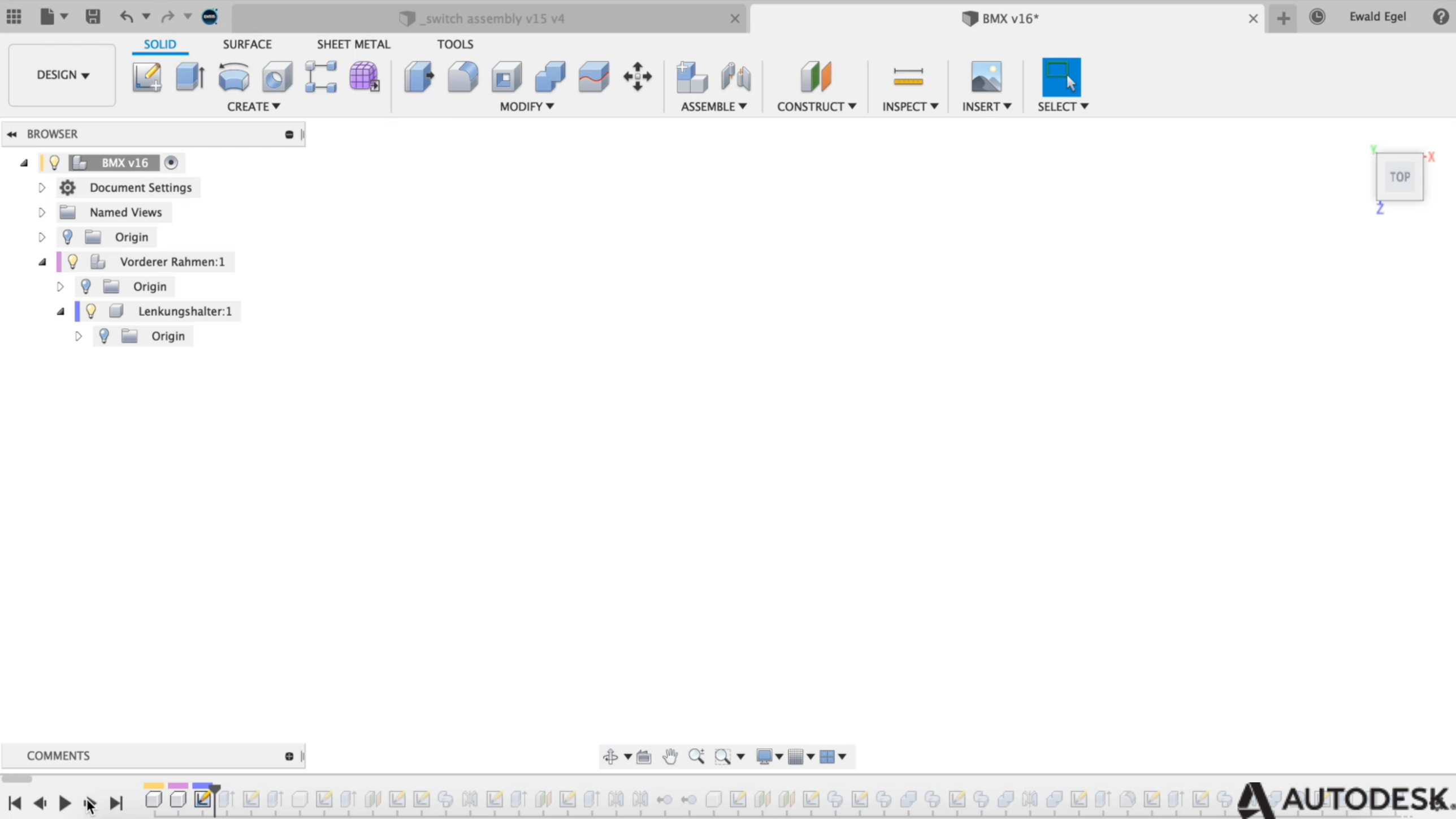
SCALE 1:1
BAC MONO
CP5000-510




BAC
01


_switch assembly v15 v4
BMX v16*
Ewald Egel
DESIGN
SOLID
SURFACE
SHEET METAL
TOOLS
CREATE
MODIFY
ASSEMBLE
CONSTRUCT
INSPECT
INSERT
SELECT
BROWSER
BMX v16
Document Settings
Named Views
Origin
Vorderer Rahmen:1
Origin
Lenkungshalter:1
Origin
TOP
COMMENTS
AUTODESK

BMX v16*

Ewald Egel

FORM

DESIGN

CREATE

MODIFY

SYMMETRY

UTILITIES

CONSTRUCT

INSPECT

INSERT

SELECT

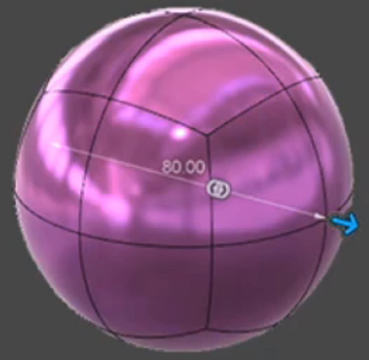
FINISH FORM

BROWSER

- Create Sketch
- Box
- Plane
- Cylinder
- Sphere
- Torus
- Quadball
- Pipe
- Face
- Extrude
- Revolve
- Sweep
- Loft

Creates a T-Spline quadball.

Select a plane then a center point for the sphere. Use the manipulators or input fields to specify the diameter and number of faces.



- Rahmen:1
- Pedalenaufbau:1
- Antrieb:1
- Saddle:1
- Generative-Splines v3:
- Saddle (1):1

COMMENTS

AUTODESK

Autodesk Fusion 360

BMX_Generative v11*

BMX v1

Harv Saund

DESIGN

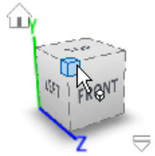
SOLID | SURFACE | SHEET METAL | TOOLS

CREATE | MODIFY | ASSEMBLE | CONSTRUCT | INSPECT | INSERT | SELECT

BROWSER

- BMX v1
  - Document Settings
  - Named Views
  - Origin
  - Joints
  - Sketches
  - Construction
  - Vorderer Rahmen:1
  - Vorderrad:1
  - Hinterrad:1
  - Rahmen:1
  - Pedalenaufbau:1
  - Antrieb:1
  - Saddle:1





AUTODESK


AUTODESK.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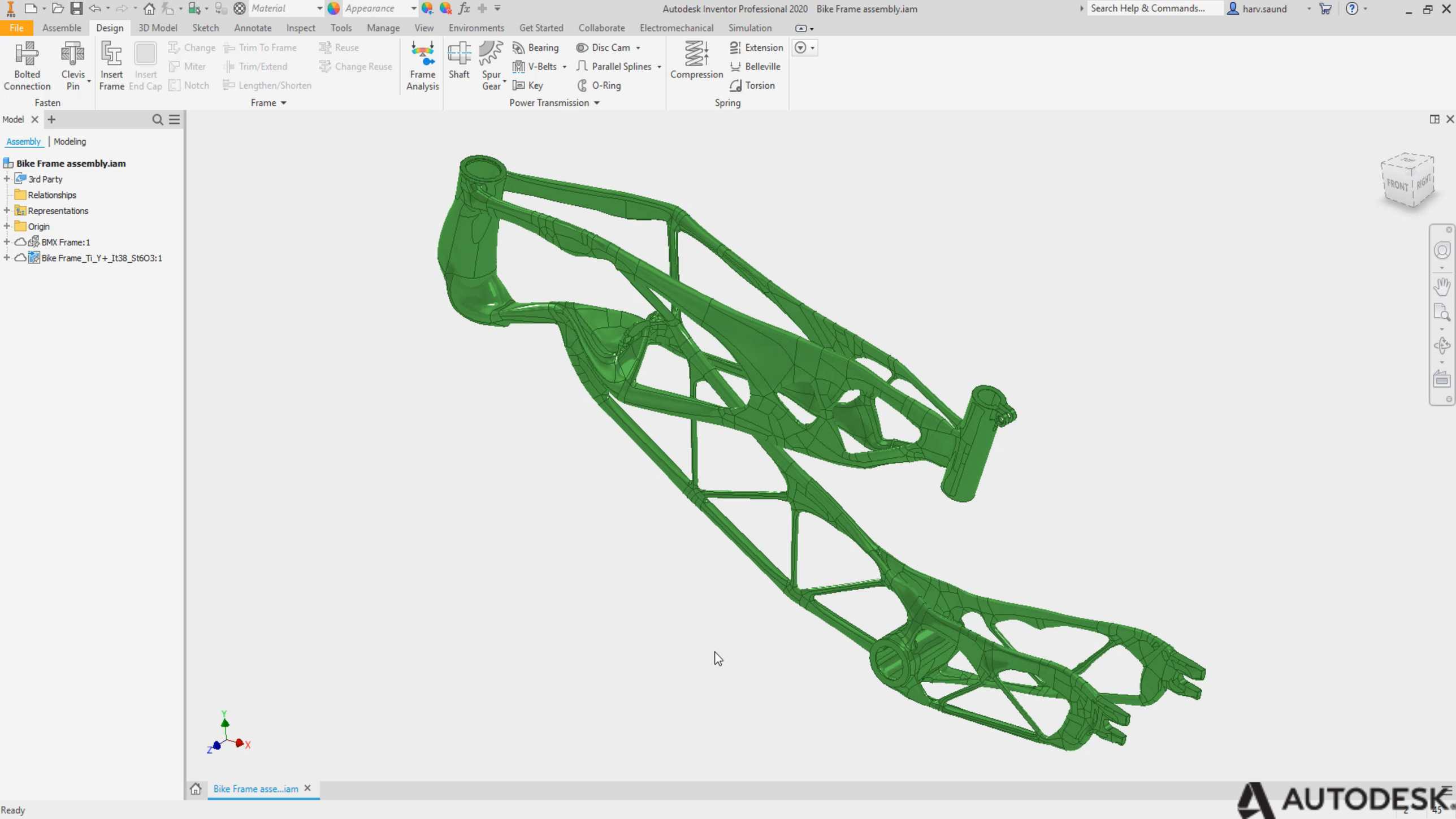
Material
Appearance
Autodesk Inventor Professional 2020
Bike Frame assembly.iam
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harv.saund
File
Assemble
Design
3D Model
Sketch
Annotate
Inspect
Tools
Manage
View
Environments
Get Started
Collaborate
Electromechanical
Simulation
Bolted Connection
Clevis Pin
Insert Frame
Insert End Cap
Change
Miter
Notch
Trim To Frame
Trim/Extend
Lengthen/Shorten
Reuse
Change Reuse
Frame Analysis
Shaft
Spur Gear
Bearing
V-Belts
Key
Disc Cam
Parallel Splines
O-Ring
Compression
Extension
Belleville
Torsion
Fasten
Frame
Power Transmission
Spring
Model
Assembly
Modeling
Bike Frame assembly.iam
3rd Party
Relationships
Representations
Origin
BMX Frame:1
Bike Frame_Ti_Y+_It38_St6O3:1
FRONT
RIGHT
Y
X
Z
Bike Frame asse...iam
Ready
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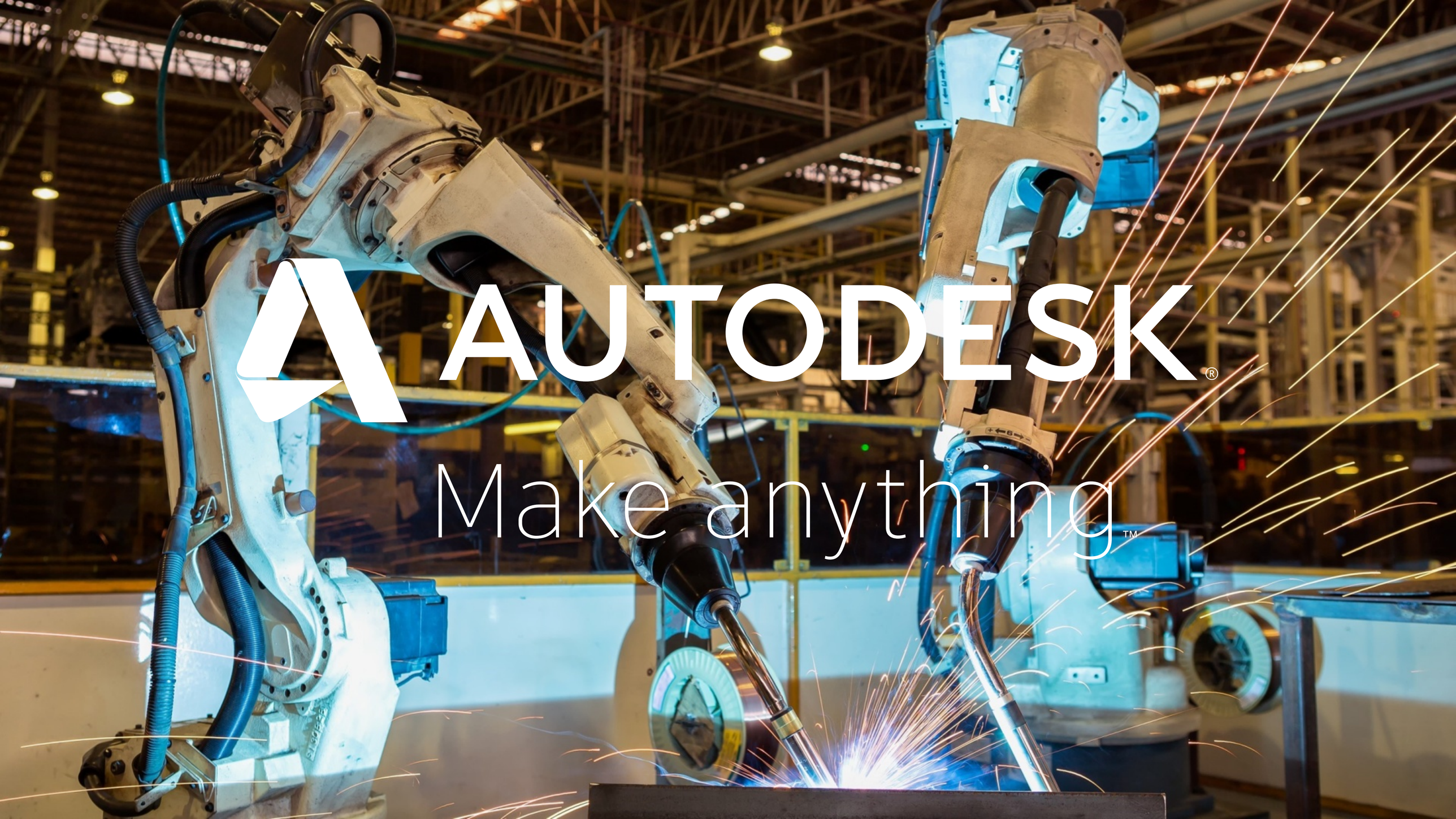
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