WINDSWEPT SADDLE

PROCESS BOOK

Windswept Saddle is a thesis project that was conducted by Dan Winegar during 2021 and 2022.

This process book is a catch-all document that holds a variety of assets that were created during the project.

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NEW FRONTIER SADDLE

WESTERN SADDLERY

The anchor piece of every ranch worker's equipment list is their saddle.

Saddle are a unique piece of equipment in that it essentially is serving as a bridge between two athletes: the rider and the horse.

Western saddles are used by ranchers in the high deserts of the American West.

TRADITIONAL WESTERN SADDLE

Western saddles have been made largely the same way for the past 200+ years. Tradition and heritage dominate the space. Workers still routinely purchase saddles from smaller bespoke craftsman.

The saddles are generally more robust than other saddle types and can be heirloom items that last for decades.

Because of how they are made, saddles can be very expensive, especially given the average ranch worker's earnings. The saddle shown here retails for $2,750.

ENGLISH POLO SADDLE

Most research and light-weighting efforts have gone into riding and polo saddles. While the forms have been stripped down and minimized, traditional leather craft is still the norm.

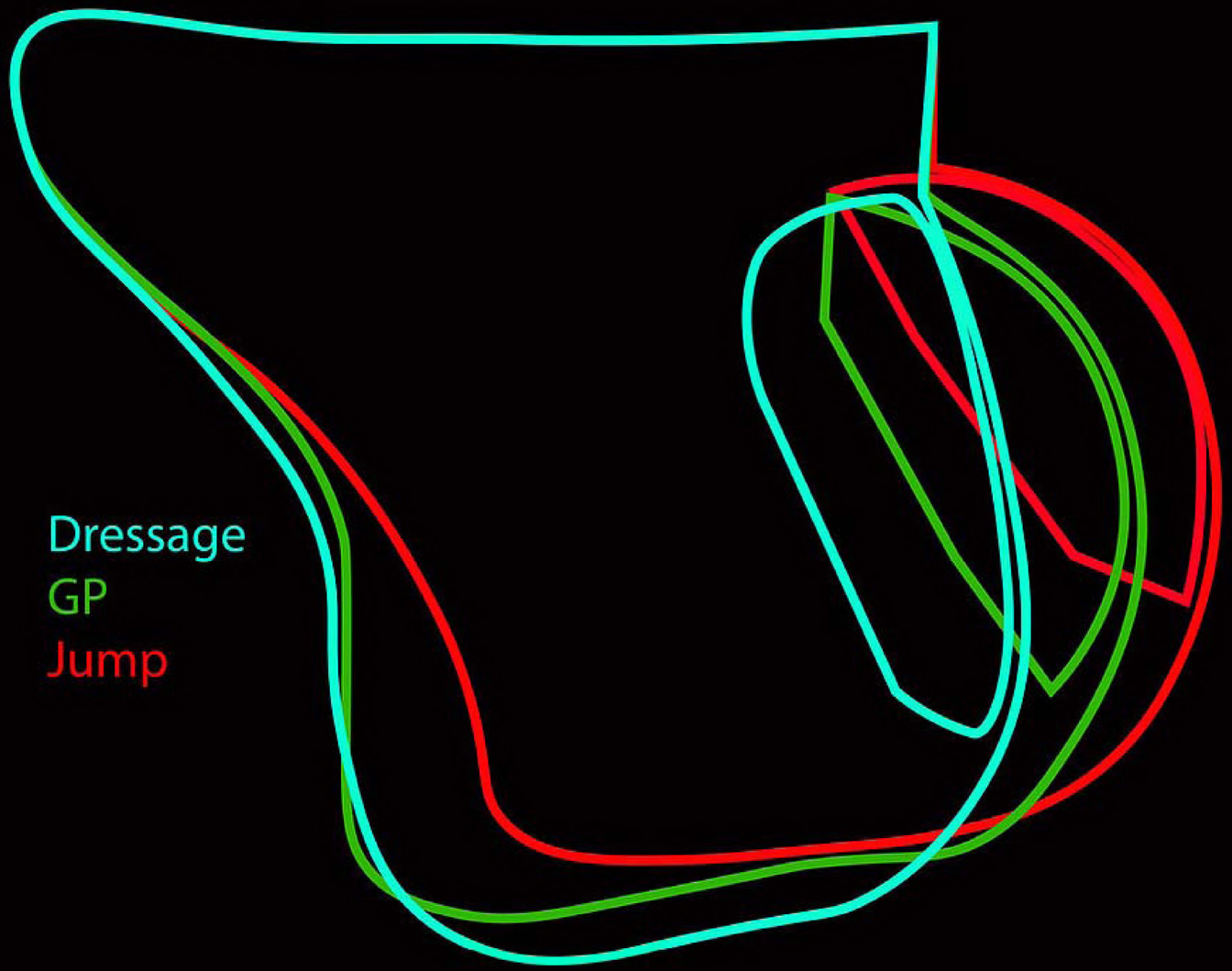
This is a polo saddle made be Hermes. It retails for $7,500.

MODERN RIDING SADDLE

Horse riding is a very traditional space and most products are made the same way that they have always been done.

One company trying to bring more science into the field is an Irish company called Bua Sport. They build a saddle meant to be more ergonomic than the typical riding saddle. The saddle shown here starts at $3,400.

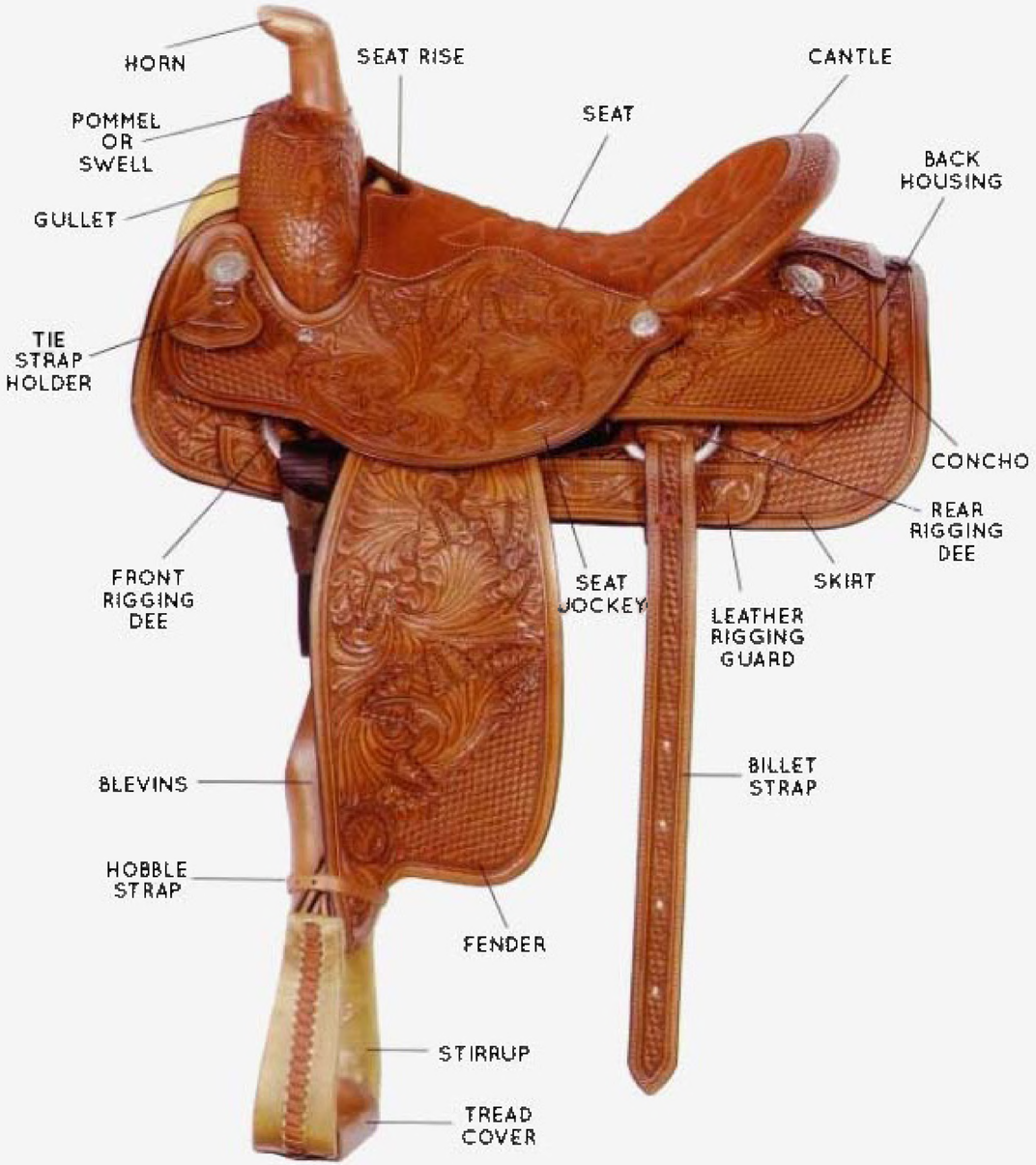
While the do incorporate some new forms and materials, it is still mostly traditional leather work.



SADDLE PROFILES

The shape of each saddle depends on what it will be used for. If the rider is crouched forward, the saddle will have a different profile to accommodate the different weight distribution.

Western saddles are most similar to dressage in that the rider is mostly upright.



ANATOMY OF A WESTERN SADDLE

The main difference between a western saddle and an English saddle is the presence of a larger spell and horn. When a rancher has an animal on the end of their rope, they loop their rope around the horn so the horse can pull back on the rope.

Saddles are often made to order and will have different features saddle to saddle.

Ultralight

Heavy Duty

CLIMBING HARNESS

When thinking of how technology could benefit traditional saddle making, climbing harnesses could be a good analogous product.

They have to accommodate varying bodies and ranges of motion. They also have to be fixed to a bodily location and manage things like friction and external force vectors.

BACKPACKING INTERFACE

Another good product to look at could be backpacking backpacks, as they also have to manage some of the same elements as climbing harnesses.

Backpacks also have to manage loads on the back and accommodate the movement of the wearer's gait.

This pack incorporates a swivel mechanism at the lower lumbar junction to let the hips move more freely.

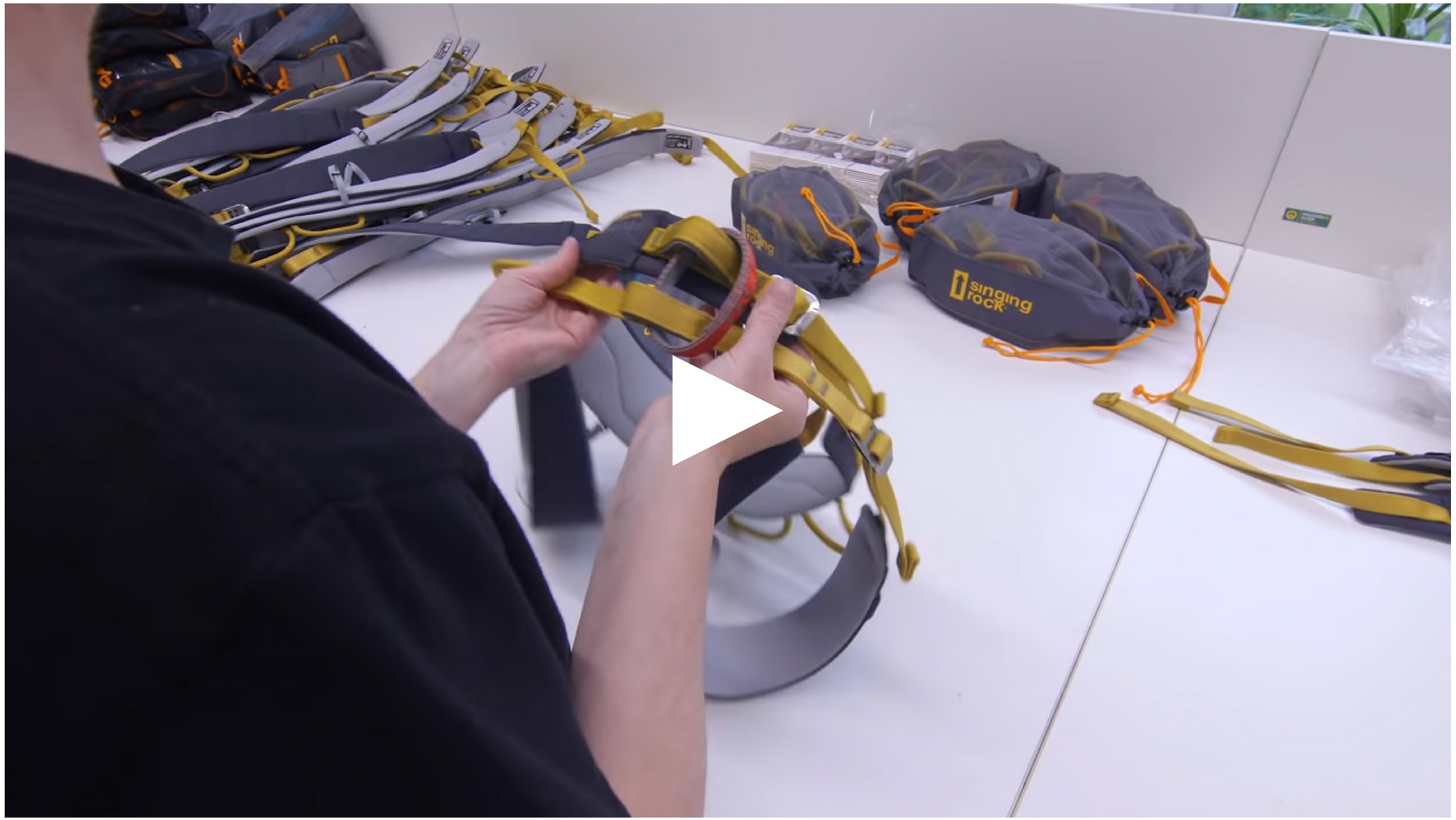
TRADITIONAL MATERIALS & MANUFACTURING

Materials:
- Veg tanned leather
- Heavy gauge nylon thread
- Rivets and dee ring hardware
- Hardwood “bones”
- Sheepskin
- Woven cotton

Methods:
- Hand and die cutting
- Wet leather forming
- Hand and machine stitching
- Burnishing
- Conditioning
- Cut and sew (skirt)

Bruce Cheaney is one of the more well known western saddle makers.

Bruce’s YouTube channel



POTENTIAL MATERIALS & MANUFACTURING

Materials:
- Nylon webbing (Nylon 66)
- High-modulus polyethylene
- Anodized aluminum
- Ballistic nylon 2x2 basket weave
- Aramid fibers (e.g.: Kevlar)

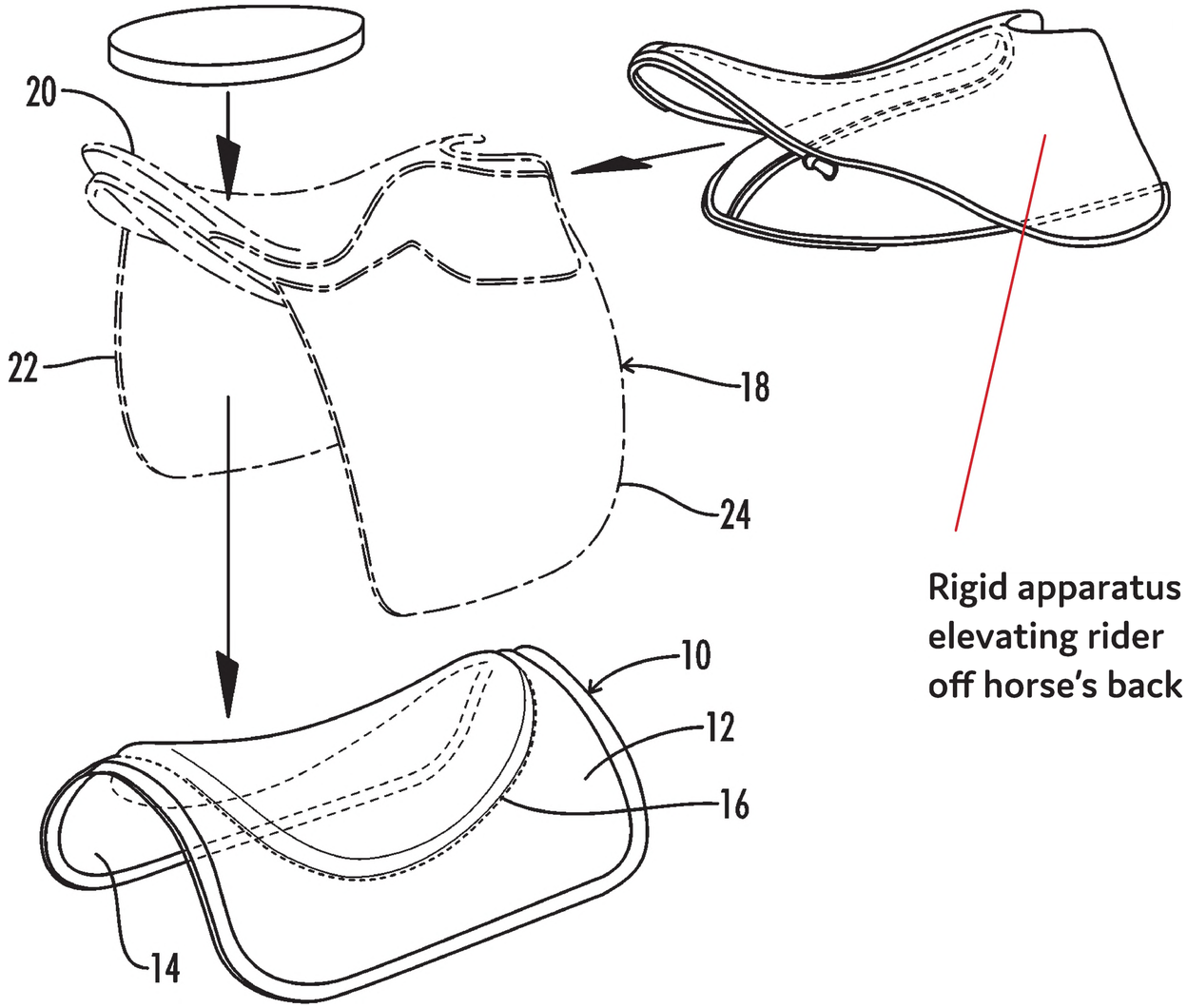
Manufacturing:
- Die cutting
- Cut and sew
- Bar tacking
- Injection molding
- Stamp forging

Below is a link to a great video tour of a harness manufacturing factory.

Climbing Harness factory video

PARAMETRIC DESIGN

This could be a great opportunity to explore light weighting through parametric design as there is a lot of complex forms with different rigidity needs.

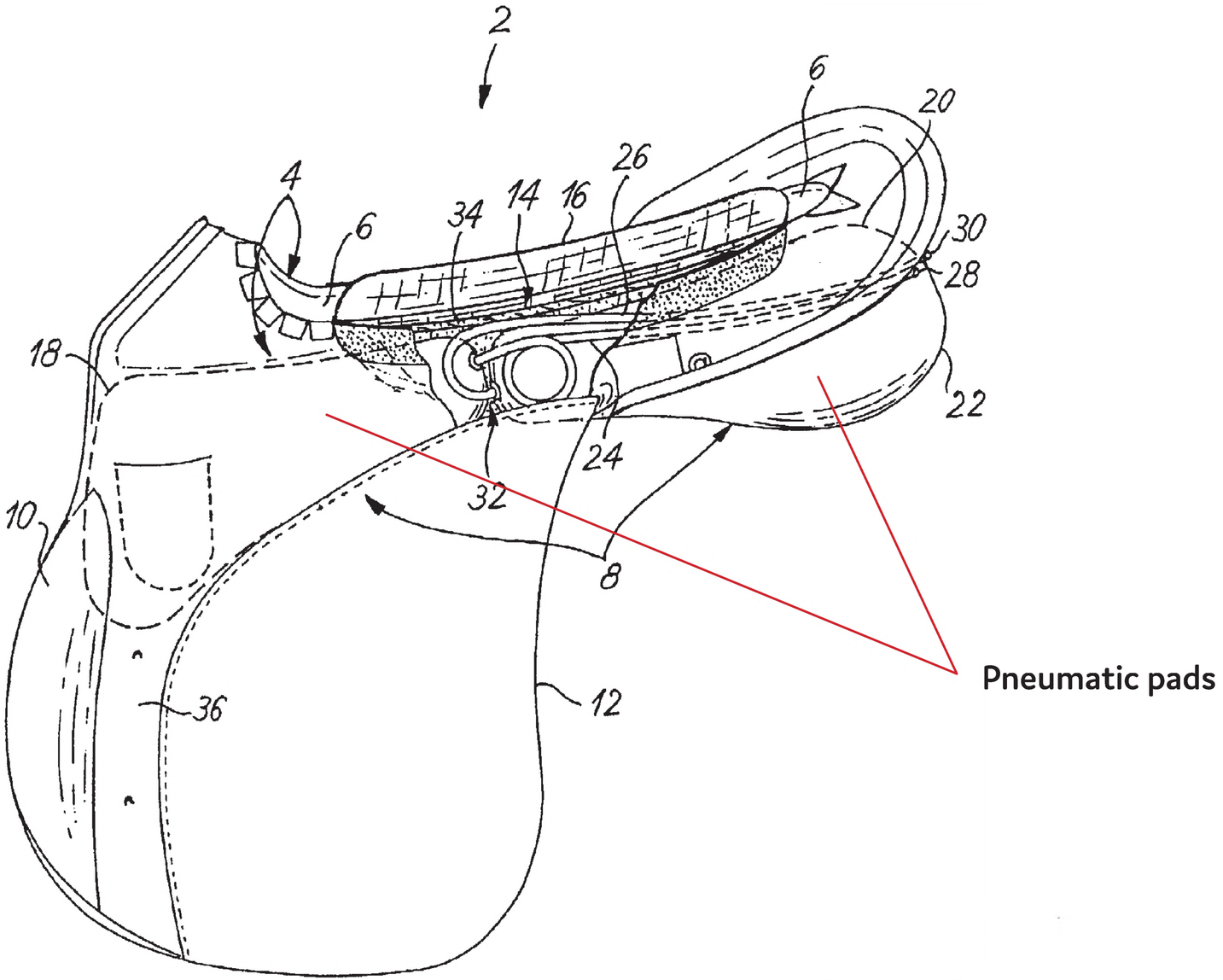


Rigid apparatus elevating rider off horse's back

PATENT US748103SB2

This patent uses a rigid element to lift the rider (or other load) off the back of the horse, primarily for better ventilation.

The apparatus insert into a saddle, fitting into a sleeve. It doesn't seem to be replacing the saddle's tree, but rather a separate piece.



PATENT EP1092675A1

This patent proposes using air bladders to create a more comfortable saddle. The bladders would insert into sleeves in the front and back of the saddle. Tubing would allow the rider to adjust pressure on the fly.

Patent WO2017035645A1 is another one to look at. It is for a tree that molds to fit the horse. Less applicable to western saddles.

PRESTIGE ITALIA X-TECHNOLOGY SADDLE TREE

This line of saddles uses membrane inserts where the rider's sit bones would be. This creates a flexible bed for them to ride on, making the ride more comfortable.

The rest of the tree is molded from one piece.

VOLTAIRE DESIGN BLUE INFINITE SADDLE TREE

This saddle uses a laser-cut composite for the body of the tree. It is molded into shape with metal and wood edging to help it hold form. There are softer rubber tips on the front of the tree, letting the front arms flex when the horse's shoulders widen during a jump.

Voltaire Design also has a versions of this saddle that are microchipped to track the rider and horses movements. A companion app gives recommendations based on the data gathered.

ENGLISH SADDLE TREE

Both of these are English saddle trees. The tree is the backbone of the harness, giving it its shape and applying the weight of the rider to the appropriate portions of the horse's back.

The tree on the left is carved from wood. The one on the right is clad in leather.

English saddles typically are fitted and belong with a specific horse.

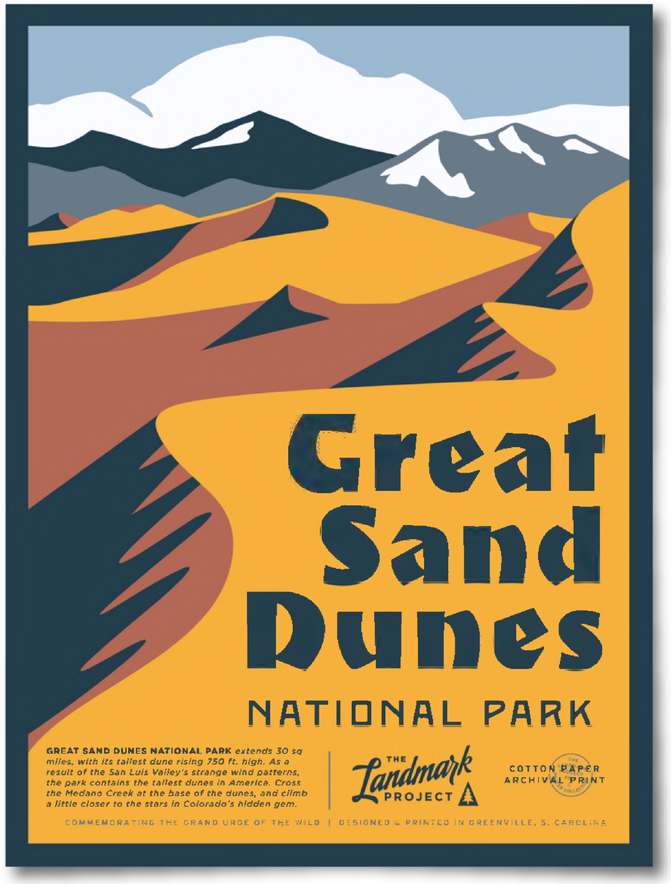
FUTURE INDUSTRY & BRANDING TRENDS

An authentic, human- and nature-connected life isnt a rejection of technology or advancement. For many it is a rebalancing; a pursuit of diverse inputs and a harmony across them.

Increasing mobility and connectivity are lowering the barriers to living more rurally.

Trends:
- “Tech-ceptance”
- Mastering wellbeing
- Intentional community

WGSN:
- Big Ideas 2023
- Ws Active Open Road A/W 22/23
- Design-wise Active S/S 23



FUTURE COLOR & GRAPHIC TRENDS

The shift towards spending time outside will continue in the coming years. These people are seeking meaning and a sense of place from the natural world.

National Parks are seen as the steward of this philosophy, and the Art Deco design language surrounding them will be a key look.

Colors:
- Tranquil blues
- Sundial yellows

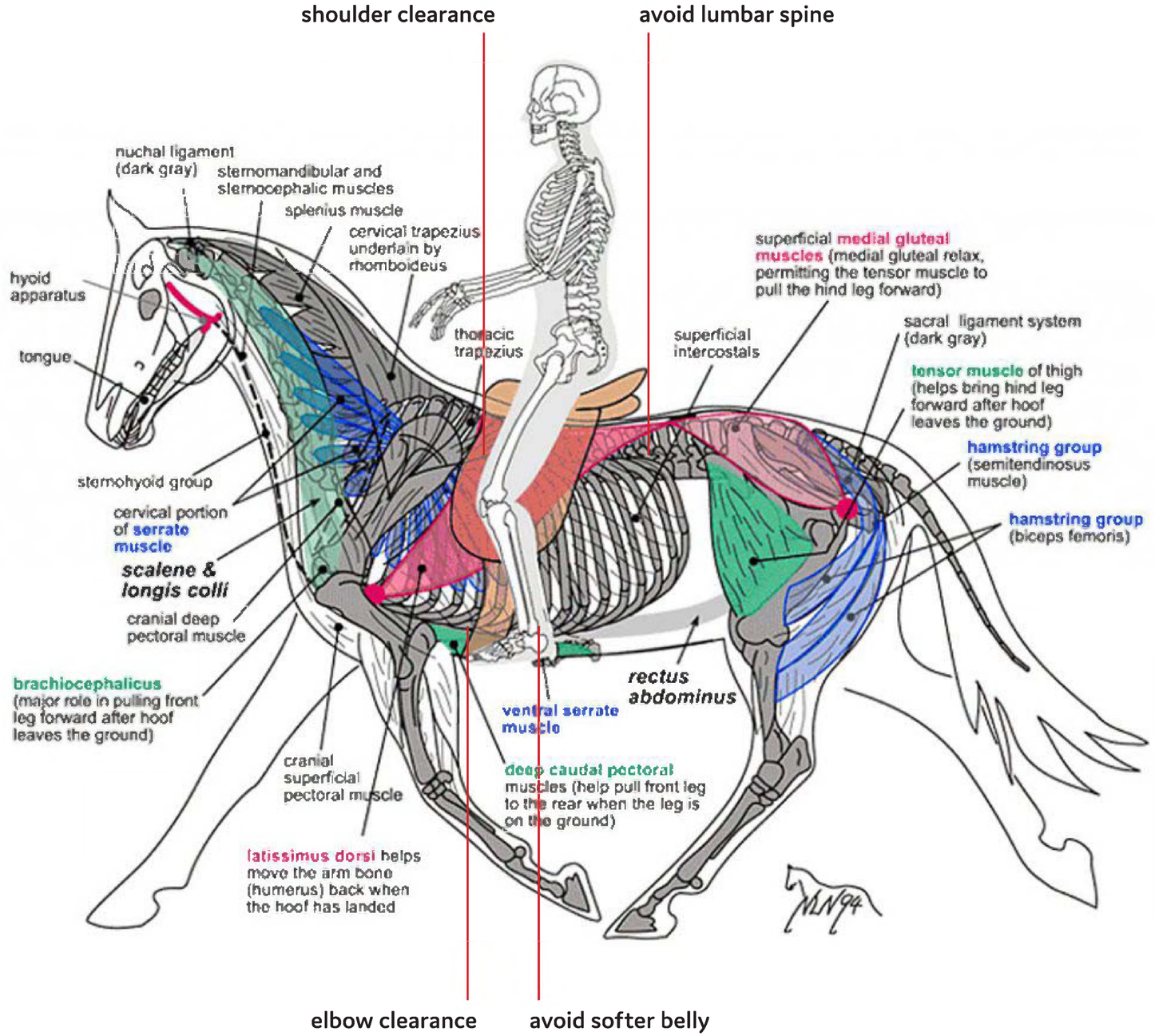
Graphics:
- Honest, active voice

WGSN:
- North America Color S/S 23
- Soul Space Active S/S 23

MORE GRAPHIC & LABELING TRENDS

Another area to look at is Modern Age (1920s-1980s) vintage style guides for National Parks and NASA. The NP manual has an aspirational, future oriented approach that brings the natural world into a modern space. Nowadays, they feel both vintage and futuristic.

Style guides:
- NASA style guide
- National Park style guide



PLACING A SADDLE

Note: Comfort = performance. The horse and rider work together, and better horse comfort means better horse performance, which also means better rider performance.

Saddle placement is critical for comfort and performance.

- Tree form must align with the horse's back.
- The front of the saddle must give enough shoulder clearance.
- The back of the saddle must not extend past the ribs onto the lumbar spine.
- The saddle's cinch must not interfere with the horse's elbow while riding. One hand back is a rule of thumb.
- If a rear cinch is used, it must lie in front of the softer belly area.

RIGGING WESTERN SADDLE CINCHES

A saddle is primarily secured with a cinch across the top of the rib cage behind the elbows. Horses seem to not mind cinches placed here.

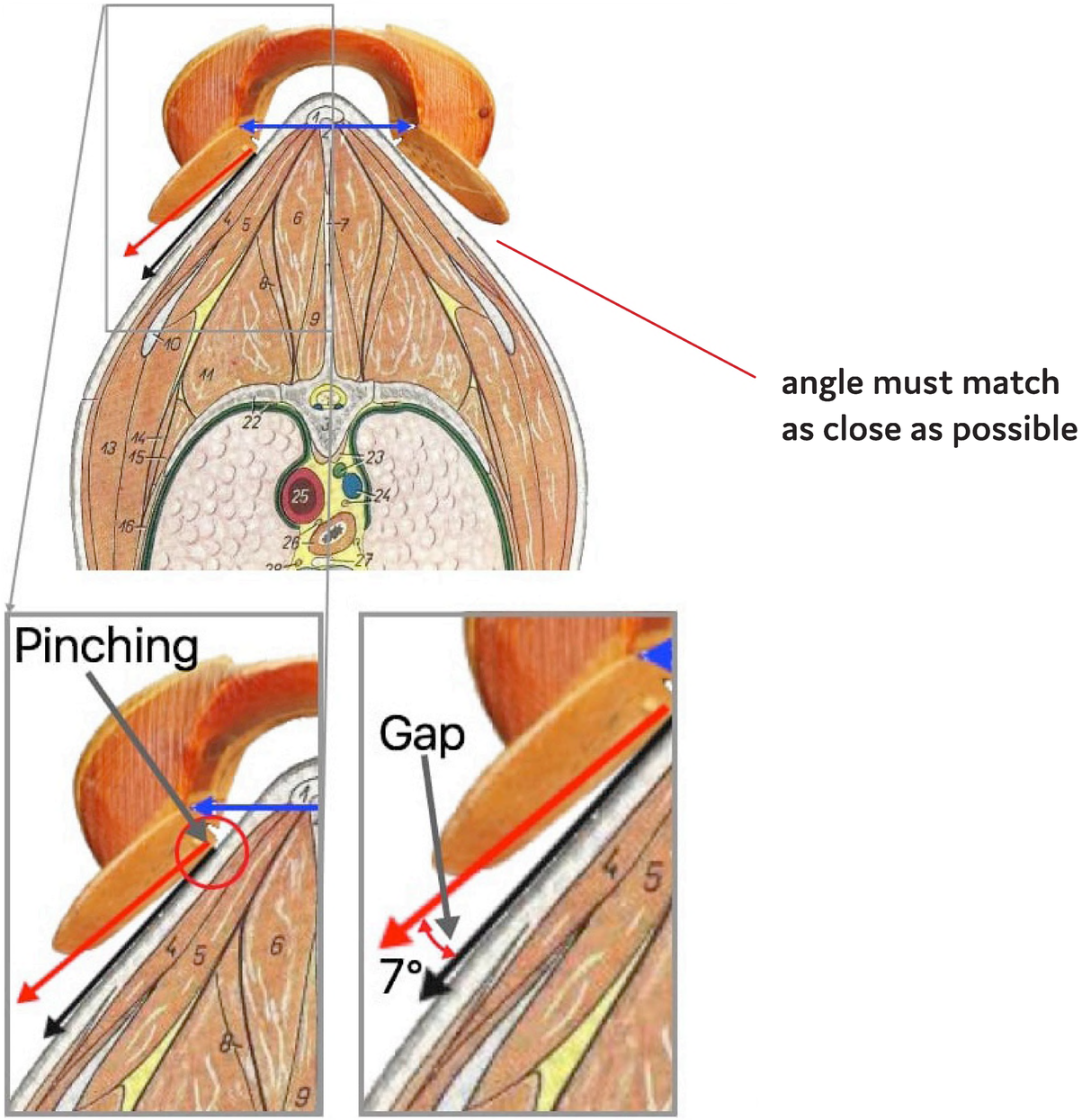
Additional rigging can be used to better secure the saddle if needed. A rear cinch is sometimes used to keep the back of the saddle down when making sudden stops or with loads to the horn.

A breast plate strap can be used if the saddle tends to drift backwards once in use.

CINCH COMFORT

The most critical part of the rigging is the main cinch. The comfort of this main cinch will greatly impact overall performance.

This Stretchtec Shoulder Relief cinch uses a contoured form to deliver more shoulder clearance while maintaining good load distribution.



PROPER TREE ANGLE

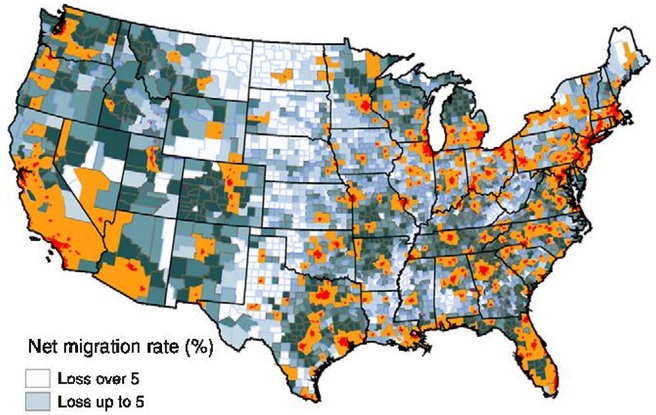
With the cinch, the tree is the other main element of saddle fit. A tree must properly conform to the horses back or it will result in pinching. Any gaps take away from load dispersion, causing hot-spots on the remaining contact points.

A better fit means better performance.

SADDLING A NERVOUS HORSE

Many ranches raise and break their own horses. It's important to have a saddling routine that the horse can learn and grow comfortable with.

Signaling rituals, like lying the saddle in front of the horse before putting it on can help.



Net migration rate (%)

- Loss over 5
- Loss up to 5
- Gain up to 5
- Gain 5 to 10
- Gain 10 to 15
- Gain over 15

Urban

- Urban (metropolitan) county
- Urbanized area

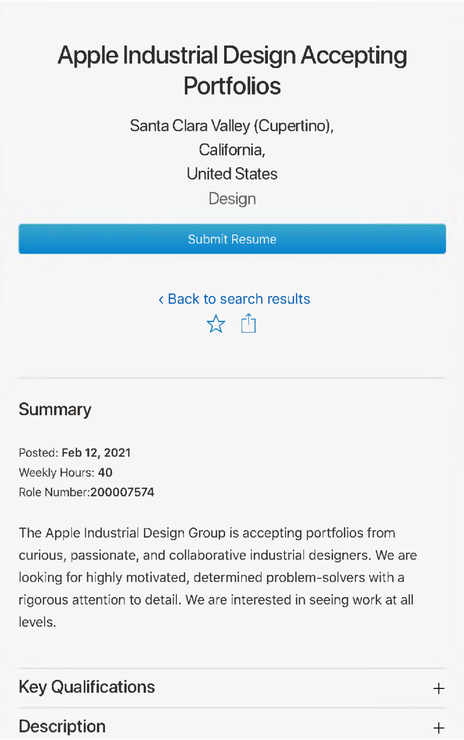

RANCH. CONSERVE. LIVE.


Ranchlands


ultra boost


OSPREY
ATMOS AG 50

?



Apple Industrial Design Accepting Portfolios

Santa Clara Valley (Cupertino), California, United States

Design

Submit Resume

‹ Back to search results

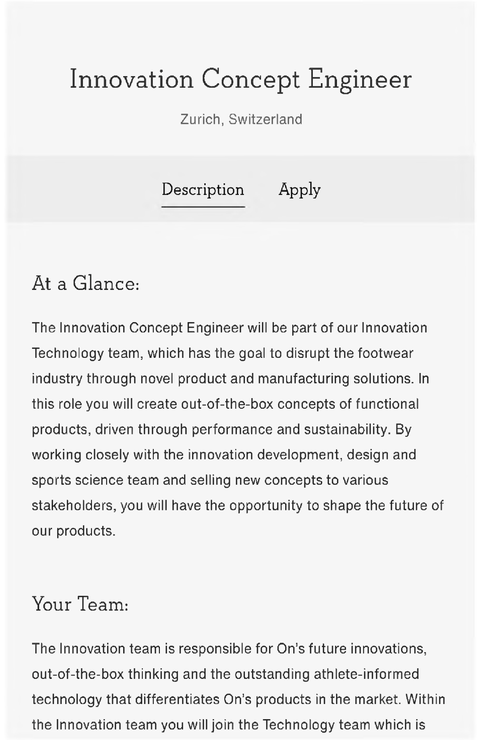
Summary

Posted: **Feb 12, 2021**
Weekly Hours: **40**
Role Number:**200007574**

The Apple Industrial Design Group is accepting portfolios from curious, passionate, and collaborative industrial designers. We are looking for highly motivated, determined problem-solvers with a rigorous attention to detail. We are interested in seeing work at all levels.

Key Qualifications +

Description +



Innovation Concept Engineer

Zurich, Switzerland

Description Apply

At a Glance:

The Innovation Concept Engineer will be part of our Innovation Technology team, which has the goal to disrupt the footwear industry through novel product and manufacturing solutions. In this role you will create out-of-the-box concepts of functional products, driven through performance and sustainability. By working closely with the innovation development, design and sports science team and selling new concepts to various stakeholders, you will have the opportunity to shape the future of our products.

Your Team:

The Innovation team is responsible for On's future innovations, out-of-the-box thinking and the outstanding athlete-informed technology that differentiates On's products in the market. Within the Innovation team you will join the Technology team which is

10.1. Professional Development

I prepped a portfolio to Apple. I've heard it can take a while if your submission gets pursued (6 months+), so I wanted to get it in the pipeline in case it's an option that works out later.

For the innovation concept engineer position at On Running, I applied and said that I would love to work on a team like this, especially if they have an apparel focused group.

10.2. Instagram Post

I posted on Instagram about horse sweating and some of the interesting points unique to horses. I then talked about why those points are relevant to a saddle project.

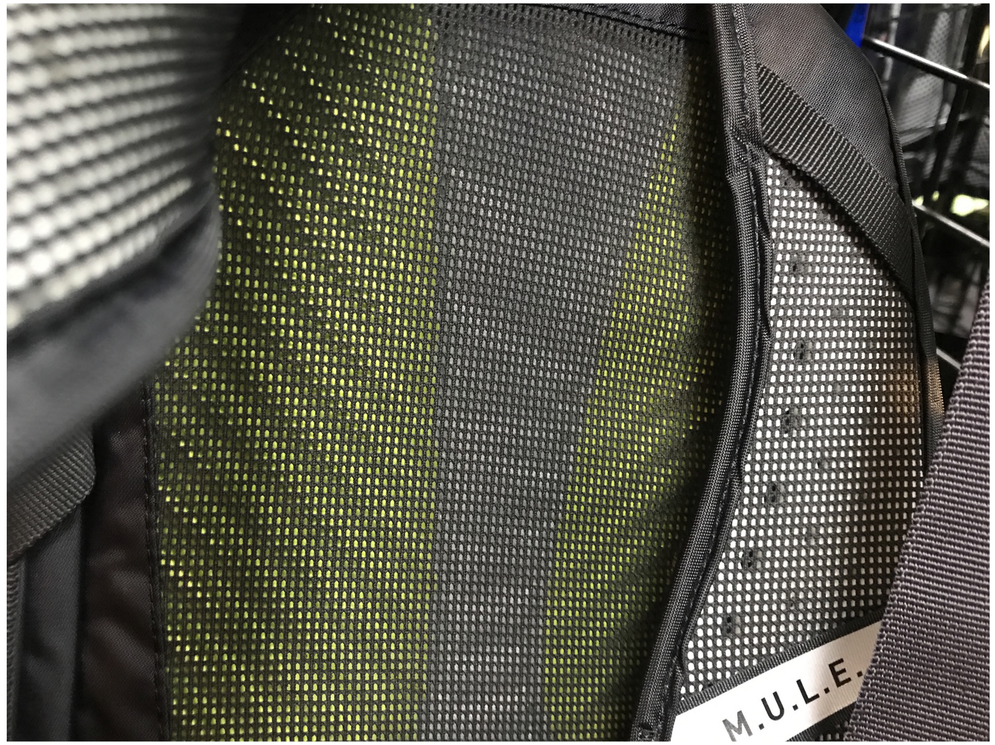
#uosportsproductdesign

10.3. Retail Research

I've been to REI quite a few times recently to scope things out, so I decided to go to Next Adventure for this round. It's a great store and I found some interesting things.

Above is a chair detail that blends robust mesh, a reinforced corner, bar tacking, webbing, and a slide buckle: all things I'll likely incorporate.

This helmet was a great example of how to attempt to keep padding as breathable as possible. The surfaces touching skin are softer, but every other surface is covered with a thin spacer mesh.



This backpack uses several layers of mesh or foam and different techniques of lightweighting. The foam along the back is limited to the anatomical parts of the back it would be touching, with grooves for air flow and flexibility. The shoulder strap foam is cored out to add some air flow and remove unnecessary material.

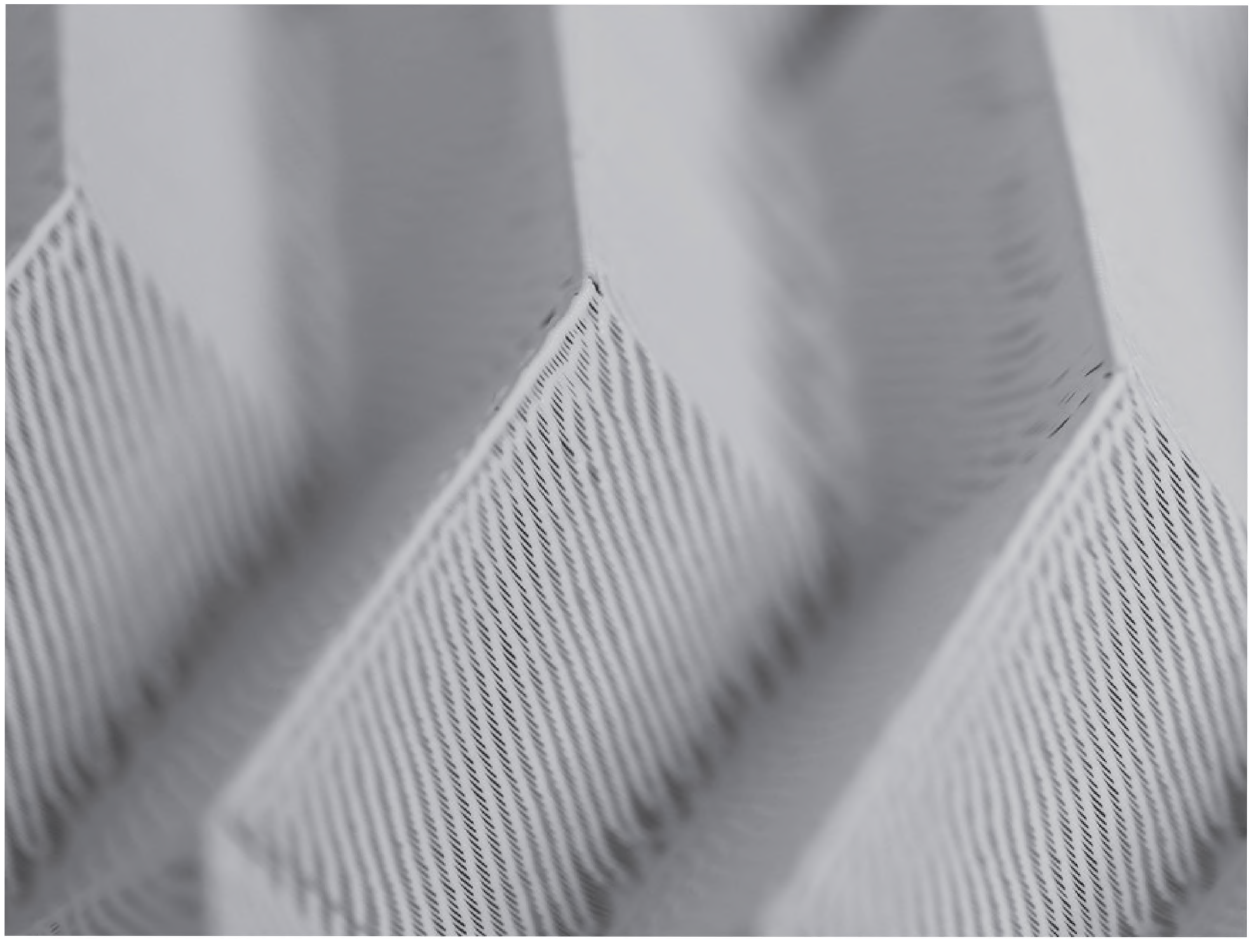
These other images demonstrate different spacer foams that are used on top of foam padding to add air flow and abrasion resistance. The orange buckle is a removable slide buckle system.

These images show several different construction methods. The heat shrink is interesting, and add a techy flare. The overalls show how new and old fabrics can work together. The foam snow shoes were interesting too.


EDELRID

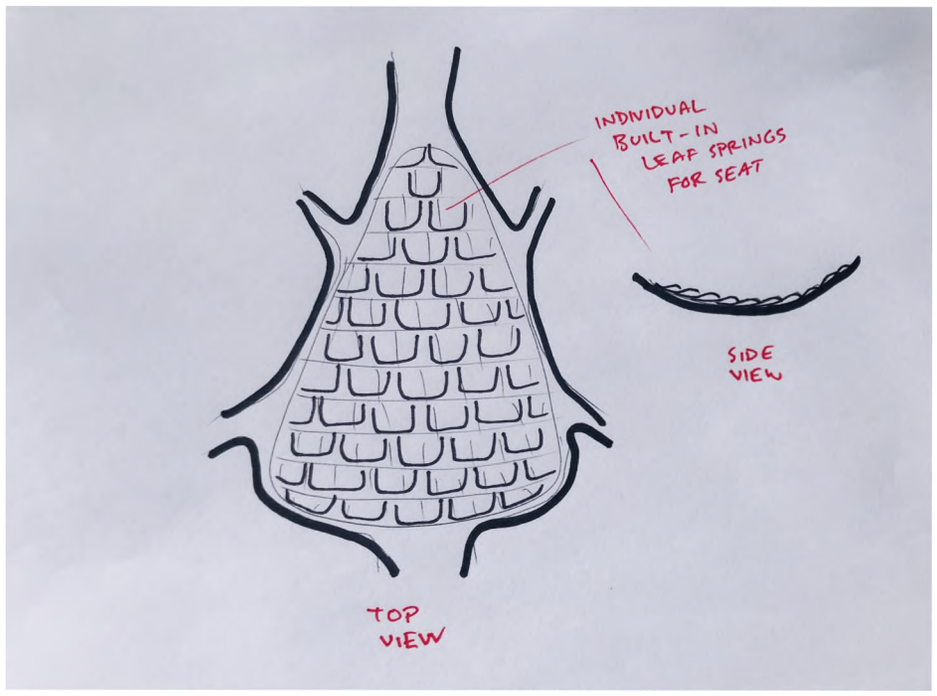
Left: climbing harness packaging.

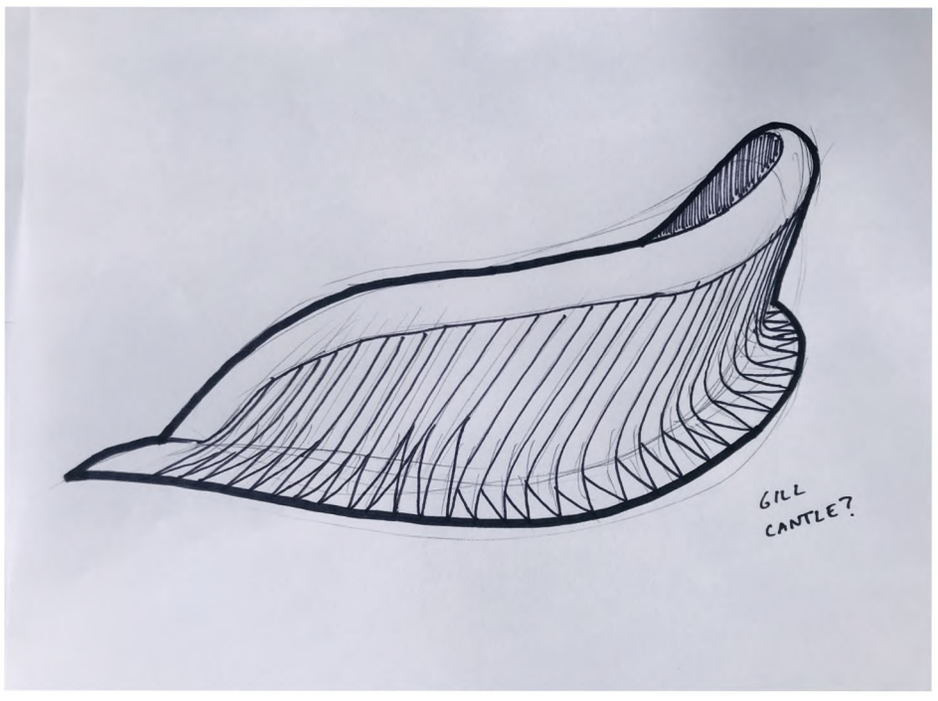
Next Adventure has an amazing collection of old wood and canvas packs. These fit in great into the narrative of how new tech has been awesome in other categories, and could be great for saddles too. I'll see if I can borrow one for a photo shoot when I get to that point.

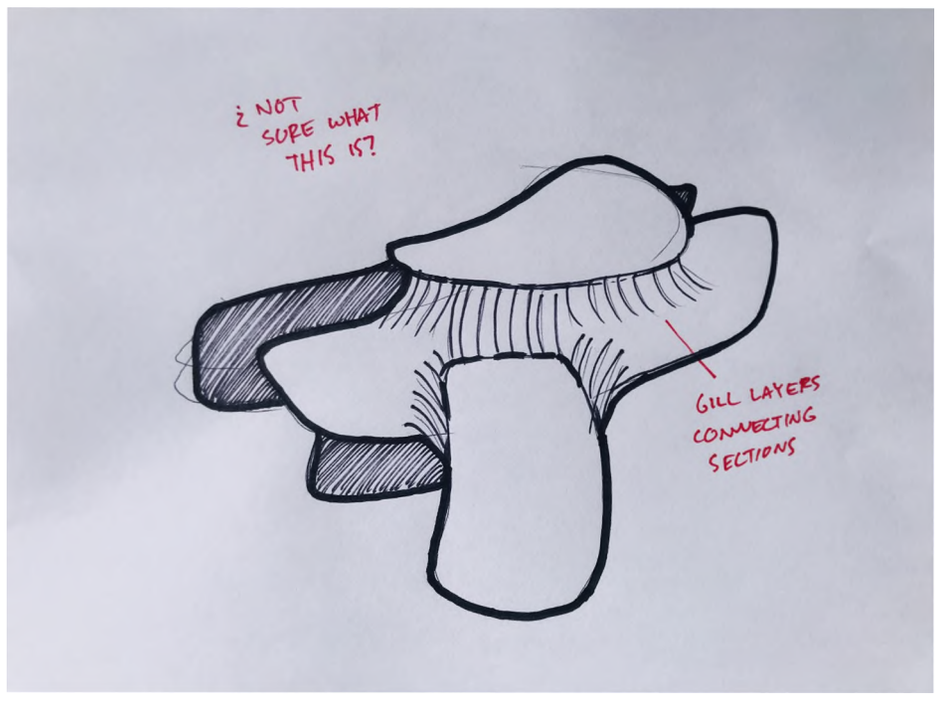


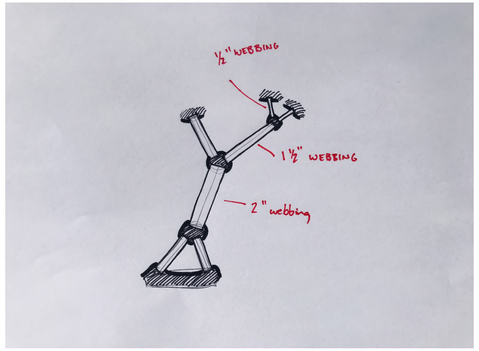
10.4. Biomimicry Exploration

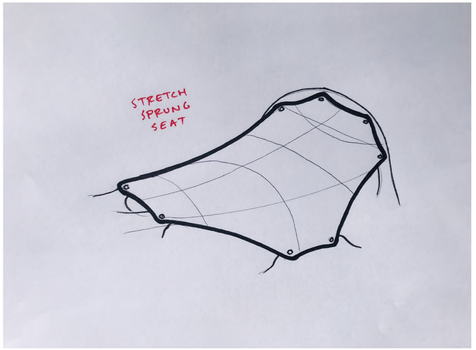
Salmon gills are optimized to allow as much water contact surface area as possible. The also have to do this while impeding water flow as little as possible. A similar form could be 3D printing “flaw” fabrics, which seek to obscure while still removing enough material to be flexible.


INDIVIDUAL
BUILT-IN
LEAF SPRINGS
FOR SEAT
SIDE
VIEW
TOP
VIEW

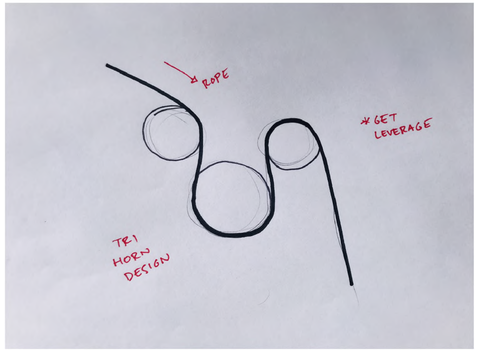

GILL
CANTLE?

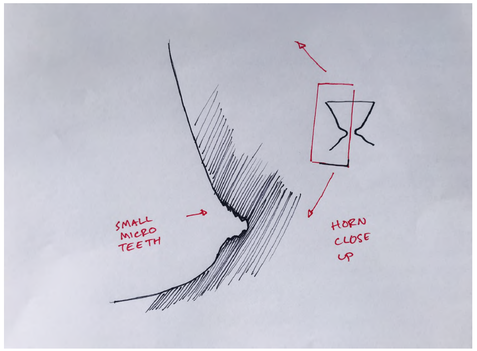

¿NOT
SURE WHAT
THIS IS?
GILL LAYERS
CONNECTING
SECTIONS



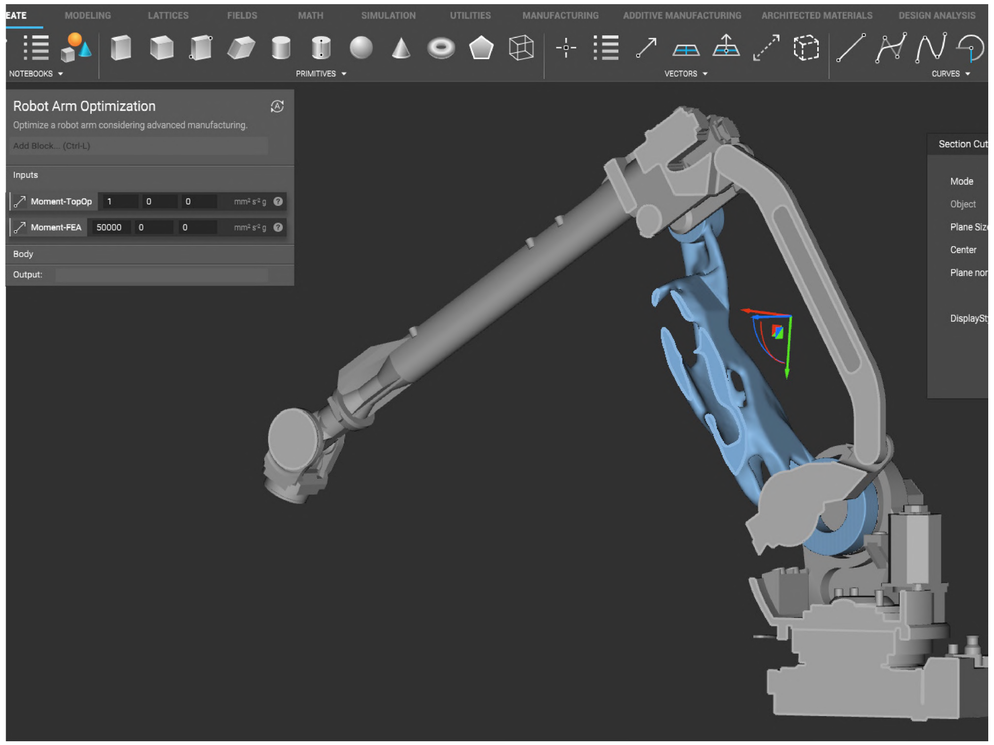


Bumblebee bats are extremely lightweight, weighing as little as a penny. They have excellent strength-to-weight ratios. Their arm starts thicker and thins out with each successive segment. This could be replicated on a saddle by having things thicker next to key strength points, and then thinning out as they get further away. This method is basically what topology optimization programs use to generate forms. They iterate by removing areas under the least strain.





Squirrels have amazing grip. You can see how the squirrel pictured here has its legs stretched out to the max, generating opposing force to further increase the grip pressure on its claws.



10.5. Project Updates

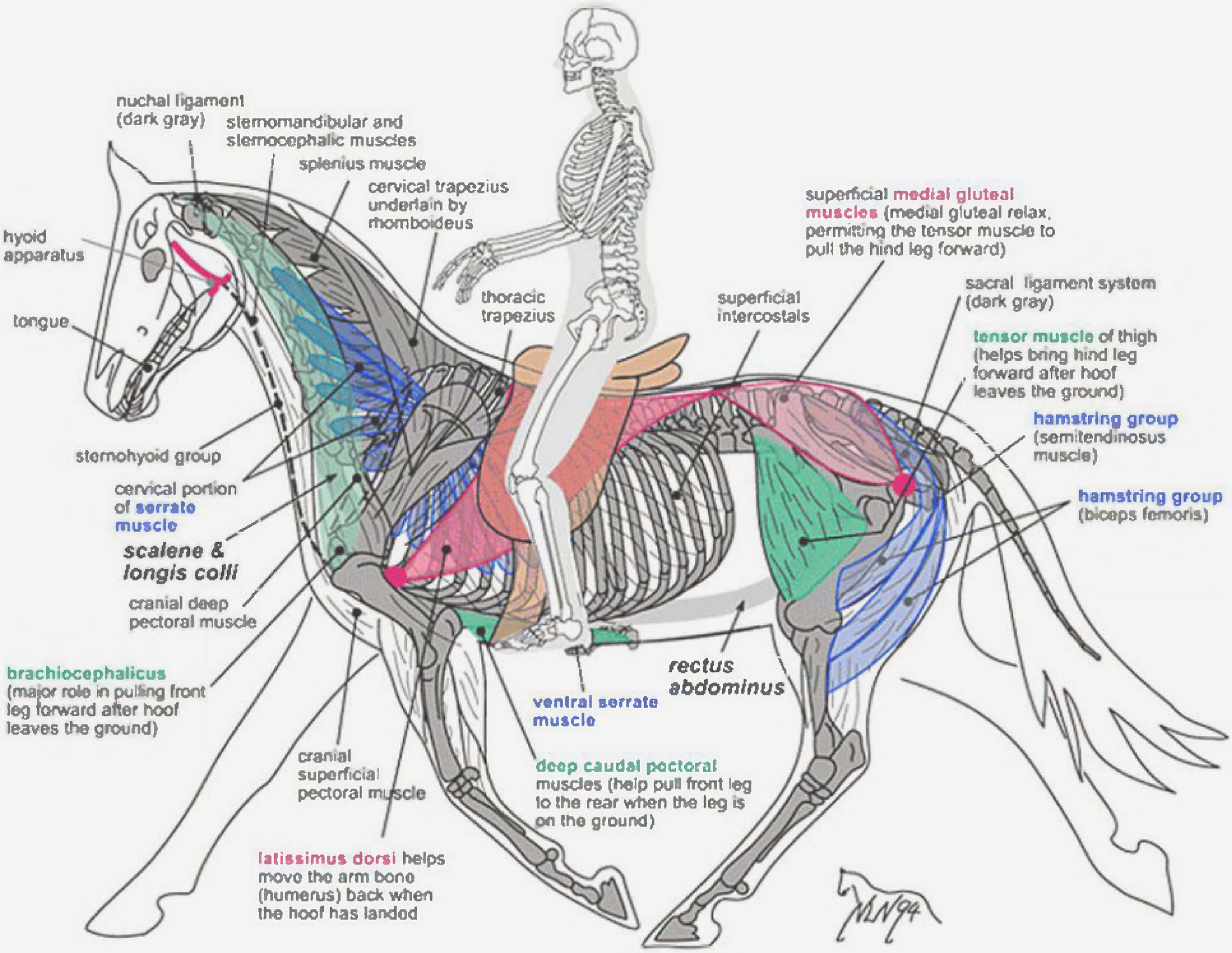
I got loaded up with strap stuff from my mentor. He recommended that I test out the webbing I want in an established buckle to make sure they work first, and then modify that geometry into my piece, while making sure it isn't exactly the same.

I got Ntopology up and running on an external drive setup since it's incompatible with macOS. Seems to run well. I did a little demo on it and it seems to go a little smoother than Fusion 360. Barring any super-big problems, I'm hoping to get a pipeline of 3D prints going to James this week that I'll then epoxy together.

Athletes

- Ranch hands
- M/F, 25-40
- Novice to semi-experienced


HORN
SEAT RISE
CANTLE
POMMEL OR SWELL
SEAT
BACK HOUSING
GULLET
TIE STRAP HOLDER
CONCHO
REAR RIGGING DEE
FRONT RIGGING DEE
SEAT JOCKEY
SKIRT
LEATHER RIGGING GUARD
BLEVINS
BILLET STRAP
HOBBLE STRAP
FENDER
STIRRUP
TREAD COVER


nuchal ligament (dark gray)
sternomandibular and sternocephalic muscles
splenius muscle
cervical trapezius underlain by rhomboideus
hyoid apparatus
tongue
thoracic trapezius
superficial intercostals
superficial medial gluteal muscles (medial gluteal relax, permitting the tensor muscle to pull the hind leg forward)
sacral ligament system (dark gray)
tensor muscle of thigh (helps bring hind leg forward after hoof leaves the ground)
hamstring group (semitendinosus muscle)
hamstring group (biceps femoris)
sternohyoid group
cervical portion of serrate muscle
scalene & longis colli
cranial deep pectoral muscle
brachiocephalicus (major role in pulling front leg forward after hoof leaves the ground)
rectus abdominus
ventral serrate muscle
cranial superficial pectoral muscle
deep caudal pectoral muscles (help pull front leg to the rear when the leg is on the ground)
latissimus dorsi helps move the arm bone (humerus) back when the hoof has landed

English riding saddle tree

Western saddle tree

40.1 pounds

Surface vessels dilate

2x sweat rate / inch^2

Can loose 4 gallons / hr

Higher electrolytes in sweat
make it harder to detect thirst

2% drop in body water leads
to 10% drop in performance

Sweat = saddle sores

Horses can’t work until they heal

EXPERT INTERVIEWS

General Saddle Prompts

1. What are the most common saddle fitting mistakes?
2. What tends wear out most on saddles?
3. What are the general problem areas for saddle sores? What causes saddle sores?

Specific Saddle Prompts

4. What do you like most about your saddle?
5. What frustrates you most about your saddle?
6. How would your horse answer those questions?
7. When was a time that your saddle broke or wore out?
8. What would you change on your saddle?
9. What is your dream saddle & accessories setup?

RANCH INTERVIEWS

Ranch Chores

1. What are your most common chores?
2. What chores are still best done while riding a horse?
3. What are the most taxing chores for you or your horse?
4. Has the heat ever impacted your or your horse's ability to get chores done? When?

Saddle Prompts

5. What do you like most about your saddle?
6. What frustrates you most about your saddle?
7. How would your horse answer those questions?
8. Do your or your horse get saddle sores? Where, when, and why?
9. When was a time that your saddle broke or wore out?
10. What would you change on your saddle?
11. What is your dream saddle & accessories setup?

SYNTHESIS

Conversational Interviews

1. Use questions as prompts
2. “Tell me that story”
3. Take notes & record audio

Synthesis of Responses and Reserach

4. Post-it note data points
5. Identify themes and insights
6. Evolve “how can we” if needed

Survey Questionairre

7. Gather background information
8. Gather physiological information
9. Create questions to gauge the validity of the determined insights. Example: During the summer, how often do you have to delay or decrease the work load on a horse due to hot weather? 1 (never), 2 (rarely), 3 (often), 4 (all the time)

SURVEY

Background

1. How long have you been riding?
2. How long have you worked on a ranch?
3. Did you grow up rurally on a ranch or farm?
4. How long have you had your saddle?
5. How much did your saddle cost?

Details (optional)

6. How tall are you?
7. How much do you weight?
8. What breed is your horse(s)?
9. How tall is your horse(s)?

Scale from 1 to 4

10. One question for each theme identified during synthesis

Open Ended

11. What has broken or worn out on your saddle?
12. What do you like to do in your free time?

TRADITIONAL SADDLE	strengths	weaknesses	obstacles	threats
tree, horn, cantle	solid, robust	heavy	expensive, static	more adjustable options
seat	wide, smooth	not adjustable	fit issues	more adjustable options
housing, fender	prevents chafing	edges can themselves cause chafing	leg lengths	lighter, more targeted
cinch, rigging	robust	not shaped well	hard to contour	better fitting optinos
human fit	evolved design	need proper clothing	hard to adjust	anatomical based
horse fit	evolved design	really hard to get to fit right	elbow and shoulders get in the way	anatomical based adjustability
repairability	any leathershop can fix	needs leather knowledge	high bar of expertise	cost of leather and parts
producibility	uses traditional methods	expensive and not industrialized	bespoke nature	radically cheaper options
durability	very durable	leather can wear out	middle strength to weight ratio	high tech fabrics
breathability	gullet provides some air	poor	leather isn't breathable	breathable fabrics and structures

SWOT: TRADITIONAL LEATHER SADDLE

BUA SPORT SADDLE	strengths	weaknesses	obstacles	threats
tree, horn, cantle	flexible	too much give	NO HORN	may not be able to bolster
seat	more comfortable	only for one position	look too different	easily replicable
housing, fender	smooth surface	not breathable	smooth and breathable is currently a trade off	may not be able to combine attributes
cinch, rigging	lightweight, minimal	nothing for extra cinches	limited adjustability	can break
human fit	good padding	focused on only one riding position	foam degradation	people different sizes
horse fit	good padding	only one horse	foam degradation	horses different sizes
repairability	leather is repairable	custom hardware is hard to replace	high level of craft makes it harder	proprietary tech
producibility	no new methods	lots of custom parts	low obstacles	getting enough orders
durability	leather coverage	spacer mesh, foam	foam may not hold up	looks different
breathability	spacer mesh padding	still full leather	breathability can = friction	horse sweat less, human more

SWOT:
BUA SPORT SADDLE

VOLTAIRE DESIGN SADDLE	strengths	weaknesses	obstacles	threats
tree, horn, cantle	strong, lightweight	still uses wood and metal rim	NO HORN	more flexible option
seat	springy	bottom out	long term durability	other new material
housing, fender	--	--	--	--
cinch, rigging	--	--	--	--
human fit	can integrate some human needs	has to form to either horse or human	horse first fit	a dual-planar solution
horse fit	anatomically formed to back	rigid ring still not very adjustable	tree angle pinching	adjustable angle tree
repairability	composite can be repaired	difficult to repair	toxic to work on	easy cut and sew options
producibility	easy to make	not sustainable	composite layering issues	integrated edge finishing
durability	perhaps	center is less durable than western trees	asymmetric forces	heat
breathability	is air permeable	stiff edges trap air	less surface area = more pressure	--

SWOT: VOLTAIRE DESIGN BLUE INFINITY SADDLE

PRESTIGE ITALIA SADDLE	strengths	weaknesses	obstacles	threats
tree, horn, cantle	large, strong cantle	not as stiff	NO HORN	could break
seat	springy sit bone cushions	not good for odd angled work	membrane could break down	other springy options
housing, fender	--	--	--	--
cinch, rigging	--	--	--	--
human fit	stellar sit bone comfort	can bottom out	not being the right shape for everyone	can be replicated with living hinge frames
horse fit	good for horse	not membrane accomodation for horse	single piece is less customizable	shoulders could gouge
repairability	--	not repairable	likely cheaper to replace	mass producible design
producibility	mass producible	material warpage in cold	have to have larger injection molding outfit	multiple sizes needed
durability	strong, one piece	membranes are the weak point	lightweighting effots	sun degridation
breathability	--	one piece is not breathable	feasibility of integrating venting	lack of ventilation on a on piece design

SWOT: PRESTIGE ITALIA X-TECHNOLOGY SADDLE

CLIMBING AND BACKPACK HARNESSES	strengths	weaknesses	obstacles	threats
tree, horn, cantle	--	--	--	--
seat	flexible, adjustable	not rigid	integrating rigid parts	too much friction
housing, fender	legs loops stay in place			
cinch, rigging	awesome cinch ability	hardware not big enough	problems making custom hardware	slipping or difficulty of double backing
human fit	very adjustable	circulation issues	look funny wearing it	different fit parts than harness in a saddle
horse fit	scalable	might not be rigid enouh	could be uncomfortable	horse doesn't like it
repairability	not great	should be done by professional	strength ratings	liability after repair
producibility	great precedent	needs mass production	patterns could get big with a horse involved	advanced tree could be tought to reproduce
durability	aramid is very durable	small fraying over time	when to buy a new one	abraision
breathability	great breathability	not as much under the straps	integrating spacer mesh	where to fix models to

SWOT: CLIMBING HARNESSES & BACKPACKING BACKPACKS

PROPOSED SADDLE	strengths	weaknesses	obstacles	threats
tree, horn, cantle	data driven lightweight and strong	material availability	printing errors	not strong enough to use
seat	lightweight, targeted cushioning	less adaptable if targeted	getting foam in the right place for everyone	prototyping difficulties
housing, fender	can be very minimal	less chafing protection	how to engineer belts	too fragile looking
cinch, rigging	excellent webbing based straps	custom hardware	getting the contouring down well	slippage during heavy use
human fit	super customizable	lighterweight = less customizable	making a harness that is good for everyone	poorly adapted bodies to something new
horse fit	super customizable	more straps = more friction	access to horse for fitting	catch hair
repairability	not super good	degredation of force rating	probably needs a pro to fix it	mass prodcution = new one is cheaper
producibility	mass producible now	pattern sizes	3d printing hardware	errors in printing
durability	generative design can help keep durable	surfaces less smooth	interaction with clothing	prototype could give final material a bad rap
breathability	lattice structures	still need surface contact patch	not increasing weight and workload	integrated leather parts?

SWOT: PROPOSED SADDLE

	TEST	METHOD	ANALYSIS	VISUALIZATION
BREATHABILITY	CFM Vapor Test (with Doug)	Place saddle between a dummy horse and rider. Seal the surroundings and perform a CMF test to see how much air passes through.	Compare the readouts from a CMF sensor behind the saddle/ barrier.	Add vapor to the air to more readily visualize what is happening. Compare numerical results in standard charts.
HOTSPOTS	Map of Hotspots	Have a rider use each saddle on a standard route. Map hotspots of each that logs location and severity.	Compute total area of each severity category of chafing or hotspot.	Juxtapose hotspot maps next to each other. Compare total area in standard charts.
HORN IMPACT	Lateral Impact on Horn	Create replicas of both a wooden tree horn and the new devised horn. Mount at 90deg and drop increasing weight until failure.	Record when each saddle horn fails	Record slow-motion video to accompany results.
TREE RIGIDITY	Measure Bend of Tree	Suspend tree from one side and add weight to the other side. Measure the degree of flex.	Compare how much each saddle bends.	Take images/video and overlay lines to show how much each one flexes.
WEIGHT	Total Weight of Saddle	Weigh each saddle	Compare weight of each saddle	Compare weight directly
COMFORT RATING	User rated comfort	Have a rider use each saddle on a standard route. Have the rider rate the comfort of each saddle post-ride.	Collect ratings for both saddles on a scale of 1-5	Compare results side-by-side.

PERFORMANCE METRICS

In addition to more subjective feedback and quotes from users, qualitative tests will be done to compare a new prototype saddle to a benchmark product.

Due to testing taking place over winter, sweat-loss testing likely won't be able to be used.

FUNCTIONAL FABRIC FAIR

La-Fonte Pads was the hightlight of the fair with its anatomical approach to cycling chamois.

Different layers and densities of foam are die cut and typically thermo-molded or sewn together. Making a sewn sample should be doable.

Other notes:

- Definitely want to make custom hardware.
- Durable/breathable can be tricky. Some good spacer mesh options.


Wilson Ranch

Problems to address:

1. **Saddle horn needs to have excellent rope grip**
2. **Saddles are heavy to carry for horses and riders**
3. **Horses and riders struggle to keep cool**
4. **Friction from sweat under pads leads to saddle sores**

Metrics for success

1. **Horn has equal grip to existing horns without needing wraps**
2. **Saddle weighs half of current saddles**
3. **Airflow is directed through the saddle with better overall breathability**
4. **Padding system allows next-to-skin breathability**

auto-locking buckle

Topology optimized structure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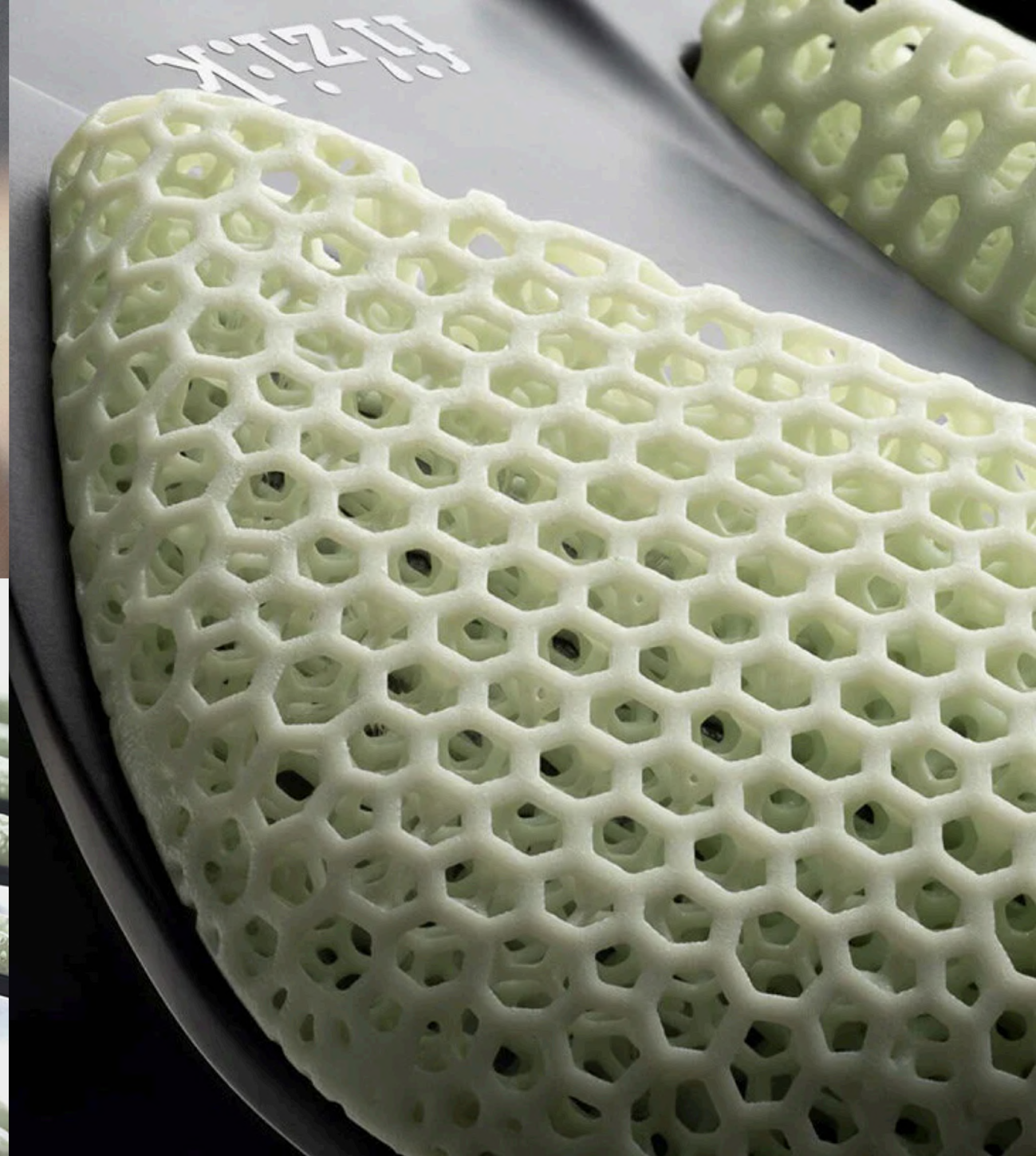
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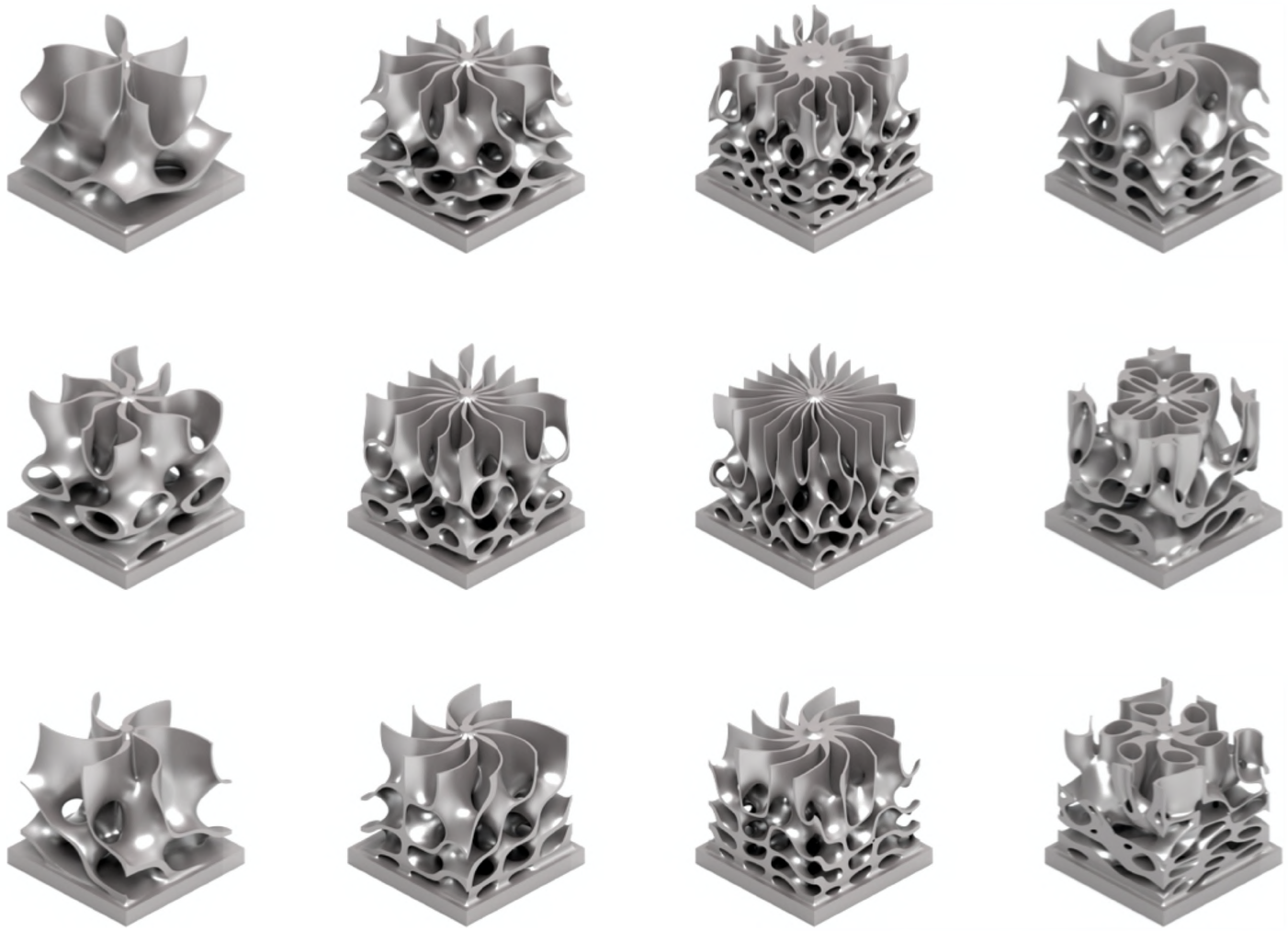

Saddles are a high priced item that people pay a lot for

The no. 1 thing that keeps people from buying a saddle is that it won't fit their horse

3D printing can accommodate bespoke workflows

Wilson Ranch

- Working ranch in eastern Oregon
- Spoke with 7 ranch workers
- Shadowed and went in-depth with Brett

Jim Karn

- 80s & 90s climbing legend
- Designer at Metolius climbing in Bend

Alli Sloop

- Runs a riding/ boarding outfit in West Lynn
- Background in Equine Science

Double H

- Saddle fitter in Salem
- Chris is the primary fitter

- Transverse dimension variety
  - Tree
    - parametric structure
    - lightweighting material removal
    - carbon fiber composite plate
    - lattice structure
    - targeted generative design
    - heavy
    - adjustable joints
    - one-time setup
    - ust boot forming
    - different diamois
    - not adjustable
    - modular construction
    - pad like edges
    - have the diamois extend beyond the tree
    - keep the tree on soft tissue
    - have the edges scale in flexibility
    - rigid edges causes chafing
    - carbon composite
    - generative design
    - eliminate redundant layers
    - Overly thick
    - lattice structure
    - perforations
    - smaller tree Mdsin softer padding
    - targeted placement
    - not breathable
    - adjustable tree, locking
    - padded withers
    - extra clearance
    - the glutei can rub on the withers
    - adjustability
    - a little bit wider range of fits
    - modular fit elements
    - more strap adjustments
    - narrower horn
    - rising can be tricky
    - shape guides rope downward
    - horn is placed lower below pommel
    - keeps rope high off the horse
    - less handle-like
    - horn tdoes grab it
    - placement to not be obvious to grap
    - padded diamois
    - army style later seat
    - better tree bridge
    - broods saddle cantlium material
    - wide smooth
    - breeks saddle camplum material
    - better pommel bracing
    - better stimuplrig
    - rough out
    - tracer
    - hard to grab friction on it
    - synthetic material
    - smooth out with perforations
    - coated material
    - rough out degrades faster
    - waxed cotton, not breathable
    - different modular diamois
    - strap altered seat shape
    - wider chair-like accomodation
    - apron chair
    - suspension seat
    - harnmak
    - hard to accommodate different sit bones
    - greater impact attenuation
    - padded diamois for the human
    - padded diamois for the horse
    - tree absorption
    - look at chair ergonomic studies
    - padding targeted to rubing gates
    - not comfortable at first
    - perforated material
    - lightweighting material removal
    - carbon fiber composite plate
    - lattice structure
    - targeted generative design
    - adjustable joints
    - one-time setup
    - ust boot forming
    - different diamois
    - modular construction
    - not adjustable
    - pad like edges
    - have the diamois extend beyond the tree
    - keep the tree on soft tissue
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    - rigid edges causes chafing
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    - generative design
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    - seat
    - narrower horn
    - knuckle collisions suck
    - more rounded horn top
    - padded where knuckles hit
    - knuckle collisions suck
    - use ATC like teeth that ring rope
    - friction surface
    - easier to daily
    - better moment arm
    - relies on material that needs replacing
    - shape guides rope downward
    - horn is placed lower below pommel
    - keeps rope high off the horse
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    - adjustable tree, locking
    - padded withers
    - extra clearance
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    - hard to accommodate different sit bones
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    - padded diamois for the horse
    - tree absorption
    - look at chair ergonomic studies
    - padding targeted to rubing gates
    - not comfortable at first
    - seat
    - have riggING not between the human and horse
    - eliminate
    - redundant layers
    - realocate functionality
    - eliminate
    - combine layers
    - ultralight stretched fabric
    - superlight snaerk
    - heavy
    - weblink
    - PSSDpack layers
    - climbing harness style buckles
    - aussie style stirrup straps
    - extremely heavy
    - climbing harness webbing buckles
    - more strap vectors for more detailed adjustability
    - limited to belt hole placement
    - thin webbing
    - keep adjustability remote up on the saddle
    - dont stack strap adjustments
    - thick stack
    - build in these options as standard parts
    - have these match the saddle design language
    - mirror the saddle tech, but upside down
    - have them as more transitional elements
    - climbing harness shoulder carry lines
    - kids climbing harness tops
    - breastplate and rear cinch afterthought
    - use a similar webbing throughout
    - perhaps 2 different webbing sizes, but same look
    - same buckle system for each strap
    - same buckle orientation for each strap
    - easy pull down straps
    - bring main saddle tech into the cinch and breastplate
    - design bags to match
    - color accents on manipulation points
    - nonessential exaggerated affordances
    - same function for all straps
    - easy pull down orientation for all straps
    - obvious, visible components
    - no hidden internal elements
    - hierarchy or flow of adjustment
    - not intuitive to beginner
    - aggressively contour the cinch
    - rely more heavily on rear and breastplate straps
    - have two cinch strap elements
    - have a specific elbow fit adjustment strap
    - can rub against the horses elbow
    - develop the whole thing as a set
    - design first for everything being used
    - design second for stripping it down
    - use the same tech on the cinch as the saddle
    - same bucktes throughout
    - same material stack on each element
    - sometimes a different design language
    - use the same tech on the cinch as the saddle
    - design first for everything being used
    - develop the whole thing as a set
    - no (minimal) metal hardware away from saddle
    - metge with rear and breastplate systems
    - latice?
    - heavy
    - removal on any unnecessary area
    - lightweight and sinuous
    - disperse pressure across larger, permeable area
    - remove all unnecessary coverage
    - use the same breathability tech as the saddle pad
    - thick stack
    - keep adjustability remote up on the saddle
    - dont stack strap adjustments
    - thin webbing
    - limited to belt hole placement
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    - easy pull down straps
    - bring main saddle tech into the cinch and breastplate
    - design bags to match
    - no common functional language
    - have riggING be less abrasive
    - trim down a bit
    - build into tree
    - can be unnecessary
    - combine function into channels
    - eliminate these layers
    - houning/fender
    - use similar construction for the cinch and breastplate
    - build out as part of the whole saddle
    - doesn't fit the family
    - layered foam with less dense bulk
    - swear molding
    - quick cry
    - trimmed down
    - streamlined
    - lighter materials
    - heavy
    - quilted patterning
    - multiple separate pads
    - lattice structure
    - perforations
    - air channels
    - insulative
    - layered foam densities
    - build in the pad
    - eliminate of redundant layers
    - more accommodating tree
    - dense foam
    - thick
    - army style later seat
    - better tree bridge
    - broods saddle cantlium material
    - wide smooth
    - padded diamois
    - not comfortable at first
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    - eliminate
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    - synthetic material
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    - coated material
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    - build out as part of the whole saddle
    - doesn't fit the family
    - layered foam with less dense bulk
    - swear molding
    - quick cry
    - trimmed down
    - streamlined
    - lighter materials
    - heavy
    - quilted patterning
    - multiple separate pads
    - lattice structure
    - perforations
    - air channels
    - insulative
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    - redundant layers
    - realocate functionality
    - eliminate
    - combine layers
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    - multiple separate pads
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    - broods saddle cantlium material
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    - padded diamois
    - not comfortable at first
    - pad

Traditional Western Saddle

- Tree
  - parametric structure
  - lightweighting material removal
  - carbon fiber composite plate
  - lattice structure
  - targeted generative design
  - heavy
  - adjustable joints
  - one time setup
  - use boot forming
  - different chamois
  - modular construction
  - not adjustable
  - pad the edges
  - have the chamois extend beyond the tree
  - keep the tree on soft tissue
  - have the edges scale in flexibility
  - rigid edges causes chafing
  - carbon composite
  - generative design
  - eliminate redundant layers
  - overly stiff
  - lattice structure
  - perforations
  - smaller tree within softer padding
  - targeted placement
  - not breathable
  - prescribe wither measurement
  - adjustable tree, locking
  - padded withers
  - extra clearance
  - the gullet can rub on the withers
  - adjustability
  - a little bit wider range of fits
  - modular fit elements
  - more strap adjustments
  - sizing can be tricky
  - narrower horn
  - more rounded horn top
  - padded where knuckles hit
  - knuckle collisions suck
  - use ATC like teeth like grip rope
  - friction surface
  - easier to daily
  - better moment arm
  - rules on material that needs replacing
  - shape guides rope downward
  - horn is placed lower below pommel
  - keeps rope high off the horse
  - less handle-like
  - placement to not be obvious to grap
  - new riders grab it
  - padded channels
  - army style later seat
  - better tree bridge
  - brooks saddle cantleum material
  - wide smooth
  - brooks saddle cantleum material
  - better pommel bracing
  - better stirruping
  - rough out
  - lattice?
  - hard to grab friction on it
  - synthetic material
  - smooth out with perforations
  - coated material
  - waxed cotton, not breathable
  - rough out degrades faster
  - different modular chamois
  - strap altered seat shape
  - wider chair-like accomodation
  - apron chair
  - suspension seat
  - hammock
  - hard to accommodate different sit bones
  - greater impact attenuation
  - padded chamois for human
  - padded chamois for the horse
  - tree absorption
  - look at chair ergonomic studies
  - padding targeted to riding plates
  - not comfortable at first
  - seat
  - parts
  - desert fit the family
  - build out as part of the whole saddle
  - use similar construction for the cinch and breastplate
  - eliminate these layers
  - combine function into chamois
  - build into tree
  - turn down a bit
  - have rigging be less abrasive
  - can be unnecessary
  - eliminate all together
  - condense layers
  - reallocate functionality to other layers
  - have all rigging operate from a common area
  - have rigging not between the human and horse
  - not streamlined
  - housing/fender
  - layered foam with less dense bulk
  - heavy
  - quick dry
  - trimmed down
  - streamlined
  - lighter materials
  - swear welding
  - build out as part of the whole saddle
  - use similar construction for the cinch and breastplate
  - desert fit the family
  - multiple separate pads
  - lattice structure
  - perforations
  - air channels
  - insulative
  - layered foam densities
  - build in the pad
  - elimination of redundant layers
  - more accommodating tree
  - thicker foam
  - active air flow with horse movement
  - passive air pumping
  - not breathable
  - quilted padmenting
  - insulative
  - layered foam densities
  - build in the pad
  - elimination of redundant layers
  - more accommodating tree
  - thicker foam
  - black
  - padded channels
  - army style later seat
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  - condense layers
  - reallocate functionality to other layers
  - have all rigging operate from a common area
  - have rigging not between the human and horse
  - not streamlined
  - housing/fender
  - no metal hardware away from saddle
  - heavy
  - merge with rear and breastplate systems
  - latch?
  - removal on any unnecessary area
  - not breathable
  - use the same breathability tech as the saddle pad
  - disperse pressure across larger, permeable area
  - remove all unnecessary coverage
  - lightweight and sinuous
  - sometimes a different design language
  - same material stack on each element
  - same buckles throughout
  - use the same tech on the cinch as the saddle
  - design first for everything bend used
  - design second for stripping it down
  - develop the whole thing as a set
  - have a specific elbow fit adjustment strap
  - have two cinch strap elements
  - rely more heavily on rear and breastplate straps
  - can rub against the horses elbow
  - aggressively contour the cinch
  - design bags to match
  - bring main saddle tech into the cinch and breastplate
  - easy pull down straps
  - same buckle orientation for each strap
  - same buckle system for each strap
  - perhaps 2 different webbing sizes, but same look
  - use a similar webbing throughout
  - rigging
  - easy pull down straps
  - same function for all straps
  - easy pull down orientation for all straps
  - obvious, visible components
  - no hidden internal elements
  - hierarchy or flow of adjustment
  - not intuitive to beginner
  - color accents on manipulation points
  - nasa/medical exaggerated affordances
  - trimmed down to the bare necessities
  - lattice structure?
  - midsole foam
  - chamois with air channels
  - active air flow with horse movement
  - passive air pumping
  - eliminate
  - combine layers
  - ultralight stretched fabric
  - superlight sheath
  - heavy
  - reallocate functionality
  - eliminate
  - redundant layers
  - have rigging be less abrasive
  - can be unnecessary
  - turn down a bit
  - build into tree
  - combine function into chamois
  - eliminate all together
  - condense layers
  - reallocate functionality to other layers
  - have all rigging operate from a common area
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  - layered foam with less dense bulk
  - heavy
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  - lighter materials
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  - perforations
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  - tree absorption
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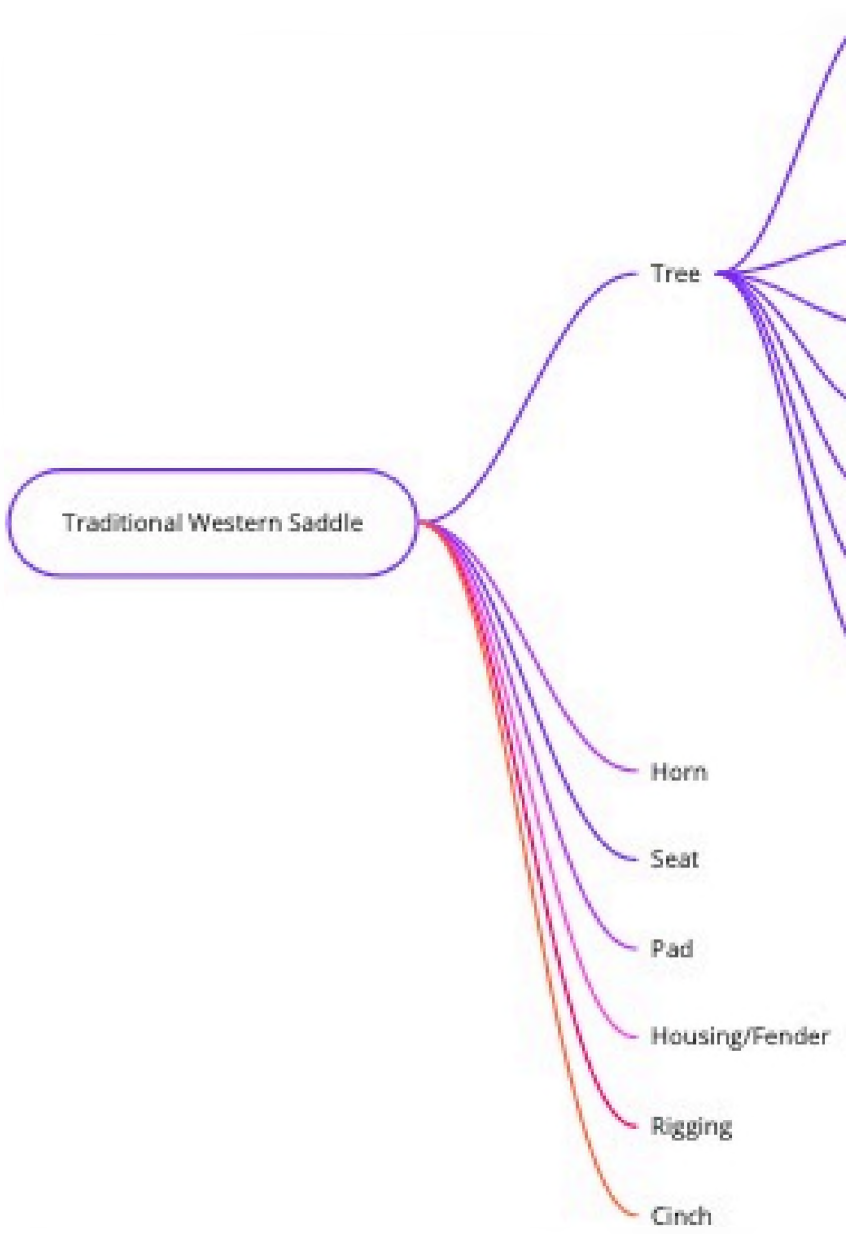
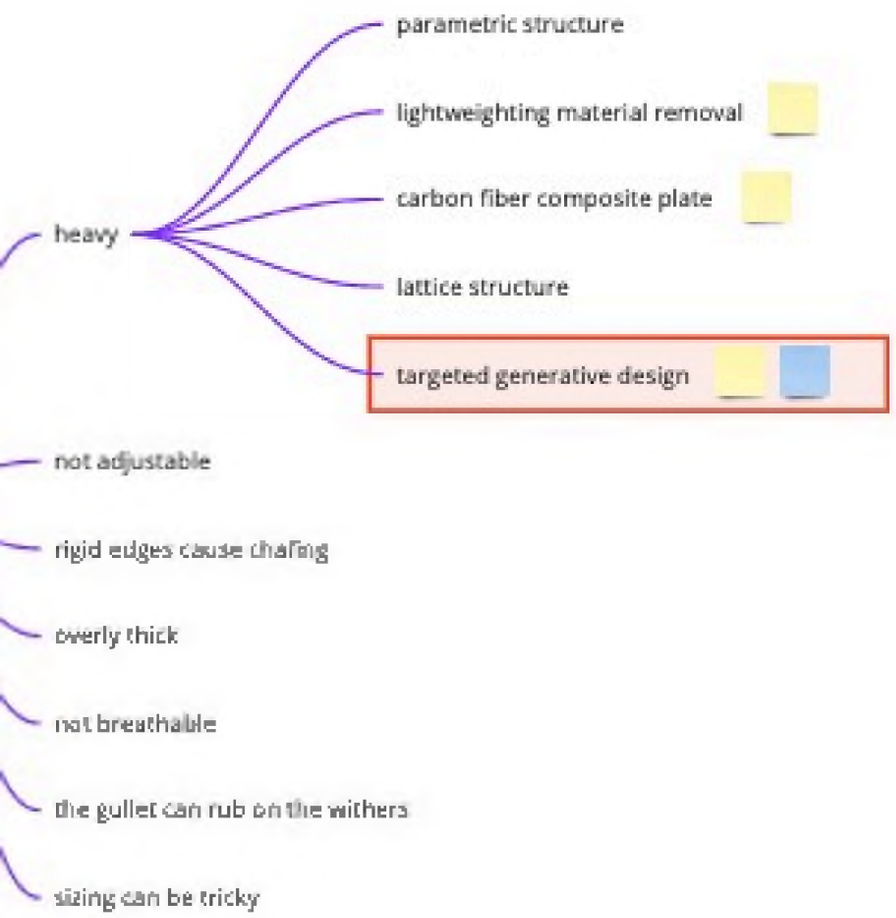
  - padding targeted to riding plates
  - not comfortable at first
  - seat
  - parts

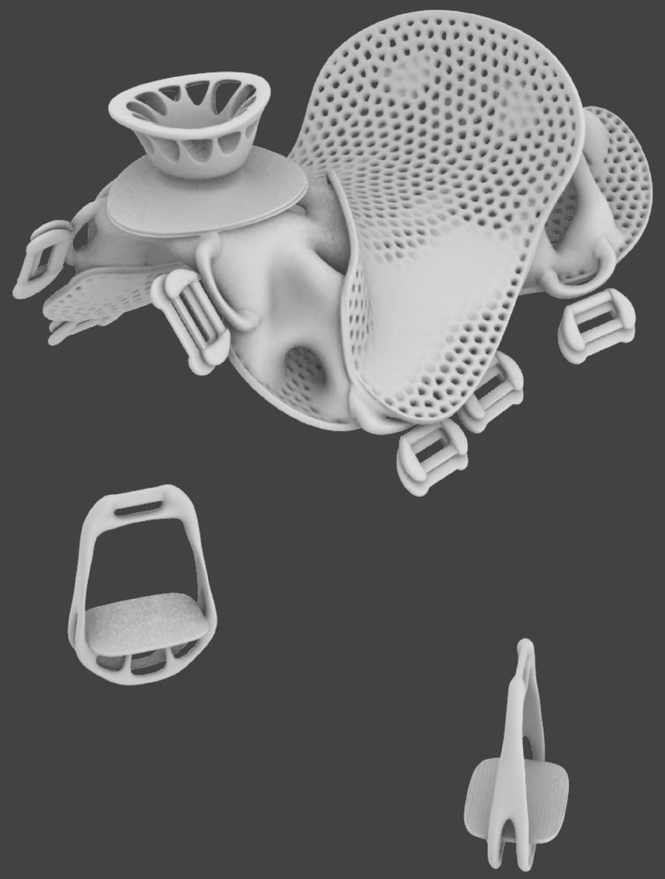

generatively designed tree form made from lightweight composite
leaf spring tree
breathability airflow test, total weight
hueso tree
anatomically streamlined pads for both human and horse
airflow enduro pads
breathability airflow test
3D printed fluted horn that guides rope downward and bites when taught
tornado horn
horn static friction test
common function, ergonomically exaggerated, climbing harness style strap buckles
simple set straps
total weight
deploy the saddle cushion and fit tech across all touchpoints
360 fit

Dan Winegar

Mind Map & Tech Names




parametric structure
lightweighting material removal
carbon fiber composite plate
heavy
lattice structure
targeted generative design
not adjustable
rigid edges cause chafing
overly thick
not breathable
the gullet can rub on the withers
sizing can be tricky

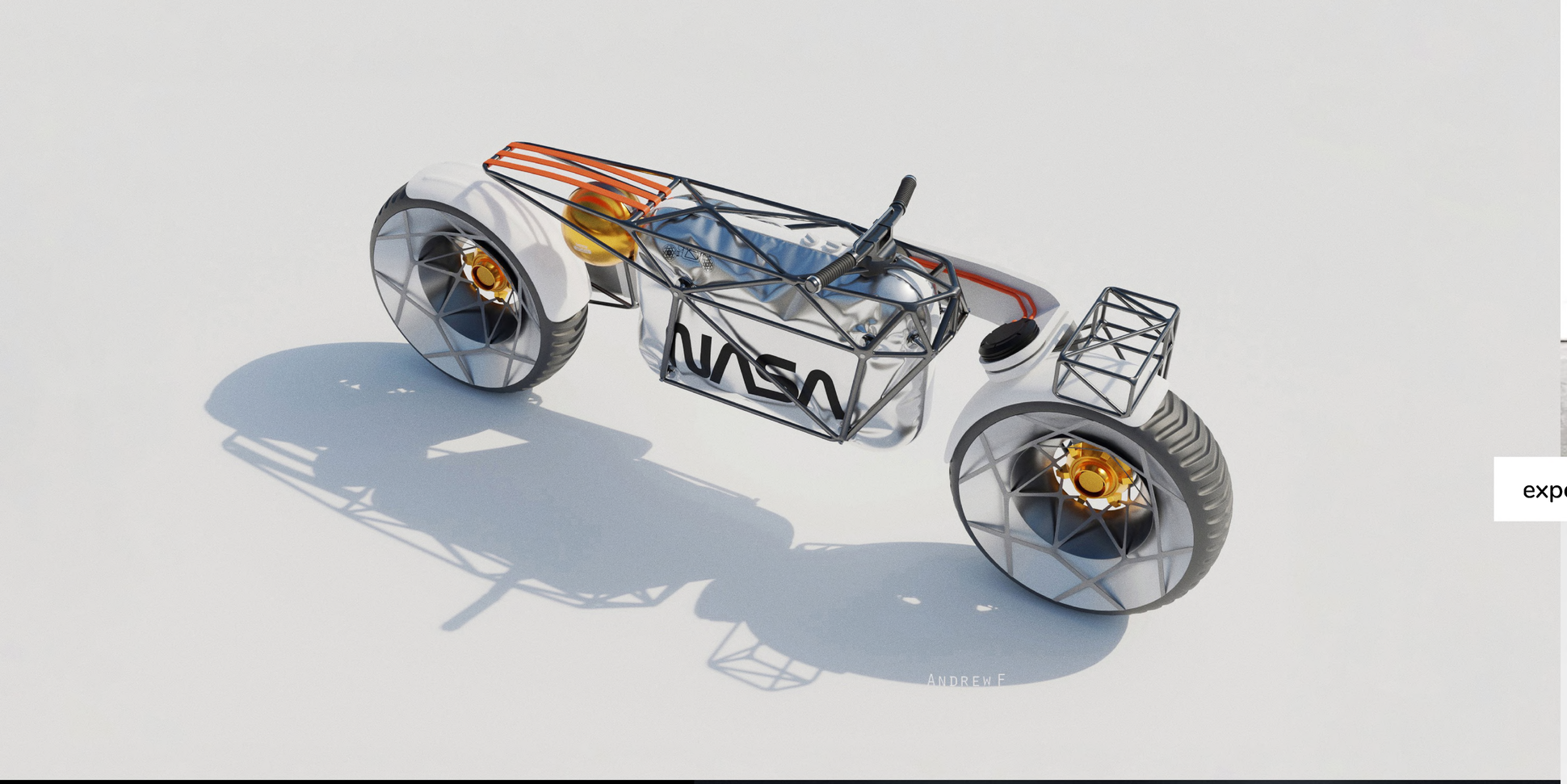


Previously ID’d Needs

- Lightweight
- Breathable
- Horn grip

New/Evolved Needs

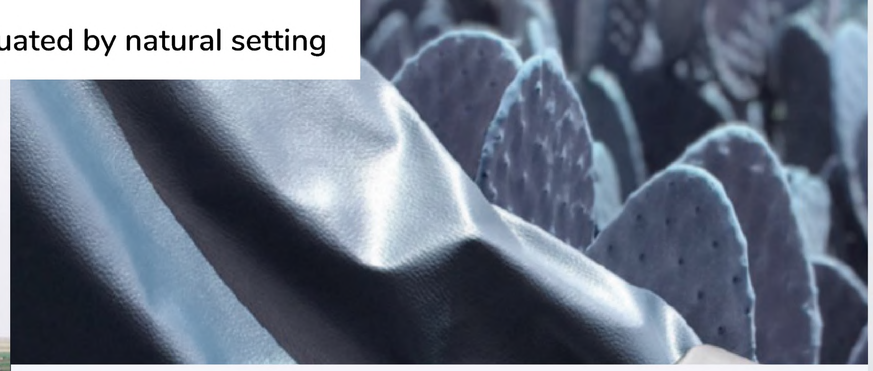
- Channeled air flow
- Weight distribution
- Impact attenuation
- Design language

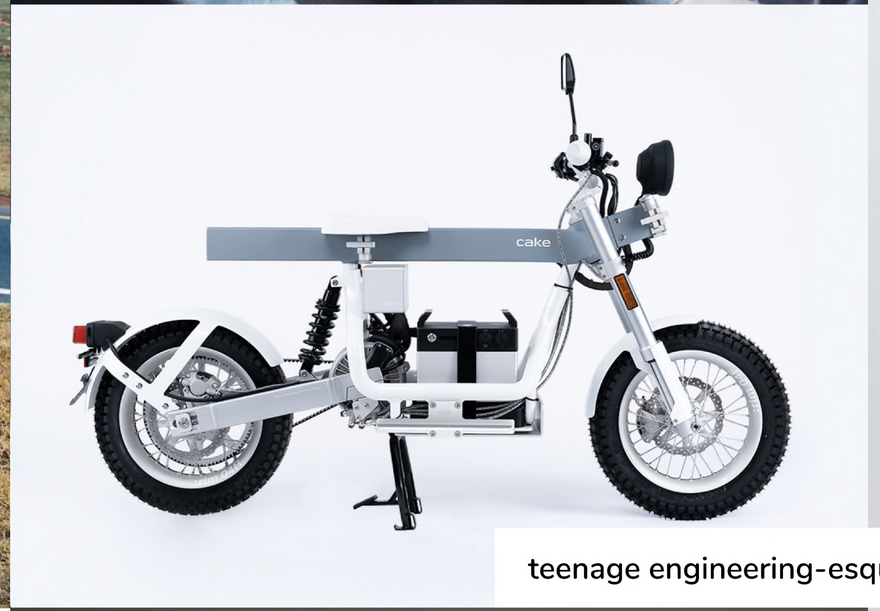


exposed structure

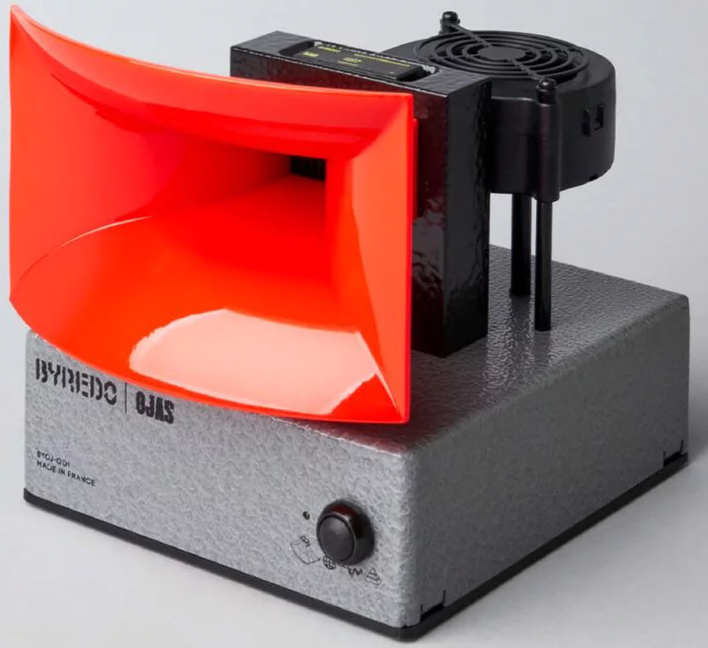
directed air flow

monolithic character accentuated by natural setting





teenage engineering-esque



high gloss accent w/ utility background

Pop Accent

PANTONE+
solid coated

Red 032 C

Fill

PANTONE+
solid coated

656 C

Alt Fill

PANTONE+
solid coated

7695 C

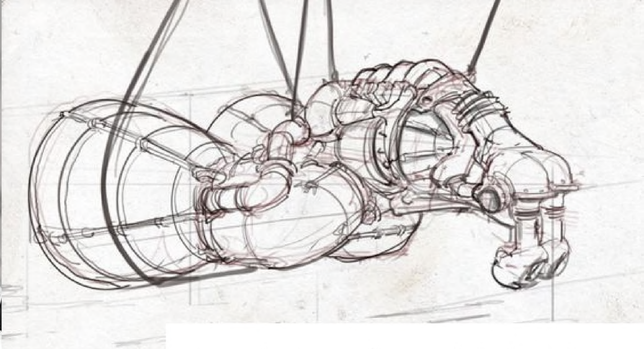
Dark Accent

PANTONE+
solid coated

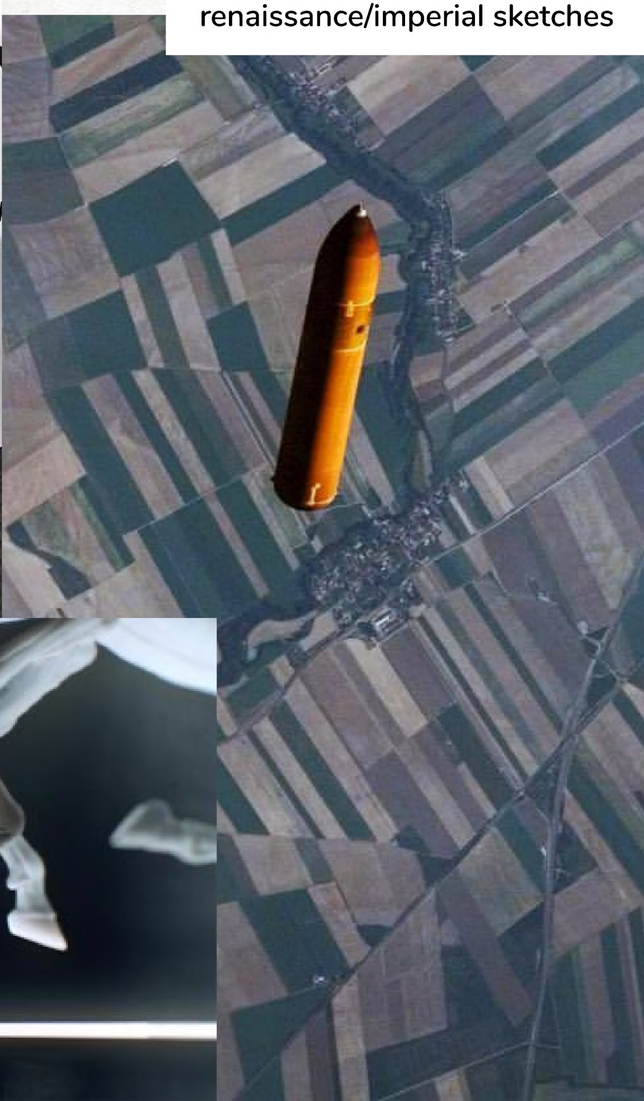
Black 5 C

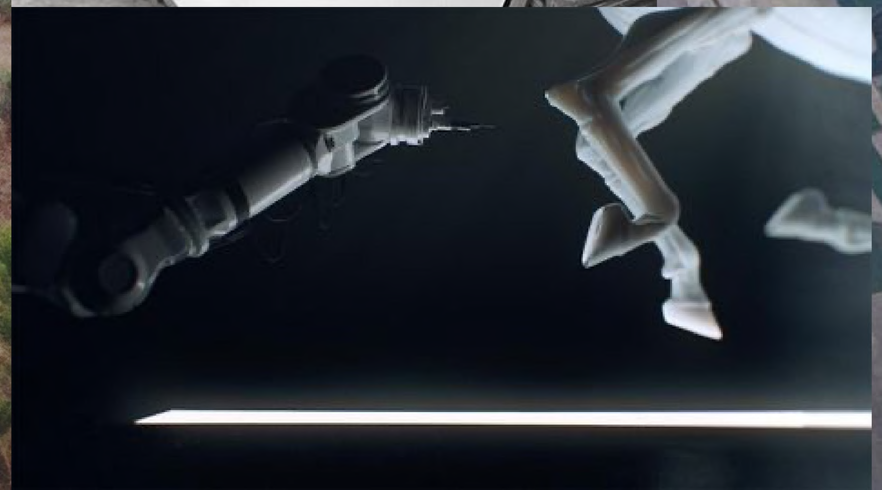
the frontier is wild

mid-century space



renaissance/imperial sketches





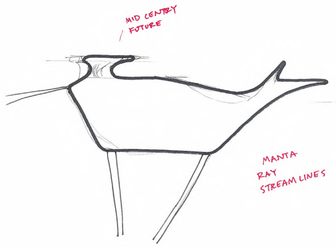

HARLEY-DAVIDSON
114
Heritage

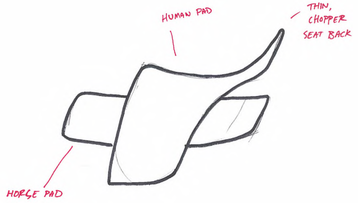

cake
:rim 04R
:rim 04F

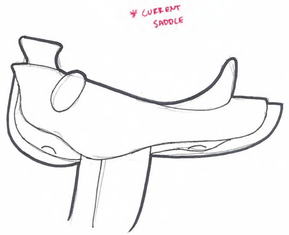

FX4
SQUIR

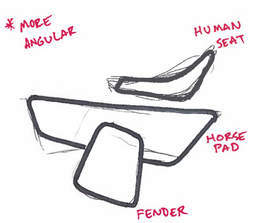
HUMAN PAD
GENERATED HUMAN & SKELETON
HORSE PAD
GENERATED SKELETON BASE STRUCTURE
HUMAN SEAT
HORSE PAD
FENDER
HUMAN PAD
SKELETAL BRIDGE TREE
HUMAN PAD
SPLIT SIDES FOR WHITENESS
HUMAN
HORSE
INTEGRATED FENDER
HUMAN PAD
THIN CHOPPER SEAT BACK
HORSE PAD

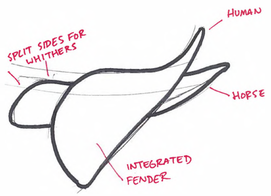
OVERALL / PADS

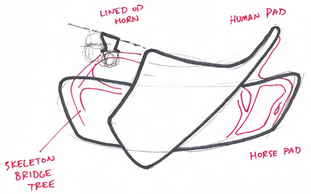


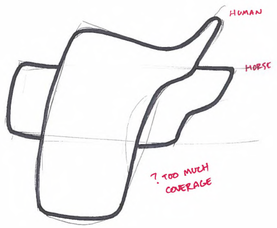


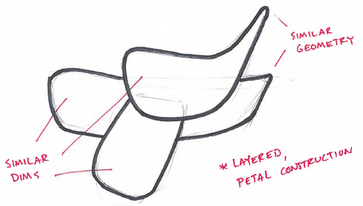




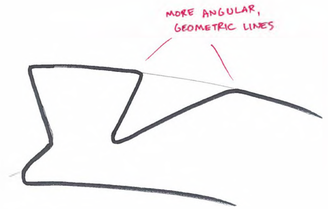


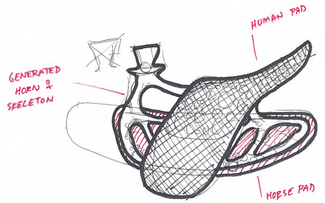


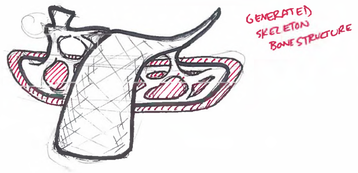


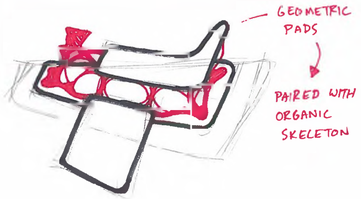


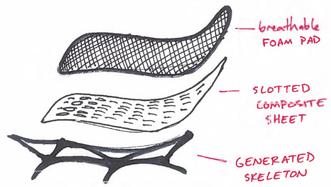
TREE & STIRRUPS

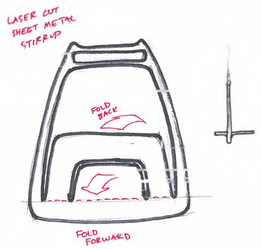


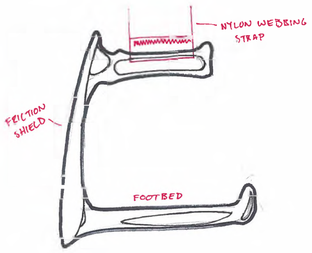




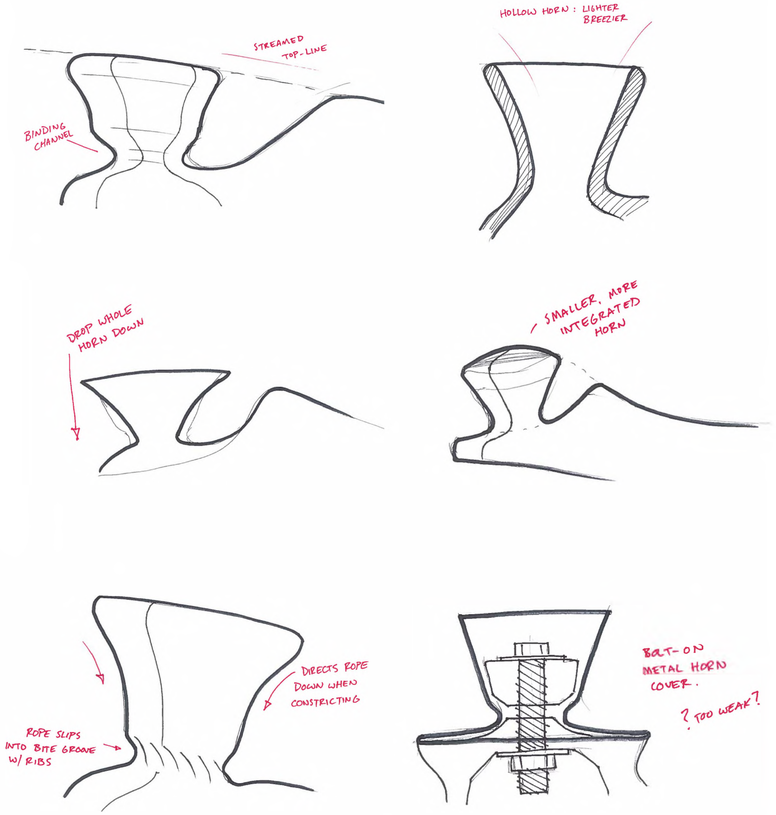




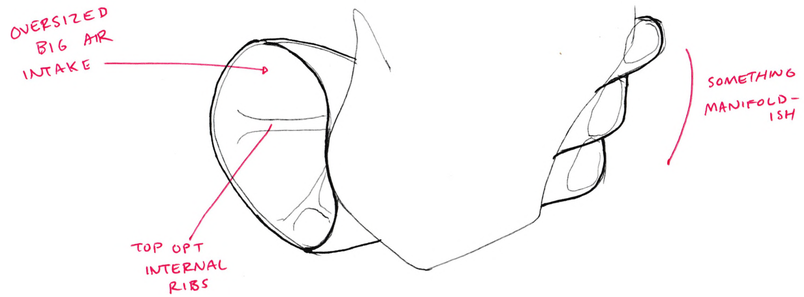


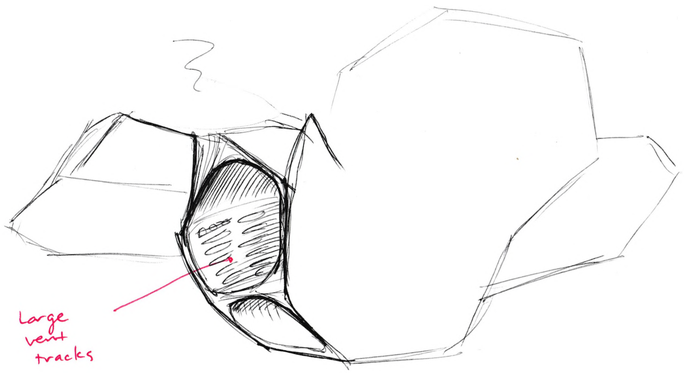


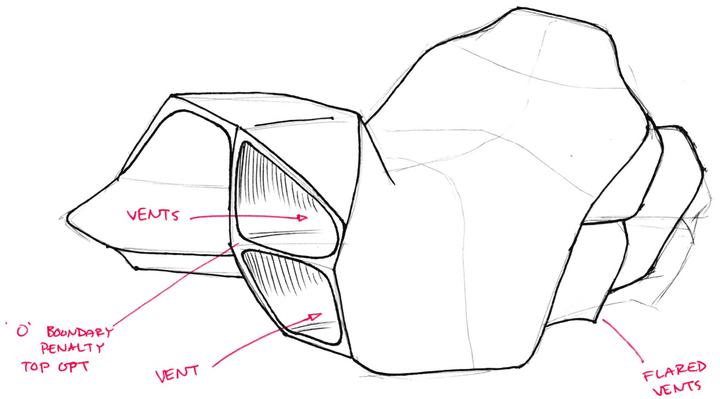
HORN

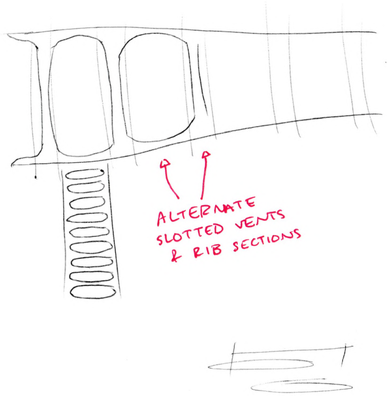

STREAMED TOP-LINE
BINDING CHANNEL
HOLLOW HORN : LIGHTER BREEZIER
* CURRENT HORN
DROP WHOLE HORN DOWN
SMALLER, MORE INTEGRATED HORN
"TORNADO" RIDGES BITE THE ROPE
ROPE SLIPS INTO BITE GROOVE W/ RIBS
DIRECTS ROPE DOWN WHEN CONSTRICTING
BOLT-ON METAL HORN COVER.
? TOO WEAK?

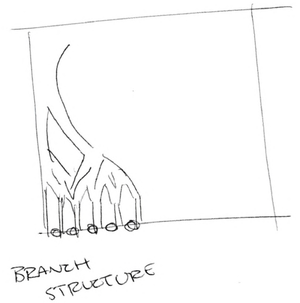
These are just a few initial sketches about airflow/ intakes. I'll have a lot more done Saturday/Monday.

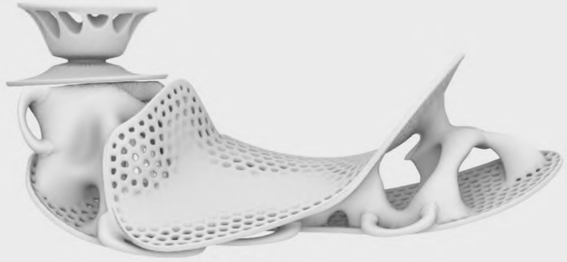


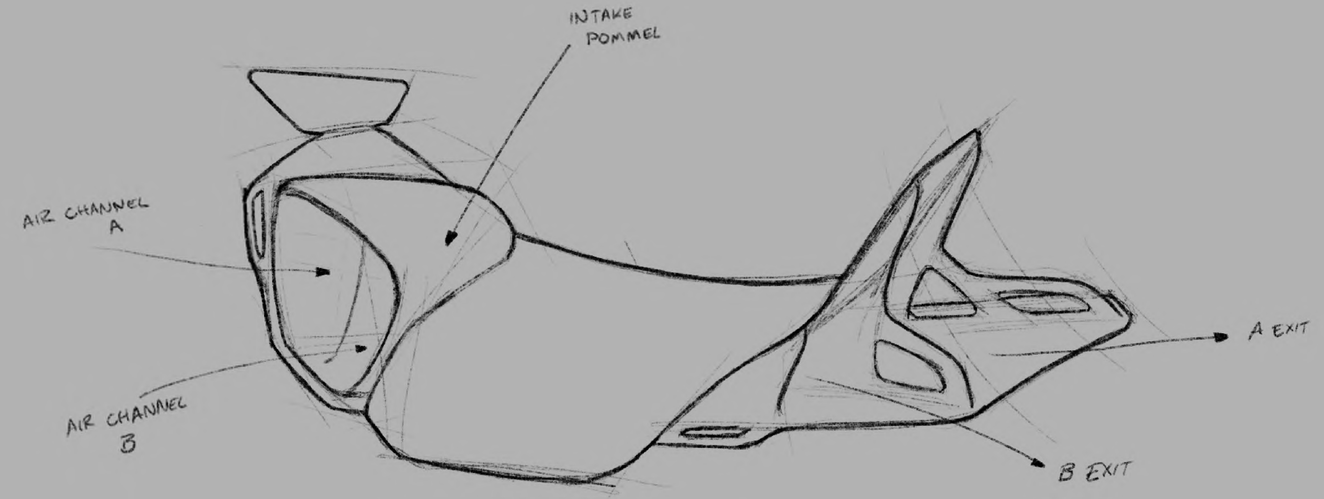


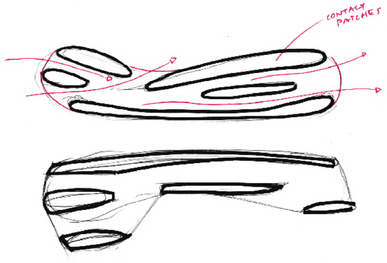


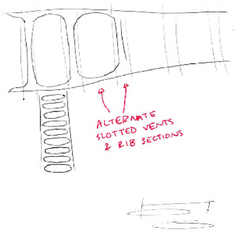


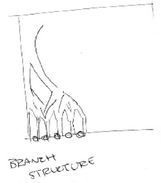


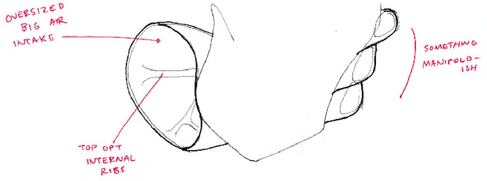


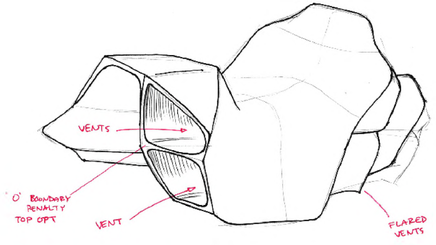

INTAKE
POMMEL
AIR CHANNEL
A
AIR CHANNEL
B
A EXIT
B EXIT

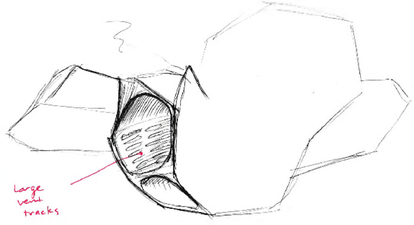

CONTACT
PATCHES

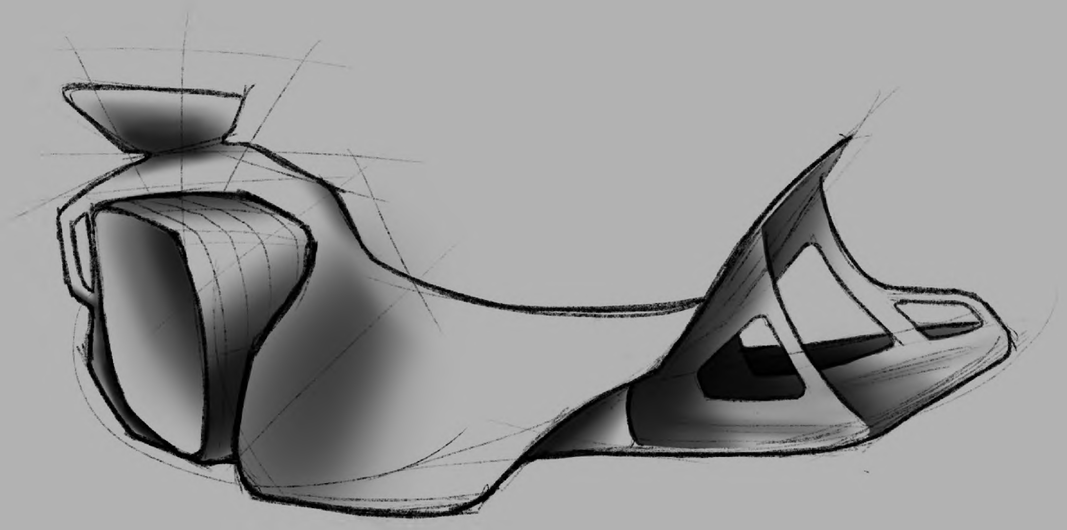

ALTERNATE
SLOTTED VENTS
& RIB SECTIONS

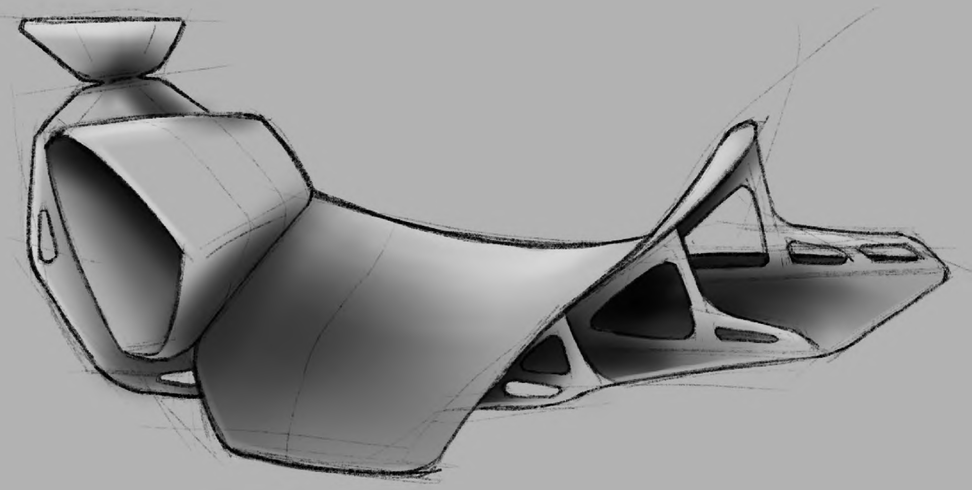

BRANCH
STRUCTURE

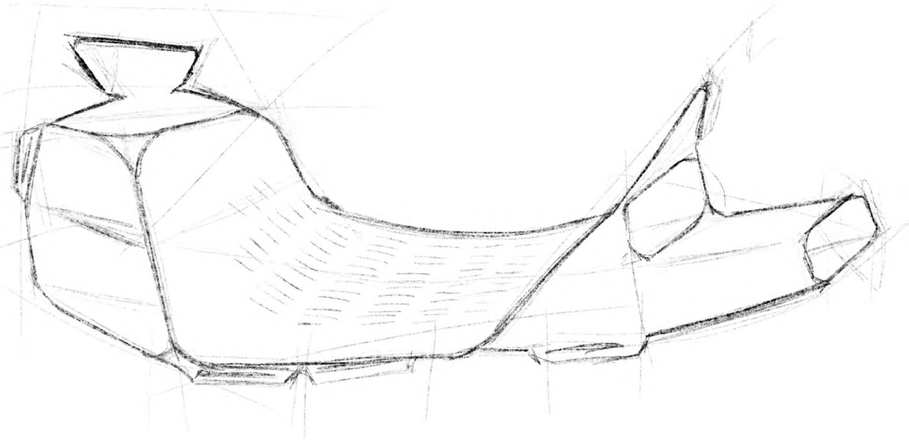

OVERSIZED
BIG AIR
INTAKE
SOMETHING
MANIFOLD-
ISH
TOP OPT
INTERNAL
RIBS

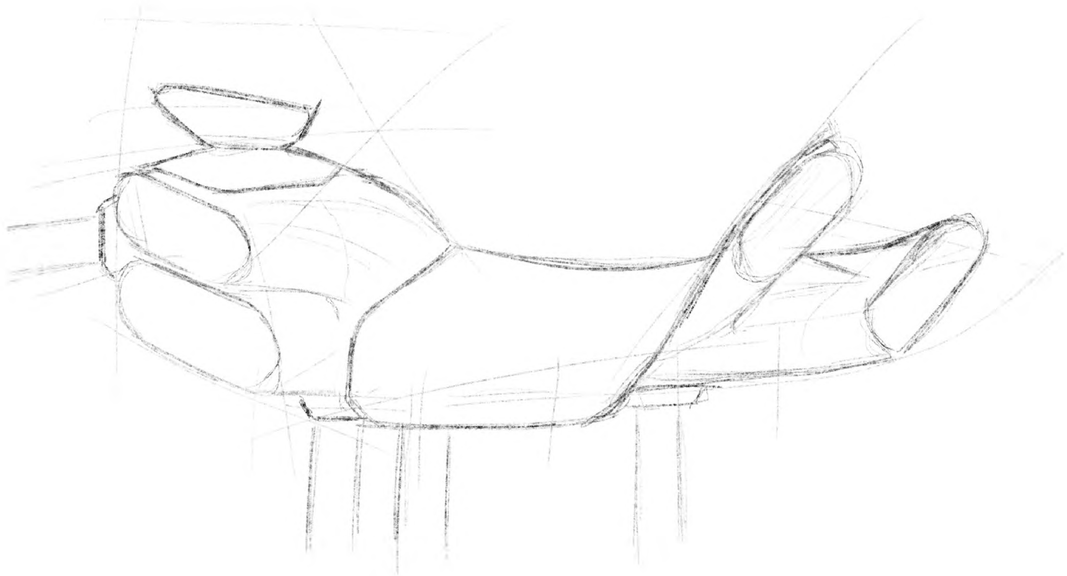

VENTS
'0' BOUNDARY
DENSITY
TOP OPT
VENT
FLARED
VENTS

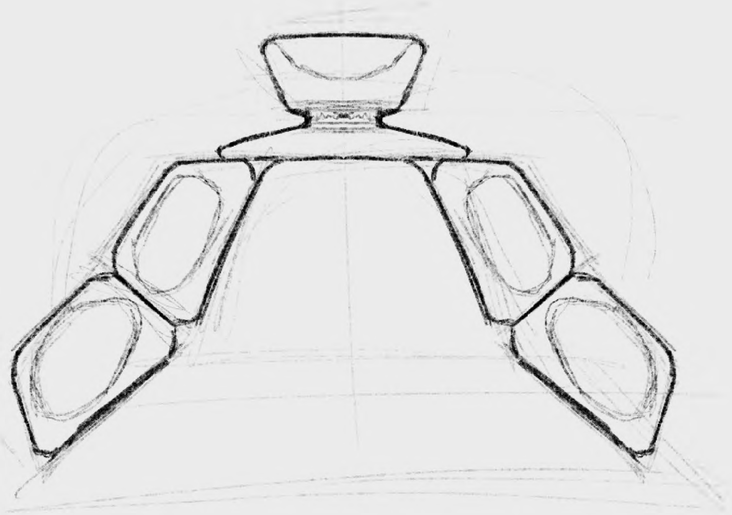

Large
vent
tracks

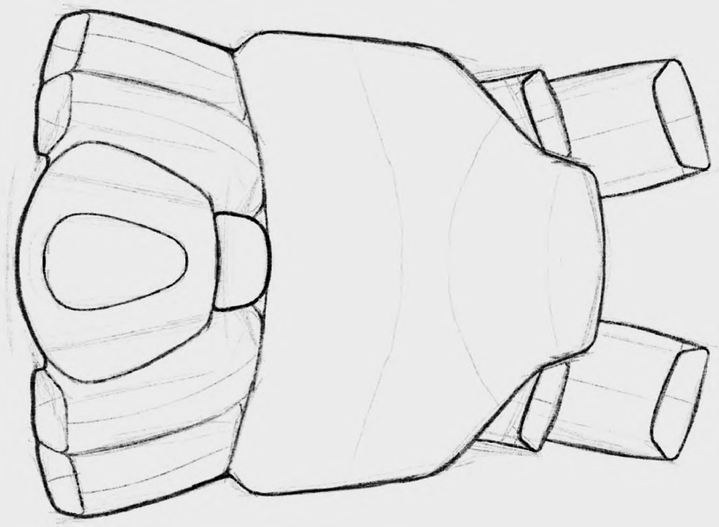


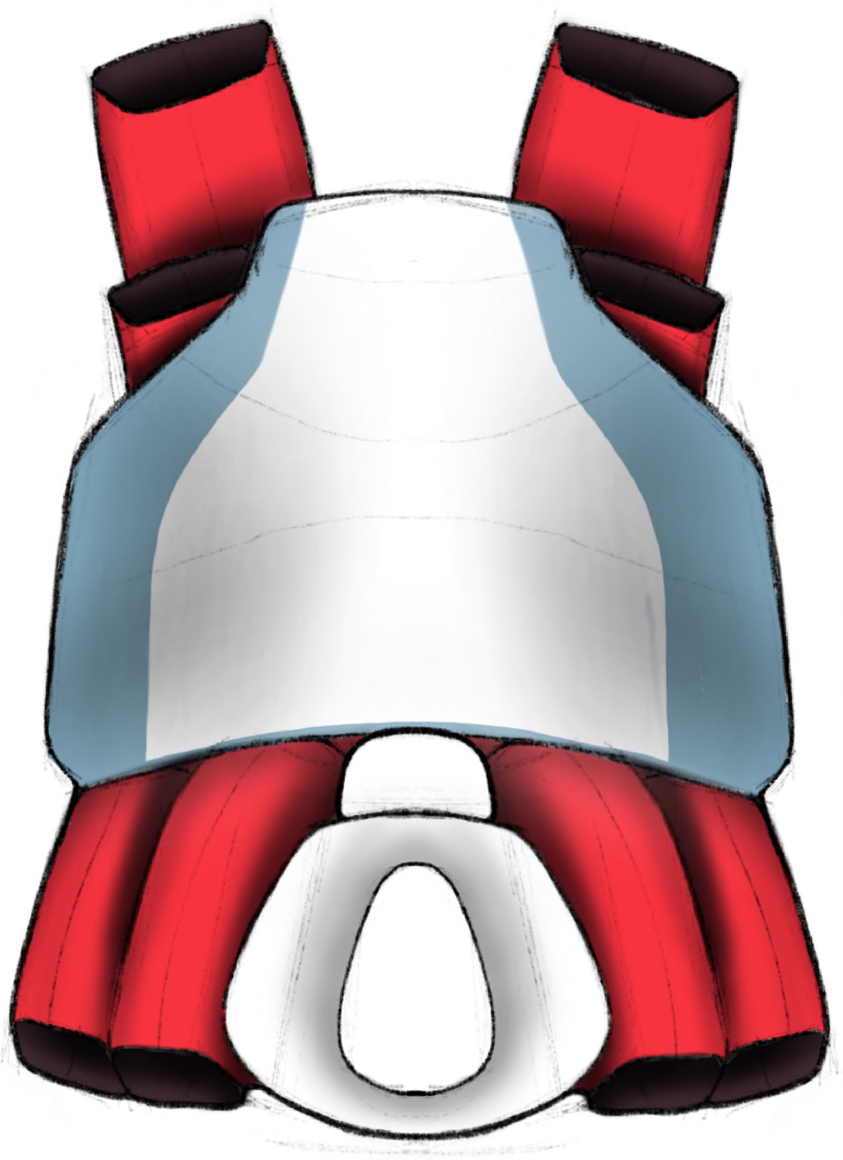


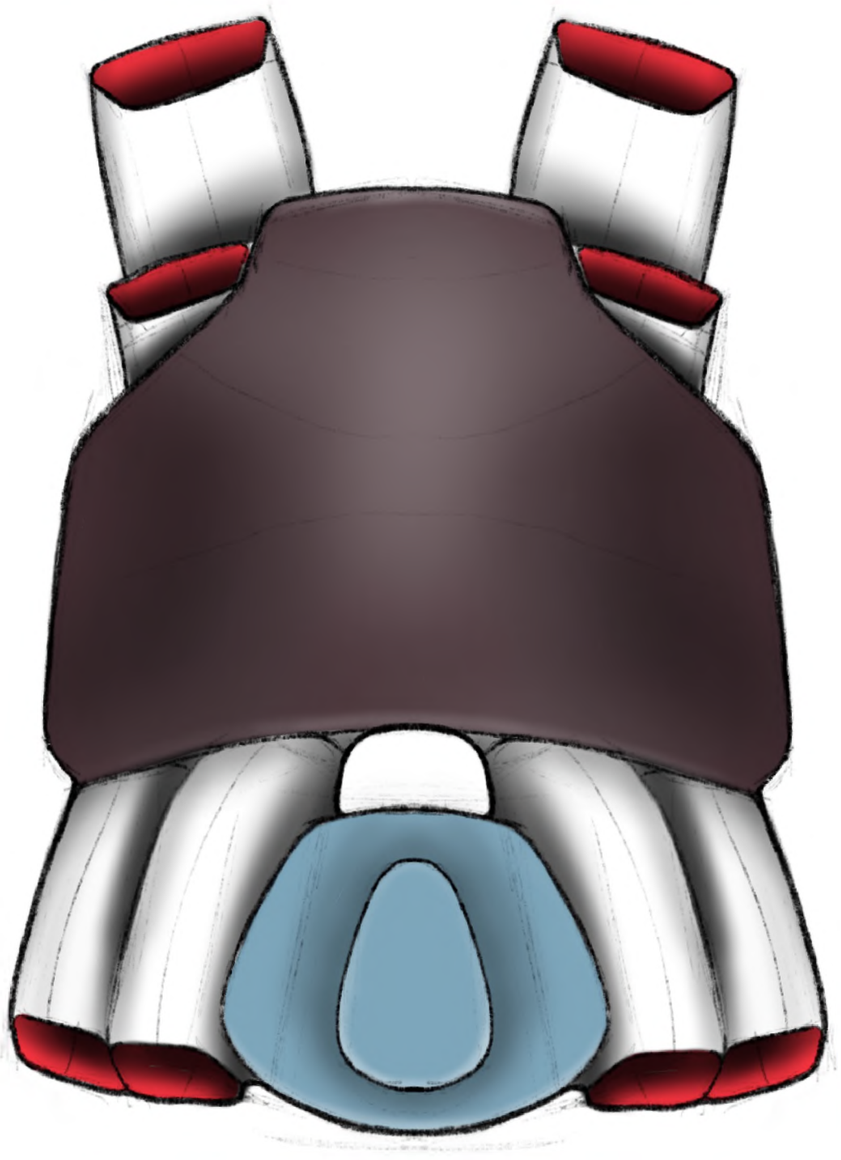






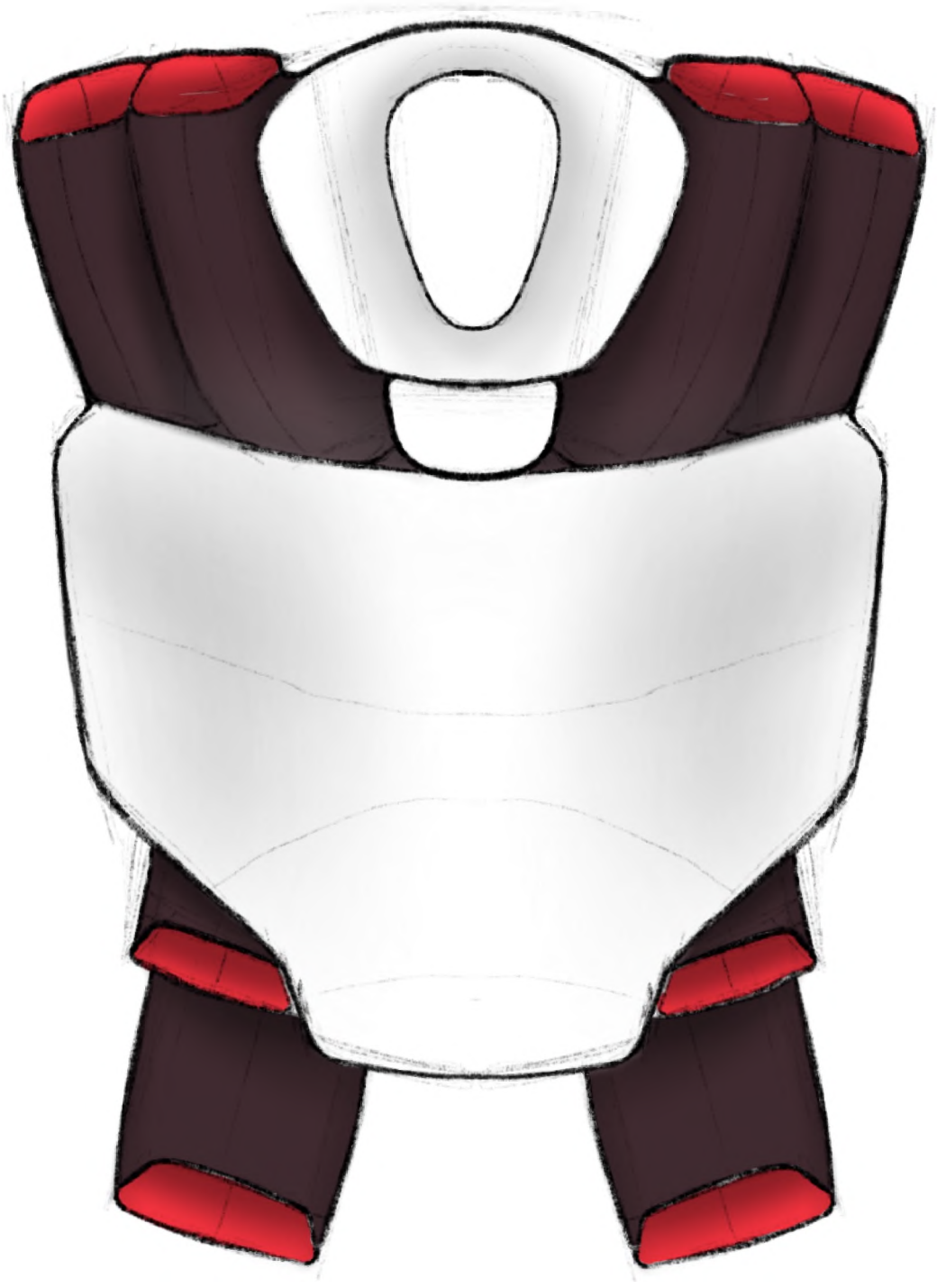






I think I'll be better off speccing colors once on a rendered model

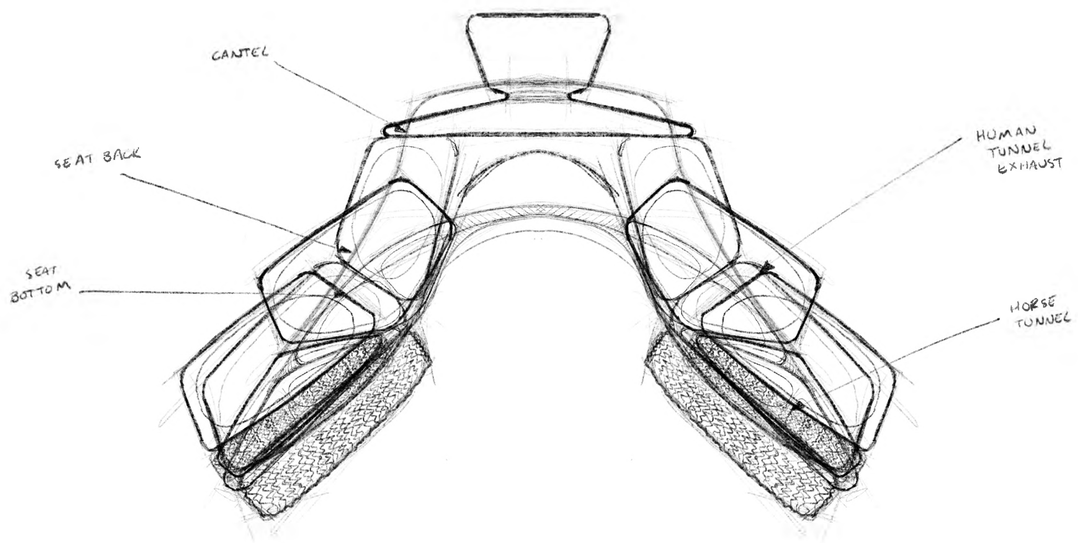
nTop will help add "utility" geometry

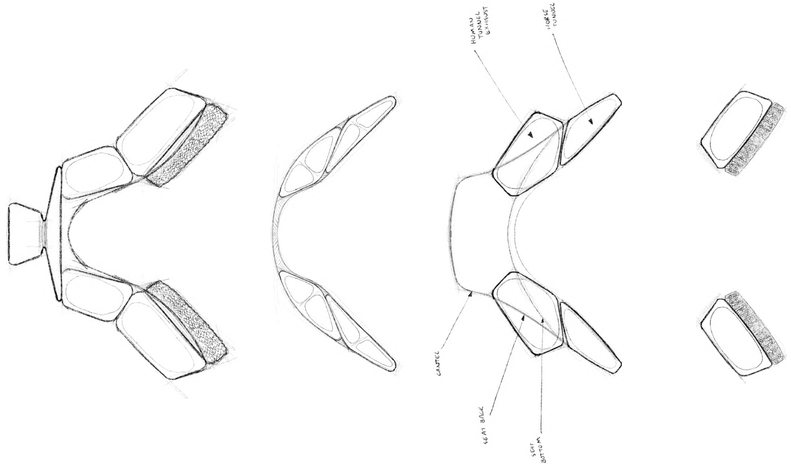


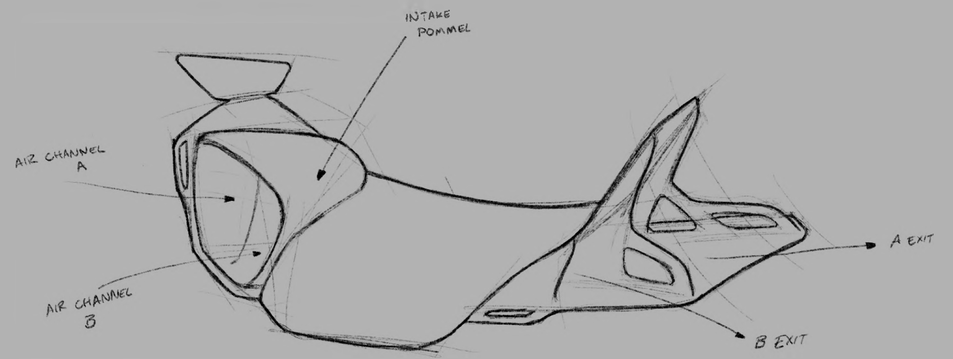


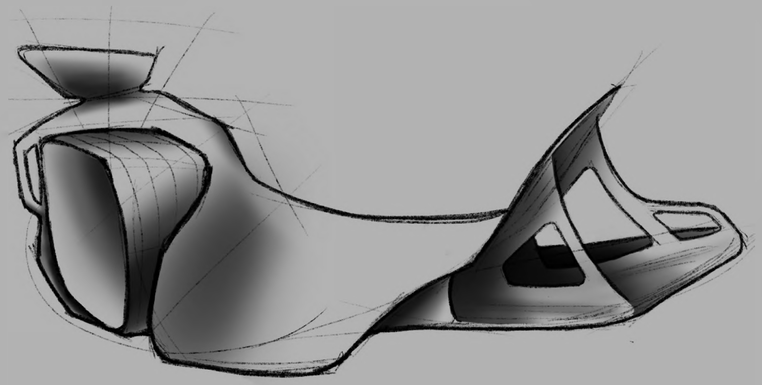
EL CAMINO

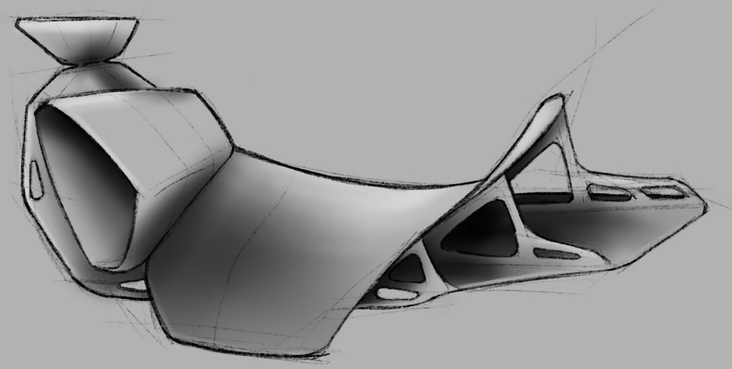
Domus (font selections)

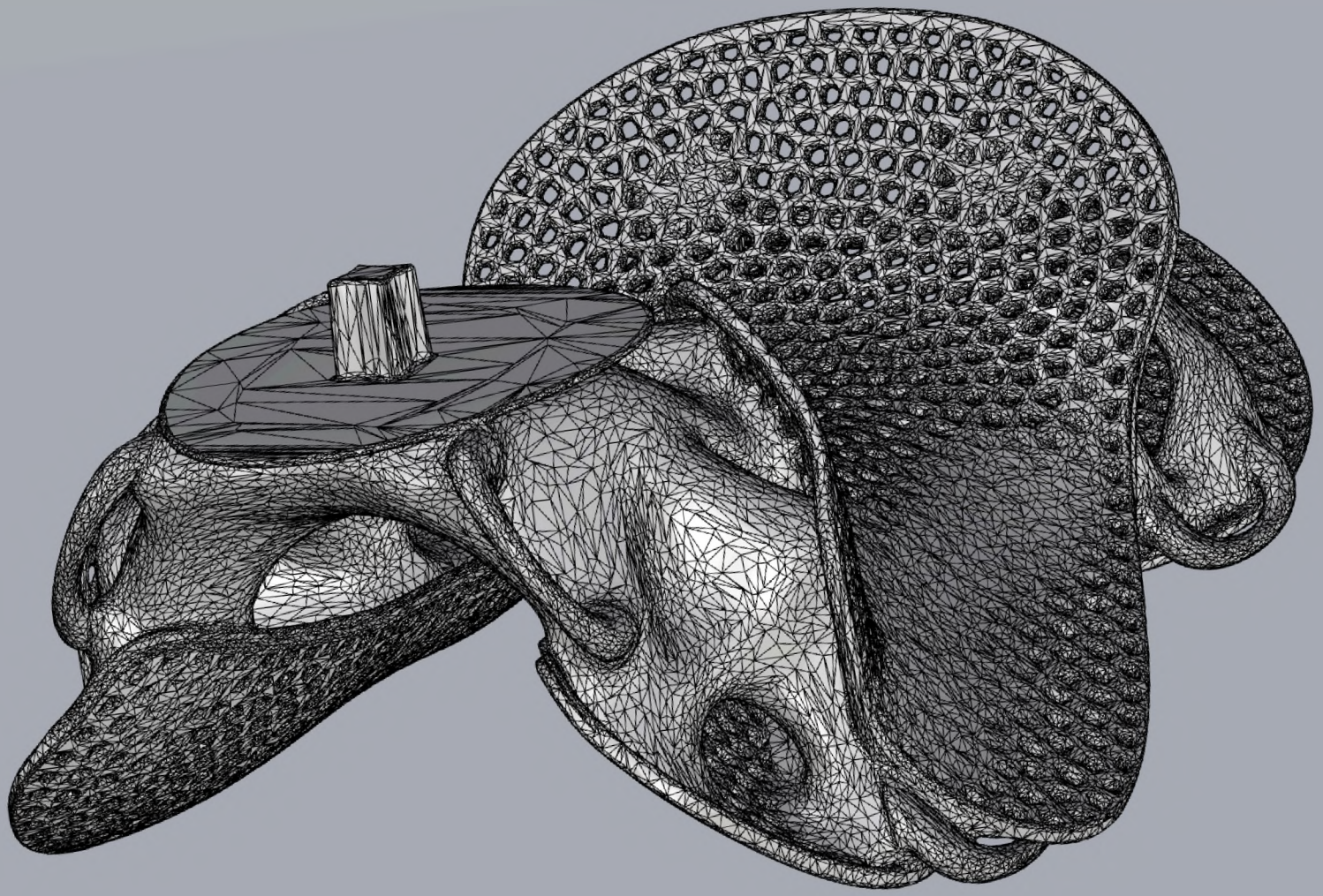

CANTEL
SEAT BACK
SEAT BOTTOM
HUMAN TUNNEL EXHAUST
HORSE TUNNEL




INTAKE POMMEL
AIR CHANNEL A
AIR CHANNEL B
A EXIT
B EXIT



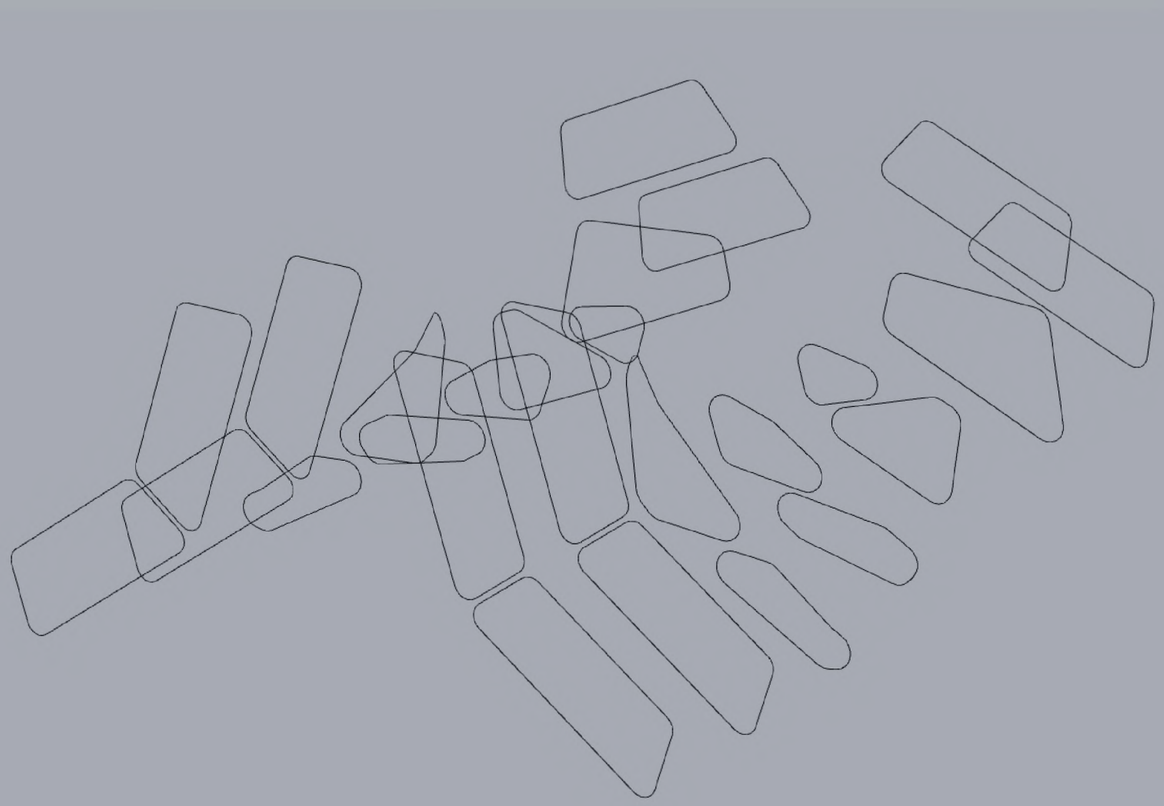


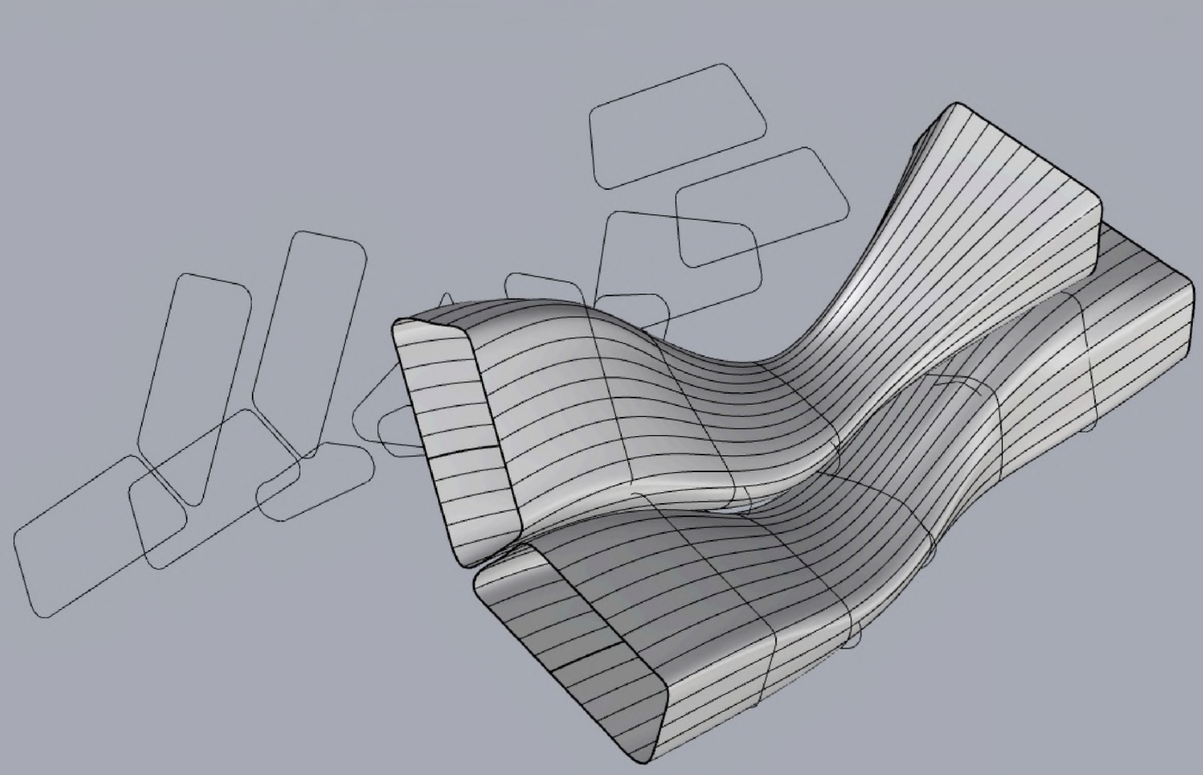


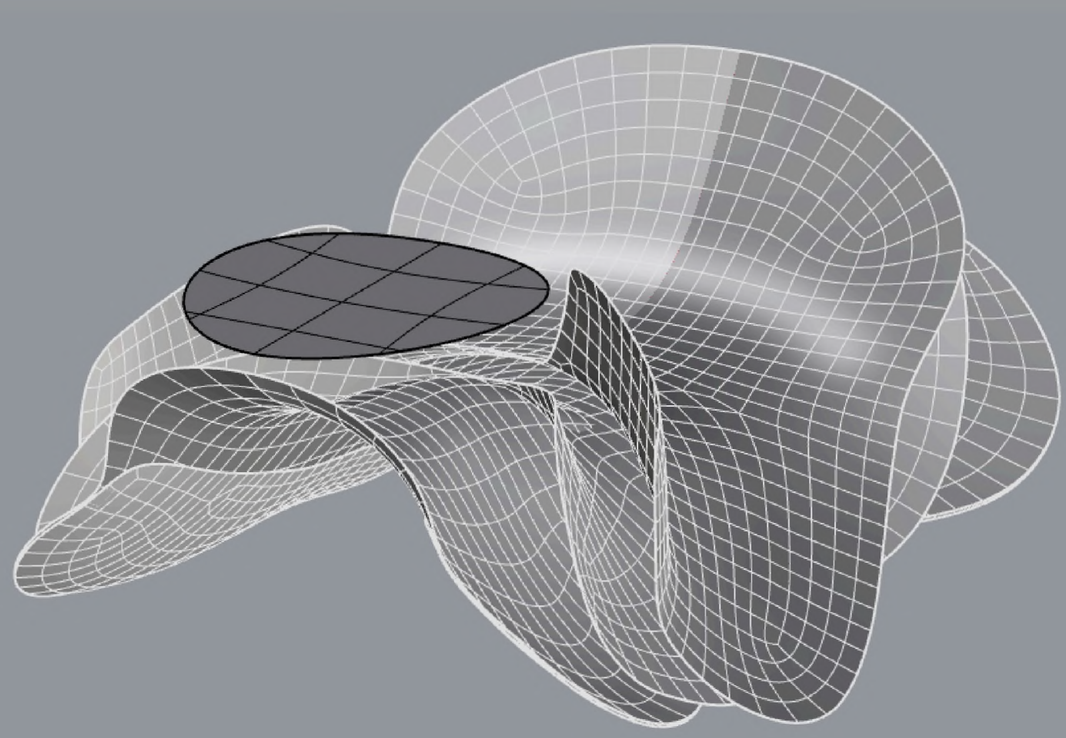
ducting overlaid on profiles

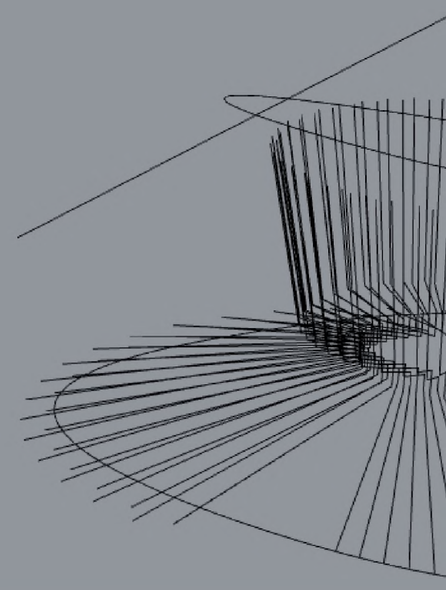
section profiles

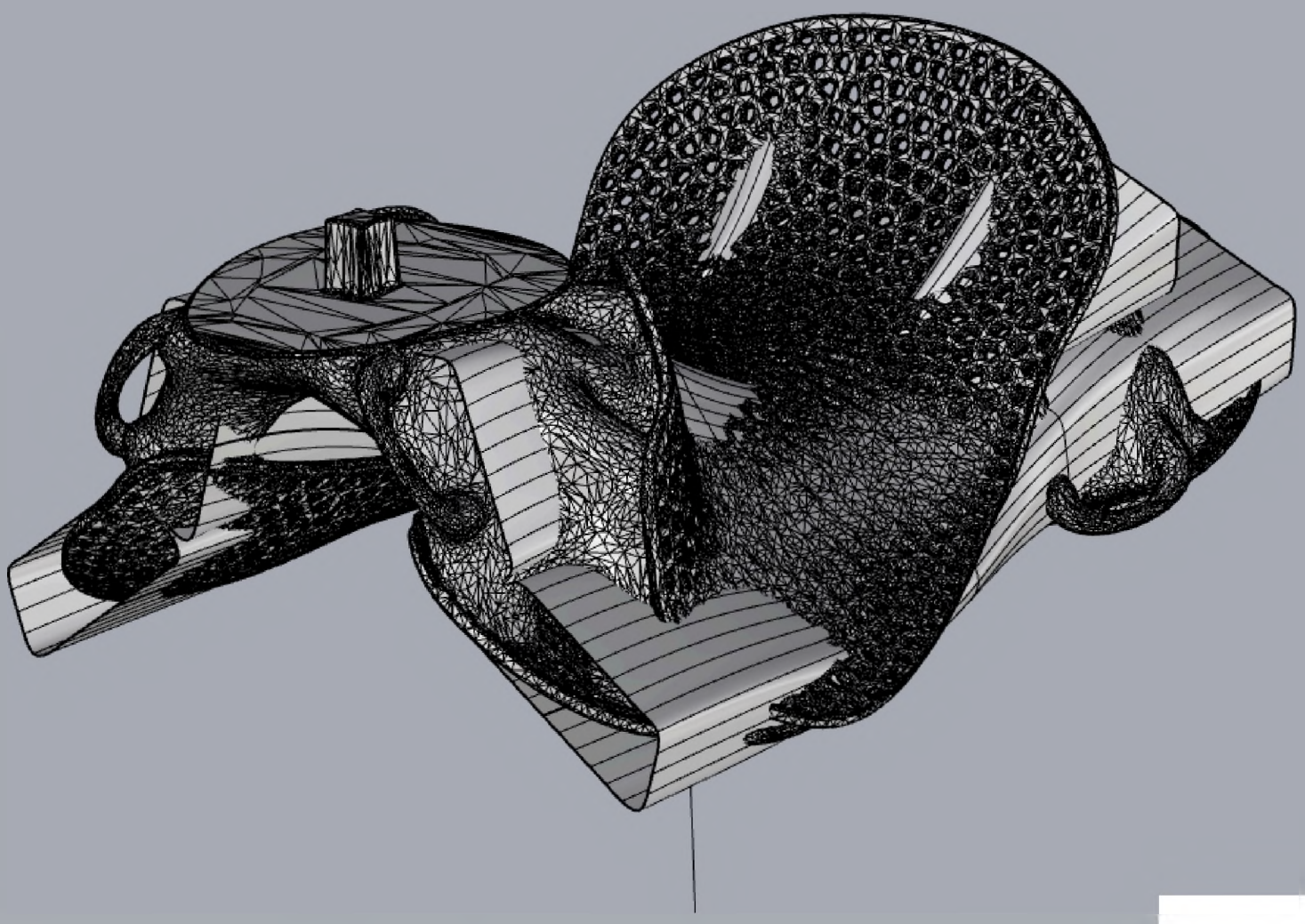
ducting



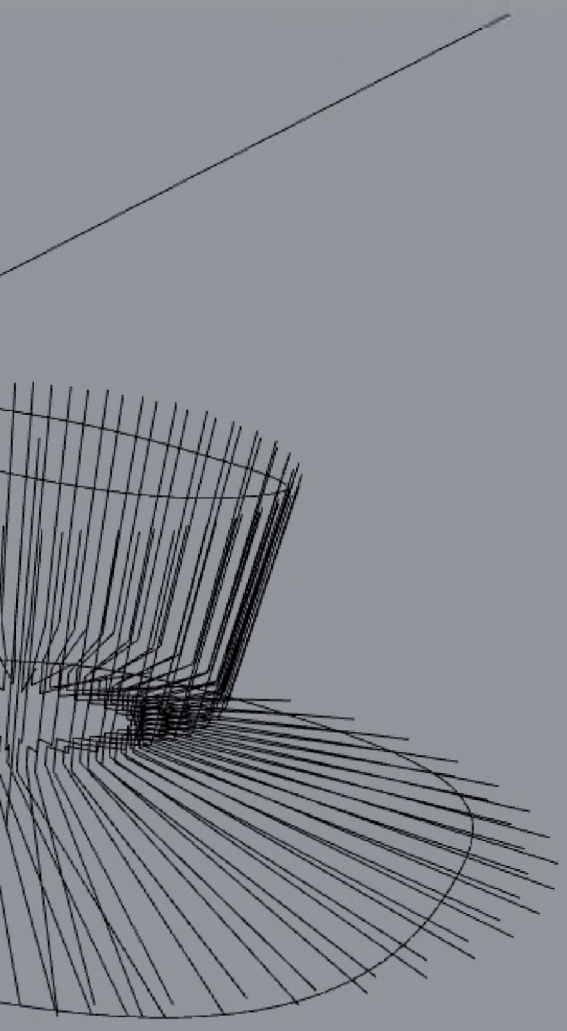








initial fitting



Material type

Plastic

Material name

Formlabs Flexible Resin 80A

Process compatibility

SLA

The flexible resin is an elastomer that makes bendable and compressible parts. However, this material has low elongation meaning that it is not stretchable.

David Mechanical Engineering Lead at Hubs

Download datasheet | Email this page

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Mechanical properties

Ultimate tensile strength	8.9 (post-cured) MPa
Elongation at break	120 (post cured) %
Hardness	80A (post cured)

Physical properties

UV resistance	No

Electrical properties

ESD Safety	Yes

Post treatments

Post-Processing	Post-curing

Common applications

- Prototyping handles grips and overmolds
- Cushioning and damping
- Wearables and consumer goods

ENGINEERING RESIN

Flexible 80A

Flexible 80A Resin for Hard Flexible Prototypes

Flexible 80A Resin is the most stiff soft-touch material in our library of Flexible and Elastic Resins, with an 80A Shore durometer to simulate the flexibility of rubber or TPU.

Balancing softness with strength, Flexible 80A Resin can withstand bending, flexing, and compression, even through repeated cycles. This material is well-suited for cushioning, damping, and shock absorption.

Handles, grips, overmolds

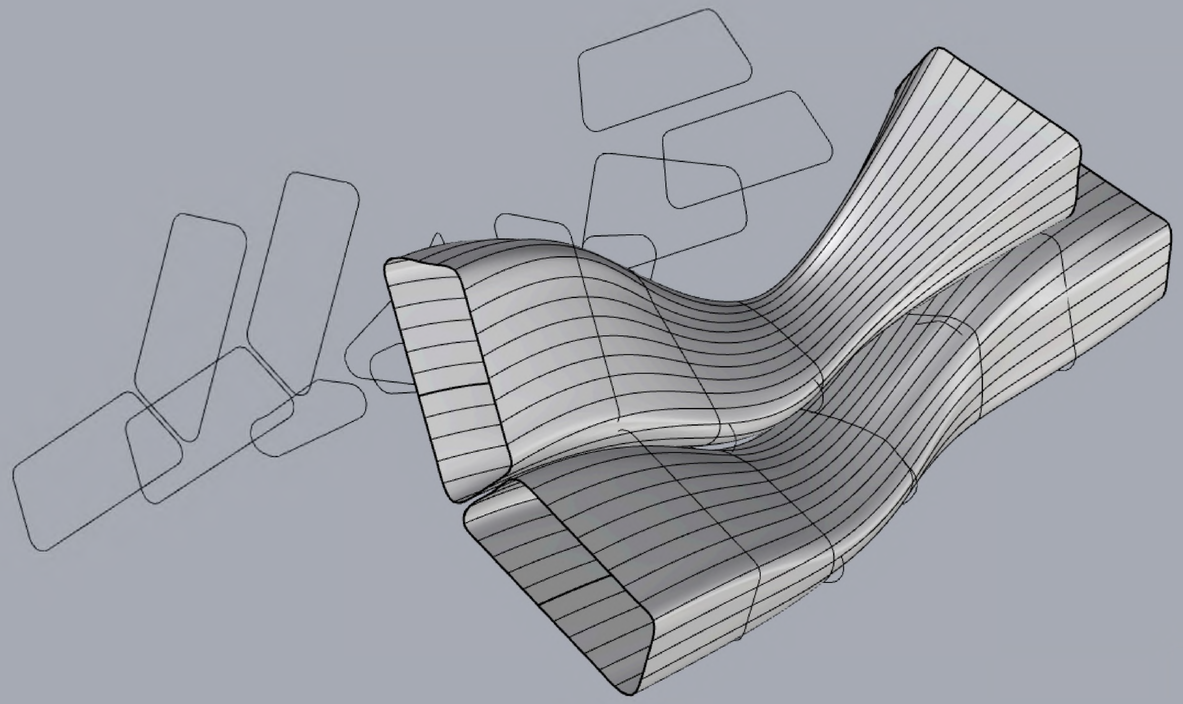
Cartilage and ligament anatomy

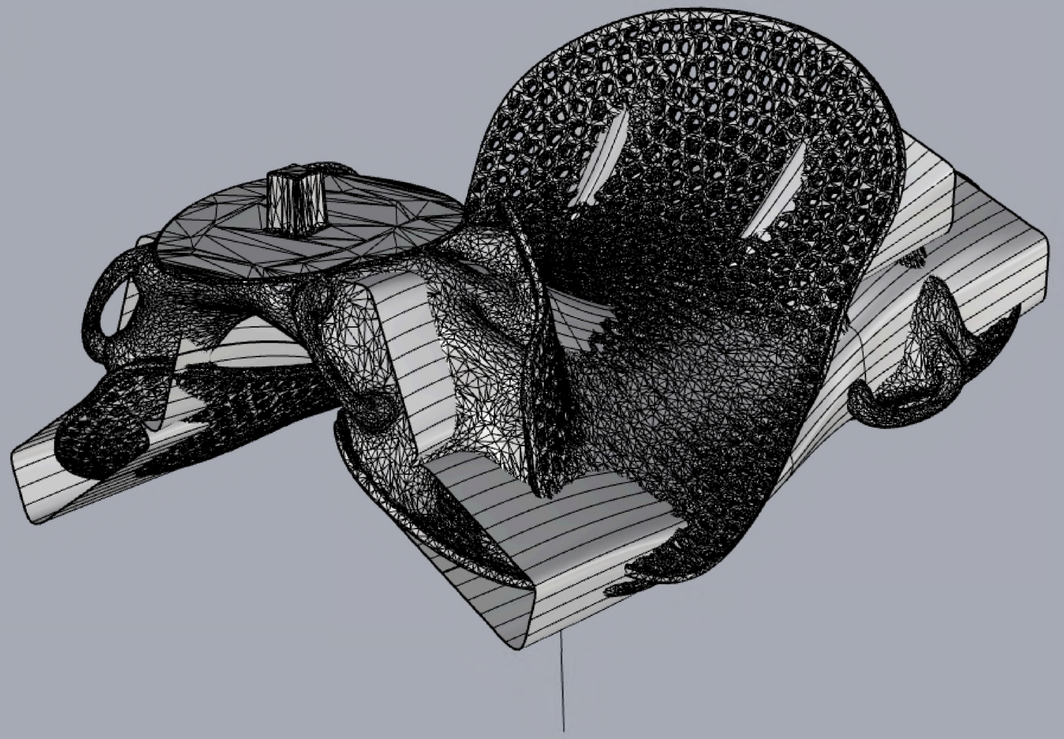
Seals, gaskets, masks

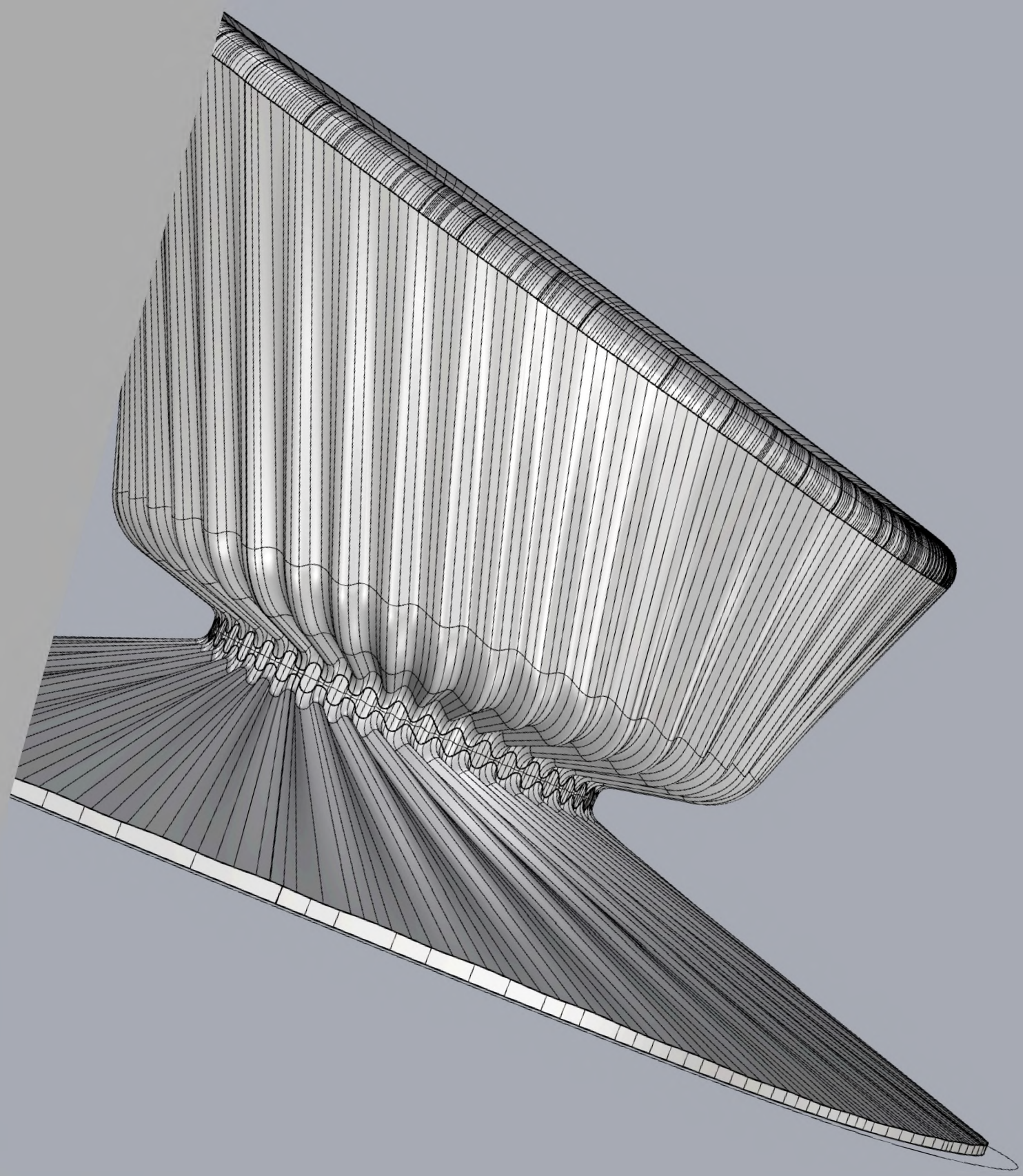
V1 **FLFL8001**

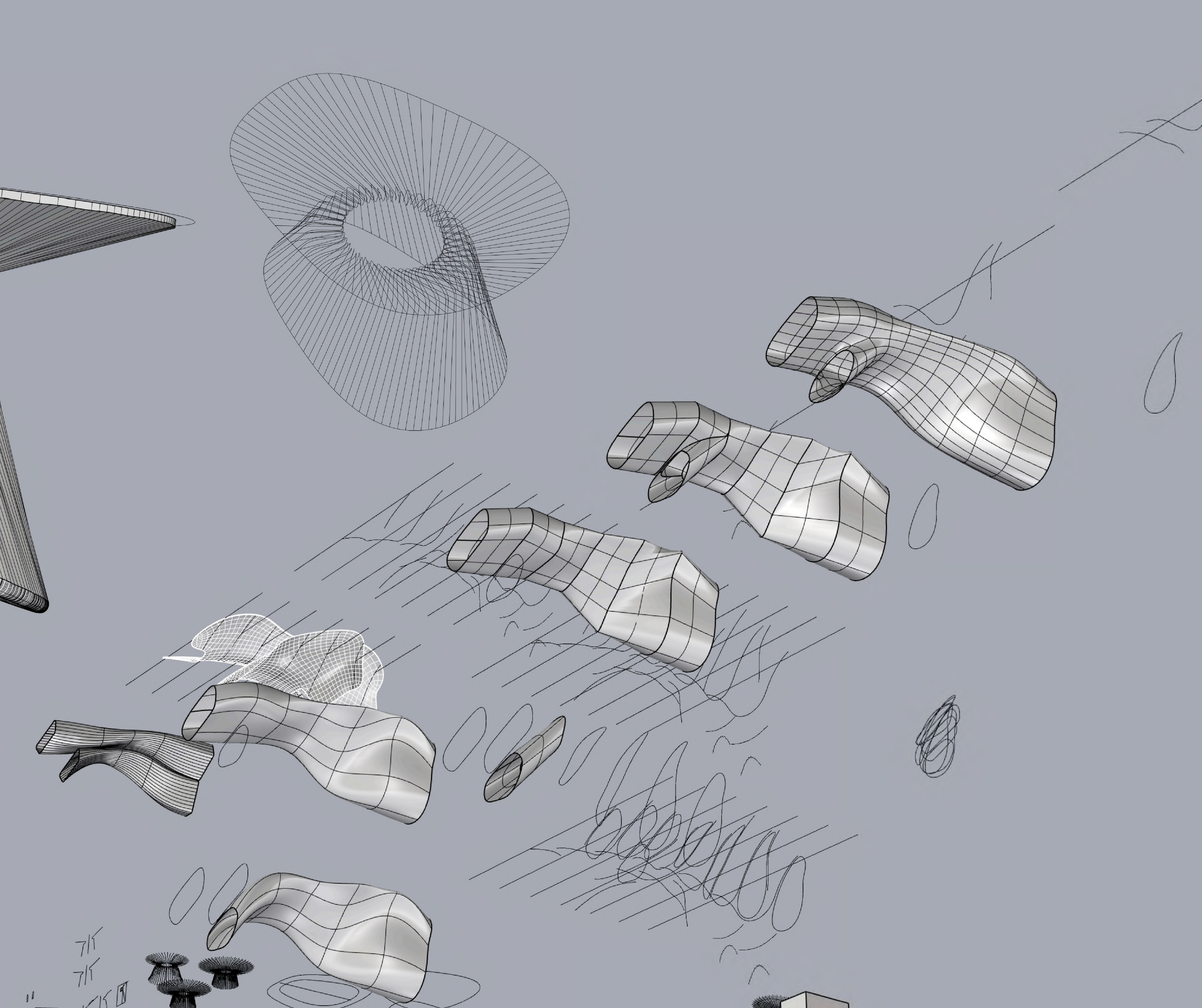
formlabs

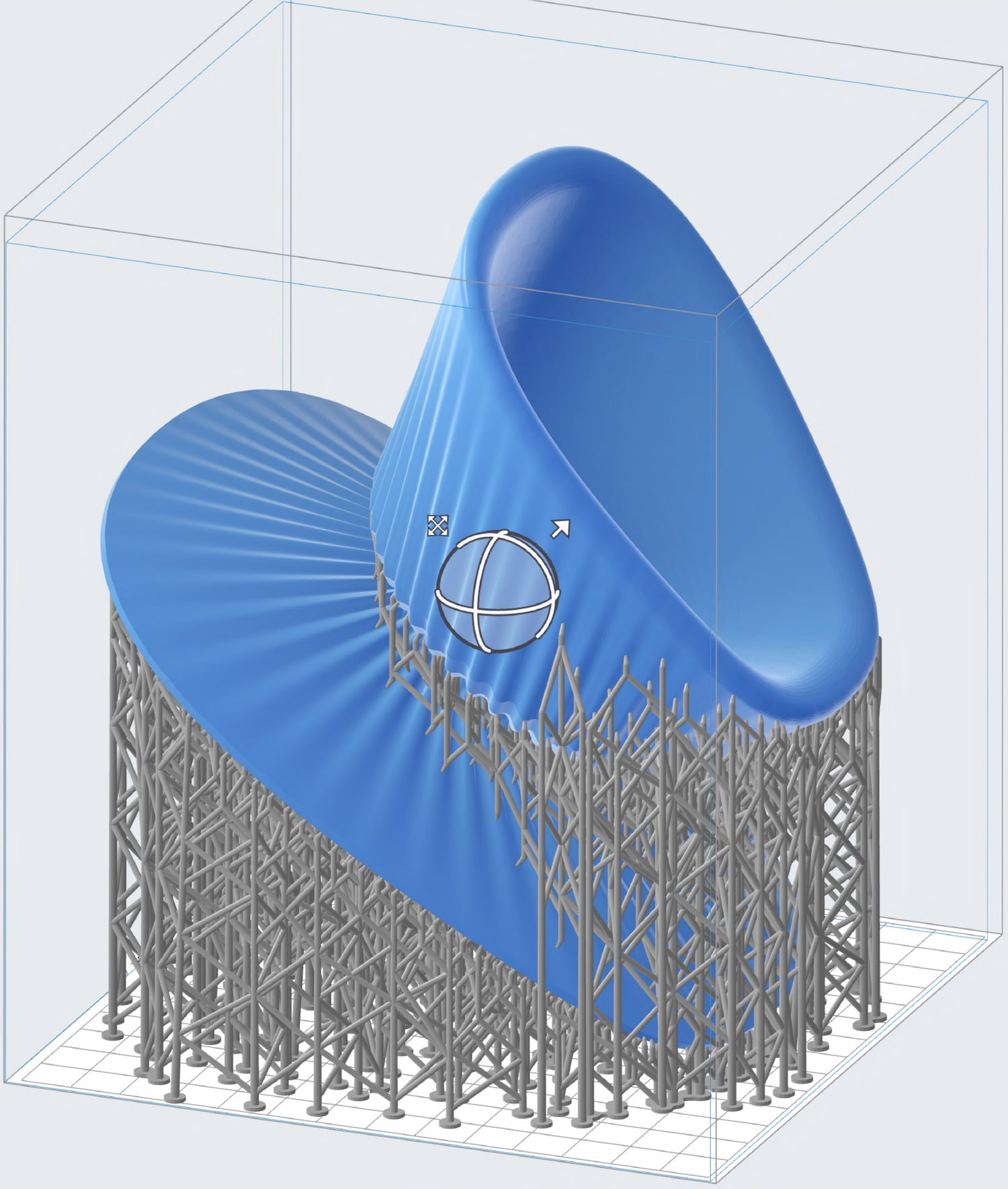
Prepared 05 . 29 . 2020
Rev 01 05 . 29 . 2020











JOB INFO

JOB SETUP

IDLE

VivaciousCobra

Ready to Print

Resin	Grey V4
Layer Thickness	0.160 mm

DETAILS

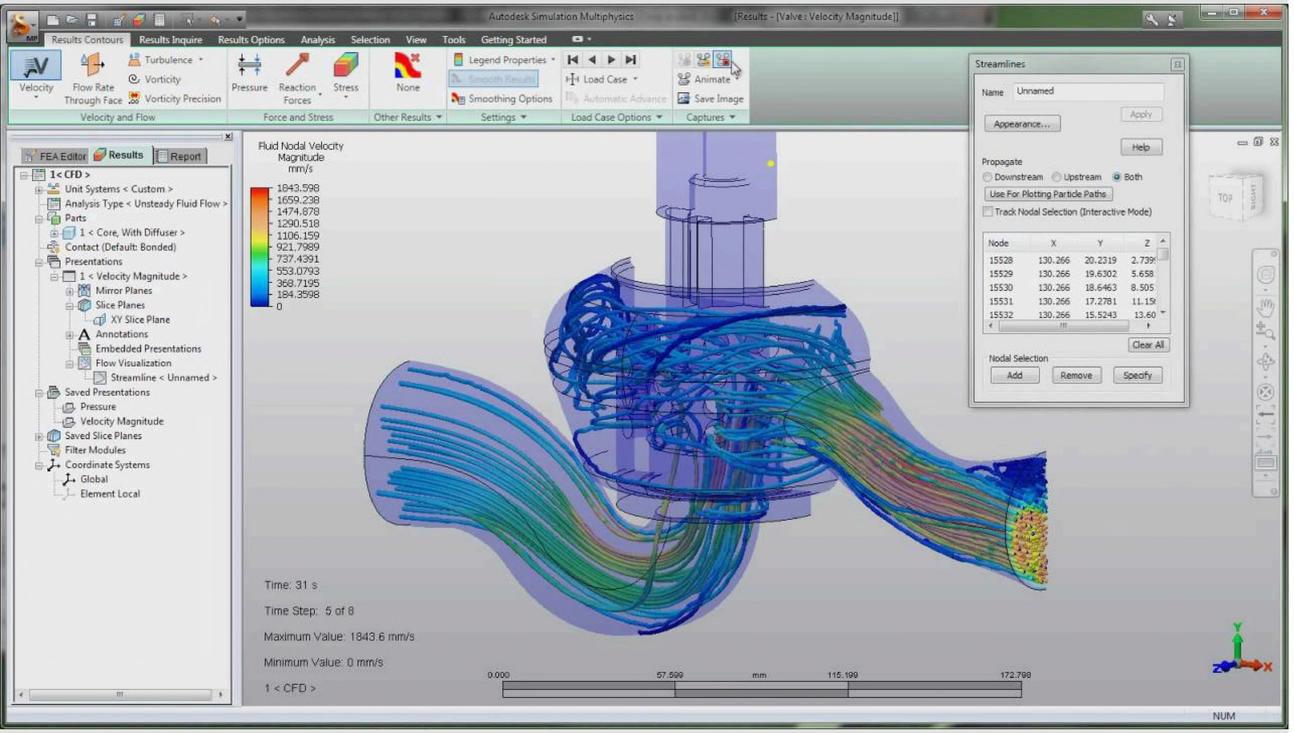
Print Time	~ 18 h
Layers	1058
Volume	508.76 mL

PRINTABILITY

Printability	Pass
Show Minima	
Show Cups	

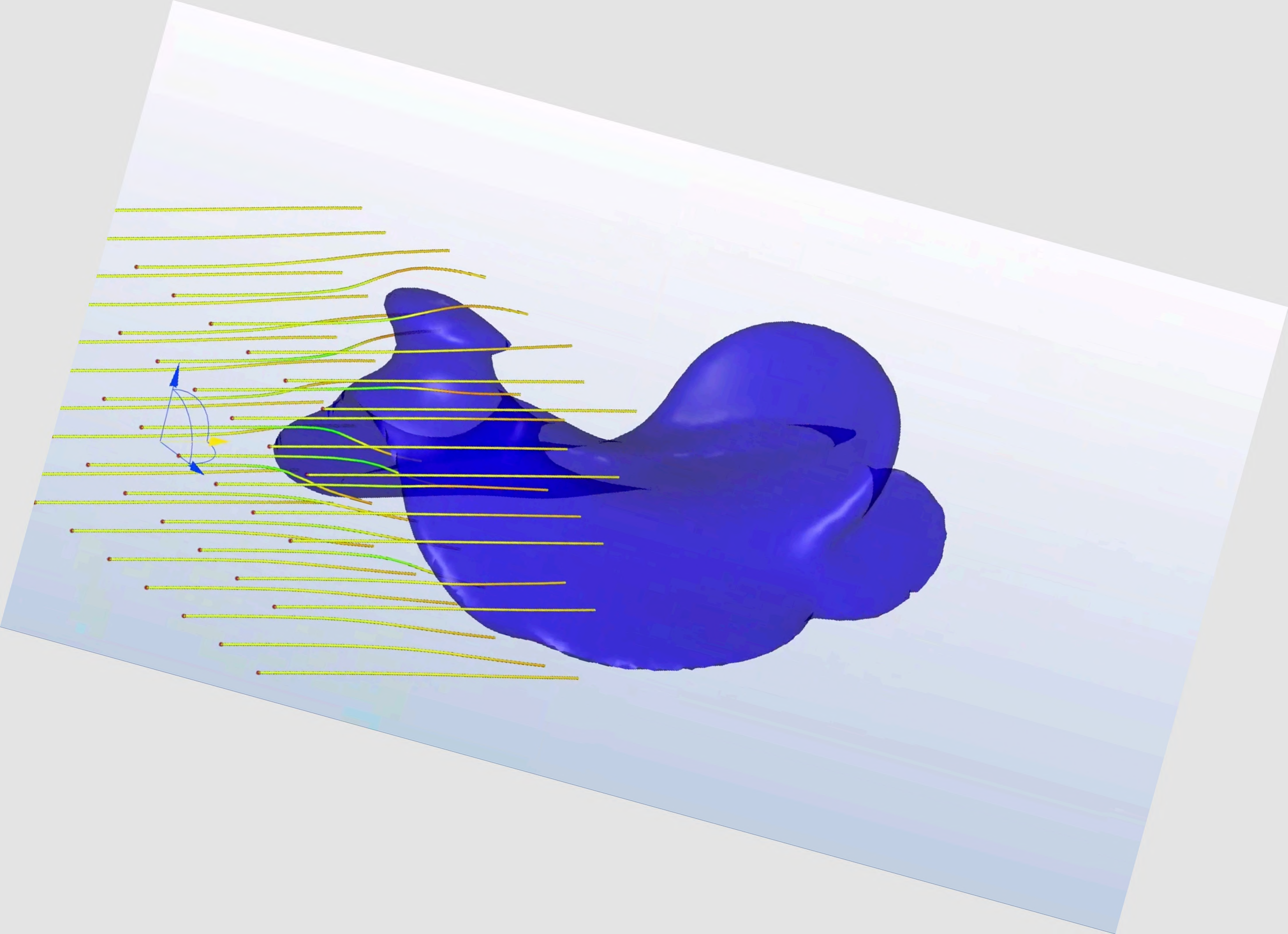
MODEL LIST (1)

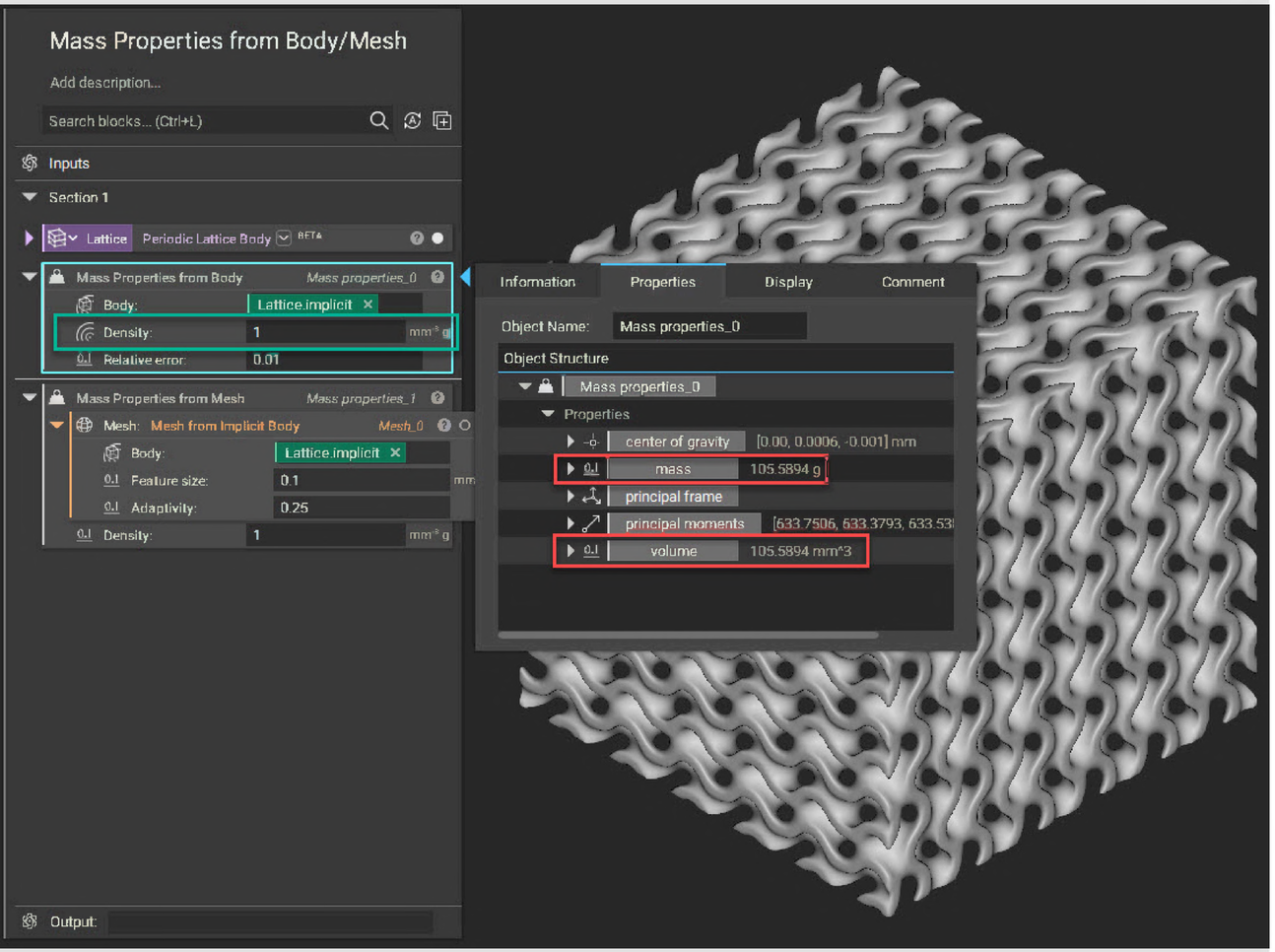
winegar_horn_v3



CFD Analysis

- Objective
  - Is the airflow better?
- Setup
  - Finalize 3D models
  - Test workflow in Autodesk CFD
- Method
  - Run CFD analysis on JCM saddle
  - Run CFD analysis on new model
- Visual
  - Side-by-side gifs of tracer lines
  - CFM results



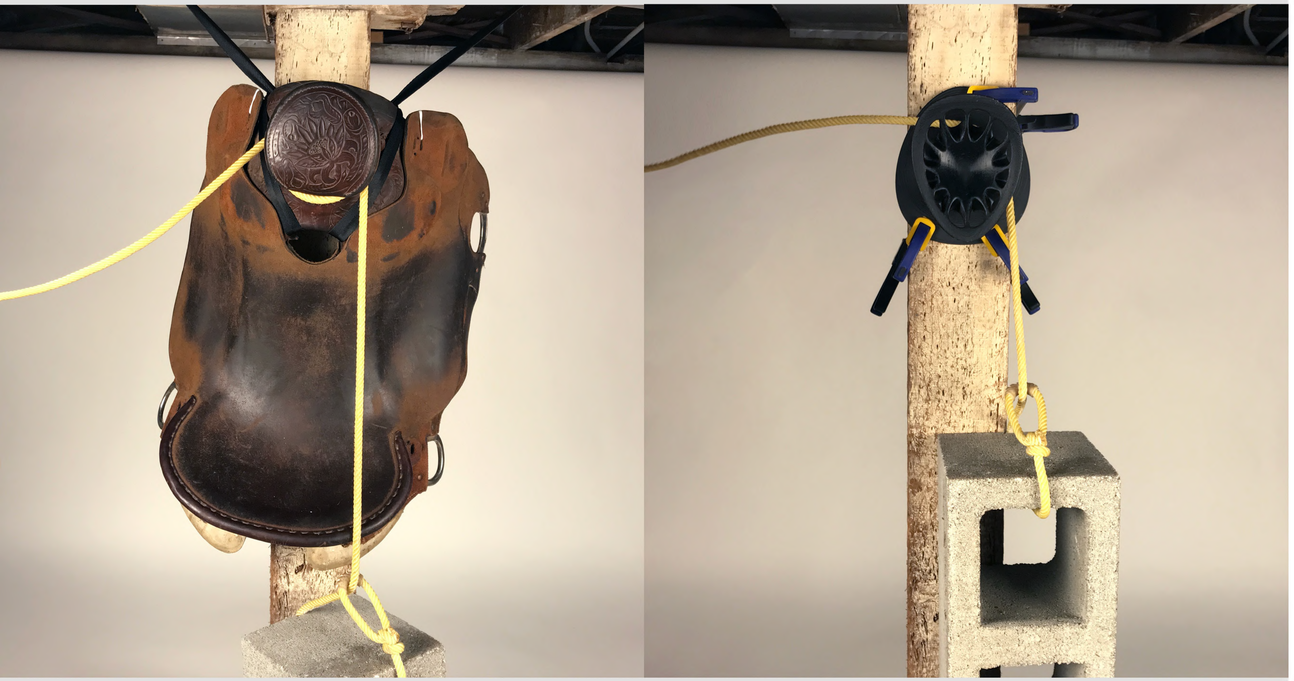


Weight Calculation

- Objective
  - Does it weight less?
- Setup
  - Finalize 3D model
- Method
  - Compute 3D printed weight from software
  - Weigh webbing
  - Use JCM weight as benchmark (40.1)
- Visual
  - Gif of JCM saddle stack + weight
  - Create gif of new model stack + weight

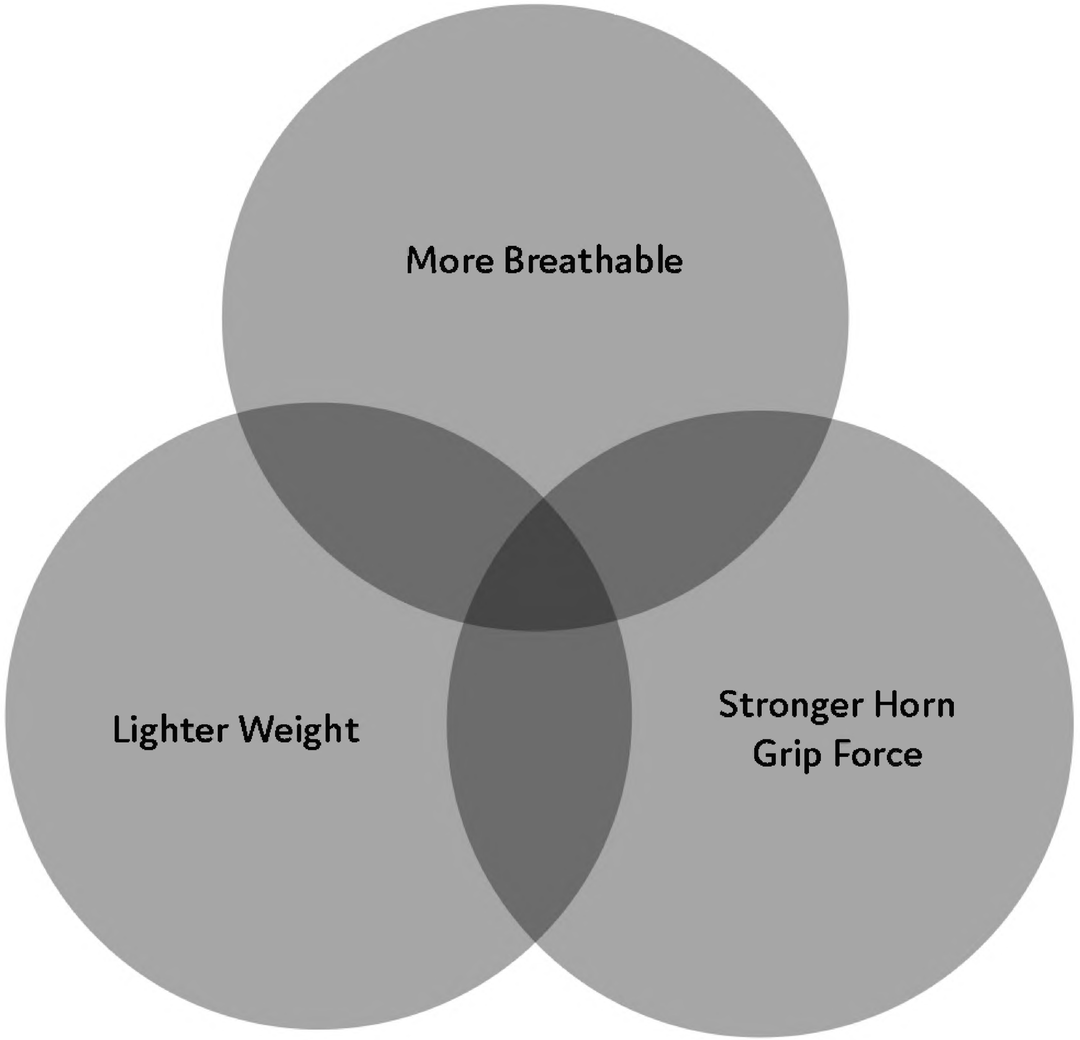
Strap Pull Fit Test

- Objective
  - Are there fit issues?
- Prep
  - Test fit at Silver Spur Equestrian with Alli Sloop
  - Tests were advised from Chris at Double H
  - Test benchmark and foam model
- Method
  - Place a series of webbing straps along the horses back
  - Lightly tighten the cinches
  - Record which straps pull out with a light pull
- Visual
  - Take video of test
  - Make overhead graphic of results



Static horn grip

- Objective
  - Do the horns have equal static friction?
- Prep
  - Test advised by Metolius
  - SLS print the new horn
- Method
  - Mount the horns vertically
  - Dally rope and attach 70 lbs of weight
  - Gradually drain water weight from opposing side of rope to determine the point of slippage
  - Calculate static friction with the static friction equation
- Visual
  - Take video of the process
  - Side-by-side time lapse
  - Static friction amounts



USER INSIGHTS

After speaking with ranch workers and visiting Wilson Ranch, a few themes emerged:

- Horses get too hot, and it slows the work down
- Saddles are heavy, but they have to be durable
- Ranch work revolves around the horn and pulling animals

Translating these into product directions:

1. More breathable
2. Lighter weight, yet same durability
3. Strong dally grip and low rope position

QUESTIONS	AVERAGE ANSWERS	GOOD QUOTE
1. How many years have you been western horse riding?	13.5 years	
2. How many years have you been working on a ranch?	6.25 years	"Too long. But this place tends to grab you."
3. How many years have you had your primary working saddle?	4.38 years	"I want to get a new one, but this one fits us both well."
4. Where did you get your saddle from and for how much?	Small saddle shop, $2,250	"You never know what you're getting at a big producer."
5. What do you like most about your saddle on a hot day?	Not a lot of answers. Leather doesn't get too hot was one common one.	"Not a damn thing."
6. What frustrates you most about your saddle on a hot day?	More likely to slip, metal can get hot	"Once the horse is slicked, you're more likely to end the day with your head on a rock."
7. How would your horse answer the last two questions?	A. Trimmed back skirt B. Extra thick skirt, slipping saddle	"I mean, it's a full inch of wool felt. How cool do you think it is?"
8. What would help your saddle be better for hot days of work?	Stay in place better. Trimmed skirt.	
9. What is your dream hot-weather saddle setup (with accessories)?	Preference for what they already have. Aluminum buckles.	
10. Where do you (or your horse) get saddle sores when it's really hot?	Along the withers usually. Or the inner thigh and crotch for the rider.	"I used to get rawer than a fresh pealed rabbit."
11. Has heat ever kept you from getting work done?	Emphatic yesses. Horses are slower. Don't work on dangerous days.	"The horses really slow down in the heat. It's unfortunate, but what can you do?"
12. What do you do to deal with heat on really hot days?	We work extra early.	"The days aren't too hot if you get out of bed early enough."

COMMON ANSWERS & QUOTES

This has been covered before, but here's the summary table of survey question answers and some relevant quotes.

SIDE NOTE:

AUSTRALIAN SADDLE

I spoke with a guy that had spent a long time ranch in Australia. He mentioned that the saddles there might be a place to look.

- Lighter weight, minimal tree
- A little more heat-oriented
- No horn

BENCHMARK PRODUCT

A JC Martin saddle will be used as the benchmark product. A fe details:

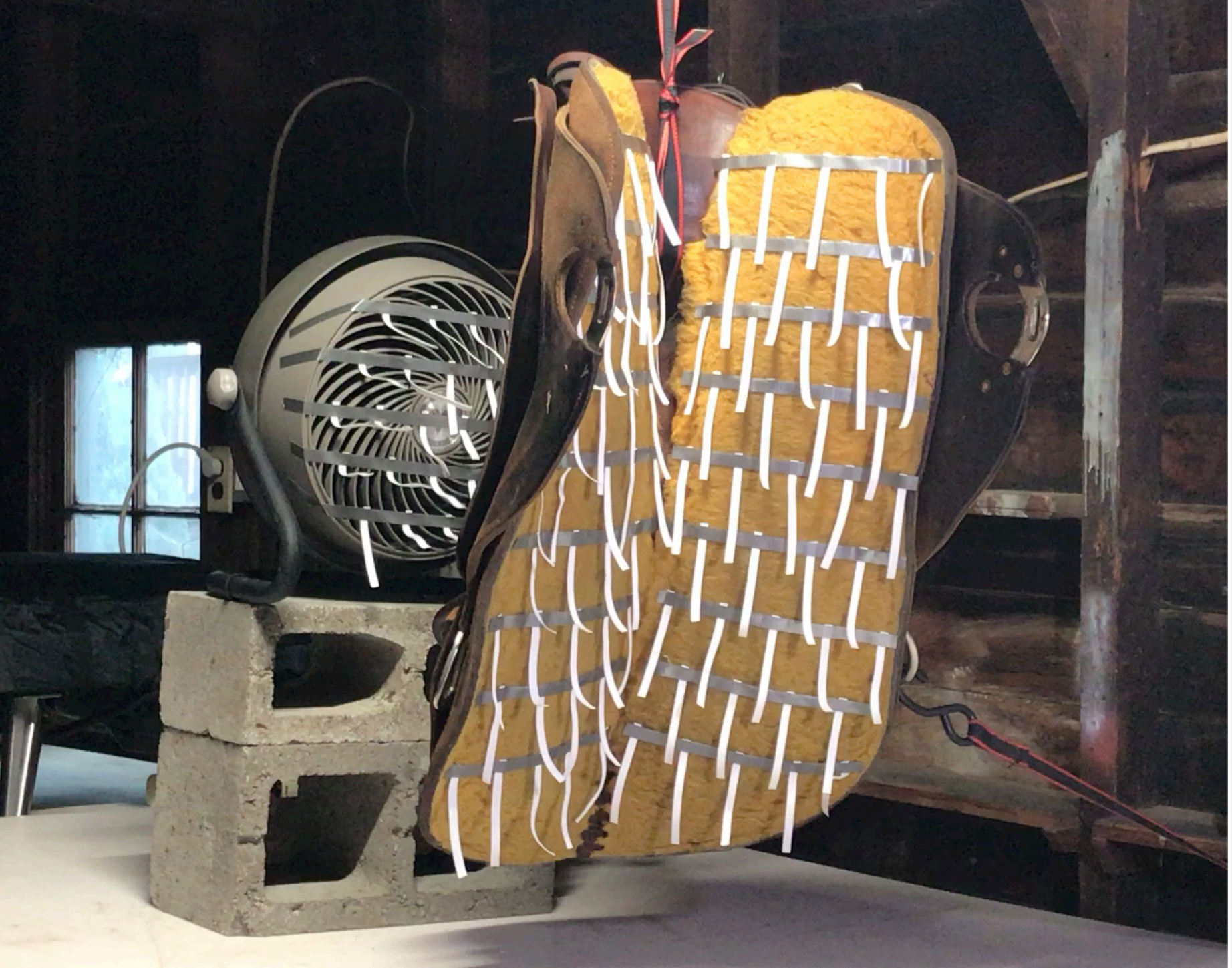
- Fiberglas tree
- 17 inch seat size
- Robust, full grain construction
- Used on a working ranch

TOTAL WEIGHT	40.1 pounds
SADDLE WEIGHT	20.2 pounds
RIGGING WEIGHT	15.5 pounds
PAD WEIGHT	4.4 pounds

CINCH STACK THICKNESS	1.25 inches
STIRRUP STACK THICKNESS	1.875 inches

BENCHMARK WEIGHTS

The saddle weighs 40 full pounds, but only half of that is the saddle itself. The other half is in the cinch, rigging, and pad.



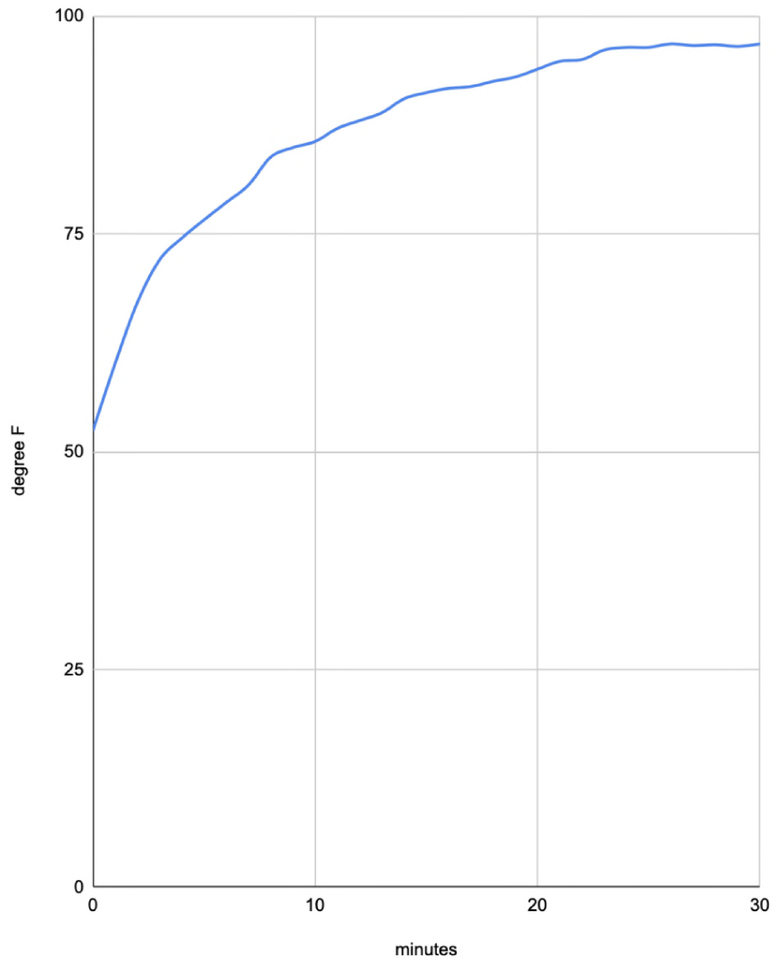
BENCHMARK
AIR FLOW TEST

Method:

1. Attach streamers in a pattern on the fan and the bottom of the saddle.
2. Blow air against the top of the saddle.
3. Compare the streamers.

Results:

It’s not really breathable at all. It won’t be hard to be a lot more breathable. There’s virtually no air flow except for open space behind the horn.



BENCHMARK HEAT TRANSFER TEST

Method:

1. Suspend saddle with low air flow underneath.
2. Suspend a space heater 5 inches above the seat.
3. Turn on space heater.
4. Take readings on the saddle seat surface every 1 minute with an infrared thermometer.

Results:

It has a typical graph. It takes about half an hour to stabilize at about 96 degrees F. Ambient temperature was cool, at 52 degrees F.

3.4 pound “grip” held a 70 pound load

Grip multiplied by 20

BENCHMARK ROPE FRICTION TEST

Method:

1. Suspend the saddle vertically to replicate the direction of the rope pull.
2. Attach 70 pounds to one side of the rope.
3. Dally the rope once around the horn and attach a container with 40 pounds of water on the other end.
4. Syphon water and record the weight of the partially filled container when the rope slips.

Results:

The rope slipped when the water container was down to 3.4 pounds. I was impressed. To pivot, I’ll try to replicate this same grip force with a metal material

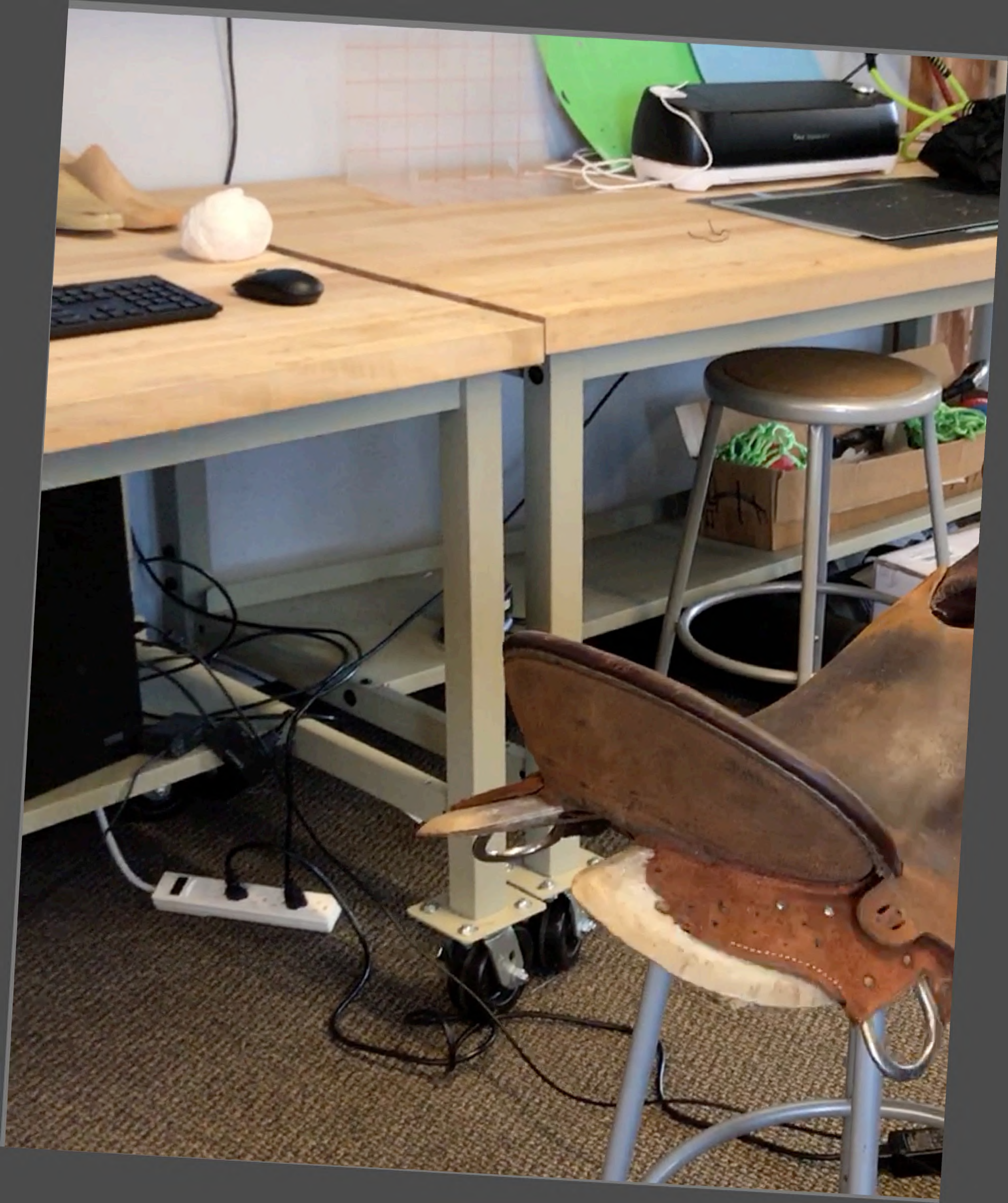
BREATHABILITY	100% more breathable
HEAT DISSAPATION	heat dissapation equilibrium 30% closer to ambient
TOTAL WEIGHT	50% less total weight (20 pounds or less)
RIGGING THICKNESS	75% thinner cinch thickness (5/8" thick or less)
ROPE RESISTANCE	Equal grabbing force with different material

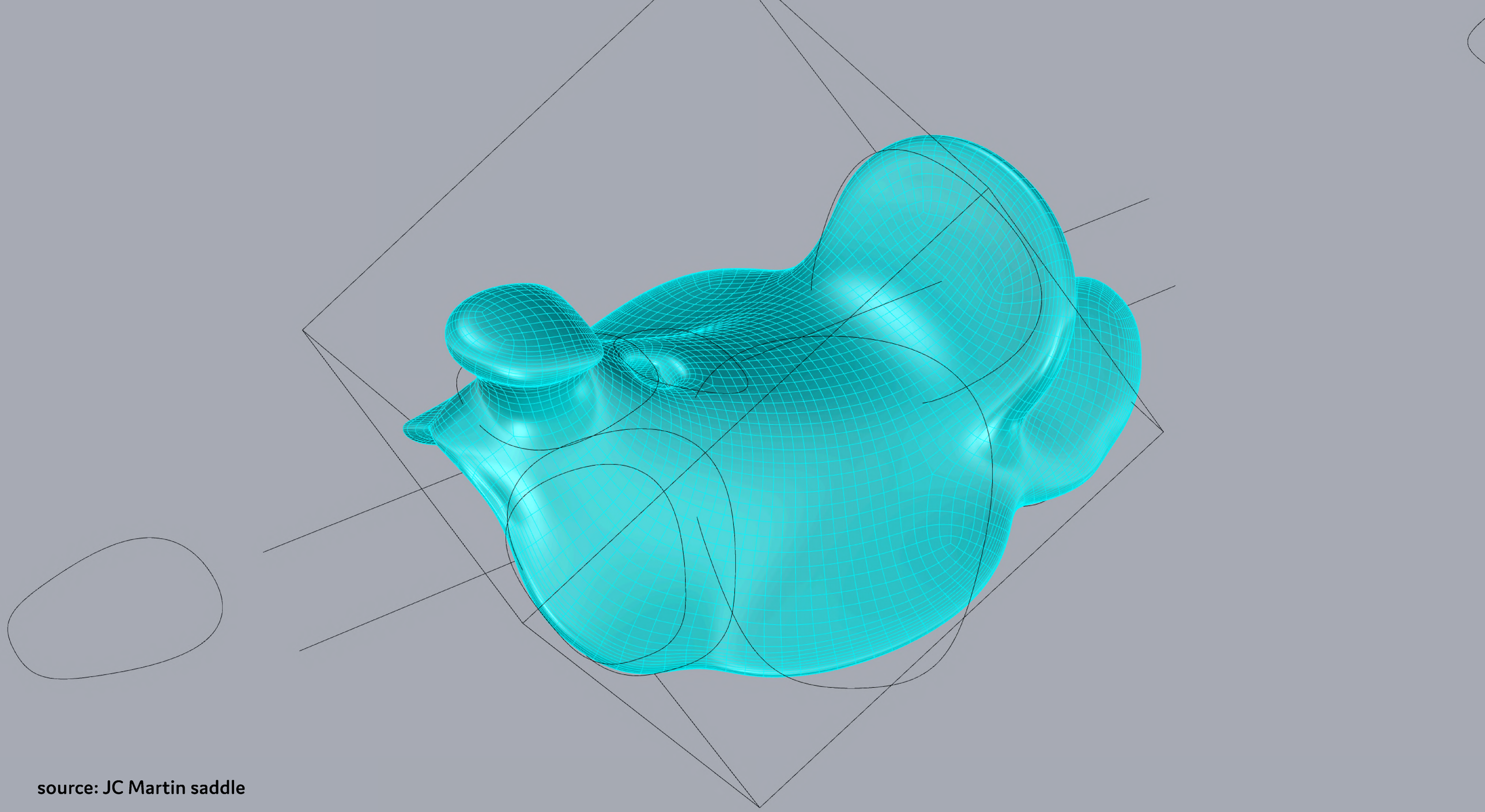
TARGET IMPROVEMENTS

For the most part, I'll stick with my original estimates as product development targets.

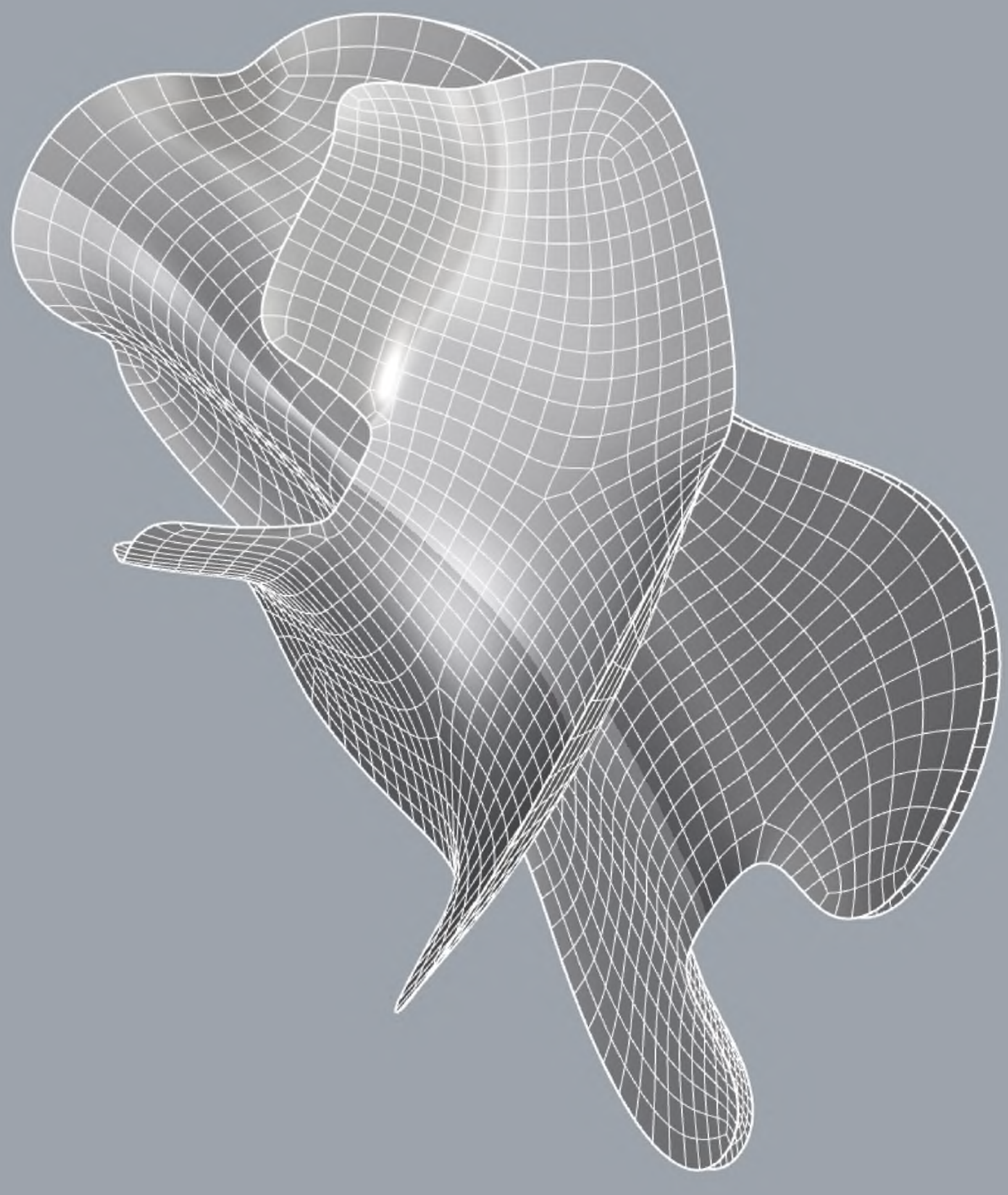
The breathability could be any number really. I think I could reasonably say 100% more breathable.

The one alteration would be with the static friction of the rope. The new goal is to just keep the same gripping force with a different material, likely 3D printed metal.





source: JC Martin saddle



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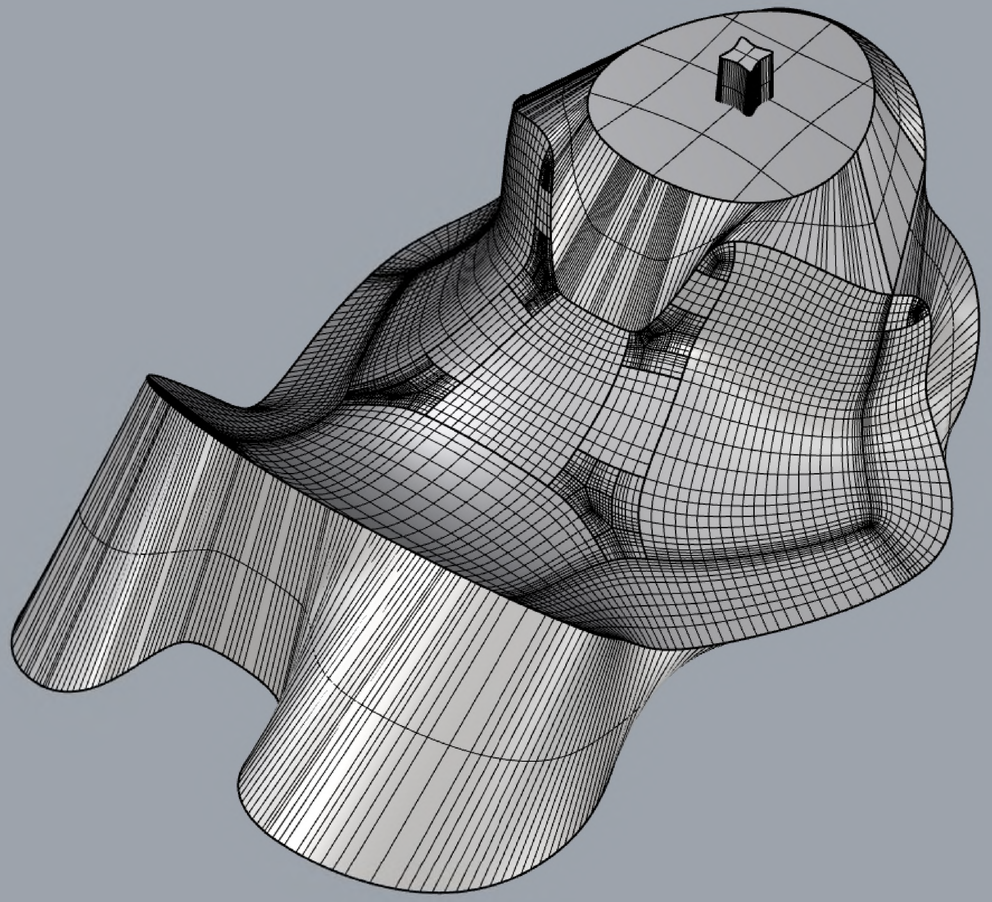
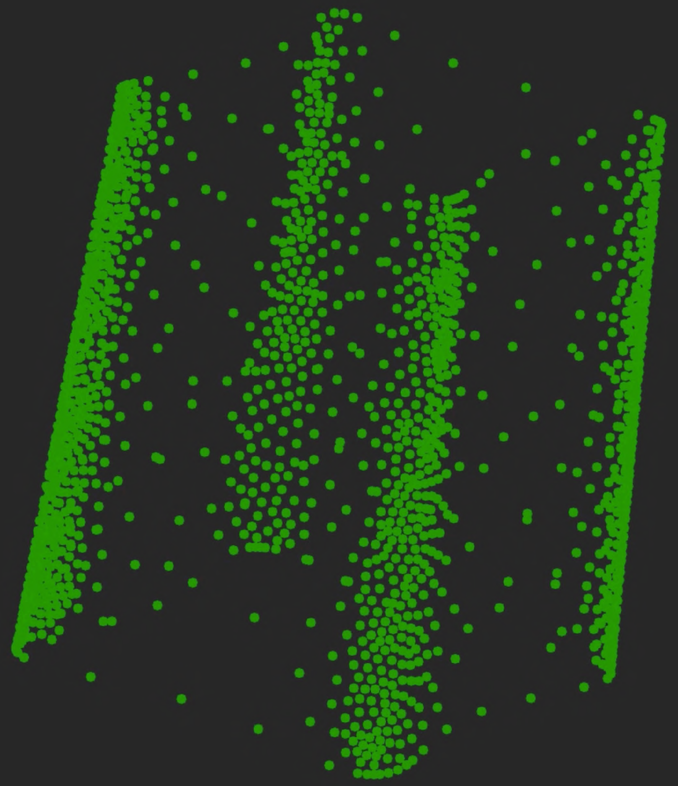
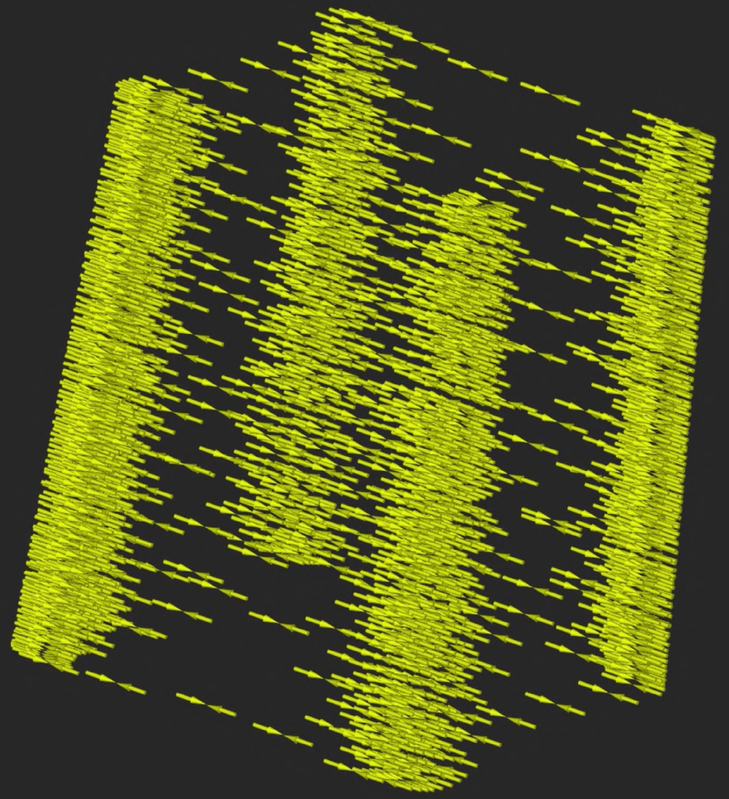
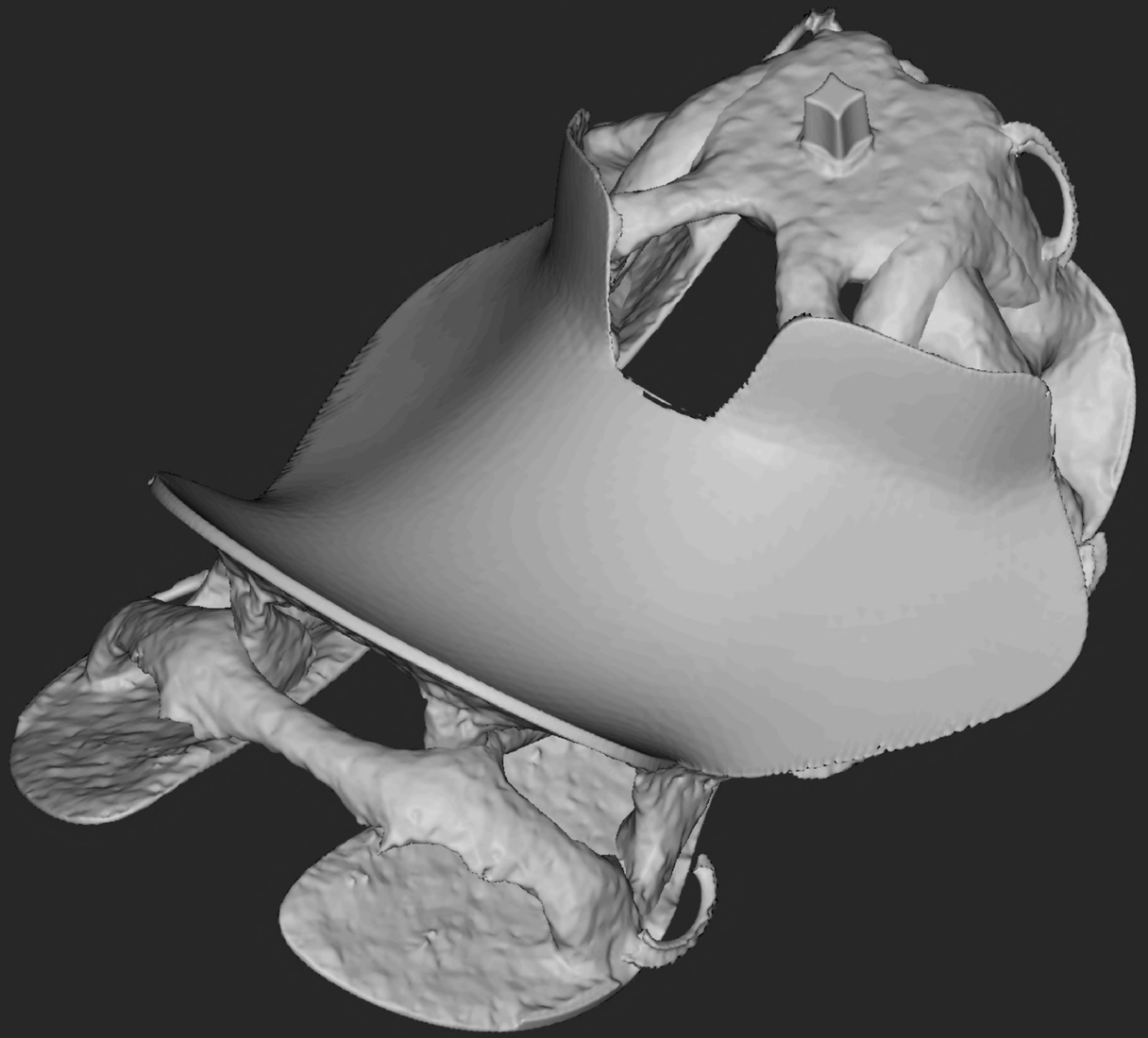
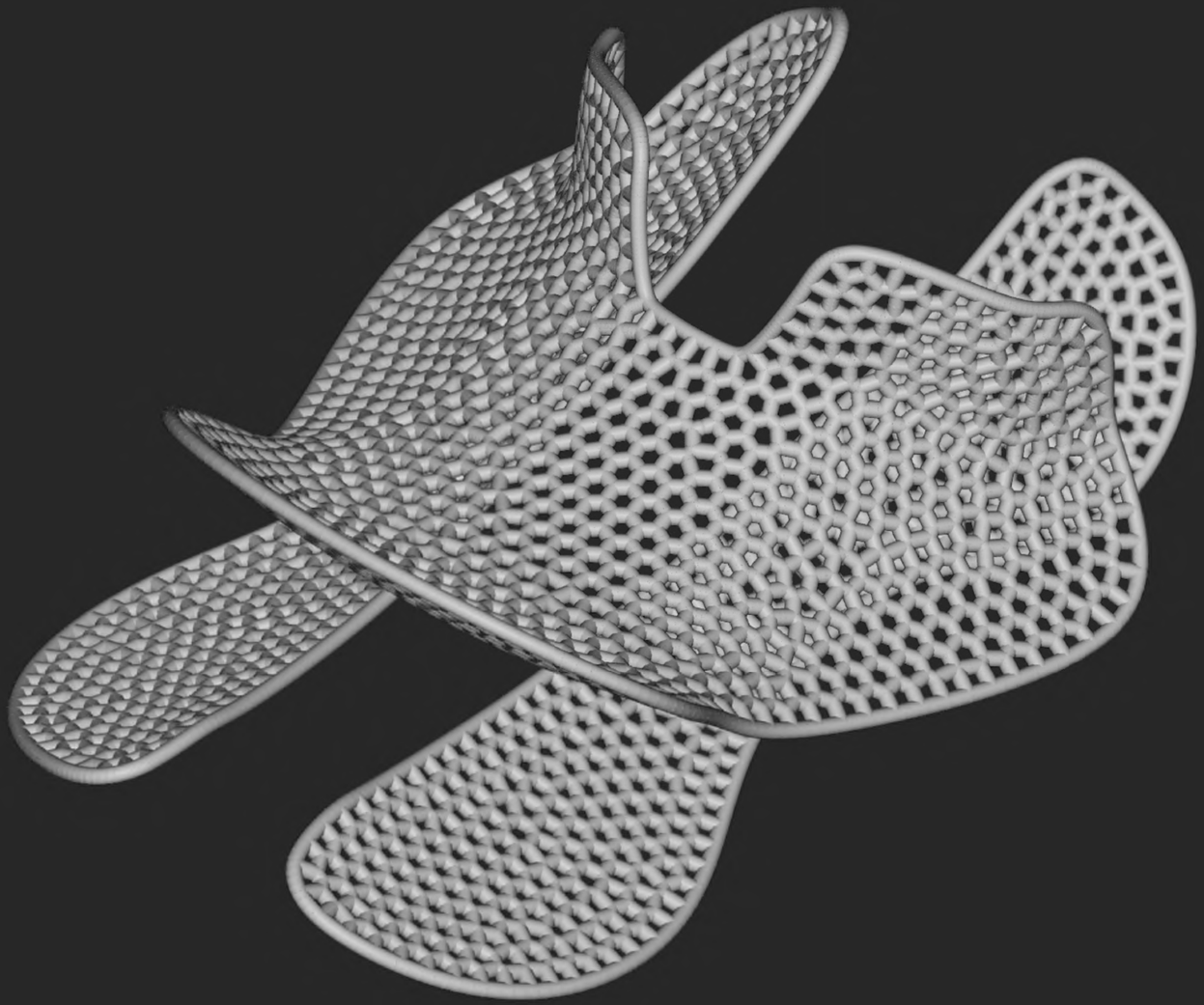
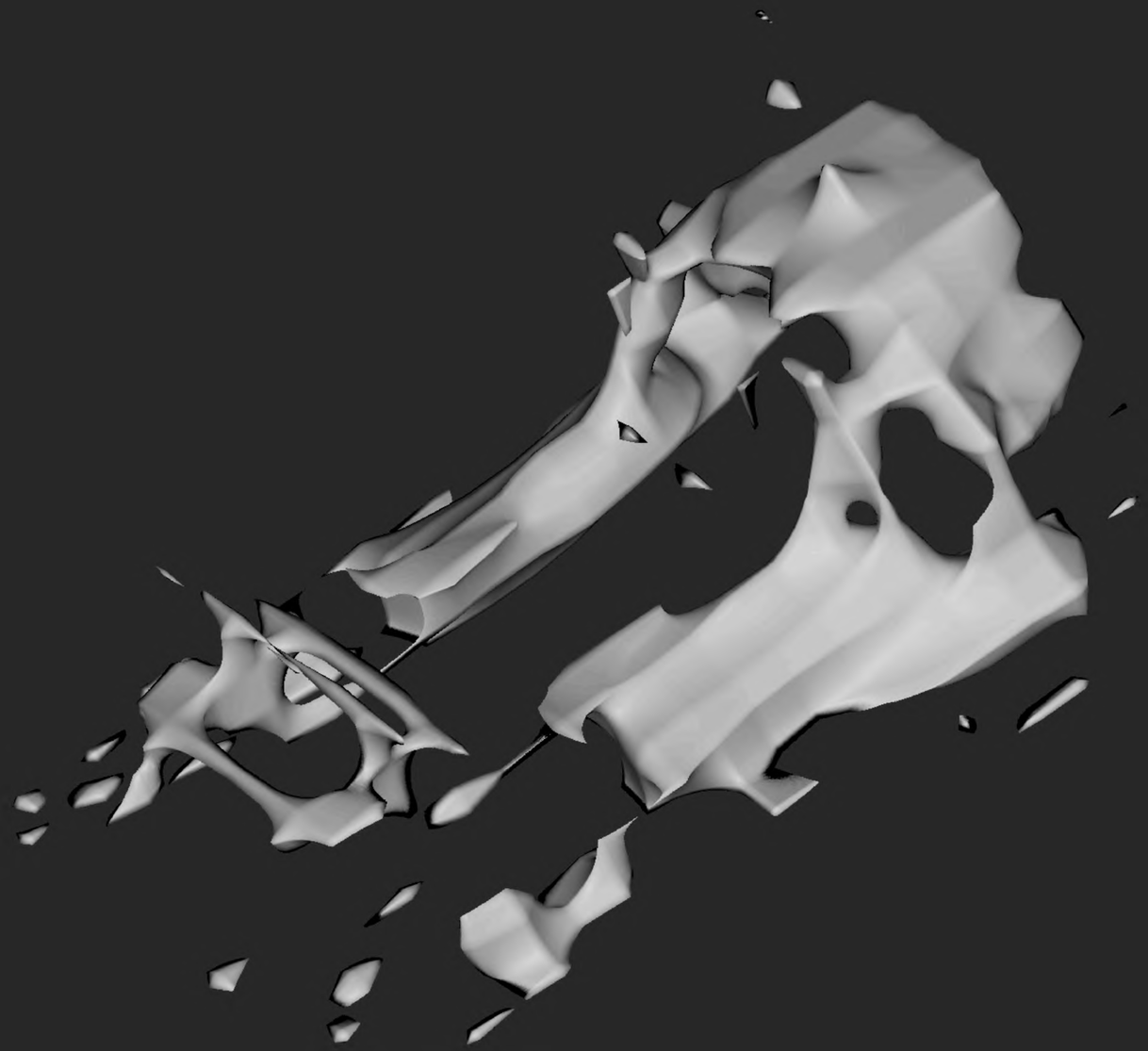


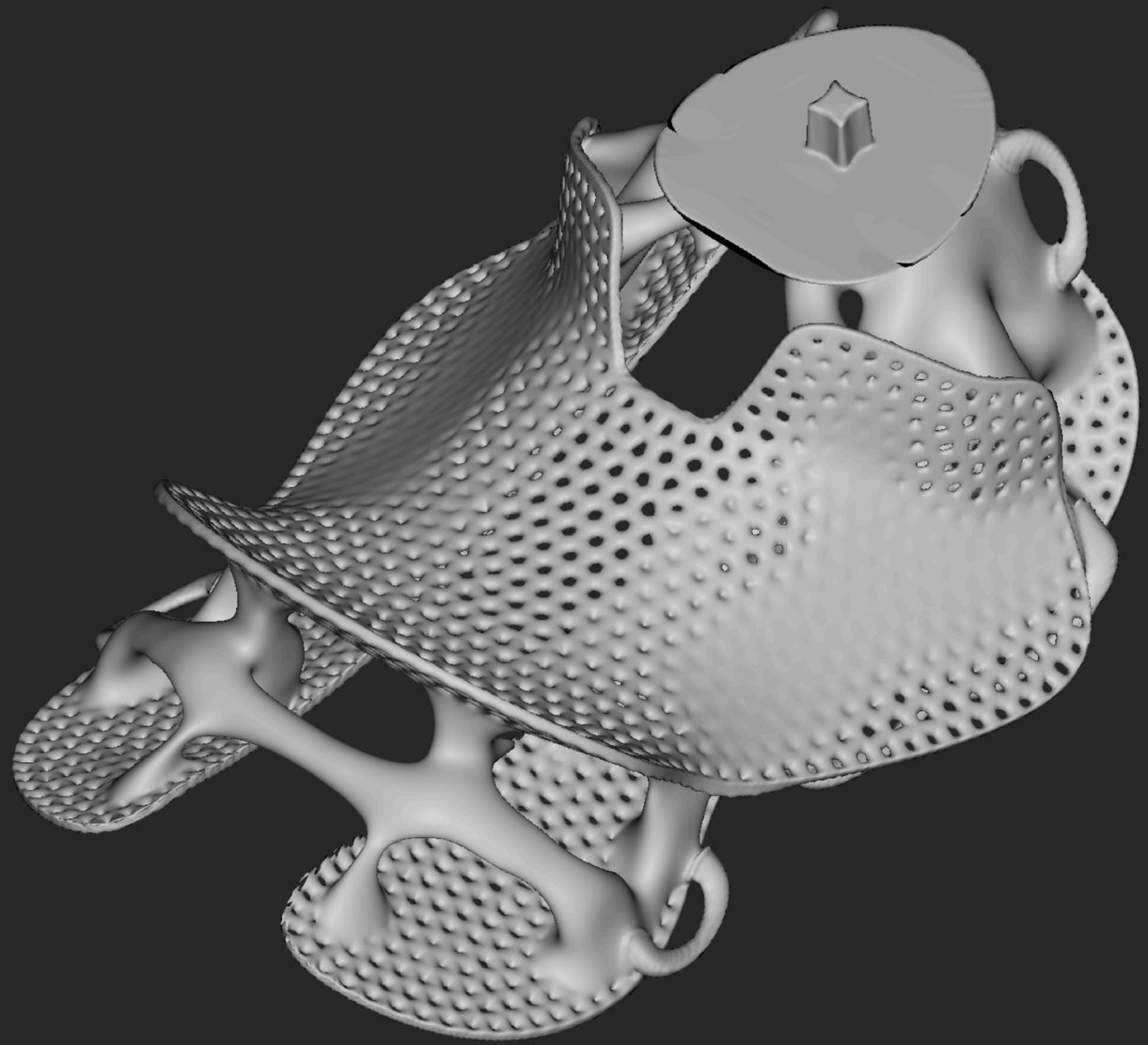


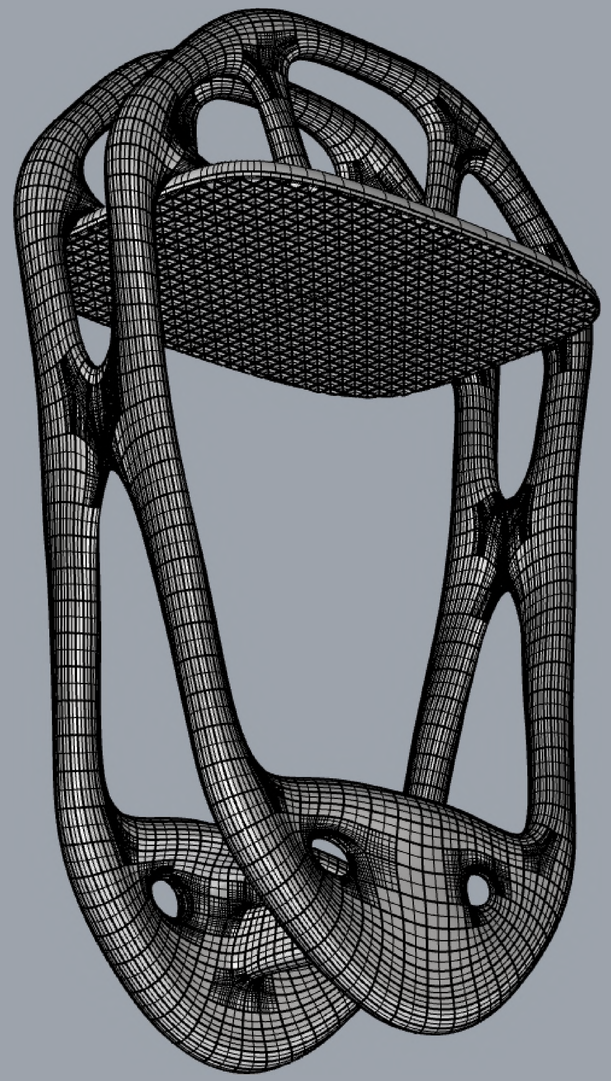


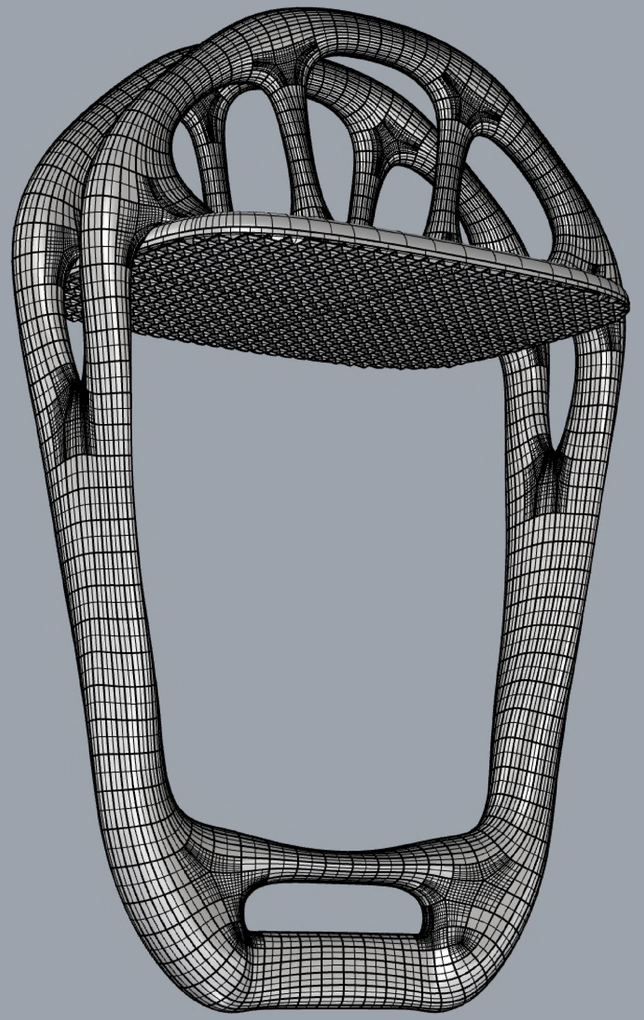


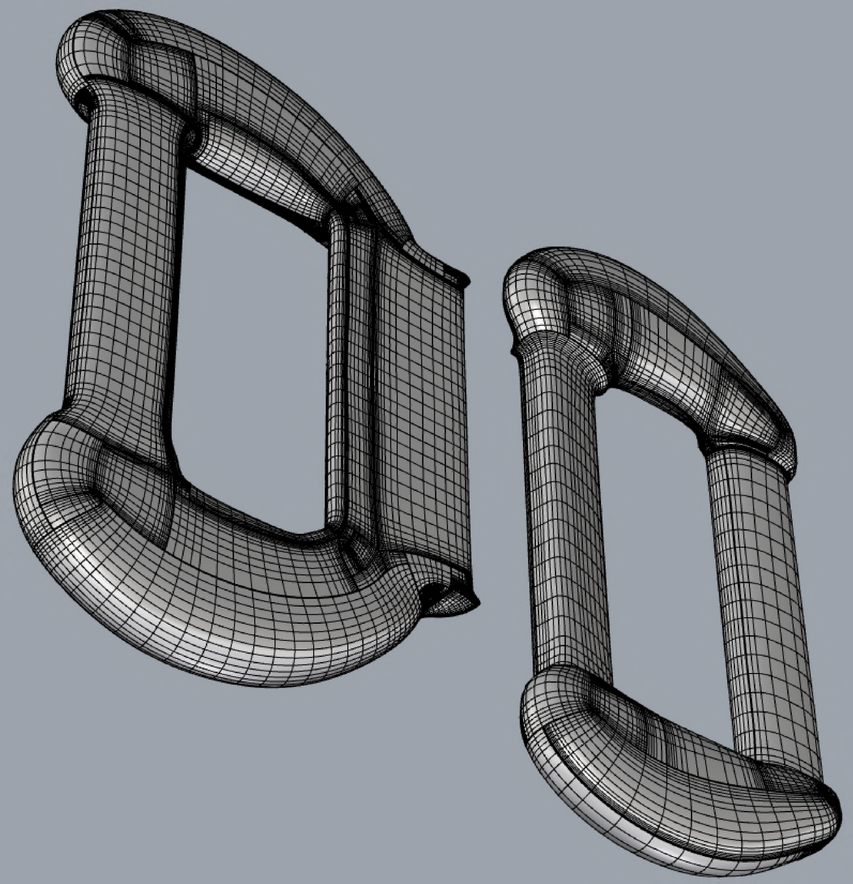


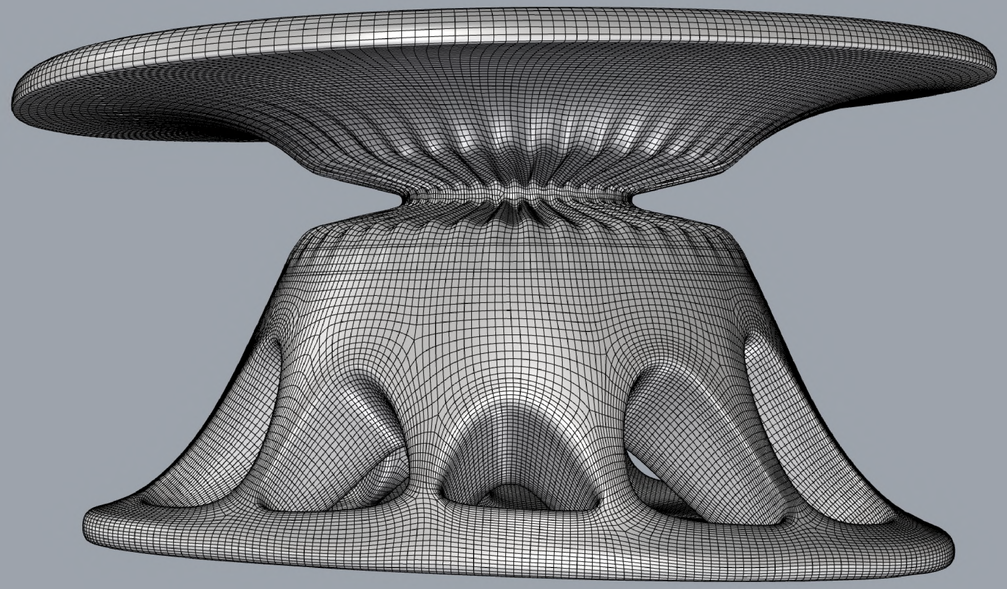


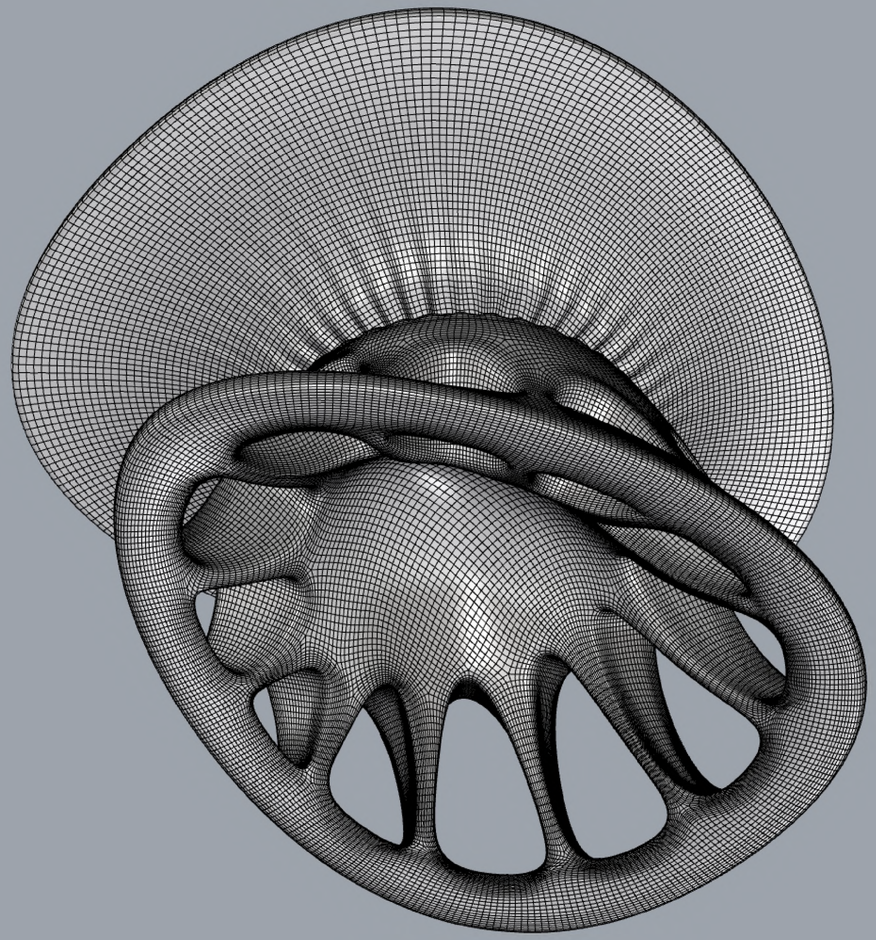


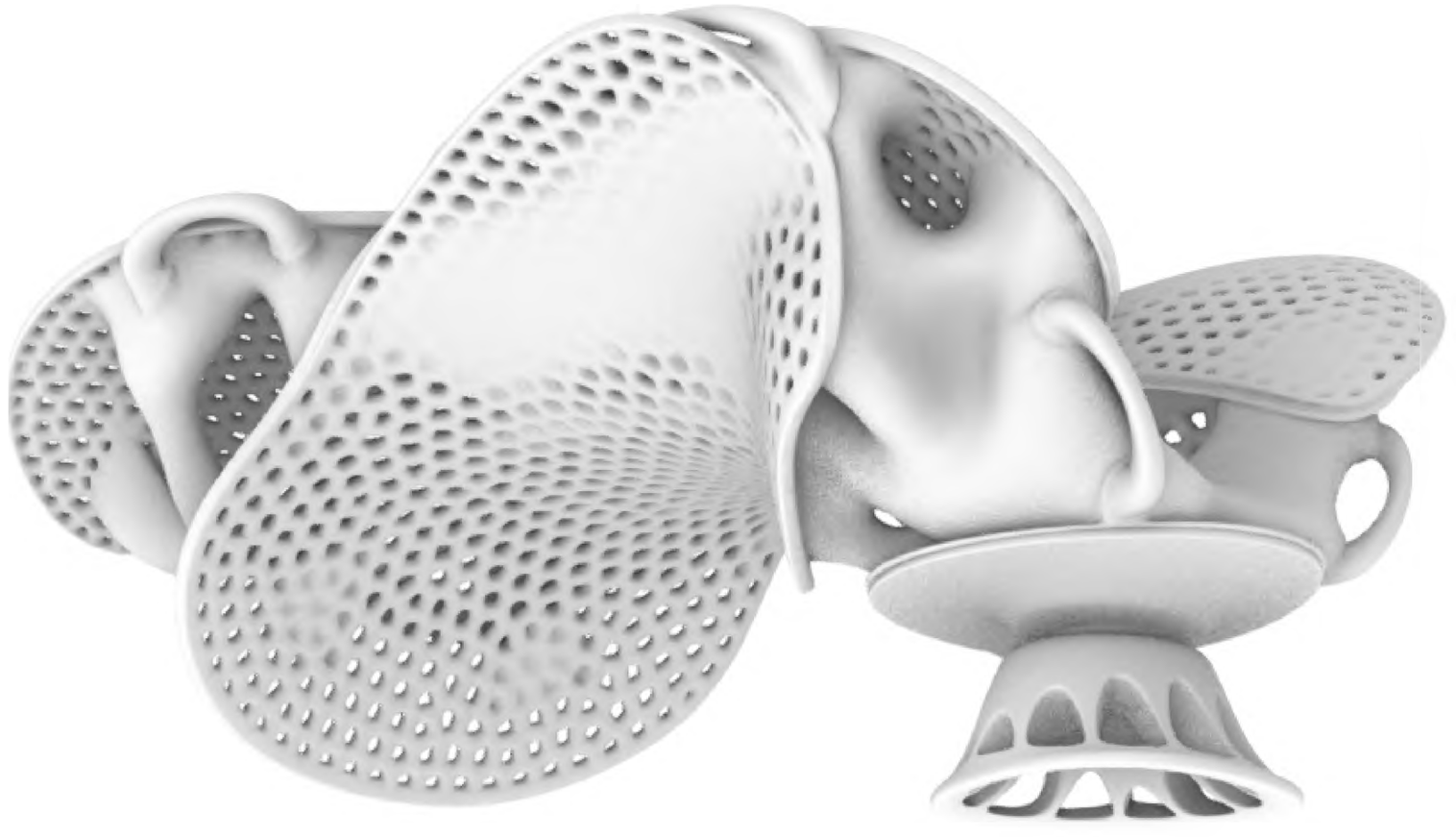


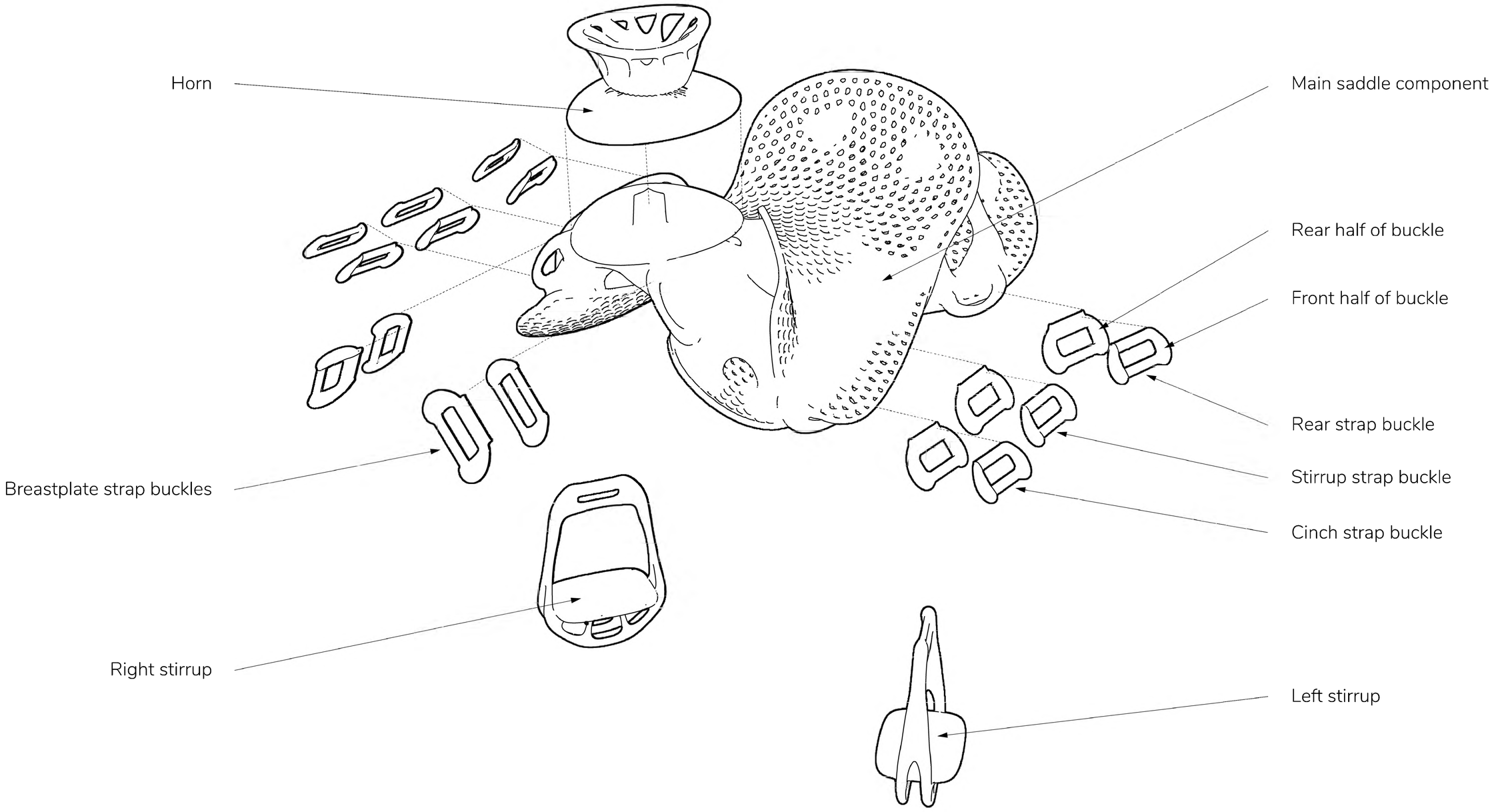








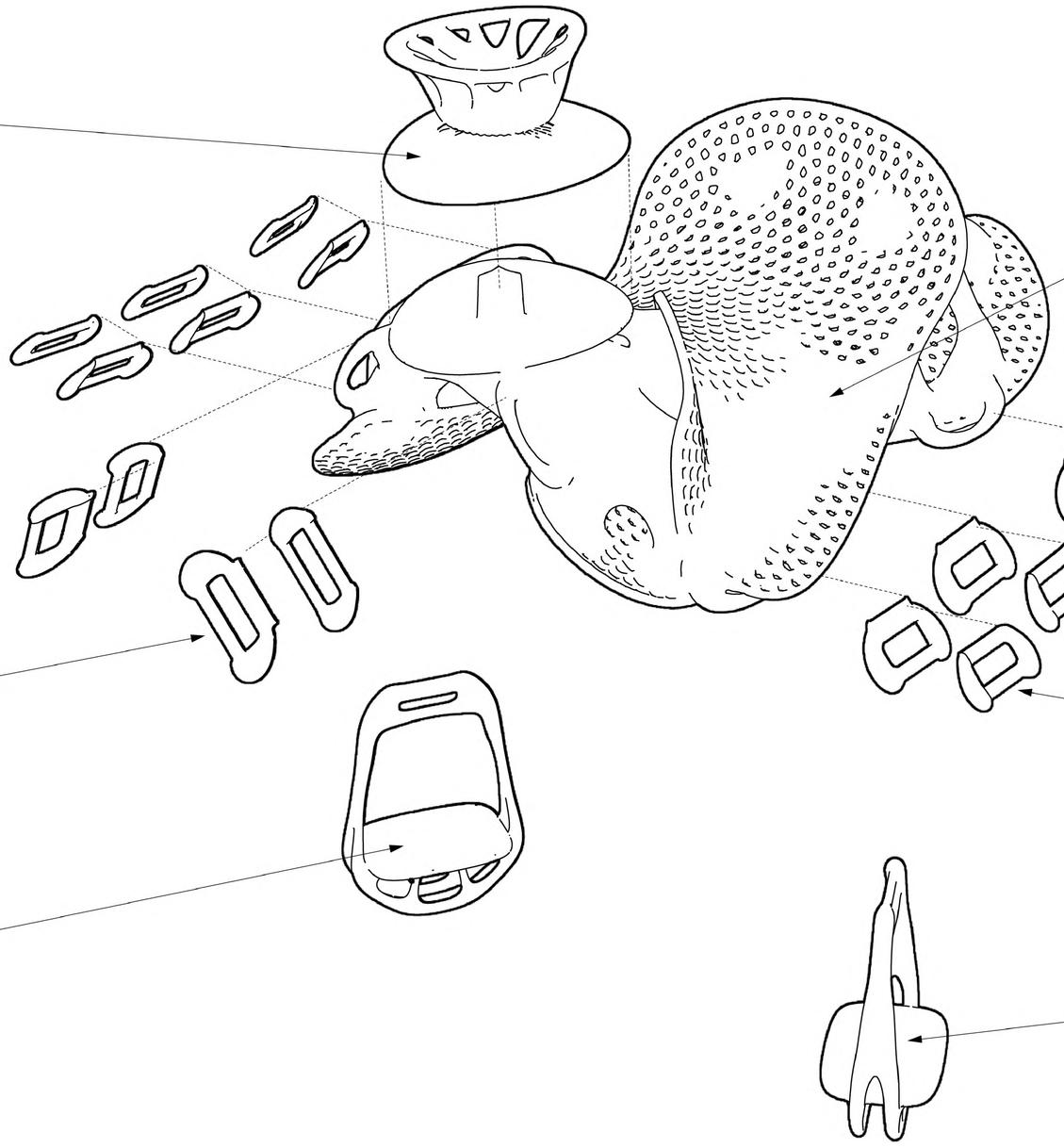



Horn
Main saddle component
Rear half of buckle
Front half of buckle
Rear strap buckle
Stirrup strap buckle
Cinch strap buckle
Breastplate strap buckles
Right stirrup
Left stirrup

Horn

Toothed groove grabs and hold the rope

Metalized SLA



Main saddle component

Top opt'd to minimize weight

SLS Nylon

Rear half of buckle

Front half of buckle

Rear strap buckle

Stirrup strap buckle

Cinch strap buckle

Adjusts easily and auto-locks webbing to hold tight

Metalized SLA

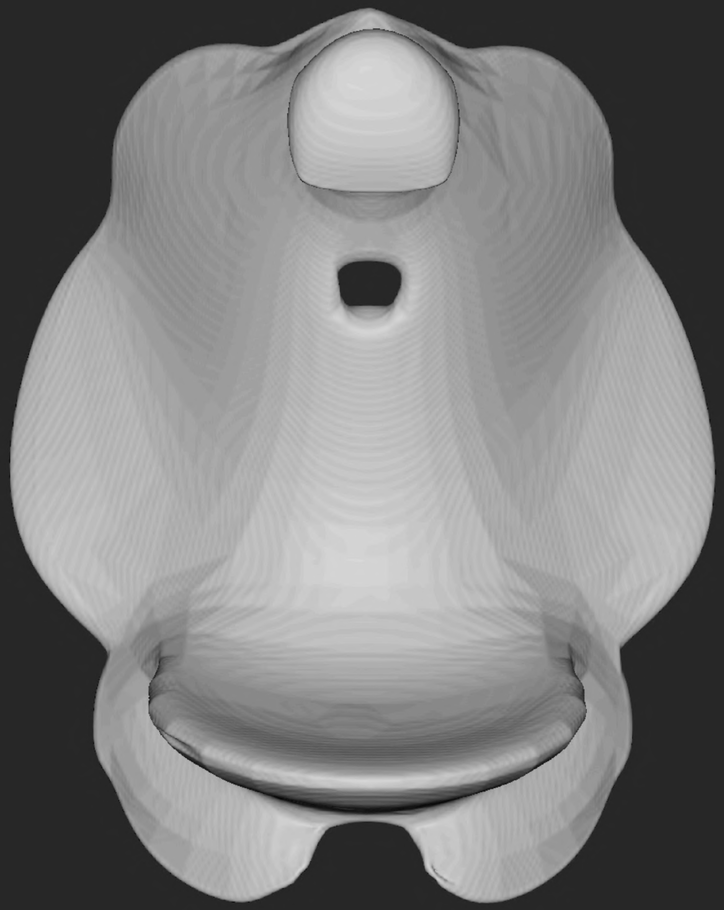
Breastplate strap buckles

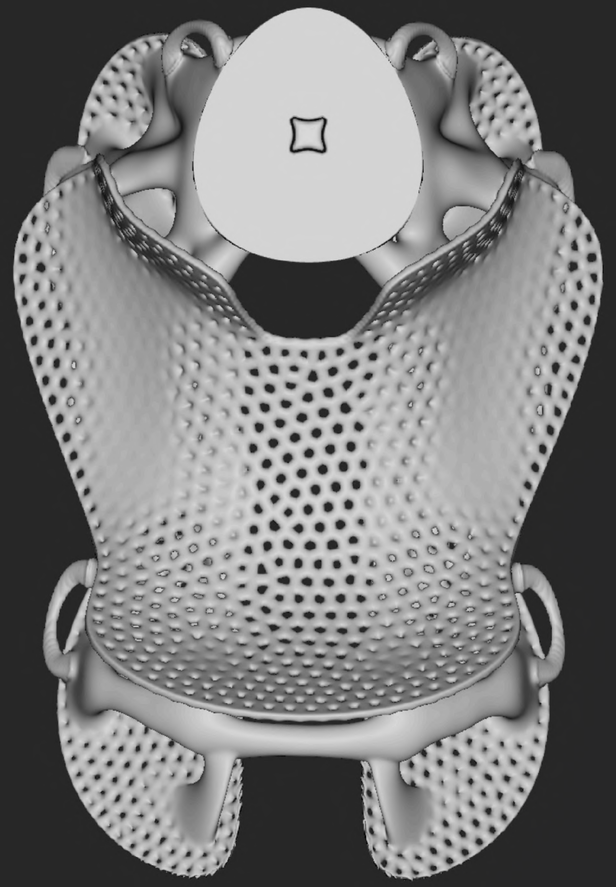
Right stirrup

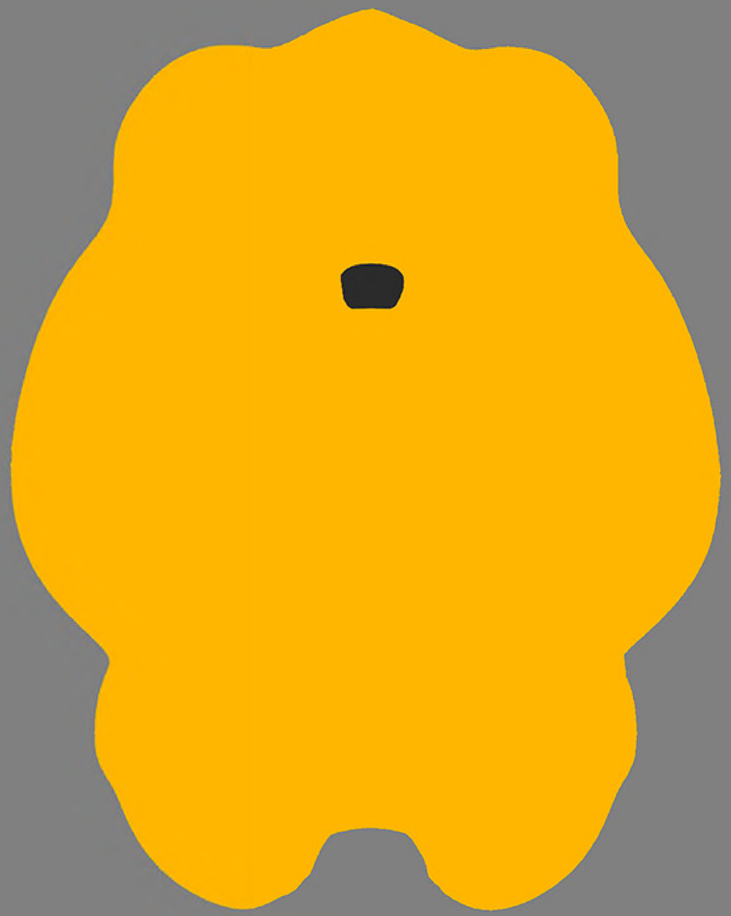
Top opt'd to minimize weight

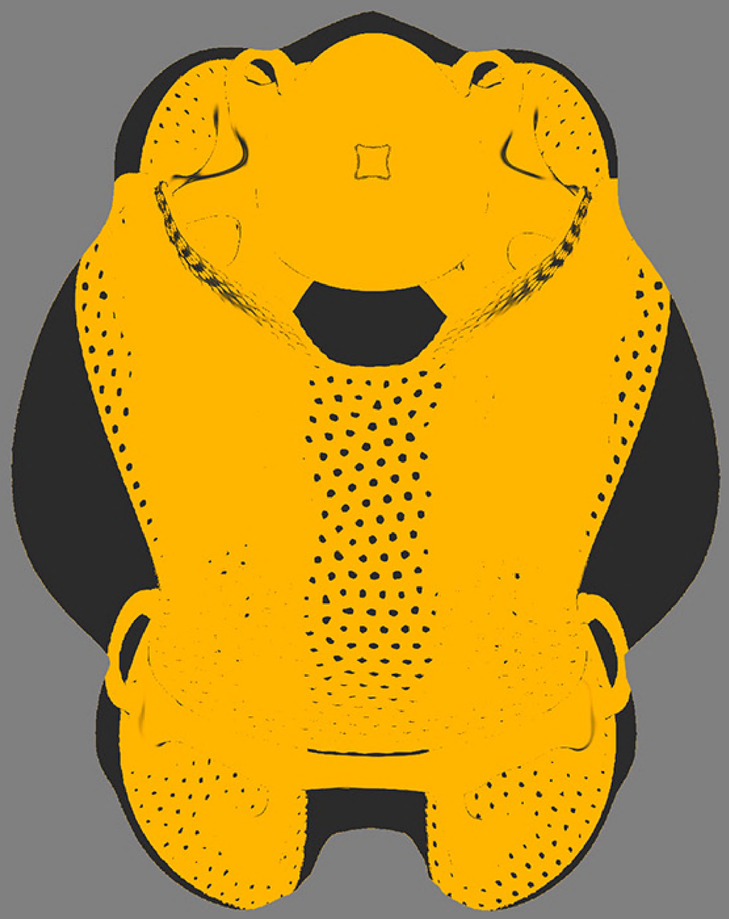
Metalized SLA

Left stirrup

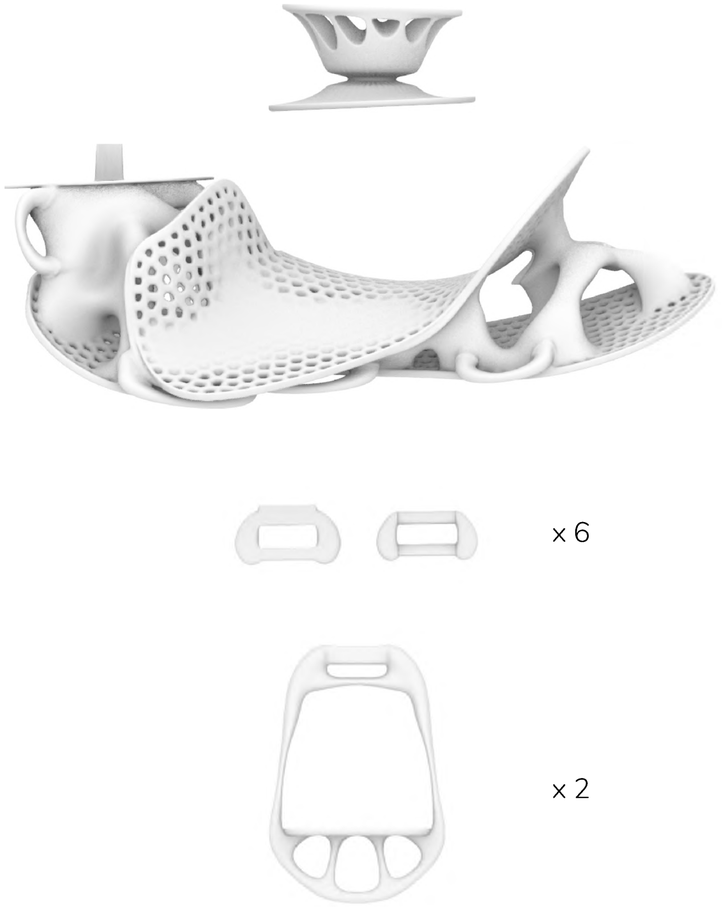






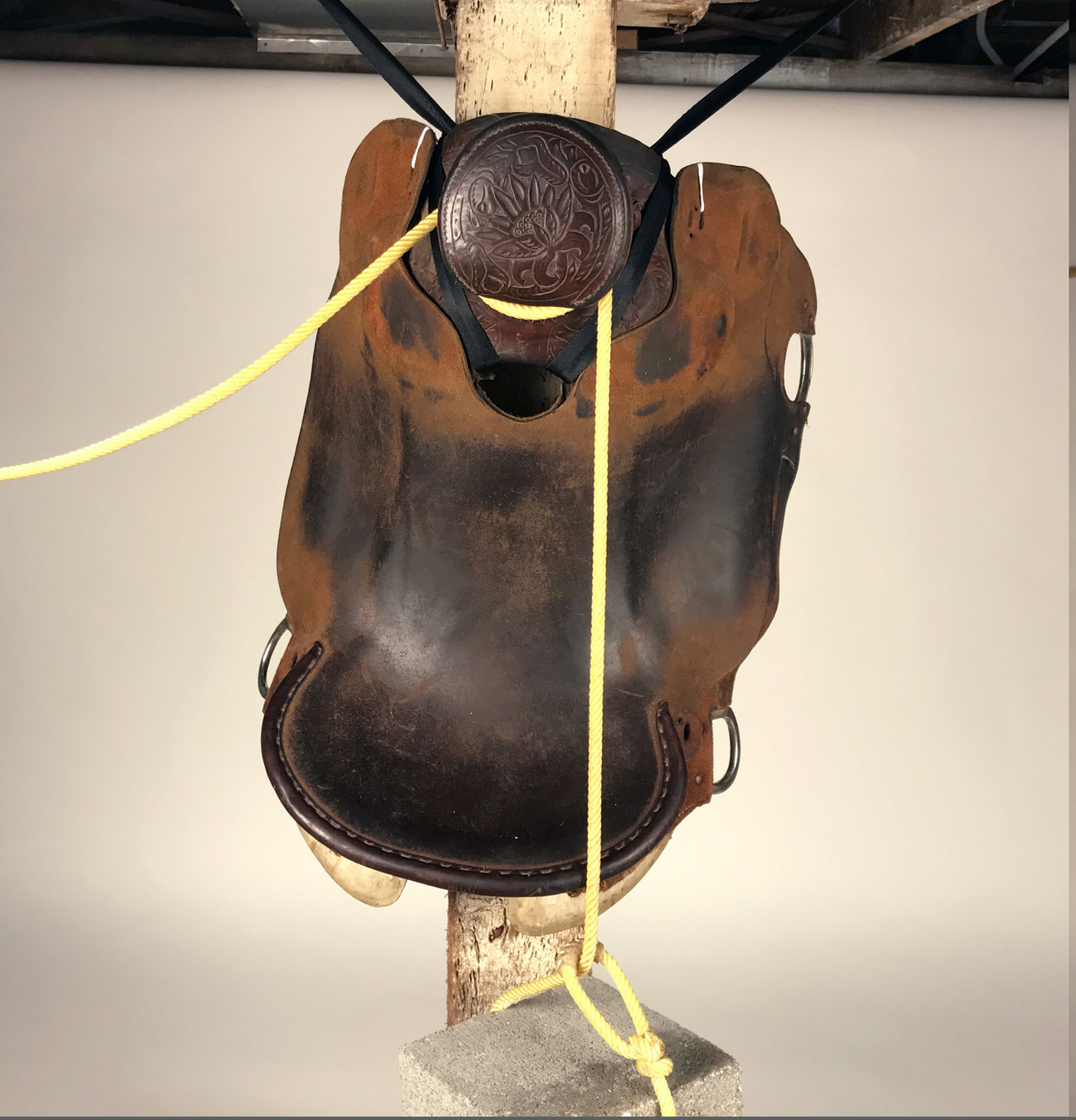


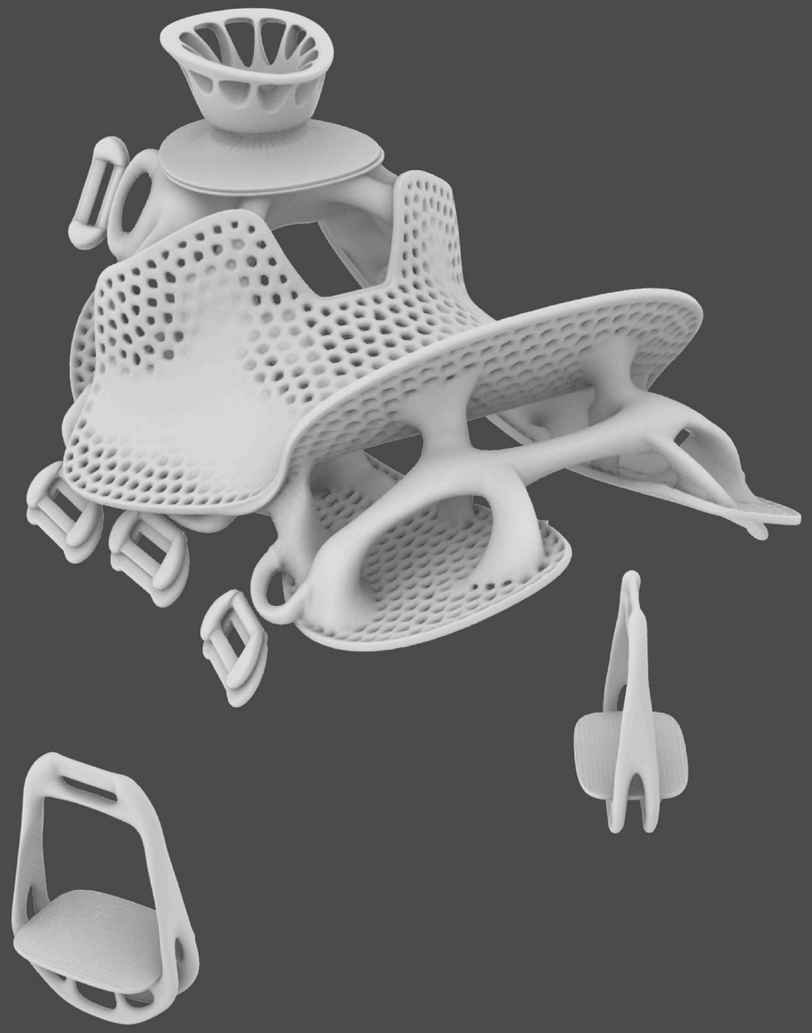
Over 40x more open space

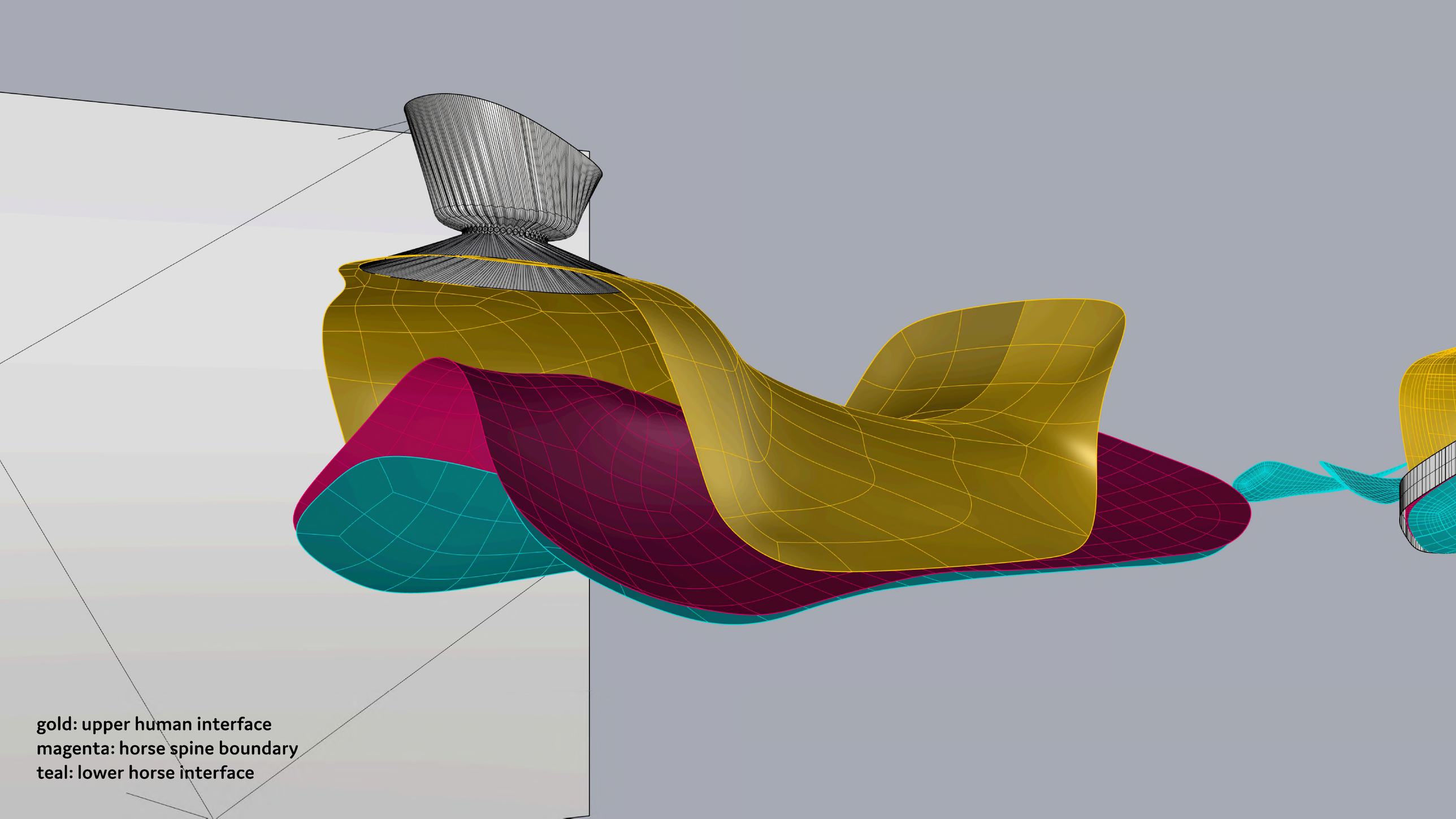


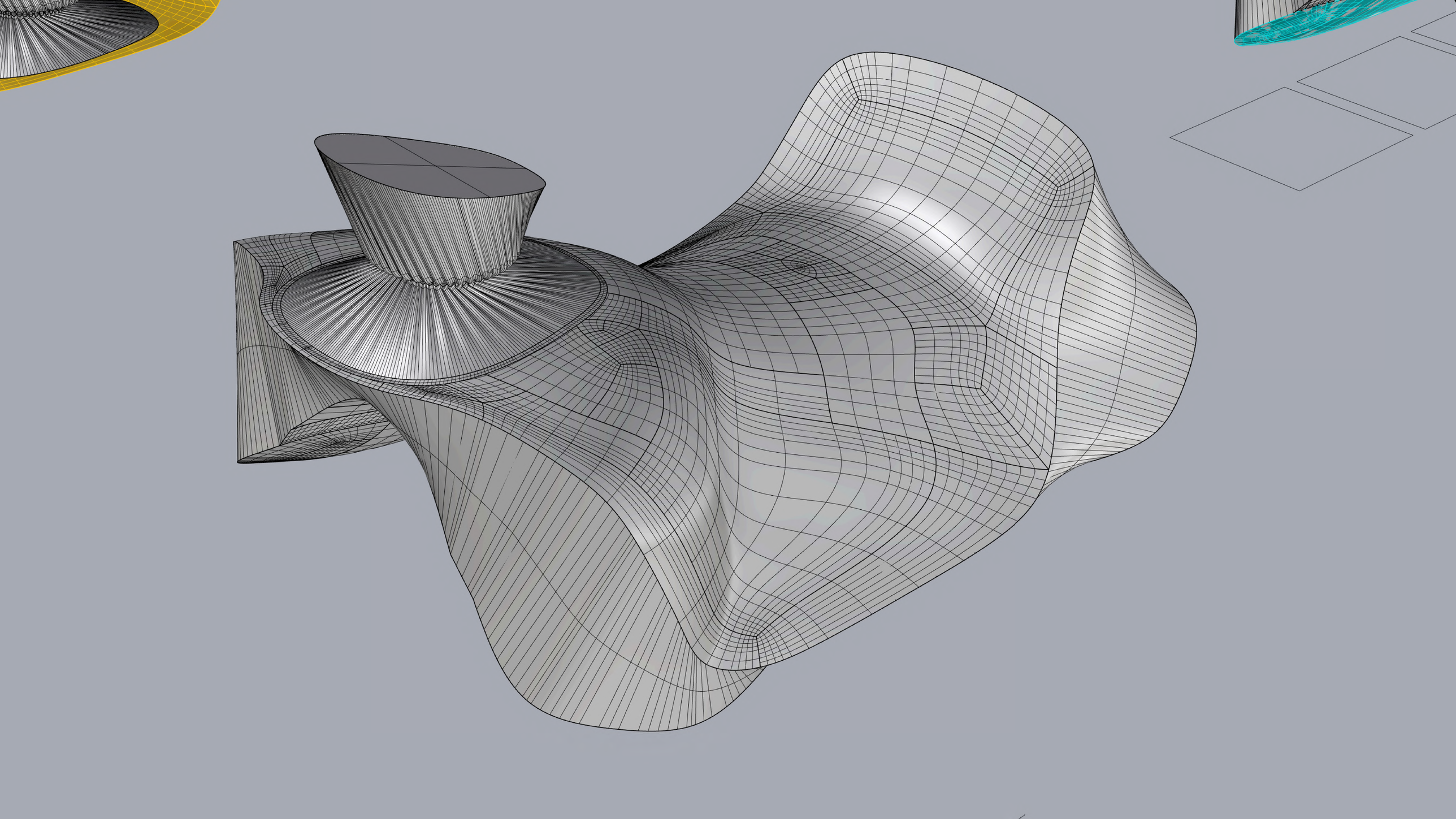
17.8 pounds

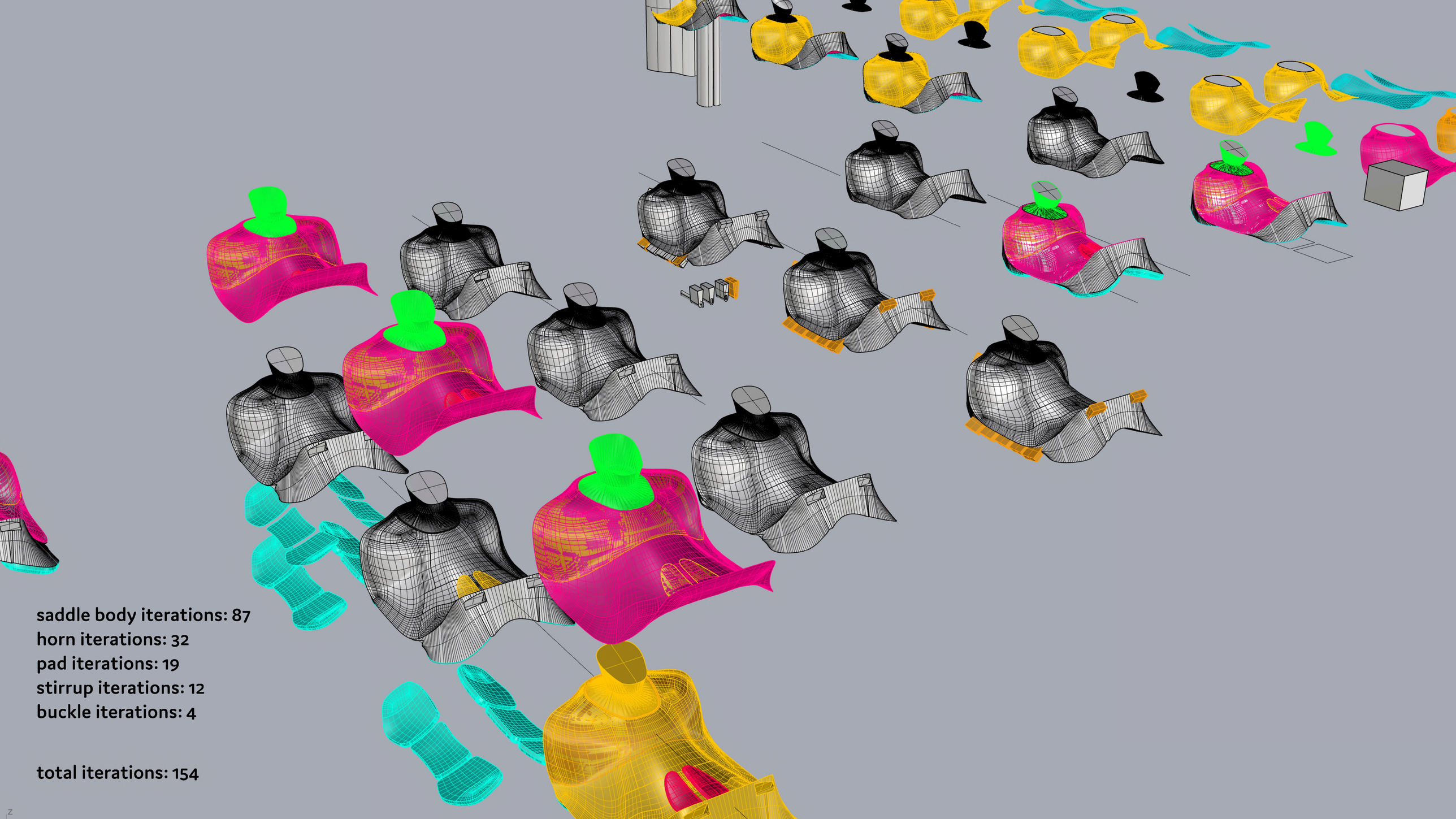
*** Computer estimate sans webbing and minimal pad. Final product will likely be heavier.**





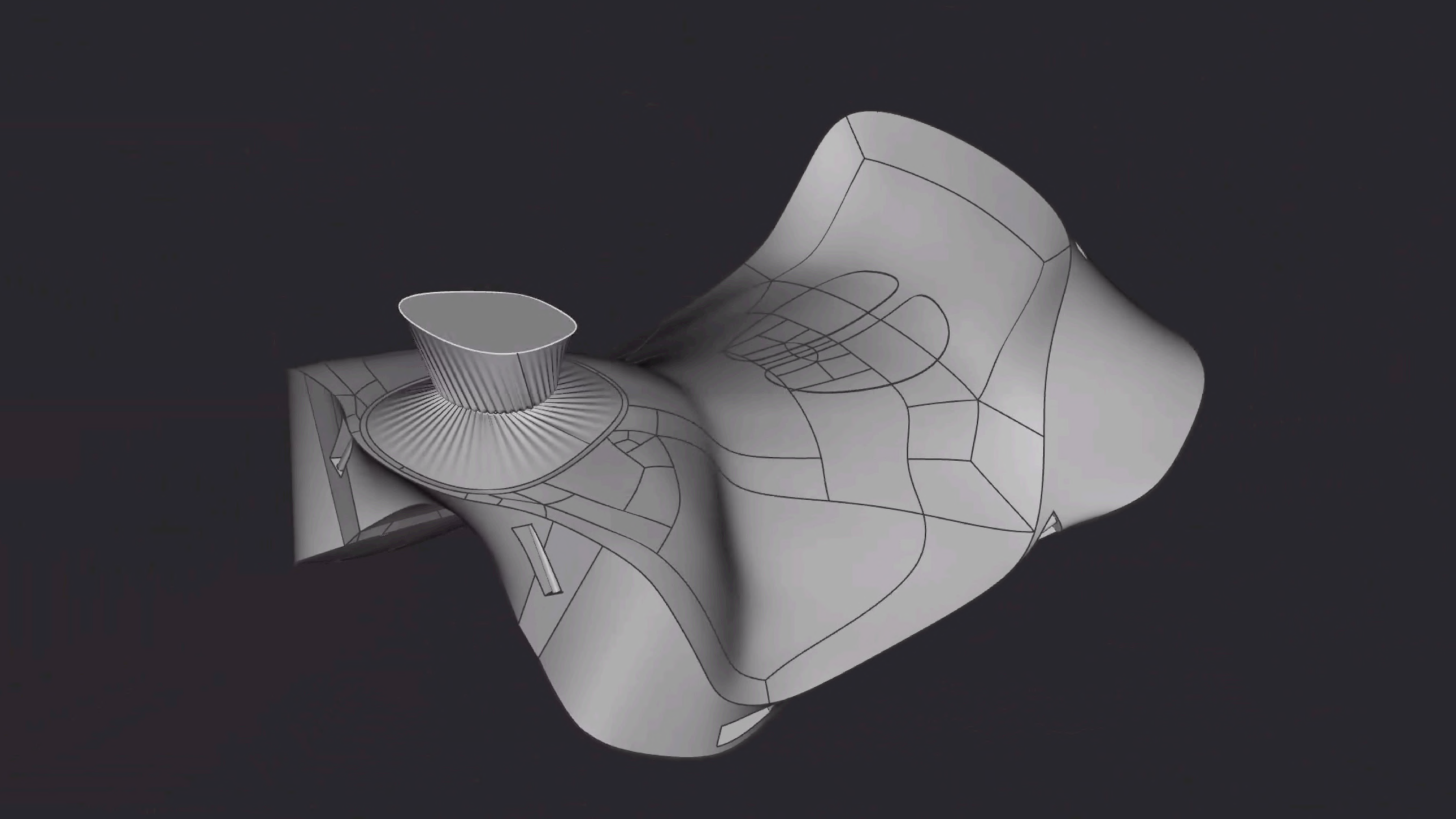

gold: upper human interface
magenta: horse spine boundary
teal: lower horse interface

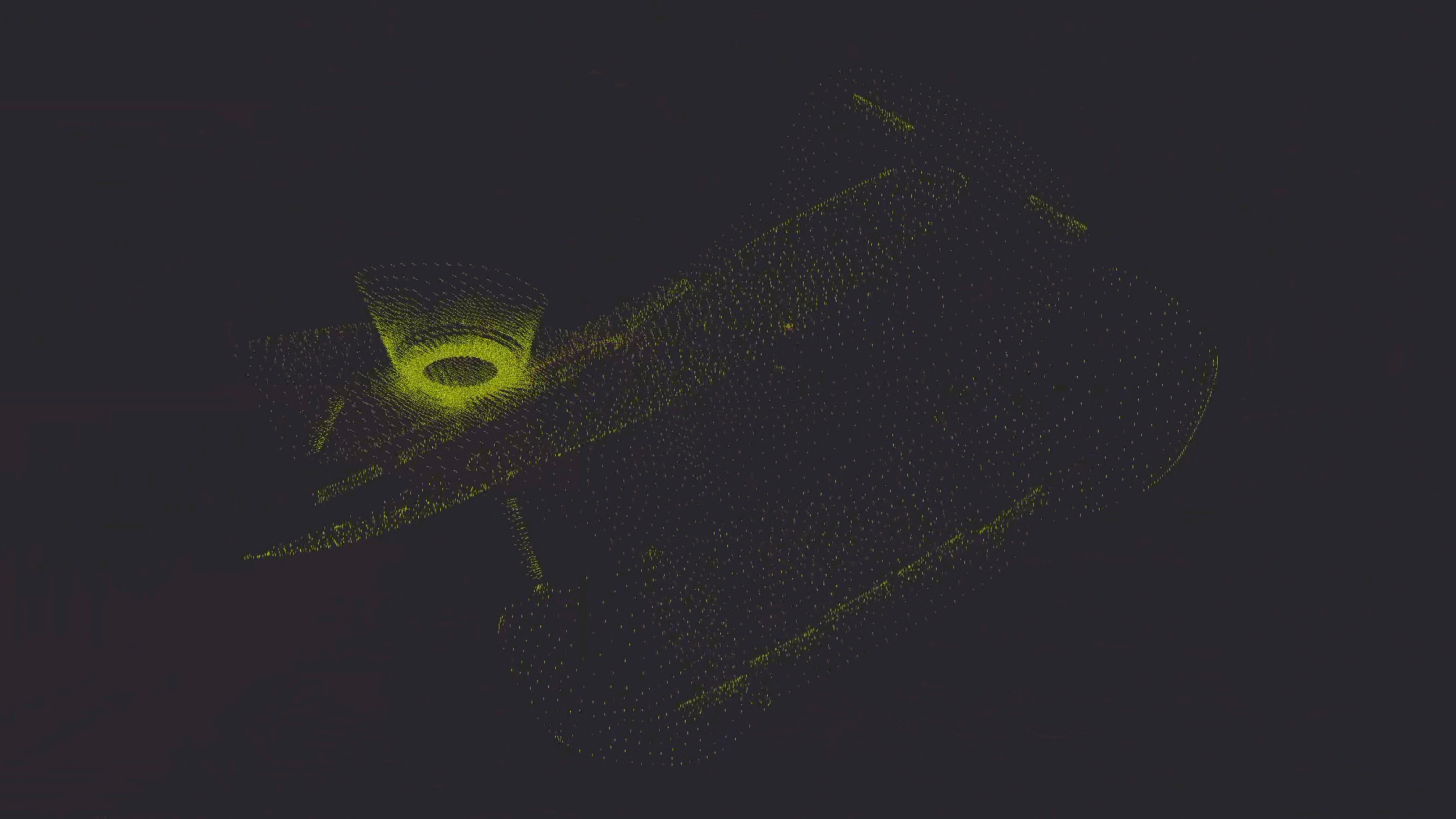


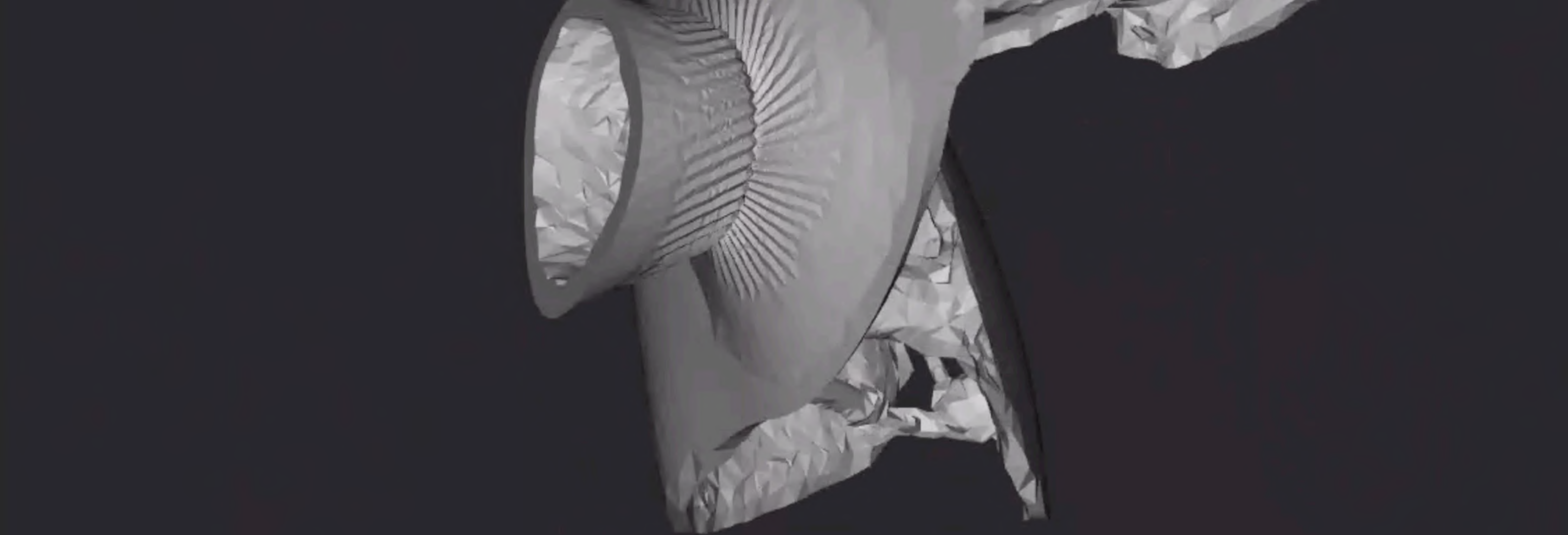


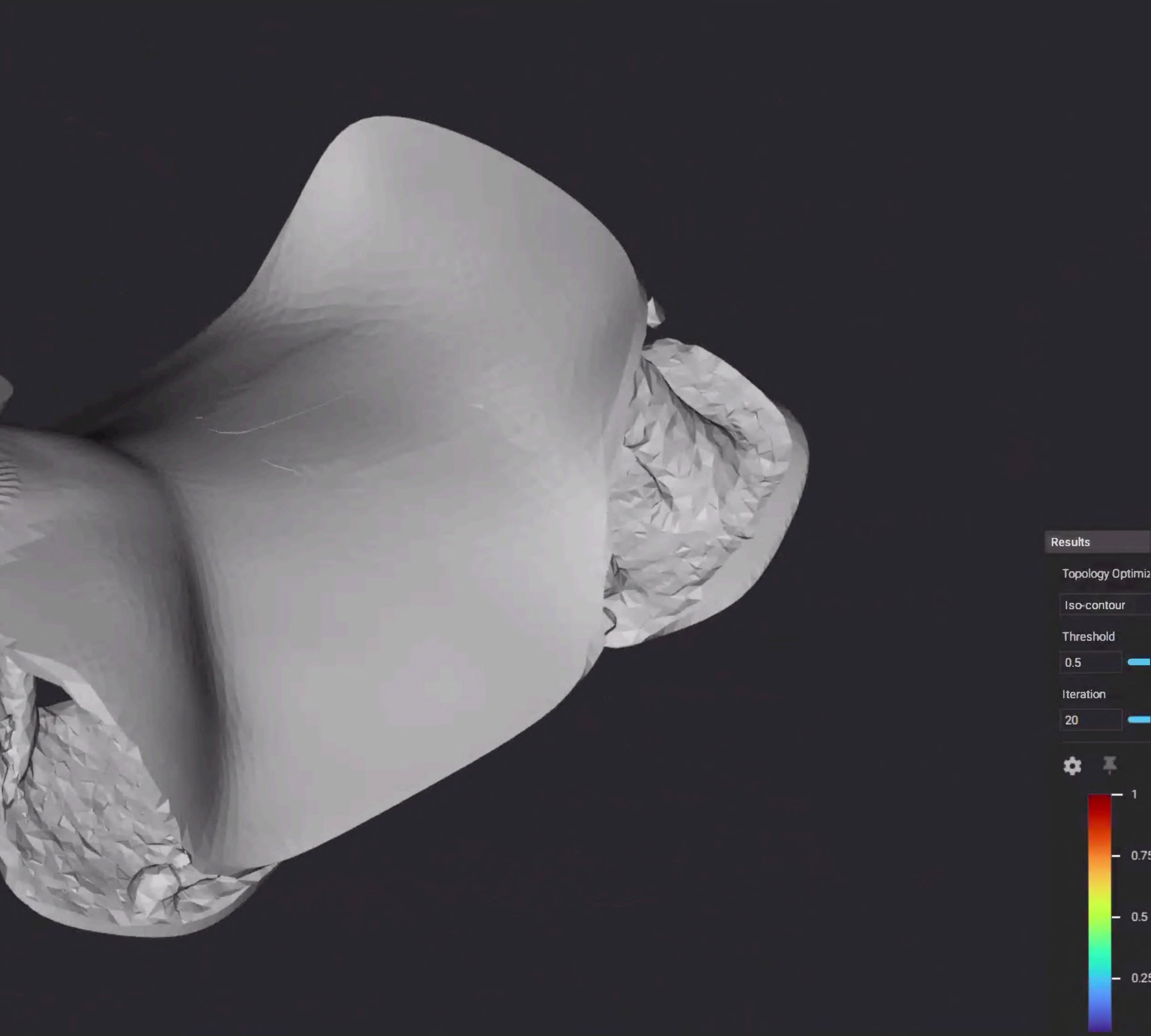
saddle body iterations: 87
horn iterations: 32
pad iterations: 19
stirrup iterations: 12
buckle iterations: 4

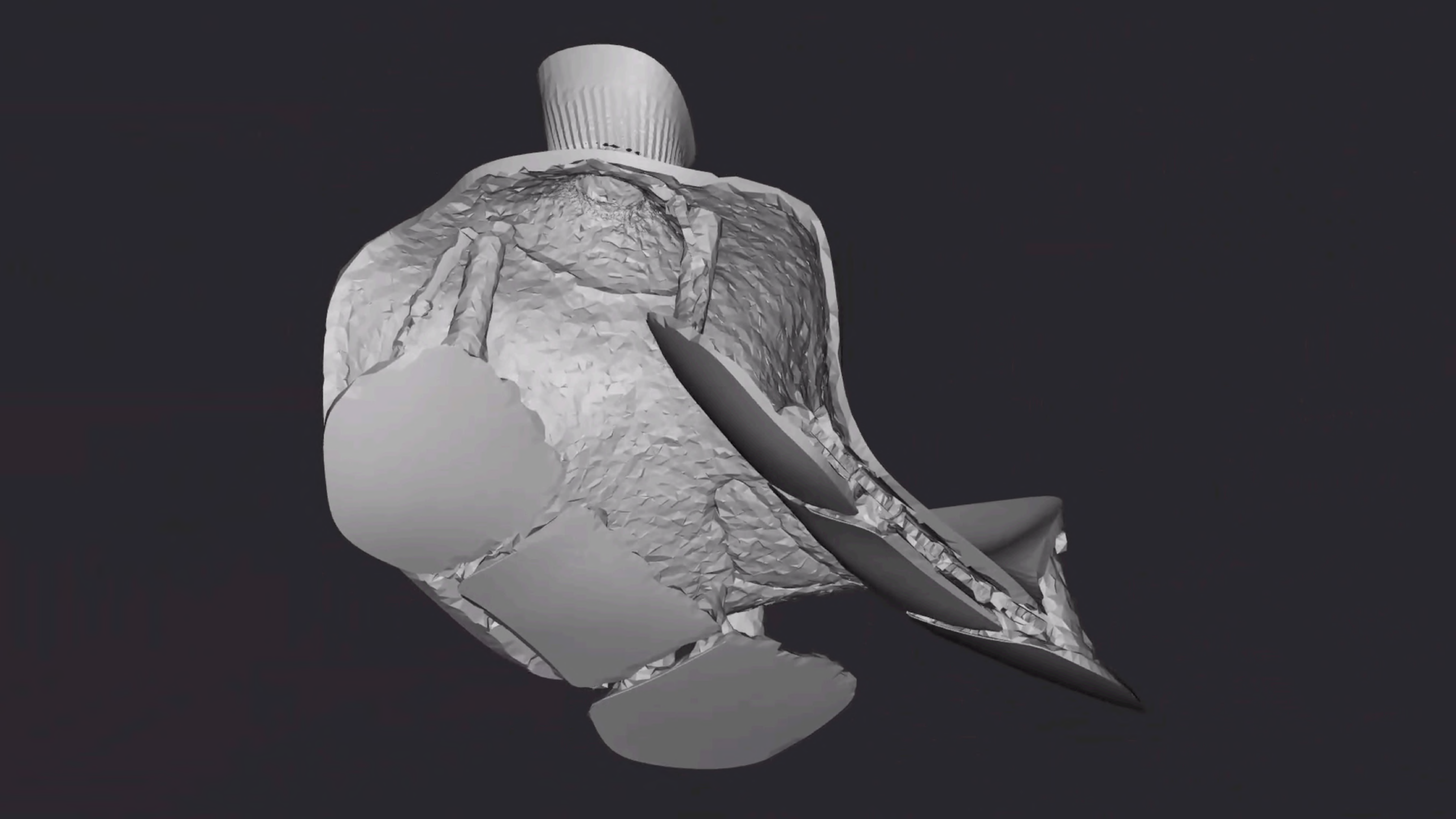
total iterations: 154

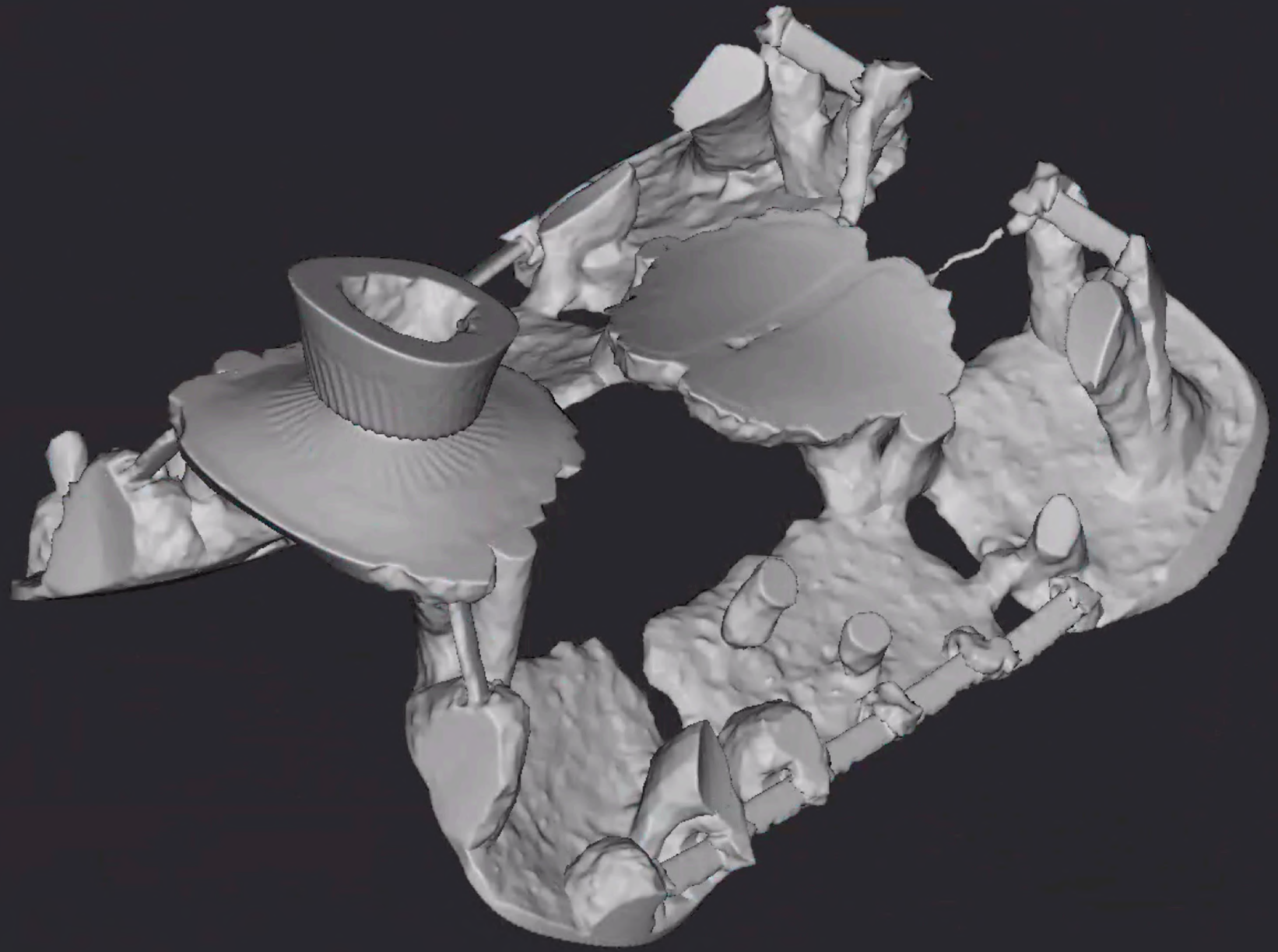


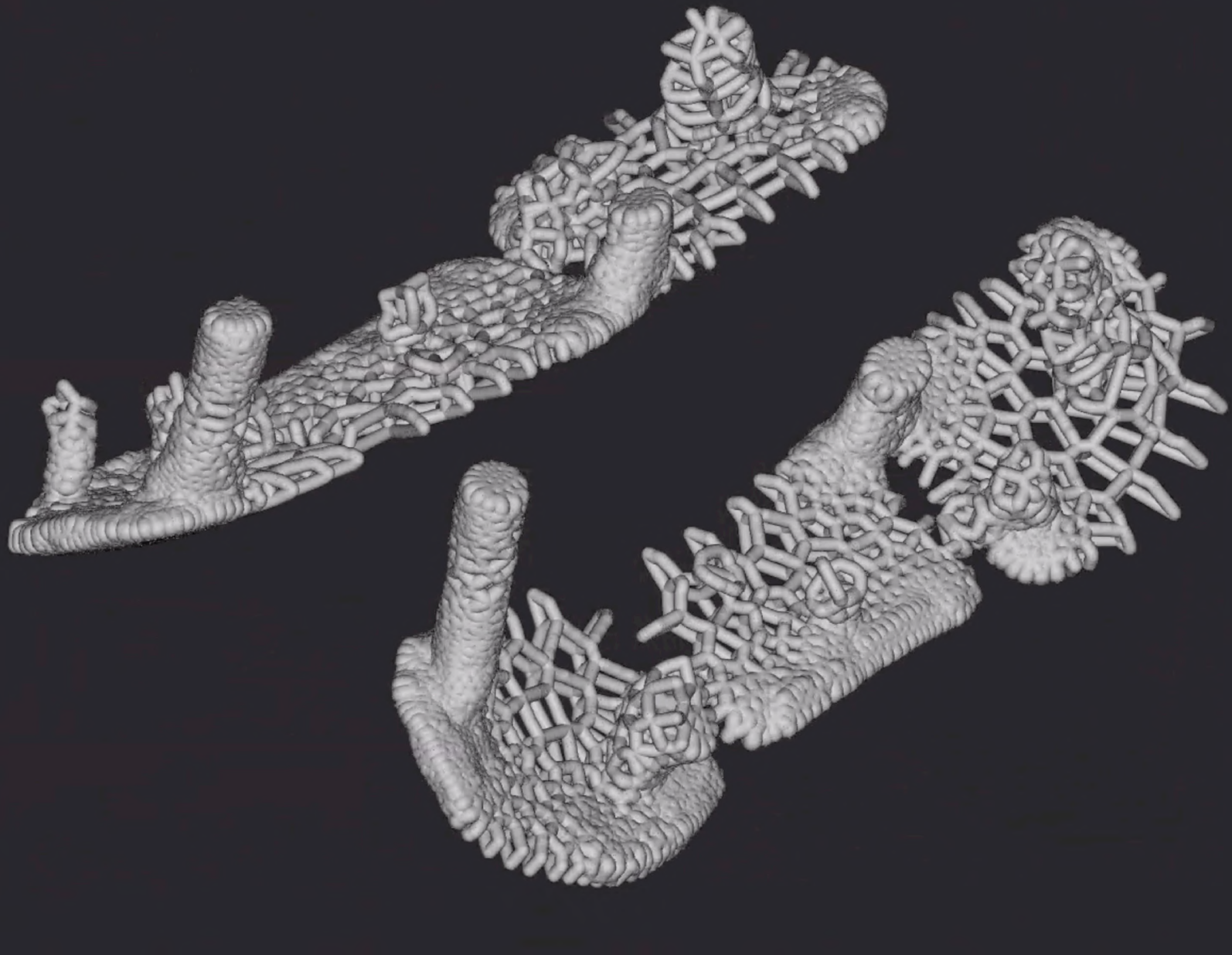


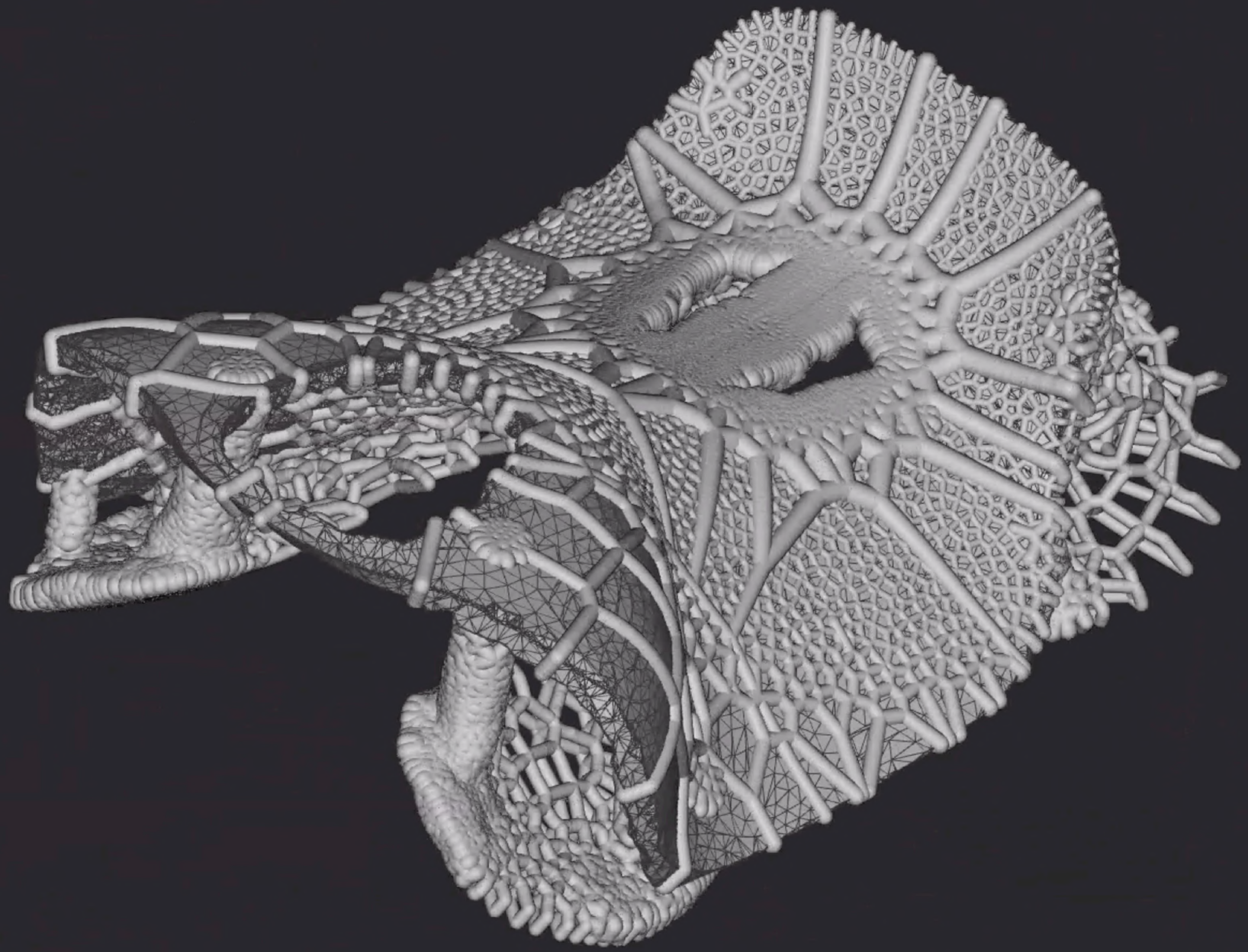


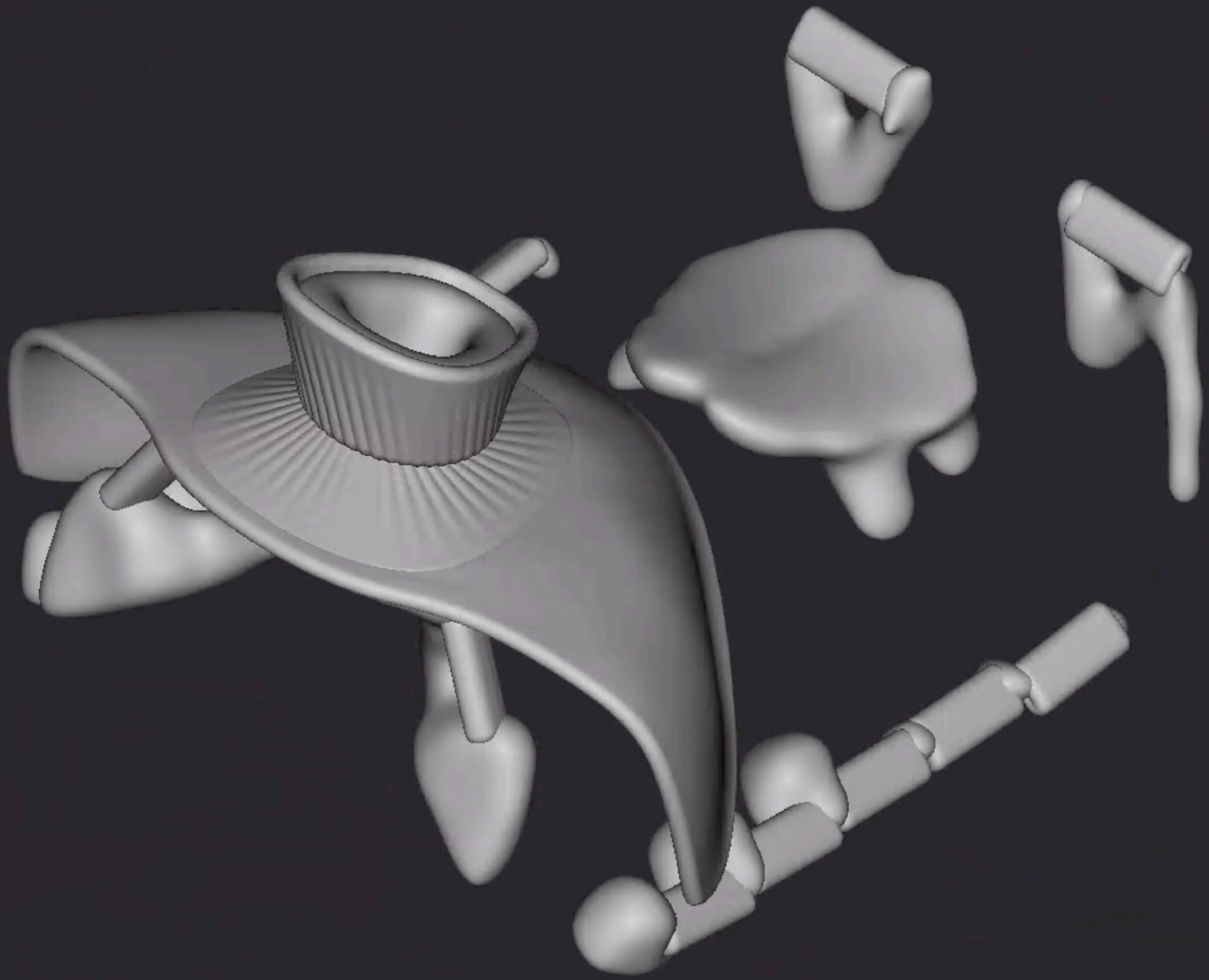

Results
Topology Optimiz
Iso-contour
Threshold
0.5
Iteration
20
1
0.75
0.5
0.25

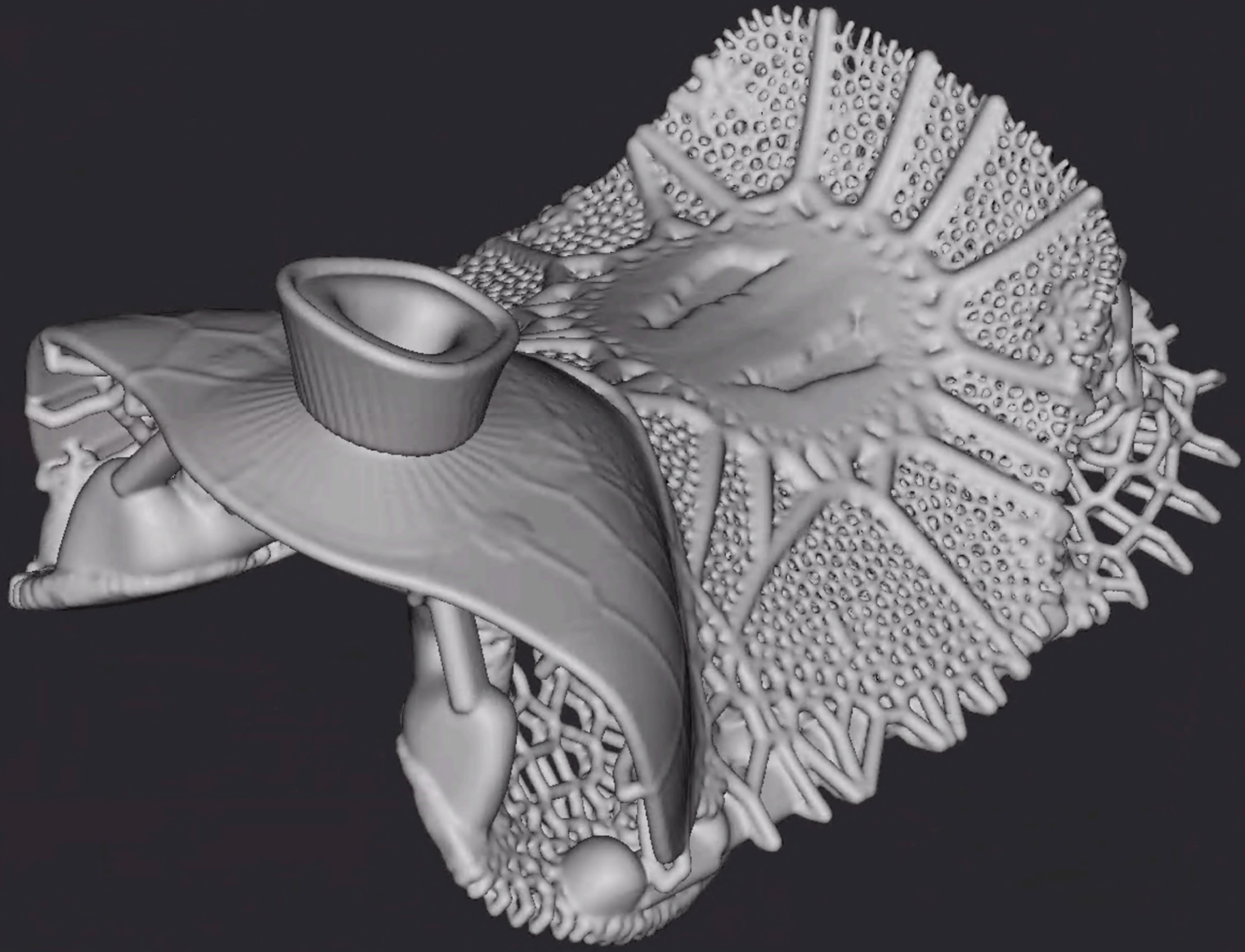


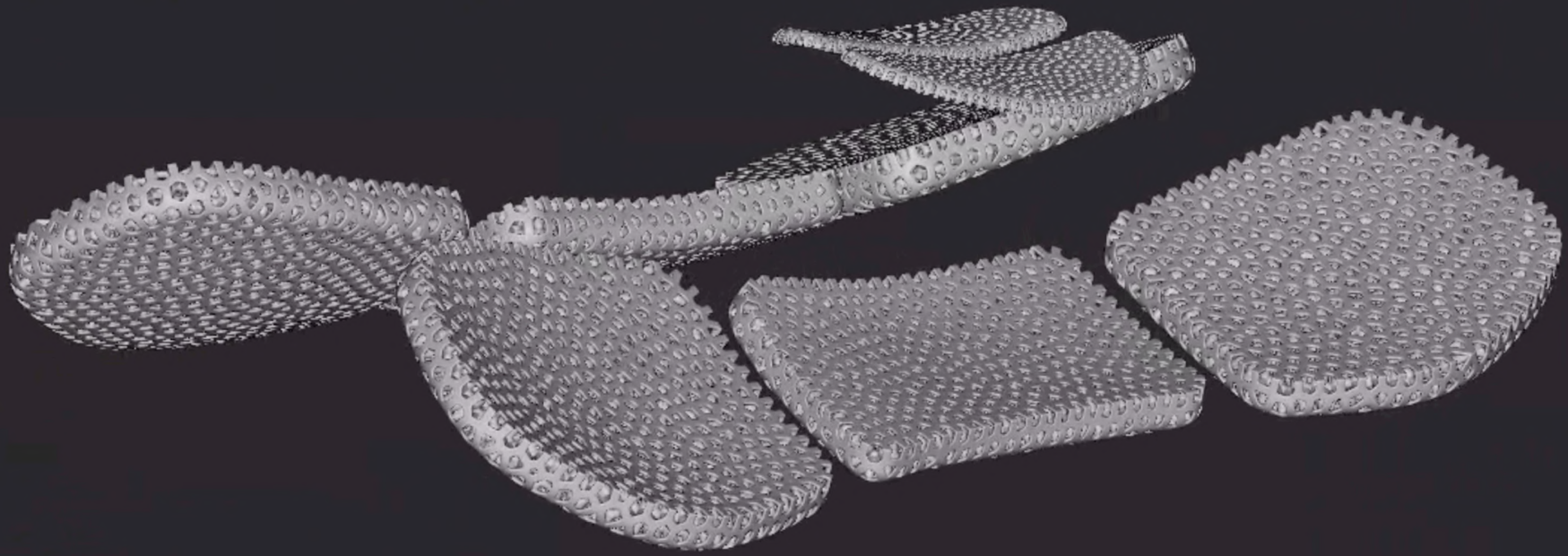


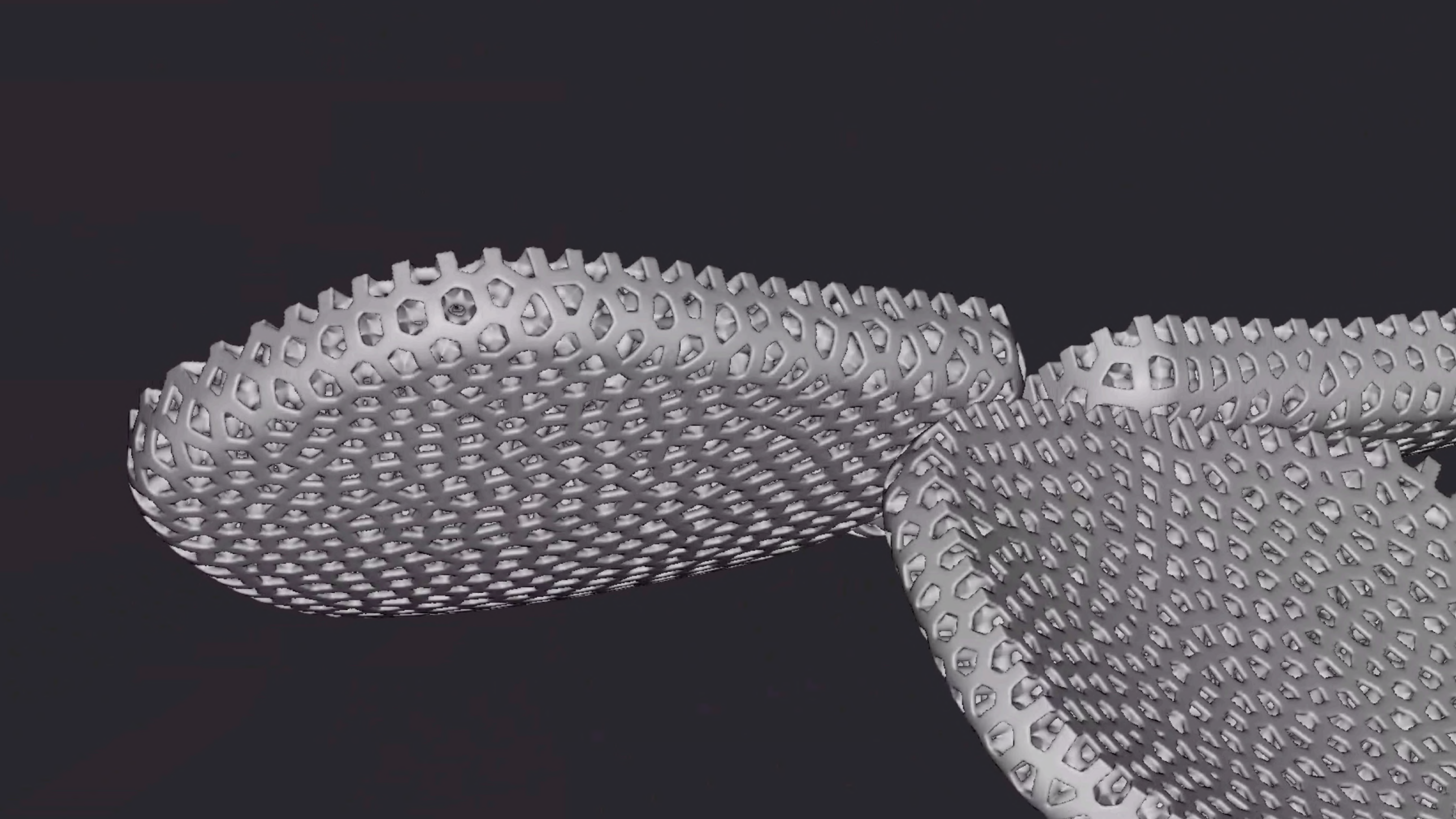


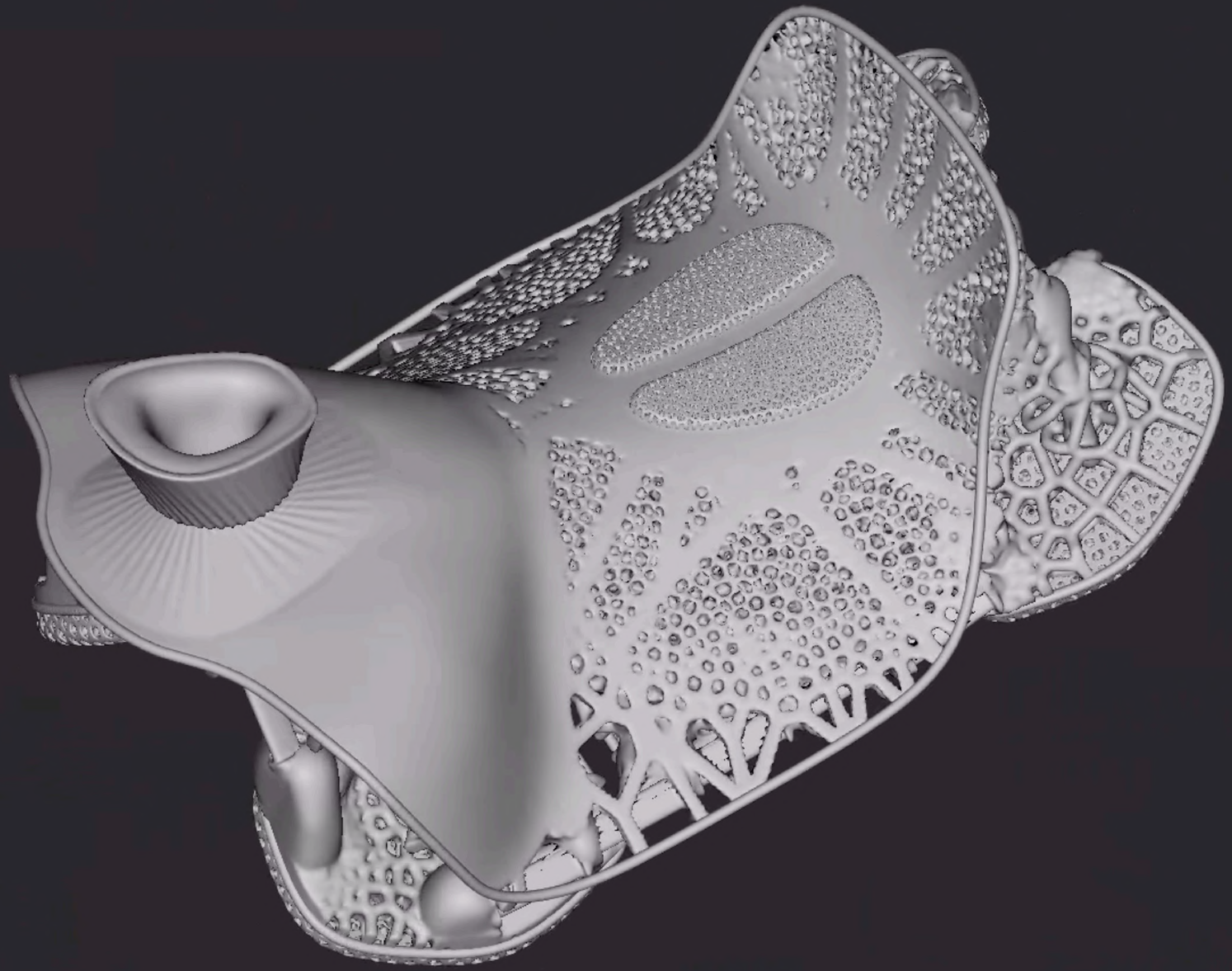




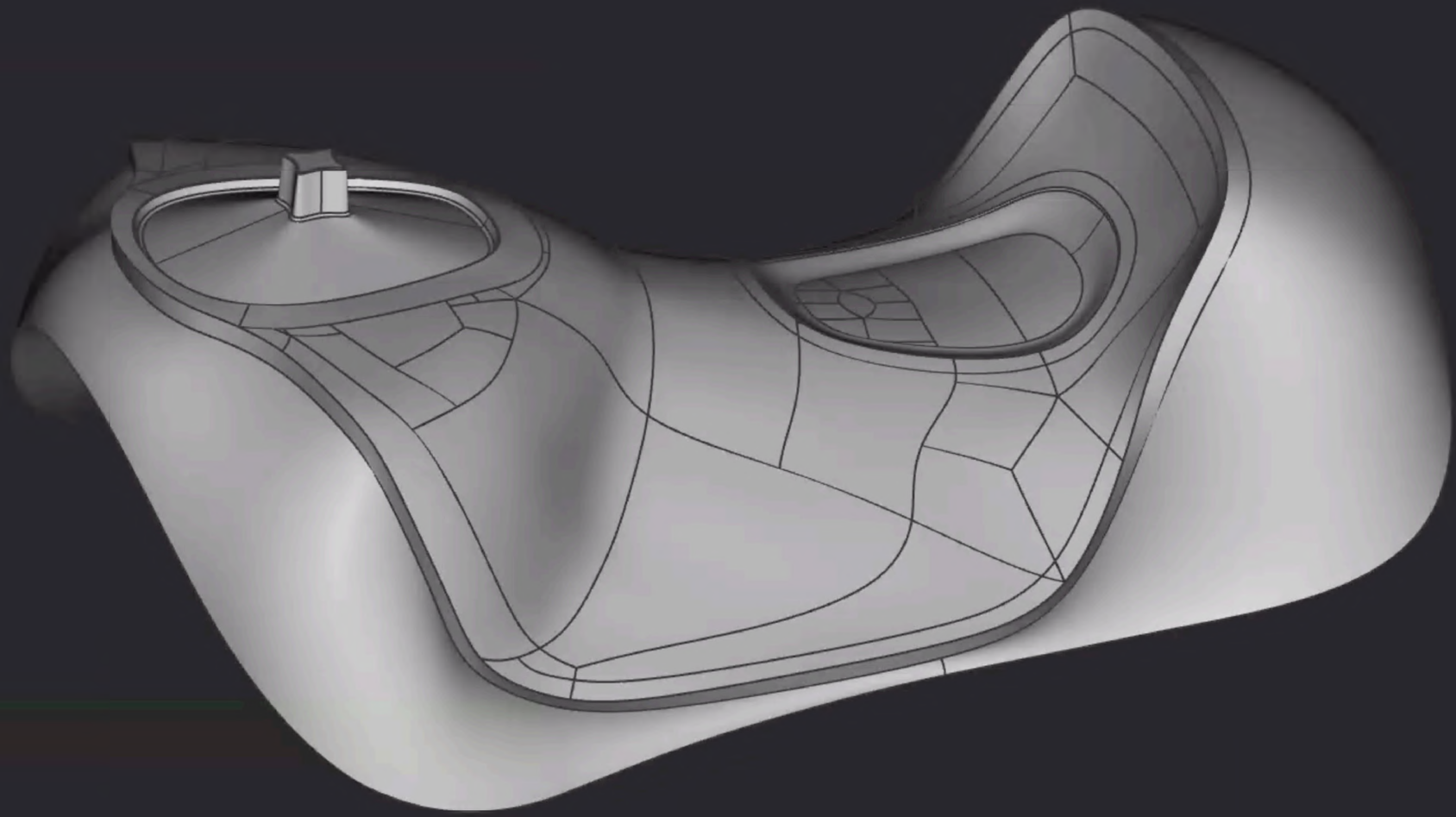






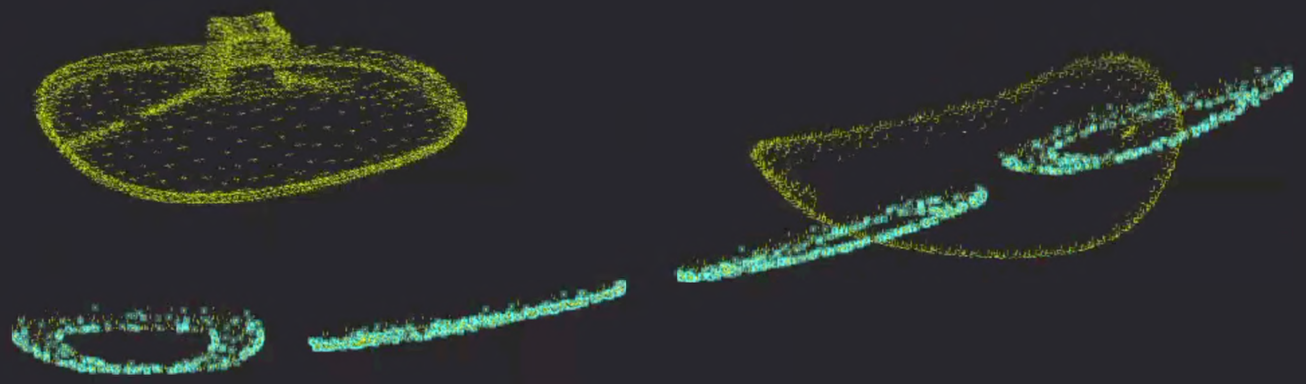


Break // Lets start over with fresh modeling



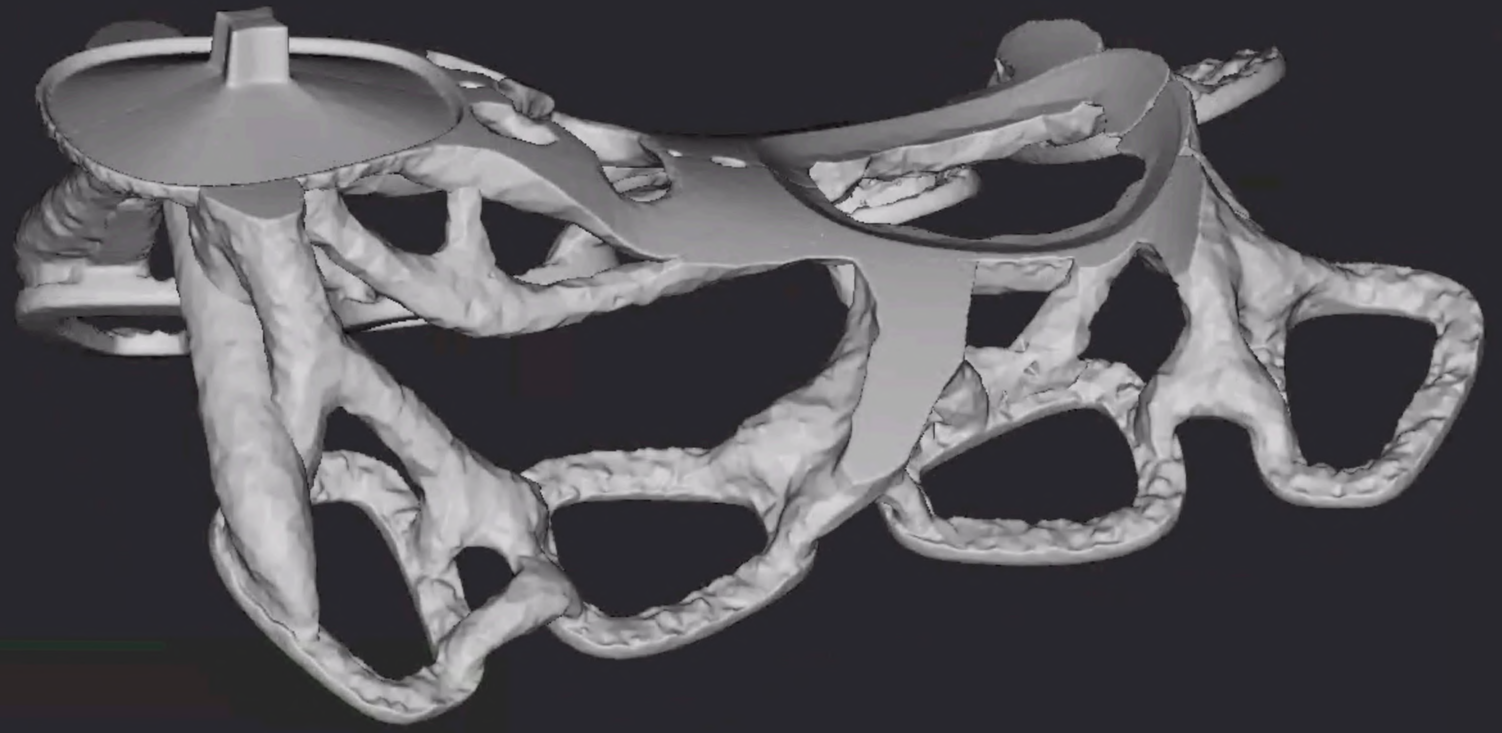
build volumes: 1
interface surface regions: 14

build volume iteration: 4



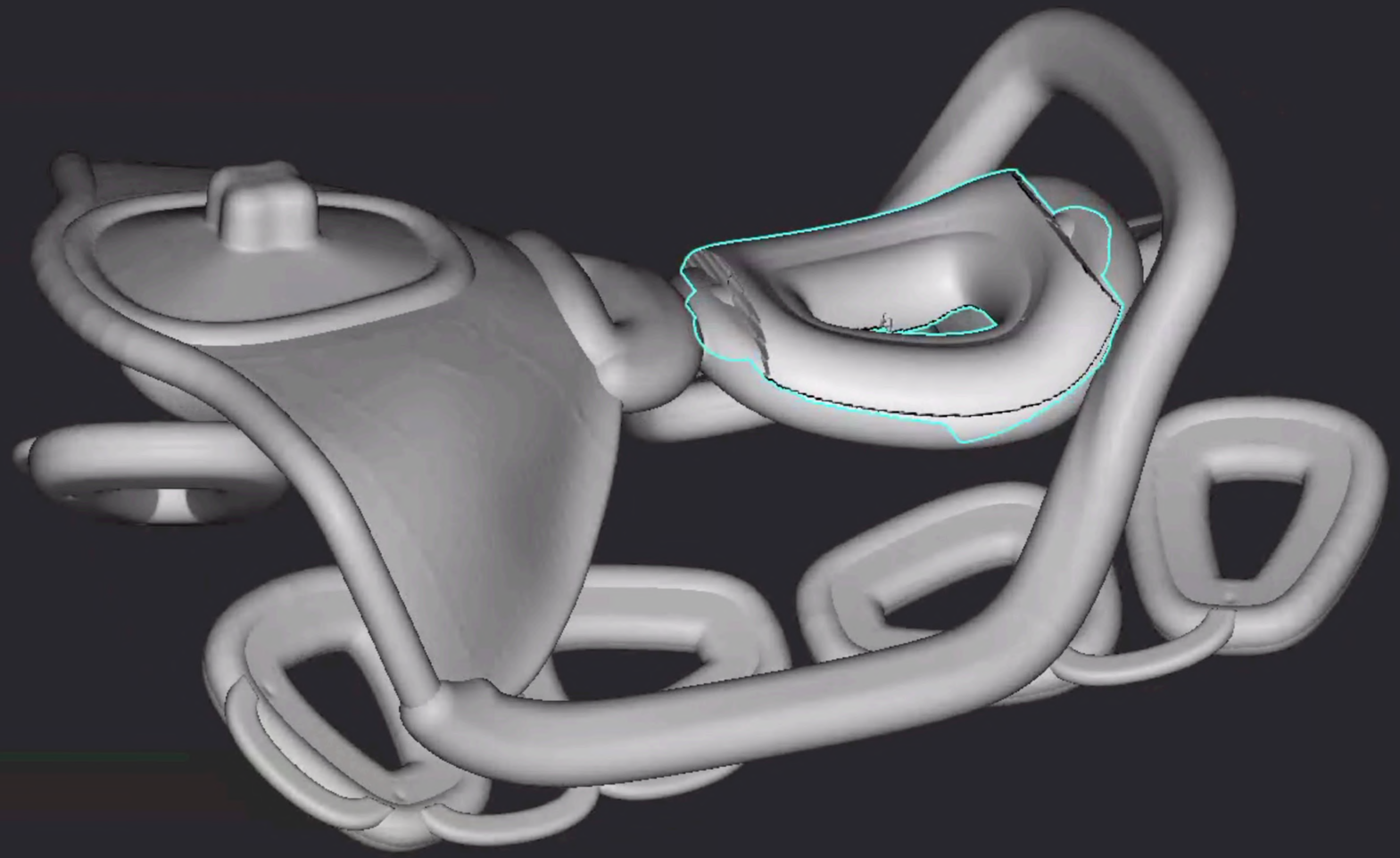
horn force vectors: 4
seat force vectors: 3
pad force vectors: 3 (mirrored)
total force vectors: 13

force vector iteration: 27

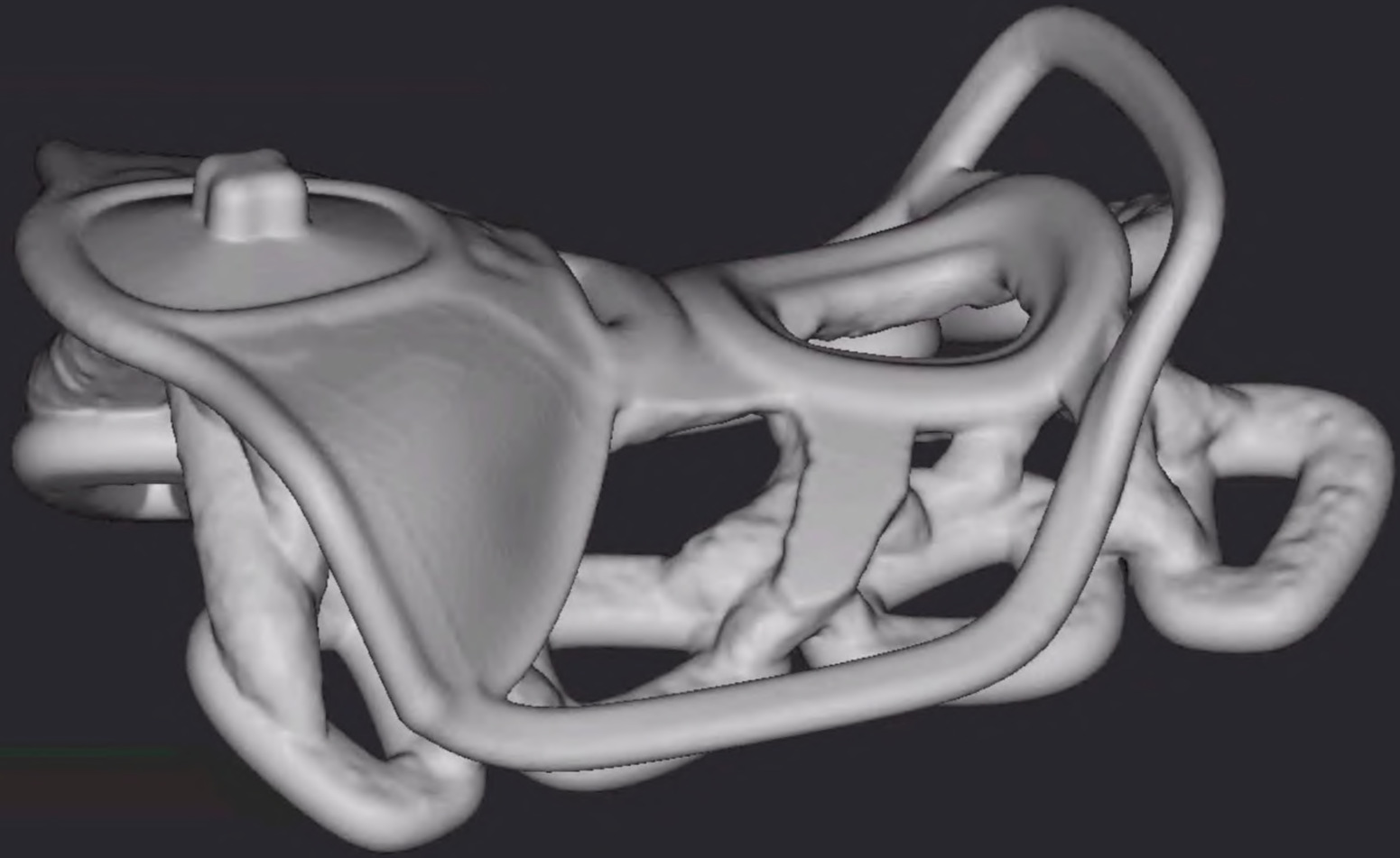


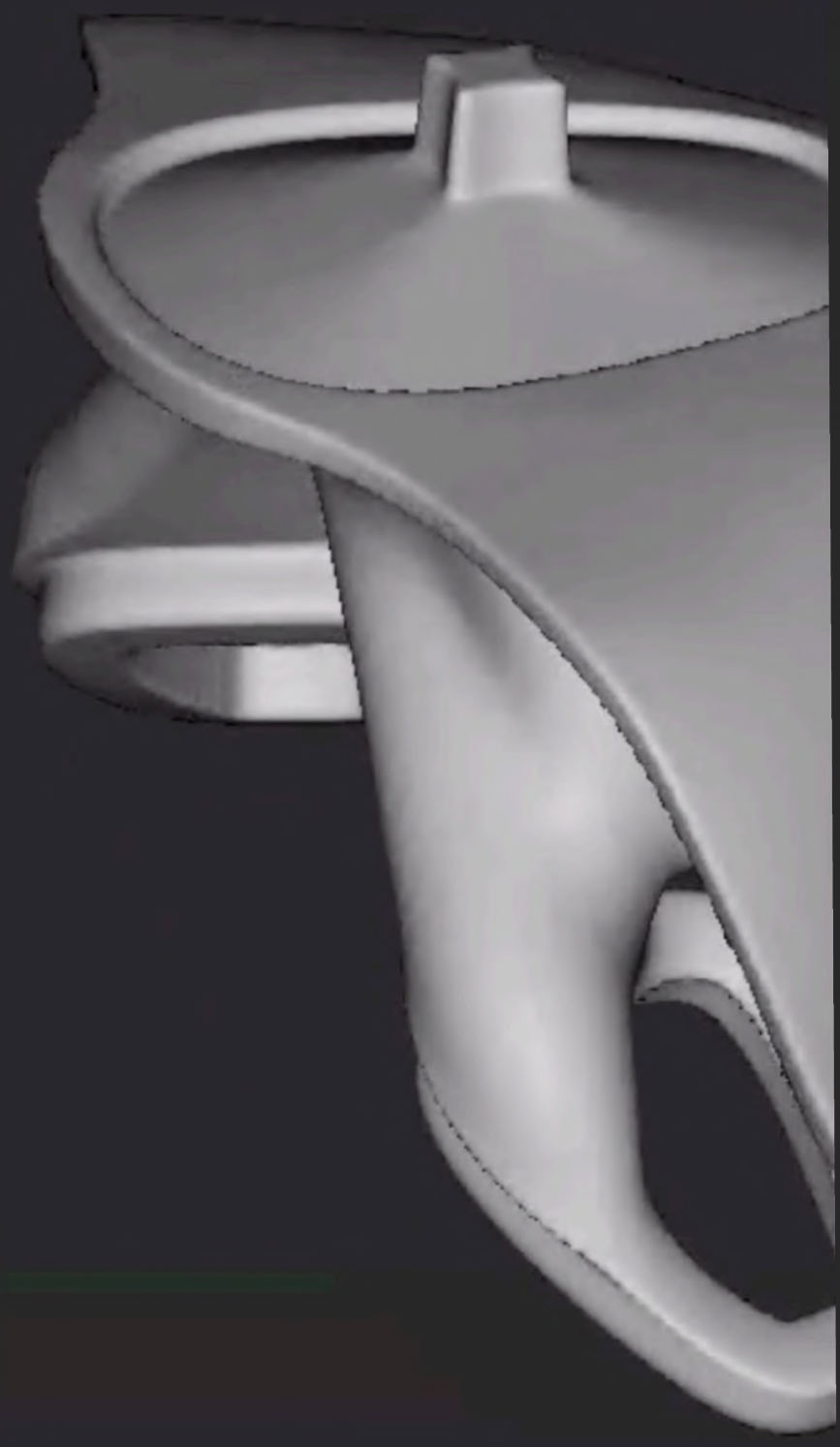
topology optimization regions: 4

top opt iteration: 51

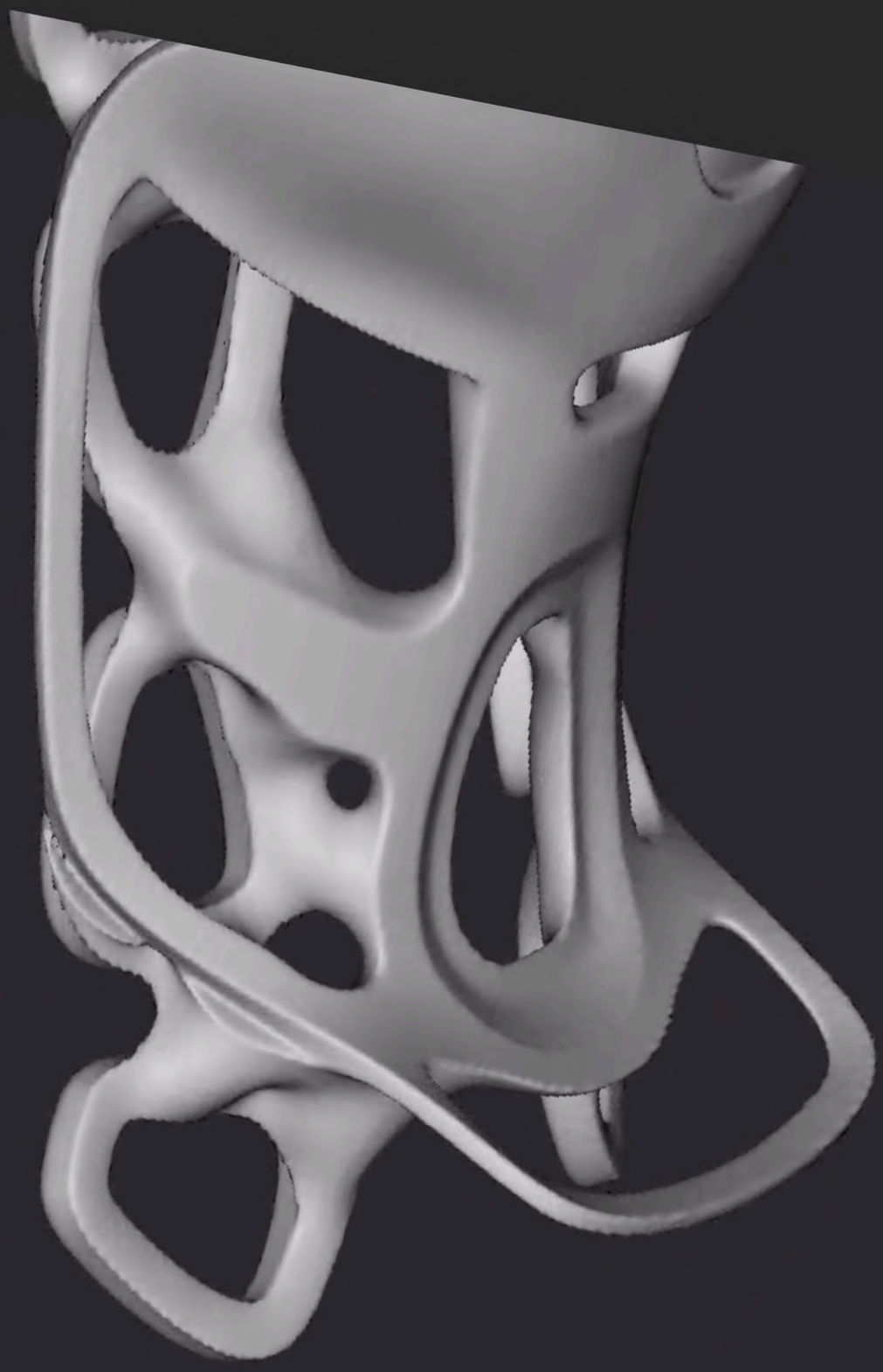


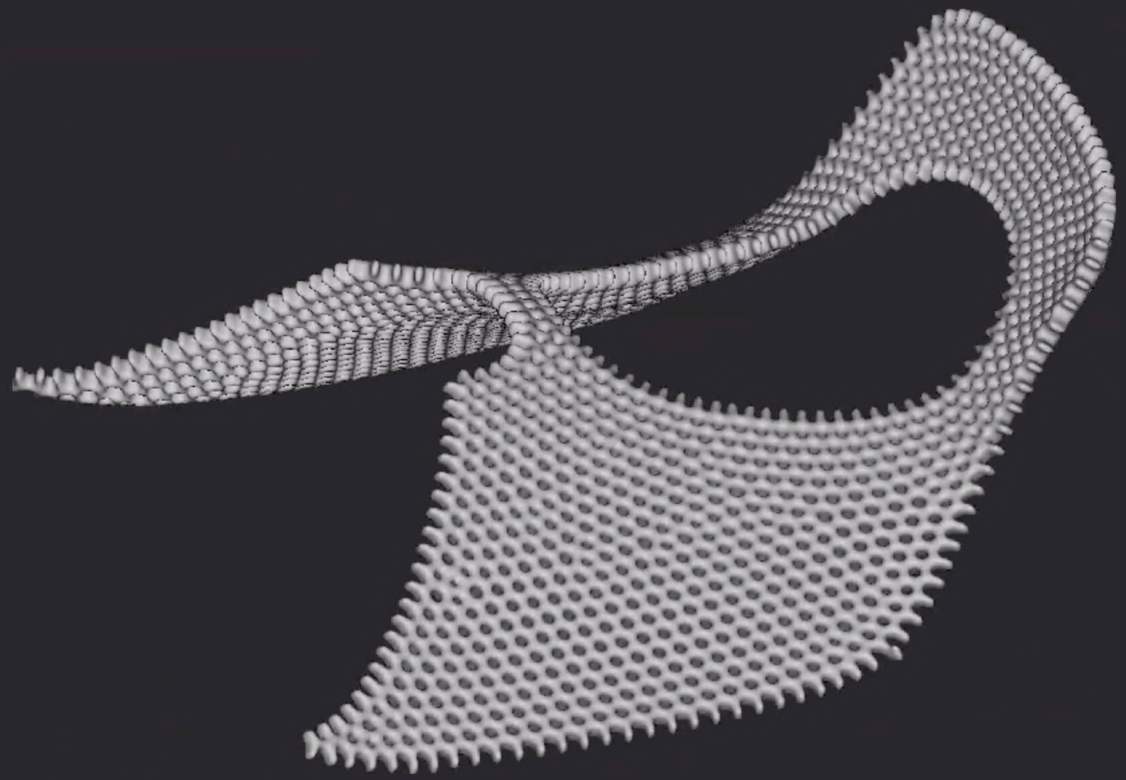
thickened interface regions: 24
attachment regions: 8





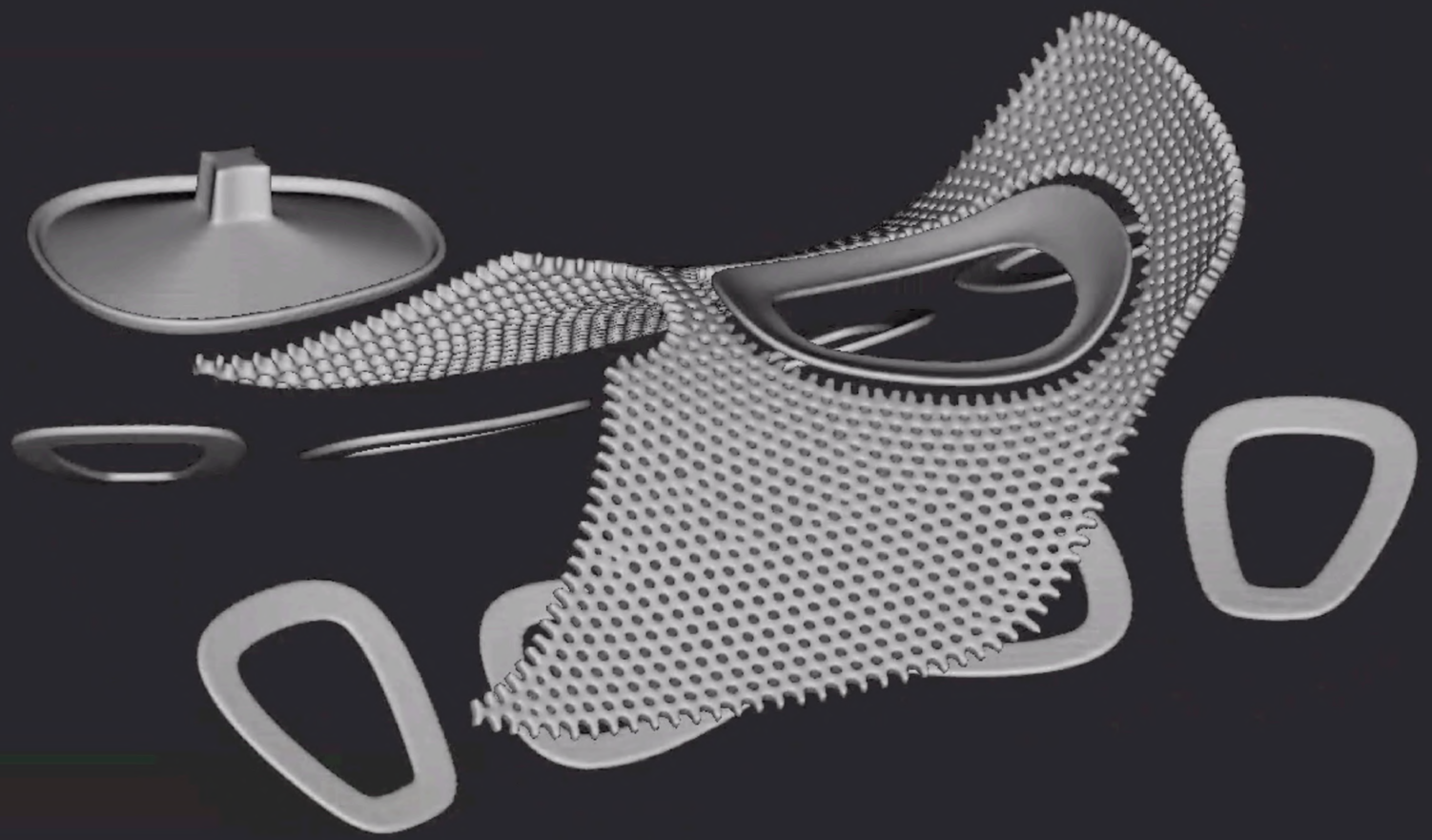
boolean iterations: 8
smoothing iterations: 3



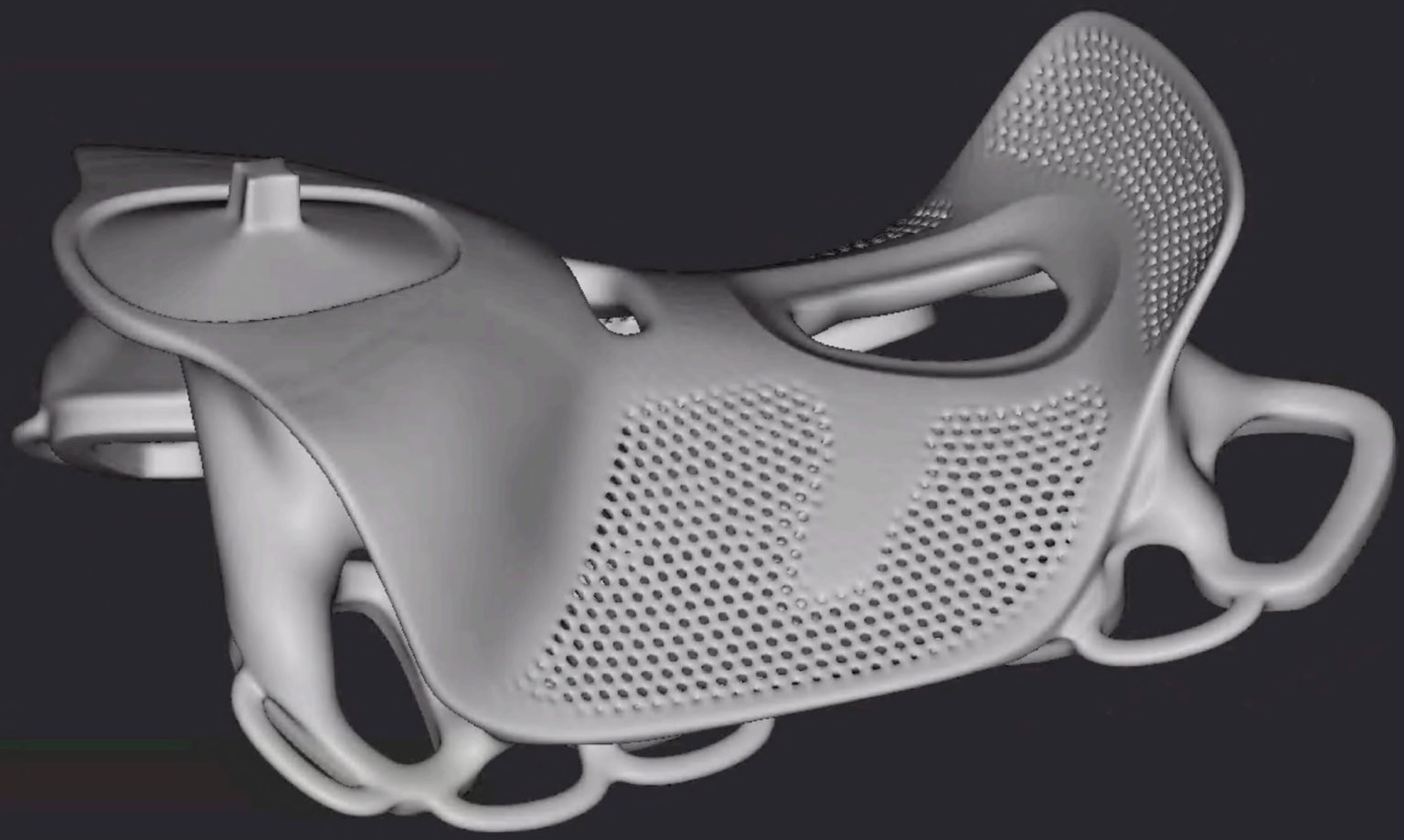


ramping factors: 2
relaxation iterations: 1000

lattice iteration: 9



final interface surfaces: 10



total line items: 1719

system:
32-core Xeon Gold
Nvidia A6000 x4
180 GB RAM

Topology Optimization

Demonstrates topology optimization on imported CAD geometry.

Search blocks... (Ctrl+L)

Inputs

Visible Bodies

final forms

pads viz — Concatenate Lists

seat viz — Empty

horn viz — horn

body viz — union 4

raw top opt

seat raw top opt viz — seat raw top ...

seat rear raw top opt... — seat rear r...

horn raw top opt viz — horn raw top...

pads raw top opt — Concatenate Lists (2)

List 1: — right pads raw t...

List 2: — mirror pads raw ...

Setting Variables

top opt settings

Mesh size — 8 mm

boundary penalty — 0

boundary penalty ra... — Ramp

Scalar field: Boolean Union — Implicit Body_128

Blend type: — Rounded

Blend radius: — 0 mm

Bodies: Implicit Body List (1... — Implicit Body ...

0: Implicit Body_1...

1: Implicit Body_1...

2: Implicit Body_1...

3: Implicit Body_1...

4: Implicit Body_1...

5: Implicit Body_1...

6: Implicit Body_1...

7: Implicit Body_1...

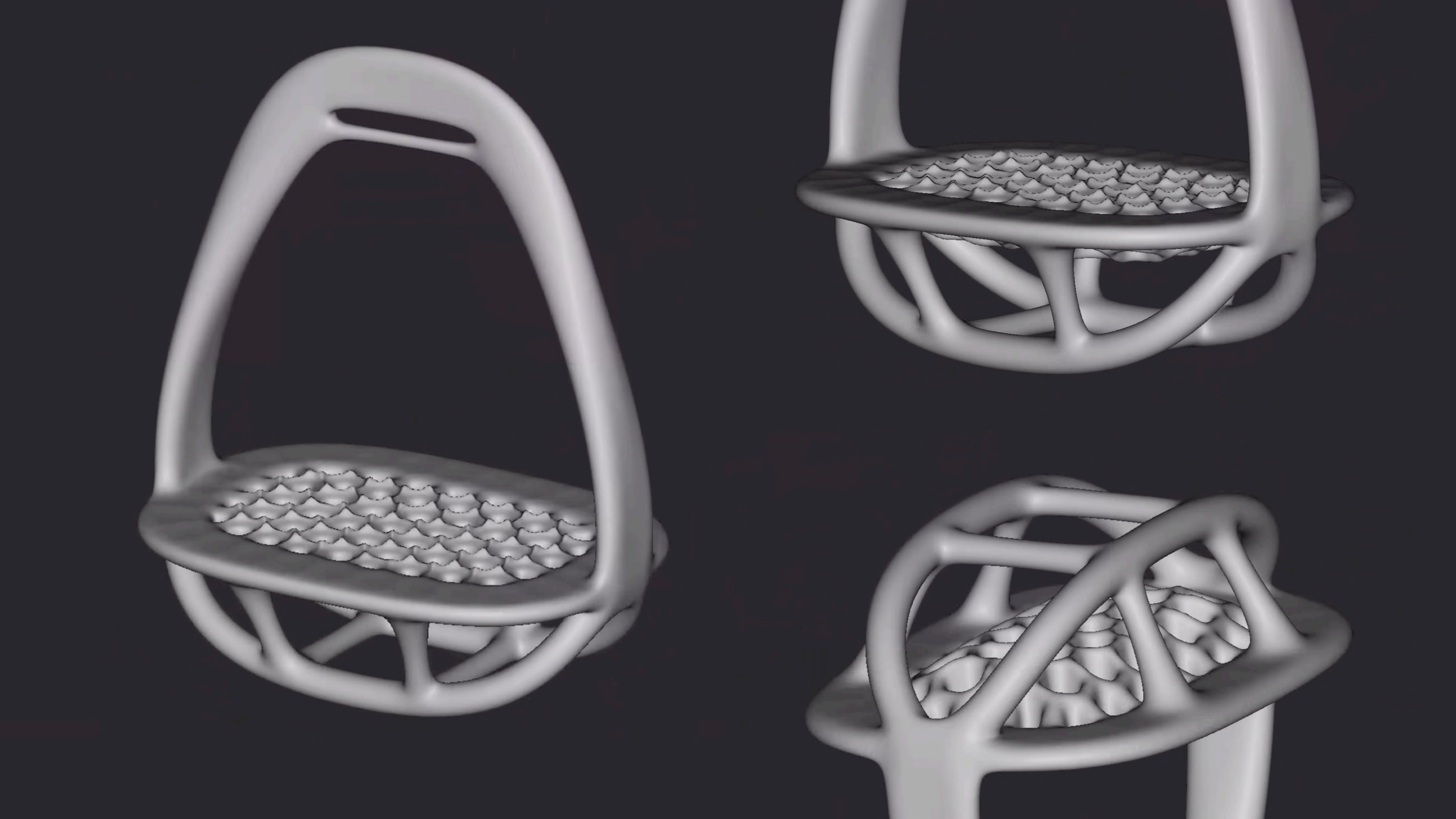
8: Implicit Body_1...

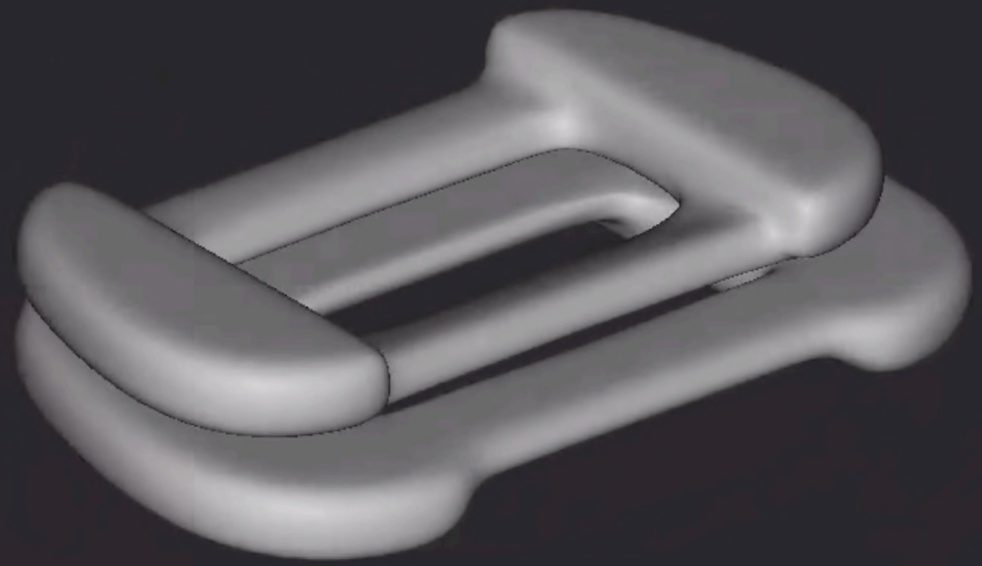
9: Implicit Body_1...

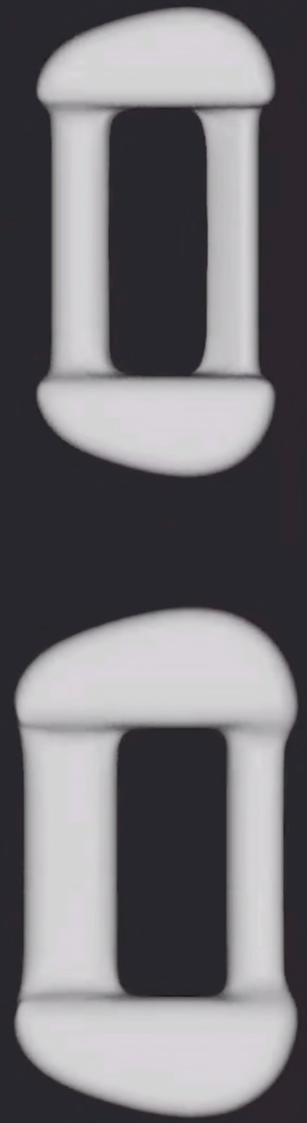
10: Implicit Body_1...

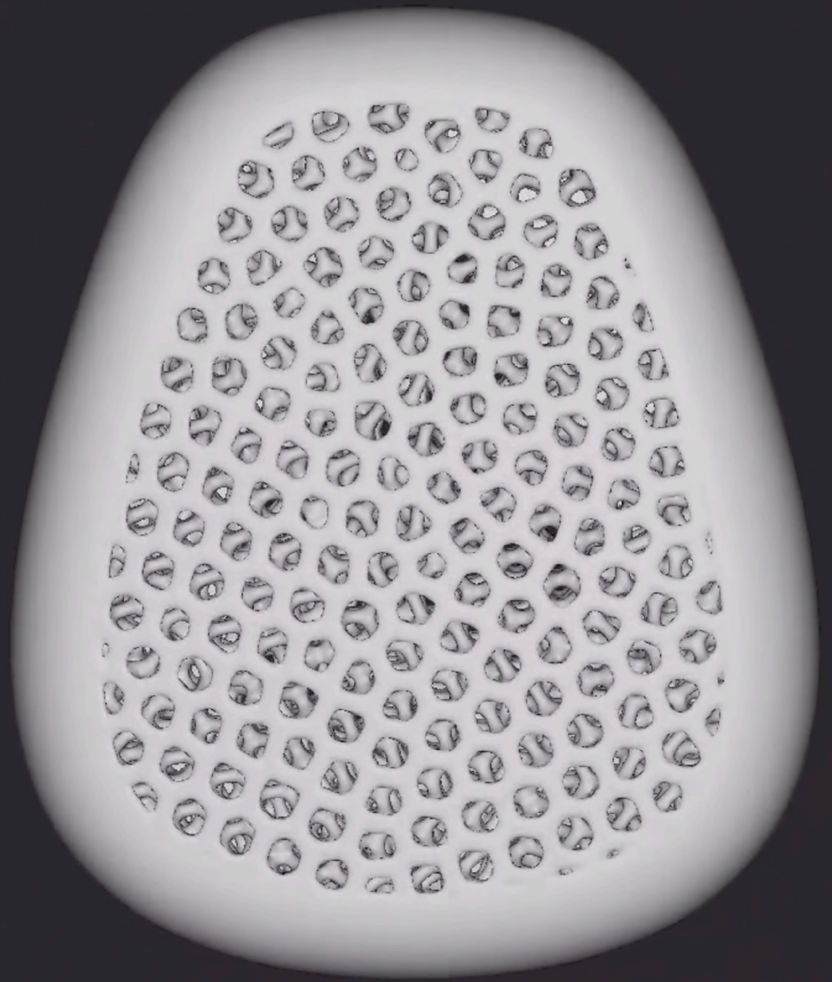
11: Implicit Body_1...

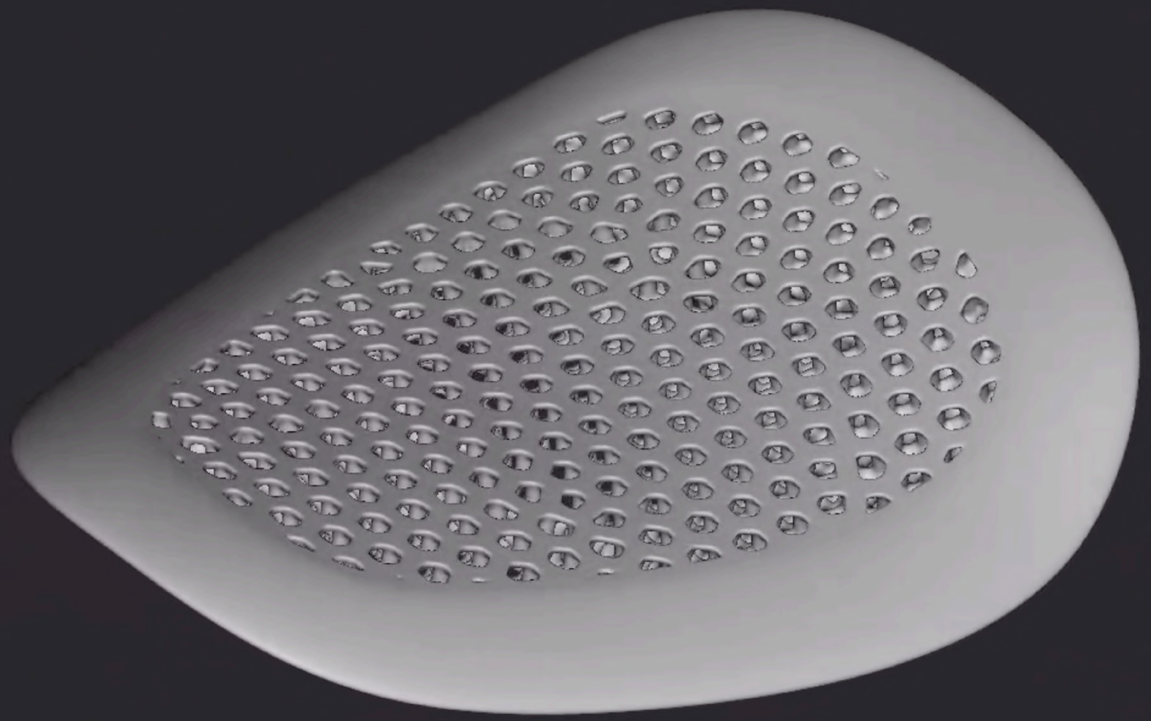
Output:

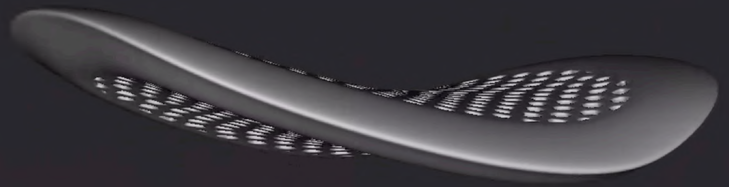


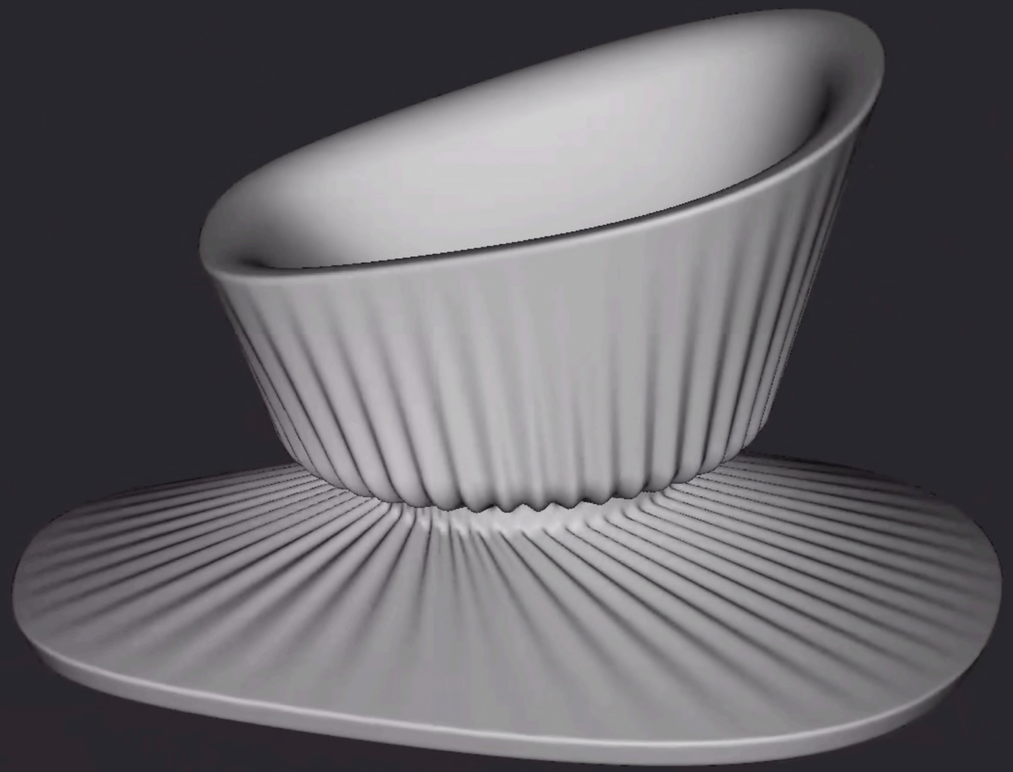
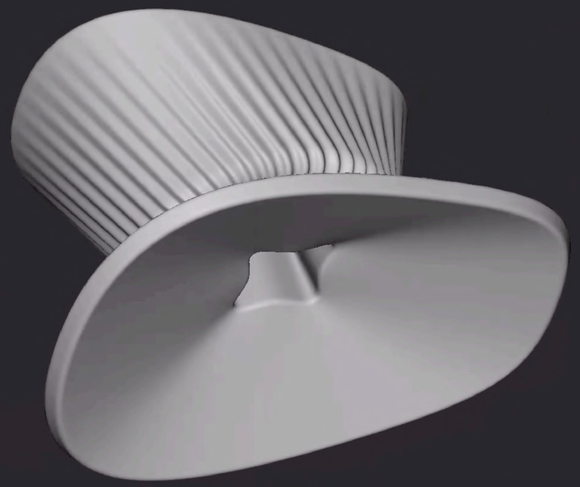
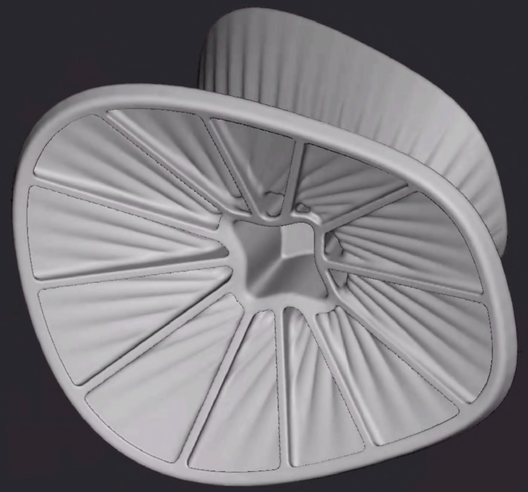
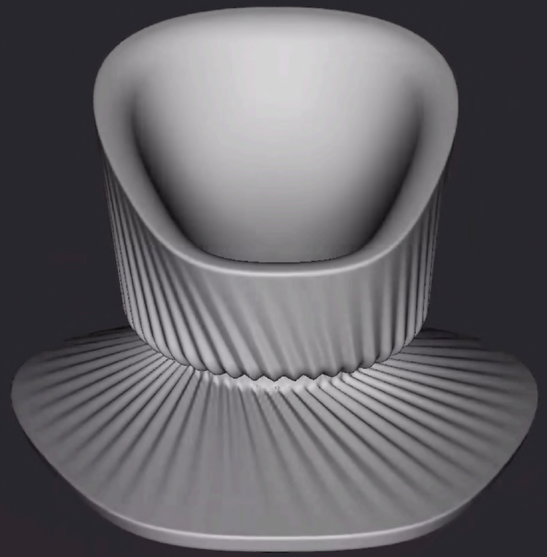


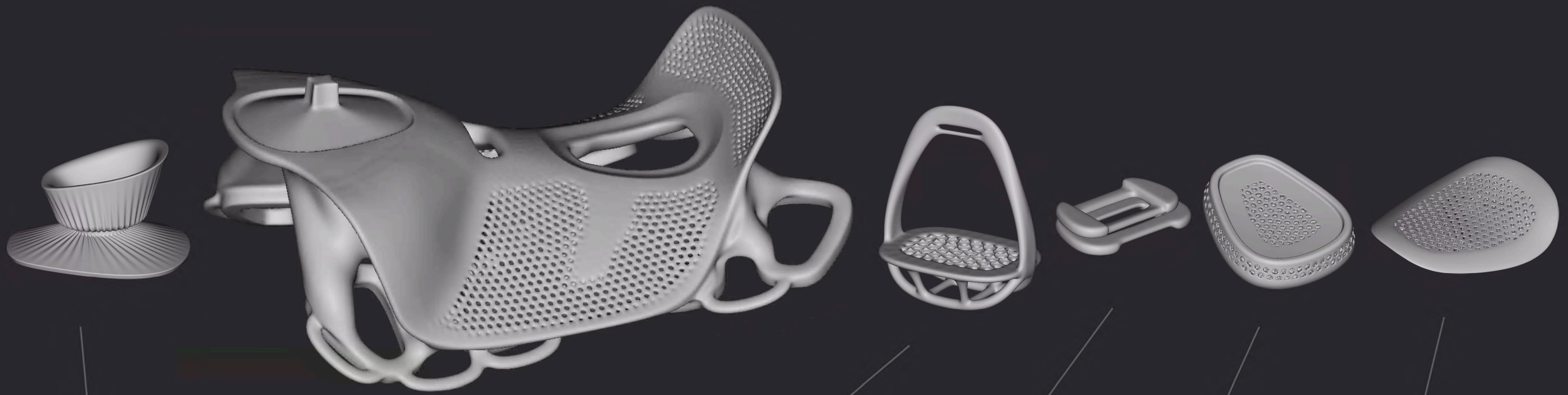








horn x1

- DMLS aluminum
- SLS nylon (proto)

body x1

- FDM nylon-wrapped carbon-core filament
- SLS nylon (proto)

stirrup x2

- DMLS aluminum
- PETG FDM (proto)

buckles x8

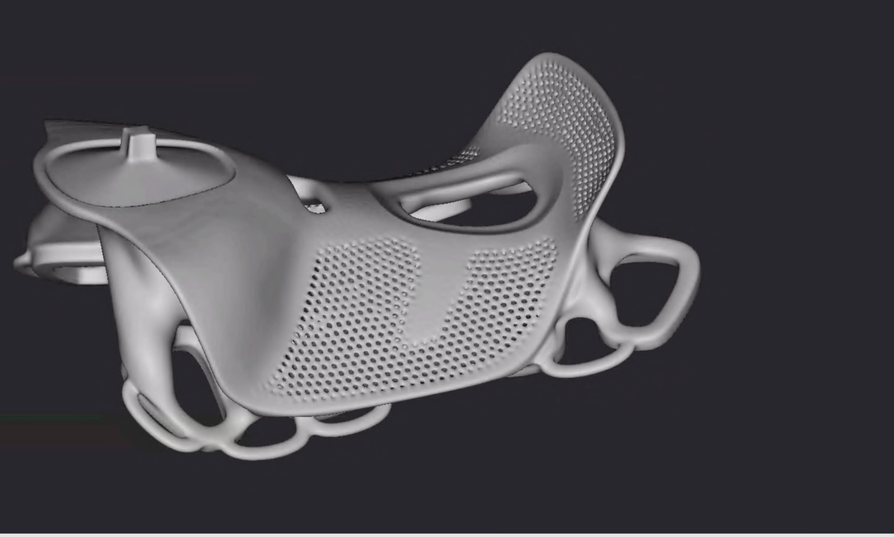
- DMLS aluminum
- SLS nylon (proto)

pad x8

- SLS TPU
- SLA Flexible 80A Resin (proto)

seat x1

- SLS TPU
- SLA Flexible 80A Resin (proto)

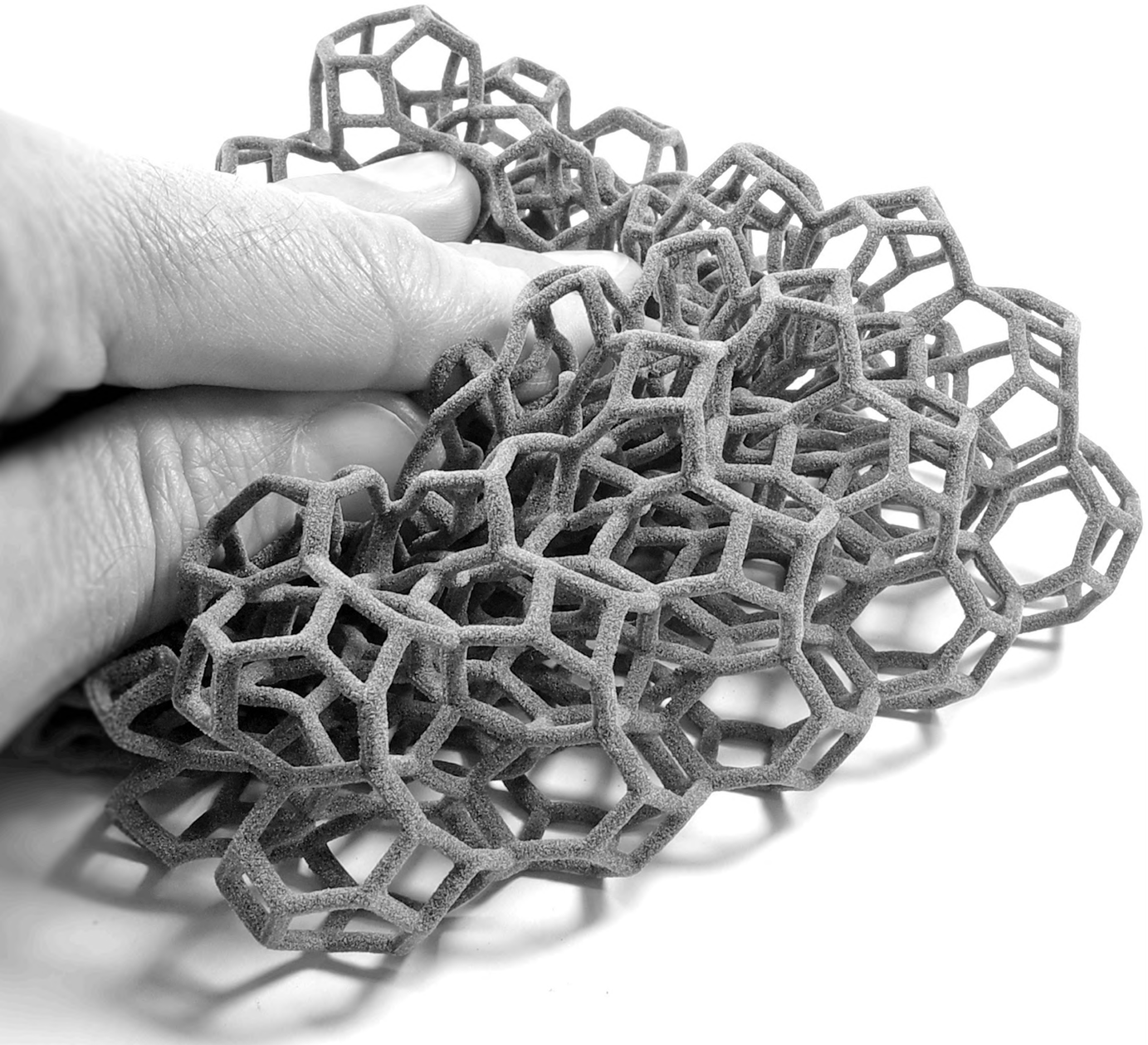


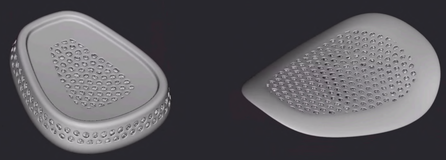
Carbon-core nylon FDM

Fused deposition modeling. Superstrata builds custom bike frames using 3D printing. They use a carbon filament wrapped in nylon. Their bike frames are more impact resistant than any CFRP bikes.

Aluminum DMLS

Direct metal laser sintering. Aluminum to minimize weight. Provides durable surfaces for the rope, webbing, and footbeds.



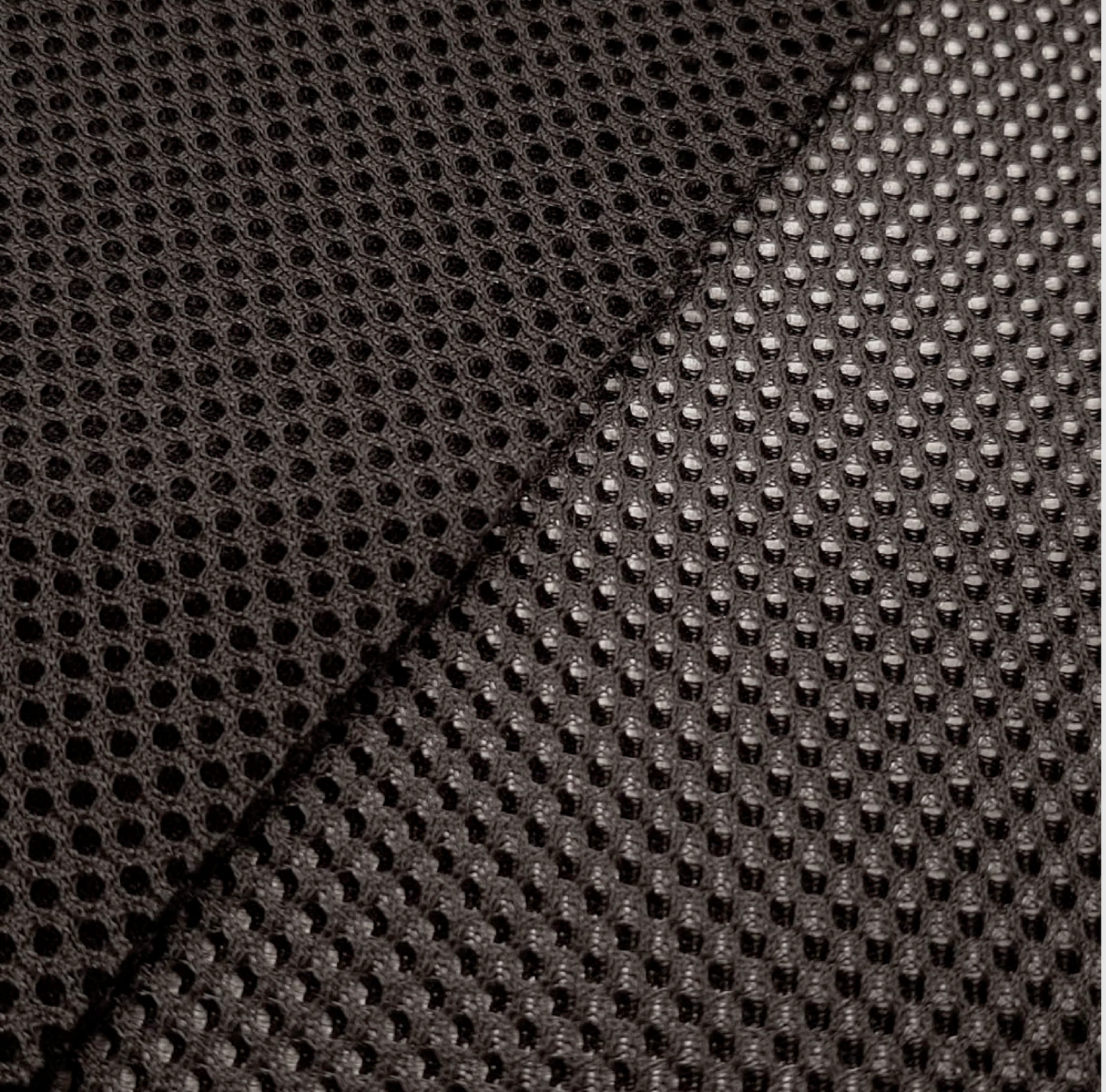


TPU SLS

Thermoplastic polyurethane selective laser sintering. SLS is great for complex structures. The prototypes are Formlabs 80A resin.

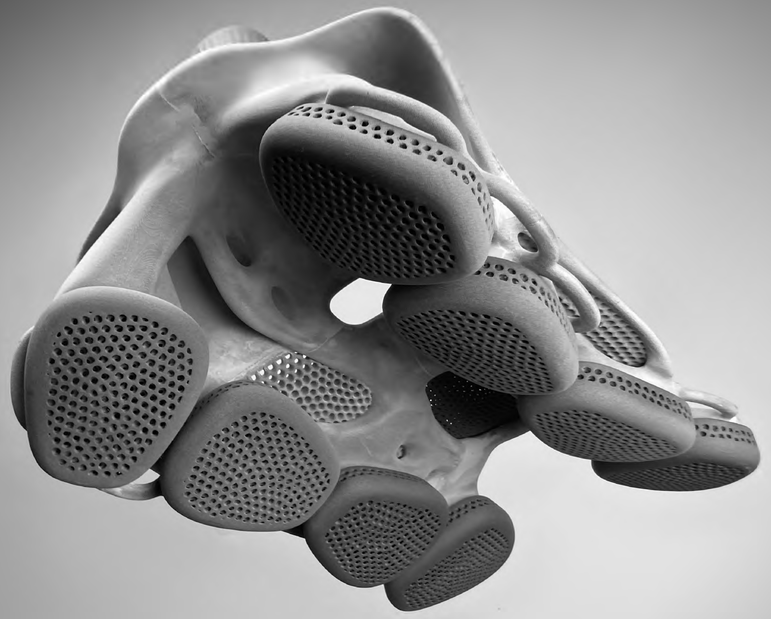
Polypropylene Webbing

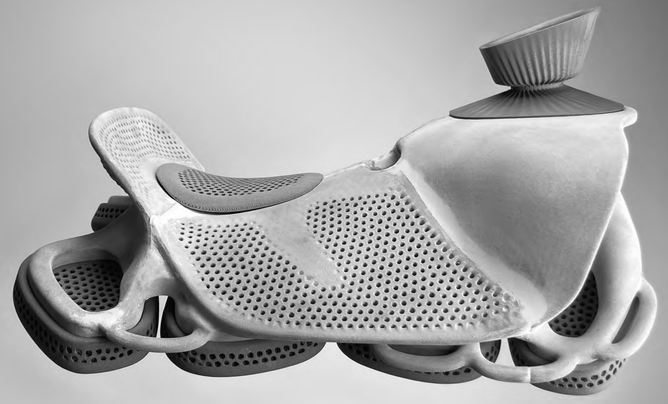
Does not stretch when wet, unlike nylon webbing. Falling from a horse is dangerous, so fit security takes precedence.

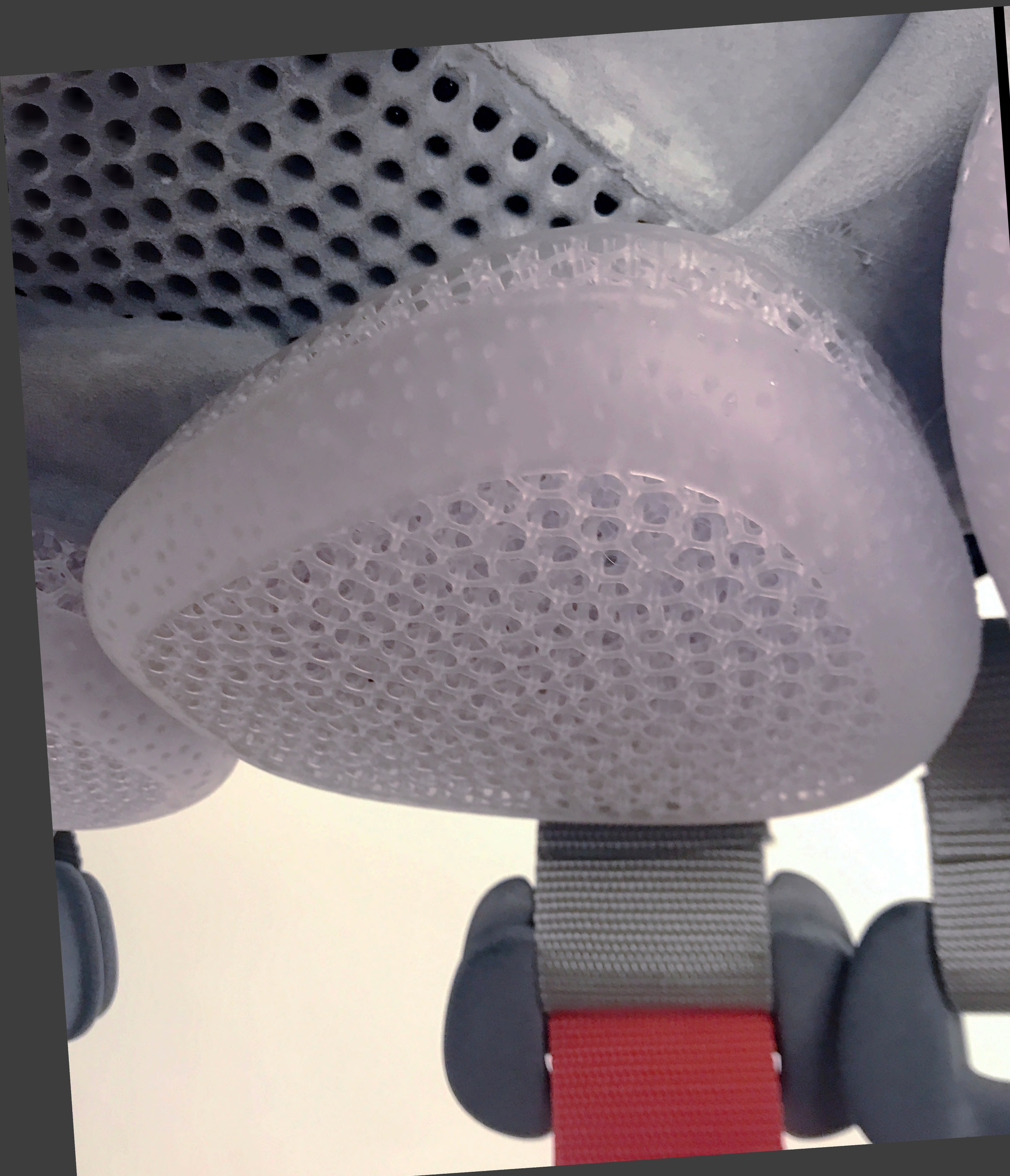


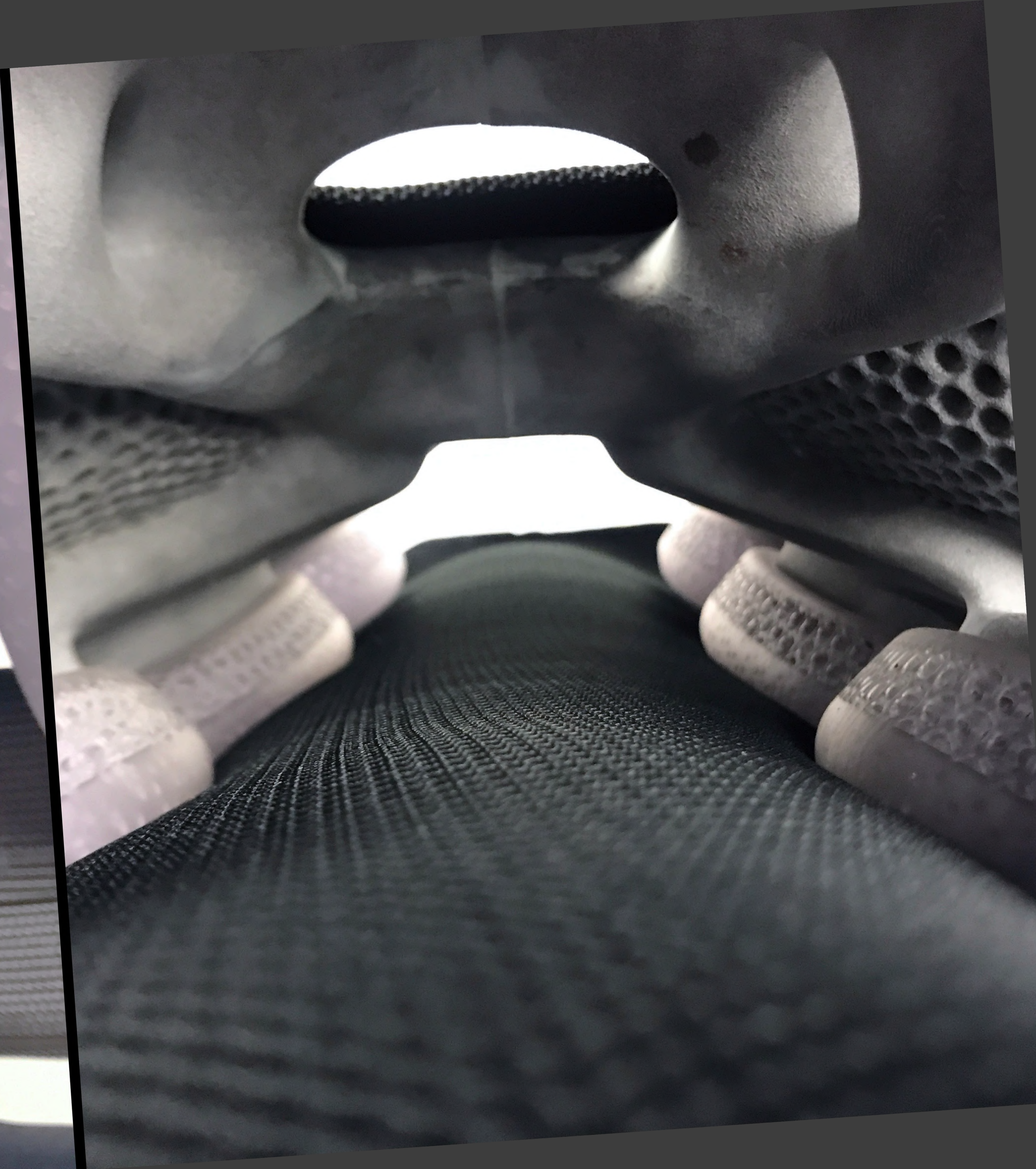
Spacer Mesh

Robust for high friction environments. Provides breathability when used next to skin. Precedents in backpacks.

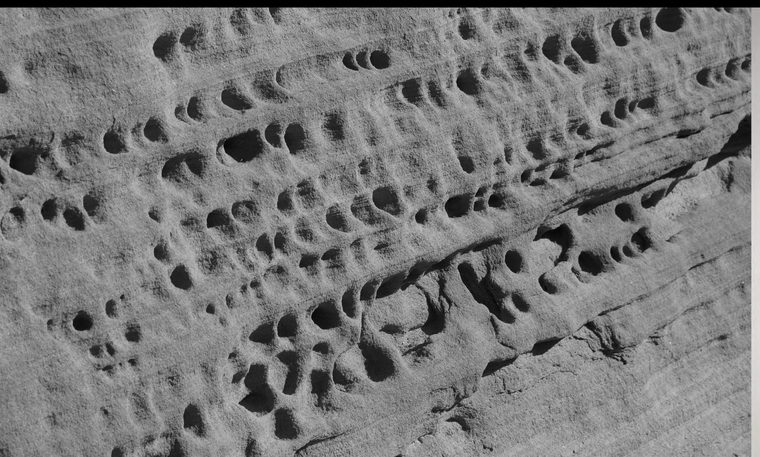


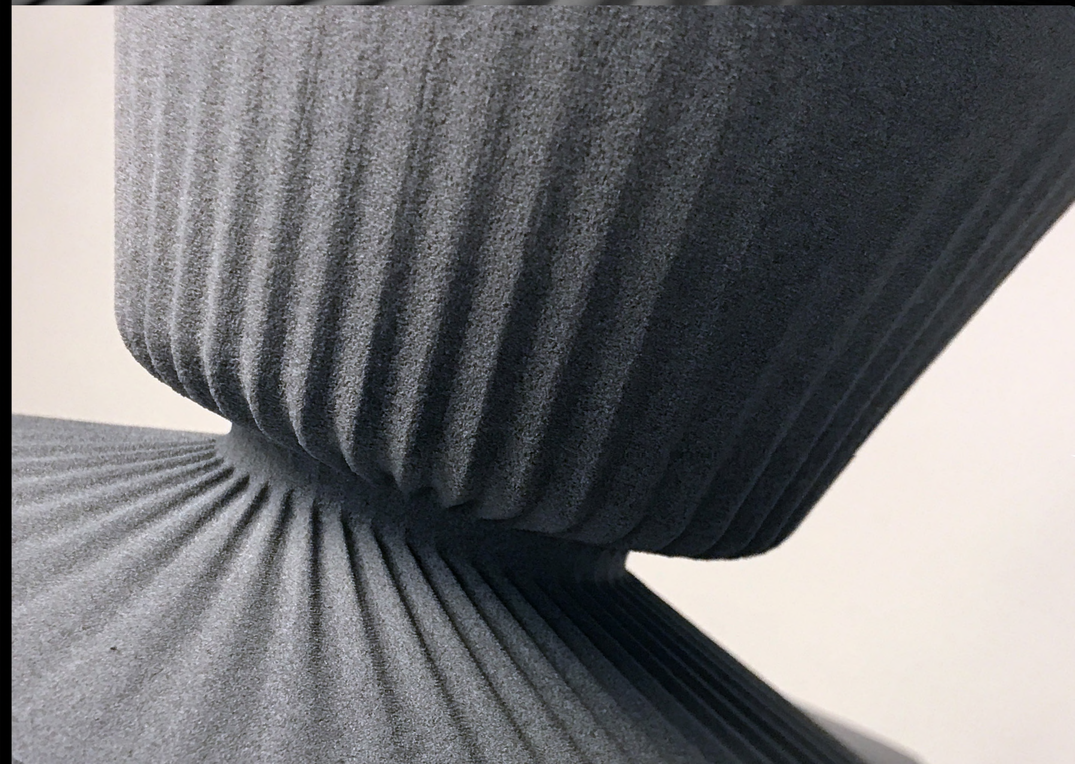






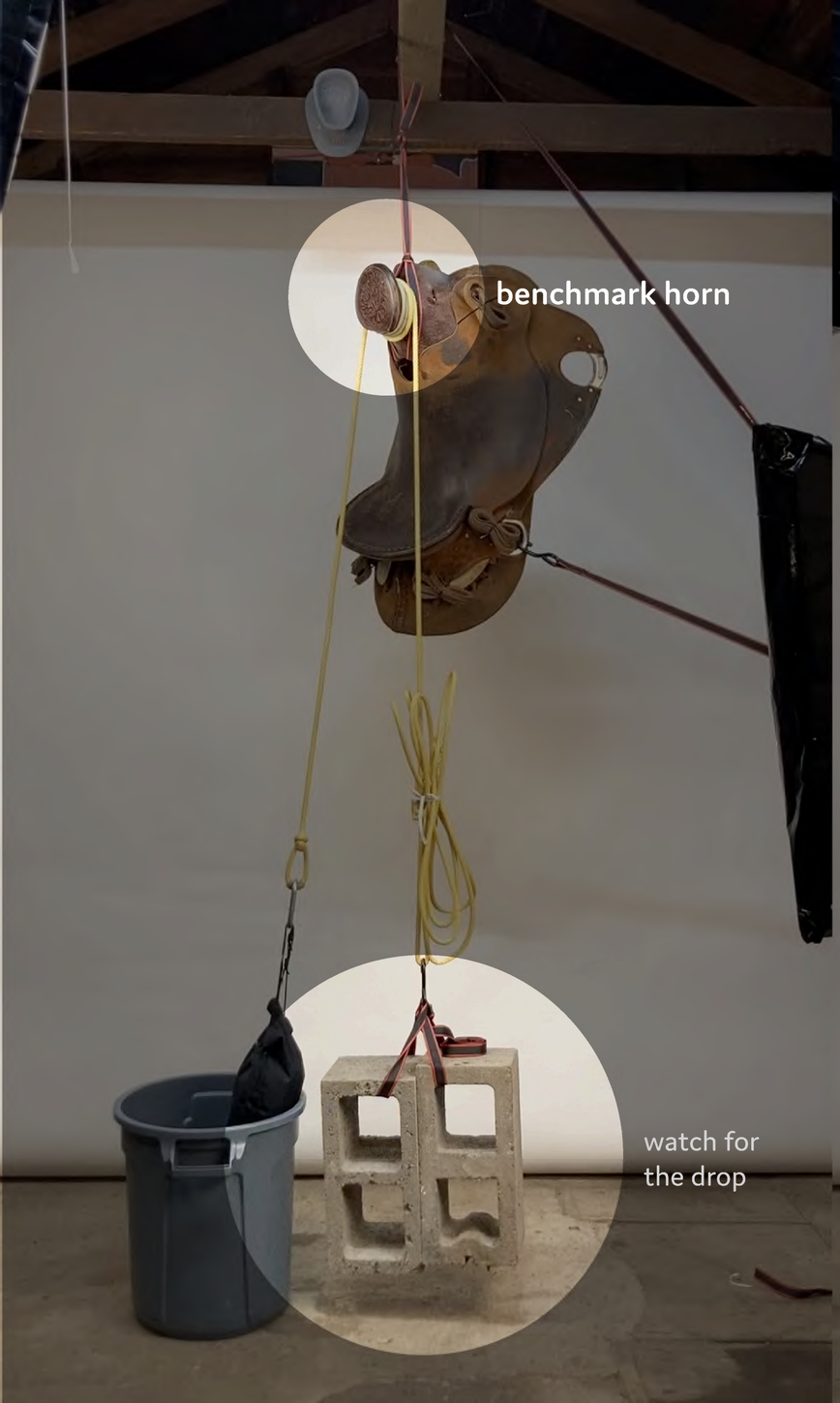






Total new saddle weight:

17.2 pounds



Benchmark horn coefficient of static friction:

0.962

New horn coefficient of static friction:

> 0.987

- See Capstan equation to calculate friction of multiple loops
- Test referred to by climbing folks

$$F_s = \mu_s N$$

F_s = Force of static friction.

μ_s = Coefficient of static friction.

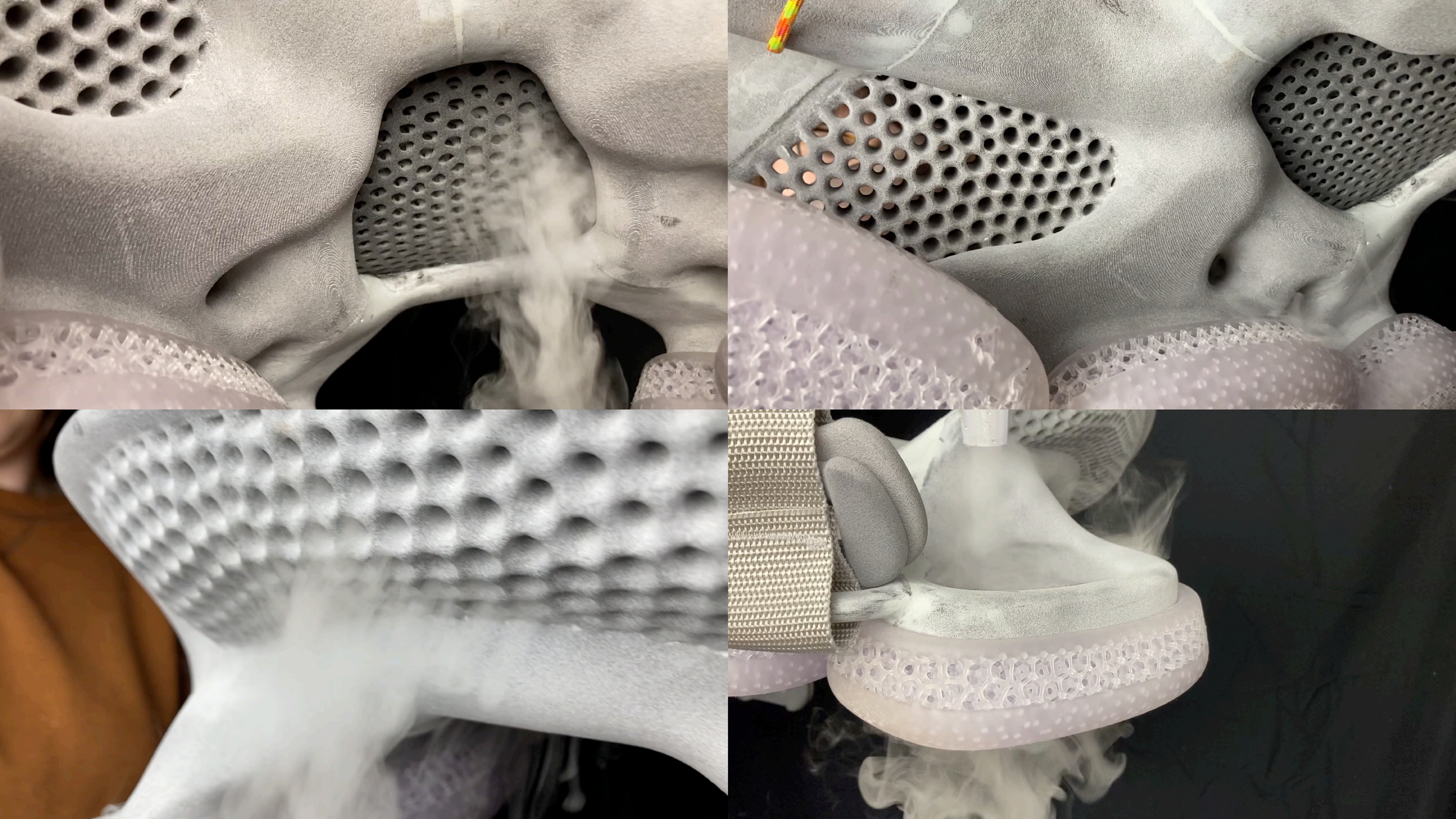
N = Normal force.

Benchmark saddle breathability:

Handle: Moderate
Seat: None
Sides: None
Padding: None

Windswept saddle breathability:

Handle: High
Seat: High
Sides: High
Padding: High



Metrics for success

SUCCESS 1. Horn has equal grip to existing horns without needing wraps

SUCCESS 2. Saddle weighs half of current saddles

SUCCESS 3. Airflow is directed through the saddle with better overall breathability

SUCCESS 4. Padding system allows next-to-skin breathability

“I have several riders that would really appreciate how light it is.”

“As cool as the saddle is, the fact that I could have a saddle made specifically for my horse is awesome.”

“I have several riders that would really appreciate how light it is. There are a lot of people that struggle to lift a regular saddle.”

“As cool as the saddle is, the fact that I could have a saddle made specifically for my horse is awesome. ... Fit is so important. Most custom saddles are really just tailoring a standard saddle, but an actual custom for-my-horse saddle is so much better.”

“I think this is the future of saddles.”

Alli Sloop

- Multiple-time Oregon Superior Horsemanship Award winner
- Equestrian Sciences Degree
- Owns/operates Silver Spur Equestrian

PANTONE+
Solid Coated
5285 C

PANTONE+
Solid Coated
2707 C

PANTONE+
Solid Coated
Red 032 C

PANTONE+
Solid Coated
Black 6 C

NEW FRONTIER

A futuristic rural plain where land-owning millennials wear AR headsets and ACG on horseback. NASA vibes.

PANTONE+
Solid Coated
454 C

PANTONE+
Solid Coated
500 C

PANTONE+
Solid Coated
581 C

PANTONE+
Solid Coated
Black 5 C

PETRICHOR

A pleasant smell that frequently accompanies the first rain after a long period of warm, dry weather.

WINDSWEPT SADDLES

We use 3D scanning and printing to deliver the best performing, best fitting saddles.

LEARN MORE

Future development notes:

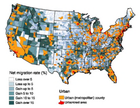
- **Explore combining body and pads into a single (possibly shore 90A) print**
- **Further minimize DMSL volume**
- **Build out accessory offerings**

Thanks:

Wilson Ranch, Jim Karn, Alli Sloop, James Tuttle, Susan Sokolowski & Rachael Volker

NEXT-GEN RANCHERS

New ranchers are leaving cities to join smaller communities and connect to the land. These people are coming with a future-oriented perspective, and they expect modern performance from their products.



Old tech shoes vs. new tech shoes

Old tech backpack vs. new tech backpack

Saddles are still made using 200-year-old tech. What would a new future-oriented saddle look like?

WESTERN SADDLES

While there is some new tech in English riding saddles, western saddles are still made with a wooden core (called a tree) and multiple layers of leather, sheepskin, and felt.

The horn on western saddles allows the rancher to brace the rope when roping animals. Great static friction is key.

Current saddles can be extremely heavy. This one with all its accoutrements weighs 40.1 pounds!

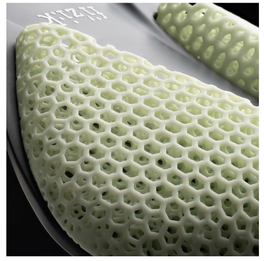
Horses sweat at twice the rate per square inch as humans. They can lose up to 4 gallons of water an hour on a hot day.

Sweat also leads to saddle sores, which keeps work from getting done.

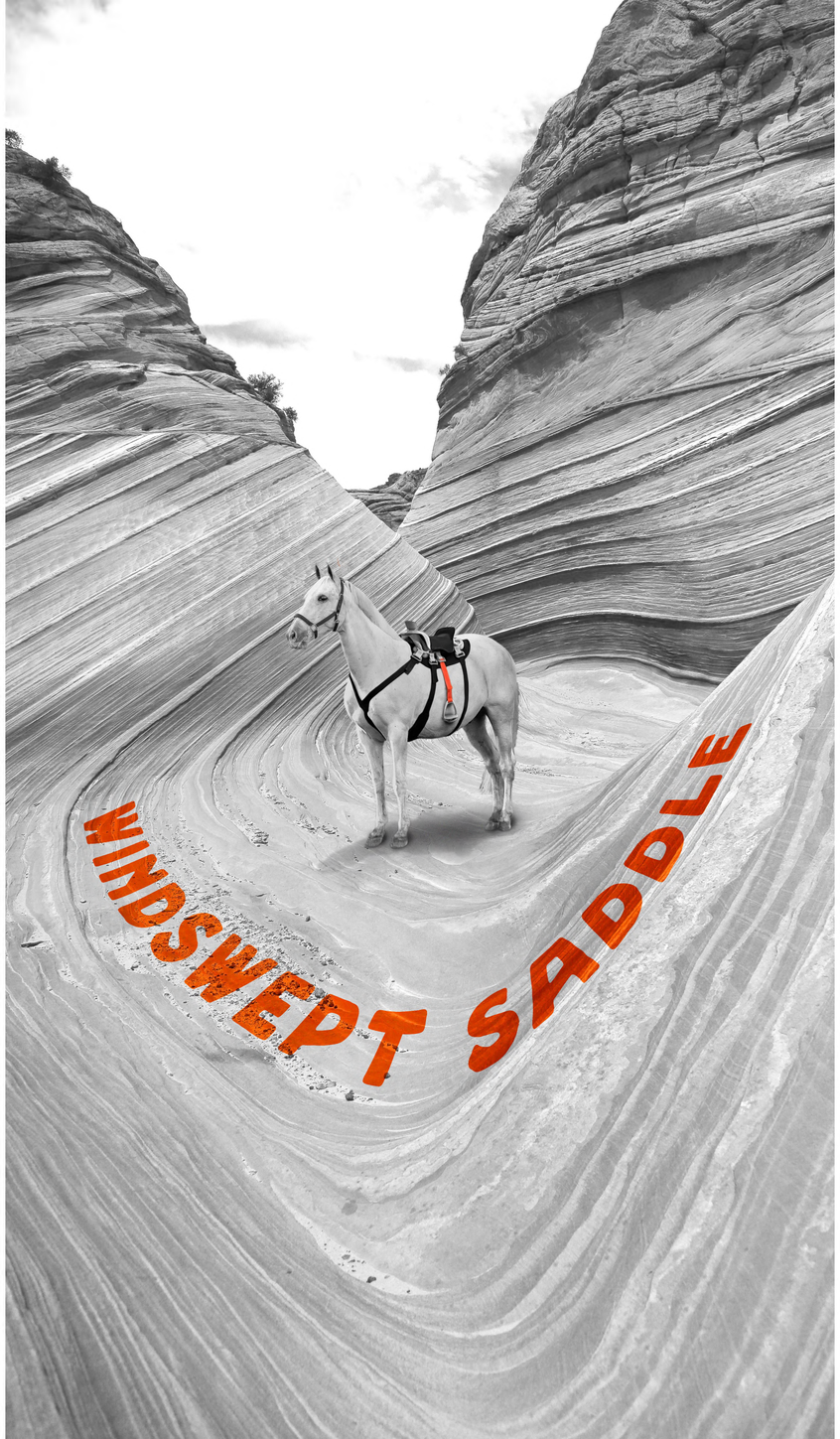
APPLIED TECH

Belay devices have small teeth that grip the rope well under load.

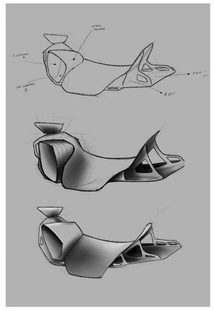
Topology optimized structures minimize the material to only what is required for a specified load case. It essentially maximized negative space, which is great for airflow and weight reduction.



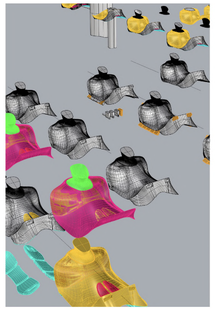
Elastomer lattice structures excel at providing impact attenuation while remaining breathable


WINDSWEPT SADDLE

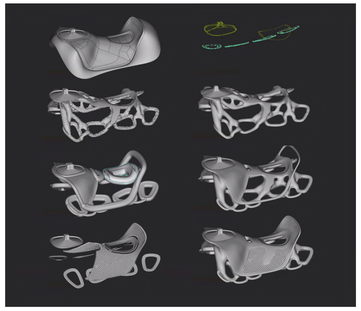
DEVELOPMENT



Converting the swell into an air intake takes advantage of the horse's movement to direct airflow through the saddle



Scan information was used to define interaction surfaces. Hundreds of iterations were developed in Rhino.

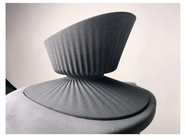


Saddle volumes and surfaces were brought into nTopology, where force data was applied to the relevant surfaces to generate a topology optimized form that satisfies load requirements while reducing build material.

FUNCTION

This saddle, with the included horse pad, human pad, and straps, weighs only 17.2 pounds, less than half of a traditional western saddle.

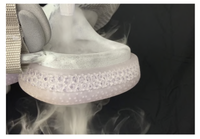
Print material:
SLS nylon, 80A Resin



The teeth match the geometry found on belay devices. As the rope constricts, it slips into the groove and grips the rope firmly.

Grip of existing horns: 96%
Grip of Dust Devil Horn: over 98%

The topology optimization creates a bone-like structure that allows for ample airflow between horse and rider. The lattice sections allows surfaces to be breathable.

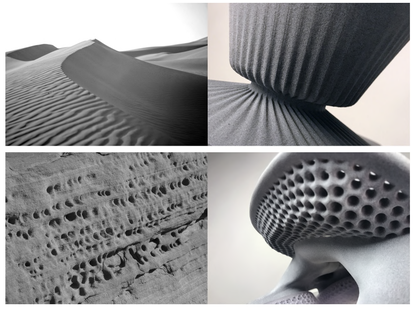


The lattice pads offer cushioning while still allowing plenty of breathability.

FORM

What forms does airflow create?

The left of each pairing is an image of wind erosion in the American Southwest. The right of each pairing is a close-up of the saddle.



Dan Winegar — Sports Product Design — University of Oregon

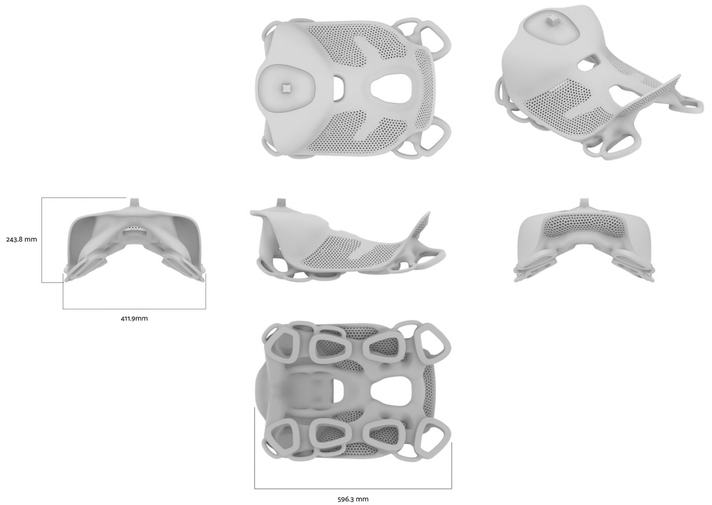
WINDSWEPT SADDLE

Tech Pack

Reference photo
Date: 06 June 2022
Contact: Dan Winegar

Notes

REFERENCE 3D FILE FOR GEOMETRY DETAILS AND DIMENSIONS



SADDLE BODY

Product: Windswept Saddle
Date: 06 June 2022
Contact: Dan Winegar

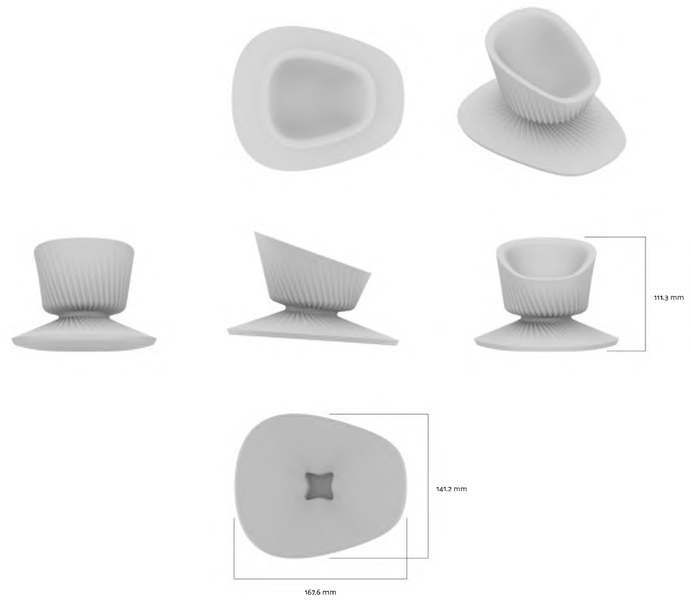
Materials

- SLS printed nylon, surface treated

Notes

Quantity: 1
No aesthetic coatings post-surface treatment

REFERENCE 3D FILE FOR GEOMETRY DETAILS AND DIMENSIONS



HORN

Product: Windswept Saddle
Date: 06 June 2022
Contact: Dan Winegar

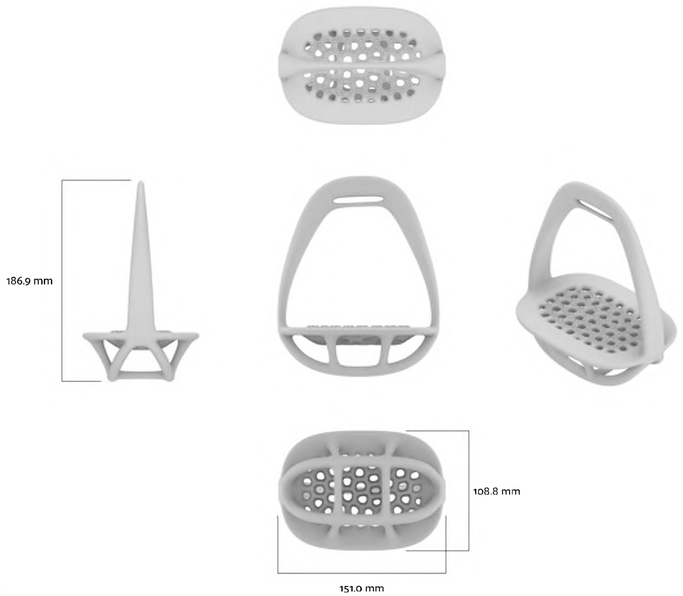
Materials

- ☐ DMLS printed aluminum, surface treated

Notes

Quantity: 1
No aesthetic coatings post-surface treatment

REFERENCE 3D FILE FOR GEOMETRY DETAILS AND DIMENSIONS



STIRRUP

Product: Windswept Saddle

Date: 06 June 2022

Contact: Dan Winegar

Materials

- DMLS printed aluminum, surface treated

Notes

Quantity: 2

No aesthetic coatings post-surface treatment

REFERENCE 3D FILE FOR GEOMETRY DETAILS AND DIMENSIONS

BUCKLE TOP

Product: Windswept Saddle
Date: 06 June 2022
Contact: Dan Winegar

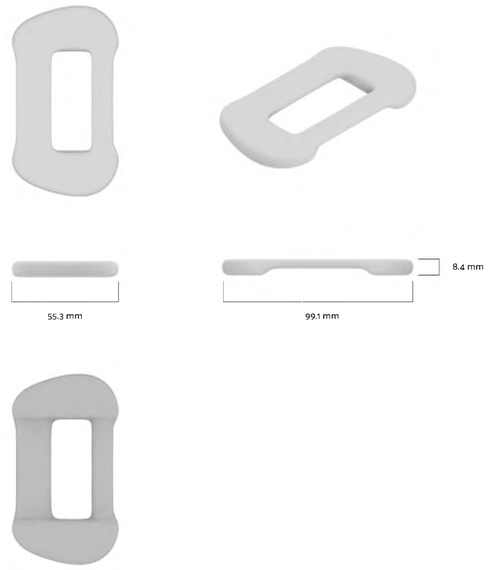
Materials

SLS printed nylon, surface treated

Notes

Quantity: 8
No aesthetic coatings post-surface treatment

REFERENCE 3D FILE FOR GEOMETRY DETAILS AND DIMENSIONS



BUCKLE BOTTOM

Product: Windswept Saddle
Date: 06 June 2022
Contact: Dan Winegar

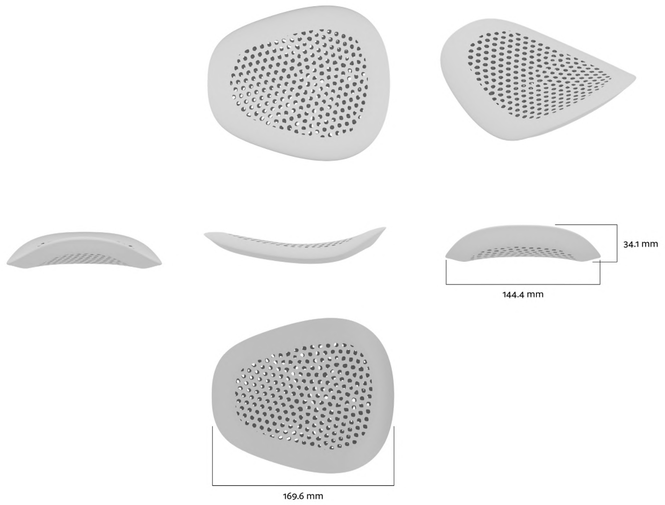
Materials

SLS printed nylon, surface treated

Notes

Quantity: 8
No aesthetic coatings post-surface treatment

REFERENCE 3D FILE FOR GEOMETRY DETAILS AND DIMENSIONS



SEAT

Product: Windswept Saddle
Date: 06 June 2022
Contact: Dan Winegar

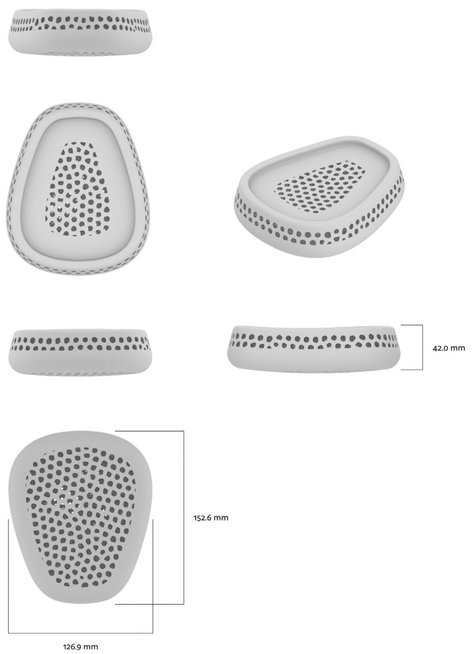
Materials

- SLS printed TPU, shore 80A, surface treated

Notes

Quantity: 1
No aesthetic coatings post-surface treatment

REFERENCE 3D FILE FOR GEOMETRY DETAILS AND DIMENSIONS



PAD

Product: Windswept Saddle
Date: 06 June 2022
Contact: Dan Winegar

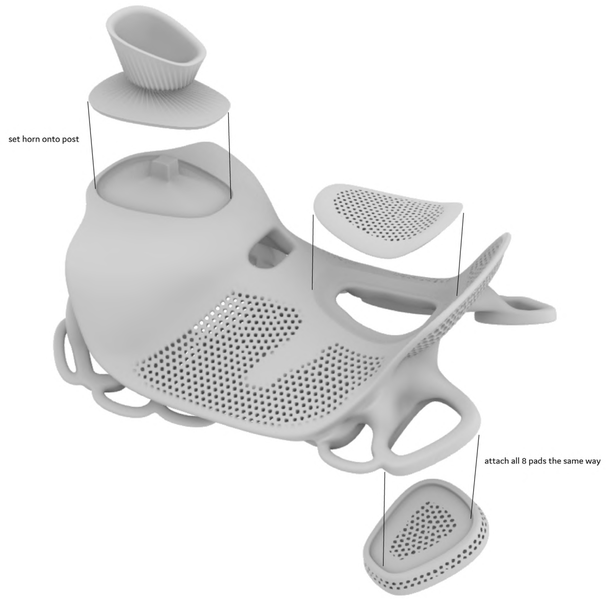
Materials

- SLS printed TPU, shore 80A, surface treated

Notes

Quantity: 8
No aesthetic coatings post-surface treatment

REFERENCE 3D FILE FOR GEOMETRY DETAILS AND DIMENSIONS



ASSEMBLY

Product: Windswept Saddle
Date: 06 June 2022
Contact: Dan Winegar

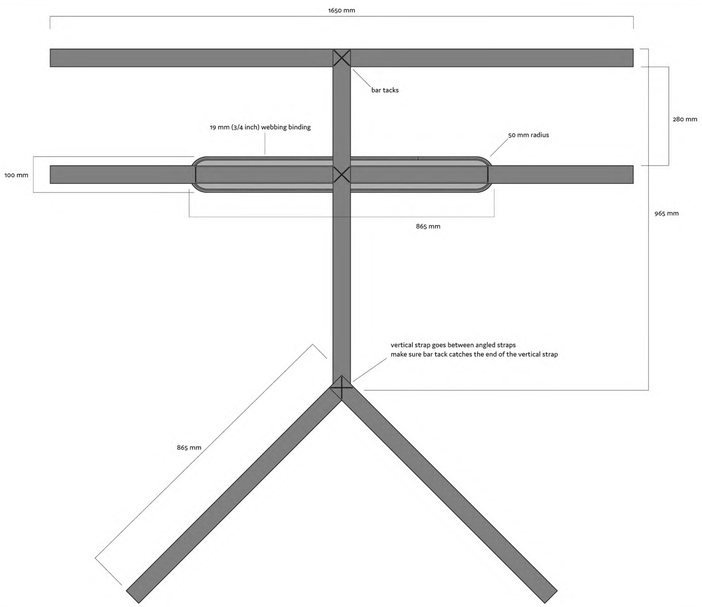
Materials

- [ ] Polyurethane glue

Notes

Rough and score all mating surfaces
Attach horn, seat, and 8 pads with polyurethane glue

REFERENCE 3D FILE FOR GEOMETRY DETAILS AND DIMENSIONS



RIGGING

Product: Windswept Saddle

Date: 06 June 2022

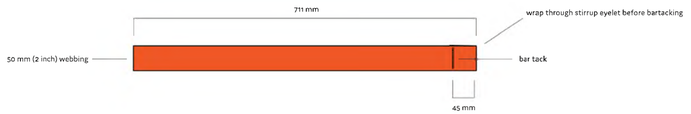
Contact: Dan Winegar

Materials

- 2-inch polypropylene webbing
  PANTONE+, Solid Coated, Black 6 C
- 3/4-inch polypropylene webbing
  PANTONE+, Solid Coated, Black 6 C
- Techno 3D spacer mesh
  PANTONE+, Solid Coated, Black 6 C

Notes

Color match all threads



STIRRUP STRAP

Product: Windswept Saddle

Date: 06 June 2022

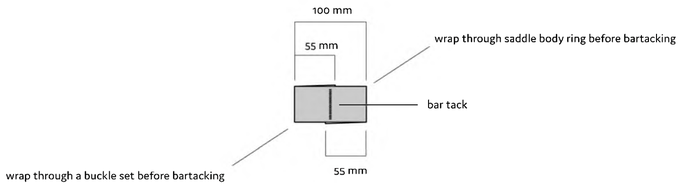
Contact: Dan Winegar

Materials

- 2-inch polypropylene webbing PANTONE+, Solid Coated, Red 032 C

Notes

Color match all threads



BUCKLE STRAP

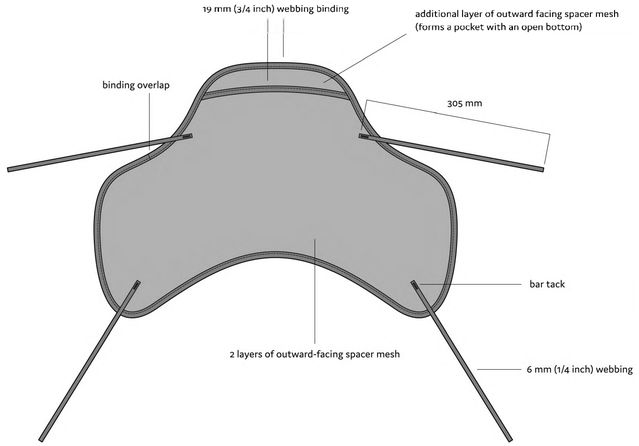
Product: Windswept Saddle
Date: 06 June 2022
Contact: Dan Winegar

Materials

- 2-inch polypropylene webbing
  PANTONE+, Solid Coated, 2707 C

Notes

Color match all threads



SEAT COVER

Product: Windswept Saddle

Date: 06 June 2022

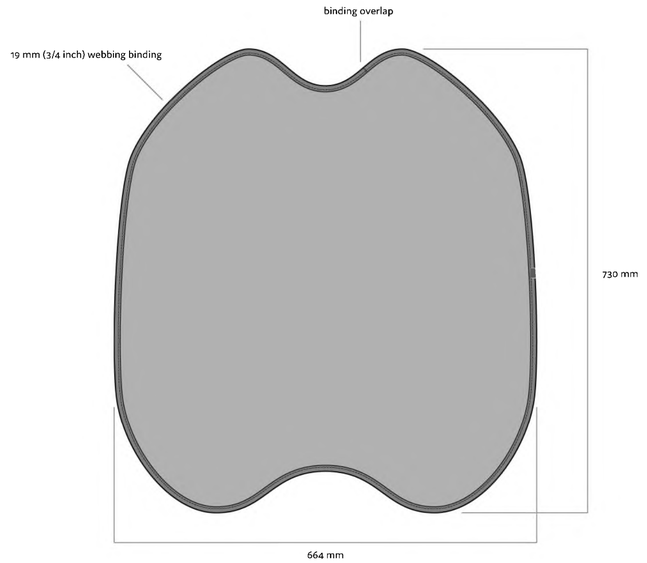
Contact: Dan Winegar

Materials

- 1/4-inch polypropylene webbing
  PANTONE+, Solid Coated, Black 6 C
- 3/4-inch polypropylene webbing
  PANTONE+, Solid Coated, Black 6 C
- Techno 3D spacer mesh
  PANTONE+, Solid Coated, Black 6 C

Notes

Color match all threads



PAD COVER

Product: Windswept Saddle

Date: 06 June 2022

Contact: Dan Winegar

Materials

- 3/4-inch polypropylene webbing
  PANTONE+, Solid Coated, Black 6 C
- Techno 3D spacer mesh
  PANTONE+, Solid Coated, Black 6 C

Notes

Color match all threads

Congrats!

You made it to the end!