New Materials and Methods for Western Saddlery

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Author Note

For a period of time in 2018, the author was in daily, direct contact with workers on a ranch in southern Colorado, which generally informs his research here. This project was conducted in Portland, Oregon and the details will at times reflect the location.

Abstract

Western ranchers have been making saddles in largely the same fashion for the past two hundred years. While some new technology has made its way into English or riding saddles, Western saddles are made from leather and are often still made by hand. Western saddles are also different than English saddles in that they have to accommodate the diverse work needs of ranchers. This paper aims to see if an analogy to climbing harnesses or backpacking backpacks could provide a saddle design that better leverages modern materials and manufacturing to make a Western saddle that performs better. Given that a saddle is a product that exists within two different sets of needs (the rider's and the horse's), data-driven design will be examined as a possible method of generating forms that would successfully bridge between both sets of needs. The goal of these new material and manufacturing approaches is to double the breathability, cut the weight in half, and retain equal horn grip performance in a new saddle prototype when compared to a benchmark saddle.

Keywords: saddle, western saddle, ranching, horse, climbing harness, backpacking, data-driven design, topology optimization.

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SECTION 1: FALL TERM

New Materials and Methods for Western Saddlery

Western ranchers have been making saddles in largely the same fashion for the past two hundred years. While some new technology has made its way into English or riding saddles, Western saddles are made from leather and are often still made by hand. Western saddles are also different than English saddles in that they have to accommodate the diverse work needs of ranchers. This paper aims to see if an analogy to climbing harnesses or backpacking backpacks could provide a saddle design that better leverages modern materials and manufacturing to make a Western saddle that performs better. Given that a saddle is a product that exists within two different sets of needs (the rider's and the horse's), data-driven design will be examined as a possible method of generating forms that would successfully bridge between both sets of needs.

Current State of Saddlery in the American West

Leatherworking is a traditional craft that is passed on from one generation of workers to the next. It often takes years to master. Each piece of leather will behave differently. Each piece need to be evaluated and worked with to accommodate its unique personality. Because of this, leather saddle making is has maintained a bespoke, handcrafted construction process. (Types of Leather, n.d.)

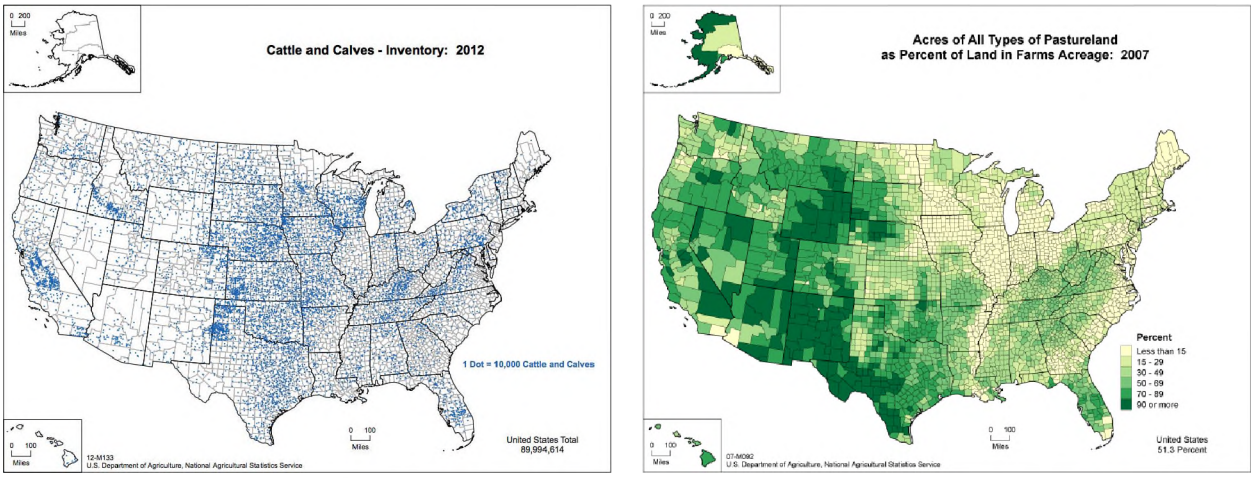
Ranches in the deserts of the American West hire workers to ride horses while herding cattle and doing other ranch work. The anchor piece of every ranch worker's equipment list is their saddle. Saddle are a unique piece of equipment in that it essentially is serving as a bridge between two athletes: the rider and the horse. Western saddles are used by ranchers in the high deserts of the American West.

High Desert Environment

Most open-ranch ranches in the United States are located in the arid climates of the Great Basin and its surrounding high deserts. (See "Location" section below). Although not entirely indicative of the entire Great Basin Region, for the purposes of this paper, when a specific location is needed, Fields, Oregon will be used as an example.

Figure 1

Cattle in the United States, Pasture as a Percentage of Farmland



Note: On the left is a map of the cattle inventory in the United States as of 2012. This includes open range cattle and cattle kept on feed lots (Kiersz, 2015). On the right is a map of how much land is used for pasture from the total available farmland. This is more indicative of where open range ranches are located (USDA, 2007).

Location

Roughly two-fifths of all land in the United States is used as farmland, half of which is used permanently as pasture. There are 2.1 million farms and ranches in the United States. Despite a decline in the percentage of Americans that are farmers or ranchers, the market is still large. (USDA - National Agricultural Statistics Service - Publications - Highlights, n.d.)

While a map of total cattle would indicate where cattle are in the United States, it doesn't communicate where the open-range ranches are. A more useful map is would be one that shows pasture and a percentage of total farmland. A greater percentage of land being dedicated to pasture indicates that cattle are more likely on open range ranches instead of feed lots. As can be seen from the included figures, the high desert shrub lands of the western United States host the most of these open-range ranches.

Temperature, Humidity, and Sunshine

In Burns, Oregon, summer temperatures can reach over 100 degrees Fahrenheit, with humidity typically around 30 percent. Burns also has an average of 211 sunny days each year. Average wind speed from June to August is 7 mph. (Redmond, OR Weather History | Weather Underground, n.d.)

Biome Challenges

Living and working in a desert comes with unique challenges. The Great Basin has its own challenges. Temperatures are known to fluctuate wildly, with dangerous highs and lows. The desertification of soil has also been a problem. Over grazing and mono-cultures remove nutrients from the soil faster than they can be replenished, leading to hotter, more dusty environments (Environmental Threats to the Great Basin (2), 2015). With less fruitful pasture, ranchers have to move their livestock even more regularly.

Ranch Work Demands

Ranching is difficult work and consists of a diverse set of tasks that need to be completed daily, weekly, or more periodically.

The main tasks pertain to maintaining and upkeeping the ranch itself. This includes servicing tractors and equipment, installing and repairing irrigation and watering systems, and mending fences, amongst other things. Ranches are often small towns unto themselves, with workers performing all tasks necessary to keep things running. (What Kind of Work Do Ranchers Do?, n.d.)

The purpose of most ranches is to raise livestock, mostly cattle. Many of the tasks involved here follow the life cycle of the cows themselves. Each year, a portion of the cows in the herd will give birth to calves. These calves are tracked and cared for, with assistance often required during the birthing process. Once the calves have raised a bit and can walk on their own, branding happens. Branding day is a cultural event for traditional ranches and the community comes together for a full day of branding. Branding labels each cow so it can be tracked and located. During the rest of the year, cattle are moved from pasture to pasture to manage how much vegetation is preserved in each piece of land. All these events can require ranch hands to guide cows while on horseback or to rope animals if they need to be temporarily restrained. (What Kind of Work Do Ranchers Do?, n.d.)

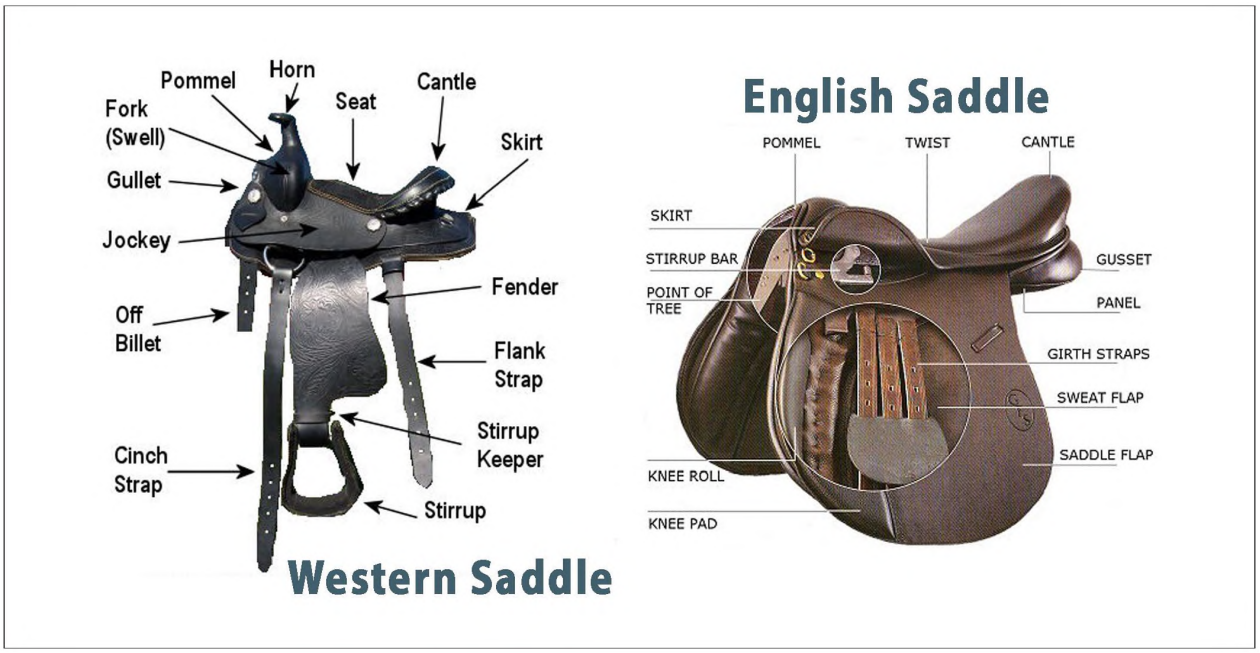
Many ranches raise and wrangle their own horses. Previously tamed horsed are ridden while working to tame new horses. (What Kind of Work Do Ranchers Do?, n.d.)

The Market for Western Saddles

There isn't a lot of hard data on saddlery, but one data point states that in 1993, $78 million was spend on saddlery and tack in the state of Oregon alone (About Severe Brothers and Their Famous

Figure 2

Western versus English Saddles



Note: English saddles are oriented towards riding, while western saddles are oriented towards the working needs of ranchers.

Saddles, n.d.). While there are many small shops that produce less than 100 saddles a year, the market as a whole is fairly substantial.

Numbers and Demographics of Ranch Workers

According to Zippia, a jobs website, there are nearly 20,000 people currently working as ranch hands in the United States. Real-world numbers are likely higher, given the lack of databases and reporting on many ranches. Roughly three-quarters are men and roughly one-quarter are women. The average age of these workers is 40 years old and their earnings are typically between $20-30k per year (Zippia, 2021). Principal rancher tend to make more, with the average ranch manager making about $71k per year (What Kind of Work Do Ranchers Do?, n.d.).

Lifespan of a Saddle

A high-quality saddle, as currently constructed, is very robust and can typically last 10-20 years if cared for properly. It is not uncommon, however, to have certain saddles last much longer. Leather saddles can have nearly any element replaced if necessary. (How Long Will a Saddle Last?, n.d.)

Western Saddle Brands and Shops

Severe Bothers is one of the most well-know saddle shops in Oregon who's notoriety has spread nation wide. They are located in Pendleton, Oregon and only produce about 60 saddles a year. It takes them about 80 hours of work to finish one of their saddle, but depending on the artwork present, can take much more (About Severe Brothers and Their Famous Saddles, n.d.).

Anatomy of a 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. (Old Ways Old Trades – The Saddle Maker - Outdoorrevival, 2019)

English versus Western Saddles

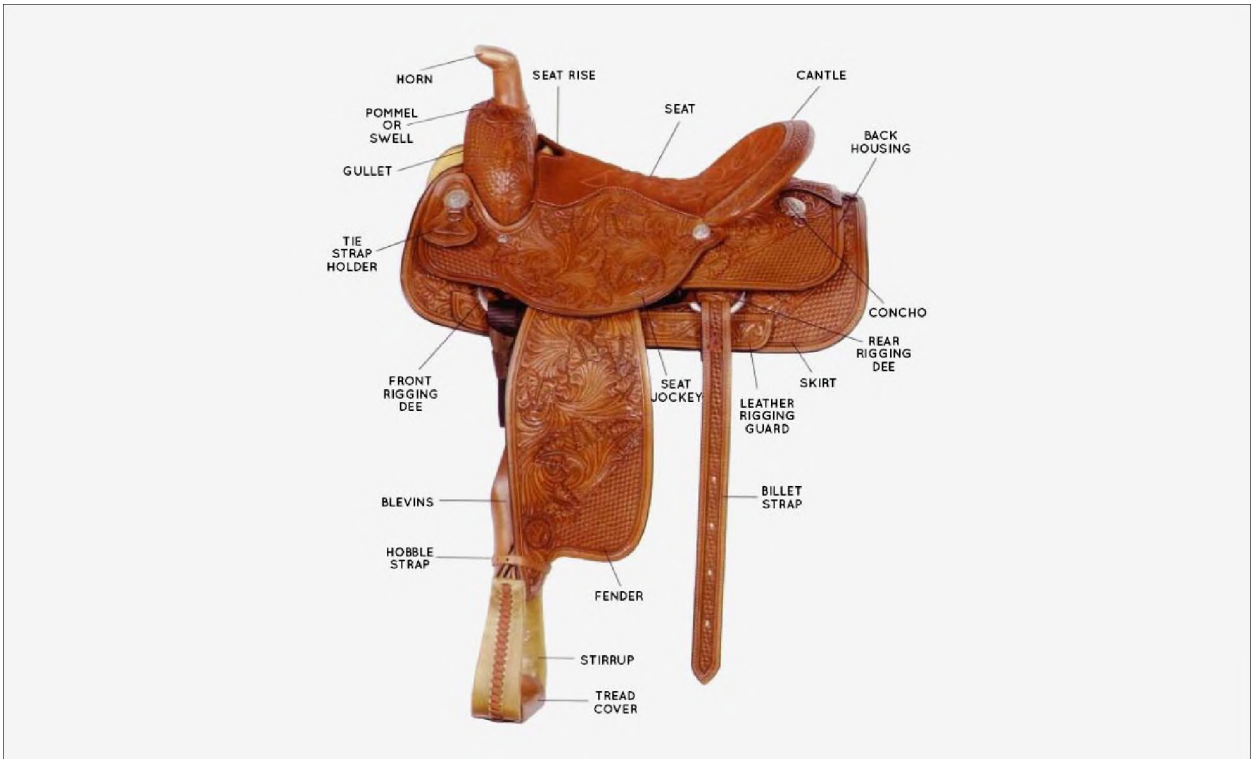
There are two main types of saddles, English saddles and Western saddles. The primary difference between the two is the presence of a horn on the front of Western saddles. This horn is used by the rider to loop a rope around if they are restraining an animal. This lets the horse share in the task of moving around an animal. Western saddles are also generally more robust and stiffer, due to the diverse working conditions that they are used in. English saddles are primarily for riding and are more streamlined and lightweight. (English vs. Western Riding, n.d.)

Saddle Diagram

Saddles have a few core parts that make up the base. Other parts are modular and can be added or adjusted as needed for each different use case. See Figure # for the location of the pieces explained in the following paragraphs. This section will define certain saddlery terms (Interactive Western Saddle Parts Diagram, n.d.).

Figure 3

Western Saddle Anatomy



Note: Although generally the same, the parts and pieces of a Western saddle can differ saddle to saddle. (Interactive Western Saddle Parts Diagram, n.d.)

Horn: This form on the front of the saddle is used to let the horse maneuver animals on the end of the rope. The rider, after roping the target animal, will wrap their rope around the horn, fixing the load to the harness.

Gullet: This space below the horn on the front of the saddle creates space for the horse's withers to not rub against the saddle. Friction against the withers (the spine of the horse) is a big problem in fitting, and ample space should be maintained.

Seat: The center of the saddle is where the rider sits, between the rear cantle and the rise of the seat and it raises up to the gullet.

Cantle: The rear of the saddle has a raised ridge for the rider to prop against. This is more important for ranchers, as they will be sitting upright in the saddle for most of the day.

Figure 4

A Wooden Western Saddle Tree

Note: The tree pictured here is constructed primarily out of wood with some composite filler used to create the shape. The horn is metal and connected by a flange to the wood. *(WESTERN DRESSAGE: SPOKEN HERE, n.d.)*

Concho: This is a piece of hardware installed behind the cantle on the saddle. Saddle bags or saddle strings (used to tie objects to the saddle, like a coat for example) are connected to it.

Fender: This is a portion of the saddle that extends down from the seat to the stirrups. It protects the horse from friction from the legs and boots of the rider.

Stirrup: These flat-bottomed loops hang on either side of the saddle for the rider to place their feet in. Riders often direct a good deal of their weight into the stirrups instead of just sitting in the seat. Stirrups also facilitate mounting and dismounting.

Rigging dees: These large dee rings are the mounting points for the straps to secure the saddle to the horse. The main strap goes on the front dee and secures just behind the horse's elbows.

Skirt: This blanket-like piece goes underneath the saddle to prevent friction to the horse's back.

Leatherwork

Traditionally, as well as contemporarily, western saddles are made primarily from leather. Sturdy, veg-tanned leather is skived down to a particular thickness and then wet-formed over a saddle tree. These pieces of leather are then saddle-stitched together to make a full saddle. Leatherworkers often add art to the surface of the leather, but not always. Once the leather is in place, it is conditioned with oiled to give it elasticity and resilience. (How It's Made Show, 2016)

Wooden Tree Construction

A wooden tree is the bones of a saddle. Several wooden parts are carved and then bonded and glued together to create a finalized form. This is the form that gives the saddle it's rigidity. (How It's Made Show, 2016)

Hardware and Accessories

A horn and other hardware are added to the saddle throughout the process. Most hardware is for the cinch and rigging of the saddle. (How It's Made Show, 2016)

The Case for a New Ranching Saddle

In this section includes an examination of the current issues in saddle fitting, thoughts on how new transplant-workers are bringing new perspectives to ranching, observations on how new technology hasn't made it to the saddle market yet, and a statement of design intent.

Fitting and Chafing Issues

There are a lot of issues that saddles have to deal with. They have to accommodate the fitting and chafing struggles of two users (the human and the horse). Due to western saddles being used in hot climates, perspiration accommodation has to be balanced with fit and work-task needs. Some areas that are especially difficult to manage are behind the horse's elbows, the horse's withers, and the human's inner thighs. ("Signs of Poor Saddle Fit," 2018)

Hotter Summers with Climate Change

Climate change has lead to more extreme weather. Extreme heat events are growing more prevalent (This Summer Could Change Our Understanding of Extreme Heat, 2021). Extreme heat days are a threat to ranching as they make it harder for ranch hands and horses to operate.

Heat Exhaustion and Reduction in Work Capacity

Horses can experience heat exhaustion and are often more susceptible than humans to it. Once a either a horse or human experiences heat exhaustion, they have to stop working and get out of the heat until they can recover. (Heat Stress in Horses, n.d.).

Heat can also reduce the amount of work that a human or horse can get done. Because heat is generated during work, warm-blooded animals need to dissipate heat to keep their core body temperatures from rising too high. As external temperature increases, more bodily resources have to be diverted to staying cool verses accomplishing muscular labor. (Kim & Lee, 2020)

Transplant Ranch Hands Bring New Perspectives

In 2018, 39% of Americans said they would prefer to live in a small town. Only two years later in 2020, that number has jumped to 48%. This difference is likely attributed to Covid-19 and new remote work opportunities (COVID-19 Is Pushing Americans out of Cities and into the Country, n.d.).

Ranchlands Staff

Ranchlands is a company that manages several large ranches throughout the high deserts of the American inter-mountain west. They focus on being good stewards of the land and seek to incorporate traditional knowledge with new science and data. A significant portion of their workforce is female, with another significant portion being transplants from larger towns and cities looking for a more rooted or authentic lifestyle. Ranchlands also seeks to be an active supporter of art and design. They have patterned with numerous artists and brands to create artwork and product lines that incorporate traditional craft and appeal to a modern, refined aesthetic. (Ranchlands, 2021)

WGSN Big Ideas for 2023

Each year WGSN produces a "Big Ideas" report on trends they see for the future. Three trends and their accompanying quotes follow.

Tech-ceptance: Sarah Hously, Senior Strategist of WGSN Lifestyle & Interiors said, "As barriers between the digital and physical worlds recede, and science starts to deliver more trusted solutions, comfort levels around technology and lab-based innovation will grow. This new acceptance of tech will see consumers become more involved in product design and development." (Webinar: Big Ideas 2023 - WGSN Fashion, n.d.)

Intentional Community: Jennifer Creevy, Head of WGSN Food & Drink said, "Consumers' communities and collectives have become more digital, social, local, and rooted in shared cultures or values, resulting in new ecosystems of buyers and creators who connect in order to trade. Successful products and services will need to intentionally align with the values of these networks." (Webinar: Big Ideas 2023 - WGSN Fashion, n.d.)

Mastering Wellbeing: Jenni Middleton, Director of WGSN Beauty said "Consumers will be assessing their emotional and physical status with a new understanding of how the two are interlinked. People will be seeking products, activities and environments that help them better regulate and harness their moods for their own good." (Webinar: Big Ideas 2023 - WGSN Fashion, n.d.)

These trends all play into a renewed interest in more authentic, fulfilling, or nature-connected lifestyles.

New Tech Hasn't Made It to Western Saddles

Leather used to be one of the best materials for making harnesses, but over time it has been replaced in the market by other higher-performing materials like nylon or other synthetics. These new material have better strength-to-weight ratios and have enables users of these materials to perform better and accomplish more. (Human Interface, 2020)

The author believes this same march of progress could potentially be useful in western saddlery as well.

Design Intent

This project seeks to design a new western saddle (as opposed to solely engineer a new saddle element). Consider the difference between engineers and designers. While there is significant overlap between these two job titles, one main difference that often takes place is that while an engineer attempts to solve for x, a designer must attempt to balance x and y. Isolating variables is extremely useful in science and engineering, but hypothetical parameters can leave large blind spots for real world users if left without context. If a designer knows their user well, they can make products that better reflect the nuanced system of needs a user might have. A core teaching of design-thinking is that humans are not monoliths and that their web of needs can be represented and accommodated through sandbox style (as opposed to more linear, scientific style) methods of insight gathering and synthesis. (What Is Design Thinking?, n.d.)

To attempt to accomplish this user-first method on this project, ranchers will be interviewed to build a need profile that will help inform some metrics of success. An example could include thermoregulation, adjustability, fit issues, and lightweighting goals, with feedback on what is most important. To keep this need profile pointed, the focus will be on horse riding in hot, desert environments.

"How Can We..." Statement

How can we use modern software, material, and manufacturing to design and prototype a western saddle that is (1) more breathable, (2) lighter weight, and (3) equally strong, rigid, and comfortable?

Design Opportunities

There are a lot of design opportunities available to a new western saddle. In this section, state of the art saddle makers will be examined, along with an analogy to climbing harnesses, several SWOT analyses, different data-driven design tools, and applicable graphic and color trends.

State of the Art Saddle Making

There are many saddle makers producing new and more advanced saddles. However, all of the ones presented here produce solely English saddles. Western saddlery remains without much innovation.

Existing Intellectual Property

An initial patent search was conducted. Three potentially relevant patents were evaluated to make sure that the new prototype can make an original contribution.

Patent US7481035B2: This patent uses a rigid element to lift the rider (or other load) off the back of the horse, primarily for better ventilation. (Williams, 2009)

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. (Merker & Konzet, 2001)

Patent WO2017035645A1: is another one to look at. It is for a tree that molds to fit the horse. Less applicable to western saddles. 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. (STOVER & RACH, 2017)

Figure 5

Bua Sport Saddle

(Bua Sport, 2021)

Bua Sport

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. While the do incorporate some new forms and materials, it is still mostly traditional leather work. (HOMEPAGE & INTRODUCTION TO BUA, n.d.)

Voltaire Design

The Voltaire Design Blue Infinite Saddle Tree 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.

Figure 6

Voltaire Design Blue Infinity Saddle Tree

(Voltaire Design, 2021)

Voltaire Design also has a versions of this saddle that are micro-chipped to track the rider and horses movements. A companion app gives recommendations based on the data gathered. (Blue Infinite, the Connected Saddle, with Its ActiveFlex Tree and SpineCare Anatomical Panels, n.d.)

Prestige Italia

Prestige Italia's most advanced line of saddles is their "X-Technology" line. 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. (Prestige - Technology, n.d.)

Analogies in Climbing and Backpacking

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.

Figure 7

Prestige Italia X-Technology Saddle Tree

(Prestige Italia, 2021)

They also have to be fixed to a bodily location and manage things like friction and external force vectors (Definition: Climbing Harness, n.d.).

Backpacking backpacks would also provide a good analogy, 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. The backpacks that humans initially used to carry loads were made of wood and leather, but with time these older, heavier materials have given way to lighter weight, higher performing modern materials (Human Interface, 2020). Perhaps the same could hold true for the apparatus that horses use to carry loads on their backs.

SWOT Analyses

A Strengths, Weaknesses, Obstacles, and Threats, or SWOT analysis, is used often in evaluating businesses and their products. (What Is a SWOT Analysis and How to Do It Right in 2021 (With Examples), n.d.). This process can also be valuable in evaluating existing products to find spaces where good product opportunities can exist. A SWOT analysis will be performed on traditional western saddles, a Bua Sport Saddle, the Voltaire Design Blue Infinity saddle tree, the Prestige Italia X-Technology saddle

Figure 8

Traditional Leather Saddle SWOT Analysis

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

Figure 9

Bua Sport Saddle SWOT Analysis

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

Figure 10

Voltaire Design Blue Infinity Saddle SWOT Analysis

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	--

Figure 11

Prestige Italia X-Technology Saddle SWOT Analysis

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

Figure 12

Climbing Harness SWOT Analysis

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

Figure 13

Proposed Saddle SWOT Analysis

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 dificulties
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?

Figure 14

nTopology Generated Bike Saddle

(3DA, 2019)

tree, and the new proposed, modern material saddle prototype. See the SWOT analysis tables for each of these products.

Data-Driven Design Tools

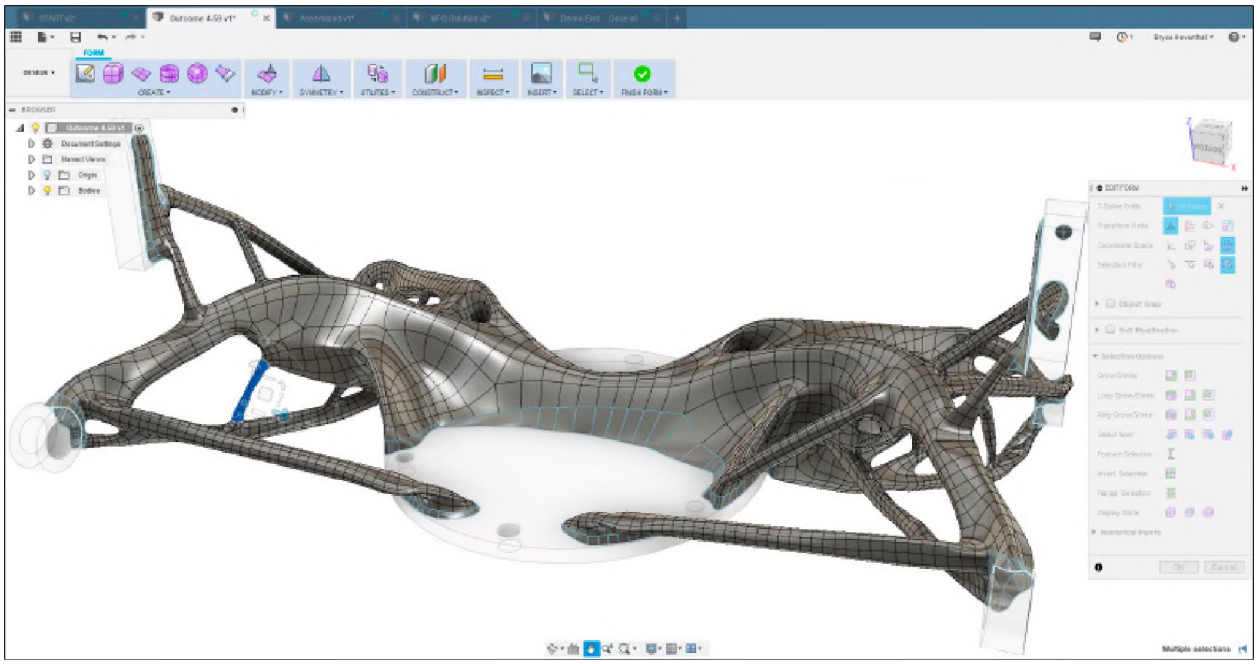
Data-driven design tools enable the user to produce potential designs that are "grown" from different data inputs. This enables a designer to create products that are grounded in real world data and needs. Lightweighting is a good example. Data can be used to generate forms that are as light as possible. (Slivka, n.d.)

nTopology Lattice Structures

nTopology is a powerful parametric design tool. It lets the user generate a form by manipulating a process tree. By changing values in the tree, whole new forms are generated and optimized. (3DA, 2019)

Figure 15

Fusion 360 Generative Design Example



(Autodesk University, 2021)

Fusion 360 Generative Design

Fusion 360 is likely the most commonly available tool for generative design. Basic zones are defined along with force and material values. These inputs are then used to generate optimized forms based on an evolutionary selection process. (Autodesk University, 2021)

Color and Graphic Trends

A great space to examine for graphic and color trends is 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. A great concept example of something in this vein that integrates more generative forms would be Andrew Fabishevskiy's Lunar Motorcycle Concept. (Fabishevskiy, n.d.)

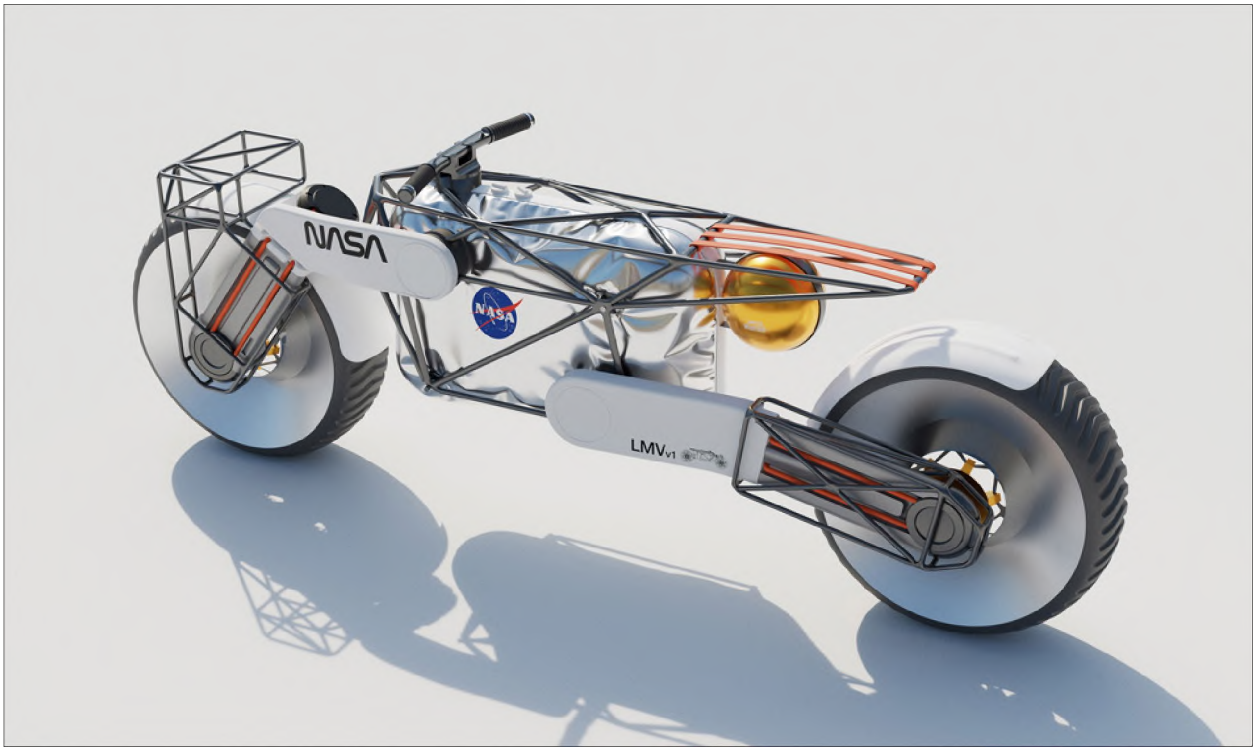
Figure 16

NASA Graphics Standards Manual

(Danne & Blackburn, 1975)

Figure 17

Lunar Motorcycle Concept by Andrew Fabishevskiy



(Fabishevskiy, n.d.)

Data Gathering

Horse and human anatomy, physiology, and biomechanics all play a large part in the successful implementation of a saddle. These and adjacent subjects will be examined in this section.

Horse Breeds

Some breeds that are present on western American ranches include: the Quarter Horse (specifically the stock variety), the Mustang, the American Painted Horse, and the Morgan Horse, amongst others. The Stock Quarter Horse is particularly useful when roping animals because of its strong hindquarters (Lee, 2019; Richards, 2021).

Equine Thermoregulation

When a horse is hot, their bodies respond first with panting and dilation of surface blood vessels. If more cooling is needed, horses will sweat from pores across their bodies. Horses sweat twice as much as humans per square inch. A horse can lose as much as 4 gallons of water per hour. Horses sweat out more electrolytes than humans, making it harder to tell when they are thirsty. A 2% drop in body water content can lead to a 10% drop in performance (Pascoe, 2017).

Saddle Fit

Saddle fit comes down to two main points: placing the saddle correctly and rigging the cinch in a comfortable way. Tree alignment and rider posture also comes into play.

Placing a Saddle

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. ("Saddle Placement," n.d.)

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

Figure 18

Dilated Surface Blood Vessels and Sweat on a Horse

(Nutrition, n.d.)

or with loads to the horn. A breast plate strap can be used if the saddle tends to drift backwards once in use. (Your Complete Guide to Saddle Rigging, n.d.)

Cinch Comfort

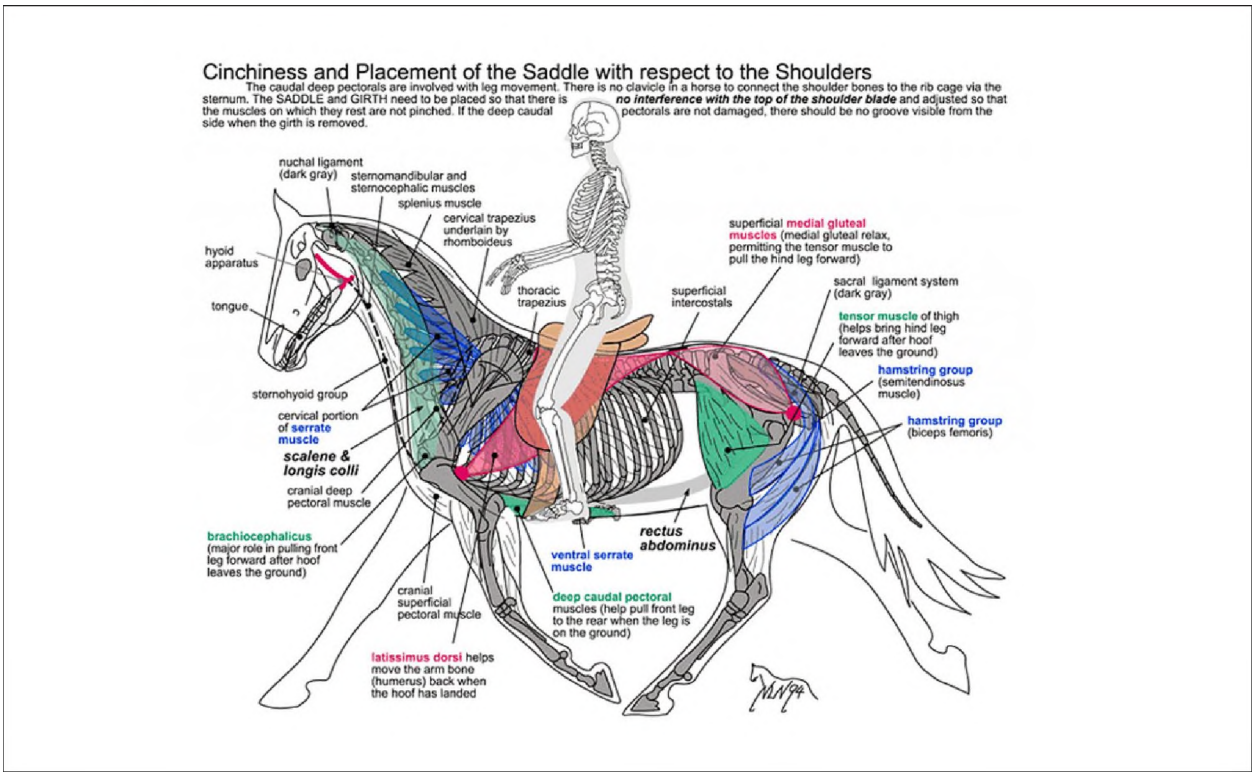
The most critical part of the rigging is the main cinch. The comfort of this main cinch will greatly impact overall performance. Stretchtec's Shoulder Relief cinch uses a contoured form to deliver more shoulder clearance while maintaining good load distribution. (StretchTec, n.d.)

Proper Tree Alignment

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. ("Saddle Fit and Tree Angle and Width - Tips #8-9 • Schleese," 2016)

Figure 19

Dilated Surface Blood Vessels and Sweat on a Horse



("Saddle Placement", n.d.)

Riding Stance

Proper riding form can have a big impact on the comfort of the rider (and the horse). The spiral seat uses a mostly upright, relaxed and level posture. The psoas and iliacus muscles are used to spring against each other, moving the pelvis forward and back while riding. (Goodnight, n.d.)

Saddle Forces

A typical cow weighs around 1,200 pounds (How Much Does a Cow Weigh?, 2020). If a cow generates around a third of it's weight in lateral force, that means there can be up to 400 pounds pulling against a ranch worker's rope if there's an animal on the end of it (Welch, n.d.).

There are large horses that can handle any height or weight of rider, but the quarter horse is typically limited to around 225 pounds. (Horseback Riding in Oregon | Scenic Riding Experience on Rustic Ranch, n.d.)

Field Research

Preliminary Survey

A series of questions was emailed to ranchers to collect the answers from ranch hands. The survey consisted of the following questions:

1. How many years have you been western horse riding?
2. How many years have you been working on a ranch?
3. How many years have you had your primary working saddle?
4. Where did you get your saddle from and for how much?
5. What do you like most about your saddle on a hot day?
6. What frustrates you most about your saddle on a hot day?
7. How would your horse answer the last two questions?
8. What would help your saddle be better for hot days of work?
9. What is your dream hot-weather saddle setup (with accessories)?
10. Where do you (or your horse) get saddle sores when it's really hot?
11. Has heat ever kept you from getting work done?
12. What do you do to deal with the heat on really hot days?

As of submitting this paper, 6 responses had been logged. Most did not respond. Wilson Ranch specifically said it'd be easier to talk in person. The initial responses confirmed that really hot days are in fact an obstacle to conducting ranch work.

Some interesting points included: They wouldn't carry water on the horse. It'd be more work than it's worth. They just have to plan in more water locations along their route. It can be a lot of backtracking throughout the day. If water did have to be brought, they would drive a truck out as close as they can get to where work is being done.

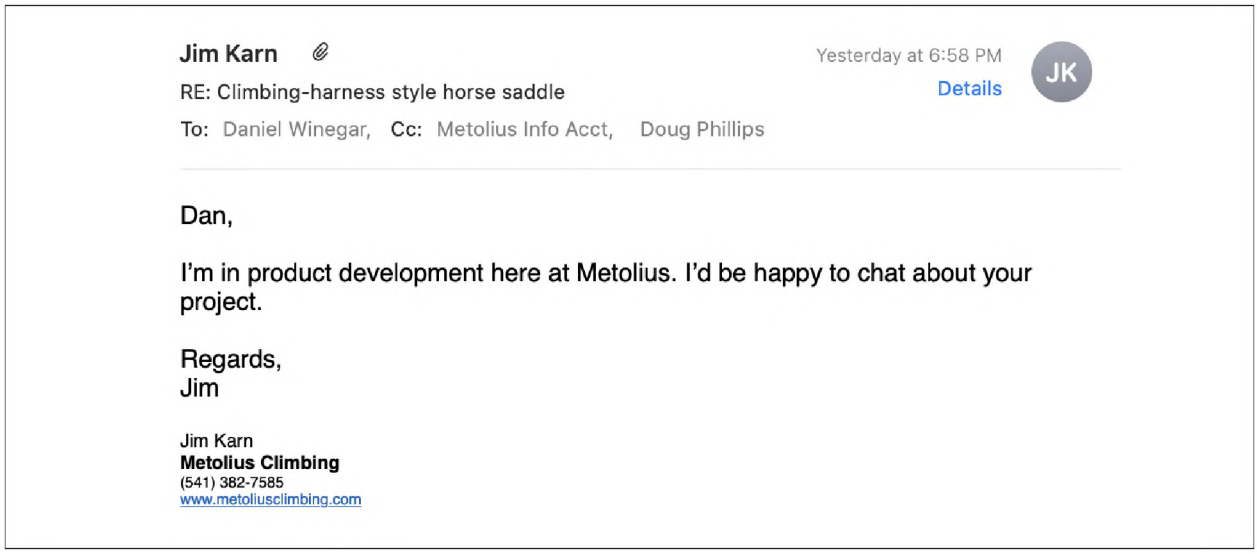
Saddle sores can be a big problem. Horses getting sore can really set work back because if there are not more available horses in a rider's stable, they can't work until the horse is healed.

Initial Prototyping Plans & Mentorship

This is a unique project and finding mentors with experience in horse riding and modern climbing harnesses or backpacks will be a huge asset.

Figure 20

Email from Jim Karn at Metolius



Ali Sloop, Riding Instructor and All-Around Horse Person

Ali Sloop is a horse riding instructor bases in West Linn, Oregon. She is enthusiastic about helping with the project and has been great to interact with. She will be able to lend her experience on what is most important in fitting and using a saddle. She has a stable of horses that will be available to test fits on. The initial visit is scheduled for December 9, 2021.

The first phase of the project will be developing guide patterns (including ranges of motion) and a 3D model to provide dimensions to design within.

Jim Karn, Product Development at Metolius

Jim works in product development at Metolius, a climbing brand located in Bend, Oregon. He is available to chat periodically about the project. Initial meetings will provide feedback on product direction feasibility, with later meeting being in-person reviews of the prototype construction.

Wilson Ranch Staff, Ranch Workers

Wilson Ranch is located east of Bend, Oregon. There are a handful of workers that will be able to provide insight and feedback. The ranch workers will be shadowed on the weekend of December 18, 2021, pending approval. They will also be able to provide real-world feedback on prototypes. Visits to Metolius and Wilson Ranch will ideally be able to be done on the same weekends.

Visits to Wilson Ranch

The Wilson Ranch is a 9,000 acre working ranch in eastern Oregon. It has been in operation for over 100 years. The arid climate of the ranch will be a good fit for this project. (Wilson Ranch, n.d.)

Three visits will be planned. The first visit will be for initial insight gathering that will generally inform and validate the product direction for this project, taking place in December of 2021. The second trip will be to validate and get feedback on a working MVP (minimum viable product), taking place in March of 2022. The third trip will be to take photos and record impressions of a finished saddle model, taking place in May of 2022.

Each trip is expected to cost around $500 ($100 for mileage, $400 for accommodations and staging area). The first trip will likely cost an extra $250 for time spent with/on horses.

Testing Protocols

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.

Benchmark Product

A benchmark product will be needed to test the new prototype saddle against. A Reinsman 2122 Wheatland Rancher is a respected option. It's a lower-priced option for a quality, full-capacity ranch working saddle (Circle Y 2122 Wheatland Rancher, n.d.). There's cheap stuff out there, but that's not the market that this project would want to compare to. Comparing to an inferior product might de-legitimize testing comparisons. The Reinsman 2122 retails for $2,700, which is out of the budget of this project.

Instead a saddle will be borrowed from Wilson Ranch to perform testing on site.

Excess climbing harnesses, backpacking backpacks, and cycling chamois have already been obtained to use and deconstruct for reference.

Breathability Testing

Breathability will be a key factor in determining the success of the new saddle prototype. A CFM test will be conducted to measure the airflow through both the benchmark traditional saddle and the new prototype saddle. Each saddle will be placed on a dummy horse with a dummy rider on top. The surrounding area will be sealed off and air will be blown in at a constant rate. The airflow on the opposite

Figure 21

Testing Protocols

	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.

side of the seal will be measured with an air flow monitor to determine how much airflow is passing through each saddle.

Fit and Comfort Testing

Each saddle (the benchmark and the prototype) will be fitted to a horse and taken on a standard ride. Video will be taken during each ride and key frames will be analyzed to determine potential wear spots. These spots will be applied to a map of each saddle to compare afterwards.

Riders will also be asked to rate how comfortable each one was on a scale of 1-5.

Strength and Durability Testing

Two main test will be done to test the durability and strength of each saddle. The first is a rigidity test. The saddle will be hung by a lateral side with weight added to the other side. Lines will be overlaid to photographs taken before and after the application of weight to determine how much bend occurs. This process will be done on both saddle so they can be compared relative to each other.

Weight Comparison

Another primary objective of this project is to create a saddle that is significantly lighter weight. A simple weight test will be done using a scale to determine the final "dry" weight of each saddle.

Project Plan and Purpose

At the end of this thesis project (from the author's perspective), there will be three main goal or deliverables: a paper detailing the research and design process, a working prototype of a new saddle design, and publishing content.

The paper will be the most extensive catalog of the data gathered and the methodologies used. It will be in APA format, although publishing is not a priority for the author.

Lots of quick-and-dirty prototypes will be used to help in the designing of the saddle. A final, finished, working prototype will be produced. This prototype will be used in testing protocols and to generate media content.

Finally, media assets will be generated throughout the projects. A focus will be on video (although photos will also be extensively used). The goal will be to make a <1 minute teaser and a <10 minute video at the end of the project, in addition to a final presentation deck.

Career Advancement

This section will be a collection of professional statements that speak to how this project will be useful to the author, told from his perspective. It will include a Golden Circle Statement, the author's design approach and aptitudes, how this thesis project will help the author, specific skills learned, companies that the project might appeal to, and a statement on autonomy and originality..

A Golden Circle Statement

I believe that living a simple, human- and nature-connected lifestyle can be a fulfilling alternative to the default urban hustle. As a designer, my approach focuses on finding nuggets of insight with big utility and then presenting them in unadorned, straightforward ways.

Recently, I've developed patterns and workflows involving CNC routing, smocking, inflatables, and parametric structures. Looking forward, I'd love to see how these methods could be useful in

designing outdoor-oriented products. Currently, I'm working on applying advanced tech to western saddle making.

Other thoughts: rendering < making, titles < culture, hustle < harmony.

Design Approach and Aptitudes

If you've read Blink by Malcom Gladwell, you'll understand the concept of "thin slicing." In the book, it is described as the ability to take in a vast amount of information and then be able to make an intuitive judgment call based on it. In a professional context, I use this method less as a means of design and more as a means of research. For example, after doing a deep dive into a subject, what seems to be the most interesting? What area deserved more looking into? This "sandbox" approach has helped me achieve results that are hard to arrive at in more linear, programmed methods of operation. This method's ability to focus on representing and evolving central themes helps it to arrive at clearer, more flavorful product visions, even if ancillary details are left out.

I also believe that making work decisions (and life in general) is about evaluating trade-offs. Everything that time is spent on comes at the expense of what could have been done instead. So do the biggest things first! Working fast and fearless is perhaps THE core tenant of design thinking. I prefer to get out in the shop and start make prototypes on day one, and to go talk to end users right away. Then, when I get to a point where technical research is needed, I'm able to find what is needed way faster now that I have a more nuanced sense of what's going on. In a world of deadlines, time is a finite resource. Moving faster = taking projects farther = better finished end results.

These approaches are not a good fit for every person or every institution, especially risk averse ones, but I firmly believe that there are people and companies that would desire and benefit from this work style and its results.

Clifton Strengths Finder results: empathy, ideation, futuristic, maximizer, strategic

How This Thesis Helps the Author

When I came to this program, I had three main goals: (1) Develop 3-5 portfolio projects that have wow factor. This comes from Milton Glaser's line of "There are three responses to a piece of design: yes, no, and wow. Wow is the one to aim for." (2) Strengthen my own internal design voice. I came here hoping to further develop a design philosophy that others could respect and find value in, and that I would be someone that they could enjoy working with. To me, a meaningful conversation about design is as

important as any portfolio piece. (3) Develop relationships with other designers and industry professionals and get a sense of the culture in different companies. I value workplace culture and employee morale more than any particular title or level of company prestige.

The saddle project has potential to deliver on all three of these areas. (1) The saddle has the potential to really make people think when they see it, which would be my goal. I don't want them to see it, say "good job blah blah," then forget it. (2) So far, finding space for my own design voice to grow has been a bit of a battle. Given my personality type (a guy who reads Edward Abbey and enjoys sawdust), operating screen-first with extensive checklists and approvals has taken a toll. I've been able to hold the wheel a little more on this project though and am hopeful that I can make something that when people see it, they get a decent sense of my perspective and skill set. (3) The Woolmark mentorship program was one of the best things I've experience in the program. I was able to develop some connections and rapport with great designers through it. I think that the saddle project could be the same conversation starter that Woolmark was if I can make something that elicits a strong reaction.

Skills Learned

While this project has the opportunity to improve practical skills in both digital and analog settings, the primary skill I'll be seeking to hone is more systematic. I get excited when products seem to grow up on their own and be something more than what I would imagine myself from the outset of a project. A gardening analogy might be appropriate. You don't know for sure how things will turn out when you plant a garden. You can't force it. But there are some principles that hold true. If you provide the right nutrients and coax along whatever springs up, you can get results with a spark of their own. I hope to be able to do this by staying open minded and focusing on a principled workflow.

Practically speaking, I hope to do this by translate information into insights, then insights into product direction. I'll then use those product directions (the starting dots) to inform design workflows that can "grow" potential product outcomes (connecting the dots in unexpected ways).

Some digital tools to be used: Procreate, Adobe Suite, Fusion 360, nTopology, Keyshot

Some analog tools to be used: interviewing, post-it synthesizing, pattern draping, cut and sew

Other production tools to be used: 3D printing, CNC routing, fixturing, vacuum forming, casting

Types of Companies This Might Appeal To

I don't really have a specific company I'm targeting, but here's a list of companies that might sit in the center section of a Venn diagram of my interests and company interests: outdoor companies like Filson, Snow Peak, Black Diamond, Patagonia; and old-guard design firms like Ideo, Frog, or Smart.

Going my own way isn't out of the question either. Here's a few designers/studios I admire: Joey Ruiter, CW&T, Josh Owen, Jay Nelson, Bertjan Pot, Dom Riccobene, Elizabeth Suzann, Ariele Alasko, and Adikt.

Autonomy and Originality

In the end, I hope this project can be something new and original, something that gets people excited; literally anything other than boring. In our society, there are strong impulses to conform, to make sense, to exist within parameters. There are already engineers, already scientists, already MBAs in the pipeline. I hope to be a designer that can tolerate the ambiguity needed to find the ideas/products out there that don't fit in tidy boxes.

SECTION 2: WINTER TERM

Further Development and Proof of Concept

From January to March 10 of 2022, the project was developed further. More research, aesthetic direction, and prototyping was conducted with the purpose of developing a proof of concept that would illustrate the viability of the new western saddle.

Note: the majority of the continued research is presented in slide format.

Western Saddley Survey

WINEGAR / THESIS

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.

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Maximal

WINEGAR / THESIS

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.

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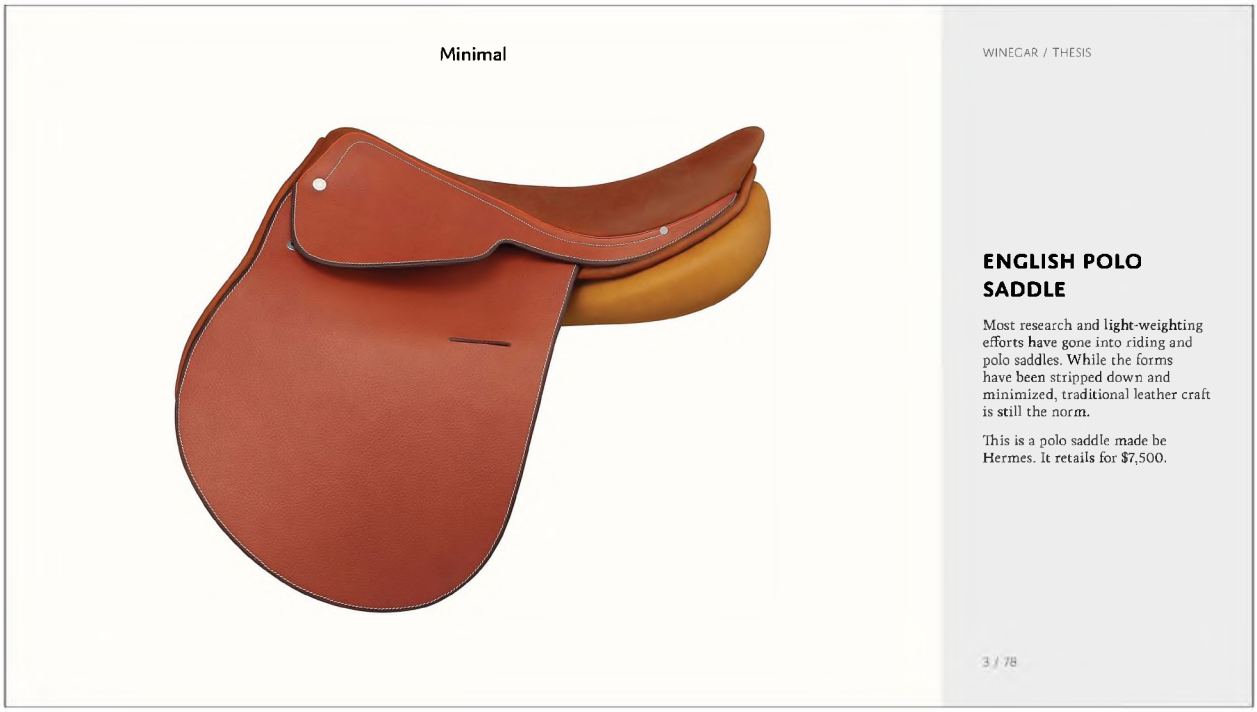
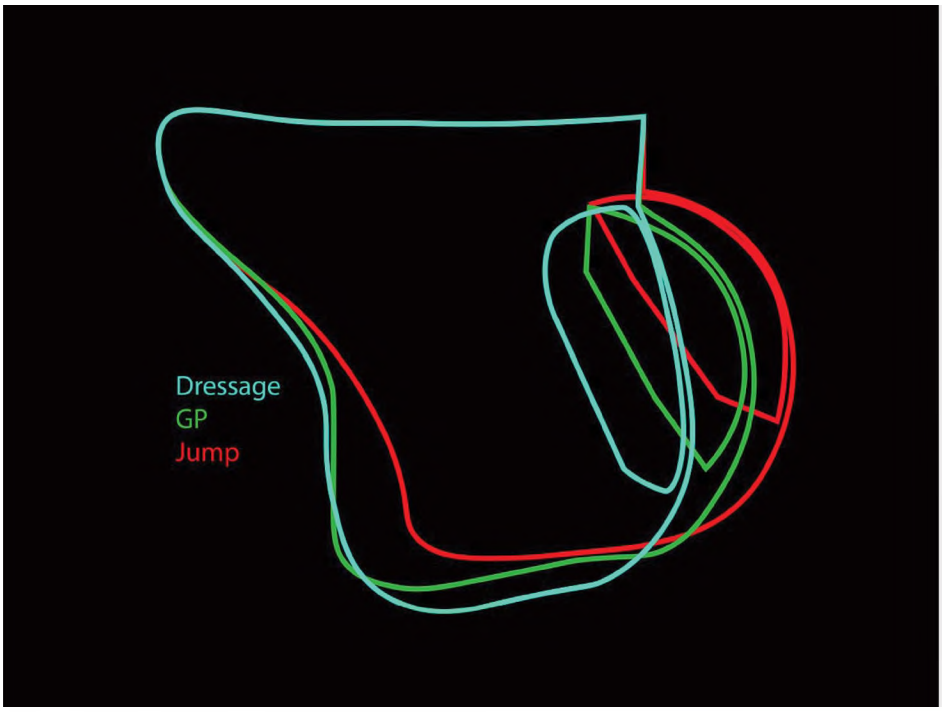
Advancements Outside of Western Saddlery



Illustrations of Saddle Elements



WINEGAR / THESIS

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.

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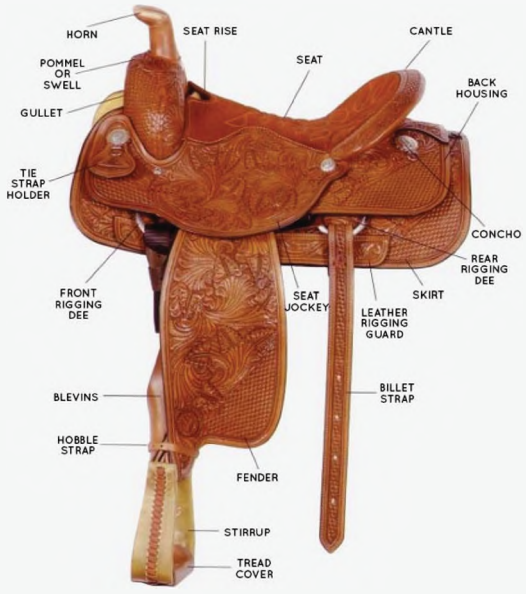

WINEGAR / THESIS

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.

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Analogies to Other Product Categories

Ultralight

Heavy Duty

WINEGAR / THESIS

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.

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Swivel Point

WINEGAR / THESIS

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.

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Construction Techniques

WINEGAR / THESIS

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

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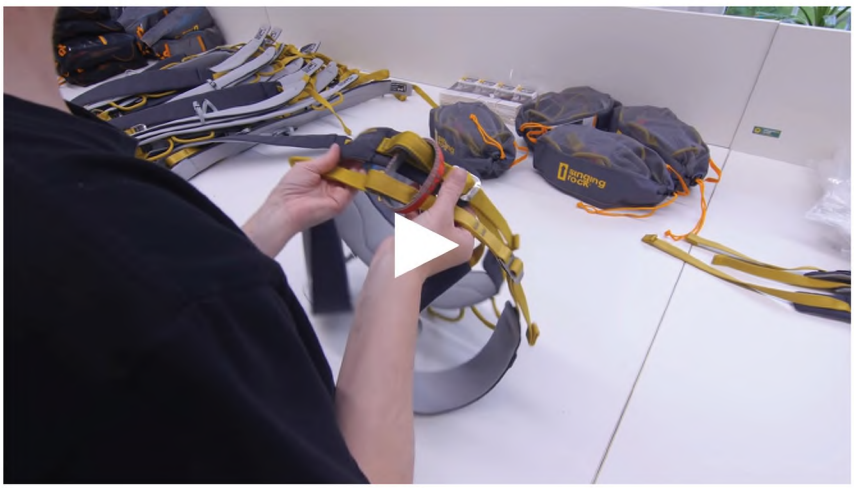

WINEGAR / THESIS

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

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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.

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12. https://www.youtube.com/watch?v=o0lTbgk6cK8
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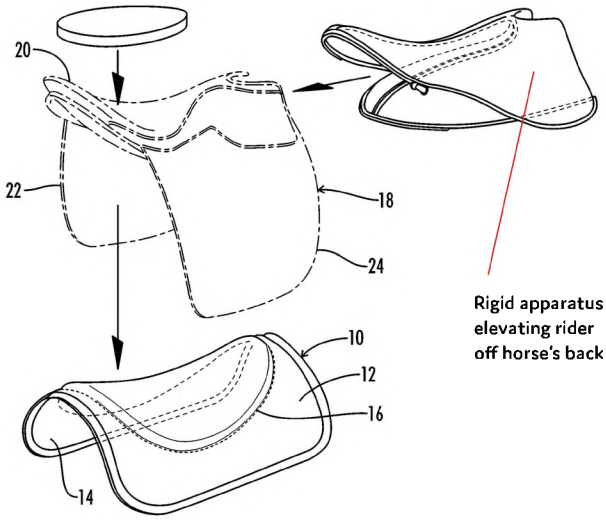
Existing Intellectual Property



WINEGAR / THESIS

PATENT US7481035B2

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.

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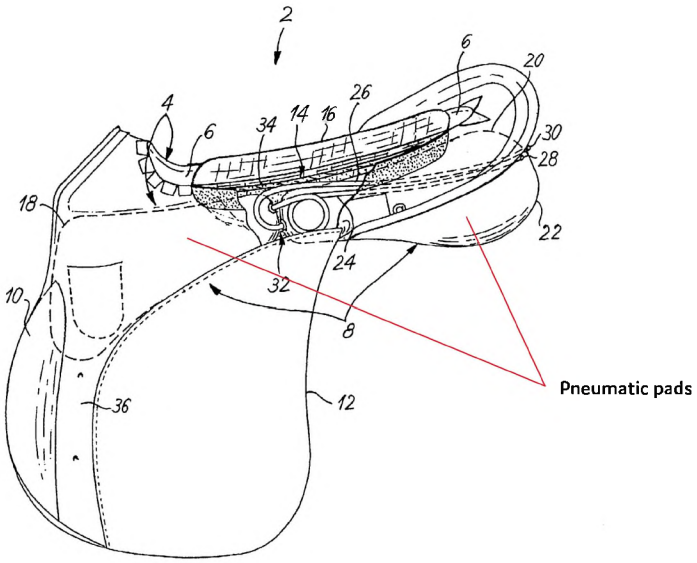

WINEGAR / THESIS

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.

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WINEGAR / THESIS

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.

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WINEGAR / THESIS

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 micro-chipped to track the rider and horses movements. A companion app gives recommendations based on the data gathered.

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Saddle Trees

WINECAR / THESIS

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.

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WINECAR / THESIS

WESTERN SADDLE TREE

Compared to English saddles, Western saddles have much larger, robust trees. The tree needs to handle the diverse loads vectors that will be applied to the horn without deforming.

Western saddles also need to be able to carry more weight as well.

Western saddles belong to a single rider and are usually used on multiple horses.

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Trend Exploration

WINEGAR / THESIS

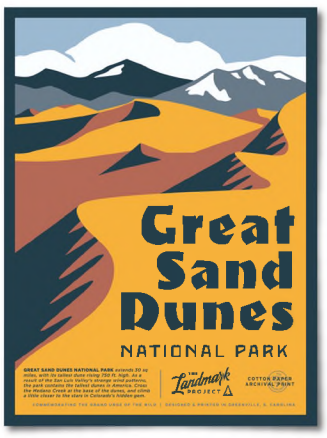
FUTURE INDUSTRY & BRANDING TRENDS

An authentic, human- and nature-connected life isn't a rejection of technology or advancement. For many it is a re-balancing; 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



WINEGAR / THESIS

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

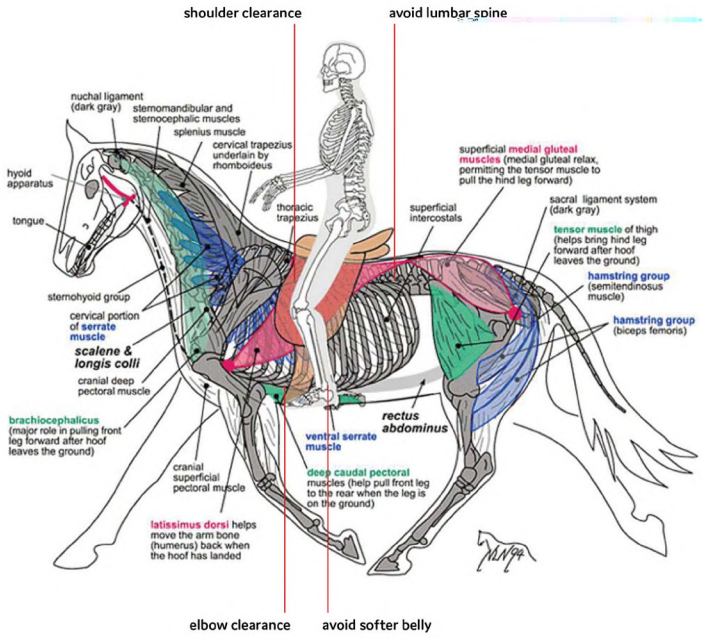
Graphics:
- Honest, active voice

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.

Equine Physiological and Biomechanic Needs

WINEGAR / THESIS

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.

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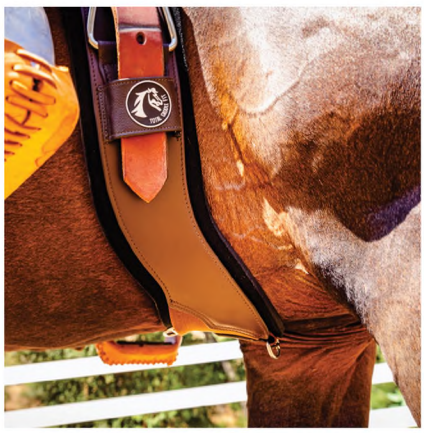

WINEGAR / THESIS

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.

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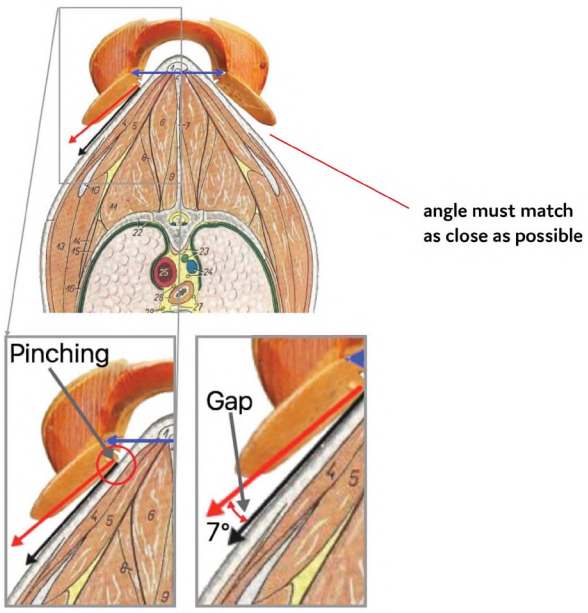
Saddle Placement



WINECAR / THESIS

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.

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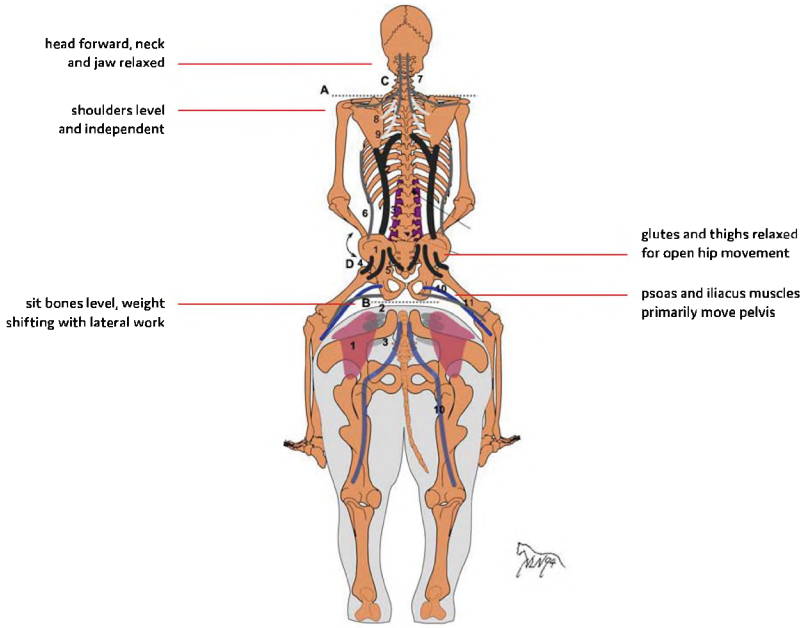

WINECAR / THESIS

RIDING STANCE

Proper riding form can have a big impact on the comfort of the rider (and the horse).

The spiral seat uses a mostly upright, relaxed and level posture. The psoas and iliacus muscles are used to spring against each other, moving the pelvis forward and back while riding.

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Various Equine Needs

WINECAR / THESIS

EQUINE THERMO-REGULATION

When a horse is hot, their bodies respond first with panting and dilation of surface blood vessels.

If more cooling is needed, horses will sweat from pores across their bodies.

- Horses sweat twice as much as humans per square inch.
- A horse can lose as much as 4 gallons of water per hour.
- Horses sweat out more electrolytes than humans, making it harder to tell when they are thirsty.
- A 2% drop in body water content can lead to a 10% drop in performance.

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WINECAR / THESIS

HIGH PERSPIRATION CAN MEAN CHAFING

Elevated sweat can mean chafing for both horses and riders. The matting from sweating underneath a saddle is clearly visible here.

High friction can lead to saddle sores for either the horse or the rider.

Riders typically wear pants that are closely fitted to prevent friction between the pants and the skin.

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WINEGAR / THESIS

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.

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WINEGAR / THESIS

THE PLAN: EXPERT INTERVIEWS

I'll arrange 5+ expert interviews. Questions will start open ended, hoping to provoke original, unthought of points. I'll wrap up with specific questions that we didn't get to.

Ideally, these will be in person with them and their horse(s).

The focus will be on ranch workers that transitioned later to the profession.

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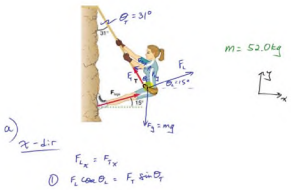
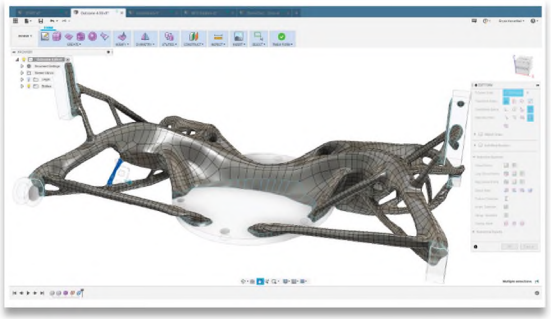
DAY-IN-THE-LIFE NOTE TAKING

I would like to arrange a ride along day to shadow a ranch worker. (Sam Bradford from Ranchlands pictured here.)

I have connections with a ranch in Colorado, but I'm reaching out to a few ranches here in Oregon within driving distance. I would love to arrange a partnership that I can make several visits to for iterative feedback.



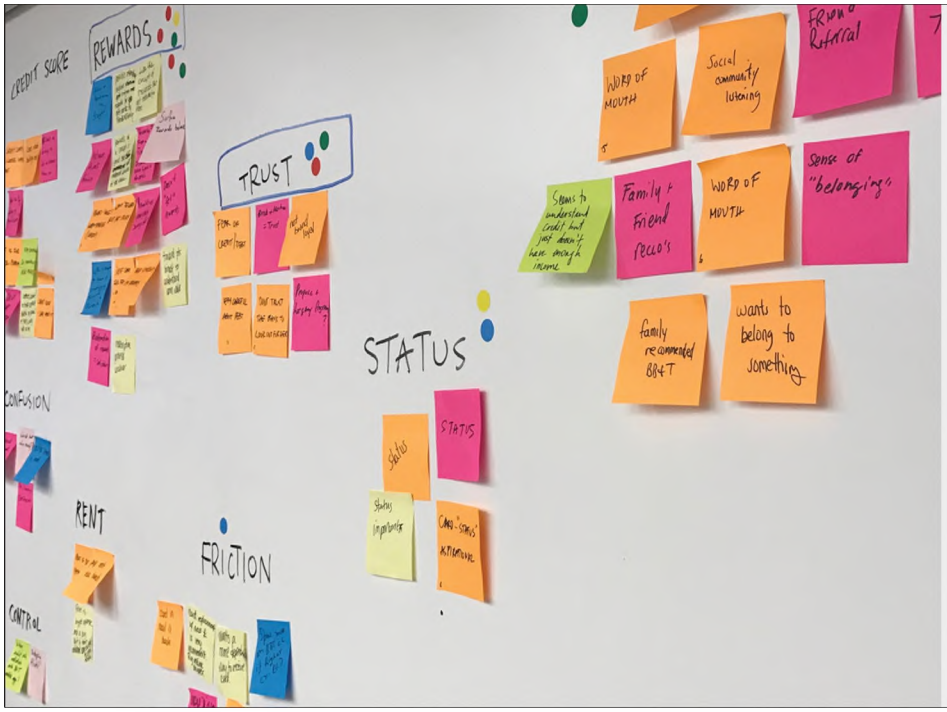


MORE INFO: FORCE DIAGRAMS

A full force diagram of the loads that a saddle has to accommodate will be key to light-weighting goals.

Fusion 360 can generate forms based upon these load requirements. These forms can be used explicitly, or used to inform other implicit modeling.

Methods of Synthesis



WINECAR / THESIS

SYNTHESIZING INSIGHTS

The data gathered from expert interviews, in-field note taking will be combined with preliminary research to synthesize a handful of useful insights. These will inform an evolved product mission statement.

The current "how might we" statement is as follows:

How might we use advanced materials, modeling, and manufacturing to create a western saddle that is lighter, more breathable, fits well and is comfortable, can handle hard work, and speaks to a new type of rancher?

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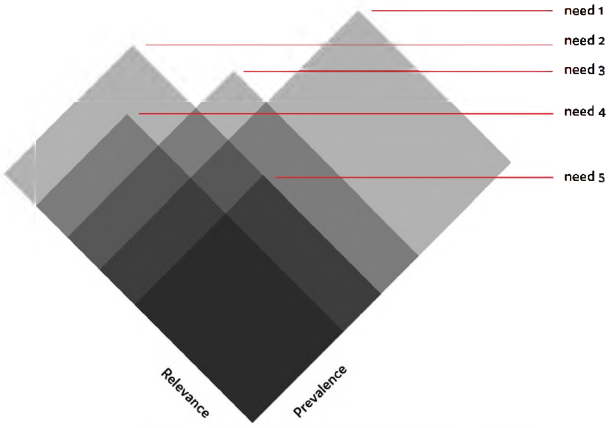

WINECAR / THESIS

DETERMINING RELEVANCE & PREVALENCE

Once insights are distilled into actionable user needs, a questionnaire will be developed based on them and sent out to potential users.

Their responses will generate a "relevance/prevalence" graph that speaks to now important each need is and how widely that importance is felt.

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SWOT Analyses

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

WINEGAR / THESIS

SWOT: TRADITIONAL LEATHER SADDLE

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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

WINEGAR / THESIS

SWOT: BUA SPORT SADDLE

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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

Benchmark Product

WINECAR / THESIS

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.
- Some good spacer mesh options for balancing durable/ breathable. Cordura had good durable fabrics.

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WINECAR / THESIS

BENCHMARK PRODUCT

This is a Reinsman 2122 Wheatland Rancher. It retails for $2,700. It's a lower-priced option for a quality, full-capacity ranch working saddle.

There's cheap stuff out there, but that's not the market I'd want to compare to. Comparing to an inferior product might de-legitimize testing comparisons.

I already have multiple climbing harnesses, backpacking backpacks, and cycling chamois I can use/ deconstruct.

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ALTERNATE USED PRODUCT

This is a used Coolhorse Ranch Roping Saddle. It's listed for $1,500.

- Still looking for a local deal on a used saddle.
- Waiting for responses on if I'd be able to test a rental 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.

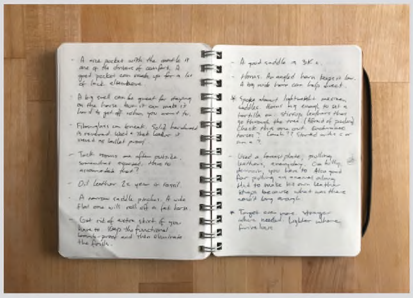
Wilson Ranch Visit

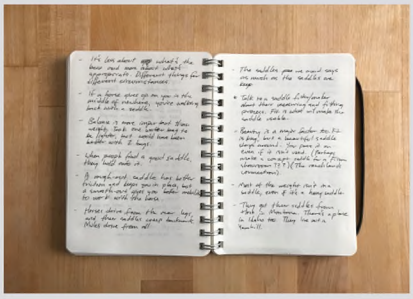
WILSON RANCH VISIT

Wilson Ranch is a family-run ranch in eastern Oregon. They manage cattle. I visited the third weekend in December.

Goals

Talk to ranch workers about their experience with saddles. Collect relevant quotes. See if there are any product directions that I've missed.





Happenings

I spoke with a handful of ranch workers and used the original interview questions as prompts. I took notes as fast as I could.

I shadowed a ranch hand while he talked me through every saddle that was on the ranch (about 20-25) and also as he tended to a pasture.

Take-Aways

Overall, they're a pretty skeptical bunch, but heat management seems like it's still a valid topic to pursue.

There's a lot of compensatory behavior with the saddle horns. Managing friction could be an area to look at.

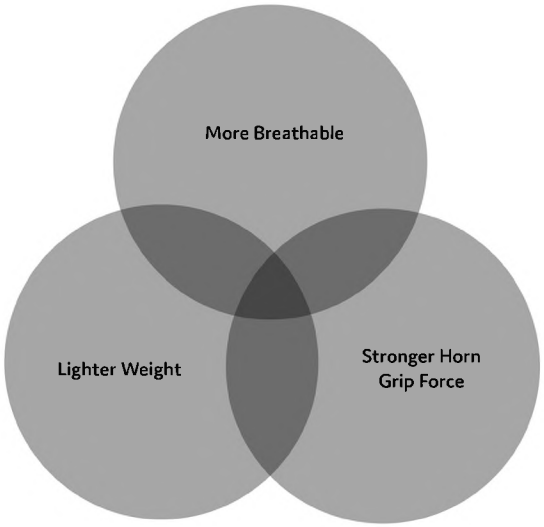
Survey Responses

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."

SURVEY RESPONSES

Overall, I had few responses online to the survey I sent out, 7 in total.

I asked these questions to ranch workers in person and they had plently to say. They said sorry but they don't get on the computer a ton.



PRODUCT DEVELOPMENT DIRECTIONS

While the ranchers didn't themselves see lightweightness as a primary objective, I believe it is still important. The hesitancy was mainly due to a belief that the saddle would be less robust if it was lighter.

More breathable would mean less sweat on hot days, leading to better saddle fit, less saddle sores, and more work done.

Climbing belay device design elements could offer substantial benefits to managing the rope while dallying.

BENCHMARK PRODUCT

This is an all-around good ranch saddle. It's an Alamo Flex Saddle and can be used for most anything on a ranch.

While I do have access to saddles that I can test with, I believe it would be extremely valuable to have on one hand. I could get a decent used one for ~$500-600 and would be able to resell it at the end of the project.

Protocol

- Create a plastic bag air chamber over the section of the saddle to test
- Place fog machine in bag and pressurize with an inlet fan
- The amount of vapor will be video recorded for qualitative comparison

Equipment

- Fog machine (Doug has one that I can use)
- Isolation chamber (I'll made this out of HDPE plastic film that I already have)
- Pressurizing fan (I'll have an extra DC fan that I can use for this)

AIRFLOW VAPOR VIZUALIZATION

Increased breathability is the biggest goal of this project. Demonstrating it visually will be key to demonstrating the merits of a new saddle design.

I'll use the fog machine method that Doug used on his Speedhack project.

I'll do a test on the exterior of the saddle seat and on the interior of the lateral skirt

Protocol

- Set saddle on a stand with a fan blowing air slowly through it
- Place a low-powered space heater above the location
- Measure surface heat with an infrared thermometer every minute for 20 minutes
- Create graph of how heat is absorbed/dissapated over time

Equipment

- Box fan (have one)
- Space heater (have one)
- Infrared thermometer (have one)

HEAT DISSAPATION DEMONSTRATION

Breathability is good, but its affect on keeping the body cool is its real merit.

To visualize this, I'll direct heat at a section of the saddle and then create ambient airflow on the opposite side of the saddle. I'll track the surface temperature with a infrared gun to see how the surface temperature moves over time.

Protocol

- Hang complete saddle on the luggage scale and take weight reading

Equipment

- Luggage scale (available in Nucleus Lab)

WEIGHT COMPARISON

This is an important, yet simple test. There's a luggage scale in the Nucleus lab that I'll use to compare the total weight of each saddle.

Protocol

- Meausre the thickness of the cinch straps of each saddle

Equipment

- Calipers (I already have a set)

CINCH FLATNESS COMPARISON

This is another simple test. I'll measure and compare how flat each set of cinches lie.

Protocol

- Hang saddle vertically
- Dally rope around the horn
- Attach force meter to one end of rope
- Hold the rope opposite in 3 different standard positions
- Measure how much static force is needed to budge the rope
- Measure how much rope is fed with a constant force above the rope's static force over 3 seconds

Equipment

- Force gauge (available in Nucleus Lab)
- Hanging equipment (I have a bunch of climbing stuff I can use for this)

RESISTANCE ON ROPE

To test how quickly the rope will feed through each horn, I'll test how much force is needed to budge and feed the rope.

As I want to find out if a wider range of rope resistance can be provided, 3 different bracing positions will be tested.

Benchmark Testing

BREATHABILITY	5x more breathable
HEAT DISSAPATION	2x better heat dissapation
TOTAL WEIGHT	1/3 total weight
RIGGING THICKNESS	1/2 rigging thichness
ROPE RESISTANCE	Equal loose feed, 2x grabbing force

ROUGH ESTIMATES ON PERFORMANCE IMPROVEMENTS

These estimates are very rough, but should be achievable given the materials that will be used in the concept saddle.

BREATHABILITY TEST	n/a
HEAT DISSAPATION TEST	n/a
TOTAL WEIGHT TEST	n/a
RIGGING THICKNESS TEST	n/a
ROPE RESISTANCE TEST	n/a

BENCHMARK PRODUCTS	COST
Circle Y Saddles x2 ($2-3k new)	$450
SRS Reining saddle ($2-3k new)	$650
Alamo Flex saddle ($2k new)	$700

BENCHMARK TESTING SUPPLY LIST

Ali Sloop has said that I can use her saddles for testing purposes.

I believe that it would be extremely useful to have one that I can have on had for the duration of the project. I've found some reasonable options on Facebook Marketplace in the $400-$700 price range.

I wouldn't need to damage it and would plan on reselling it after the project.

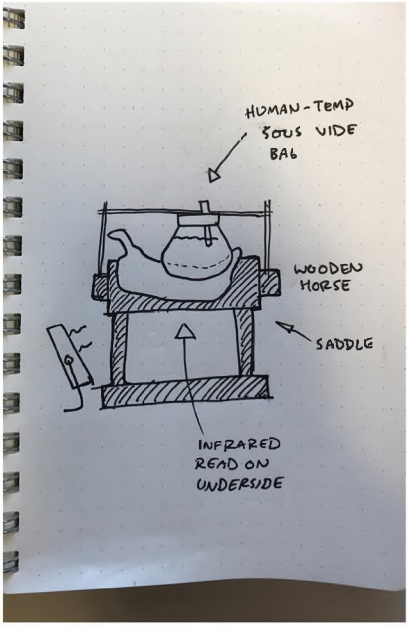
	COLLECT	REPORT	PURPOSE	DOABLE?	TIMELINE
VAPOR TEST	tape chamber over either seat or skirt of saddle, place fog machine inside chamber and video record opposite side	record video of test, screenshot keyframes	demonstrate that the new saddle is more breathable	3.5 / 4	everything should be done with the benchmark saddle by Jan 15th
HEAT TRANSFER TEST	create ambient airflow along the bottom of the saddle, direct low heat at either the seat or skirt, track temp over time	manually record surface temp with an infrared thermometer every 30 seconds during test	demonstrate that the increase in breathability + new materials helps prevent heat build up	3.5 / 4	
WEIGHT / DIMENSIONS	measure total weight and thickness of rigging	use a luggage scale to record weight and calipers to record rigging thickness	demonstrate that the new saddle is lighter and more streamlined	4 / 4	
DALLY ROPE GRAB	dally rope around the horn and fix into a belay device to represent a grip, attach a weight to the other end of the rope and drop it	place the force meter between the rope and the weight to record how much force is present before the rope moves	demonstrate that more grab power can be generated with the new saddle horn	2.75 / 4 *most figuring out	

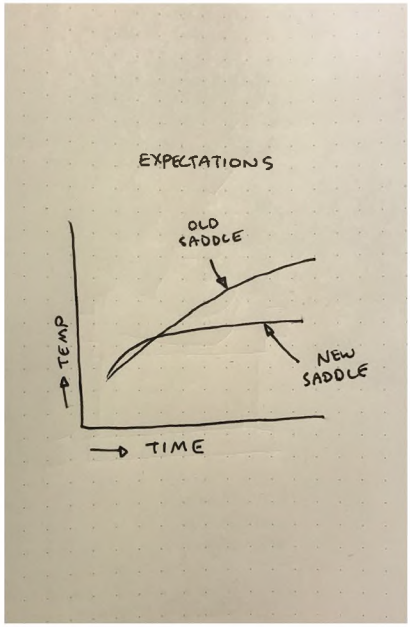
BENCHMARK TESTING (HW2)

I'm planning on demo-ing everything in class but here's a brief table-summary of what I have prepped.

Goal:

Decently produced ***side-by-side*** video clips of each test.

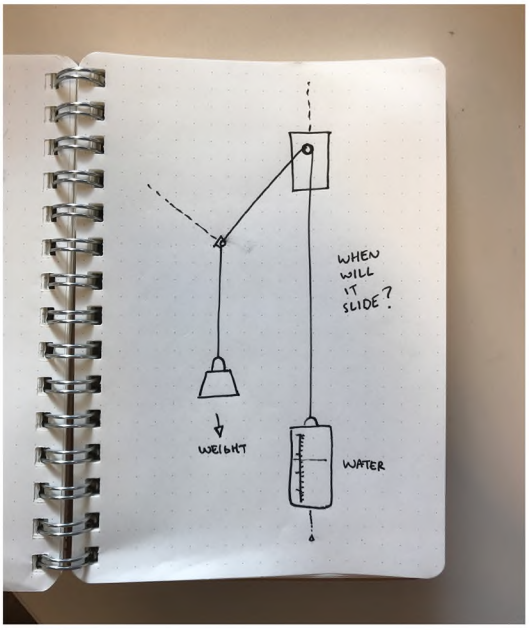




HEAT DISSIPATION TEST

This is a secondary test to support the vapor test. It's to show why increased breathability is good.

Here's a couple methods. I'll have the saddle and stand tomorrow.



$$F_s = \mu_s N$$

F_s = Force of static friction.

μ_s = Coefficient of static friction.

N = Normal force.

ROPE BITE / STATIC FRICTION TEST

As the weights will be pretty heavy (150 pounds), I'll be able to calculate the static

BENCHMARK SADDLE

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

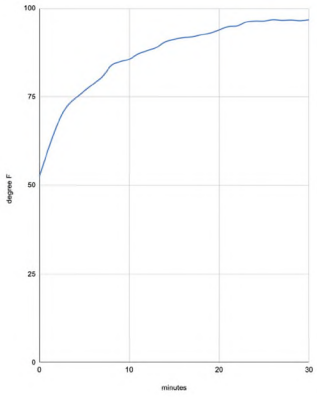
BREATHABILITY TEST

Method:

- Attach streamers in a pattern on the fan and the bottom of the saddle.
- Blow air against the top of the saddle.
- 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.



HEAT BUILDUP TEST

Method:

- Suspend saddle with low air flow underneath.
- Suspend a space heater 5 inches above the seat.
- Turn on space heater.
- 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 deg F.

3.4 LBS OF "GRIP FORCE" ON THE HOLDING SIDE CAN RESTRAIN 70 LBS ON THE LOAD SIDE

HORN ROPE GRIP TEST

Method:

- Suspend the saddle vertically to replicate the direction of the rope pull.
- Attach 70 pounds to one side of the rope.
- Dally the rope once around the horn and attach a container with 40 pounds of water on the other end.
- 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

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

WEIGHT & CONSTRUCTION

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.

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

PRODUCT GOALS

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.

INSPO / PALLET (2)

These images blend a mid-century color palatte with geometic forms.

Branding and Concept Exploration

LUNAR SADDLE

TURBINE SADDLE

REBOOT SADDLE

WINECAR / THESIS

WORKING TITLE

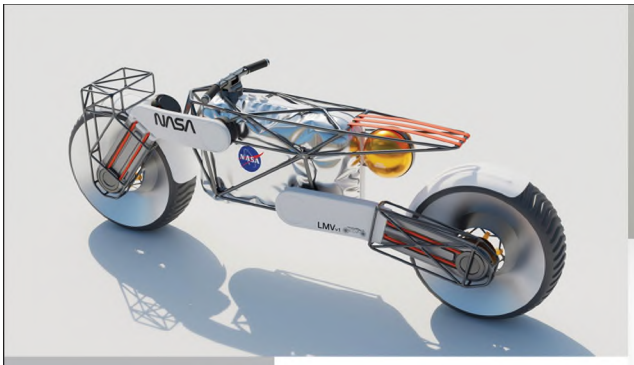
I normally like to find a title that makes sense upon first read. It's a little backwards to name it before it's built with that ideology, but here's some options that reflect some of the backstory work that has been done so far.

Lunar Saddle references NASA space race techy stuff.

Turbine Saddle references wind turbines, and the tornado horn.

Reboot Saddle references Joey Ruiter's Reboot Buggy.

67 / 78



WINECAR / THESIS

INSPO / PALLETE

I'm interested in how some of these products blend organic shapes with raw function. I'm also interested in the exoskeleton theme on the nasa rover, exposing all the elements.

68 / 78

Livory. A handwritten font.

Esedipsantur? Orum doluptae nitium deres volorrundae erferes simaxim ilique ommolor umquas re praesed quiscit prae non ellab ide voluptam dipsape liquiam estiur aperum etur ma dolorerum evendene voloreprate volorepe earitiatiur? Evereni consequam, sam, aut harchil ius mostiis vel

DOMUS TITLING.

GEOMETRIC, CARVED.

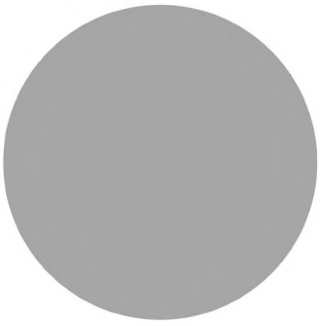
Esedipsantur? Orum doluptae nitium deres volorrundae erferes simaxim ilique ommolor umquas re praesed quiscit prae non ellab ide voluptam dipsape liquiam estiur aperum etur ma dolorerum evendene voloreprate volorepe earitiatiur? Evereni consequam, sam, aut harchil ius mostiis vel illa evendae plaborem hilis

TYPOGRAPHY

A sentence to demonstrate body text. The quick brown fox jumped over the lazy dog. Boy, that dog sure was lazy, wasn't he.

I try to keep things simple. I want critical attention to be on the product design.

read 1

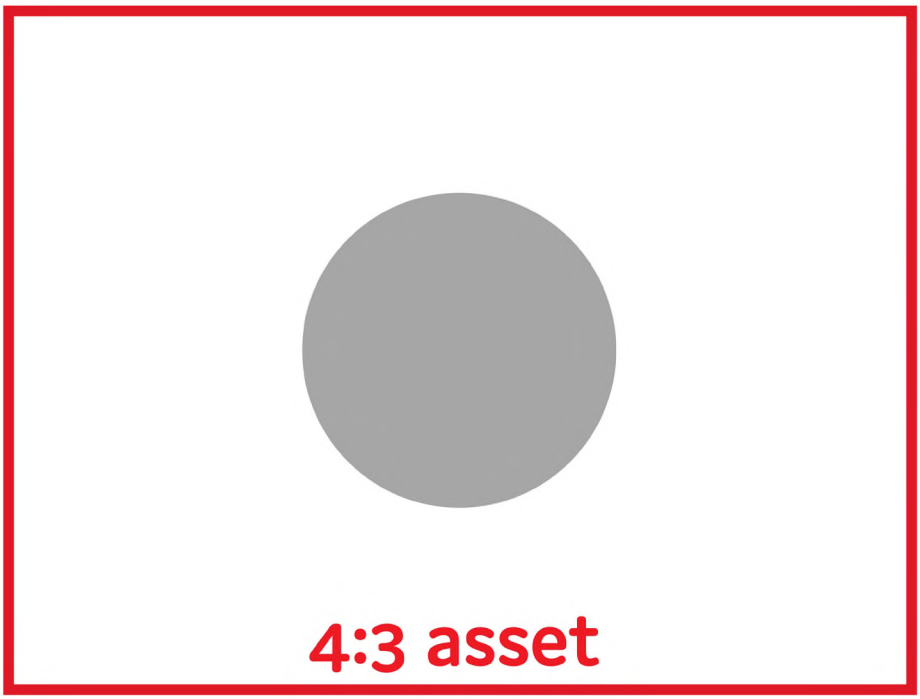


read 2

TEMPLATE

Orum doluptae nitium deres volorrundae erferes simaxim ilique ommolor umquas re praesed quiscit prae non ellab ide voluptam.

read 3



narrative / storyboard tag

TEMPLATE

Orum doluptae nitium deres volorrundae erferes simaxim ilique ommolor umquas re praesed quiscit prae non ellab ide voluptam.

stand alone copy

Prep
- Fit/alter benchmark saddle to horse
- Foam/harness/strap draping
- Scan horse's back

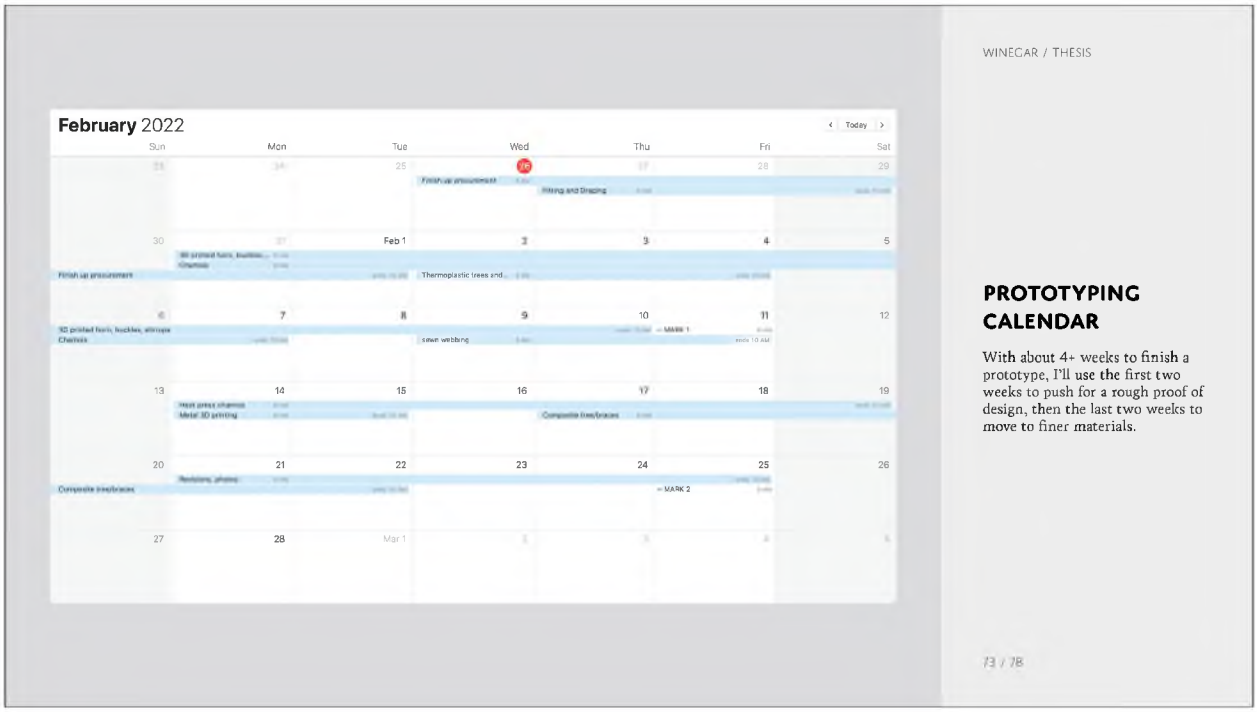
Mark 1
- Sewn layered chamois (1 human, 3 horse)
- Thermoplastic sheet forming for tree and braces
- 3D printed horn, buckles, stirrups
- Final webbing, sewn

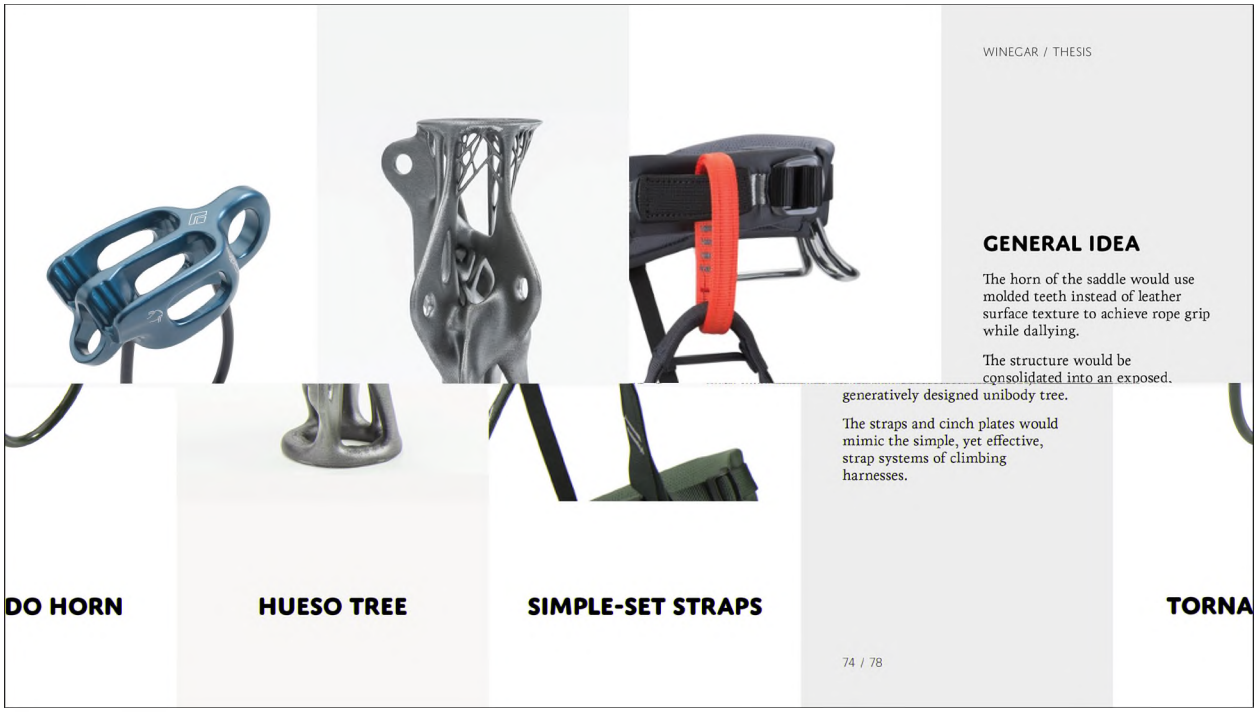
Mark 2
- Heat pressed chamois, slip-on
- Carbon fiber composite tree and braces
- Metal 3D printed horn, buckles, stirrups (nylon stirrups?)
- Final webbing, bar tacked

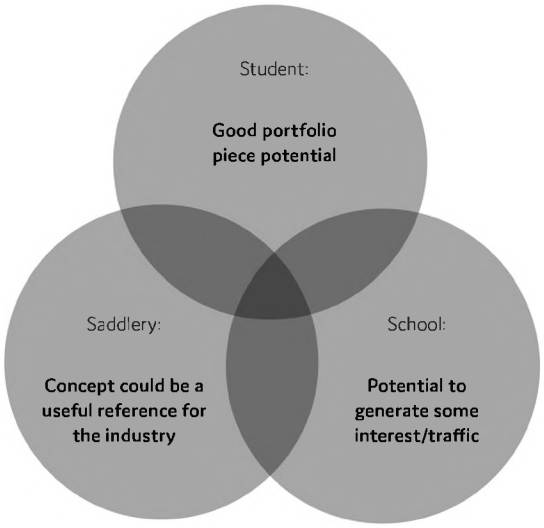
PROTOTYPING LIST

I'm planning on three main phases.

- Prep. Collect dimensions and scans from a horse.
- Mark 1. Build rapid prototypes until there's an MVP of placeholder material.
- Mark 2. Translate the Mark 1 to more finished materials.


February 2022
Today
Sun
Mon
Tue
Wed
Thu
Fri
Sat
Feb 1
Finish up procurement
Thermoplastic trees and...
sewn webbing
MARK 1
MARK 2
Metal 3D printing
Composite liner/braces
WINEGAR / THESIS
PROTOTYPING CALENDAR
With about 4+ weeks to finish a prototype, I'll use the first two weeks to push for a rough proof of design, then the last two weeks to move to finer materials.
73 / 78


WINEGAR / THESIS
GENERAL IDEA
The horn of the saddle would use molded teeth instead of leather surface texture to achieve rope grip while dallying.
The structure would be consolidated into an exposed, generatively designed unibody tree.
The straps and cinch plates would mimic the simple, yet effective, strap systems of climbing harnesses.
DO HORN
HUESO TREE
SIMPLE-SET STRAPS
TORNA
74 / 78



PROJECT POTENTIAL

After a thorough examination, this thesis topic seems like as good a topic as any to acheive a successful outcome for all the stakeholders.

BACKGROUND

Previously, I worked in a leathershop in Colorado developing and producing a line of bags and accessories for Filson. I was intrigued by the saddle maker in the shop and everything that went into making a saddle.

The ranch hands would have to dedicate a serious portion of their money to a saddle. They (and their horses) were exhausted at the end of the day.

Other experience: experimental CNC furniture shop, internship at Smart design, worked in a couple consumer product start ups.

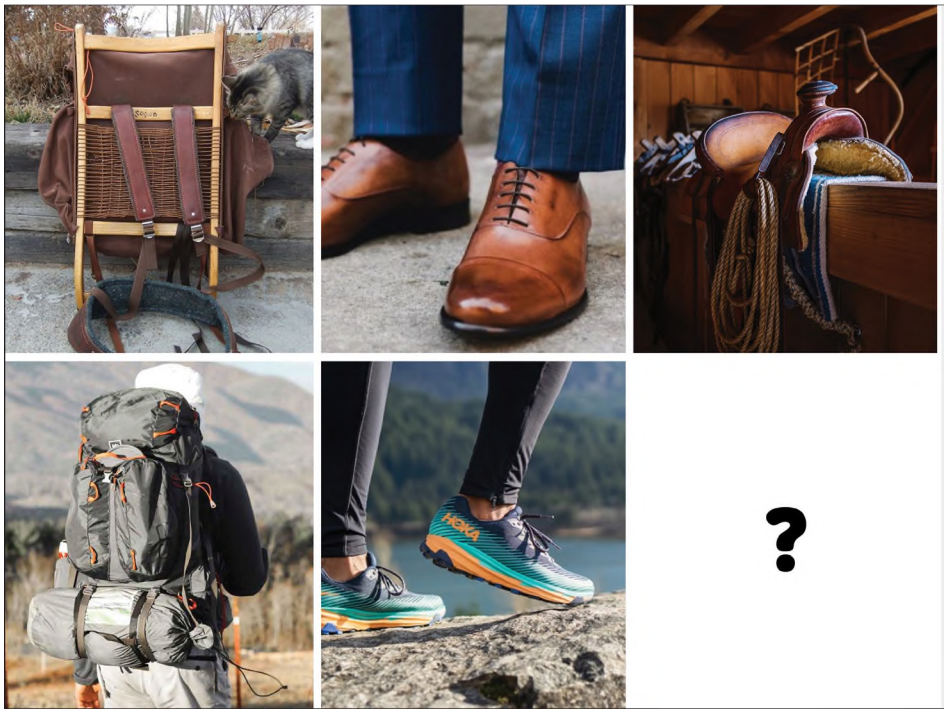
RANCHLANDS

The Zapata and Chico Basin ranches in southern Colorado are two of several managed by Ranchlands.

Their approach to ranching uses traditional knowledge and the newest research to steward the land responsibly.

Most people on the ranch are women (different than the usual) and many are city transplants looking for a more authentic or rooted way to live.

Ranchlands regularly partners with artists and brands to craft pieces that blend rugged utility with refined style and aesthetics.



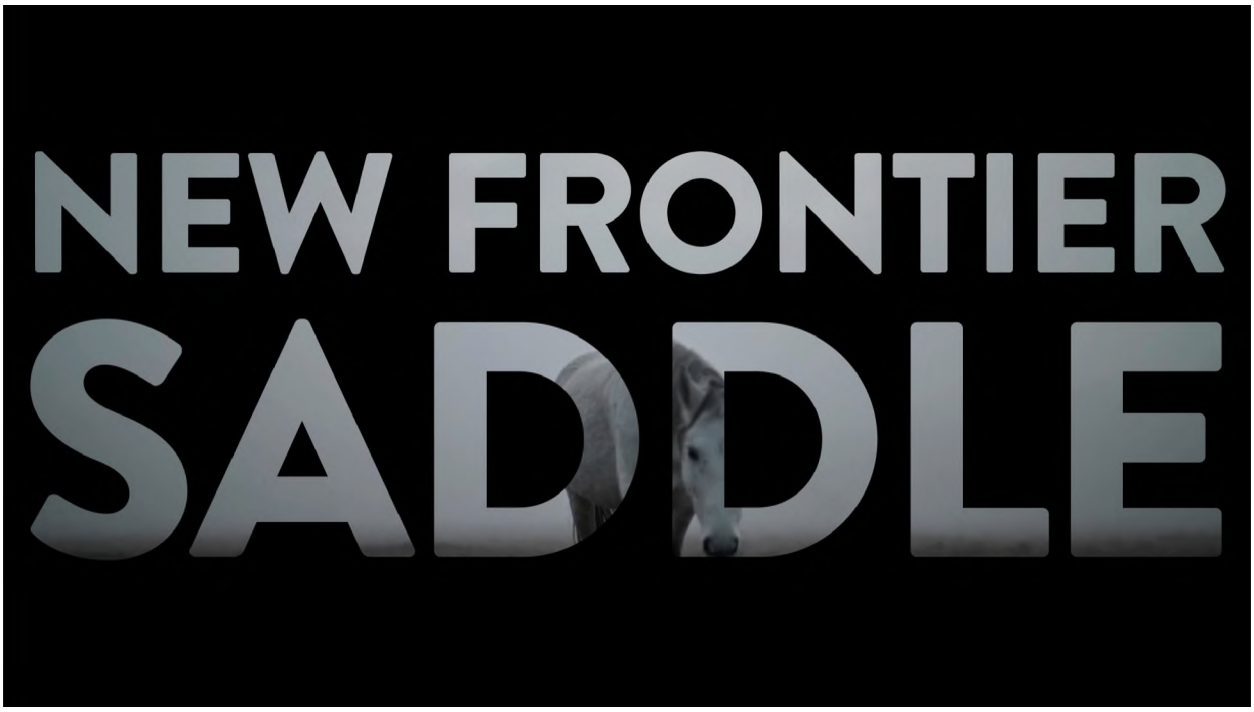
THE PITCH / ANALOGIES

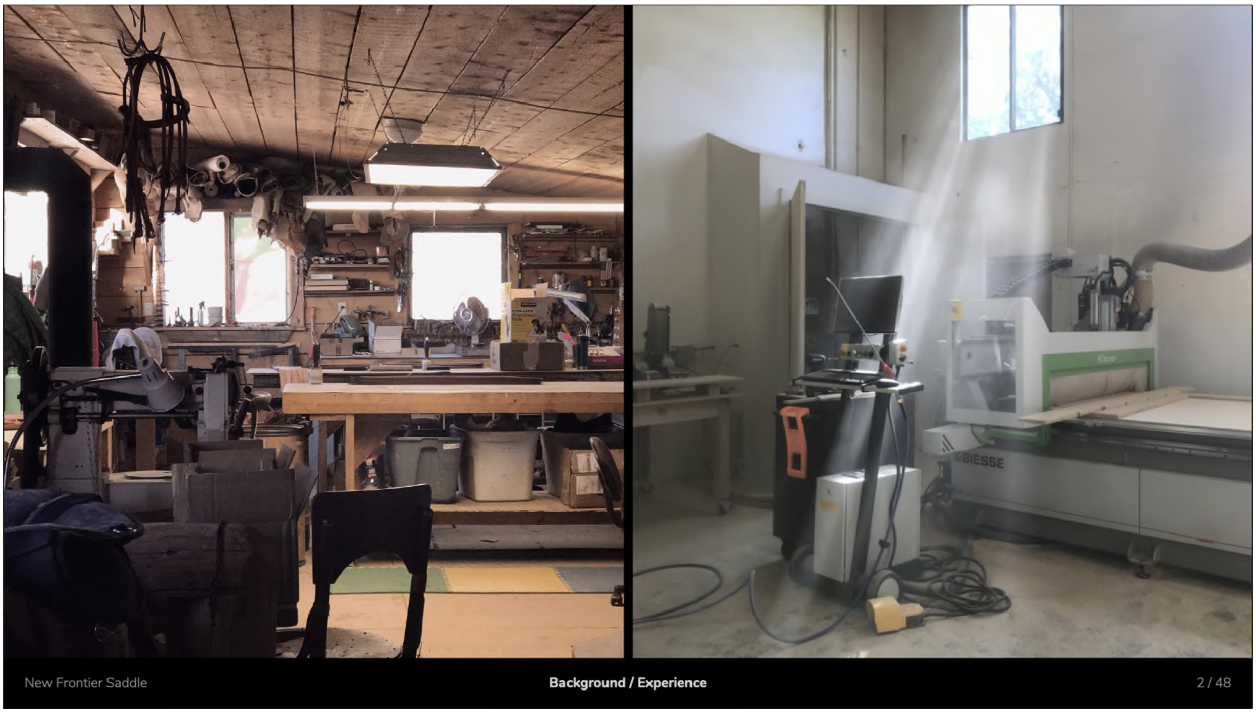
When thinking of how technology could benefit traditional saddle making, climbing harnesses could be a good analogous product.

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.

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

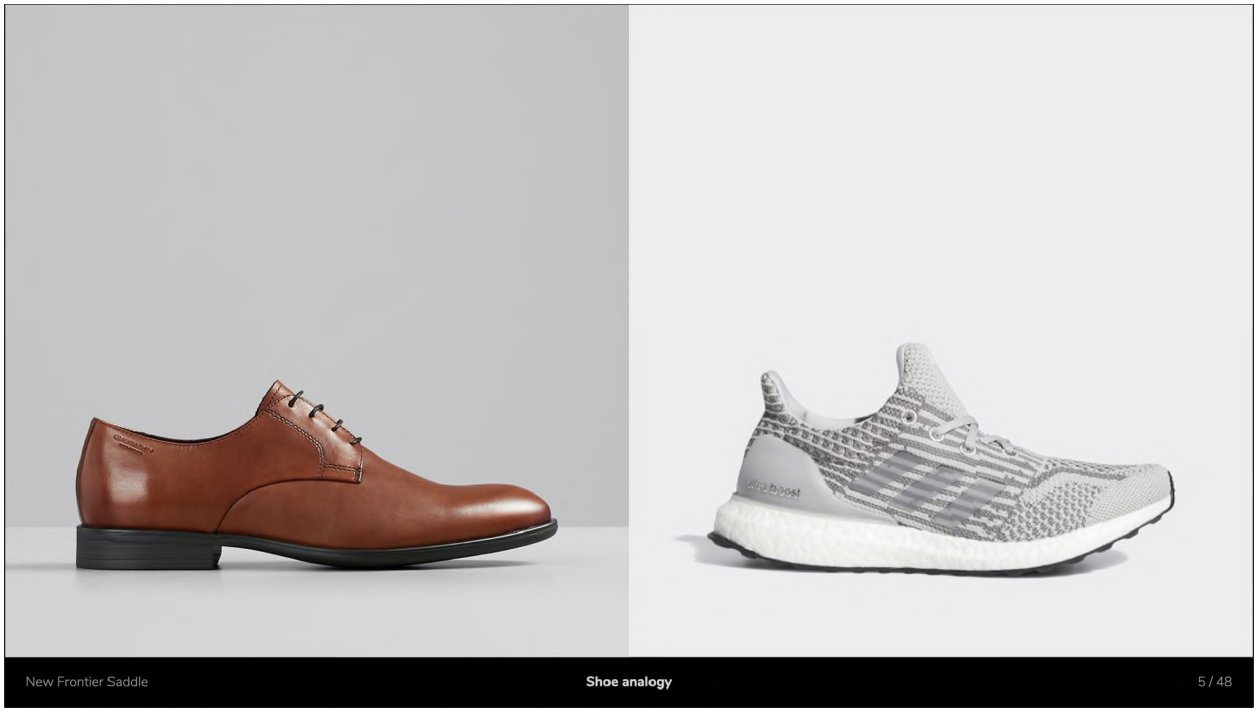
New Fontier Saddle

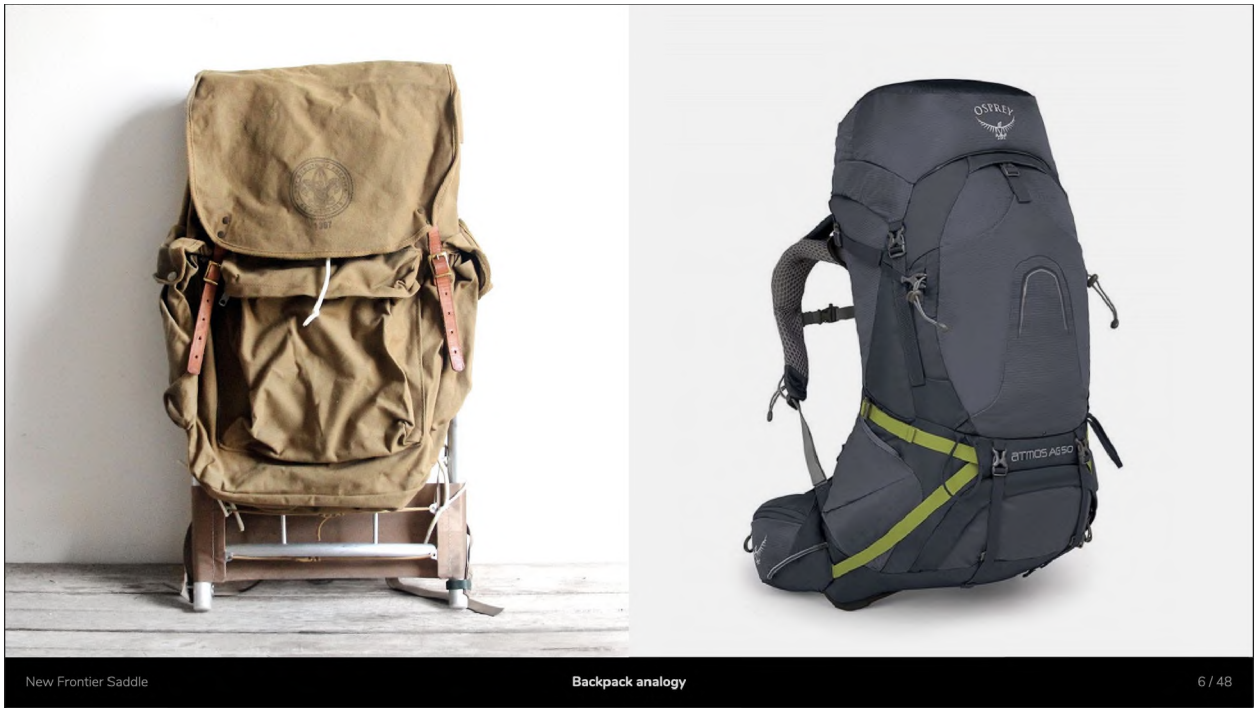




Who is a Rancher?

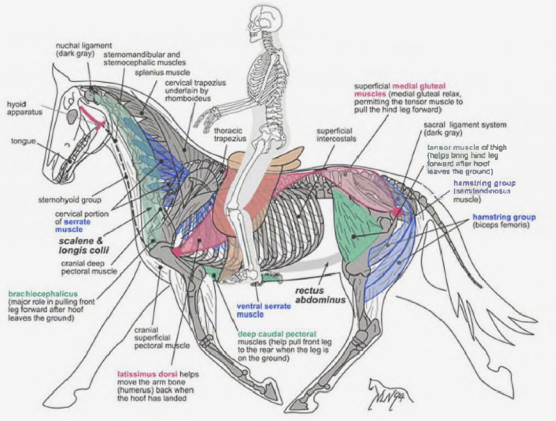
Defining Project Direction





?


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
BILLET STRAP
BLEVINS
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
deep caudal pectoral muscles (help pull front leg to the rear when the leg is on the ground)
cranial superficial pectoral muscle
latissimus dorsi helps move the arm bone (humerus) back when the hoof has landed

New Frontier Saddle — **The saddle horn lets the rider and horse work together** — 9 / 48

New Frontier Saddle — **Rigging** — 10 / 48

New Frontier Saddle **Western Saddle Tree** 11 / 48

New Frontier Saddle **Any new tech is limited to English saddles** 12 / 48


New Frontier Saddle
Weight comparison
13 / 48


40.1 pounds
New Frontier Saddle
Weight comparison
14 / 48

Surface vessels dilate

2x sweat rate / inch²

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

Any load on a horse slows them down and/or heats them up. Current saddles are relatively heavy.

+

Riders and horses overheat when it's hot and struggle to keep dry. Excess sweat leads to saddle sores.

+

The horn grip is critical to working with animals. It's often wrapped with rubber to get more grip.

=

Can we make a saddle that weighs half as much, is twice as breathable, and has equal horn grip?

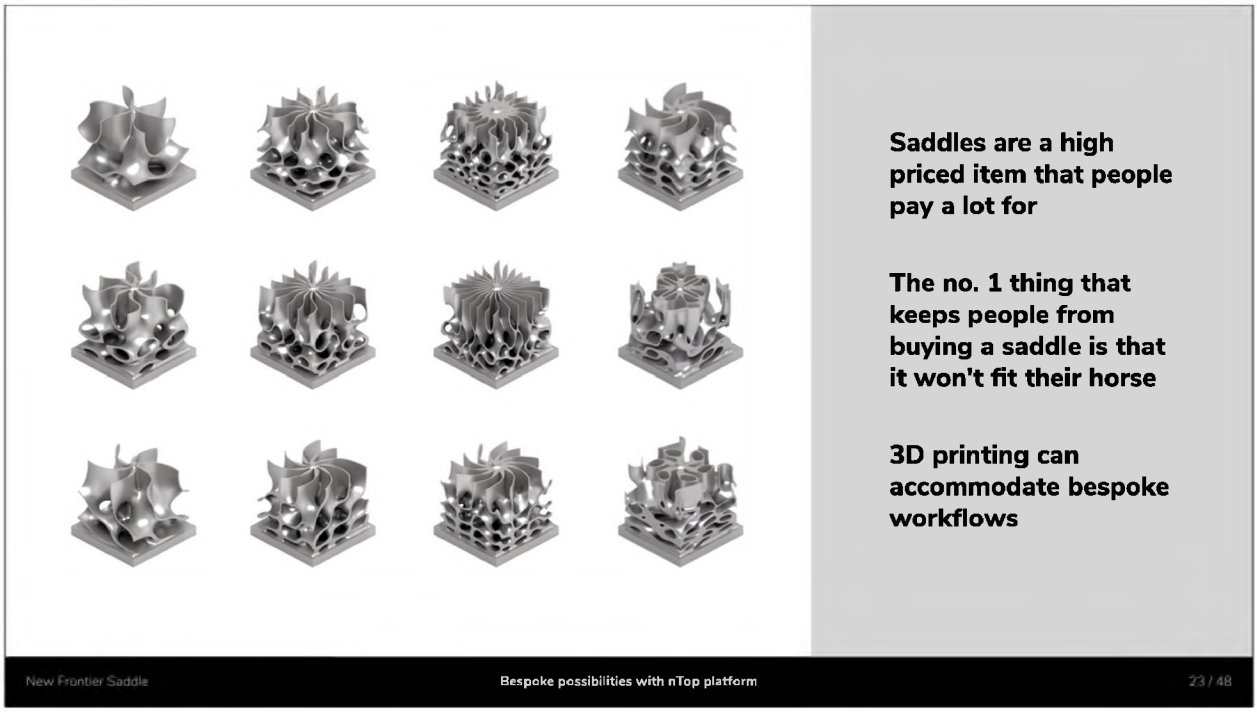
How would today's highly crafted saddle take shape?

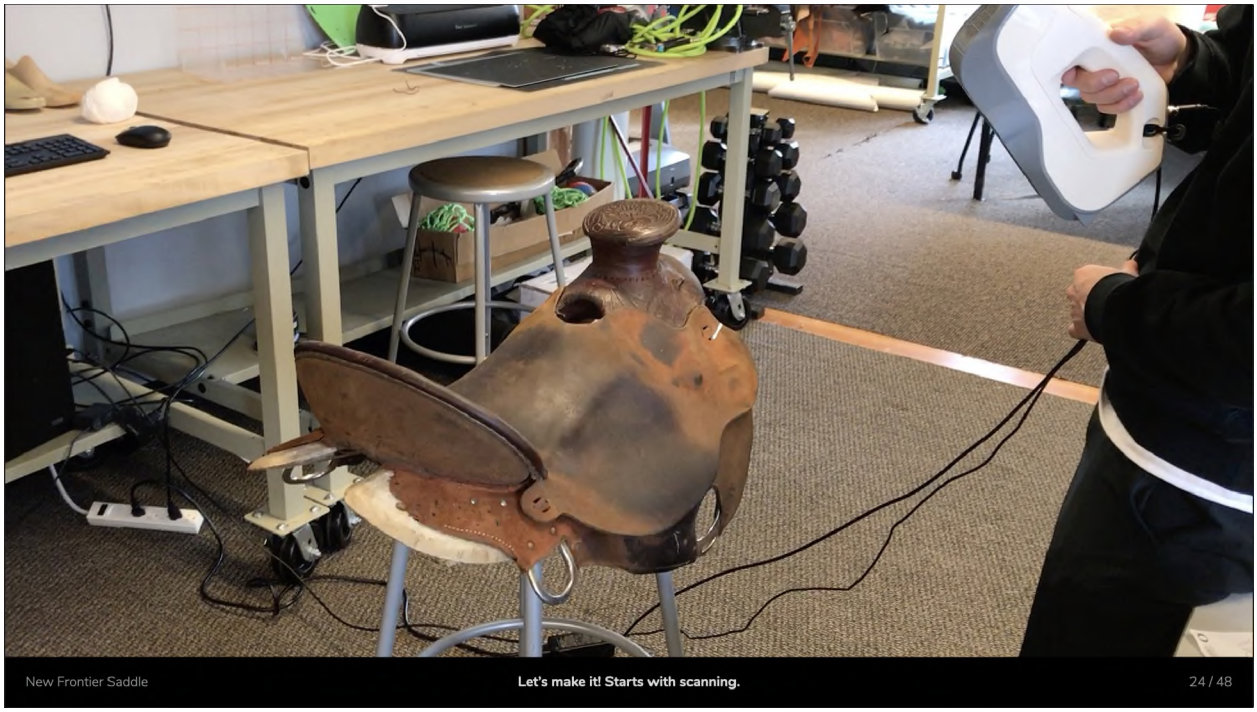
New Frontier Saddle **Lightweighting strategies like topology optimization can be inherently more breathable** 19 / 48

New Frontier Saddle **ATC belay device grooves with teeth** 20 / 48

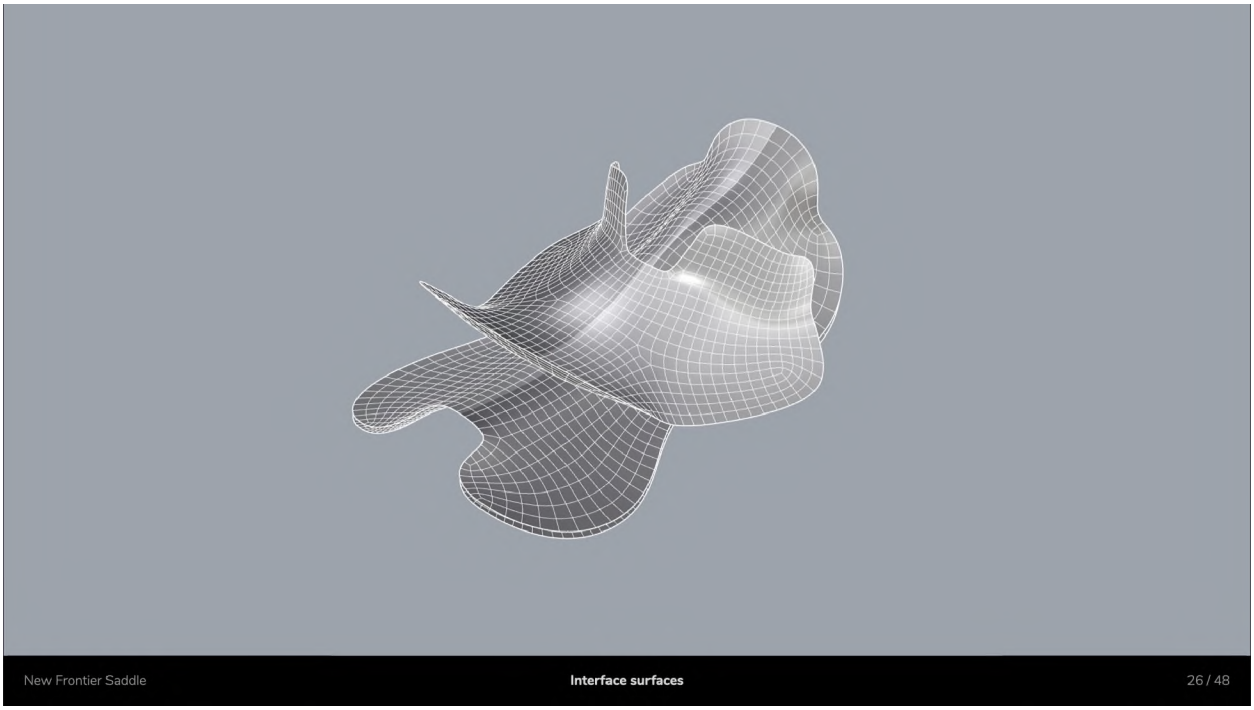
New Frontier Saddle **Climbing harness style auto-locking buckles** 21 / 48

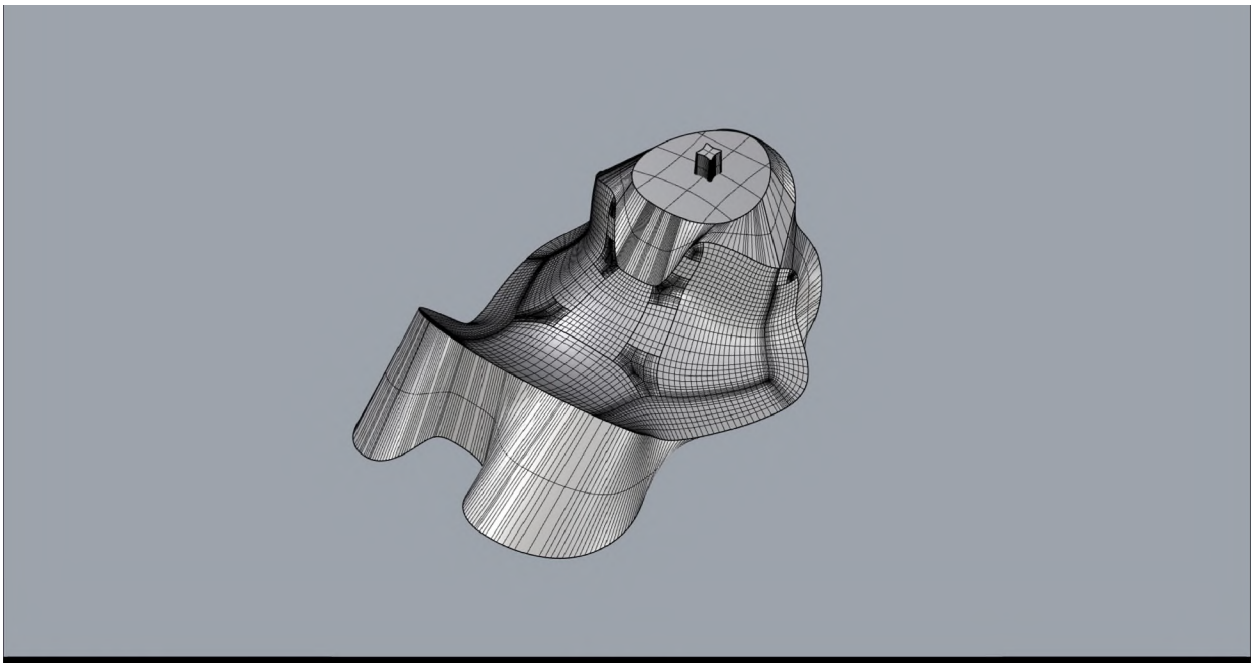
New Frontier Saddle **Industry precedent for 3D printing (Formlabs demo snowboard binding)** 22 / 48


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
New Frontier Saddle
Bespoke possibilities with nTop platform
23 / 48

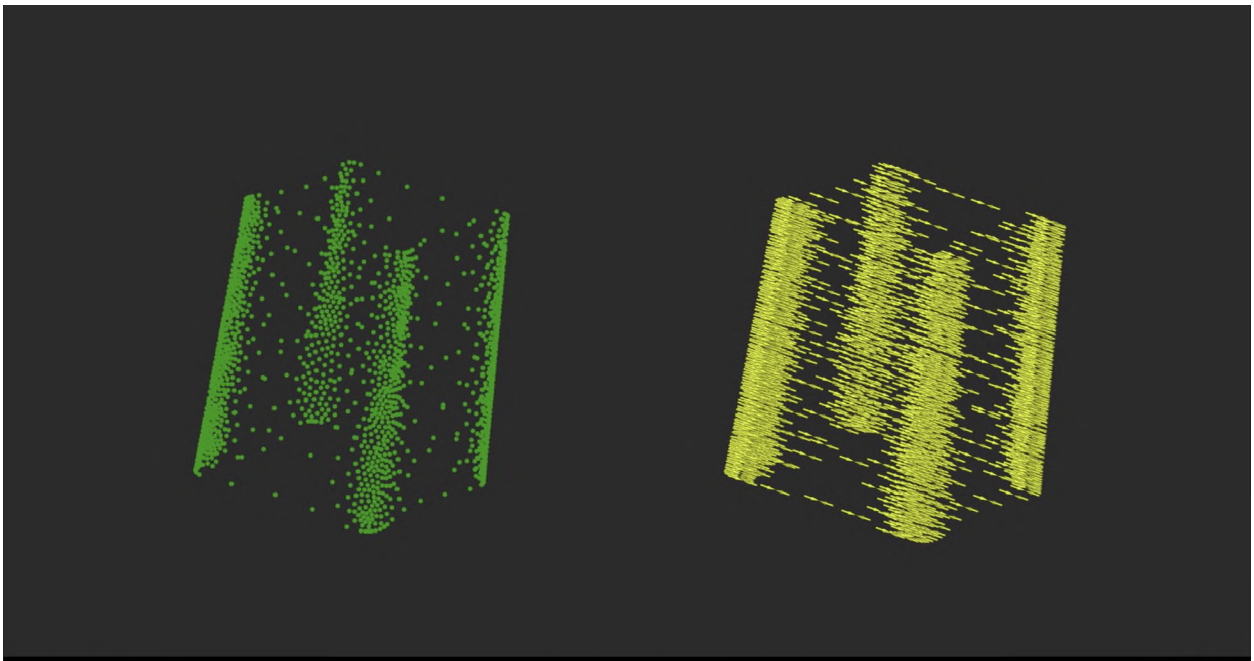

New Frontier Saddle
Let's make it! Starts with scanning.
24 / 48

Modeling a Proof of Concept

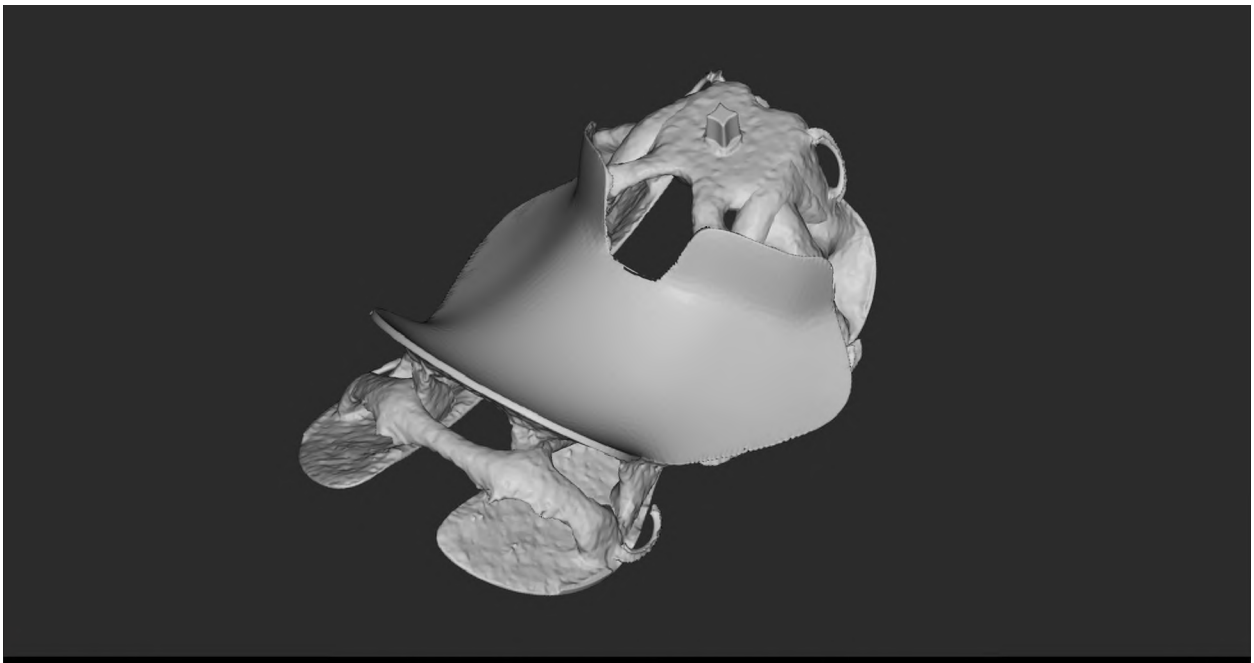




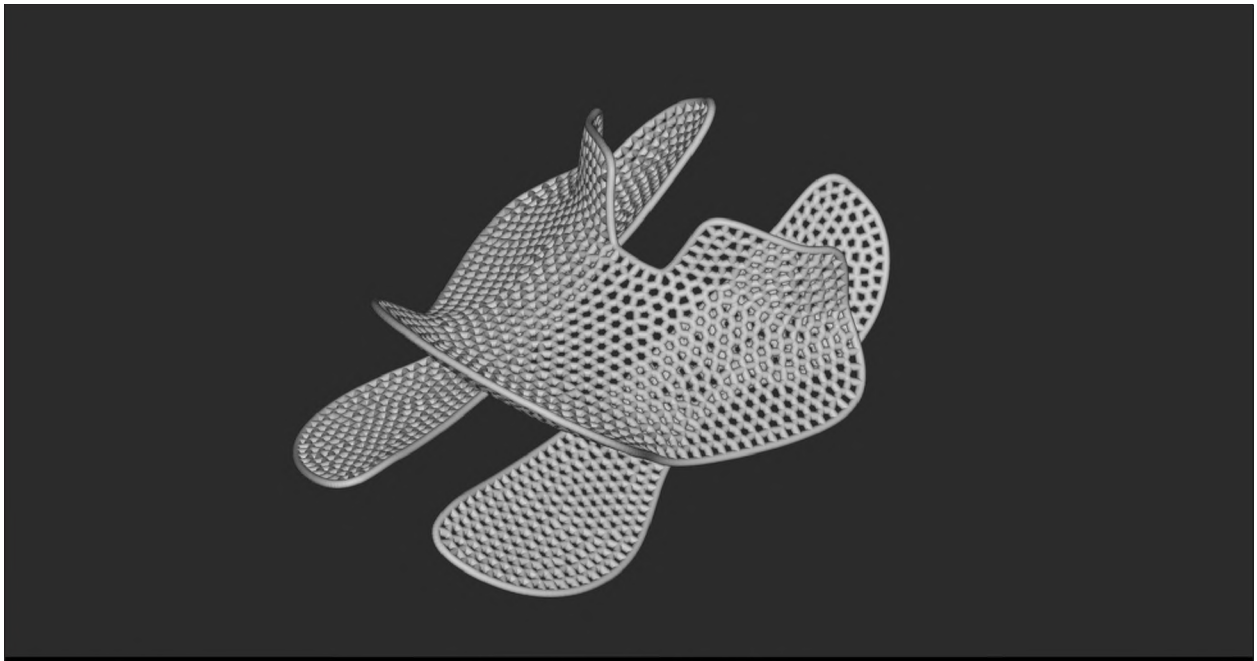
New Frontier Saddle **Work volume** 27 / 48



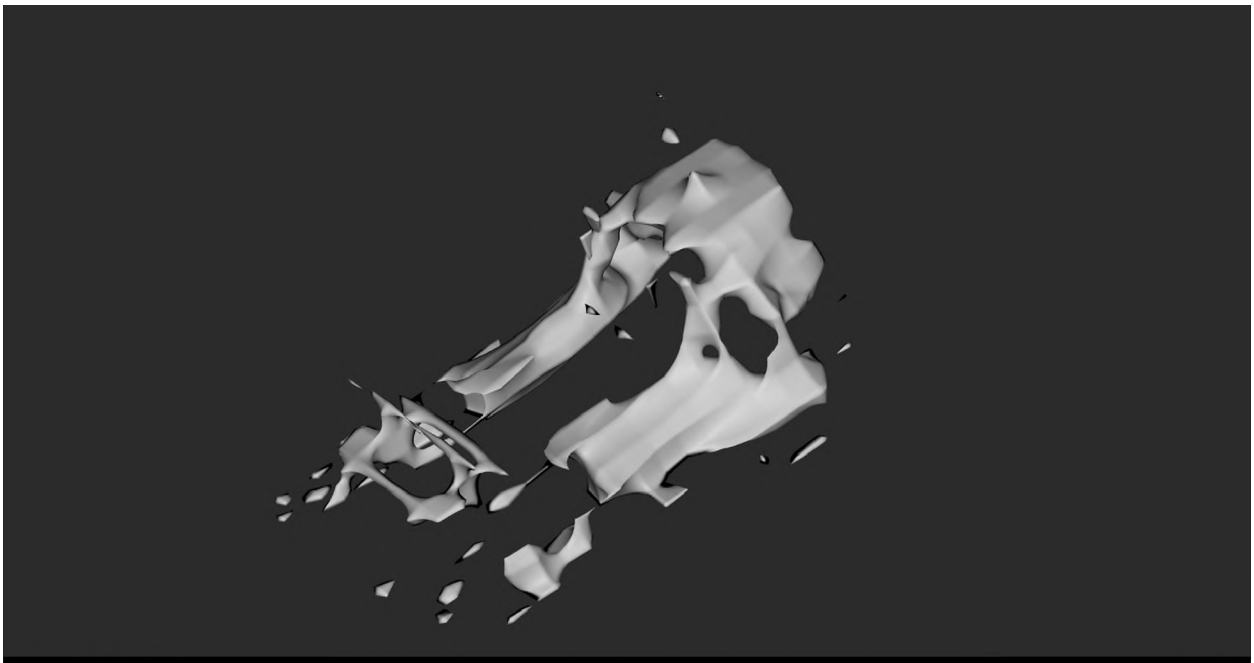
New Frontier Saddle **Horn detail of force nodes and vectors** 28 / 48

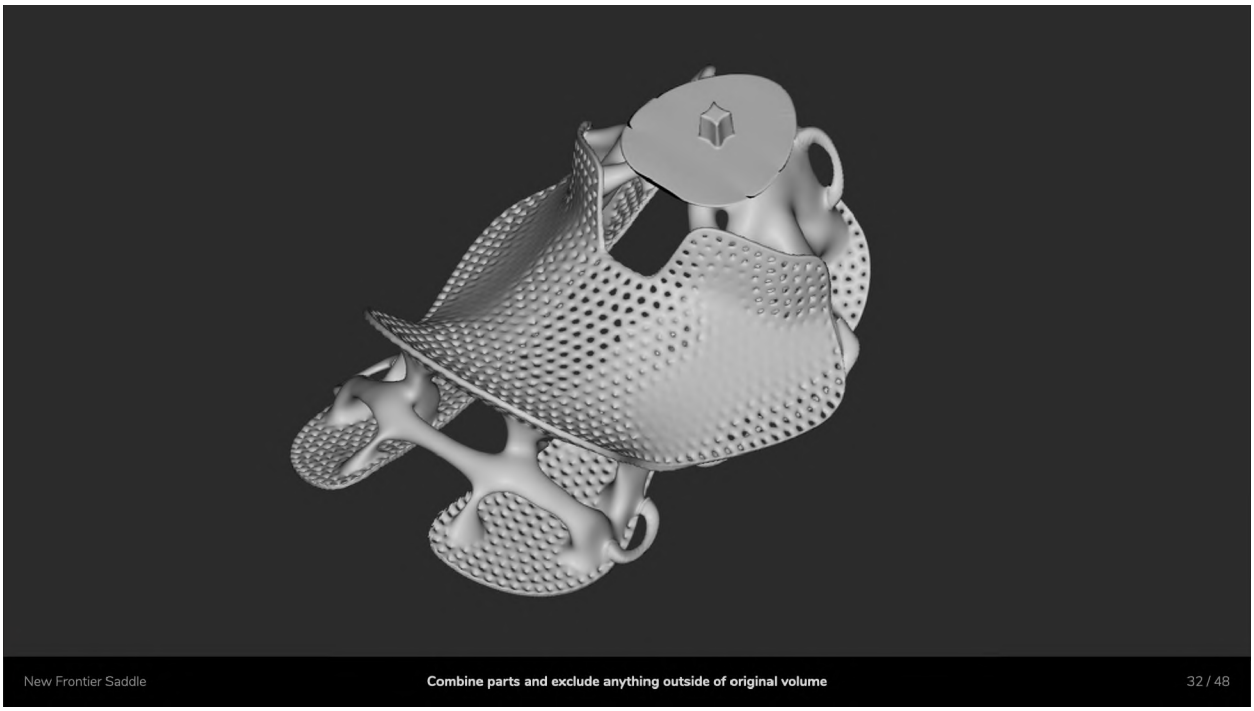


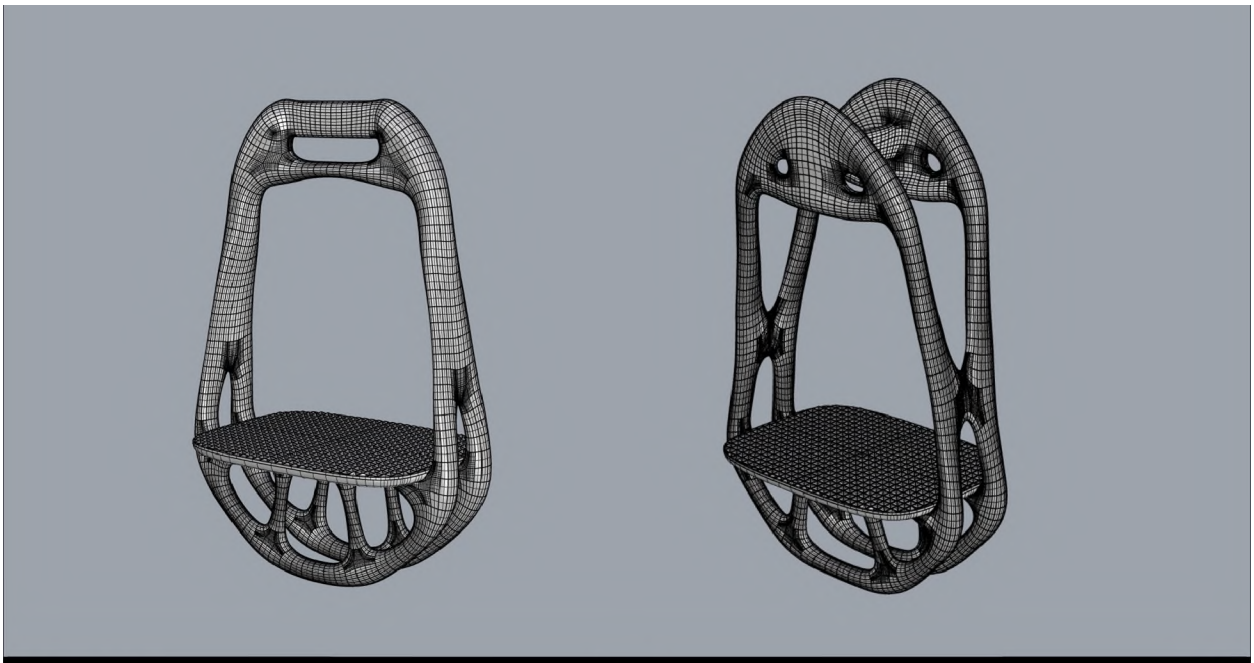
New Frontier Saddle **Iterate with different settings to generate a topology optimization result** 29 / 48



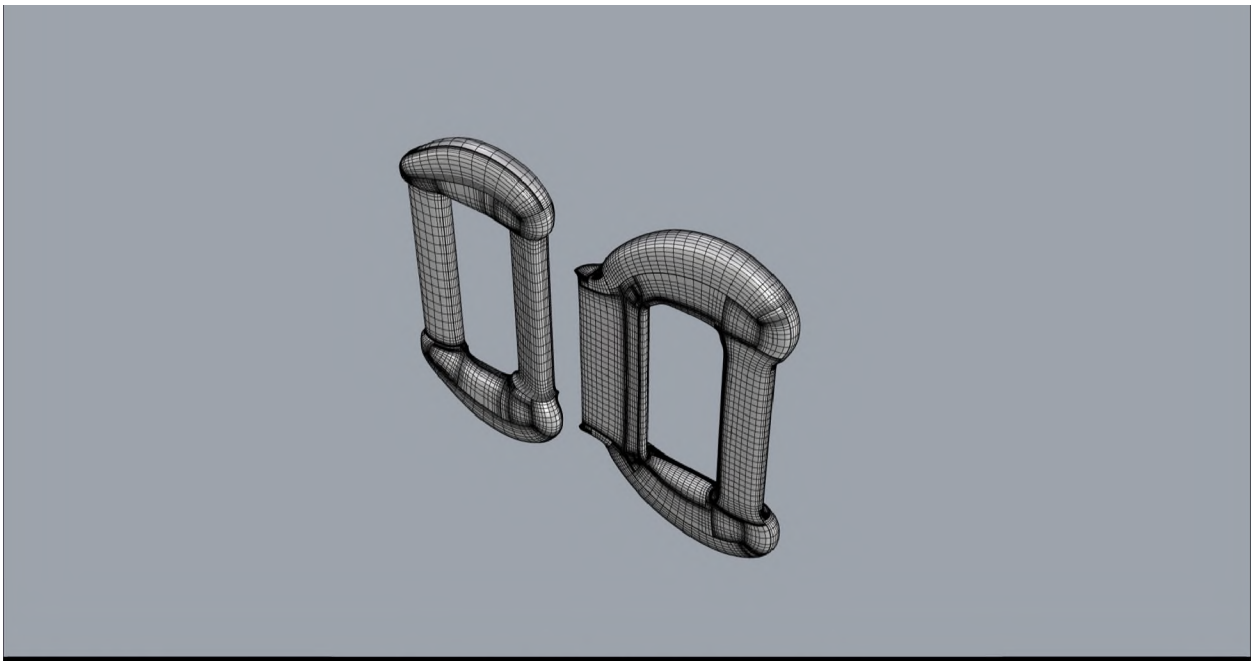
New Frontier Saddle **Recompiling with the meshed seat and bases** 30 / 48


New Frontier Saddle
Combine and smoothen with bloated interface geometry
31 / 48

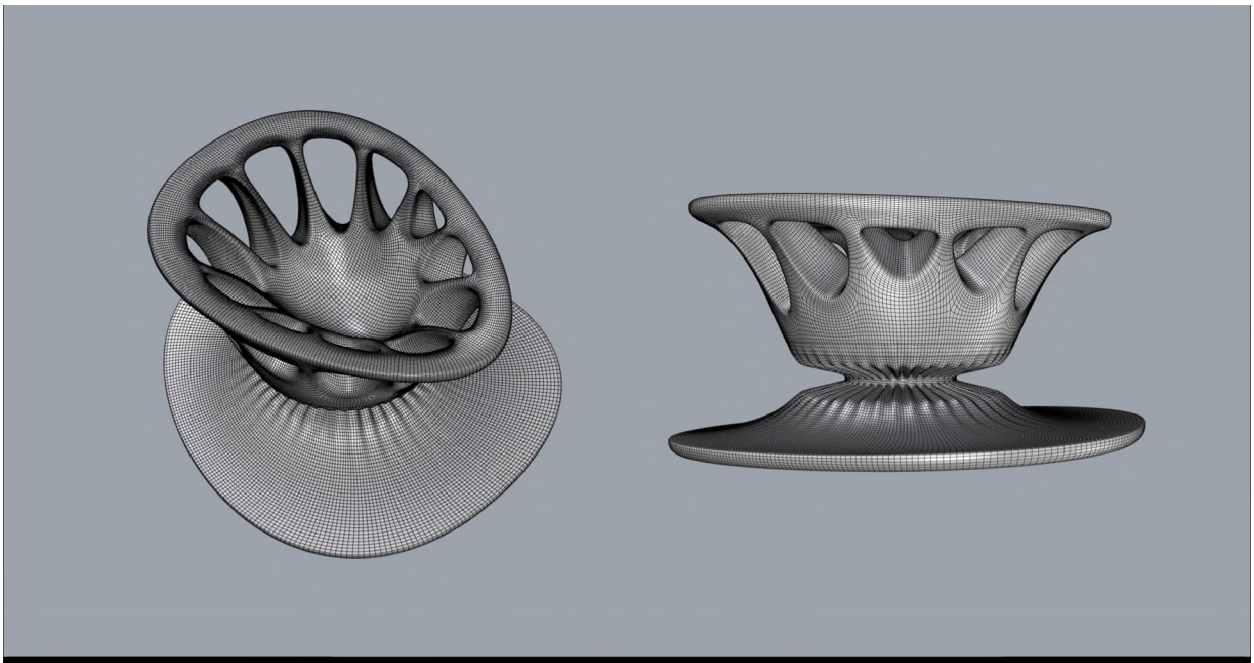

New Frontier Saddle
Combine parts and exclude anything outside of original volume
32 / 48



New Frontier Saddle **Stirrup** 33 / 48

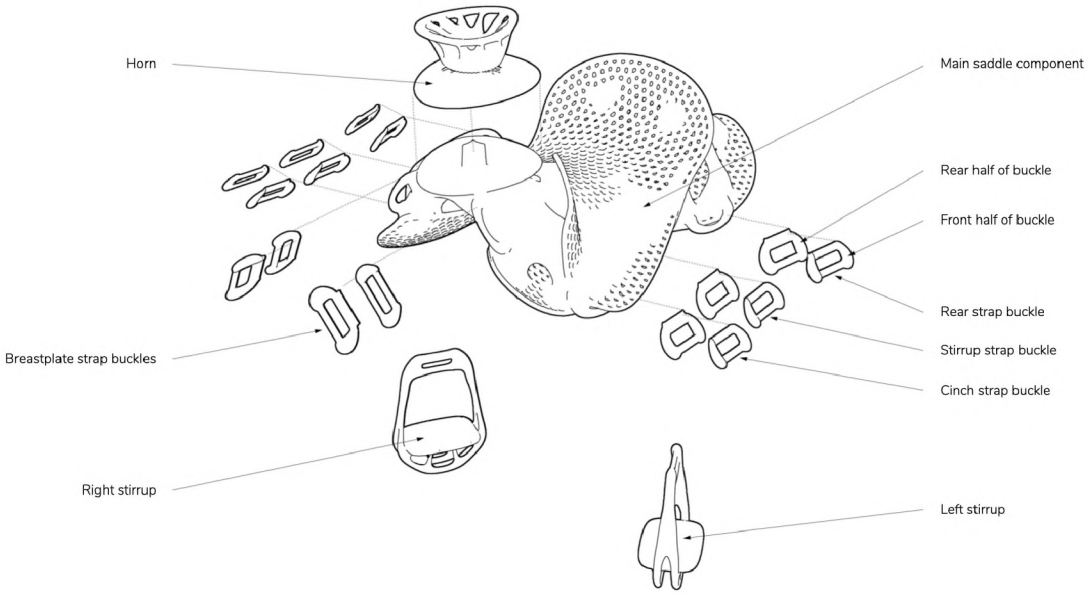


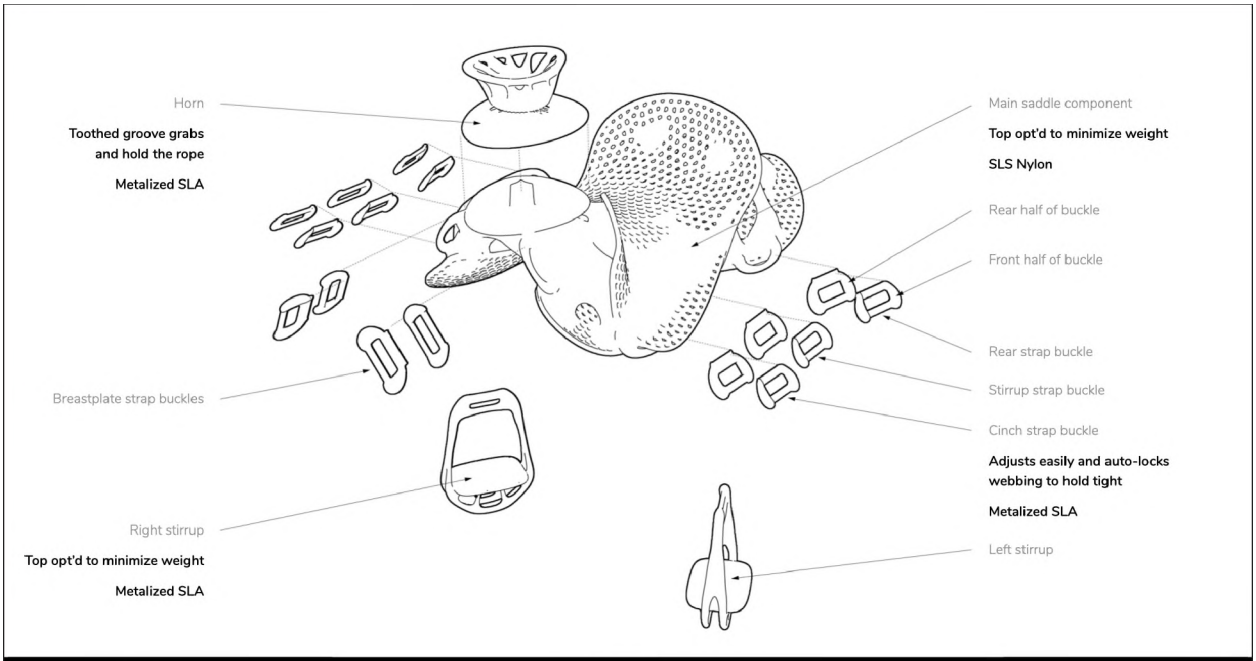
New Frontier Saddle **Self-tightening buckles used in climbing harnesses and top opted version** 34 / 48



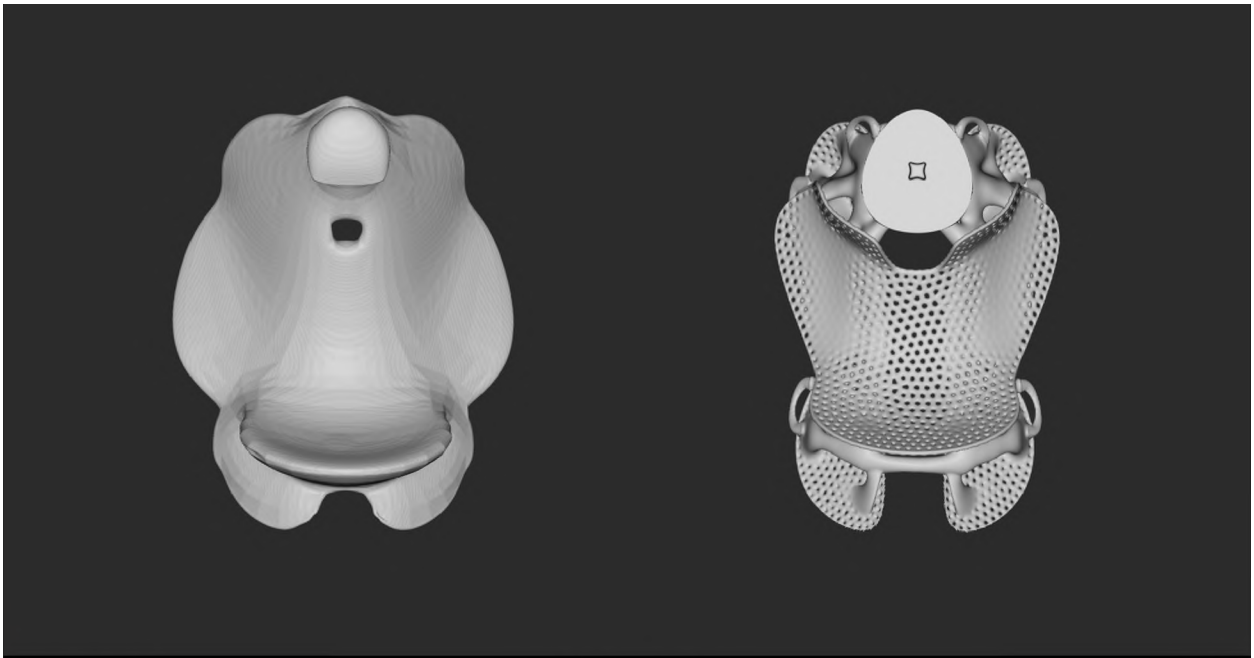
New Frontier Saddle **Horn with rope grip groove, top opted and rebuilt in Rhino** 35 / 48

New Frontier Saddle **Assembly** 36 / 48


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

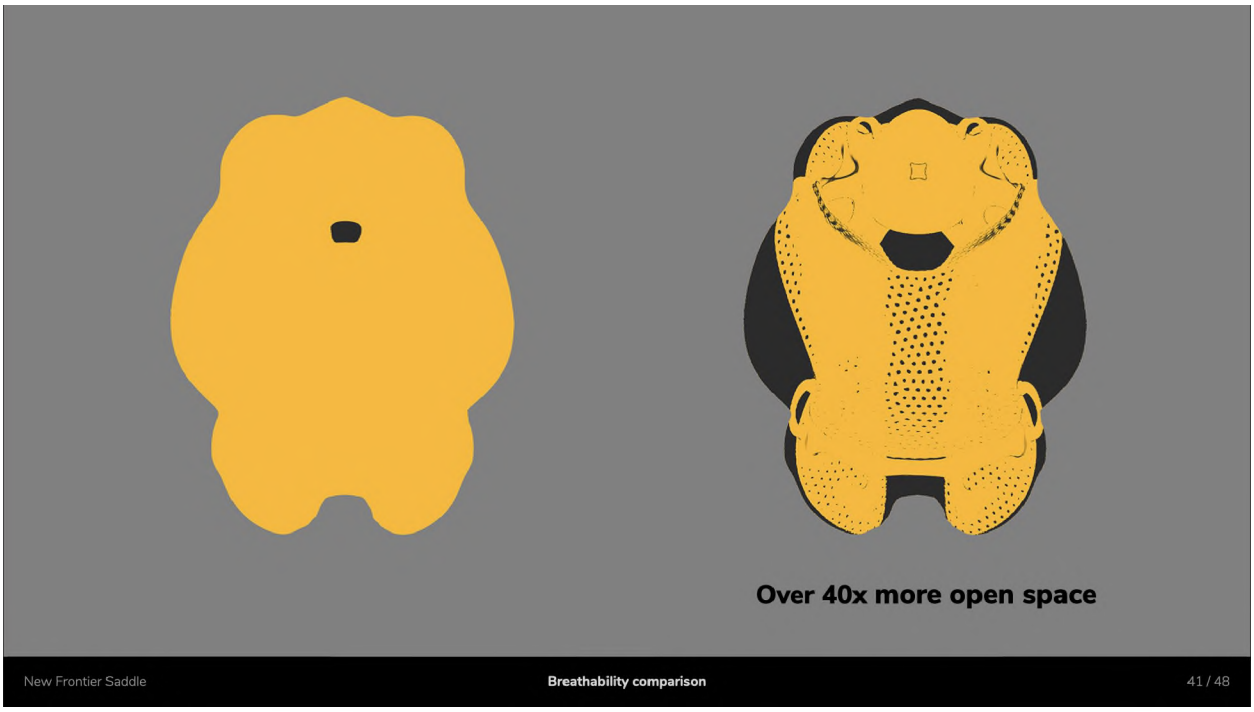


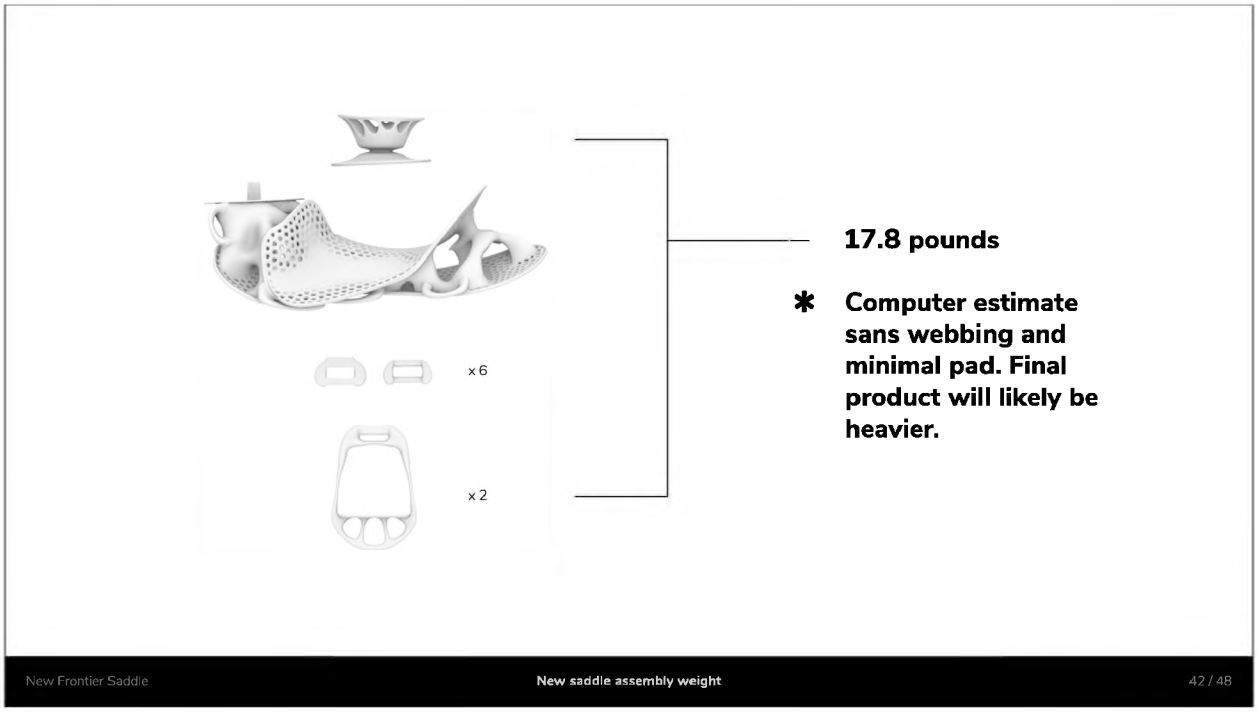
New Frontier Saddle **Exploded View** 39 / 48



New Frontier Saddle **Breathability comparison** 40 / 48

Demonstrating Viability of Concept



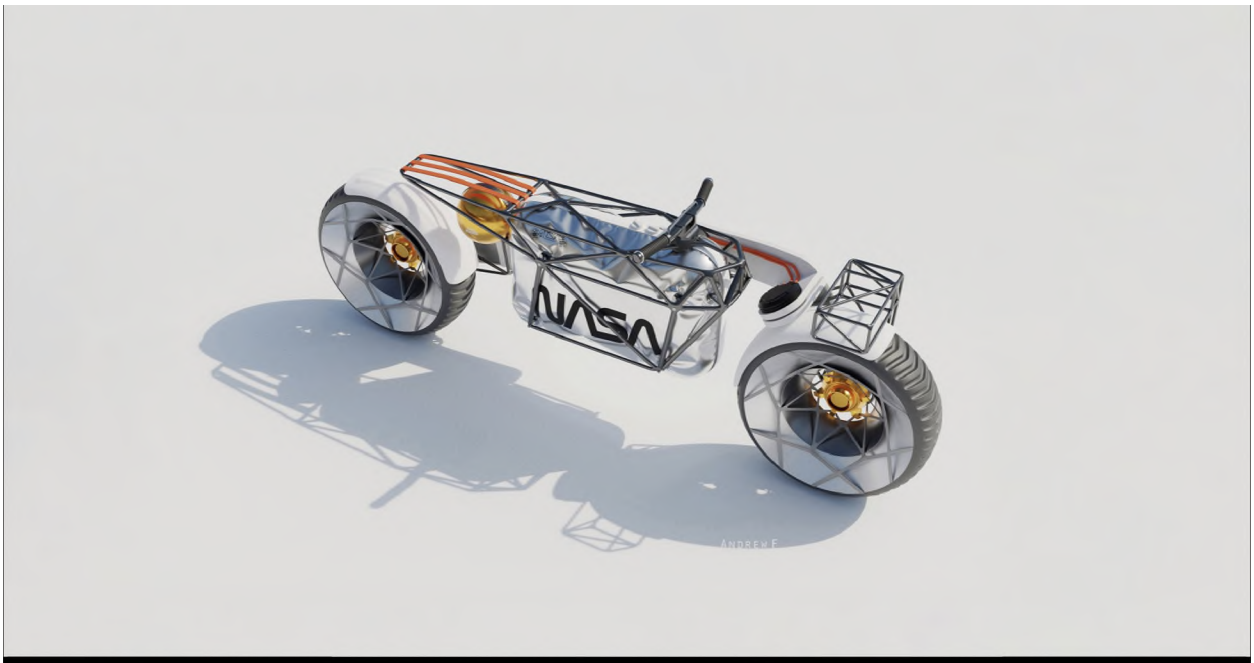


New Frontier Saddle — Horn grip comparison — 43 / 48

≥ 40x more breathable + ~50% lighter weight + ≥ Equal horn grip

= We can make a saddle that is radically lighter weight, more breathable, and with excellent horn grip

New Frontier Saddle — MVP performance improvements — 44 / 48



What's Next?

Further scale the generated structures based on loads within nTop

Develop an aesthetic "skin" to be universally applied to the forms

Develop a minimal pad

Protolabs can print the full saddle

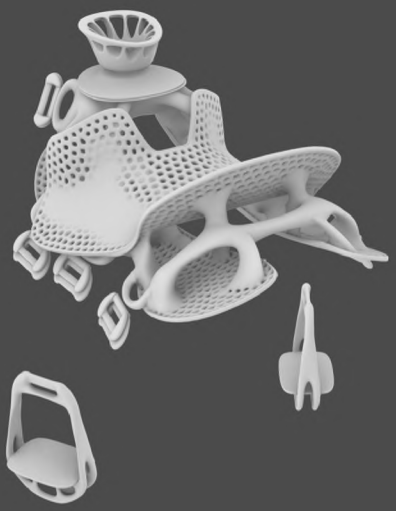
An open source nTop doc that can be scaled to horse measurements...?

What did I learn?

There's a whole field of rural products that aren't benefitting from performance-oriented design and materials

Maintaining an open mind let things grow organically and lead to solutions that I wouldn't have thought of ex nihilo

Western saddlery, Rhino, nTop top opt, additive manufacturing, Autodesk CFD, cloud computing



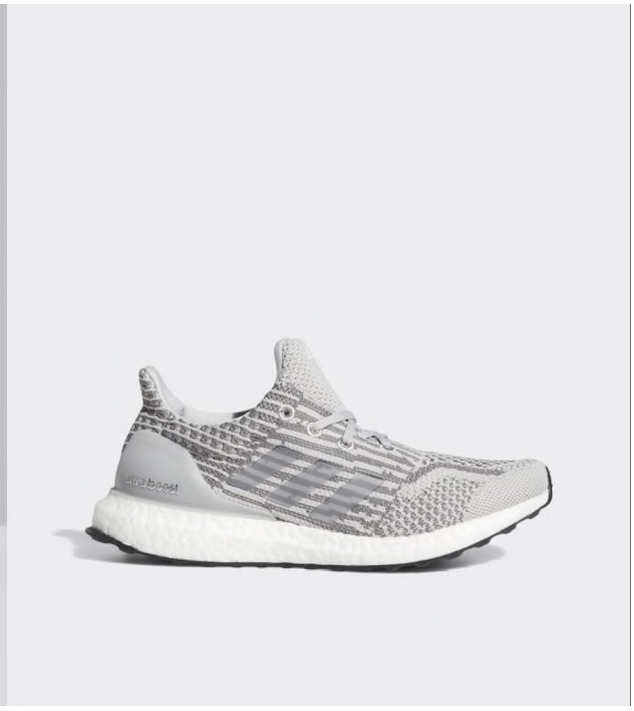
SECTION 3: SPRING TERM

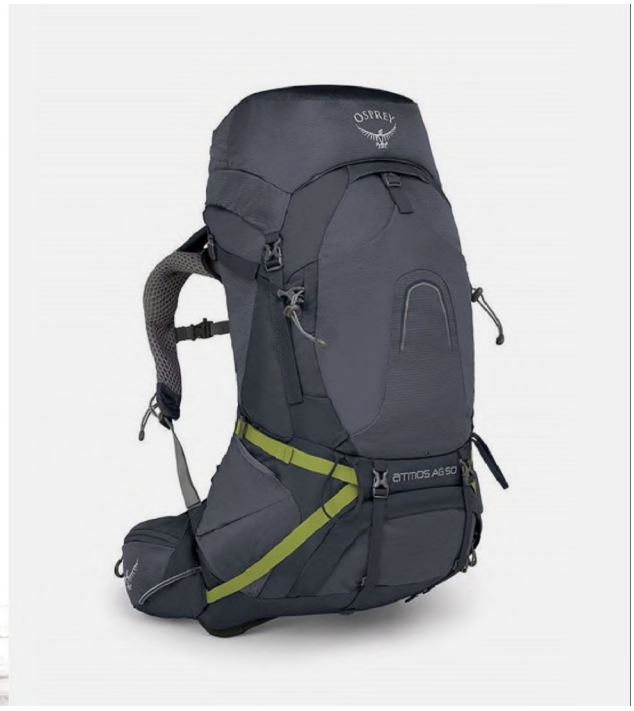
This project was finalized during the 2022 University of Oregon spring term, from March 10 to June 8, 2022. Over this section, the final branding of "Windswept" will be introduced. The target user will be further defined to future-oriented city dwellers that are moving to the country. The modeling process, including topology optimization throughout the saddle, will be covered below.

Final validation testing was conducted (results are seen below) and verified with Alli Sloop, an equestrian expert local to the Portland area. Production methods are laid out and a full-scale prototype is shown in use on horseback. The design concludes with a couple colorway options, a demo website for ordering a custom saddle, and a tech pack.

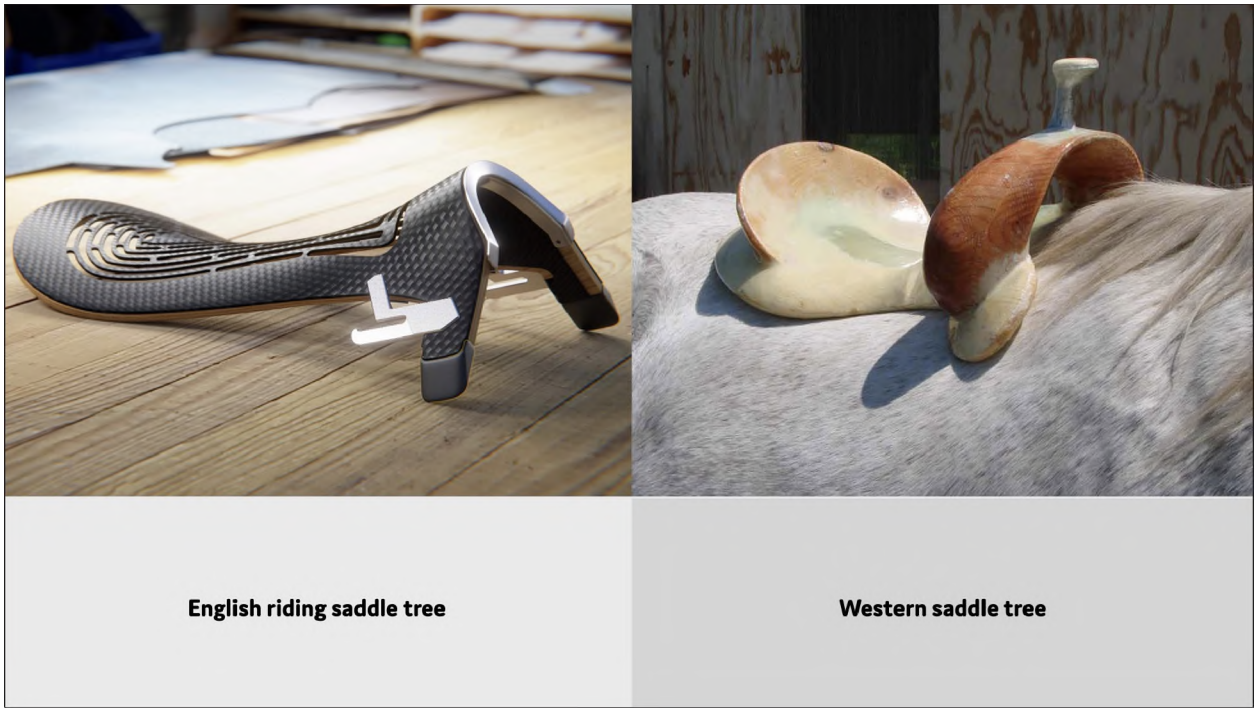
The Next Generation of Future-Oriented Ranchers

Final Product Analogies





Distilling the Core Needs of a Western Saddle



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

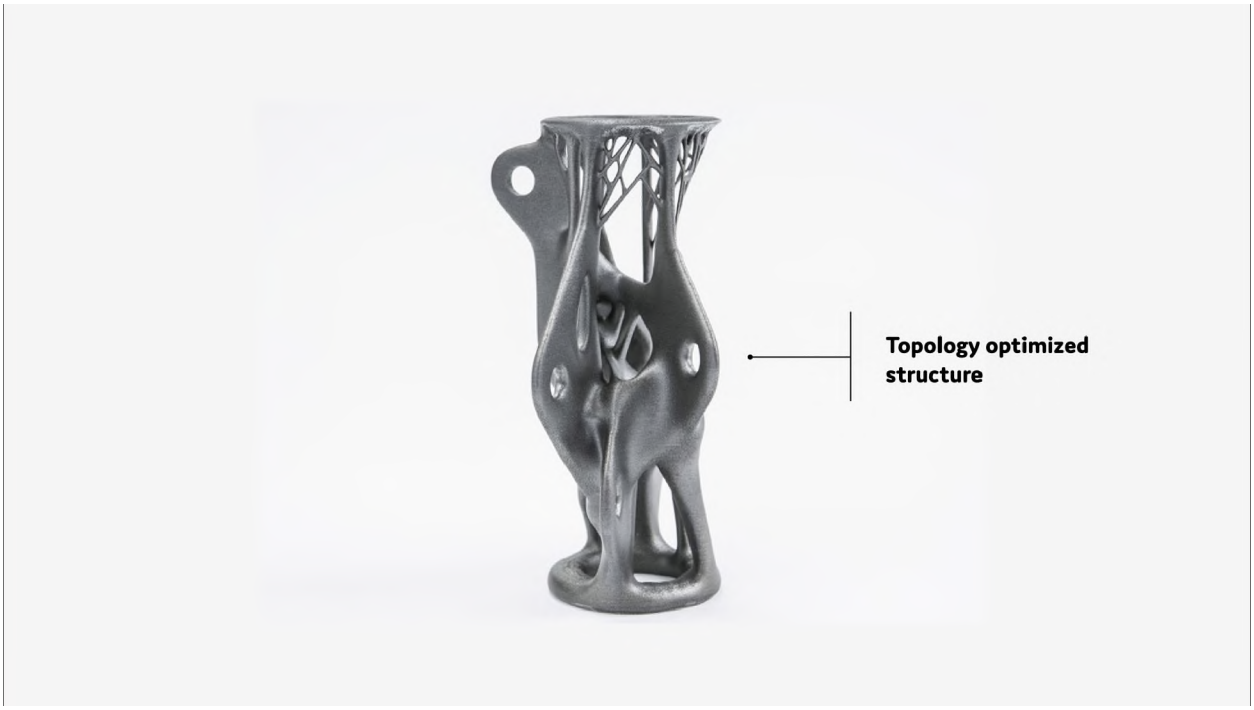
Problems to address:

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**

Target Metrics and Applied Tech

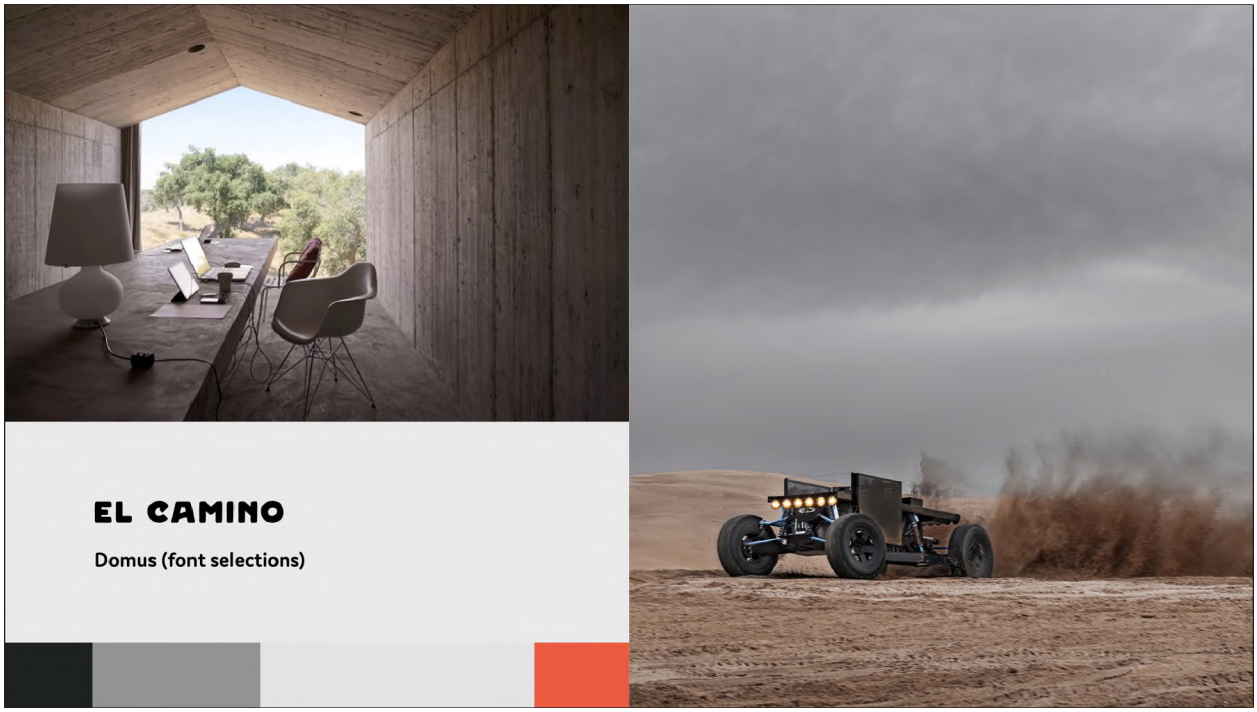
Metrics for success

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**

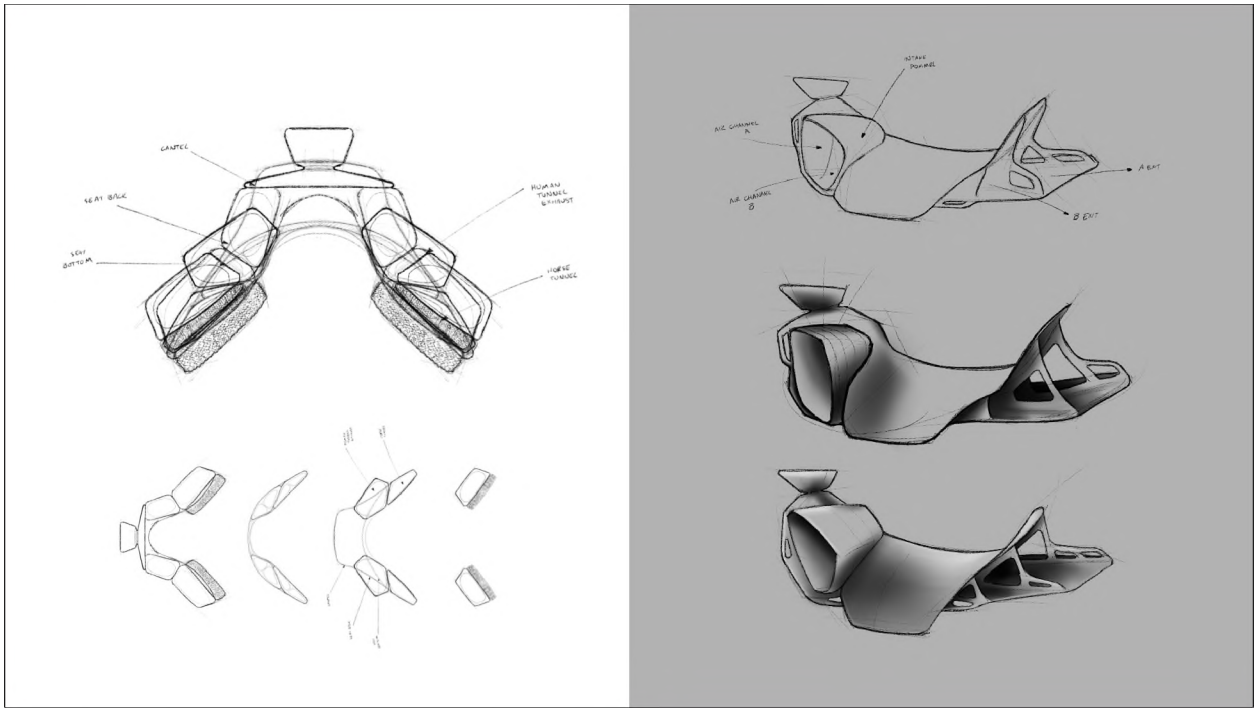

Topology optimized
structure


fi'zi:k

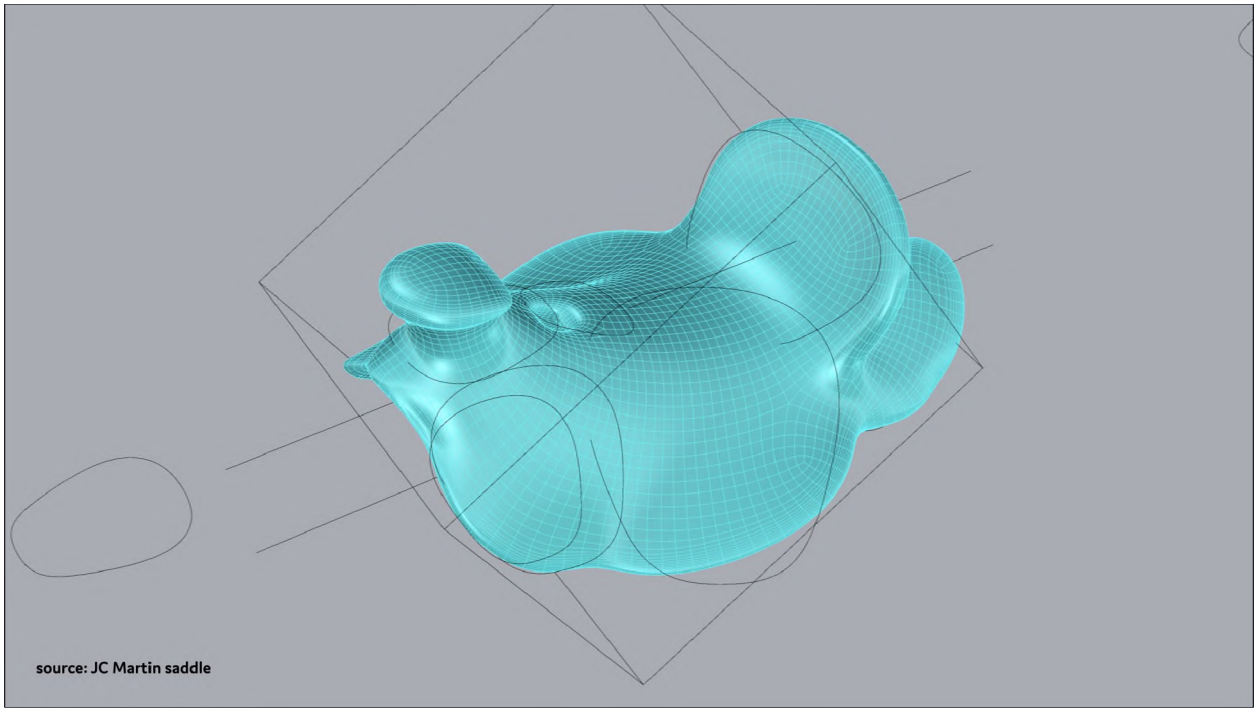
Windswept Branding

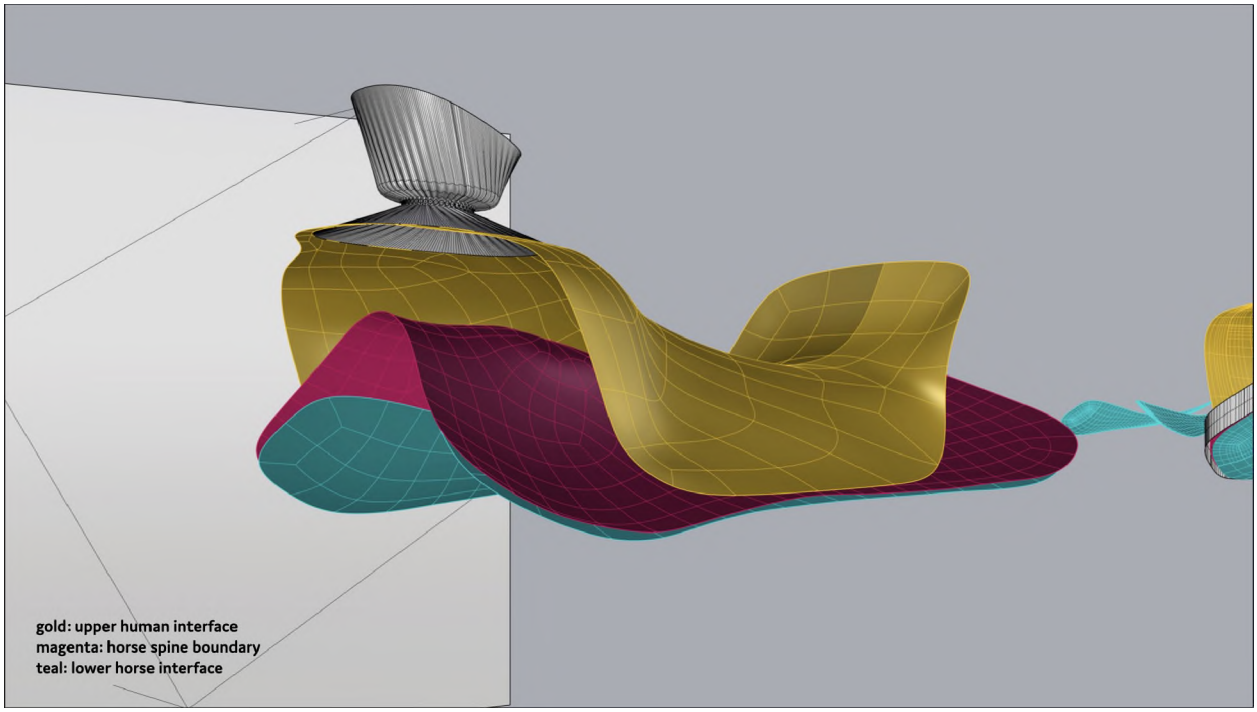


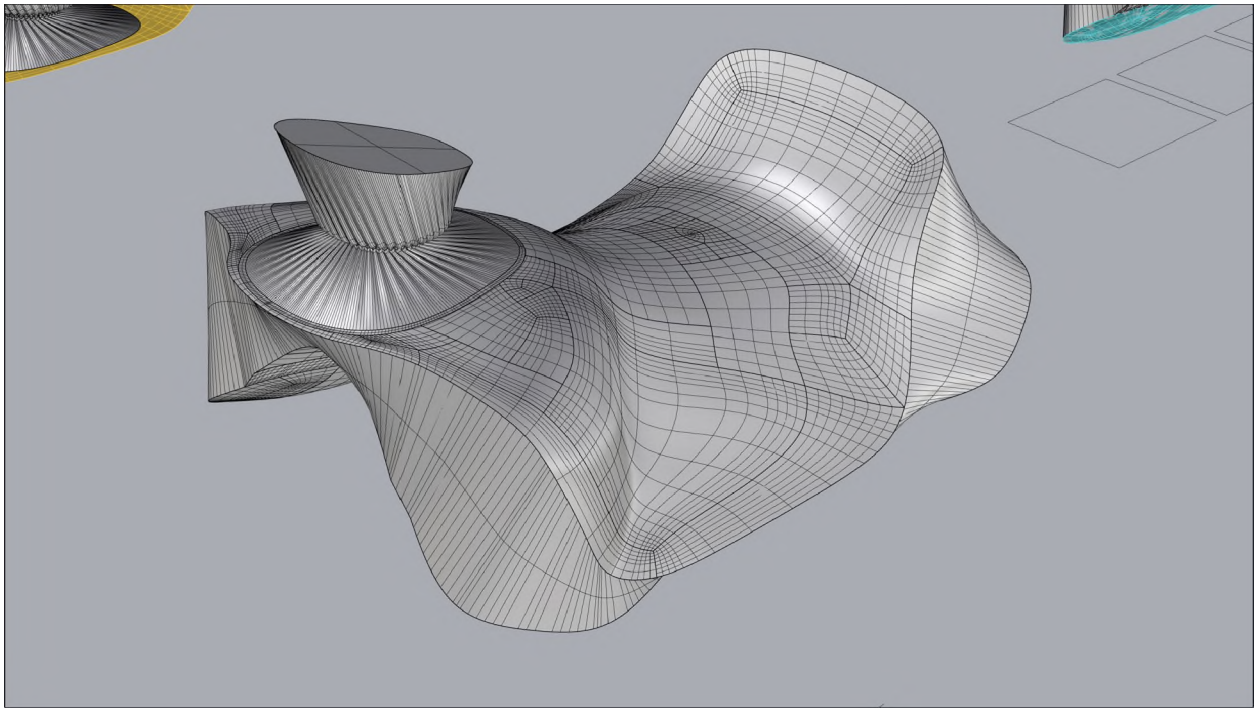
Airflow Management

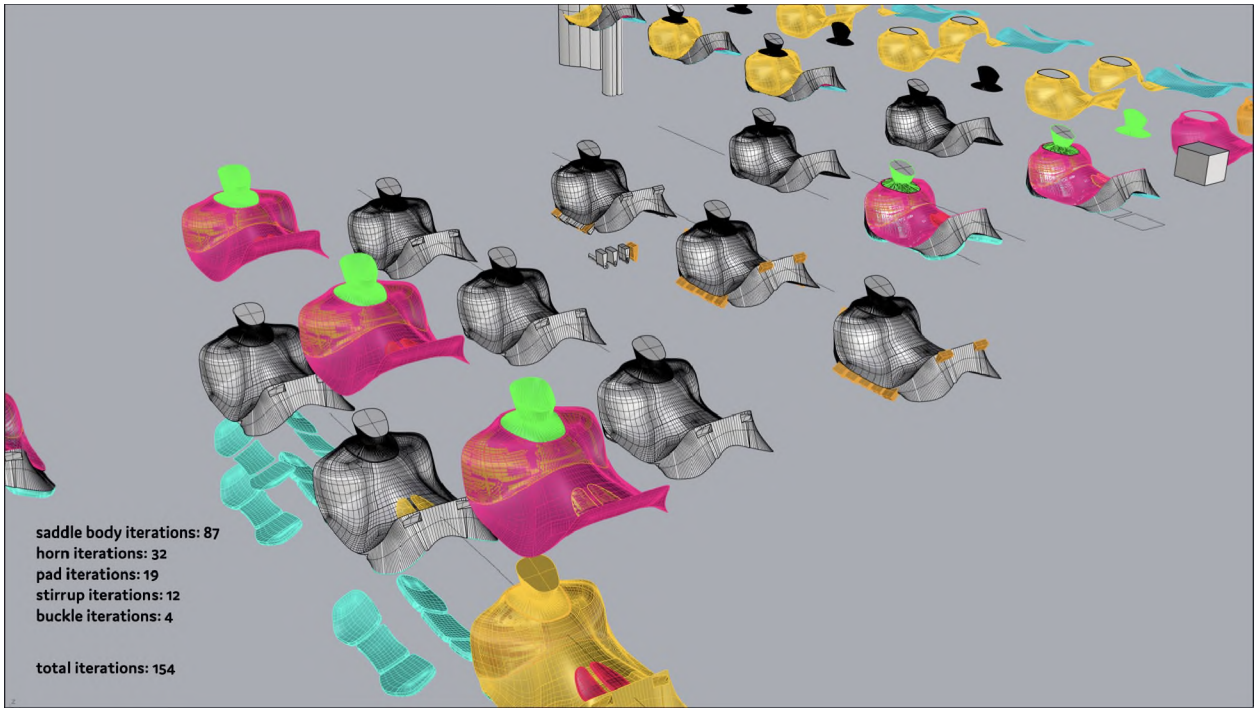


Critical Surface Driven Modeling

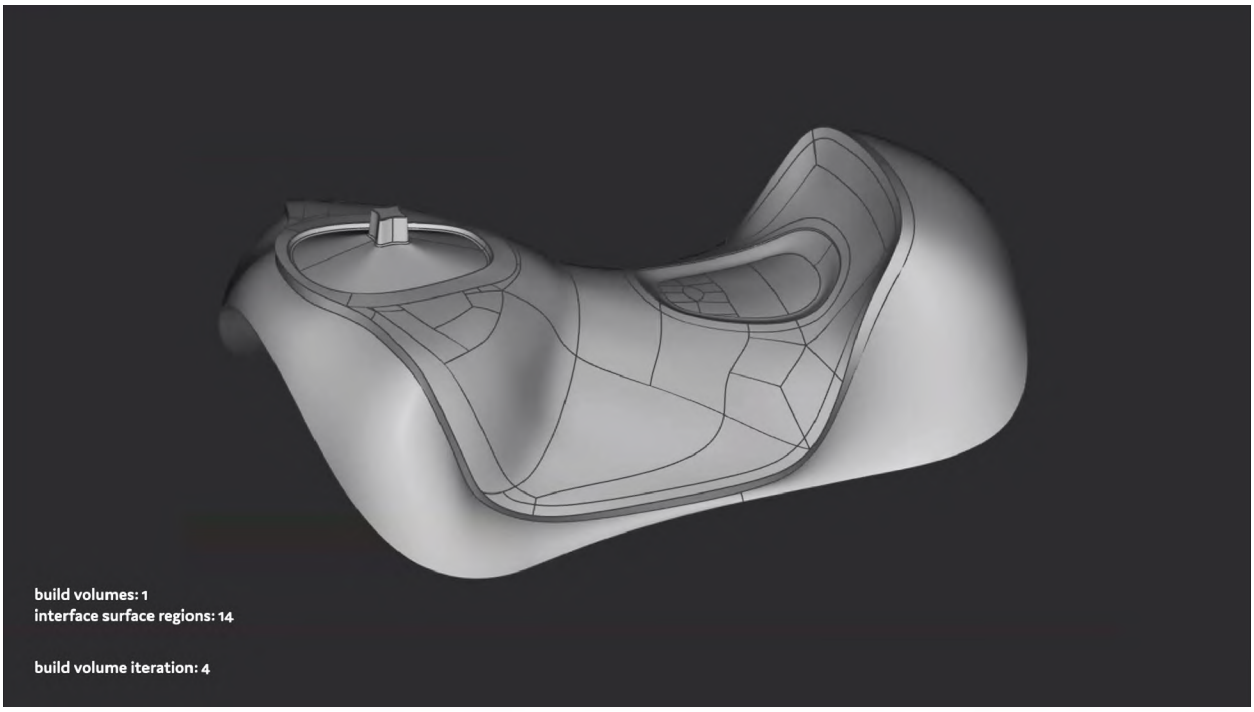


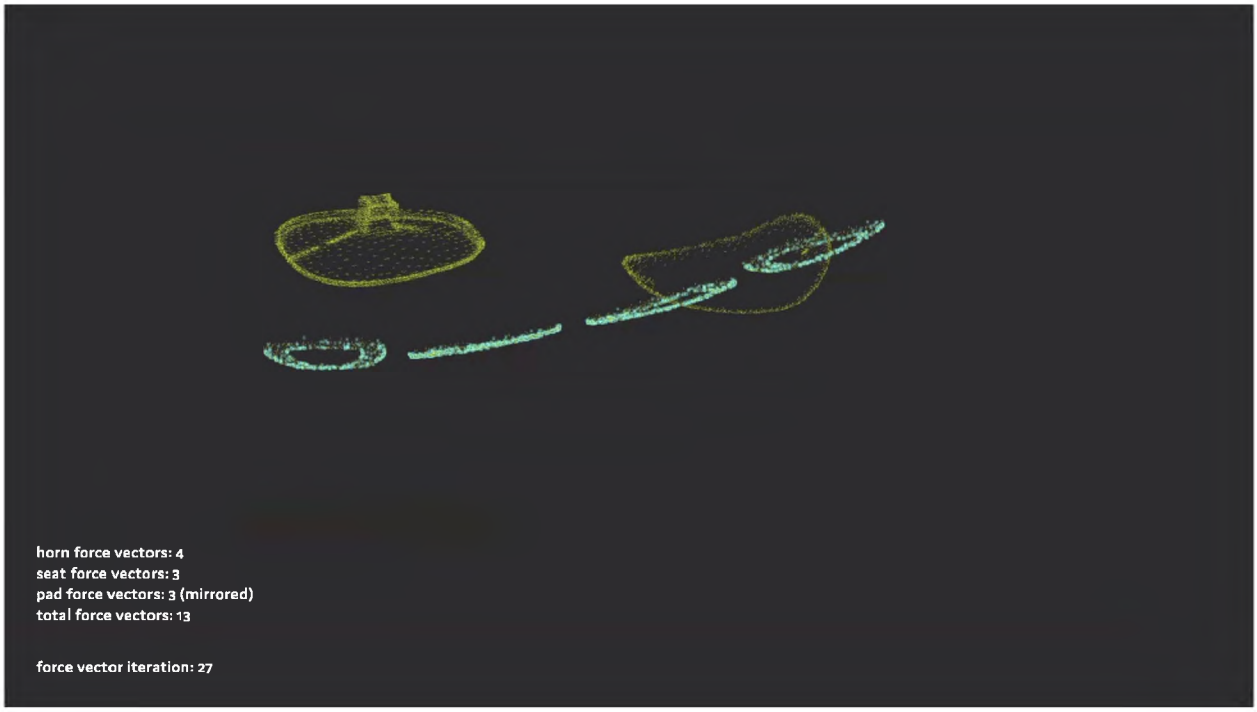


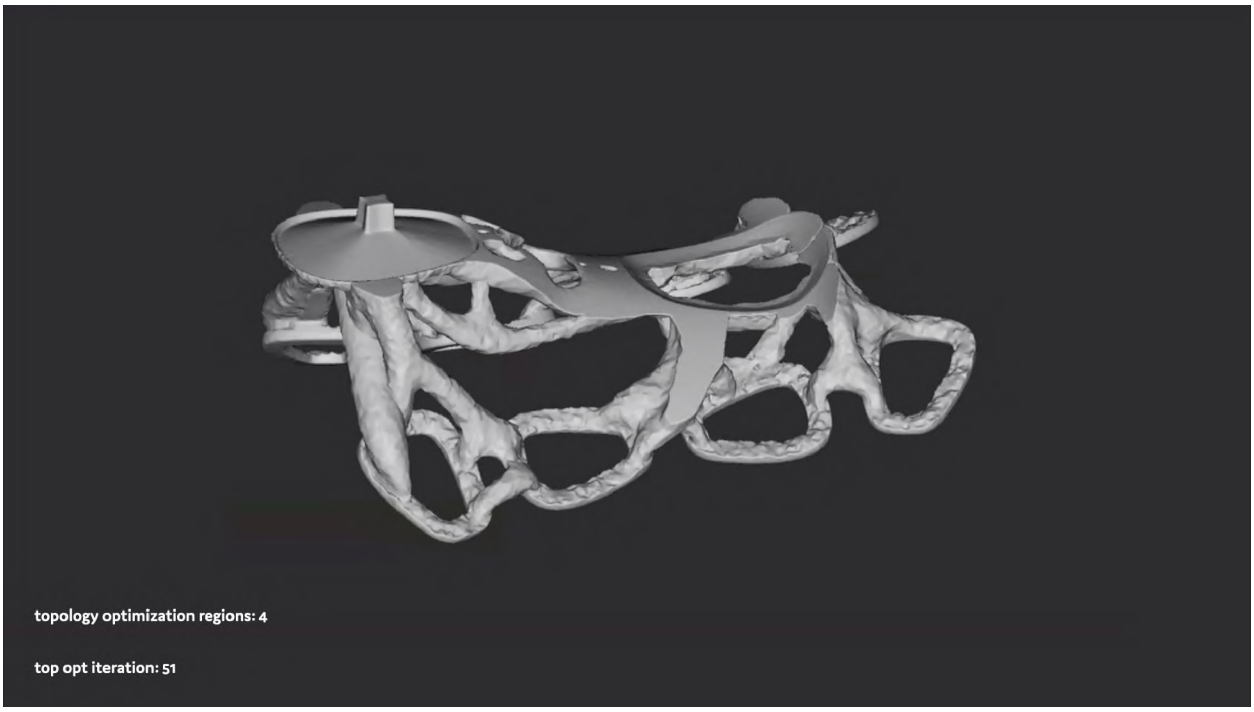


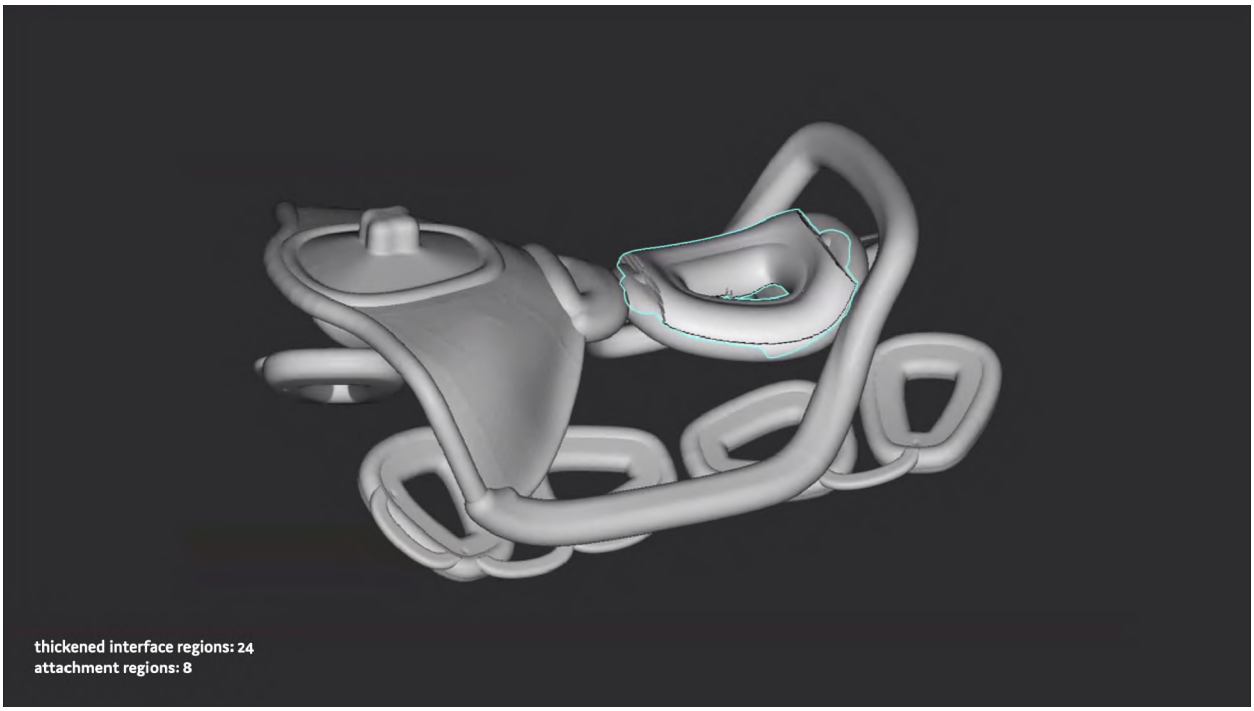

saddle body iterations: 87
horn iterations: 32
pad iterations: 19
stirrup iterations: 12
buckle iterations: 4
total iterations: 154

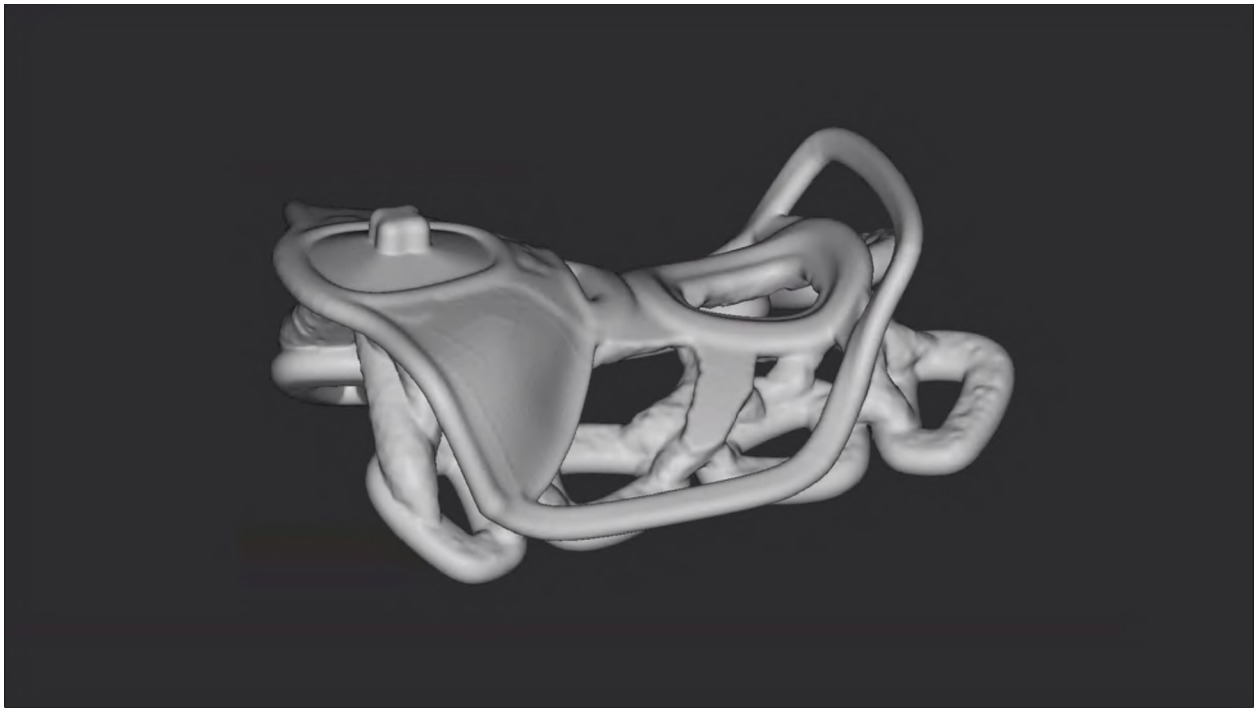
Topology Optimization

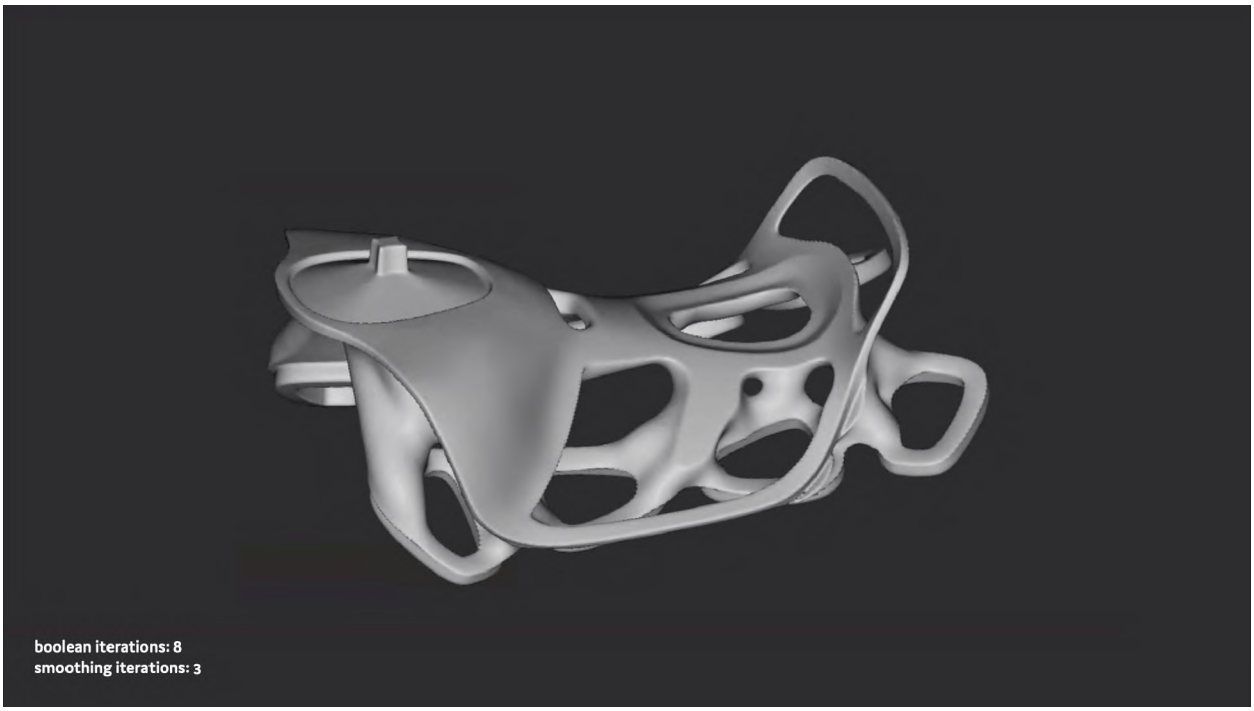




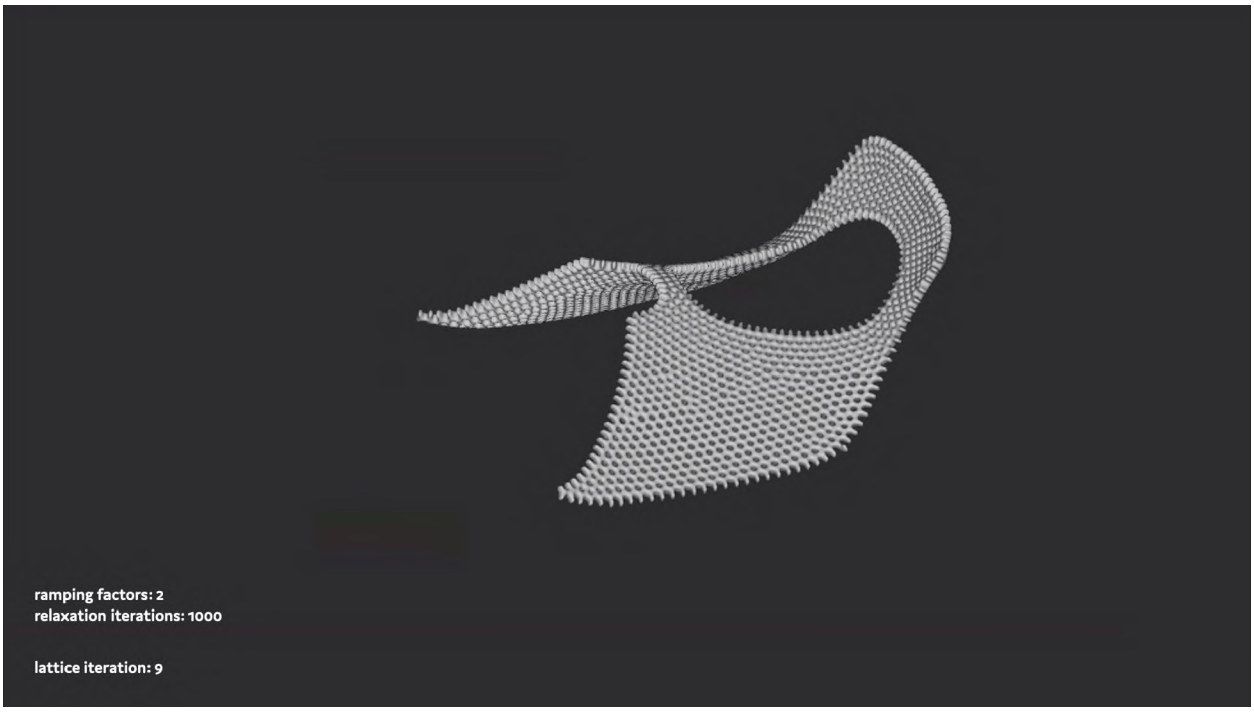

topology optimization regions: 4
top opt iteration: 51

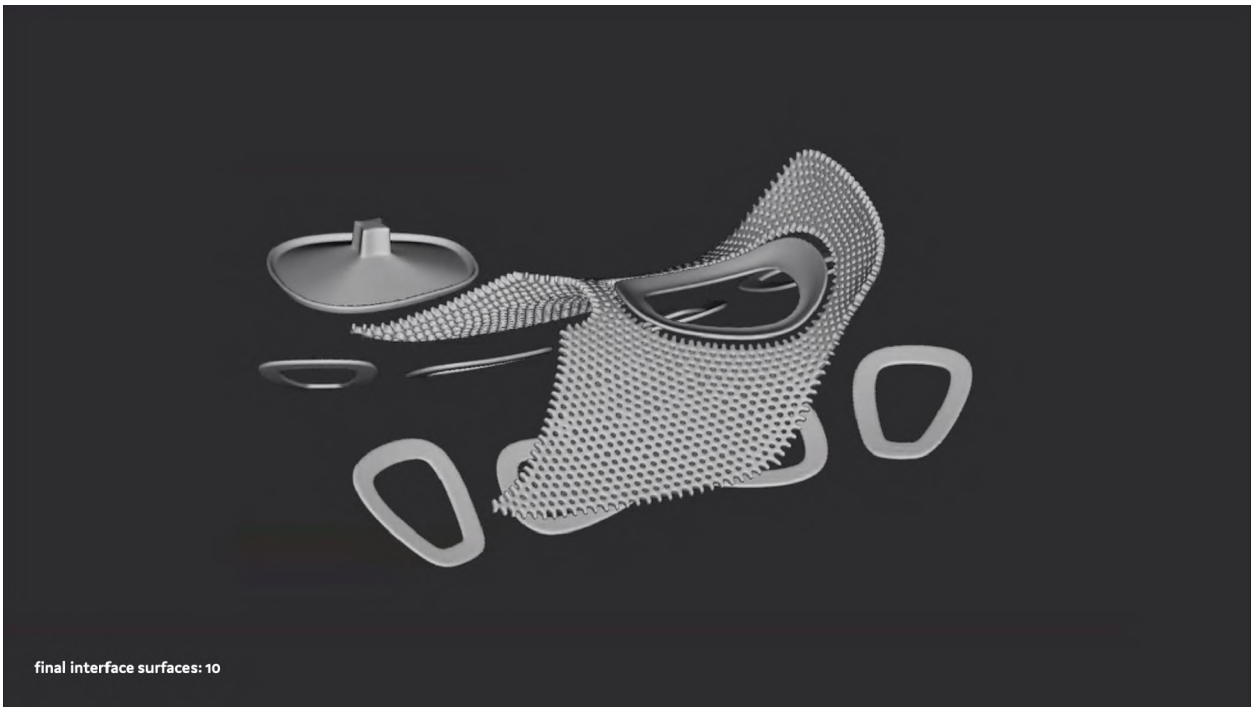

thickened interface regions: 24
attachment regions: 8

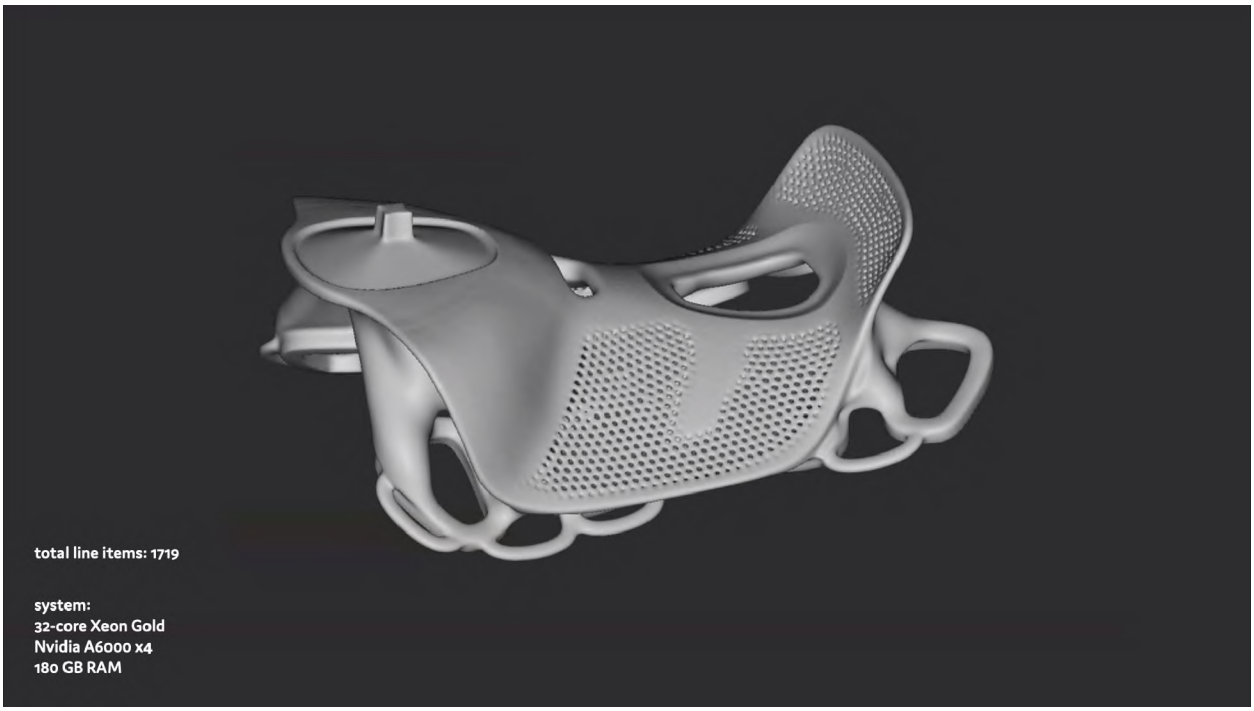


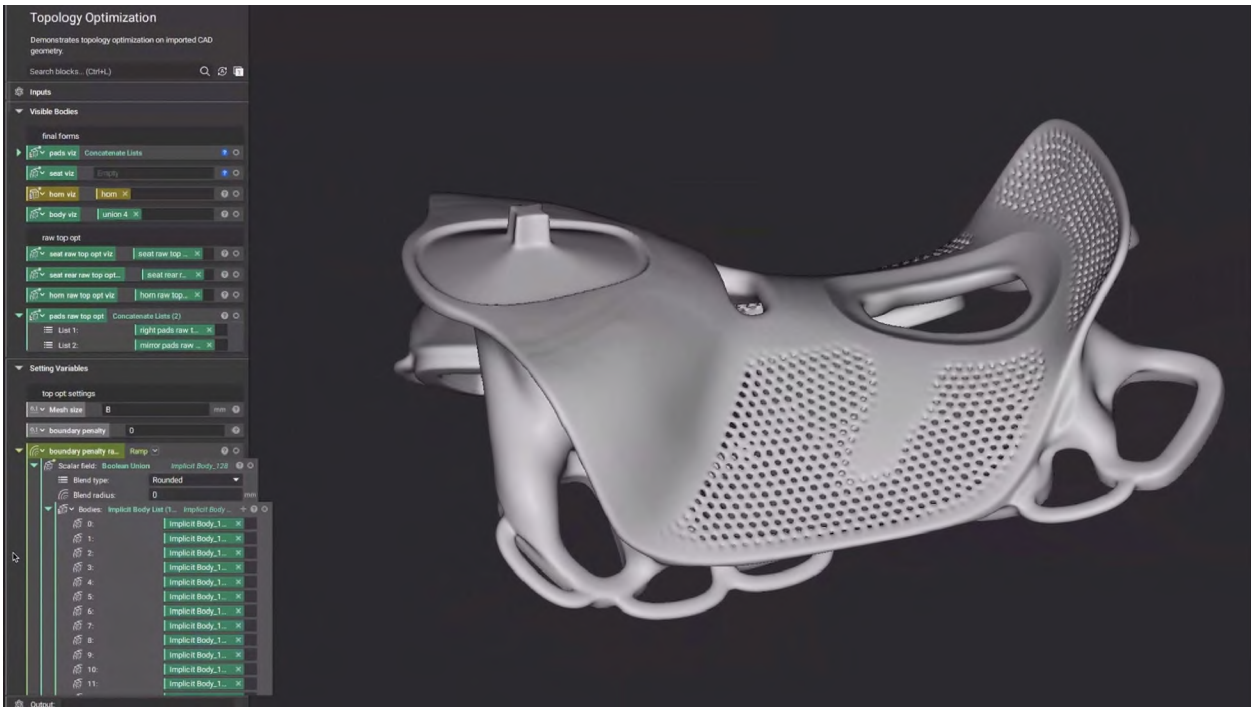

boolean iterations: 8
smoothing iterations: 3

Lattice Generation

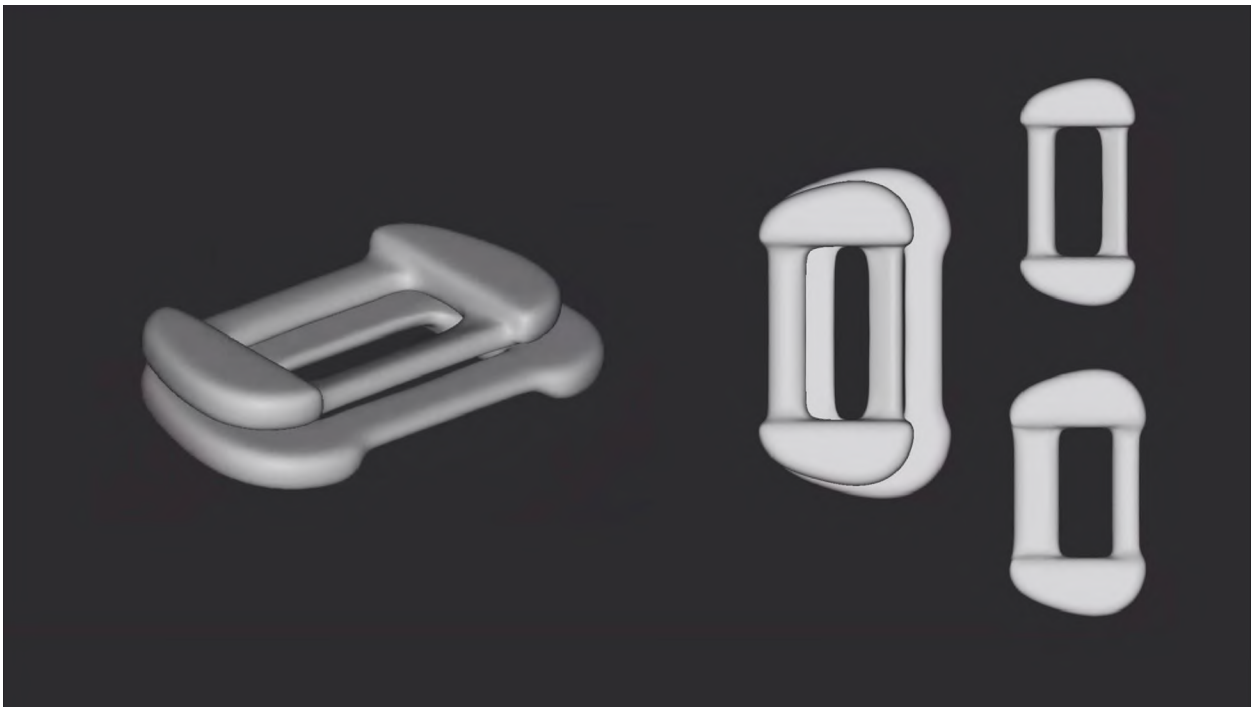


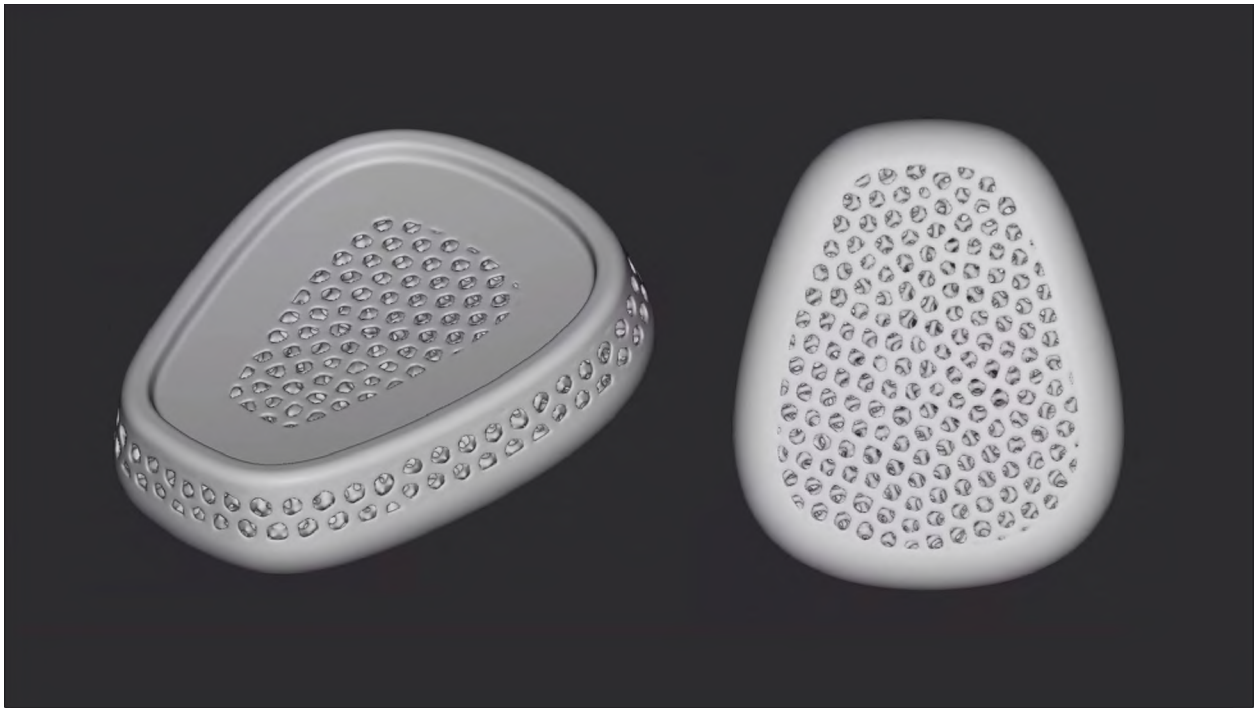


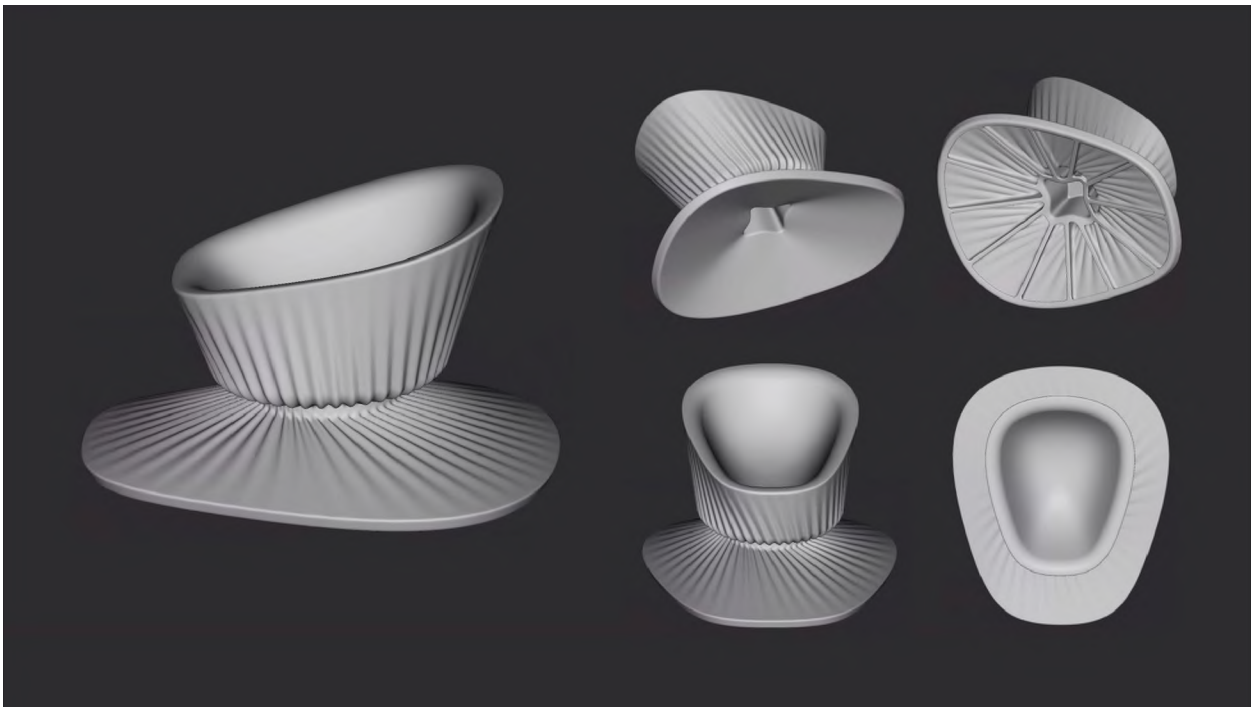

total line items: 1719
system:
32-core Xeon Gold
Nvidia A6000 x4
180 GB RAM

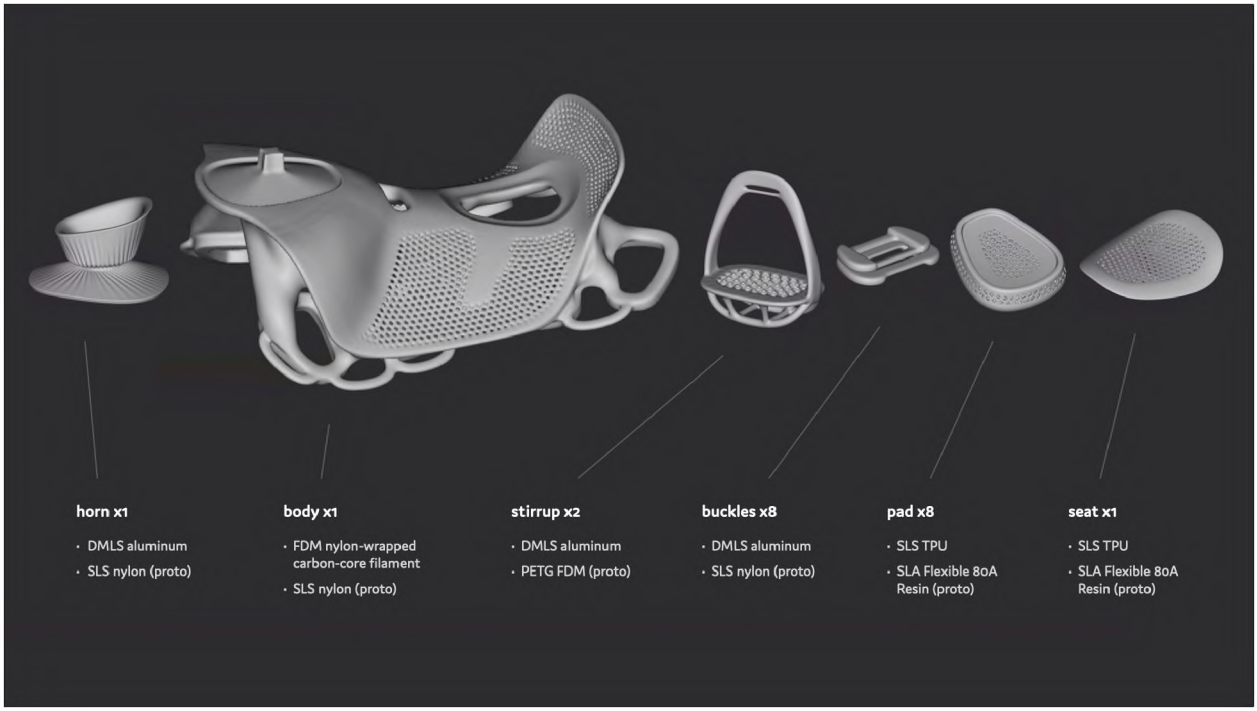

Topology Optimization
Demonstrates topology optimization on imported CAD geometry.
Search blocks... (Ctrl+L)
Inputs
Visible Bodies
final forms
pads viz
Concatenate Lists
seat viz
Empty
horn viz
horn
body viz
union 4
raw top opt
seat raw top opt viz
seat raw top ...
seat rear raw top opt...
seat rear 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:
1:
2:
3:
4:
5:
6:
7:
8:
9:
10:
11:
Implicit Body_1...
Output

Auxilliary Parts

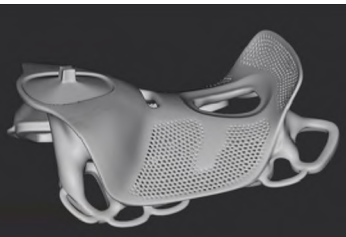







horn x1
• DMLS aluminum
• SLS nylon (proto)
body x1
• FDM nylon-wrapped carbon-core filament
• SLS nylon (proto)
stirrup x2
• DMLS aluminum
• PETG FDM (proto)
buckles x8
• DMLS aluminum
• SLS nylon (proto)
pad x8
• SLS TPU
• SLA Flexible 80A Resin (proto)
seat x1
• SLS TPU
• SLA Flexible 80A Resin (proto)

Materials and Manufacturing

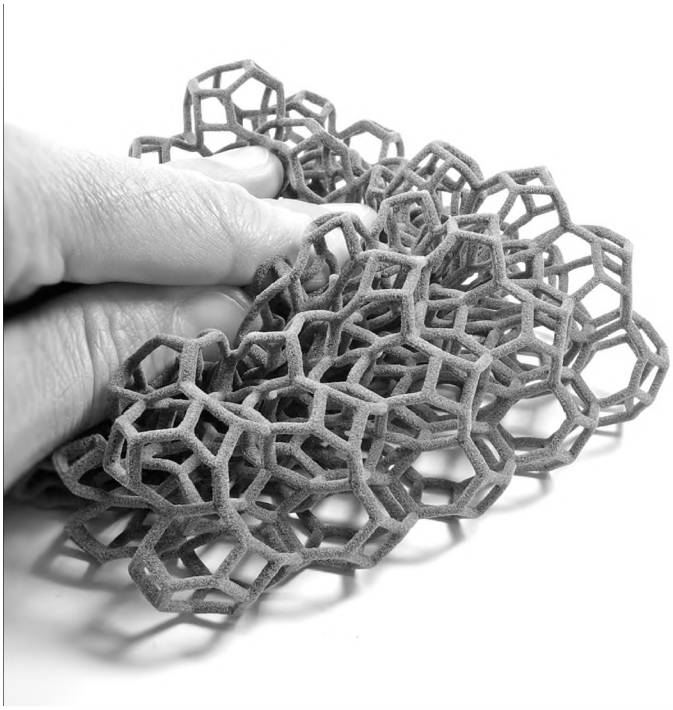


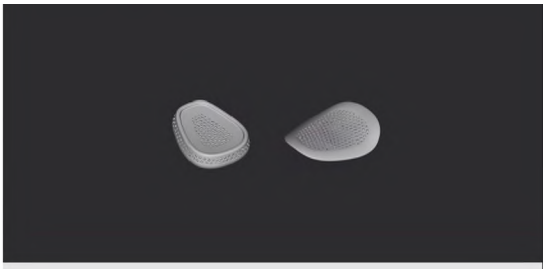
Carbon-core nylon FDM

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.



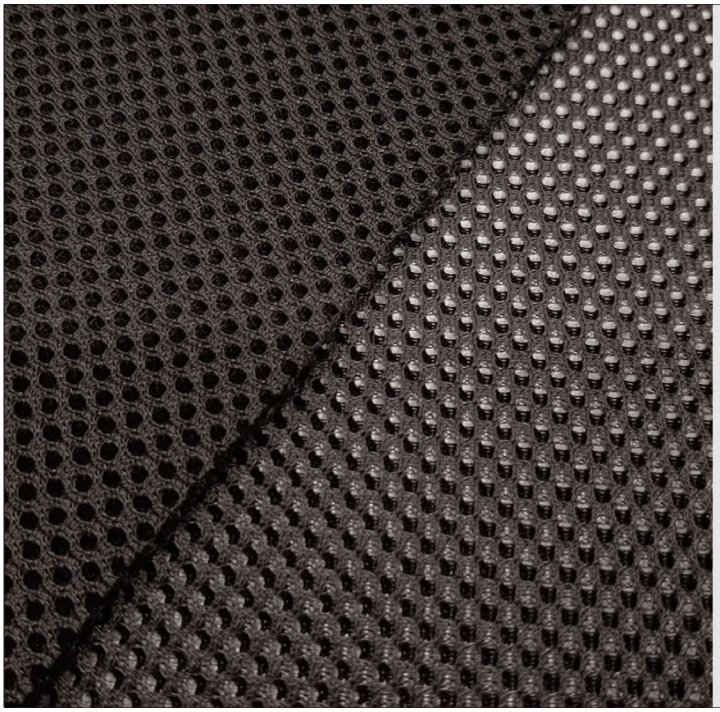


TPU SLS

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

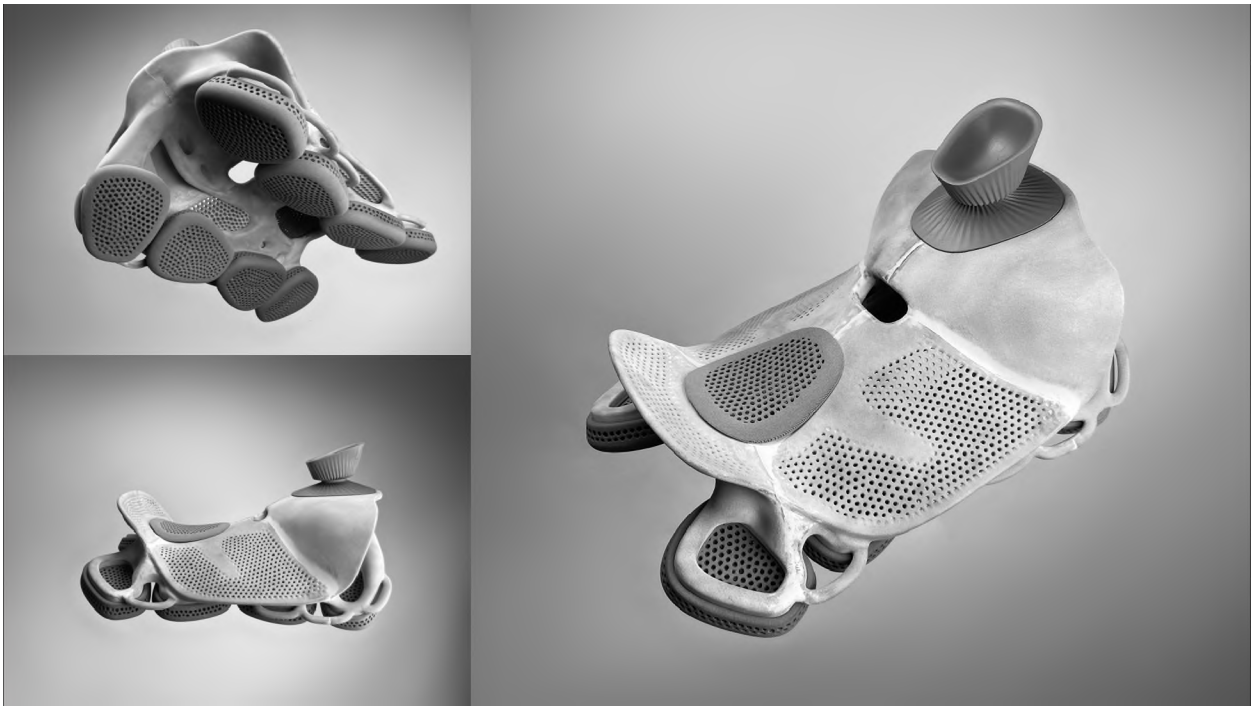
Polypropylene Webbing

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

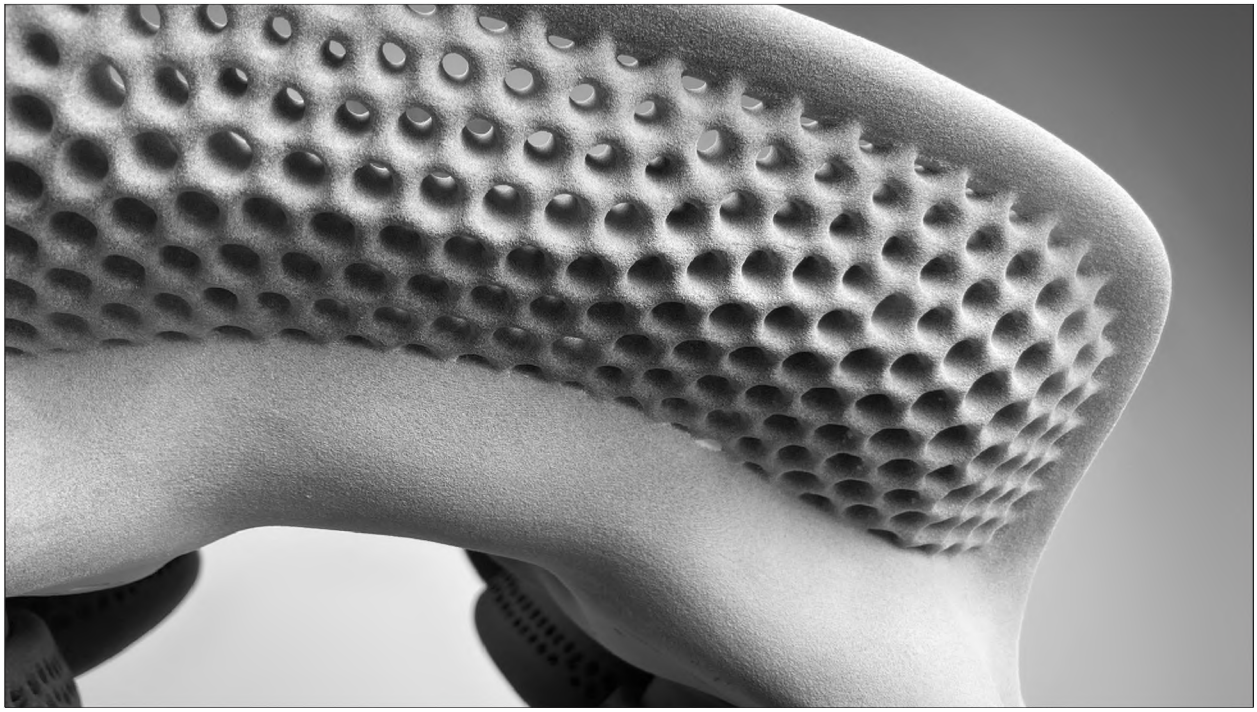


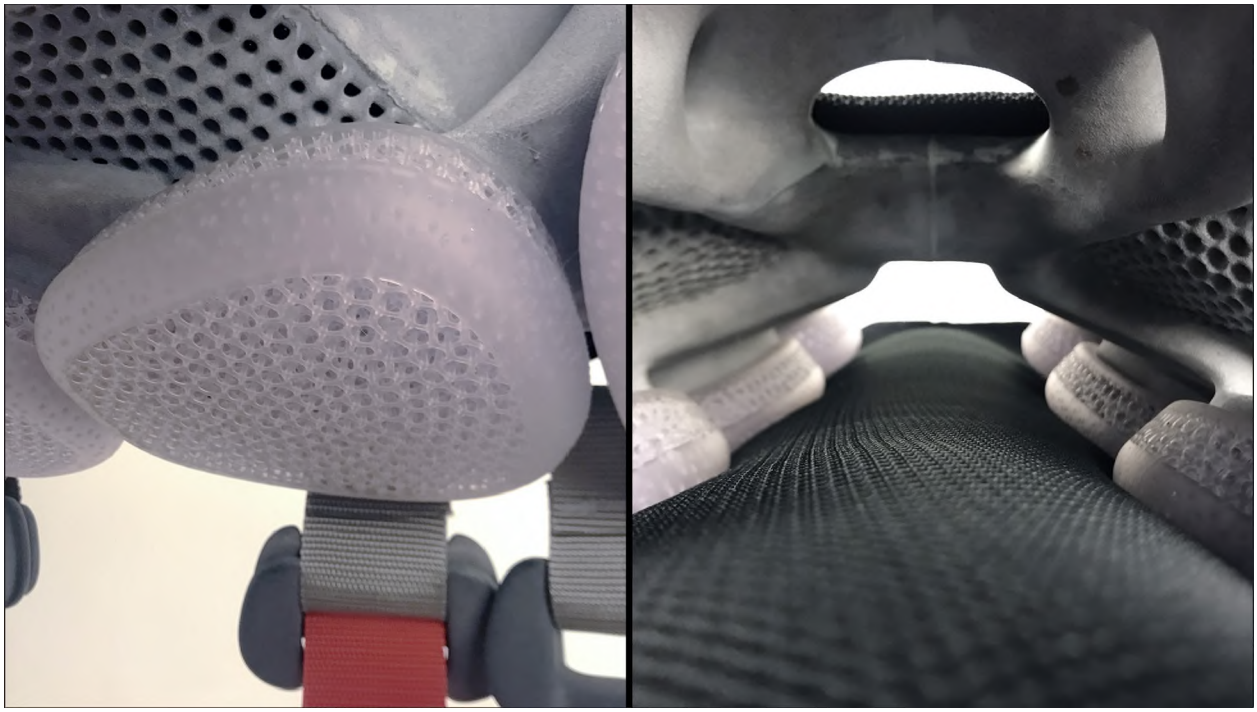
Spacer Mesh

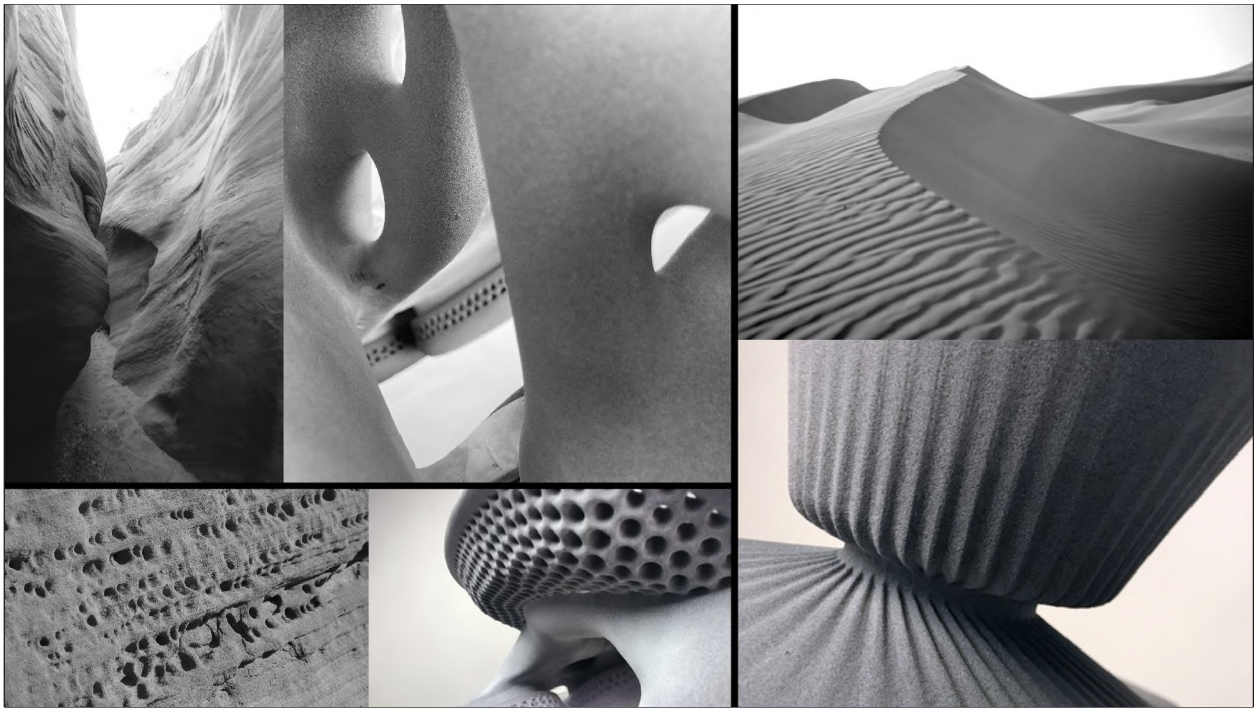
Robust for high friction environments. Provides breathability when used next to skin. Precedents in backpacks.



Final Prototype







Total new saddle weight:

17.2 pounds

Testing Validation

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

$$F_s = \mu_s N$$

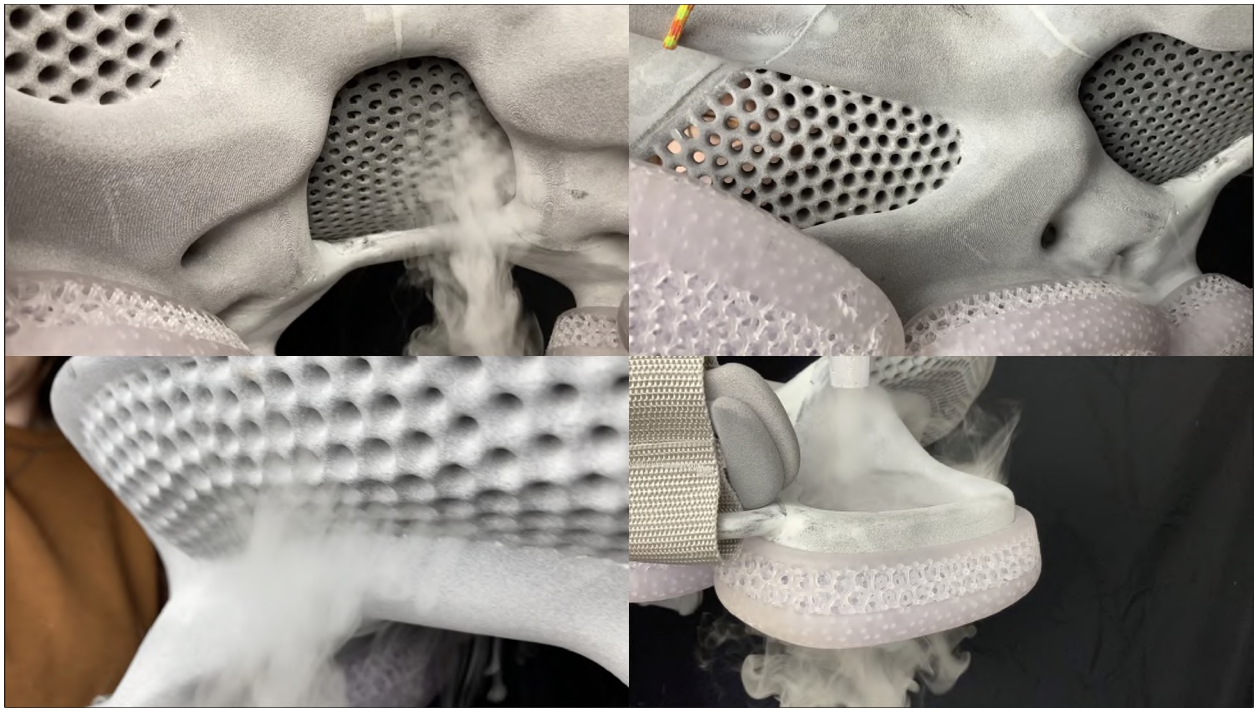
F_s = Force of static friction.
μ_s = Coefficient of static friction.
N = Normal force.

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

Expert Validation

"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."

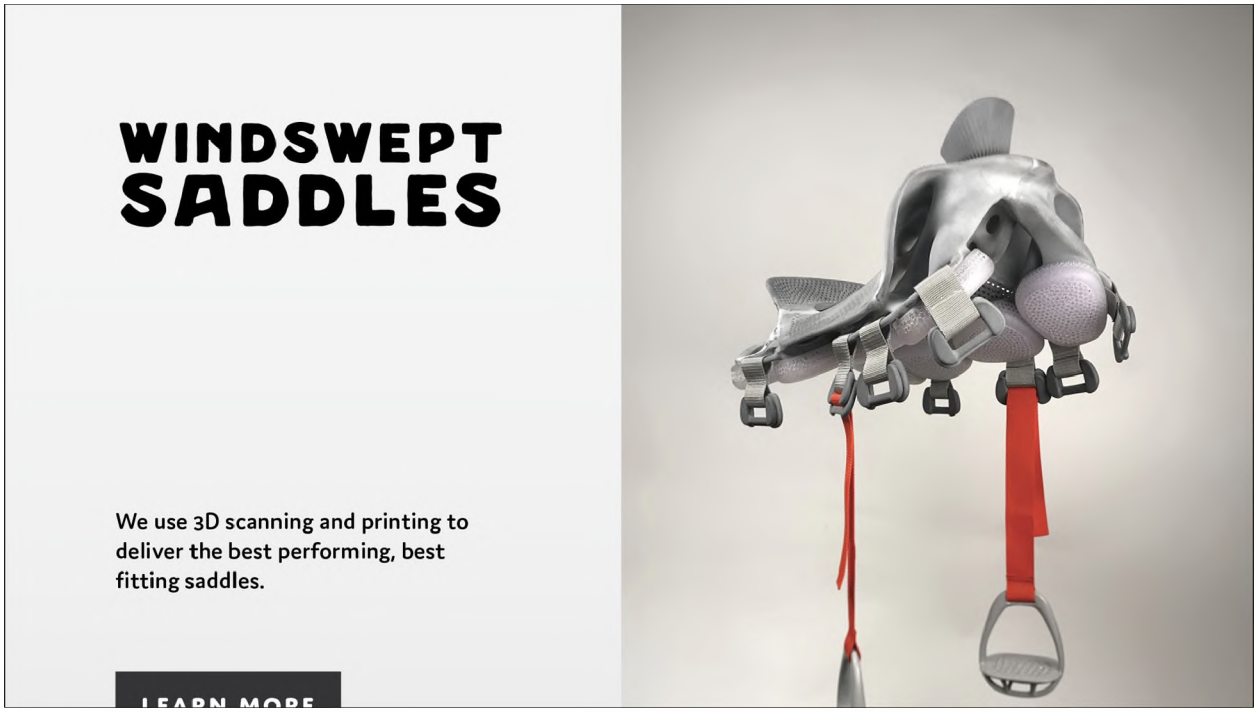
"As cool as the saddle is, the fact that I could have a saddle made specifically for my horse is awesome. ... Fit is so important. Most custom saddles are really just tailoring a standard saddle, but an actual custom for-my-horse saddle is so much better."

"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

Website and Future Development



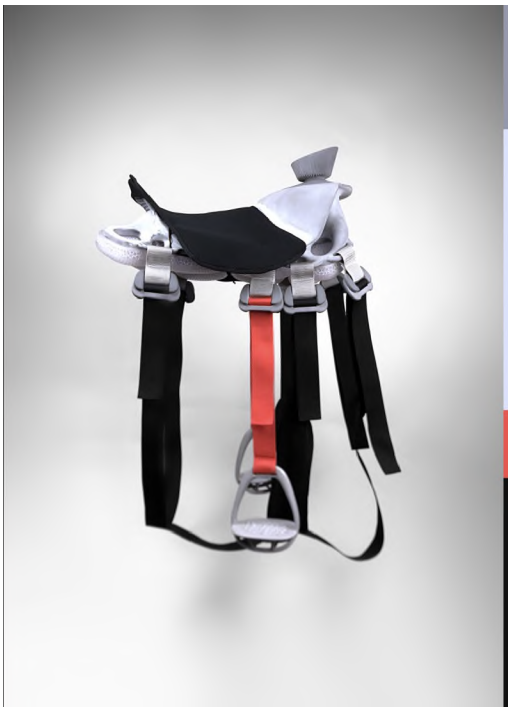
Future development notes:

- **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

Colorways



PANTONE+
Solid Coated
5285 C

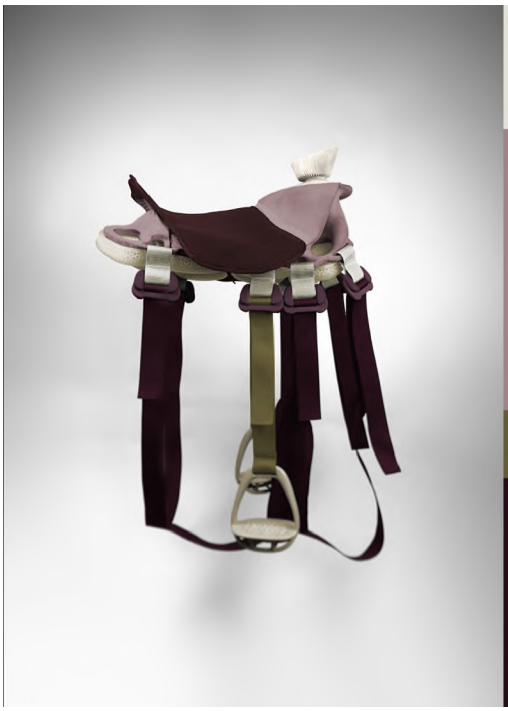
PANTONE+
Solid Coated
2707 C

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

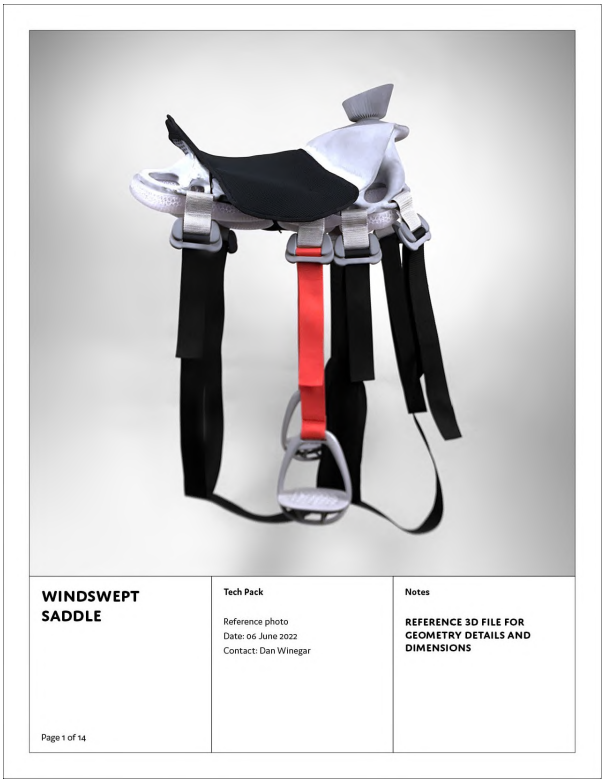
PANTONE+
Solid Coated
581 C

PANTONE+
Solid Coated
Black 5 C

PETRICHOR

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

Tech Pack



WINDSWEPT SADDLE

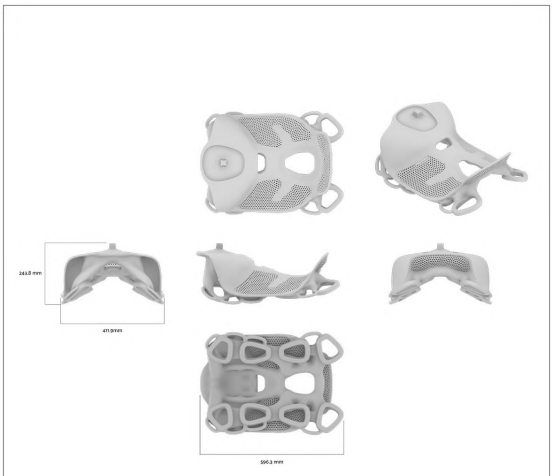
Page 1 of 14

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

Page 2 of 14

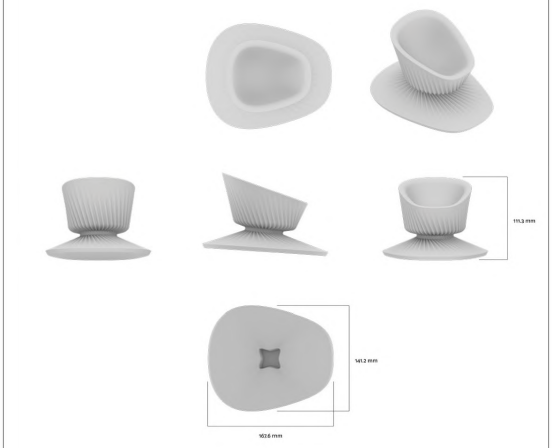
Materials

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

Page 3 of 14

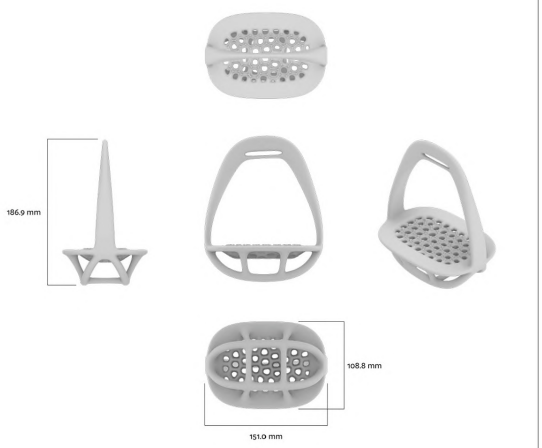
Materials

☐ 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

Page 4 of 14

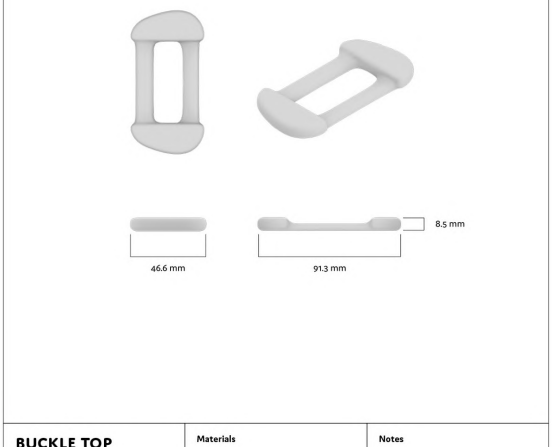
Materials

☐ 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

Page 5 of 14

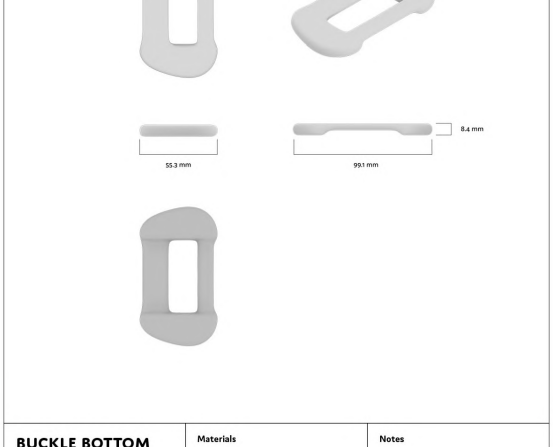
Materials

☐ 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

Page 6 of 14

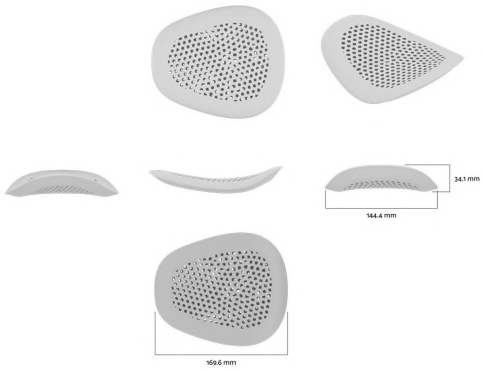
Materials

☐ 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

Page 7 of 14

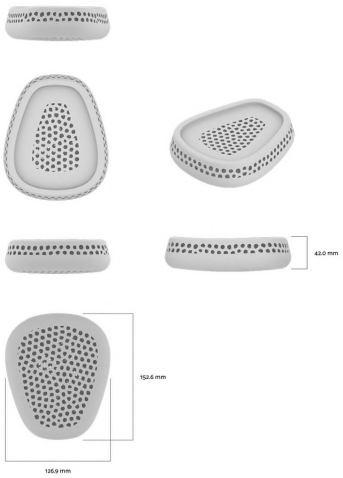
Materials

- 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

Page 8 of 14

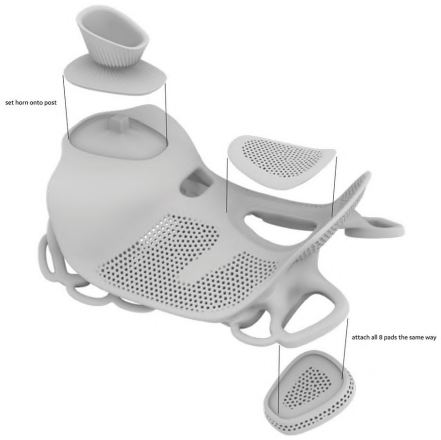
Materials

- 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

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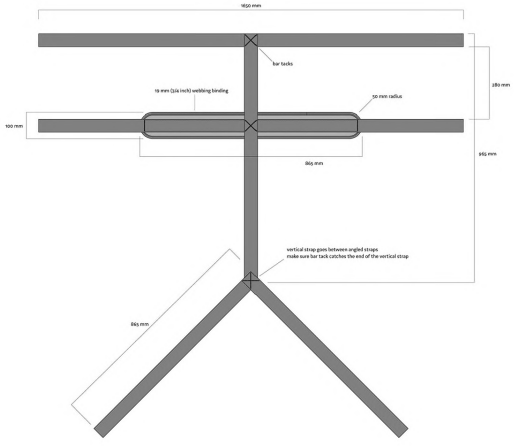
Materials

- 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

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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

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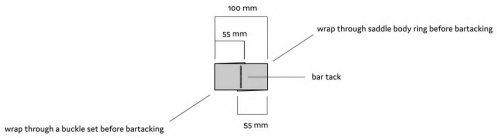
Materials

- 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

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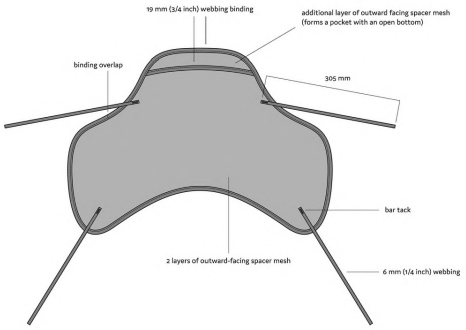
Materials

- 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

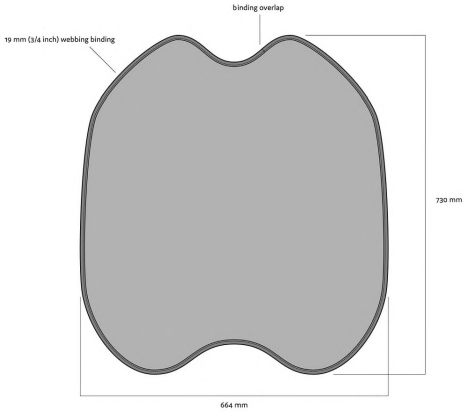
Page 13 of 14

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

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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

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