Theseus Bouldering Kit

Waste-Led winter bouldering apparel and equipment designed for repair.

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Table of Contents

Project Overview

Climbing is a sport born out of humans' inherent lust for adventure. First, the mountains were calling, then it was big walls, and over the past few decades climbing has found a new discipline, bouldering.

Bouldering is a sport that requires not only strength but endurance, mental fortitude, willpower, and much more. At the highest levels, bouldering has been known to break athletes down. Those who can efficiently fix themselves up succeed. This sport is just as hard on the gear made for it as it is on the athletes wearing it. Even the best gear breaks, it's inevitable.

There's an ancient Greek thought experiment called 'The Ship of Theseus'. Theseus was an ancient Greek mythological hero best known for slaying the Minotaur. After his triumph, he continued to sail around the Mediterranean on his beautiful wooden galley. Theseus wasn't a god, and like all mortals, eventually passed away, however his legacy didn't die with him. The people of Athens, determined to keep his legacy alive, went about preserving his ship. Years, decades, and centuries passed. During this time wooden planks of the ship would rot away and be replaced, getting to a place where not a single plank on the ship was original. This led philosophers to ask 'After several centuries of maintenance if every part of the Ship of Theseus had been replaced, one at a time, was it still the same ship (Encyclopaedia Britannica, 2022)?

"It would be irresponsible to be working in the field of design and not be challenging myself to consider how to extend the life of what I make or the life of what already exists." (Nike, 2022)

—Marie Crow, Director Materials Design Nike Women's Sportswear

Today, unfortunately, we live in a throwaway culture. Last season's clothes are tossed to make way for next seasons. A tear in the sleeve renders a garment "unusable". Moving towards a more circular future requires solving problems on the consumer and designer levels. Waste-led design is the practice of considering the end of life of the product at the beginning of the design process. Some things to think about are material choices, waste avoidance, disassembly, versatility, durability, and refurbishment (Nike, 2022).

Over the last few years, it has become increasingly popular for companies to develop repair processing facilities. Arc'teryx has its ReBird program, Patagonia has WornWear, and Burton works with Oregon-based company Rugged Threads to process repairs. The introduction of these repair facilities, a need for circular design solutions, and the rising popularity of bouldering have led me to the formation of an interesting question….

How can we rethink apparel and bag design to increase repair process efficiencies, and extend the life of modern elite boulders gear?

Designing for repair and durability are at the forefront of this project but there are other things to consider as well like how can designing for repair increase consumer joy and benefit

the brand? The outcome of this project is a collection of bouldering apparel and equipment that increases repair process efficiencies without compromising performance, reduces repair costs for the brand and consumer, and provides a timeless garment that tells a story.

Product Classification

Apparel and equipment collection comprised of technical climbing bibs, a performance belay parka, and a bouldering backpack. Designed for the modern elite boulderer, age range 18-38.

The technical climbing bibs will need to withstand constant contact with rock walls, provide an adaptable performance fit for climbing and travel, and allow users easy access to tools while cleaning routes. The Belay parka needs to provide warmth during climbing sessions and increase comfort while traveling. The bouldering backpack needs to hold essential bouldering gear and allow for easy carry while hiking with a crashpad.

History

Back in the late 1800s is when modern bouldering first started to take shape. Rock climbers needed an easy way to train for big mountain ascents. England's Lake District and its many boulders provided a perfect training ground for local climbers. It was through this community that the term bouldering was first coined (Gill, 2017). Over the next few decades bouldering proved to be a useful training tool for sport climbers.

Bouldering as a form of training started to spread, and in the early 20th century it made its way over to France (Wilkinson, 2019). Home to famous mountains such as Mount Blanc, France had no shortage of climbers. The French alpine climbing community was one of the most dedicated in the world, always seeking ways to improve their sport. Just a few miles south of Paris they found the perfect training ground. The forests surrounding Fontainebleau offered hundreds of pristine boulders to hone their skills on. Between the years of 1920-50, led by climber Pierre Allain the Fontainebleau bouldering area exploded in popularity. During this time developments such as a problem grading system, smooth-soled climbing shoes, and bouldering rugs came about (Gill, 2017). It is estimated that at this time boulderers were climbing around the V4 grade (the V-scale is the most common grading system used in North America today) (Gill, 2017).

In the early 1950s on the other side of the ocean in the United States, John Gill, a math professor, and avid gymnast was developing techniques that would revolutionize the sport of bouldering (TheShortSpan, n.d.). Viewing bouldering as an extension of gymnastics rather than hiking, Gill introduced short dynamic moves and chalk to the sport. Gill has been quoted saying "I was inspired by controlled releases and catches in artistic gymnastics, I began practicing controlled dynamic moves, as a technique of choice as well as one of necessity, calling some free aerials dynos" (Gill, 2017). It's estimated that between 1950-70 Gill was climbing around the V7 grade. These developments earned John Gill the title "The godfather of modern bouldering".

By the 70s bouldering had established itself as a respected climbing discipline. The sport continued to evolve. The 90s saw the introduction of the Hueco or V scale as well as Chris

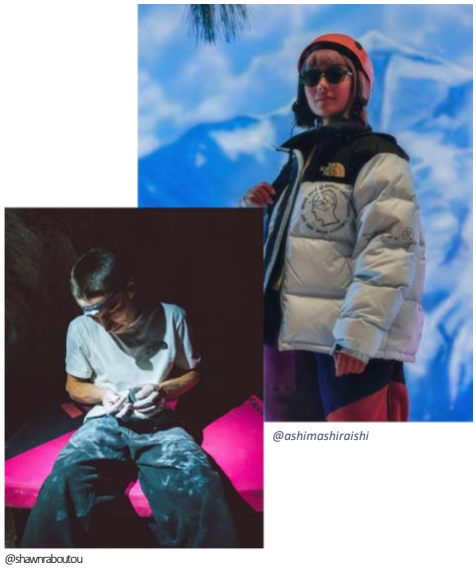
Sharma (Beale, Grades: The Complete Guide, 2021). Sharma is often considered one of the most influential rock climbers (Clarke, 2022). His laidback attitude and ability to achieve levels of performance never seen before gained him a following. Sharma really put his sport in the spotlight by being one of the first to release climbing films. Through video, fans could now follow his adventures as he traveled around the US and the world establishing some of the hardest problems (Clarke, 2022).

Today many of the new elite climbers are building upon the climbing mindset that Sharma introduced. Breaking away from traditional competition and forging their own path, today's elite boulderers are pushing performance to new heights, climbing grades as high as V17.

User

Many of the top boulderers today started at a young age often training for indoor competitions. Brooke and Shawn Raboutou are the children of two world-class climbers, Margo Hayes started climbing at the age of 10 under the instruction of the Raboutou family, and Ashima Shiraishi got her start on Rat Rock in Central Park at the age of 6 (Williams, 2018). Competing in the professional circuit allows an athlete to develop their technique alongside world-class talent and showcase their skills. After many years in the circuit, those who come out on top often do so with a following, but time and time again the bouldering community has seen these top competitive athletes leave the competition world in search of something different.

The digital age has reshaped many communities and bouldering is no exception. Chris Sharma first started making climbing films in the 90s and since then bouldering has seen an explosion in popularity. Almost every professional climber in the competitive circuit has an active Instagram to update their fans on their life. YouTube is filled with climbing content ranging from training videos, to travel videos, to videos titled “Girlfriend reacting to climbing with Alex Honnold” (Midtbo, 2022). All of these forms of media have opened new doors for climbers to make a living off of something other than competition.



A new breed of boulderer is on the rise. Performance still reigns king for these athletes but content is a close second. As mentioned earlier, more and more elite boulderers are leaving the competitive circuit in search of a different lifestyle often trading plastic indoor holds for real outdoor rock all over the world. These young athletes usually age 18-30 utilize their success in the competitive scene to make a smooth transition to the “bouldering content creator” lifestyle. What does it take to be a bouldering content creator? Some of the most important traits are the ability to continue to push the sport to new heights, a lifestyle and personality people can look up to, and lots of travel.

Their performance is usually something they have developed during their years in competition however climbing outdoors is much different from indoors. Mental and technical techniques differ but that hasn’t stopped athletes like Shawn Raboutou from solving the hardest boulder problem ever climbed, graded at V17 (Miller, 2022). Using the internet to

showcase their accomplishments, modern boulderers can hone their skills while building a following. Having a following is extremely important for any content creator. For modern boulderers, it's part of their livelihood.

What's so unique about this new breed of boulderer is the amount of traveling they do. It’s not just from climbing gym to climbing gym anymore. These athletes travel all over the world to places like Magic Wood in Switzerland, Rocklands in South Africa, Buttermilks in California, and many other areas that offer world-class bouldering. This travel allows them to see new places, climb new problems, experience new cultures, and create captivating content.

Environment

1https://www.climbing.com/people/katie-lamb-interview/

The modern elite boulders travel takes them all over the world, exposing them to a wide range of environments. This project won't focus on one specific environment but rather any number of environments the athletes might find themselves in.

The modern boulderer climbs in almost all conditions (excluding wet) all over the world. Conditions can change from trip to trip or even from hour to hour on a single trip. Every environment these athletes will find themselves in will include rocks to climb. The three main types of rock used for climbing are granite, sandstone, and limestone (Rex, 2022). Each offers different formations, textures, and features.

The weather in these environments is ever-changing, seasons often determine when conditions will be ideal. Moisture is the enemy. Perfect climbing conditions are generally cold dry environments anywhere from 30ºF-50ºF (Bishop, 2022). The products that make up this collection will be designed to perform best during the cooler climbing seasons.

Athlete Roles/ Rules

There are only a few roles or positions when it comes to bouldering. The first and most obvious one is the climber. It is their job to successfully solve the boulder problem or at least give it a good attempt. The second role is the spotter. It is always a good idea to boulder with a crew. This is because when one climber is on the wall other climbers can be on the ground providing safety as a spotter. It is the spotter's role to reposition crash pads as the climber moves along the wall, redirect the climber if they fall in a bad spot, and communicate with the climber about any potential safety concerns (Jackson, 2019). Athletes often switch roles throughout a bouldering session.

2https://www.climbing.com/skills/bouldering-skills-the-art-of-spotting/

Many of these athletes have years of experience on the world-cup bouldering circuit where following the many rules is crucial to their success. Rules aren't as important when climbing recreationally outdoors although there are still a few to follow.

The goal of bouldering is to solve the problem in as few attempts as possible. There are two main types of attempts when it comes to climbing. The first is the redpoint. A redpoint is

when the athlete successfully solves the problem having attempted or practiced it prior. This is the most common type of attempt. The most sought-after type of attempt is the flash, which is solving the problem on your first attempt (Sportrock, 2019).

Athletes cannot rely on any mechanical advantages, and cannot come in contact with another person while on the problem. In recreational bouldering, it is okay for your spotter or other climbers to give you advice during an attempt. When it comes to recreational bouldering the main rule is to safely have a good time.

Market Size

Bouldering is more popular than ever. More than 140 countries host climbing walls, YouTube climbers like Magnus Midtbo have almost 1.5 million subscribers, and climbing made its Olympic debut at the Tokyo 2020 summer games (Climbing Business Journal , 2020).

In the US the number of climbing gyms in operation has grown steadily since the early 90s. In 2021 there was an 8.2% increase in the number of climbing gyms with a total of 53 new gyms opening (Climbing Business Journal, 2022). Around 45% of these new gyms were bouldering specific. In 2018 the International Federation of Sport Climbing estimated that there are a total of 44.5 million climbers across all disciplines worldwide (Climbing Business Journal, 2022). The 2019 bouldering world cup circuit saw a record number of attendees with the stop in Chamonix hosting over 18,000 in-person viewers (Climbing Business Journal , 2020).

As bouldering grows in popularity so does its digital audience. The IFSC website reached never before seen numbers of users and page views on their website in 2021. An estimated 500,000 users (a 133% increase from the previous year) and over 3 million page views were

recorded (International Federatrion of Sport Climbing, 2021). Outside of its website, the IFSC recorded an audience of almost 200,00 on Instagram, 11,000,000 YouTube views, and around 300,000 engaged users on TicTok (International Federatrion of Sport Climbing, 2021). As the number of athletes continues to grow so does the number of people seeking out bouldering content across the internet.

The number of world traveling modern elite boulders is small. A rough estimate would be somewhere between 100-200 individuals. The market for this collection can and needs to be expanded. Anyone who is into rock climbing (indoors and out) regardless of skill level or anyone looking to showcase the bouldering style in urban environments has the potential to be included in this market. With the inclusion of all these groups the possible market size can reach well into the millions.

Competitor Analysis

Every year the number of products available to boulderers increases. Products range from expensive, highly technical apparel and equipment, to basic, budget-friendly gear. Below is a curated list of performance bottoms, jackets, and bags that align with the needs of the modern boulderer. The price of climbing-specific pants can range from $150 up to $300. Belay parkas range is wider reaching prices of $1000, while backpacks can reach prices as high as $500.

Pants

POC Consort MTB Dungaree
MSRP: $500
- Durable 3L stretch weave fabric
- Adjustable straps for finding the right fit
- Zipped sides for ventilation
https://na.pocsports.com/collections/mountain-biking-apparel-pants/products/consort-mtb-dungaree?variant=43412093173926

Klattermusen Mithril 3.0
MSRP: $280
- Minimal seams for increased comfort
- Pre-bent for flexibility
- Aramid-reinforced fiber for durability
https://www.klattermusen.com/en/men/pants/15578m01-mithril-3.0-pants-ms-raven/

E9 BLAT1-TT Pant
MSRP: $130
- Hidden adjustable belt
- Cinch cuffs
- Brush holders on both sides
https://shope9.com/collections/mens/products/blat1-tt

Belay Parkas

TNF HMLYN Down Parka
MSRP: $380
- Lightweight and compressible for storage
- 550 fill goose down for warmth
- Three-piece hood for added warmth
https://arcteryx.com/us/en/shop/mens/alpha-parka

Arc'teryx Alpha Parka
MSRP: $999
- Down composite mapping for strategic insulation
- Cuff gaskets to seal out drafts
- Durable Hadron Gore-Tex material
https://arcteryx.com/us/en/shop/mens/alpha-parka

Mountain Hardware Phantom Parka
MSRP: $400
- Ultralight Pertex® 20D Diamond Fuse ripstop shell fabric
- Box-wall constructed baffles eliminate cold spots
- Two harness-compatible zippered hand pockets
https://www.mountainhardwear.com/p/mens-phantom-parka-1851251.html?dwvar_1851251_color=450

Backpacks

Klattermusen ULL
MSRP: $320
- Back ventilation for thermoregulation
- Adjustable volume for secure carrying
- Loop webbing for simple equipment attachment
https://www.klattermusen.com/en/backpacks/lightweight-backpacks/40399U02-Ull-Backpack-30L-Dusk/

1733 Roll-Top backpack 2
MSRP: $500
- Lightweight durable Dyneema material
- 30 Liters holds a weekend's worth of gear
- Recycled materials reduce carbon footprint
https://www.seventeenthirtythree.com/shop/p/rolltop-backpack-ultra200tx

Mountain Hardware Scrambler 35L
MSRP: $185
- Waterproof 4-Layer Dimension-Polyant™ fabric
- Contoured ventilated back panel with lightweight frame sheet supports loads
- Dual density shoulder straps provide ample support
https://www.mountainhardwear.com/p/scrambler-35-backpack-1830221.html?dwvar_1830221_color=061

Product Anatomy

The state-of-the-art climbing pant has four main points of interest. First the waistband. A key feature for proper fit, most climbing pants utilize an adjustable webbing belt sometimes paired with areas constructed with elastic. Fit plays a huge role in the performance, overlooking the waistband can lead to improper fit and ultimately a failed product.

https://www.klattermusen.com/en/men/pants/15578m01-mithril-3.0-pants-ms-raven/

There are two main areas that require extra reinforcement on climbing pants. The first is the knees. In an area that often sees contact with the rock wall, the knee panels in current products are designed for abrasion resistance. Most state-of-the-art climbing pants achieve this by either constructing double-walled knee panels or using an extremely durable material such as Cordura for the panel piece. It is important to note that the knees still need to allow for a high range of motion and designing articulation into the patterns is common. The back panels extending from the waistband to the calf, are often

designed with the same principles as the knee panels. The last key area on climbing pants is the ankle cuff. Most state-of-the-art products utilize adjustable elastic cinch cuffs.

Belay parkas have become increasingly popular in the outdoor bouldering community as it's a nice balance between weight, warmth, and comfort. The center front zipper, side panel/armhole, hand pockets, and hood are all key areas of this product. Often seen in a quarter of full zip configuration, the center front zipper is important when it comes to easy donning and doffing of the garment.

https://www.mountainhardwear.com/p/mens-phantom-parka-1851251.html?dwvar_1851251_color=450

A well-designed armhole is critical to proper mobility while performing in the garment. The shape of the patterns plays a large role in mobility, but state-of-the-art products today also incorporate stretch side panels that aid in fit and freedom.

Hand pockets can be found on just about any jacket designed for the outdoors. State-of-the-art jackets haven't redefined what the hand pocket is. Common zip pockets for storage and warmth are found on most parkas today. The hood is another area of interest when it comes to protecting the wearer from the elements. State-of-the-art hoods such as Arc'teryx's StormHood incorporate a laminated hood for shape, and a compression system for articulation all while keeping the wearer warm (Arc'teryx, 2022).

Five key areas make up the anatomy of top climbing backpacks on the market today, the closure system, bottom panel, shoulder straps, back panel, and hip belt. Many packs rely on a roll-top closure system. The roll-top system allows the bag to compress down when not fully packed or open for extended volume when carrying a big load is necessary.

https://www.klattermusen.com/en/backpacks/lightweight-backpacks/40399U02-ULBackpack-30L-Dusk/

The bottom panel is an area of high wear. Most products use a material different from the shell for this area, one that is more abrasion resistant. Klattermusen uses a material reinforced with Aramid fibers on the bottom panel of their ULL pack (Klattermusen, 2022).

The back side of the pack is where most of the technology is housed. Straps and the hip belt both aid in effectively dispersing forces from the load. Mountain hardware's Crag Wagon backpack uses dual-density padded foam shoulder straps and hip-belt (Mountain Hardware, 2022). The back panel uses a similar foam but requires zoned placement to increase ventilation.

Intellectual Property Landscape

Listed below are several patents that are relevant to the products in this collection. Care will need to be taken so as to not violate any of them.

EP3258800B1

This is a patent held by Nike related to enhanced mobility in portions of the upper torso. The patent outlines a specific way for layering shoulder and side panels to reduce material pull (Germany, France Patent No. EP3258800B1, 2016).

US11147328B2

This is a patent held by Amer Sports. The patent outlines a circumference closing system i.e. waistband for bottoms. Garments using this patent utilize at least one constrictable tubular length to releasably retain a selected size of the closable circumference or opening (United States Patent No. US11147328B2, 2017).

EP1736074B1

This is a patent held by Arc'teryx Equipment Inc. The patent outlines a specific way of constructing the back panel to include a ridged or semi-ridged frame for support (Germany Patent No. EP1736074B1, 2006).

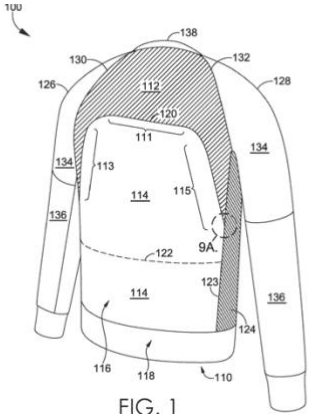
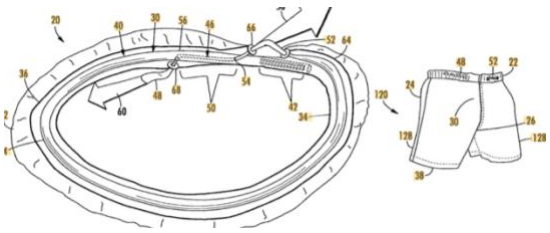
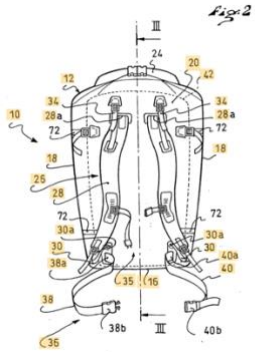


FIG. 1





EP3258800B1 US11147328B2 EP1736074B1

Materials

Climbing pants come in several different materials but most often are constructed from synthetic fibers due to their durability and weather protection properties. The Klattermusen Mithrel 2.0 is a great example of a company utilizing state-of-the-art materials in its product. Their proprietary WindStretch material is a softshell fabric with high levels of abrasion resistance and stretch. Made of a blend of 70% recycled polyamide, 20% polyester, and 10% elastane, WindStrech fabric provides protection from the elements, performance while climbing, and is bluesign approved (Klattermusen, 2022).

Belay parkas utilize more lightweight materials than climbing pants and introduce insulation as a material. The Arc’teryx Alpha Parka is at the top of its class when it comes to material choice. A proprietary Hadron shell fabric with 2L Gore-Tex reinforces high wear areas, while a 2L Gore-Tex Infinium fabric makes up the rest of the shell. The Alpha Parka uses both 850 fill goose down and Coreloft synthetic insulation for increased warmth even in high moisture areas (Arc'teryx, 2022).

There are many materials used when it comes to outdoor bag design. One that has taken the backpack world by storm is Challenge Sailcloth’s Ultra 200. Used by many brands including 1733, Ultra 200 has a woven UHMWPE face with laminated backing. This material is tear resistant, has extremely high abrasion resistance, and offers long-term waterproofing (Challenge Sailcloth, 2022). Besides the shell of the bag, the shoulder strap and back padding foam are materials that cannot be overlooked. The Mountain Hardware Scrambler backpack utilizes dual-density foam in its shoulder straps and back padding. Dual-density foam is a combination of open-cell and closed-cell foam (C., 2017).

Manufacturing

Each of these three product categories is manufactured using traditional cut-and-sew techniques apart from a few newer technologies. More and more companies are starting to utilize bonding in different applications. SewFree seam bonding is an adhesive bonding technology developed by Bemis which seeks to replace traditional sewing. One of the advantages of sew-free bonding is the creation of a low-profile seam which can aid in garment comfortability. Another technology by Bemis is their embellishment films which are used to enhance aesthetics and replace traditional branding such as embroidery (Bemis, 2022). The use of embroidery compromises the durability of the material. Embellishment films apply logos or other graphics without puncturing the material.

When it comes to down jackets there are two main types of baffle construction. The first and more traditional construction is the sew-through method. Here baffles are created by layering down in between the shell and liner and sewing straight through. This is the fastest way to construct down baffles but creates areas of little to no insulation where sew lines are. 3D baffles or box construction is a method of creating down baffles that relies on thin strips of materials sewn between the shell and liner which creates something of a cube to hold insulation. This ensures that the down is evenly distributed across the whole garment and there are no cold zones. This is a more labor-intensive process but is a key feature in any high-quality down jacket (Warm Things, 2017).

Color Trend

Most climbing apparel and equipment on the market today utilize a simplistic color palette. Solid earth tones or just black is popular among companies like Arc'teryx and Houdini. Most opt to blend in rather than stand out with their colors.

Figure 3 Active colour forecast S/S 24https://www.wgsn.com/fashion/article/93702

The color palette used in this collection comes from WGSN's active color forecast for 2024. The palette is built around Astro Dust, a warm earth tone that can evolve over time. Other supporting colors include more warm earth tones, a cooler Sage Leaf hue, as well as pops of purple and Cyber Lime. In WGSN's own words "Combine these warm hues with refreshing pops of Purple Swirl and Cyber Lime. Use on versatile pieces that can be layered, mixed, matched, or even disassembled or repaired (Kostiak, 2022)."

Graphic Trend

Figure 4 K2 Snowboard https://k2snow.com/en-us/p/brain-dead-excavator-snowboard-2023

https://gramicci.com/collections/mens-t-shirts/products/stoneheads-l-s-tee?variant=43266064023805

The climbing industry currently utilizes a wide variety of graphic trends. Many of the big names such as Arc'teryx and Patagonia opt for a clean aesthetic with minimal graphics. Smaller companies like Gramicci focus more on visuals that are rough around the edges as seen in their graphic tees. The Theseus Bouldering Kit will take note of past and future graphic trends to form a unique graphic aesthetic.

Subversive Surrealist

This graphic trend is all about breaking the rules and going against the grain. Subversive surrealism removes the pressure to pursue perfection, making way for an imperfect more human take on sportswear. Athletes who may be a little rough around the edges and pursue their sport for pleasure first and performance second will be drawn to this trend. Subversive surrealist trends pull inspiration from skate, punk, and snowboard cultures (Kostiak, 2022)

Amped-Up Retro

This trend is all about going back to the future. Pulling inspiration from anything retro such as old comic illustrations, or vintage clothing, and putting a modern twist on it.

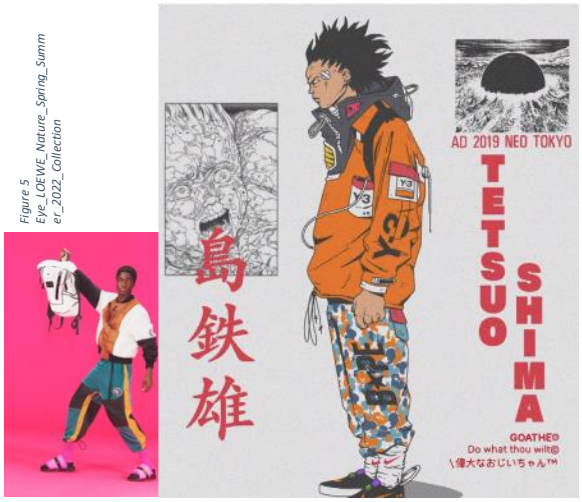
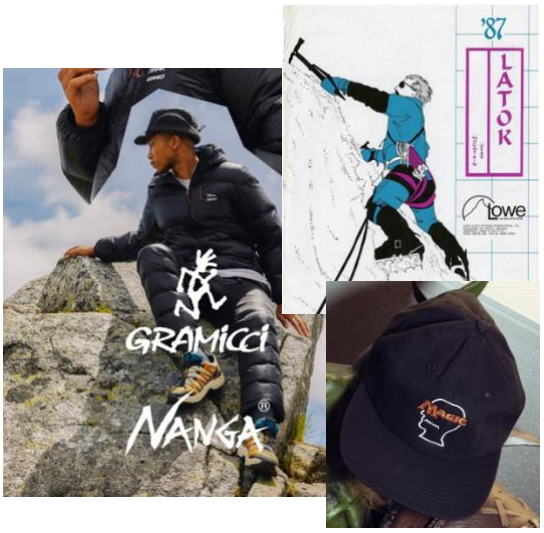


Figure 5 Eye_LOEWE_Nature_Spring_Summer_2022_Collection

Figure 6 https://www.instagram.com/p/BxNQa6cnvjl/

Using heritage references in bold proportions as well as artificial and natural tones is a must. Supersize logos and monogram prints and motifs paired with bold geometric patterns bring this trend into the future (Kostiak, 2022).

Branding Trend



Today many outdoor companies rely heavily on collaborations with other brands to attract new customers. It's not just about how great the branding looks by itself, today it's important to have branding that plays well with others. One logo that easily incorporates others such as the Brain Dead logo, or multiple variations for different uses such as Burton's logo system makes collaborations that much better.

Looking back through outdoor company archives can yield branding inspiration with a retro twist that can appeal to the modern outdoor adventurer. Branding that doesn't take itself to seriously will speak to the scrappy, fun-loving, risk-taking nature of bouldering and its community.

Physiology

Physiology is one of the most important sciences when it comes to bouldering. Some athletes are born with physiological advantages and others train hard to achieve their physiological goals. The proportions of one's body, how the body moves, and how easily the body is prepared for activity all play critical roles in performance outcomes.

Ape Index

When introducing professional climbers at competitions, commentators will often say athlete's names, their age, the country they climb for, and their ape index. Ape index is a comparison of arm span to height. A positive ape index is established when an athlete's wingspan is greater than their height. A majority of elite climbers have an ape index of +1 or more (Ondra, 2019). The average human body has an ape index of 0 meaning their wingspan is as wide as they are tall. Daniel Woods, who is considered one of the best boulders today is 68in tall with a wingspan of 72in. This gives him an abnormally high ape index of +4 which plays a role in his performance output (Beale, Ape Index Calculator, 2021). As is the case with a number of sports, a greater reach provides an advantage however, it is commonly believed that trainable factors are more predictive of climbing performance.

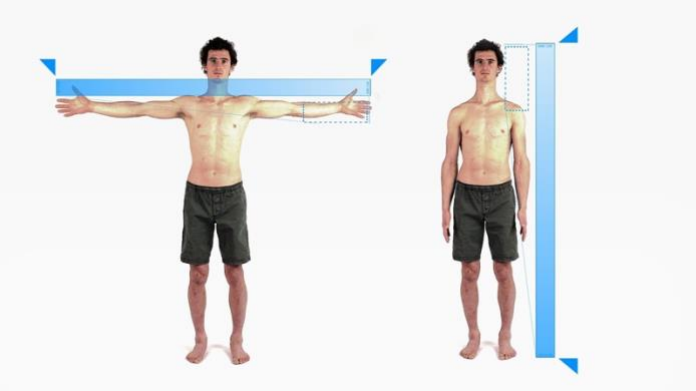


Figure 7https://www.youtube.com/watch?v=yFfkOM8RgAU

Mobility

When attempting to solve boulder problems, the ability to have controlled movements from beginning to end range of motion are extremely beneficial. Mobility determines the range of motion of an athlete's joints and greatly affects problem-solving. Flexibility is the ability to bend one's body into a shape, while mobility is the ability to bend one's body into a shape under the control of their own muscles (Feehally, 2021). The two are often confused. Many

climbers compensate for poor mobility by solving boulder problems in a different way. Higher mobility levels allow for more energy-efficient moves while on the wall.

The anatomy of joints, connective tissues, muscles, tendons/ ligaments, and neurological factors all play a role in mobility. A goniometer is a basic instrument with two arms and a friction pivot point, with a 360-degree protractor commonly used by medical professionals to collect data on an individual's range of motion (LaBat, 2019).

When it comes to increasing mobility there are two methods used. The first is static training. This constitutes pushing one's joints slowly toward the full range of motion either actively (using muscular force) or passivity (using external forces). It is important to note that static training is not recommended right before climbing as it can decrease the muscle's ability to generate force and power in the short term. The second method, dynamic mobility training, is much more suitable if climbing right after. Dynamic training pushes the joints to full extension but in quick succession (Mobråten, 2020).

Warm-Up

A warm-up generally serves two purposes in sport. First to prepare the athlete mentally, and second to prepare them physically. Improper warm-ups often lead to low performance or injury. Ideally once a warm-up is complete, an athlete's body can perform as well as it can. Specifically, a warm-up needs to increase the temperature of muscles and tendons to bring them to their optimal performance temperature (MacLeod, 2020). For bouldering, there are three main areas one needs to focus on during warm-up, the upper body, the lower body, and the fingers.

Biomechanics

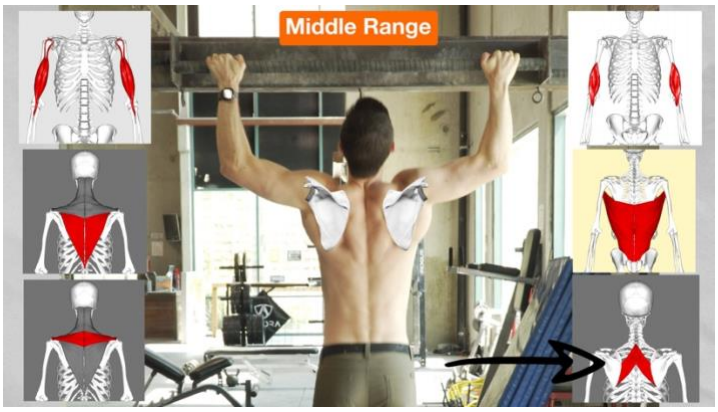


Figure 8https://www.hoopersbeta.com/library/how-pullups-work-wide-grip-standard-chin-up-biomechanics

Pull-Ups

Pulling is objectively the most fundamental movement in bouldering. Whether an athlete is in the weight room training, or outdoors on the wall, proper pull-up mechanics are necessary for high levels of performance. There are three main types of pulls or pull-ups, the standard grip, wide grip, and narrow grip. The standard grip, if done with good form, offers almost zero risk of injury. As the hands move further away from each other or closer, the angle at which the arm meets at the elbow changes, creating a mechanical disadvantage (Hooper, n.d.).

An important variation of the pull-up is the lock-off. Unlike the pull-up where one smoothly pulls from a hanging position all the way up and back down, the lock off requires the athlete to lock their arms while bent and hold that position (Mobråten, 2020). Training lock-offs is important for performing static moves while on the wall.

Hip-Mechanics

When climbing, having your hips close to the wall shifts the load from one's arms to their much stronger legs. Proper hip biomechanics is necessary for high levels of performance in climbing. The hip is a ball and socket joint that possesses three degrees of freedom and operates in both an open and closed kinematic chain (LaBat, 2019). The motions of the hip joint

are flexion/extension in a sagittal plane, abduction/adduction in a coronal plane, and medial/lateral rotation in a transverse plane (LaBat, 2019). Focusing on the active range of motion and end range of motion provides climbers with a mechanical advantage.

Sitting

Sitting is unfortunately a necessary part of traveling and can take a toll on an athlete's body. How one sits and what one sits on affects the health of the spine. Sitting can cause several biomechanics inefficiencies. Reduction in lumbar lordosis, trunk-thigh angle, knee angle, and an increase in muscle effort and disc pressure are all results of improper seated posture. Seated posture is affected by seat-back angle, seat-bottom angle and foam density, height above the floor, and the presence of armrests (Harrison, 1999). Sitting leads to 40 - 90% more stress on the back (disc pressure) than standing posture (Cornell University).

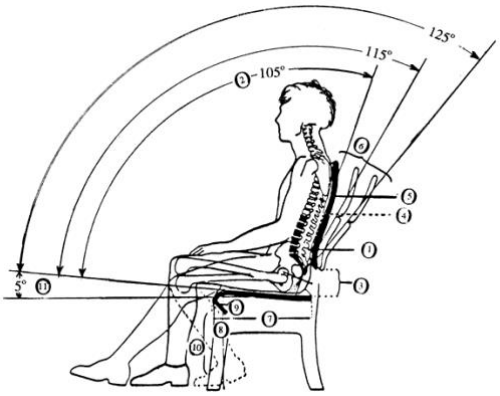


Figure 9https://www.sciencedirect.com/science/article/abs/pii/S0161475499700205

There is no definitive answer to what the optimal seat angle is, but research seems to show 100-110° is a good range. After the angle, the backrest is one of the most important features. The low-level backrest supports the lumbar region, and the depth of the curve should be between 0.6-2". Medium-level backrest supports the shoulders and should be about 26" high to accommodate the average male. High-level backrest supports the head and neck and should be about 36" high (Cornell University).

Psychology

"The brain is the most important muscle in climbing"

- Wolfgang Güllich (Mobråten, 2020)

There is a direct correlation between mental preparedness and performance levels when it comes to bouldering. If an athlete wants to become a better climber motivation and goal setting are critical. When on the wall, concentration, focus, confidence, and inner dialogue can be the keys to solving bouldering's toughest problems.

Motivation

Every single elite bouldered had to work hard to get to where they were at. Motivation is what drives them to get there. The most important factor when it comes to motivation is that the athlete finds joy in what they are doing. There are two main ways of experiencing joy or fun. The first is type 1 fun which happens when an individual experiences joy while participating in the activity. Type 2 fun is when the individual is not having fun at the moment but can look back on the experience and find lots of joy (Cordes, 2018). An important technique for staying motivated is goal setting. Humans inherently feel a sense of accomplishment when they reach their goals and this pushes them to set new goals and seek out continuous improvement.

Concentration

Concentration is the act of forgetting all else and focusing on the task at hand. Long-term and short-term concentration are both important when it comes to bouldering (Mobråten, 2020). If an athlete wants to push their performance they need to concentrate on their goals over days, weeks, months, or years. If an athlete wants to solve the boulder problem in front of them they need to concentrate on the movements necessary to complete it. It is important to not concentrate too much thought. This can lead to overthinking which can negatively impact flow while on the wall or derail an athlete from the goals they have set for themselves.

Confidence

Confidence is the thought process of believing you can achieve whatever the task at hand is. It is a skill that is crucial for pushing oneself. Like any other skill, it can be trained. Even if a boulderer has attempted a problem one hundred times without success, approaching it each time with faith that they have what it takes to solve it builds confidence.

Preparation goes hand in hand with confidence. When an athlete approaches a problem knowing that they have done everything they can to prepare for this moment it increases confidence which increases motivation which in-turn raises the level of performance output (Mobråten, 2020). It is important to note that confidence can ebb and flow from day to day or

even attempt to attempt. Through training, athletes can better cope with short-term failure and approach each attempt with renewed confidence.

User Research

Semi-structured interviews are to be carried out with several high-level boulderers. The goal of these interviews is to better understand the lifestyle of these athletes, the relations they have with their bouldering gear, and what travel looks and feels like for them. The interviews will be semi-structured in-order to create a candid dialog about the topic which will aid in collecting qualitative information. This information will be used to inform the designs of the final garments and gear in this collection. Below are the questions to be asked during the interview in no particular order. It is important to note that the semi-structured interview format can lead to more than just these questions being answered.

1. What do you value in your climbing apparel/gear?
2. How often do you replace your gear?
3. What keeps you from repairing your apparel/gear?
4. What performance features do you need from your apparel?
5. How long do you usually wear a garment (what's its lifetime)?
6. What is your ideal bouldering apparel and equipment setup?
7. What do you think about when climbing?
8. How do you prepare for a climbing trip?
9. What's the best part about traveling for you?
10. What's the worst part about traveling for you?

Athlete Feedback

An interview was conducted with Katie Lamb over Zoom. Katie is a 24-year-old professional climber who focuses on outdoor bouldering. She is considered by many to be one of the best female boulders out there right now with an impressive checklist of boulder

problems getting as high as V14. Having grown up in the competitive circuit, and then leaving it to pursue other climbing goals, Katie is the ideal athlete to provide feedback. Below are some key takeaways from the interview.

-Warmth is a primary concern when winter bouldering. Katie almost always has base layers on. In between climbs, she relies on a puffy jacket to keep her warm. Since she doesn't climb in the puffy she opts for the biggest one she can find. Weight and mobility of the puffy jacket don't concern her, it all comes down to if she'll be warm enough or not.

-Second to warmth is style. "What's nice about bouldering is you don't really need super tech'd out apparel, I prefer a baggier look".

-Durability comes third.

-One season of bouldering is tough on climbing apparel.

-Katie does a lot of her own repairs on her gear. She showed a pair of pants with at least four patches on the back side and a puffy jacket with lots of duct tape.

-There are two cases when she'll send something in to be repaired. The first is when a zipper breaks and the second is when the company makes it easy to send in a repair. She wears a lot of Patagonia and will send it in to be repaired rather than patching it herself.

-"I will intentionally do a visible mend with a different color instead of trying to match". Showing off your repairs can be a badge of honor.

-When traveling she basically only packs climbing clothes. She will travel in the same clothes she climbs in.

-She likes to bring her puffy jacket on the plane to use as a pillow.

-The worst part of climbing travel is being on a plane.

-She’s back and forth between her house and Bishop December through March.

-When hiking into a crag, Katie always puts her backpack between her pads rather than wear it on the front but this can deform the pads over time.

-Likes the haul bag style.

-Climbing bibs would be great for cleaning and developing new boulders.

-Her body shape doesn’t change much but she does often change the number of layers she's wearing. Climbing bibs could help with fit in this regard.

S.W.O.T

S.W.O.T

Patagonia Iron Forge Bib

$140

	Strength	Weakness	Opportunity	Threat
Upper Bib	Adjustable fit	Can restrict movement	Increased thermo retention	A less popular way of securing garments.
Knee Panels	Added durability	No addition benefits	Improved articulation	Increased cost of production
Cuff closure	Reduces risk of snagging on objects	Not adjustable	Performance mode & Travel mode	Can be an unwanted feature by some
Side Closure	Open for ventilation	Hard to repair if broken	Zipperless ventilation	Other options might not be as clean

S.W.O.T

Arc'teryx Alpha Parka

$1000

	Strength	Weakness	Opportunity	Threat
Hood	Doesn't impact sight and designed with articulation	Not designed for travel	Design for travel	Travel features might not be useful while climbing
CF Closure	Easy donning and doffing	Zipper hard to repair	Zipperless CF	Zipperless CF could impact donning and doffing
Insulation	Goose down with mapped synthetic insulation	Synthetic insulation is not sustainable	Eco insulation	Eco insulation might not perform as well
Pockets	Ergonomic pocket configuration	No clear weakness	Pockets built for chalky hands	No clear threat

S.W.O.T

Watershed Chattooga 22L Duffle

$130

	Strength	Weakness	Opportunity	Threat
Top Closure	Roll-top closure	No clear weakness	Quick open and close roll-top	No clear threat
Shoulder Straps	Sling strap allows bag to sit off hip	Single shoulder strap	Carry set-up when crashpad is on back	Front carry is only useful while hiking into crag
Material	Durable weather resistant material	Not constructed for repair	Construct for repair	Added construction cost
Carry Features	External points of attachment	Not optimized to carry climbing gear	Shoe and chalk garage	No clear threat

Testing Plans

Repair Testing Methodology

Before any repair testing happens an analysis of repair data from Rugged Threads and Arc'One will take place. The goal of this is to determine the most common repairs needed and the average time these repairs take, as well as standard operating procedures for repair.

The first round of repair testing will be focused on seam-type deconstruction. When it comes to repair process efficiencies, ease of garment deconstruction is a leading factor. Pro's and cons of three common seam types will be laid out. The single needle lock stitch, the overlock stitch, and the chain stitch will be reviewed. Durability, stretch, commonality of the sewing machine, and ease of deconstruction will be considered. Sample seam will be made for each stitch type and then simple time trials will be completed to collect data on how fast each seam can be deconstructed.

The second round of repair testing will happen after P2 prototypes have been completed. P2 samples will be taken to the Rugged Thread repair facility. A repair technician will analyze each garment and run each through several common repair scenarios. They will record their normal metrics and after we will meet to go over the successes and failures of the product in terms of increasing repair process efficiencies.

Performance Fit Testing Methodology

The performance fit testing will be looking at two things. The first is mobility while wearing the garment. For this a sit-and-reach test, backscratch test, and squat test will be used. (Parker, 2019) To begin, mobility data will be recorded with form-fitting stretch garments on. This will set a baseline for the user's current mobility. Users will then wear the garments, run through the same mobility tests, and record data on areas where the range of motion has changed. Separate tests will be taken for the jacket and the bibs.

The second set of testing will look at comfort both in performance situations and travel situations. While wearing the product the user will run through a number of situations that the actual athlete might find themselves in. Climbing actions and travel actions will be rehearsed. The goal of this is to collect qualitative data about comfort levels in different situations. The qualitative data collected from these tests will provide a greater understanding of areas where articulation and general comfort can be improved.

Below are steps to be followed for testing

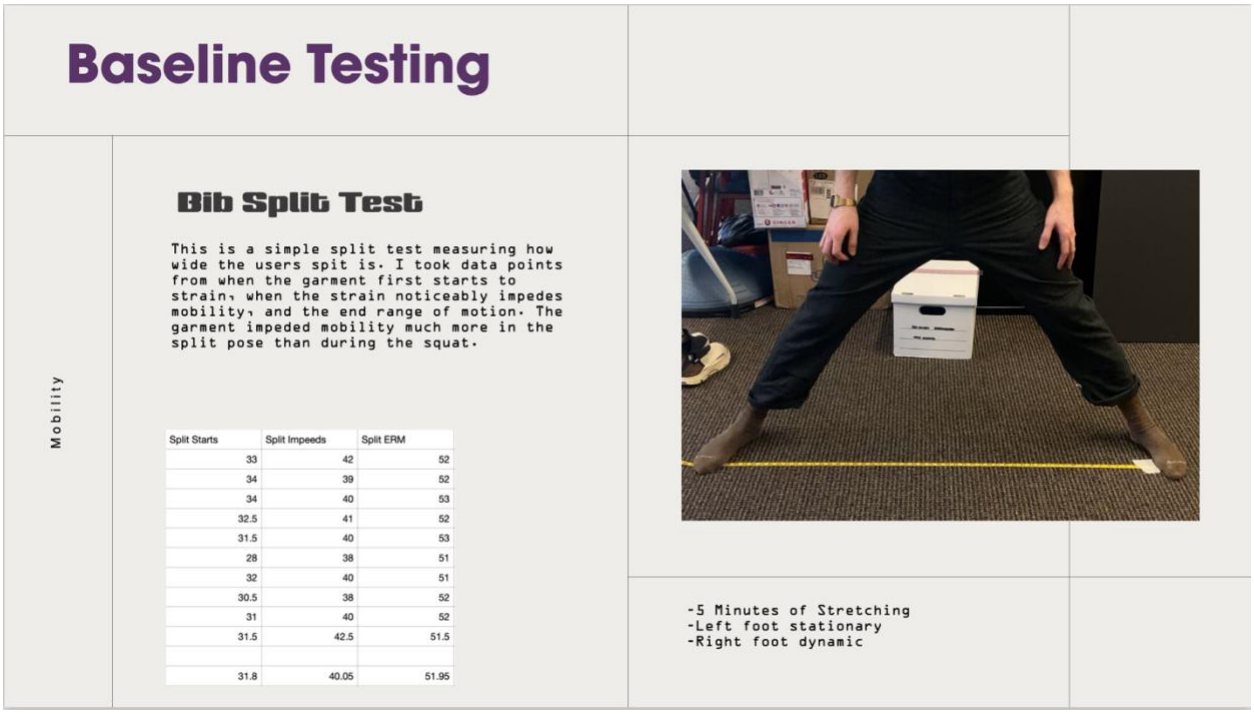
Mobility Tests

1) Have test subjects fill out consent forms.
2) Have subjects complete sit and reach, backscratch, and squat tests in non-restrictive stretch garments and record results.
3) Have subjects complete sit and reach, backscratch, and squat tests in Arc’teryx Alpha Parka and record results.
4) Have subjects complete sit and reach, backscratch, and squat tests in POC MTB Dungarees and record results.
5) Collect any qualitative data subject may have to share.

Performance Fit Tests

1) Have test subjects fill out consent forms.
2) Wearing non-restrictive baselayers, have subjects perform five pull-ups, walk .5 miles on a treadmill with a crashpad on their back, and sit in a chair with armrests for 30 min.
3) Have subjects repeat the same set of tests but with Arcteryx Alpha Parka on.
4) Have subjects repeat the same set of tests but with Iron Forge Bibson.
5) Have subjects repeat the same set of tests but with both garments on.
6) Record qualitative feedback on comfortability from subjects

Baseline & First Prototype Testing



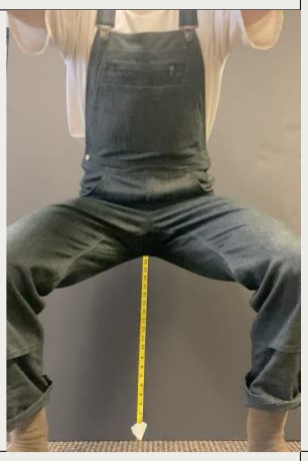
Baseline Testing

Mobility

Bib Squat Test

This is a simple squat test measuring how close the seat of the garment can get to the ground. I took data points from when the garment first starts to strain, when the strain noticeably impedes mobility, and the end range of motion. My conclusion is that the baseline bibs do impede mobility but only minimally.

Squat Start	Squat Impeeds	Squat ERM
23	17	10.5
23	16	9.5
23	16.5	10
23.5	16	10
23	16	9.5
22.5	15	10
22	16.5	9
24	15.5	9
23.5	15	10
23	16	9.5
23.05	15.95	9.7



-5 Minutes of Stretching
-User 16" from backdrop
-Stance is 18" wide
-Camera is 10.5" off ground
-Camera is 56" from backdrop

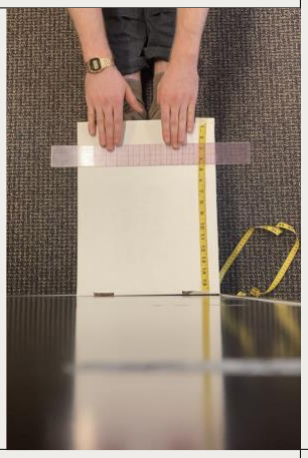
Baseline Testing

Mobility

Bib Squat Test

This is a simple sit-and-reach test measuring the user's mobility during a forward fold. I found that the garment had almost no impact on user mobility in this position.

S&R
2.5
3
3
3
2.75
3
3.25
3
3
3
2.95



-5 Minutes of Stretching
-Box hight: 10.5"
-No shoes

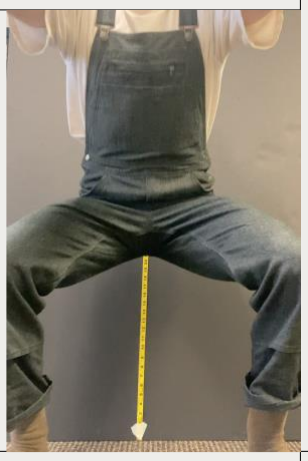
P1 Testing

Mobility

Bib Squat Test

This is a simple squat test measuring how close the seat of the garment can get to the ground. I took data points from when the garment first starts to strain, when the strain noticeably impedes mobility, and the end range of motion. My conclusion is that my proto bibs don't impede mobility. The end range of motion was not affected by the garment.

Squat Start	Squat Impeeds	Squat ERM
Na	NA	8.5
Na	Na	7
Na	Na	7.5
Na	Na	7.5
Na	Na	7.5
Na	Na	7
Na	Na	7
Na	Na	7
Na	Na	7.5
Na	Na	7



-5 Minutes of Stretching
-User 16" from backdrop
-Stance is 18" wide
-Camera is 10.5" off ground
-Camera is 56" from backdrop

P1 Testing

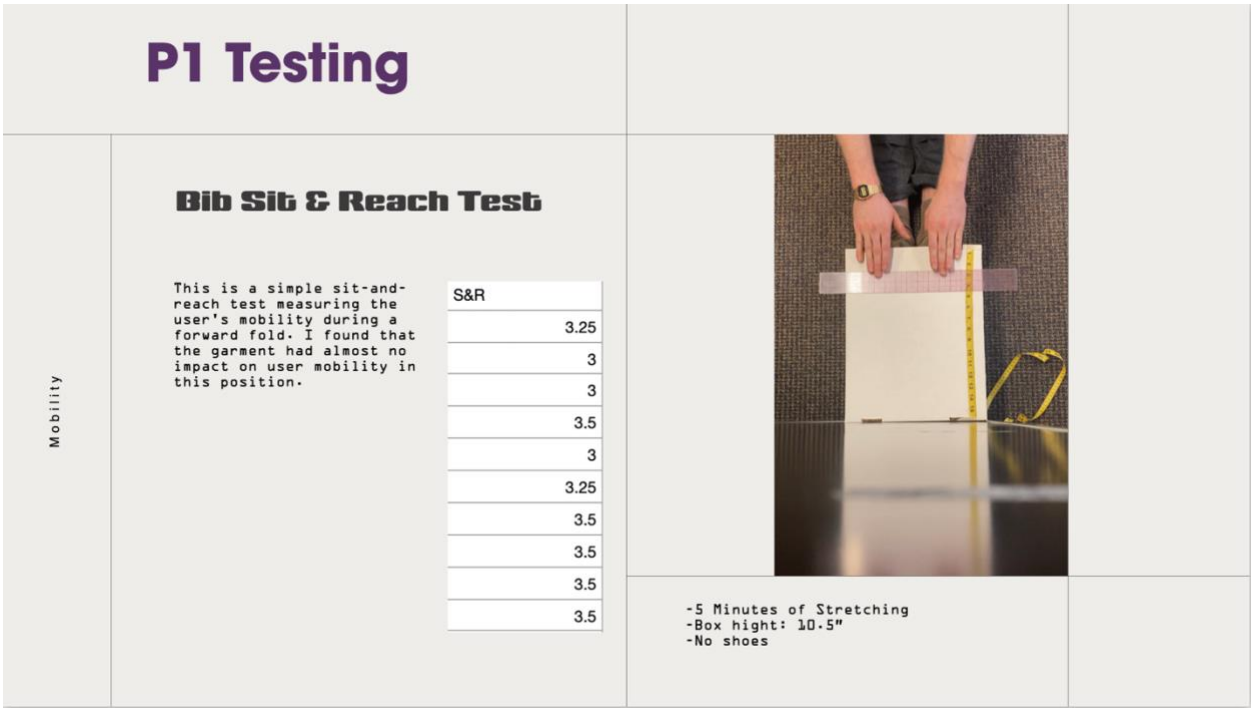
Mobility

Bib Split Test

This is a simple split test measuring how wide the users spit is. I took data points from when the garment first starts to strain, when the strain noticeably impedes mobility, and the end range of motion. Very minimal stain was felt in the garment. This is a huge improvement over the baseline.

Split Starts	Split Impeeds	Split ERM
50	NA	52
49.5	NA	52.5
50.5	NA	52
50	NA	52
50	NA	52.5
50.5	NA	52
51	Na	52.5
50.5	Na	53
51	Na	53
51	Na	53

-5 Minutes of Stretching
-Left foot stationary
-Right foot dynamic



Professional Statement

Pushing performance while promoting the planet is at the core of who I am as a designer. I like a little style too. The Theseus Bouldering Kit encompasses all these values and

aligns with my strengths defined by the Clifton strengths finder assessment. Intellection, input, and ideation strengths are par for being a good designer, but what sets this project apart from others is its relationship to my relator and learner strengths.

Relators look to deepen their understanding of relationships. How does repair fall into the bigger picture of circularity? How can design for repair benefit people, the planet, and brands? Why do bouldering and repair go hand in hand?

The future is happening right now. As a designer, it's important to learn what, why, and how. Learning what new technologies are at the forefront of design, why they will be important for pushing the industry and promoting the planet, and how to implement them will benefit not only this project but anyone I can share my findings with. I love to learn but even more so, I love to share. A rising tide floats all ships…even ones that need a little repair.

The Theseus Boulder Kit is a blend of all my passions. It is my hope that this work will help push me into a career in technical outdoor apparel and equipment at a company that puts people and planet above all else.

Golden Circle

Why: Push the limits of outdoor sports while protecting the environments that we play in.

How: Utilizing new technologies to design better products for people and planet.

What: Highly functional, meticulously designed apparel and gear.

Clifton Strengths

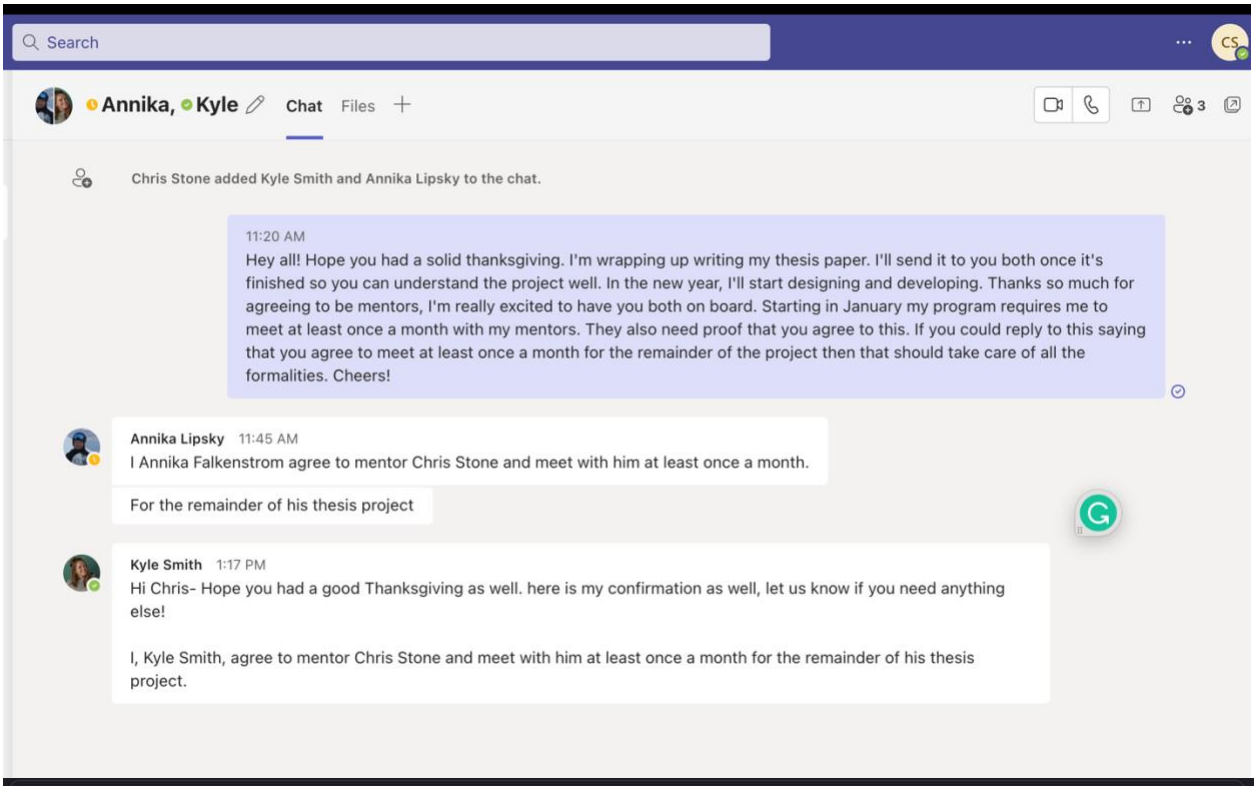
1. Intellection
2. Input
3. Relator
4. Learner
5. Ideation

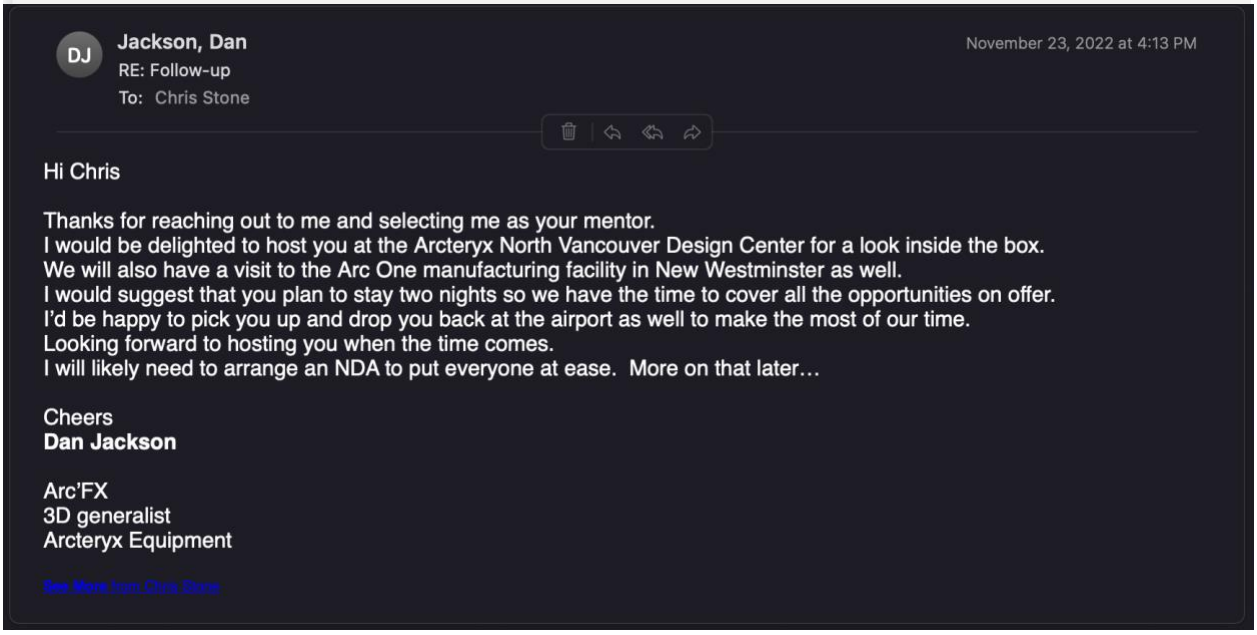
Mentors

Annika Lipsky:
Burton Snowboards
Technical Designer
Can meet weekly

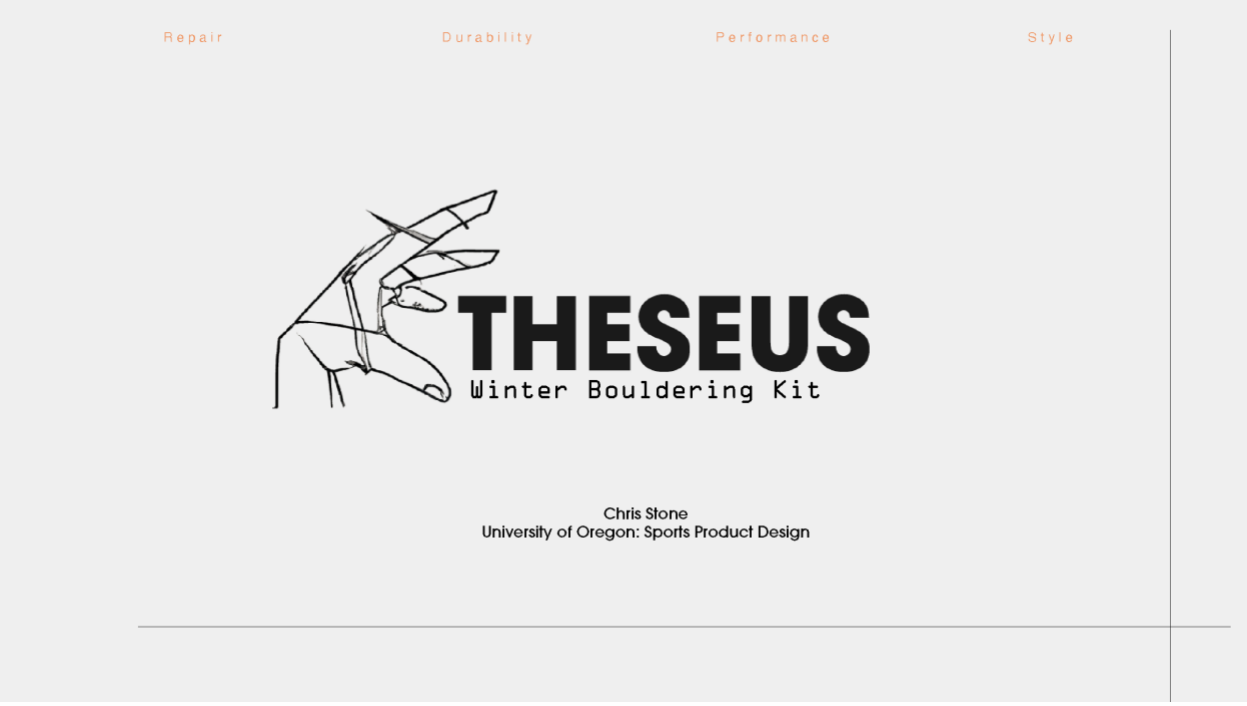
Kyle Smith:
Burton Snowboards
Senior Developer; Advanced Development
Can meet weekly

Dan Jackson:
Arc'teryx
Advanced Concepts Designer
Agreed to meet at least monthly


Search
CS
Annika, Kyle
Chat
Files
3
Chris Stone added Kyle Smith and Annika Lipsky to the chat.
11:20 AM
Hey all! Hope you had a solid thanksgiving. I'm wrapping up writing my thesis paper. I'll send it to you both once it's finished so you can understand the project well. In the new year, I'll start designing and developing. Thanks so much for agreeing to be mentors, I'm really excited to have you both on board. Starting in January my program requires me to meet at least once a month with my mentors. They also need proof that you agree to this. If you could reply to this saying that you agree to meet at least once a month for the remainder of the project then that should take care of all the formalities. Cheers!
Annika Lipsky 11:45 AM
I Annika Falkenstrom agree to mentor Chris Stone and meet with him at least once a month.
For the remainder of his thesis project
Kyle Smith 1:17 PM
Hi Chris- Hope you had a good Thanksgiving as well. here is my confirmation as well, let us know if you need anything else!
I, Kyle Smith, agree to mentor Chris Stone and meet with him at least once a month for the remainder of his thesis project.


DJ
Jackson, Dan
RE: Follow-up
To: Chris Stone
November 23, 2022 at 4:13 PM
Hi Chris
Thanks for reaching out to me and selecting me as your mentor.
I would be delighted to host you at the Arcteryx North Vancouver Design Center for a look inside the box.
We will also have a visit to the Arc One manufacturing facility in New Westminster as well.
I would suggest that you plan to stay two nights so we have the time to cover all the opportunities on offer.
I'd be happy to pick you up and drop you back at the airport as well to make the most of our time.
Looking forward to hosting you when the time comes.
I will likely need to arrange an NDA to put everyone at ease. More on that later…
Cheers
Dan Jackson
Arc'FX
3D generalist
Arcteryx Equipment
See More from Chris Stone

Appendix


Repair
Durability
Performance
Style
THESEUS
Winter Bouldering Kit
Chris Stone
University of Oregon: Sports Product Design

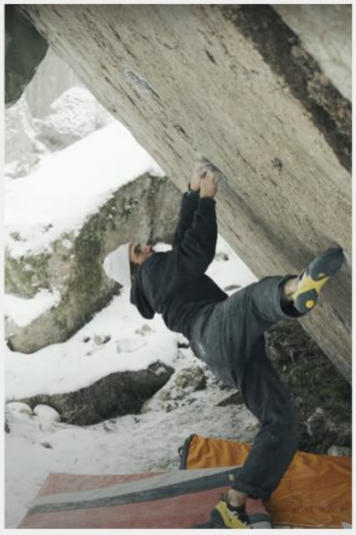
The fashion industry stands in dire need of adopting a more circular approach. One such measure being undertaken is the implementation of enhanced repair systems. The industry must take it further by prioritizing repair-oriented design.

Incorporating durability and repairability as key design elements from the outset can result in garments that endure greater stress, streamline the repair process, and foster a stronger connection with the wearer.

THESEUS

THESEUS
Winter Bouldering Kit

How can we rethink apparel and bag design to increase repair process efficiencies, and extend the life of the modern boulderer's gear?



About Me

Chris Stone

Past:

University of Vermont
Environmental Studies

Present:

University of Oregon
Sports Product Design

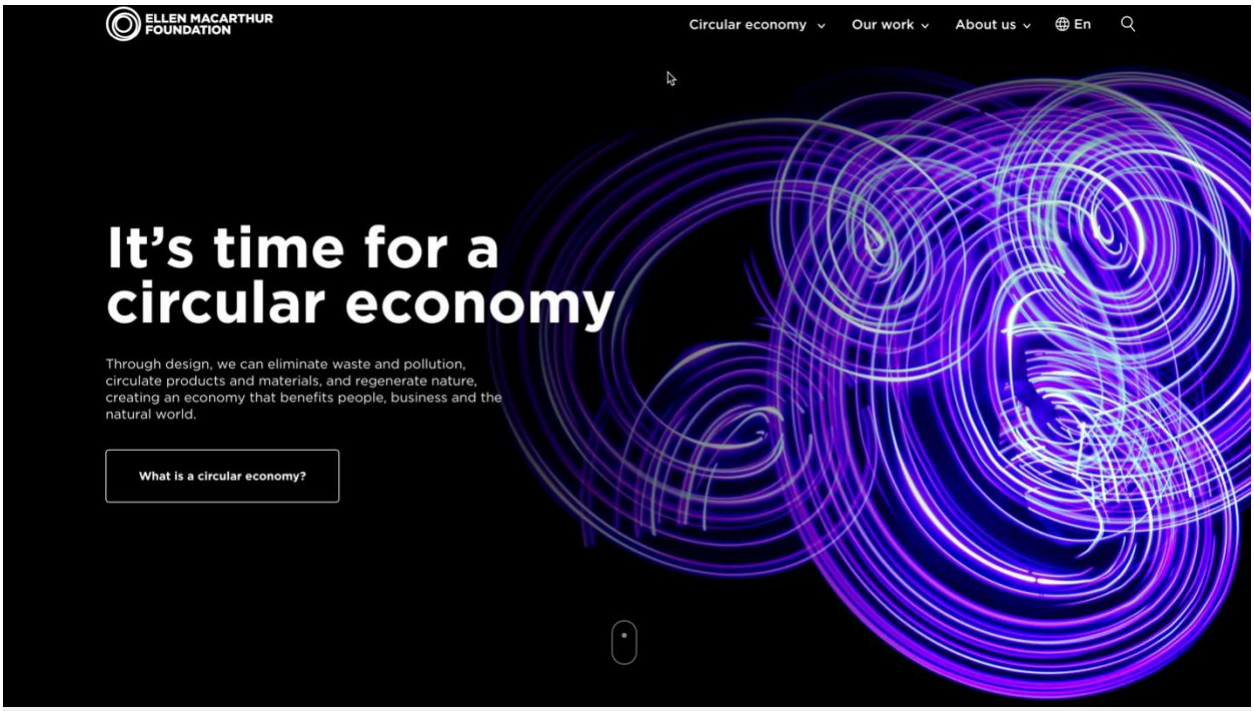
Future:

Arc'teryx
3D Technical Specialist

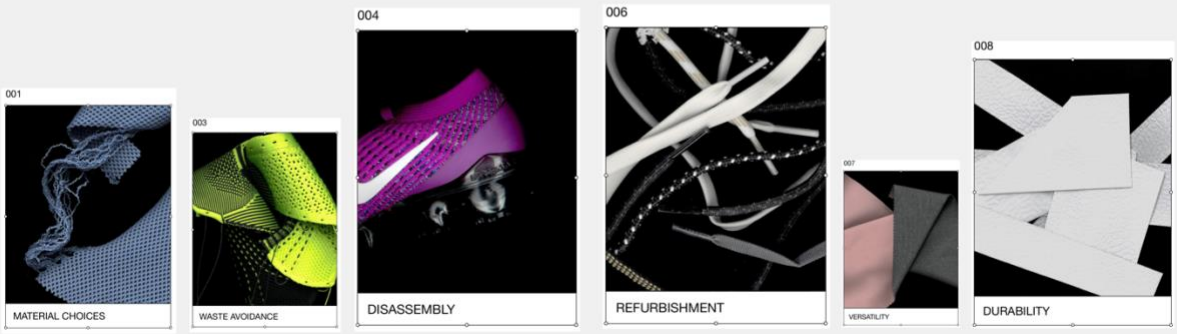
The Goal: Create mountain sports apparel for brands that strive to make a lasting positive impact on people and planet.

Initial Concept

Repair + Legacy



Principles of Circularity

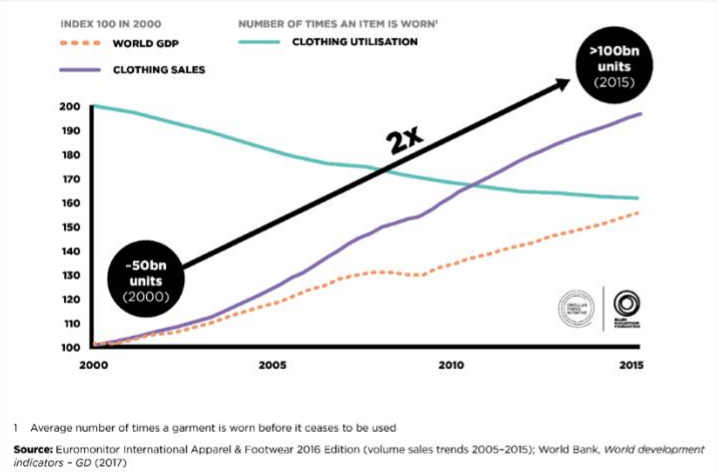


What to Ask

- Which components are prone to break or wear out?
- What market would design for repair make the biggest impact in?
- How can design for repair benefit brands?
- How can design for repair benefit athletes?
- How easily can these components be disassembled?
- How might we design clothes that users feel emotionally connected to?
- What digital resources can be created?

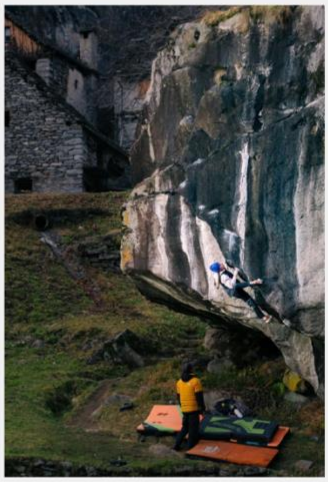
Repair

Why?



1 Average number of times a garment is worn before it ceases to be used

Source: Euromonitor International Apparel & Footwear 2016 Edition (volume sales trends 2005–2015); World Bank, *World development indicators - GD* (2017)



•Repair is growing in popularity.

•Designing garments for repair can reduce repair costs by as much as 25%, can greatly reduce processing times.

•A report by the Outdoor Industry Association listed bouldering among the fastest-growing outdoor recreational activities in the US.

Arc'One Visit

Expectations

- Process
- Obstacles

Outcome

- Skills
- Equipment
- Process
- Obstacles
- Consumer Education

Focus

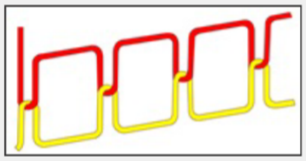
1] **Seam Construction**

2] **General Construction**

3] **Patterning**

Seam Identification

Single Needle Lock Stitch

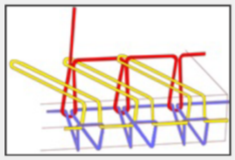


Stitch Type	Stitch Name	Appearance	
		Top View	Bottom View
301	Lockstitch		

Pros:
- Most common type of sewing machine
- Clean and Neat

Cons:
- Doesn't stretch
- Seam ripping can damage material

Overlock Stitch

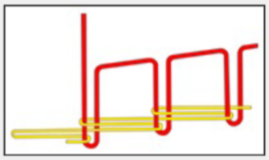


504	3 Threads Serging		

Pros:
- Sew Speed
- Stretch

Cons:
- Seam Strength
- Seam ripping can damage material

Chain Stitch



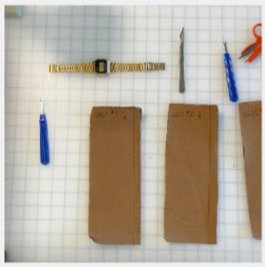
Stitch Type	Stitch Name	Appearance	
		Top View	Bottom View
401	Two-thread Chain Stitch		

Pros:
- Fastest seam deconstruction
- Allows stretch

Cons:
- Uncommon equipment in repair facility

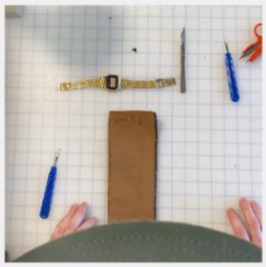
Seam Deconstruction Testing

Single Needle Lock Stitch



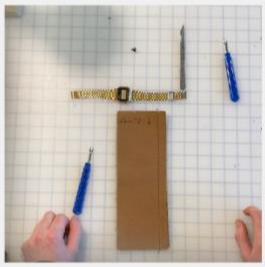
Average Time: 17:23 seconds

Overlock Stitch



Average Time: 27:98 seconds

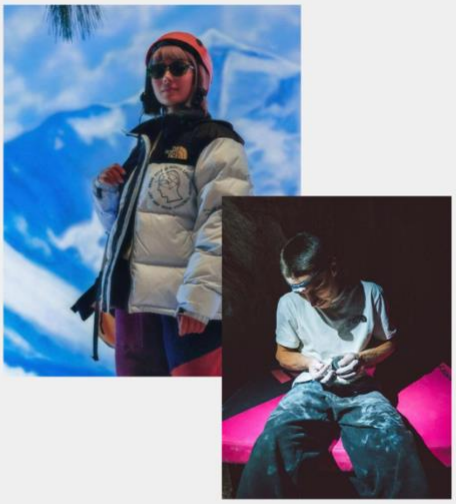
Chain Stitch



Average Time: 13:64 seconds

The Athlete

The Modern Dirtbag

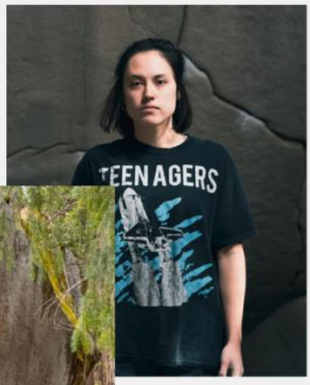


Skill: Avid Climber

Age: 18-38

Bio: A passionate young outdoor climber driven by performance and the culture of the sport. They train rigorously to improve and constantly push their limits. May travel the world seeking new bouldering spots, connecting with fellow climbers, and immersing themselves in different cultures. Their journey is a testament to the beauty of climbing and the indomitable spirit it inspires.

Driven Curious Open Unconventional



@klambies

- Since she doesn't climb in the puffy she opts for the biggest one she can find. Weight and mobility of the puffy jacket don't concern her.
- Second to warmth is style.
- There are two cases when she'll send something in to be repaired. The first is when a zipper breaks and the second is when the company makes it easy to send in a repair.
- "I will intentionally do a visible mend with a different color instead of trying to match".
- She likes to bring her puffy jacket on the plane to use as a pillow.
- When hiking into a crag, Katie always puts her backpack between her pads rather than wear it on the front but this can deform the pads over time.
- Climbing bibs would be great for cleaning and developing new boulders.

Katie Lamb

Age: 25

Katie is a professional rock climber currently focused on pushing the sport of outdoor bouldering.

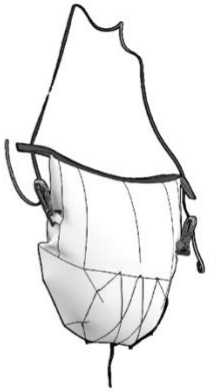
Her bouldering checklist includes some of the hardest boulders ever completed by a male or female.

USER Insights

The Design

01. Climbing Bibs

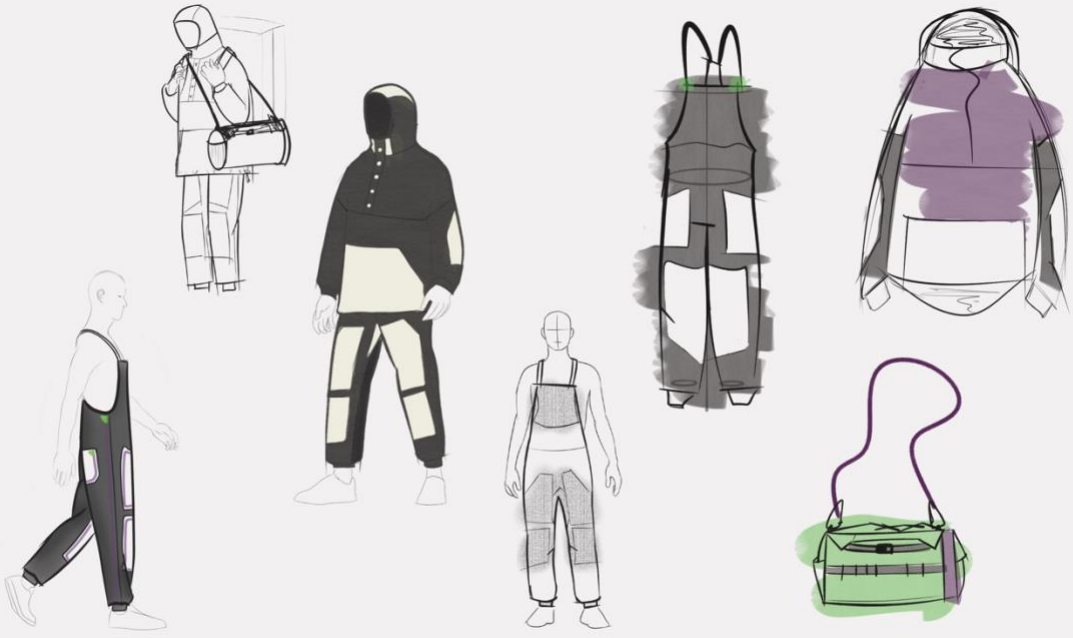
02. Belay Parka

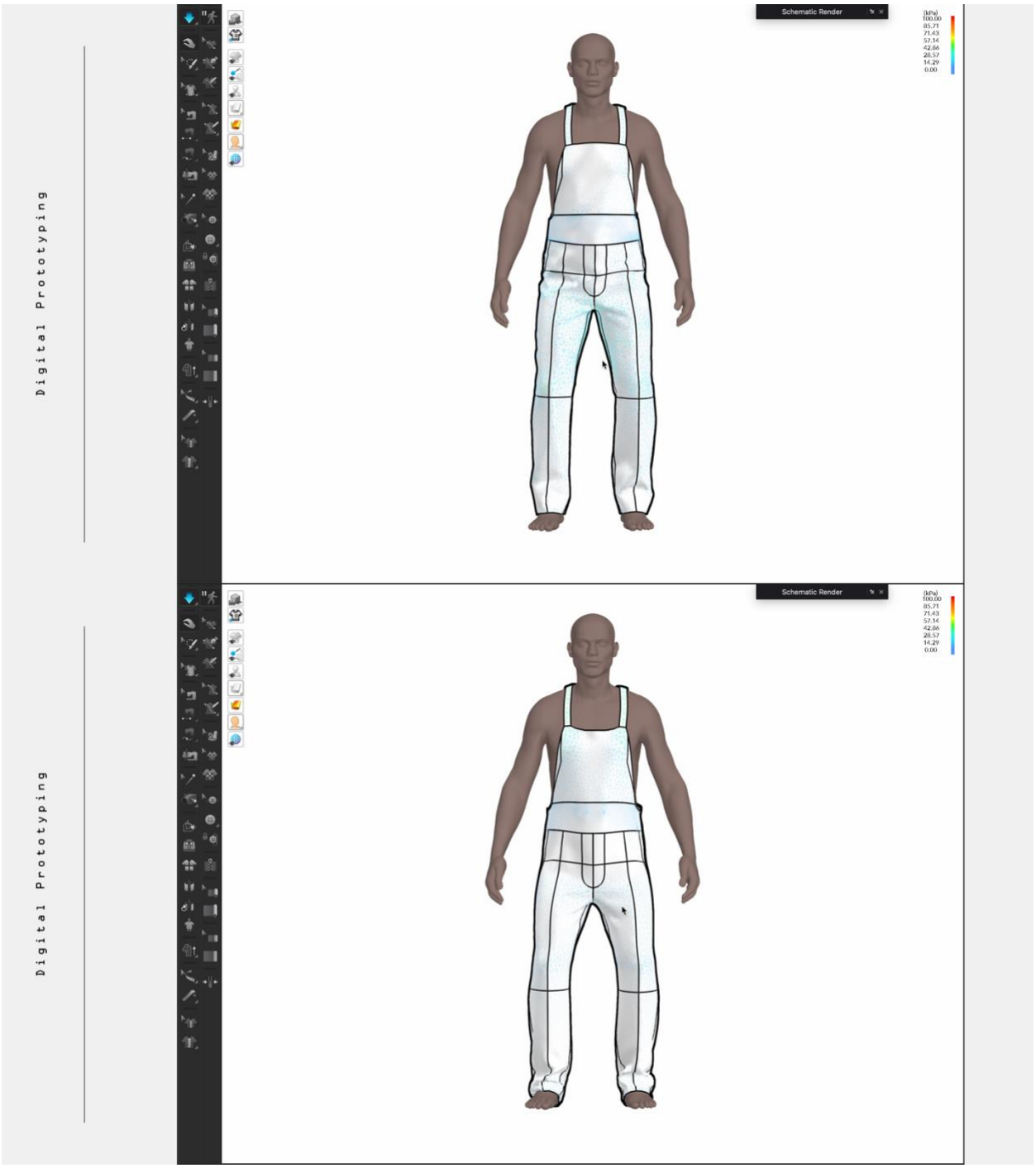


03. Bouldering Bag

Mood Board

Sketch Exploration




Digital Prototyping
Schematic Render
(kPa)
100.00
85.71
71.43
57.14
42.86
28.57
14.29
0.00
Digital Prototyping
Schematic Render
(kPa)
100.00
85.71
71.43
57.14
42.86
28.57
14.29
0.00

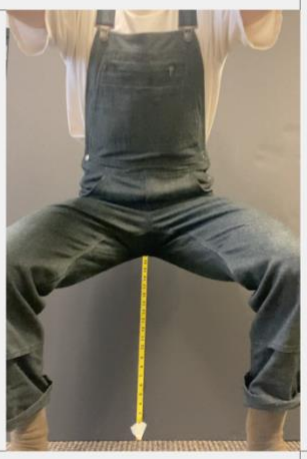
Mobility Testing

Mobility

Bib Squat Test

This is a simple squat test measuring how close the seat of the garment can get to the ground. I took data points from when the garment first starts to strain, when the strain noticeably impedes mobility, and the end range of motion. My conclusion is that the baseline bibs do impede mobility but only minimally.

Squat Start	Squat Impeeds	Squat ERM
23	17	10.5
23	16	9.5
23	16.5	10
23.5	16	10
23	16	9.5
22.5	15	10
22	16.5	9
24	15.5	9
23.5	15	10
23	16	9.5
23.05	15.95	9.7



-5 Minutes of Stretching
-User 16" from backdrop
-Stance is 18" wide
-Camera is 10.5" off ground
-Camera is 56" from backdrop

Early Field Testing

Belay Parka

Features

- **Side Repair Seam**
- **Adaptable Side Panel**
- **Baggy Fit**
- **Forward shoulder**
- **Brush guards**
- **Durable Aluminum Snaps**

Materials

Self
1.6 oz HyperD™

Liner
1.0 oz HyperD™

Insulation
Climashield APEX

Hardware
Aluminum Light Strength Snaps

Embellishment
Bemis Embellishment Film

Climbing Bibs

Features

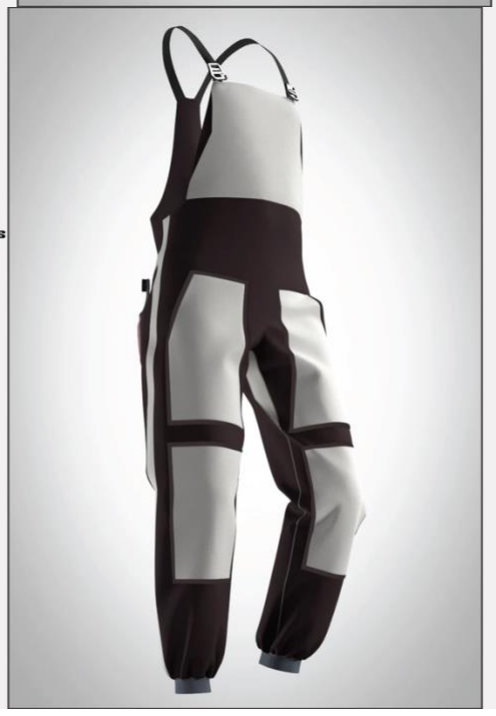
- **Side Repair Seam**
- **Adaptable Side Panel**
- **Quick Replace Abrasion Panels**
- **Crotch Gusset**
- **Articulated Knees**
- **Zoned Merrow Stitch**

Materials

Self
9.3 oz Stretch Mesh Nylon Dyneema®

Hardware
1" Aluminum G-Hook

1" Climb-Spec Tubular Webbing



Boulder Bag

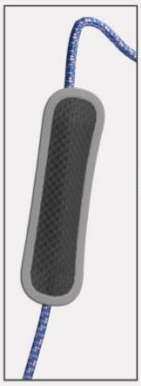
- **Side Repair Seam**
- **Contoured Back**
- **Padded Shoulder Strap**
- **Roll-top Closure**
- **Exterior Gear Storage**
- **Durable Climbing Grade Hardware**

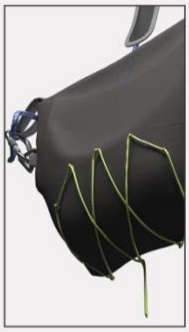
Materials

Body
Challenge ULTRA 200

Mesh
3D Spacer Mesh

Hardware
Aluminum Carabiners, Rings, & Buckle





Platform Technology

Hatch

Zoned repair seams

In the context of shipbuilding, a hatch is a covered opening that provides access to the inner compartments of a vessel. Similarly, in the realm of garment design, the Hatch platform technology centers around the incorporation of seams that enable a repair technician to swiftly open up a garment, providing easy access to the inner workings of the apparel. Typically, the durability of a seam is inversely proportional to its ease of disassembly. However, Hatch platform technology defies this convention by maintaining a high level of durability in the product while simultaneously minimizing repair processing times. This revolutionary design approach results in apparel that can withstand heavy wear and tear without compromising on repairability.

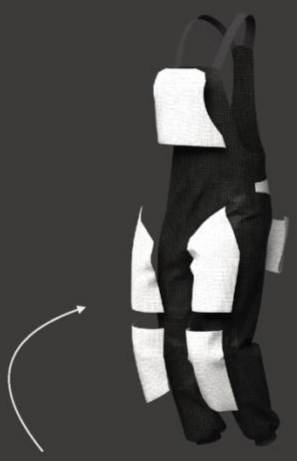
Zoned chain-stitch with high-vis colored thread will aid the repair technician.

Platform Technology

Plank

Quick Replace Abrasion Panels

Drawing inspiration from the classic philosophical paradox of Theseus's ship, the Plank platform technology incorporates a modular component that can be effortlessly detached from the product and replaced. The Plank technology focuses on the areas of the garment that typically experience high wear due to articulation, utilizing high abrasion-resistant stretch fabric to construct the planks. This innovative approach not only maximizes the durability and longevity of the apparel but also facilitates ease of repair, ultimately enhancing the sustainability of the product.



Planks will be zoned in high-wear areas such as the elbows, knees, seat, and bag base.

Platform Technology

Strip

Customization

Strip planking is a boat construction method involving the adhesion of narrow wood strips to form a resilient and lightweight hull structure. Its correlation with resizable panels on climbing pants arises from the shared concept of customization and adaptability. By integrating adjustable strips or panels, climbing pants grant climbers the ability to tailor the garment to their unique physique, movements, and preferences. This dynamic feature cultivates enhanced comfort, unrestricted mobility, and the opportunity to optimize performance in diverse climbing environments. Both strip planking and resizable panels on climbing pants exemplify the significance of personalized solutions tailored to individual requirements.

Legacy Label

Full Circle (larity)

The fashion industry stands in dire need of adopting a more circular approach. One such measure being undertaken is the implementation of enhanced repair systems. The industry must take it further by prioritizing repair-oriented design.

Incorporating durability and repairability as key design elements from the outset can result in garments that endure greater stress, streamline the repair process, and foster a stronger connection with the wearer.

THESEUS

Thank You

THESEUS
Winter Bouldering Kit

Works Cited

Arc'teryx. (2022). *Alpha Parka*. Retrieved from Arcteryx: https://arcteryx.com/us/en/shop/mens/alpha-parka

Arc'teryx. (2022). *The StromHood*. Retrieved from Arc'teryx: https://arcteryx.com/ca/en/explore/obsessive-design/stormhood/

Beale, A. (2021). *Ape Index Calculator*. Retrieved from 99 Boulders: https://www.99boulders.com/ape-index-calculator

Beale, A. (2021). *Grades: The Complete Guide*. Retrieved from 99 Boulders: https://www.99boulders.com/bouldering-grades

Bemis. (2022). *Outerwear*. Retrieved from Bemis World Wide: https://www.bemisworldwide.com/markets/outerwear/

Bishop. (2022). *Bishop Area Climbing*. Retrieved from Mountain Project: https://www.mountainproject.com/area/106064825/bishop-area

C., G. (2017). *The Definitive Guide to Foam Padding*. Retrieved from Pangolins With Packs: https://pangolinswithpacks.com/the-definitive-guide-that-you-never-wanted-foam-padding-fe60def98582

Challenge Sailcloth. (2022). *UltraWeave*. Retrieved from Challenge Outdoor: https://www.challenge-outdoor.com/ultra-weave

Clarke, O. (2022). *One of the best most influental climbers of all time*. Retrieved from Climbing: https://www.climbing.com/people/chris-sharma-climber-best-all-time-5-15/

Climbing Business Journal . (2020). *IFSC Releases Its 2019 Annual Report*. Retrieved from Climbing Busiuness Journal: https://www.climbingbusinessjournal.com/ifsc-releases-its-2019-annual-report/

Climbing Business Journal. (2022). *Gyms and Trends 2021*. Retrieved from Climbing Business Journal: https://www.climbingbusinessjournal.com/gyms-and-trends-2021/

Cordes, K. (2018). *The Fun Scale*. Retrieved from REI: https://www.rei.com/blog/climb/fun-scale

Cornell University. (n.d.). *Sitting and Chair Design.* Retrieved from Cornell.edu: https://ergo.human.cornell.edu/DEA3250Flipbook/DEA3250notes/sitting.html

Dan Green, M. B. (2006). *European Patent Office Patent No. EP1736074B1.*

Encyclopaedia Britannica. (2022). *Ship of Theseus*. Retrieved from Britannica: https://www.britannica.com/topic/ship-of-Theseus-philosophy

Fayle, T. W. (2017). *United States Patent No. US11147328B2.*

Feehally, N. (2021). *Beast Making.* Vertebrate Press.

Gill, J. (2017). *Origins of Bouldering*. Retrieved from John-Gill: http://www128.pair.com/r3d4k7/Bouldering_History1.0.html

Green, D. (2006). *Germany Patent No. EP1736074B1.*

Harrison, E. (1999). Sitting Biomechanics Part 1. *Journal of Manipulative and Physiological Therapeutics*.

Hooper, J. (n.d.). *How Pull-Ups Work*. Retrieved from Hoopers Beta: https://www.hoopersbeta.com/library/how-pullups-work-wide-grip-standard-chin-up-biomechanics

International Federatrion of Sport Climbing. (2021). *IFCS 2021 Annual Report.* IFCS.

Jackson, J. (2019). *Bouldering Skills: The Art of Spotting*. Retrieved from Climbing.com: https://www.climbing.com/skills/bouldering-skills-the-art-of-spotting/

Keating, D. (2022). *How Do Climbers Make Money*. Retrieved from Climbing House: https://climbinghouse.com/how-do-climbers-make-money/

Klattermusen. (2022). *Mithril 3.0*. Retrieved from Klattermusen: https://www.klattermusen.com/en/men/pants/15578m01-mithril-3.0-pants-ms-raven/

Klattermusen. (2022). *ULL*. Retrieved from Klattermusen: https://www.klattermusen.com/en/backpacks/lightweight-backpacks/40399U02-Ull-Backpack-30L-Dusk/

Kostiak, Y. (2022). *Active Colour Forecast S/S 24.* WGSN.

Kuelthau, W. (2018). *The Statistics Behind the Growth of Rock Climbing & Bouldering*. Retrieved from 99 Boulders: https://www.99boulders.com/the-growth-of-climbing

LaBat, K. L. (2019). Human Body: A wearable Product Designers Guide. CRC Press.

MacLeod, D. (2020). *How to warm up for climbing*. Retrieved from YouTube: https://www.youtube.com/watch?v=2BkD4auSKDo&t=178s

Midtbo, M. (Director). (2022). *Girlfriend Reacting to Climbing with Alex Honnold* [Motion Picture].

Miller, D. (2022). *Shawn Raboutou Does First Ascent of "Alphane" (V17)*. Retrieved from Climbing: https://www.climbing.com/news/shawn-raboutou-alphane-v17/

Mobråten, M. (2020). *The Climbing Bible.* Vertebrate Press.

Mountain Hardware. (2022). *Crag Wagon 35L Backpack*. Retrieved from Mountain Hardware: https://www.mountainhardwear.com/p/crag-wagon-35l-backpack-1997631.html?dwvar_1997631_color=339

Nike. (2022). *Guiding the Future of Design*. Retrieved from Nike Circular Design: https://www.nikecirculardesign.com

Ondra, A. (2019). *What is the best body type for climbing?* Retrieved from YouTube: https://www.youtube.com/watch?v=yFfkOM8RgAU

Parker, R. (2019). *How to test Flexibility*. Retrieved from Human Kinetics: https://humankinetics.me/2019/09/13/how-to-test-flexibility-and-balance/

Rex. (2022). *The Best Type of Rock for Rock Climbing*. Retrieved from Rockclimbingguru: https://rockclimbingguru.com/the-best-type-of-rock-for-rock-climbing-climbing-geology/

Roscoe, J. (2015). *United States Patent No. EP 3258800B1.*

Roscoe, J. (2016). *Germany, France Patent No. EP3258800B1.*

Sportrock. (2019). *On-sight vs. Flach vs. Redpoint*. Retrieved from Sportrock: https://www.sportrock.com/post/on-sight-vs-flash-vs-redpoint

TheShortSpan. (n.d.). *Bouldering Legend*. Retrieved from Three Rock Books: https://threerockbooks.com/interview-with-john-gill/

Warm Things. (2017). *Baffle Box vs. Sewn Through Construction Comforters*. Retrieved from Warm Things Online: https://warmthingsonline.com/blogs/news/baffle-box-vs-sewn-through-construction-comforters

Wilkinson, F. (2019). *Rock climbing: from ancient practice to Olympic sport*. Retrieved from National Geographic: https://www.nationalgeographic.com/adventure/article/rock-climbing?loggedin=true

Williams, R. (2018). *Off the Wall with 17-year-old rock climbing superstar Ashima Shiraishi*. Retrieved from SSENSE: https://www.ssense.com/en-us/editorial/culture/year-old-ashima-shiraishi-is-our-favorite-rock-climbing-star