

CLAES NELLESTAM DESIGNS A SKI BOOT IN THIRTEEN WEEKS !

The Ski Boot Project



> A Master degree project
in Industrial Design <



> **INTERVIEW:**
Jon Örabäck
Swedish ski superstar

> **PICTURE
GALLERY**
The F_S_B_C



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Ski boots are specialized footwear that is used in skiing to provide a way to attach the skier to skis using ski bindings. The ski-boot-binding combination is used to transmit control inputs from the skier to the snow.



The Ski Boot Project

Master thesis from Lund University,
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Abstract

The subject of this Master degree project is skiboosts. I saw a need of improvement in the skiboost industry. Skiboost technology has not progressed much the last decades while the ski culture has changed a lot. The skiboost is a challenging product to design as it is a stiff plastic shoe to wear while performing tough physical activity. I myself am a passionate skier which is part of the reason why I choose this as my subject.

My goal has been to define the target group and create a ski boot concept with features and improvements based on my own experience and what the target group requests, and thereafter to present a digital 3D model that explains my ideas and design.

I narrowed down the focus points to: stability, comfort, walking properties and keeping the skiers foot warm and dry. The methods I used were: a blog and a target group survey, web research, and my own experience and preunderstanding.

The result is basically a 3 piece construction with a lower Poly Urethane part, a carbon fiber flex tongue and back support. A ventilation system keeps the foot warm and dry and a titanium feature in the sole of the boot improves the walking properties.

It has been a nice interesting experience to work with the skiing target group who knows precisely what they want and is very trend sensitive.

> Background

I have been skiing since I was born and I consider my interest in the winter sport culture an important part of my personality. Skiing is an activity connected to a very positive lifestyle which I find appealing.

When skiing you will need warm clothes, a pair of skis, bindings, poles and a pair of ski boots. The equipment is of great importance and is constantly developed and improved. Skiers are often closely involved in the design process of new ski products and the winter sports brands employees are often over represented by skiers. The market is open and usually has a very positive attitude towards new innovations and ideas. This makes the winter sport industry

very appealing to me as a young ski loving designer.

When deciding what to design I used my own experience of the sport. In 1992 I first tried a snowboard, which for a 12 year old boy in 1992 was about a billion times cooler than skiing. I got hooked and spent 15 years of snowboarding. A couple of years ago skiing started merging with the snowboard scene and skis became wider and had a twin tip design, similar areas of competitions like slope style, big jump, ski cross and half pipe became popular. I then changed back to skiing and quickly realized how spoiled snowboarders feet are in their soft boots compared to the hard plastic boots used by skiers. When looking

at the construction of a modern ski boot it pretty much looks the same as twenty years ago. Technical details, materials and styling have of course developed over the years but the basic layout remains. This I find interesting and challenging. I also find the ski boot interesting in an environmental perspective due to its long lifespan and that they rarely end up in the garbage can.

Another reason for choosing a winter sport product as Master degree project is to show my design competence within the area and generate interest and opportunities for me in the ski industry.

- Claes Nellestam



content // my Design process

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- CD Digital version
- Survey results
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- Tiff images of the F_S_B_C

The intention

My goal is to define the target group and create a ski boot concept with features and improvements based on my own experience and what the target group requests. My aim is to present a digital 3D model that explains my ideas and design.

BASIC PLAN...

Create basic intelligence. collect facts / info / images.	1
Learn about history / technology / market / material / history.	week
Study Target group. Create Questionnaire. (Initial idea: one part regarding boots available on market, which is the: best looking, most comfortable, warmest, user friendly, best feature, best quality, best all around, dreamboot? and one part regarding other products design, clothes, gadgets, alpine equipment, furniture, cars, architecture etc.)	1 week
Carry out Questionnaire. (Maybe use www.freeride.se users)	0,2 week
Summary of Questionnaire result.	1 week
Create Background and Brief. (Decide demarcations)	0,1 week
Further research based on Questionnaire result and the Brief. Create inspiration image bank.	0,2 week
Create Function analysis.	0,2 week
Brainstorm, Idea sketching and concept developing.	1 week
Concept evaluation. Create new Questionnaire to get feedback on concept from target group.	0,5 week
Refine Concept and decide details and design.	1 week
Realize Concept: 3D model, mockup, function model.	4,5 week
Create report and presentation.	2,3 week
Examination !	

METHODS

Experience and preunderstanding

I have been skiing all my life and have through the years collected knowledge and experiences about the ski boot.

Web research

I used the internet to hunt for valuable information. I used the ski boot brands websites to learn about different design solutions, online shops to analyze the market and the scientific databank Elin (Electronic Library Information Navigator of Lund University) to collect interesting publications in the subject.

Blog

I created a blog on www.freeride.se/blog/pingpong/ were I posted information and illustrations of the progress of my project and received comments on them from my target group.

Interviews and discussions

I had interesting discussions primarily with Ch-uansi Gao, PhD and assistant lecturer, and Kaley Kuklane, associate professor, about foot-climate-technical questions and suitable material alternatives. I interviewed Jon Örarbäck, Professional skier and member of Nordica's International Freeski Team, about his ski boot opinions and the ski life style. I also communicated my ideas to Jon for feedback.



Target group surveys

I carried out two surveys. The first one collected facts about the target group's typicality, their thoughts regarding existing ski boot design and their ideas about a new design. The second survey was about how the target group associates shapes, colors and material with two different genres of the ski culture. Both surveys were posted on the website: www.freeride.se which is a website about skiing, snowboarding and the snow worshipping lifestyle. Freeride.se has up to 125.000 visitors a month during high season and about 60.000 registered users. Here I could find my target group and approach them with the questionnaires. I created one survey with 33 questions regarding both typical behaviors, opinions and situations and also more direct about their own ideas and thoughts regarding ski boot design. I posted the survey in an equipment forum and on the blog. Based on the answers I could make a target group profile and get an insight in how the ski boot users think. I also got important information about which existing designs the target group prefers. For the second survey I used a tool called Vipet (Visual Internet Product Emotion Tool) created together with Per Kristav MA, Adjunct Lecturer at Machine Design, Lund University. The tool lets the person drag and drop pictures along a scale. With this survey I wanted to see how the target group values and associate form, color, materials, environments and culture. Unfortunately the second survey was never published due to technical problems.





Nordica Lady Polaris (\$275)



Dolomite Sportlite (\$225)



Lange XL-T (\$300)



Salomon SX 90 Equipe (\$295)



Hanson Alto (\$325)



Garmont Falcon (\$235)



San Marco AX 1-R (\$285)



Caber Sider



BASIC FACTS

Ski boots were originally made of leather and resembled standard boots. As skiing became more specialized as a form of recreation, so too did ski boots.

Boots intended for downhill use are generally composed of a hard plastic shell with a softer foam liner to provide climate and tactile comfort. Concerning liners, a thick soft liner will be more comfortable and provide more insulation while thinner, harder liners provide more precision. Comfort has been improved in recent years by the use of conformable linings (usually heated to fit) which allow an otherwise stiff liner to be molded to the foot making it comfortable to a large variety of foot shapes. Shells come in various degrees of stiffness, beginners typically like a softer and more padded boot, while more advanced skiers generally prefer a stiffer boot with a thinner liner. Softer boots are able to be flexed with less pressure applied to the cuff making them a good choice for lighter or less aggressive skiers and translates into a more forgiving ride. This quality is also desirable when efficiency and comfort dur-

ing touring is a concern. Softer boots are often lighter as well due to thinner shell material; a desirable quality when touring as well.

Boots which are too soft for a skier will not feel sufficiently responsive, and will over flex during high-performance skiing. Increased boot stiffness generally translates into more precise energy transmission from the skier to the ski. It also provides better support during high-speed turns, and heavier skiers. Stiff boots however are often less comfortable and heavier than their softer counterparts. Boots that are too stiff for a skier will transmit unintended control movements to the skis, and will not flex sufficiently in varying terrain or during normal intensity skiing.

Alpine Ski Boots have rigid soles and attach to the binding at both toe and heel using ISO DIN standard bindings. Because of the bindings, hard plastic is used in the sole for better safety and precision.





< 1930-1950 leather ski boot



Lange WC 130 2008 racing ski boot >

ISO DIN standard bindings >



Components

Of a modern Ski Boot

Forward Lean Adjustment

Many ski boots have an adjustment feature which allows you to change the angle that your shin makes with the boot closed. By using this adjustment, you are able to change your stance and center of mass.

Flex Adjustment

Many ski boots have an adjustment feature which allows you to change the amount of resistance to the forward movement of your ankle. You can make this flex stiffer or softer. People often use this feature to compensate the flexibility changes of the boot under cold and warm weather conditions.

Lateral Upper-Cuff Adjustmet

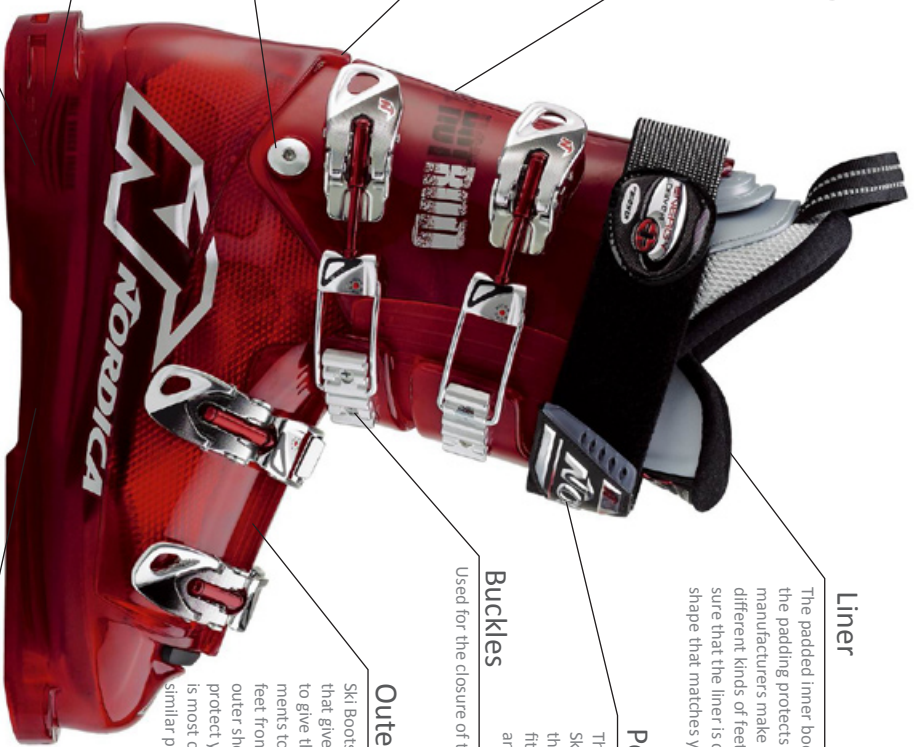
This adjustment allows you to shift the upper boot. This feature is very useful for bowlegged or knock-kneed people who need to adjust their upper boot to the angle of their lower legs.

Canting

Allows the entire boot (lower shell and upper cuff) to be tilted inward (medial) or straight (lateral) up and down.

Ramp Angle Adjustmet

Some boots allow you to change the angle in which your feet rest on the sole of your boot. In this way, you are able to shift your center of mass forward or backward.



Liner

The padded inner boot keeps your feet warm and the padding protects you from impacts. Different manufacturers make different kinds of liners for different kinds of feet. It is very important to make sure that the liner is comfortable and has the shape that matches your feet.

Power Strap

The Velcro strap at the top end of the Ski Boot can be used to make sure that the top of the Ski Boot gives a tight fit, connecting well with your calves and shin.

Buckles

Used for the closure of the boot shell.

Outer Shell

Ski Boots typically have a stiff Plastic outer shell that gives the Ski Boot its ability to support and to give the most direct transfer of body movements to the Skis. They protect your ankles and feet from bending too far and possible injury. The outer shell is waterproof and tough enough to protect your feet and lower legs from impacts. It is most commonly made from polyurethane or a similar plastic.

Foot Bed

The foot bed provides support and alignment for the foot which reduces strain and cramps in the forefoot and arch.



3 Piece design

Developed for its fitting versatility, easy handling, and dynamic performance advantages with modern ski shapes. Incorporates three structural elements:

- > Lower shell
- > Upper cuff
- > External shell tongue



Classic 2 Piece Overlap design

The industry's most common design construction. Two piece overlap ski boots (sometimes referred to as "shellfit" boots) incorporates two structural elements:

- > Lower shell with overlapping and under lapping flanges that "wrap" to adapt to different volume feet and feet shapes securing the lower foot inside the ski boot.
- > Upper cuff with over and under lapping flanges which, when closed, secure the lower leg and ankle inside the ski boot.



| Design |

Old style ski boots were originally made from cut and stitched leather and at a time there were 350 manufacturers worldwide. Now highly-tooled mouldings are used to make ski boots, which have a different appearance and tactile quality from the previous generation. Seventy five percent of the market is now supplied by only three manufactures due to the high tooling costs for the modern generation of boots. As a result the basic construction design of the ski boot has not changed that much the last twenty years and the different brands collections look pretty similar. To differentiate the boots from each other the brands use colors, transparency, graphics and technical features. As in all consumer product branches trends come and go. Basic colors like red, green, blue, black and white has always been popular and still is. Transparency which I think communicates technological progress and trust has become a common design detail. Graphics is strongly connected to the genre of the boot for example a racing boot have racing stripes and a "fast" font while a freestyle boot might have a crazy pattern and a "flashy" font. Technical features have lately become more subtle compared to the eighties/nineties pretty conspicuous detailing. A key trend apparent throughout the winter sports gear design is the fusion between snowboarding and freeride skiing. In some cases, skate style is also playing a part. (Snow Fusion, C. Griffin, 2007)

| Material |

Polyurethane (PU) is the most common material used in the main shell. To enhance the boots performance, parts of the shell could be done in stiff carbon fiber or softer plastic and rubber. The materials must be strong, durable and not be affected greatly by temperature.

The liner or parts of it is often made of open-cell foam which provides comfort due to its ability to shape around the foot. A drawback is that the foam compacts overtime which cause the boots performance to change.

The buckles are made of either hard plastic, metals like aluminum and titanium or combinations. You want the buckles to be durable and lightweight.

For styling purpose materials like fake fur and leather is used.



Technical // what's hot.



Full Tilt Full flex tongue

(fulltiltboots.com)

Is a ribbed external tongue which is independent of the rest of the shell. This technology results in a progressive flex and a comfortable boot.



Salomon Custom Shell

(Åka Skidor 2/08)

Part of the lower shell is made of a moldable plastic which expands up to 6 millimeters. Heat up the entire boot before you put it on the first time and it will shape after your foot.

Atomic I-Flex

(atomicsnow.com)

Flexible plastics and thin wall thicknesses in special areas of the lower part of the boot ensure easy step-in, precise foot hold and support your natural biomechanical foot function.



intuition liner

(intuitionsports.com)

The liner is made of ULTRALON™ EVA foam which is a patented foam developed specifically to be moldable, flexible and durable. You heat up the liner and put your foot in and it will reshape and mold in the shape after your foot. This process can be repeated.



SOMA TEC

(fischerskis.com)

Somatic stand position. The construction of the boot allows the foot to remain in its natural V-position. Edge switching is much easier as a result.



Booster Strap

(masterfitterprises.com)

The Booster Strap wraps around the boot cuff top to secure the lower leg, eliminating the need to over-tighten buckles. The Booster instantly improves ski control by dynamically "bonding" the calf to the boot, providing increased rebound power and turn initiation precision.

Dalbello Dynalink

(dalbellosports.com)

Dalbello's Dynalink System holds the foot securely and prevents it from sliding forwards and backwards inside the shell giving the rider more stability, protection, and control.



Problem definition

Issues which occurred during the initial research.

Stability

You want to have a stabile but yet comfortable boot. A stabile boot equals a hard boot which usually means an uncomfortable boot.

Shock absorbing

The skier usually executes jumps and drops which results in large forces applied to the skiers foot.

Weight

A hard and stabile boot is constructed with a thicker plastic shell making it heavier.
You do not want to carry around any extra weight when skiing.

Durability

A ski boot is often treated rather brutally and needs to withstand rough conditions.

Fit

Every skier has a unique foot with different ergonomic needs.

Temperature

You want to have an enjoyable warm and dry climate inside a plastic boot which often is worn in snow, ice and subzero degrees.

Walk properties (grip, flexibility)

A ski boot needs to be useful when disconnected from the ski as well. A ski boot might need to walk, run, climb and dance.

Don/doff

A hard plastic boot with a tight fit is not easy to put on in the morning or remove after a day on the mountain.



Profile Target person

The survey included 33 questions regarding both typical behaviors, opinions and situations and also more direct about their own ideas and thoughts regarding ski boot design. I posted the survey in an equipment forum and on the blog and after two weeks I had received 131 answered questionnaires. Based on the answers I could make a target group profile and get an insight in how the ski boot users think. I also got important information about which existing designs the target group prefers. The survey can be reviewed on the attachments CD. Based on the survey a typical target person may be described as follows:



- Is between 15 and 20 years old.
- Shoe size is 42 to 43 (Europe size).
- Has been skiing since birth.
- Is an advanced skier.
- Skis 3 to 9 weeks a year.
- Skis mainly the Scandinavian mountains.
- Enjoys both deep powder off-piste as well as a well prepared park and pipe.
- Is into snowmobiles.
- Feels pain in the front side of the lower -- leg and the outer area of the front part of the foot when using their current ski boot.
- Values the boots ability to fit the foot most of all.
- Thinks that the way the boot looks is important.
- Claims that the Salomon SPK is the best looking ski boot.
- Would rather have a Italian sports car than a American pickup.
- Prefers a mountain cottage instead of a modern minimalistic villa.
- Wants me to design a ski boot with progressive forward flex, that is super stable, is extra comfortable around the lower leg, keep the toes warm, have a intuition liner and a clean and agile design.

Profile

Jon Örarbäck



Jon in British Columbia >>

- Professional skier and member of Nordica's International Freeski Team.
- Is 32 years old.
- Has grown up with skiing.
- Used to compete in the classic alpine racing disciplines.
- Later changed to compete in the more modern skiercross discipline in the X-games.
- Now he mainly just freeski big mountains.
- Skis approximately 5 months per year.
- Enjoys skiing the big mountains of the Alps and Canada.
- Is one of the men behind the Swedish Posse ski movie series.
- Besides skiing Jon enjoys skateboarding, motocross, running and doing carpentry.
- Currently rides with Nordica Blower 130 flex.
- His dream ski boot has an even hard flex with good comfort, warm and comfortable when walking. Styling wise he prefers a simple and clean appearance.





SCENARIO

Simon is 17 years old and has been skiing since he learned how to walk. He practices slalom and is pretty good but not great. His father used to compete a lot and finished 8th in the Swedish Championship of 1976 and he pushes Simon to practice hard. What Simon is not telling his father is that he is dreaming about a X-games slope style gold medal far from a 8th place in the Swedish Championships.

Finally it is weekend! No school and slalom training until Monday. Simon and four of his friends are up early and among the first in line to the lift that will take them to the top station at 1274 m. When they arrive at the top station they hike about 200 meters east around a big cliff. They put on their skis and ski down thru the powder until they reach the treeline. They have a favorite spot here where they use to build jumps. They shape a jump in about an hour and have to sit down and relax for a while. Soon they regain their powers and are ready to start jumping. Today Simon is positive that he will land his first perfect 900 spin. When you jump you start by hiking back uphill for about 50 meters to gain speed, you try to regulate your speed, you hit the kick of the jump and fly off into the air trying to execute the trick you had in mind. A second later you will hit the ground, hopefully standing up and feeling proud of yourself. When you come to a standstill you take off your skis put them on your shoulder and start hiking back up again.

This Simon and his friends do for about three hours before they decide to go all the way down thru the forest via the park and stop for lunch.

The rest of the afternoon they spend back up the mountain jumping and enjoying life in the best way possible.

Simon finally lands the perfect 900 spin, unfortunately his friends claims that no one saw his landing and that it therefore does not count!

Demarcations »

||
I decided to narrow down the focus points to: stability, comfort (especially around the anterior musculature of the lower leg), walking properties and keeping the skiers foot warm and dry. This decision is based on the result of the target group survey, research, available resources and time.

The Brief

I would like to design a ski boot which applies to how the ski culture has evolved. It could be used and experienced both as a park/pipe boot and a deep powder backcountry boot. The user wants to be able to ski the whole mountain.

“Put the boot on, take the lift up the mountain, hike for twenty minutes, surf down the mountain, execute a 360 spin off a cliff, ski thru the forest, do some high speed turns in the pist, hit everything in the park, drop in fakie in the halfpipe, stop for lunch then take the lift back up again and again and again..”

I would like the ski boot to be easy to put on, be warm and dry, have good walking properties, give support, absorb shocks, be comfortable and have an esthetic appearance that suites the target group.



MF = Main Function
N = Need
W = Wish

Functional Analysis

Connect	Ski	MF
Give	Support	N
Support	Balance	N
Allow	Flex	N
Sustain	Usage	N
Protect	Foot	N
Be	Comfortable	W
Lower	Weight	W
Prevent	Moisture	W
Allow	Walking	W
Keep	Warm	W
Absorb	Shock	W
Easy	Handle	W
Easy	Entry	W
Easy	Exit	W
Look	Appealing	W



INSPIRATION



3 piece construction of Full Tilts Bumblebee ski boot



The warm and comfortable design of snowboard boots



The buckle mechanism of snowboard bindings



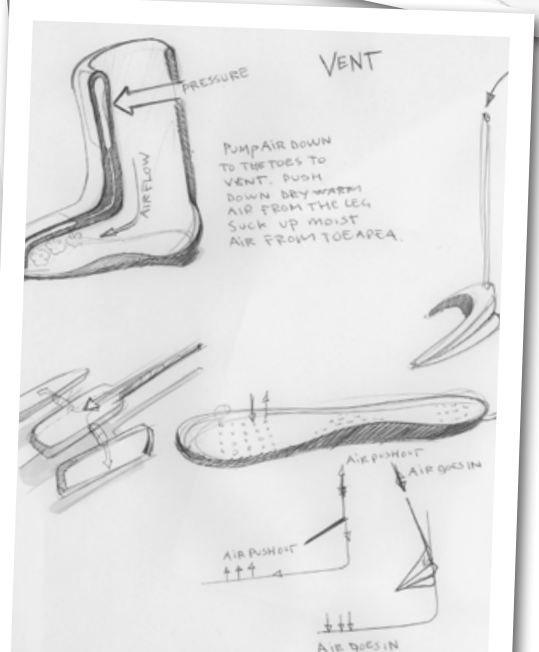
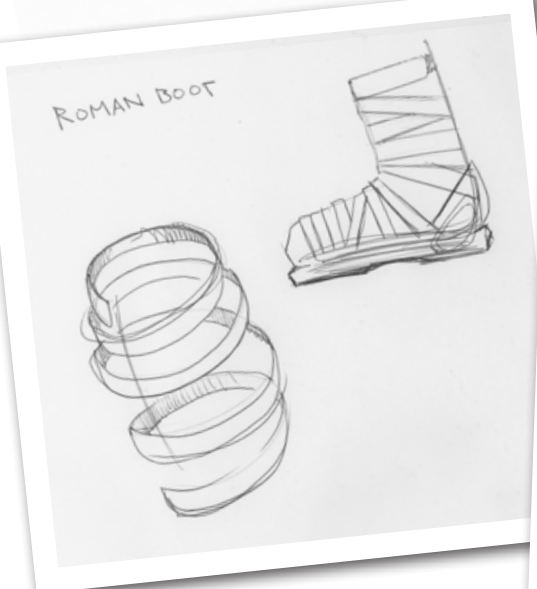
The tongue design of Nikes Air Jordan 19 basketball shoe



The appearance of Nikes Air Jordan 6 basketball shoes



Concept Development



I started with a brainstorm phase where I sketched on lots of different ideas, trying to have my research results in mind. My discussions with Chuansi Gao and Kalev Kuklane in the climate laboratory played an important part in the birth of the Pump Ventilation Liner concept.

The Pump Ventilation Liner uses the forces produced by the movements of the skier's foot to pump air thru the boot transporting moisture away from the foot.

Another concept was the "Flexaton" an idea that involved a hard outer skeleton wrapping around a snowboard boot inspired liner. The skeleton has two different flex zones giving the boot a progressive forward flex and

good walking properties. With changeable "flex inserts" you could change the stiffness of the boot.

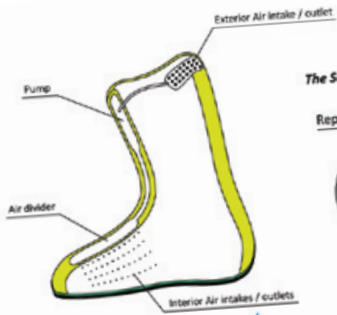
The "Air Jordan" concept was my third concept. It had some styling elements inspired of the Air Jordan shoes. It is basically a three part construction with an independent replaceable flex tongue. The main difference is that the lower part of the shell around the toebox is cut opened and replaced by soft impregnated leather. This should result in better foot climate due to the fact that the boot "breaths" thru the leather part. It also gives the toes a more generous space which was requested by many users in the survey. Another positive quality of the concept was that the cut away hard material

would make the boot less stiff in a good way giving it good walking properties.

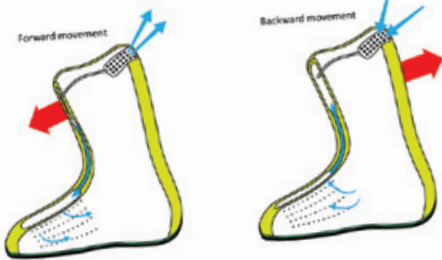
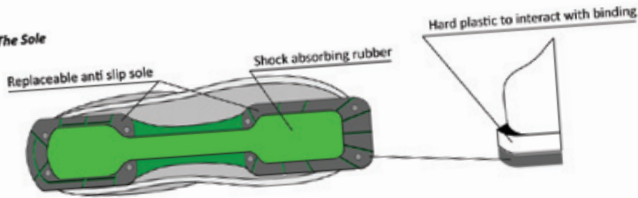
Both "Flexaton" and "Air Jordan" had ratchet designed tightening buckles inspired by snowboard bindings buckle system. Straps is drawn under and around the boot and then attached to the ratchet buckles. This makes it possible to tighten the boot evenly around the foot. The Pump Ventilation Liner could be combined with both concepts.



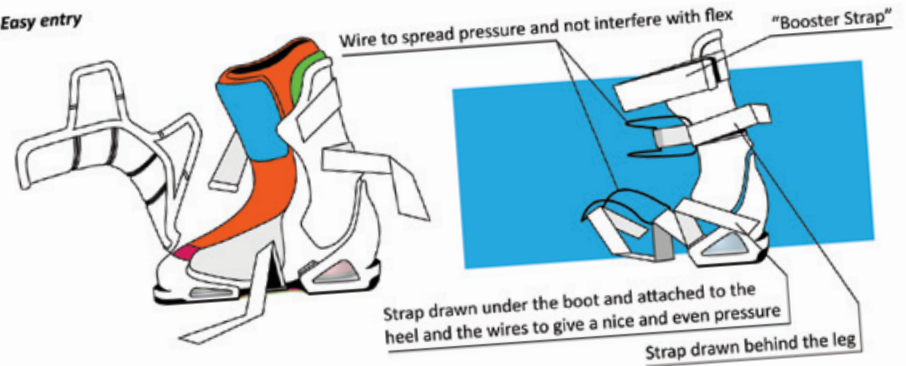
Concept Air Jordan



The Sole



Easy entry



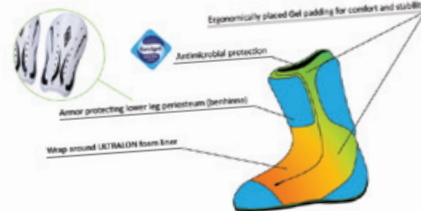
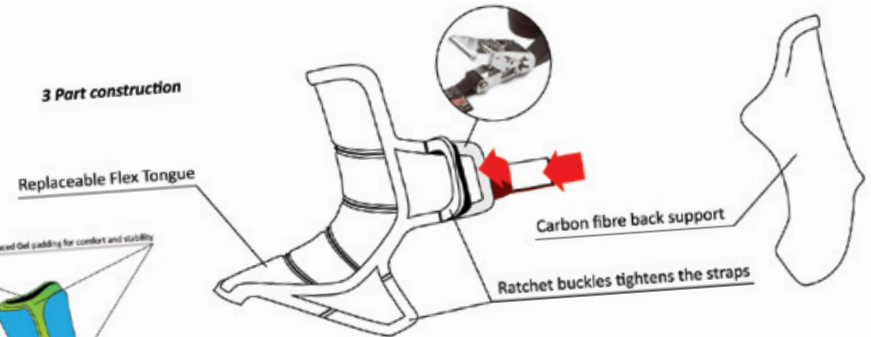
Concept Flexaton



Basic Idea



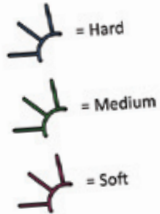
3 Part construction



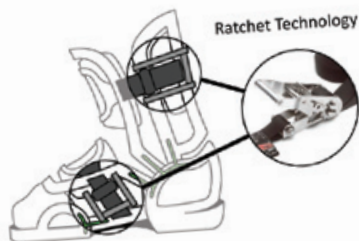
PU main construction reinforced with Carbon fibre and with a leather lining for comfort, ventilation and warmth

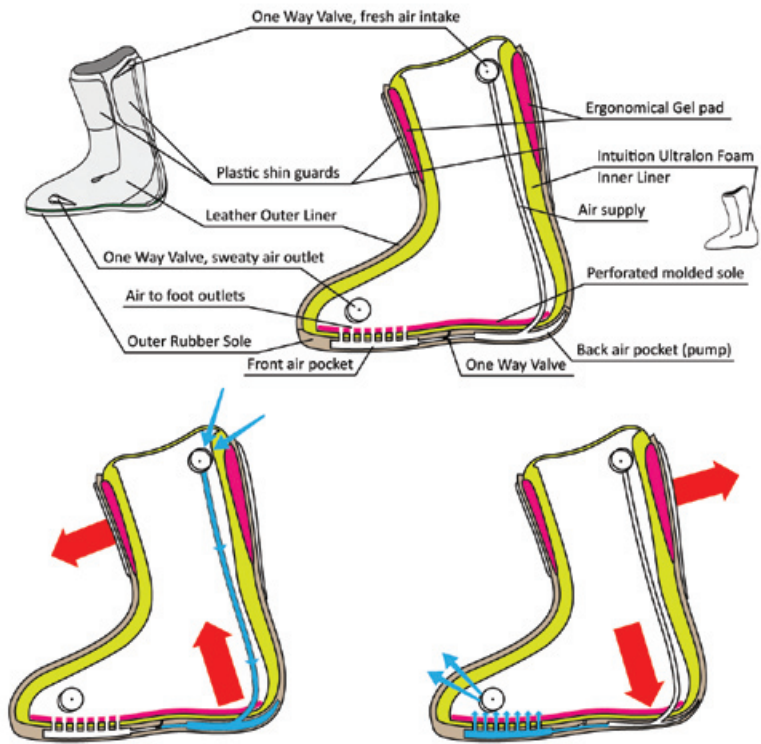
Leather part for comfort

Flex Inserts



Ratchet Technology Buckles





Concept Refined

I published illustrations of the concepts on the blog to get feedback from the target group. I received comment on all three of them. They thought that the Pump Ventilation Liner looked really interesting but distrusted the primary layout of the technology and came with useful input how it could be improved. The "Flexaton" concept did not receive as much interest. Only a few comments about which material I would use for the inserts. My own opinion is that it looked a bit weak compared to the "Air Jordan". The "Air Jordan" received positive feedback. Not so much constructive, more commendations that it looked cool. A general comment was to keep refining the walking properties.



Considering the feedback I now merged the Pump Ventilation Liner with the "Air Jordan". I used the input from the comments and discussed and sketched on a new solution together with Chuansi Gao. This resulted in a trustful and more efficient new technical layout of the liner. I fine tuned the design of the shell and made some changes how the buckles are fastened. Instead of having a leather covered opening in the shell I made an entire outer liner of leather and let the hole in the shell be open. To further improve the walking properties I designed a titanium frame to be positioned in the sole of the boot. The frame is designed to be "bendable" only upward and stiff in all other directions. This will support the foot's biomechanical properties and make the boot soft and stiff in the right places.

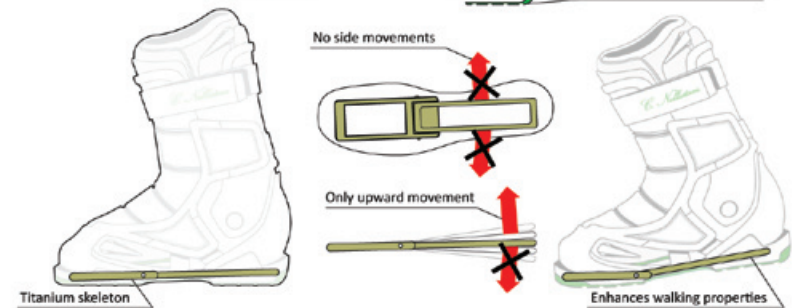
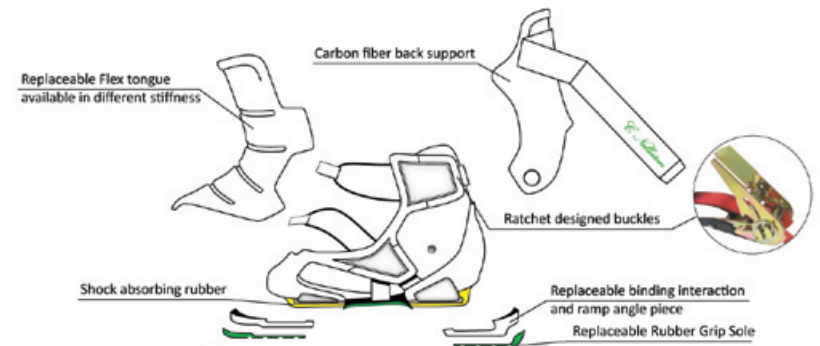


Outer Shell:
Polyurethane
Carbon fibre
Rubber

Assembled Liner

Outer Liner:
Fully impregnated Leather
Plastic
Rubber
Ergonomic Gel pads

Intuition Inner Liner
Ultralon Foam



Final evaluations

I now published illustrations of the final concept on the blog and received good feedback.



Examples of comments on the final concept:

“You got really good ideas! ! Would be really nice to see your design in a real product.”

“Looks Reeveally Fresh !!.”

“Must say that this ideas looks very interesting.”

“Well done.”

F_S_B_C

Freestyle Ski Boot Concept

With a big portion of self-confidence I now made a digital 3D model from which I could generate realistic renderings of the design. I also made a couple of color variations. I showed Jon Örarbäck the renderings and he reacted by sending: "You guys must get in contact with this guy and see his work. Seriously this could be taking Nordica boots where we want them!!" to Nordica's ski boot design division. This I take as I succeed well in designing a freeride ski boot!





F_S_B_C DESIGN

walking properties. To prevent slipping and falling I added a thin soft rubber outer sole with an anti slip pattern similar to a normal walking boot.

All parts of the boot is changeable which gives the skier the opportunity to custom build their personal boot and it also gives the boot a long lifetime which makes it cheaper for the skier and better for the environment.

The design is basically a 3 piece construction with a lower Poly Urethane part, a carbon fiber flex tongue and back support. The front of the lower part is open thru to the liner to soften it and to improve walking properties, ventilation and toe space. The flex tongue and back support is offered in different stiffness. The liner has an inner foam intuitions part for comfort and an outer leather soft part for warmth and ventilation. The leather part also contains a ventilation system which uses the skier's foot movements to pump dry air thru the ski boot. The ski boot is tightened using two straps and a buckle with ratchet technology. One strap pulls the foot towards the heel and the second strap creates a tight fit between the shin and the calf. To further improve the fit a "Booster Strap" is positioned on the cuff. Inside the sole I have placed a Titanium construction which is stiff in all directions except upwards making the boot better follow the natural foots movements and improving

Components

Of the Freeride Skiboot





Design
Features
 Of the Freeride Skiboot



CrazyChameleont



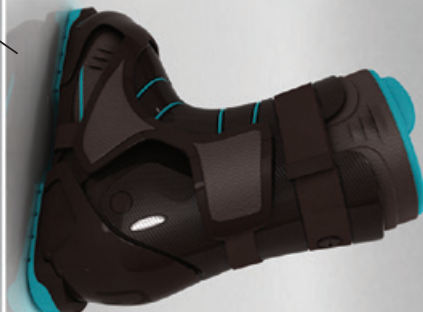
Vintage 90ies



Tennis



ChocoTurc



colours

Of the Freeride Skiboot

Nightrider





› Discussion

Due to lack of time and resources I did not construct a physical prototype to prove the efficiency of my design. The Vipet survey would have been interesting for the aesthetic expression. More material investigations could also have made a big impact on the result.

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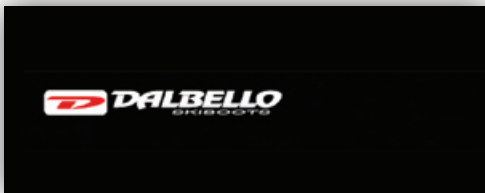
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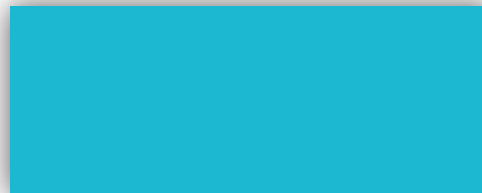
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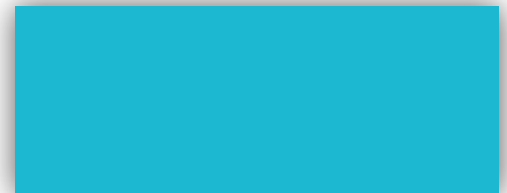
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