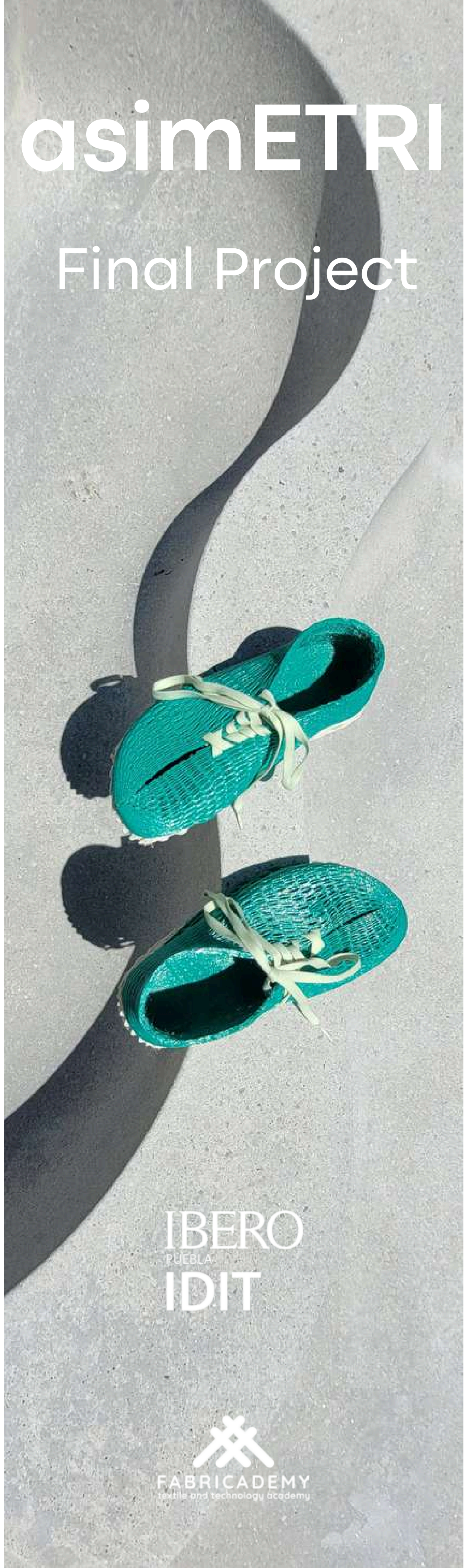
asimETRI

Final Project



IBERO
PUEBLA
IDIT

FABRICADEMY
textile and technology academy

by MAR

Fabricademy 2024 - 2025

CONTENTS

STATE OF THE ART

Orthopedic Insoles as Orthotic Devices

Orthopedic insoles are medical devices designed to correct, compensate for, or improve foot function and body posture. These insoles are considered orthotic devices (orthoses) because they support, align, or enhance the biomechanics of the foot and gait.

What is an Orthosis?

An orthosis is an external device designed to modify structural or functional aspects of the musculoskeletal system. It is used to:

- Correct misalignments (such as leg length discrepancies).
- Evenly distribute pressure, reducing impact on certain areas of the foot and preventing issues like plantar fasciitis, heel spurs, or joint overload.
- Provide support and stability, improving posture and reducing the risk of injuries.
- Relieve pain and prevent complications in people with flat feet, high arches, limb length differences, diabetes, or other conditions affecting gait.

Types of Orthopedic Insoles

1. Functional Insoles: Designed to improve foot biomechanics, correct foot strike, and align the body.
2. Postural Insoles: Correct postural imbalances and alignment-related issues.
3. Cushioning Insoles: Absorb impacts and redistribute pressure, benefiting individuals with joint problems or those engaged in high-impact activities.
4. Custom Insoles: Manufactured to meet the specific needs of the user.

Materials and Manufacturing
Insoles can be made from rigid, semi-rigid, or soft materials, depending on the required level of support. Common materials include:

- Polymers and resins for increased rigidity.
- EVA foams or gels for cushioning.
- Carbon fiber for lightweight yet durable support.

Tutorials

You tube:

3D Beast
Oficina Paramétrica

Referenses

Asymmetric Lower-Limb Malformations in Individuals with a Novel PITX1 Mutation, this study analyzes how mutations in the PITX1 gene can cause asymmetric malformations in the lower limbs. While it does not specifically focus on the use of insoles, it provides insights into the genetic basis of bone asymmetry.

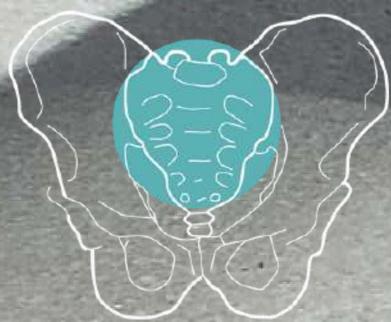
Understanding Leg Length Discrepancy (LLD), this article from Foot Levelers explains the causes of leg length discrepancy, which can have a genetic origin, and discusses how custom orthotic insoles can help correct this asymmetry.

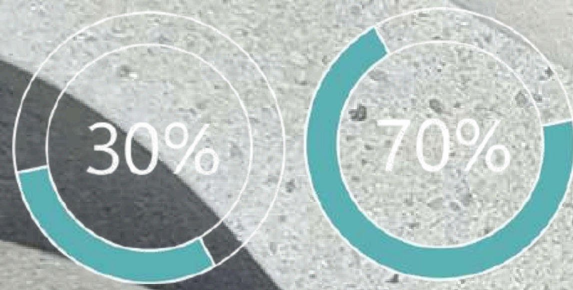
Leg Length Discrepancy: Anisomelia Causes & Treatments, the Hospital for Special Surgery (HSS) provides a detailed overview of the causes of leg length discrepancy, including genetic factors, and explores various treatment options, including the use of orthotic insoles.

Teachmeanatomy, this page discusses the arches of the foot: two longitudinal (medial and lateral) and one transverse. These arches, formed by the tarsal and metatarsal bones, along with ligaments and tendons, allow the foot to support body weight and absorb impact during activities such as walking and running.

The page "Anatomy, Pathology and Treatment of the Foot & Ankle" provides a detailed overview of the anatomy of the foot and ankle, highlighting that the foot consists of 26 bones and 30 major joints, bearing up to 1.5 times body weight when walking and up to five times when running. It covers common causes of pain in this region, including soft tissue injuries such as Achilles tendinopathy, ligament sprains, and muscle injuries, as well as bone and joint issues like osteoarthritis and stress fractures.

Introduction



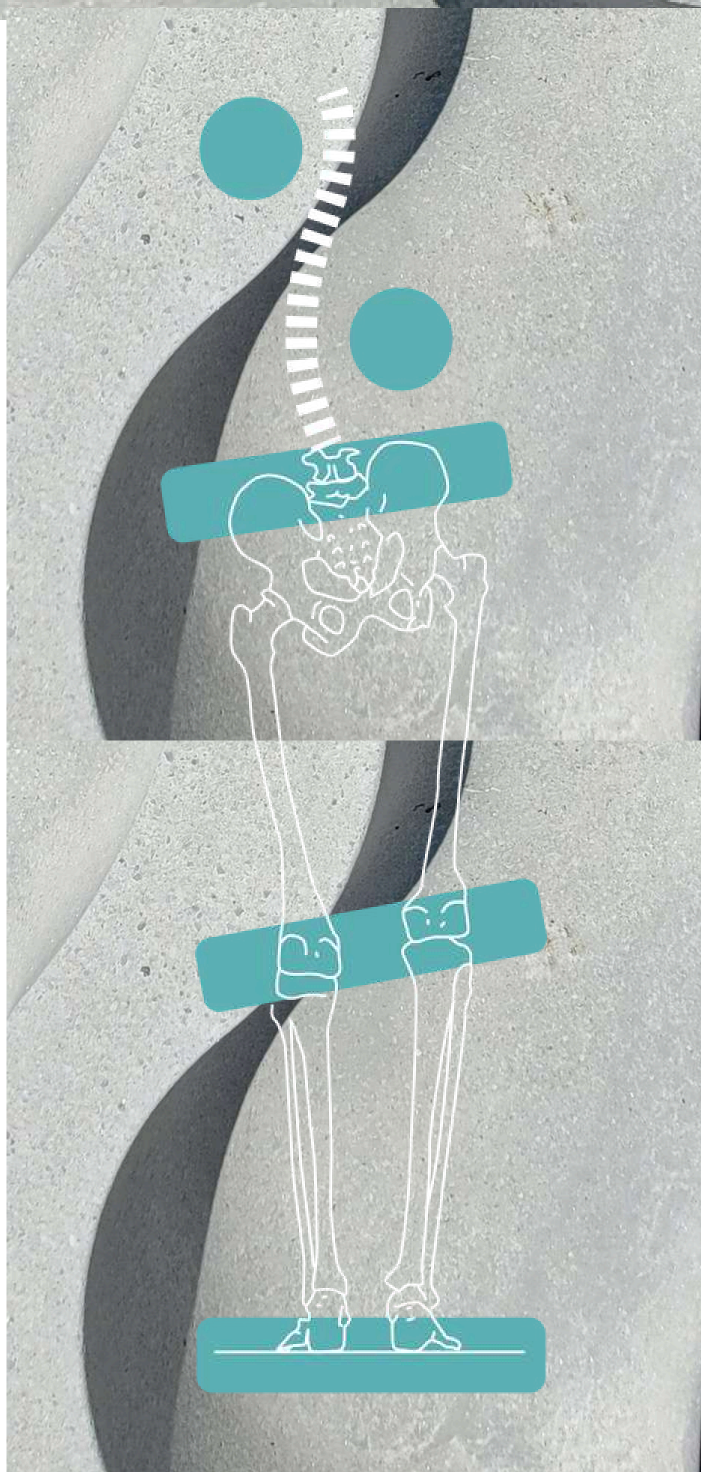


(1) Este es el rango de porcentajes de las personas que tienen lower limb discrepancy.

asiMETRI is a project that stems from my leg length discrepancy (also known as limb length inequality). While many people don't even notice this condition, in my case, it significantly affected me, causing hip and spinal issues. I experienced severe hip inflammation because the sacrum and pelvis tend to tilt or rotate, leading to postural imbalance, joint wear, and lower back or sacroiliac pain.

My leg length difference is approximately 1 cm. Typically, for discrepancies between 1 and 3 cm, custom insoles are recommended. However, since I did not address the issue in time, I had to wear a brace for six months and start using custom-made insoles. This was possible thanks to several tests conducted by my orthopedist, which were crucial for accurately diagnosing my condition.

It is important to highlight that, without the guidance of a specialist, symptoms can often be misinterpreted. For instance, there is a condition known as "functional leg length discrepancy," which is not caused by an actual bone difference but rather by muscular or postural factors. That is why consulting a professional is always essential for obtaining an accurate diagnosis and appropriate treatment.



THE PROBLEM

In my daily life, I need to wear orthopedic insoles, which are essential for preventing complications caused by the difference in length between my legs. This condition is hereditary, as my mother also has it, meaning it is not acquired but rather part of my genetics. However, I was not diagnosed until I was 31, as I had always assumed my discomfort was due to poor posture. This led to acute pain caused by inflammation in my hip, eventually requiring me to wear an orthopedic brace to correct my spinal alignment.

The treatment involves using insoles that function as orthotic devices, allowing me to move with greater comfort and stability while providing security in my movements.
However, after analyzing my daily routine, I identified several challenges associated with using insoles:

- Spending extra time placing them in my shoes.
- Frequently cleaning them to prevent fungal growth or unpleasant odors.
- Being unable to wear sandals or open-toed shoes, as the insoles are too large for this type of footwear.
- Avoiding narrow shoes, as they tend to deform the insoles and compromise their functionality.

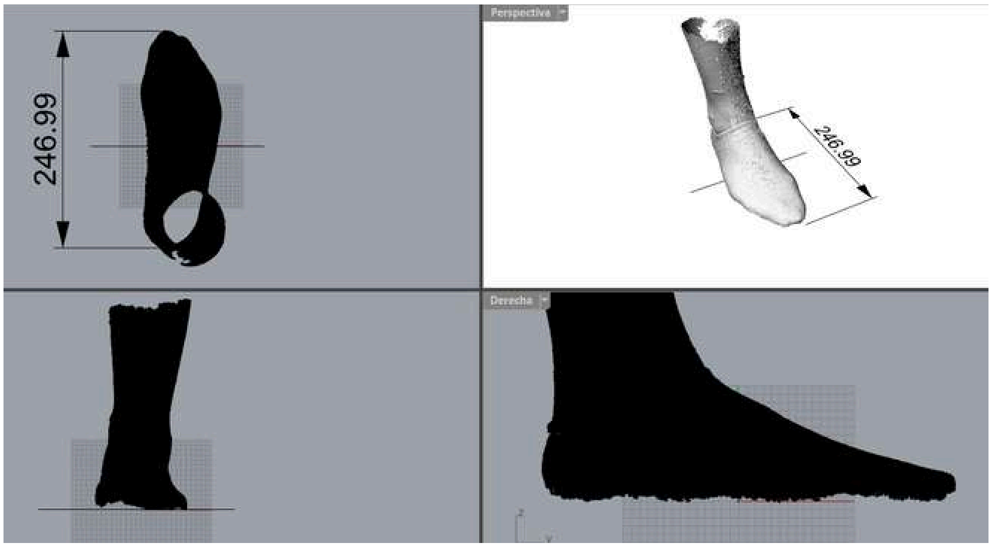
These challenges became the starting point for innovation, motivating me to design a project that enhances my daily experience. My goal is to streamline the process and enable the use of open footwear without limitations.

These are the shoes in which I can't use my insoles


ANALYSIS

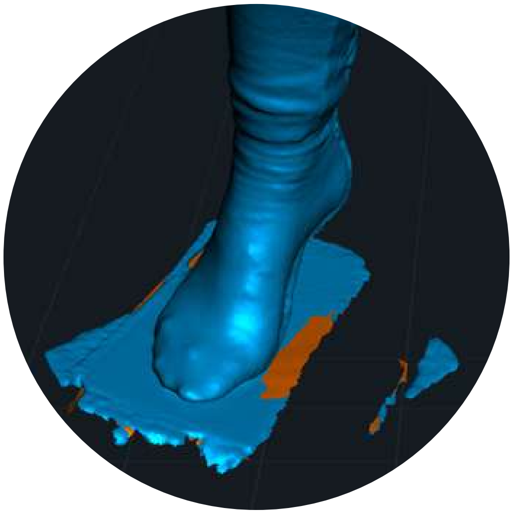
Scanning my feet

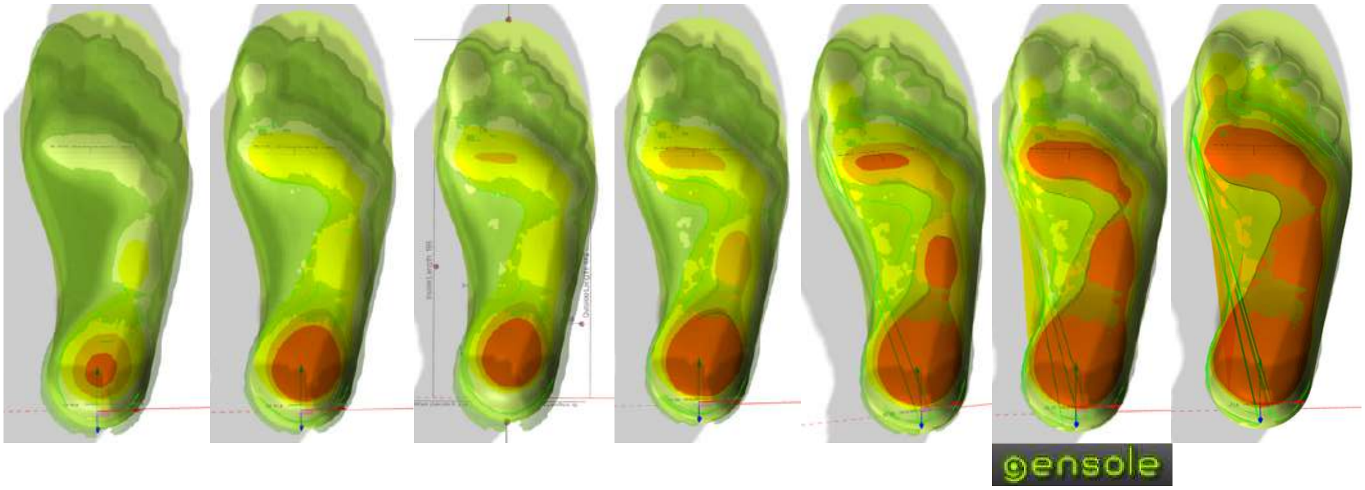
I scanned my foot using the machine HandySCAN 3D|SILVER. This technology is not yet available in our FabLab, but a team came to give us a demonstration, and I asked them to help me with the scan, as it is rare to have the opportunity to use such a specialized product.



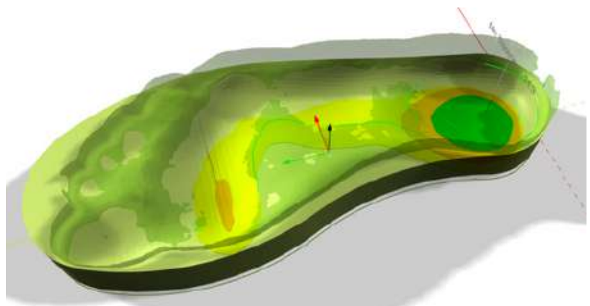
For my next scan, I made a mold to obtain a positive impression of the plantar pressure of my foot while standing for about 5 minutes.

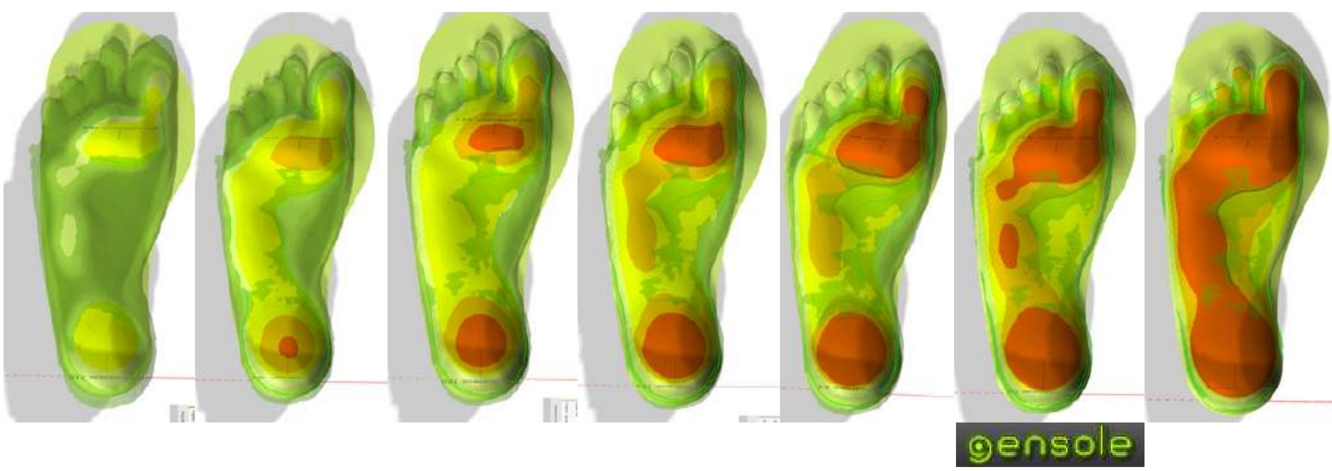
Scanned the molds using the CR-Scan Ferret 3D Scanner and cleaned up the point cloud in the software provided by the same manufacturer.



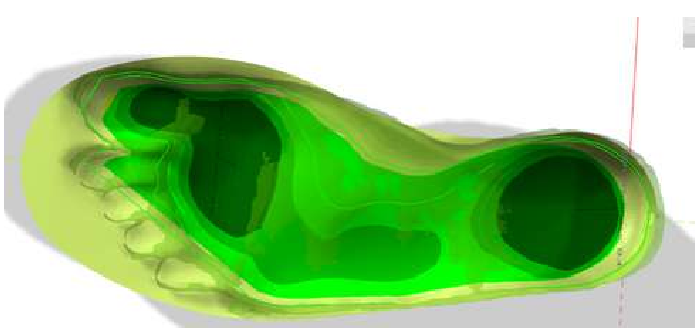


Right foot





Left foot




DIAGNOST

Using the 3D design of my foot soles, captured while applying pressure with my own body, I conducted a foot pressure test with the Gensoles project. This test allowed me to observe the difference in pressure between my left and right foot. While I had some initial assumptions, I decided that the best course of action was to consult the orthopedic specialist who had previously treated me. His analysis would help assess my current condition, my progress or setbacks, and his perspective on my workflow for this project.

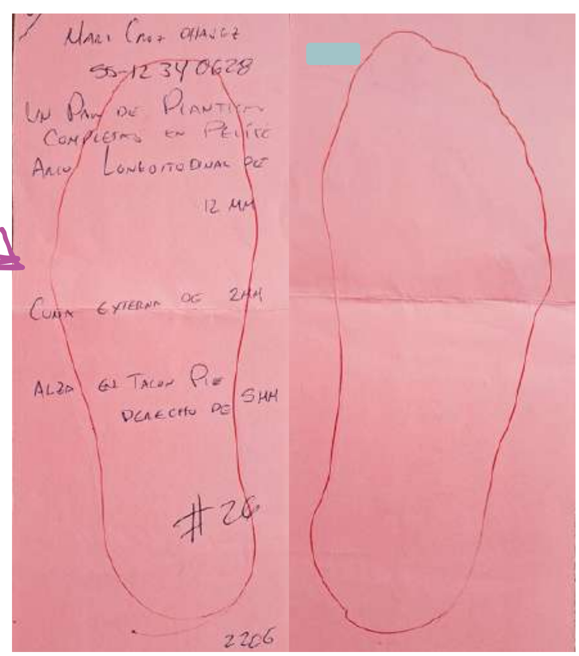
With the help of a more professional diagnosis, my doctor informed me that the test I had previously undergone was a full-body densitometry.

I repeated this study, and the results showed that my spine had improved. However, he recommended that I exercise more due to the long hours I spend sitting at the computer. My hip still had some residual issues that could be improved with physical therapy and anti-inflammatory medication.

Regarding the insole, he specified the key adjustments needed to correct my gait:

- 12 mm longitudinal arch to improve arch support.
- 2 mm external wedge to correct joint alignment (my heel has a slight curvature because I put more weight on the outer part of my foot). In my foot pressure test, it is evident that the red marking on my right foot is less evenly distributed compared to my left foot. This is due to the pressure imbalance I mentioned earlier.

Doctor's notes:
"His notes indicate a pair of full insoles in Pelíre: 12 mm longitudinal arch, 2 mm external wedge, and a 5 mm heel lift for the right foot, size 26."



This is the analysis I requested:
Full-body densitometry, with a cost of 584.25 MXN.

Monto total	$ 584.25
Ahorro digital	$ 194.75
Forma de pago	Pagado en línea
Fecha del pedido	28-02-2021
Hora del pedido	10:06:50

Descargar Cotización

El resumen de tus estudios

DENSITOMETRIA DE CUERPO ENTERO

Precio $ 584.25

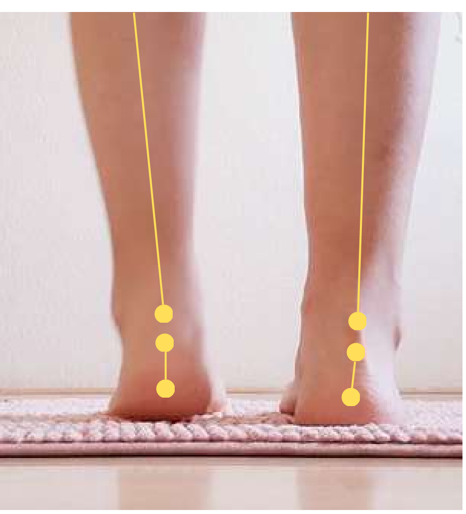
- 5 mm heel lift for my right foot—for which I am grateful I consulted a specialist, as an up-to-date diagnosis is crucial. This adjustment is particularly important because, without this assessment, I might have mistakenly increased my right foot lift to 1 cm instead of the 5 mm it actually needs, potentially worsening the issue.

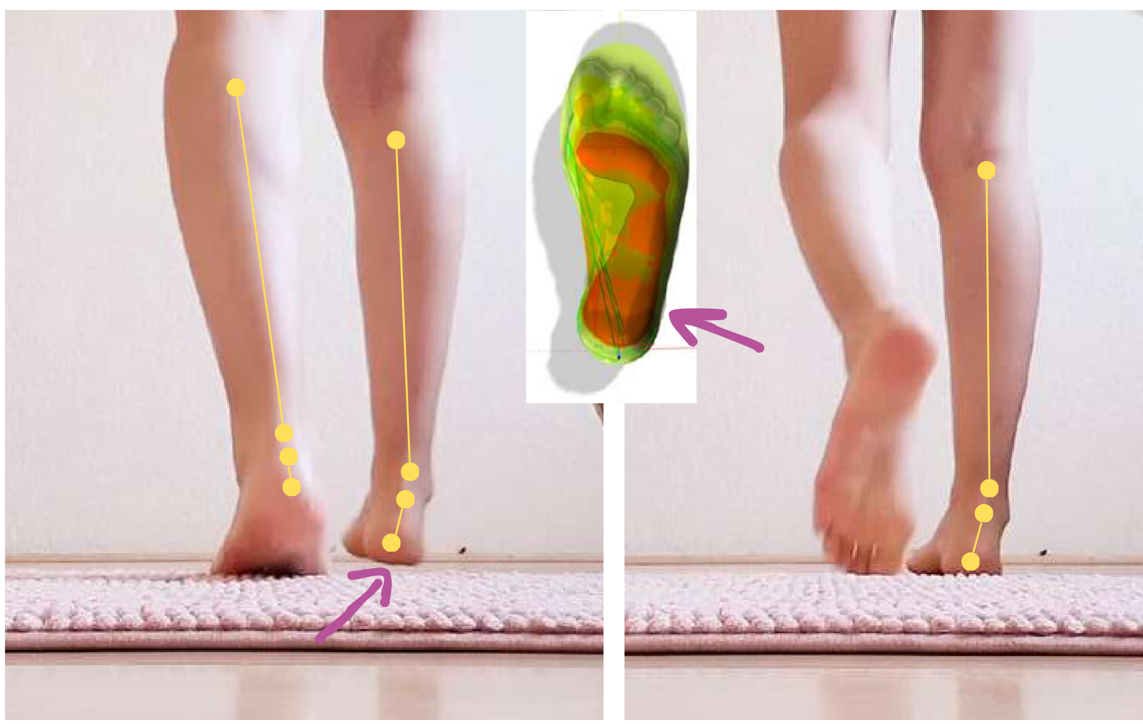
- In contrast, my left foot distributes pressure more evenly.

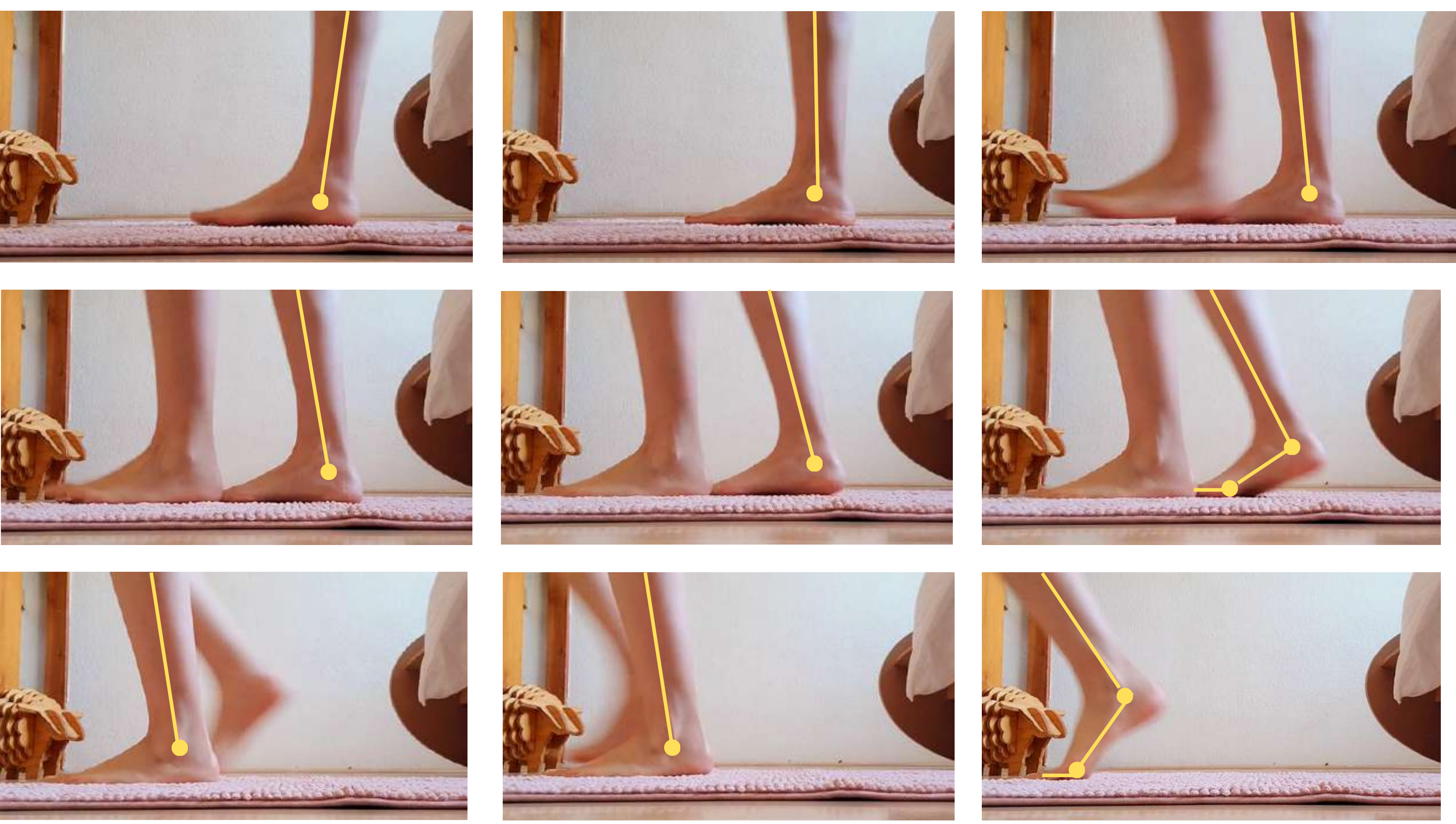
I was also informed that my insole can be considered an orthotic that helps with my sacral condition. The imbalance I have directly affects this bone, which is a triangular structure at the base of the spine that connects the spine to the pelvis.
When a person has one leg shorter than the other, the sacrum and pelvis can tilt or rotate, leading to postural imbalance, joint wear, and lower back or sacroiliac pain.
Because of this, professional supervision is essential. Therefore, I will be closely monitoring the insole I created to ensure its effectiveness.

Over-supination

Over-supination (or excessive supination) in the gait occurs when the body's weight shifts too much to the outer edge of the foot while walking or running.





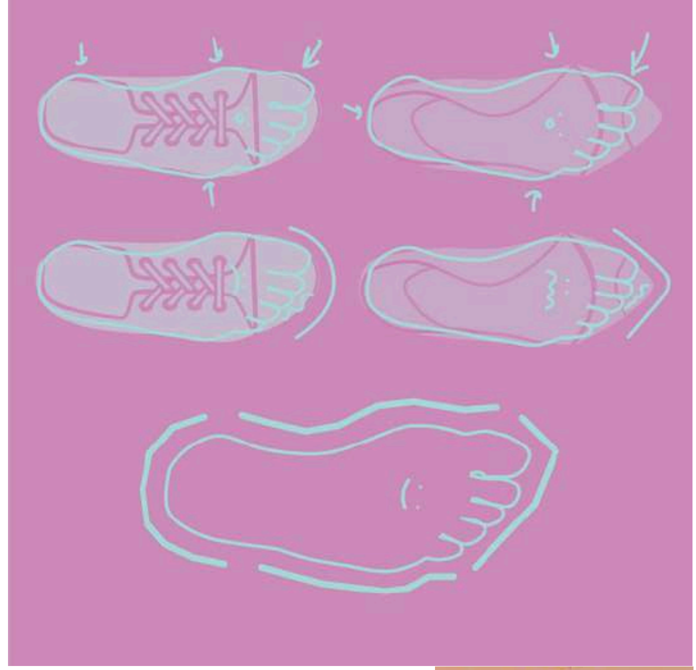


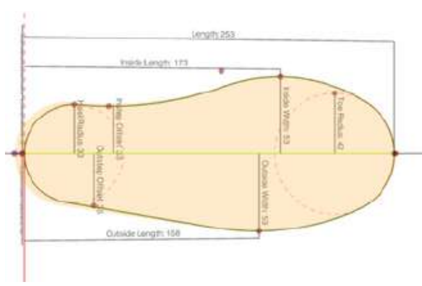
Generic insoles

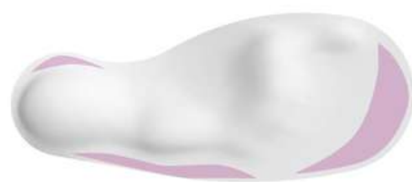
With the intention of further analyzing my foot mechanics, I continued examining common shoes and insoles. These often alter the natural position of the feet in general, our feet adapt to the shape of the shoe when, ideally, it should be the other way around.

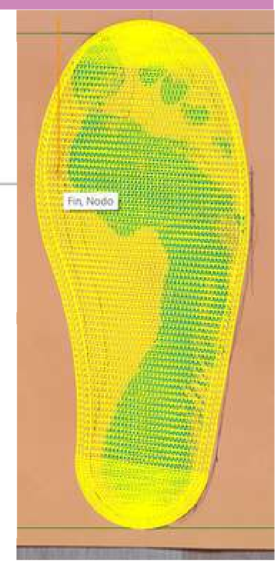
In this image, the following points can be observed:

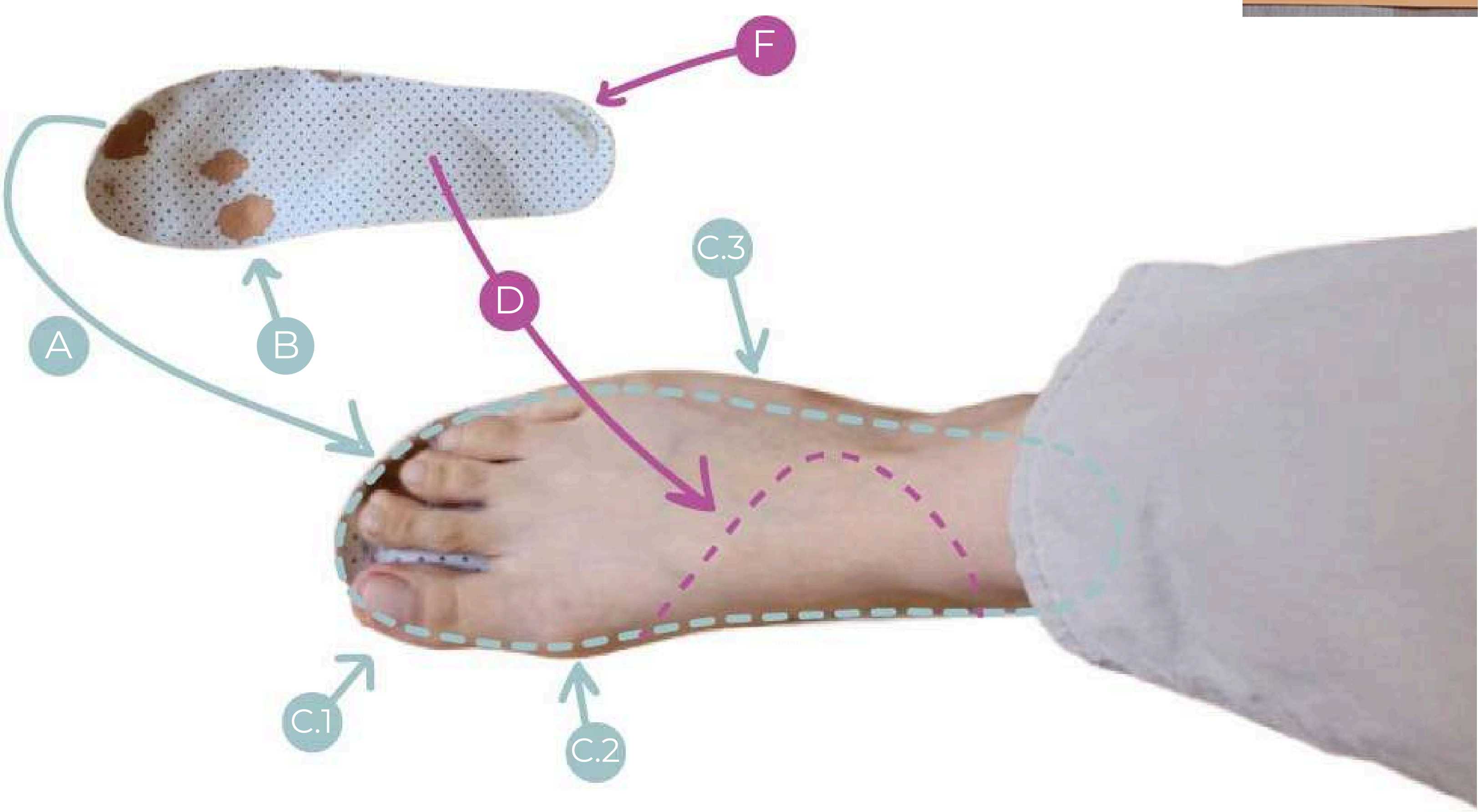
- A. Wear marks in the toe area because the insole is larger than it should be in this region.
- B. Wear in the metatarsal ligament area.
- C.1 My toe extends beyond the insole.
- C.2 The ligament area also extends beyond the insole.
- C.3 My foot is noticeably larger than the generic insole.
- F. The arch support follows a standard shape, which does not fully adapt to my foot. Wear marks on the right side of the insole indicate that I exert more pressure in that area.












DESIGN

Sketches

I wanted to create some sketch proposals to experiment with how a parametric design would look on the shoes.

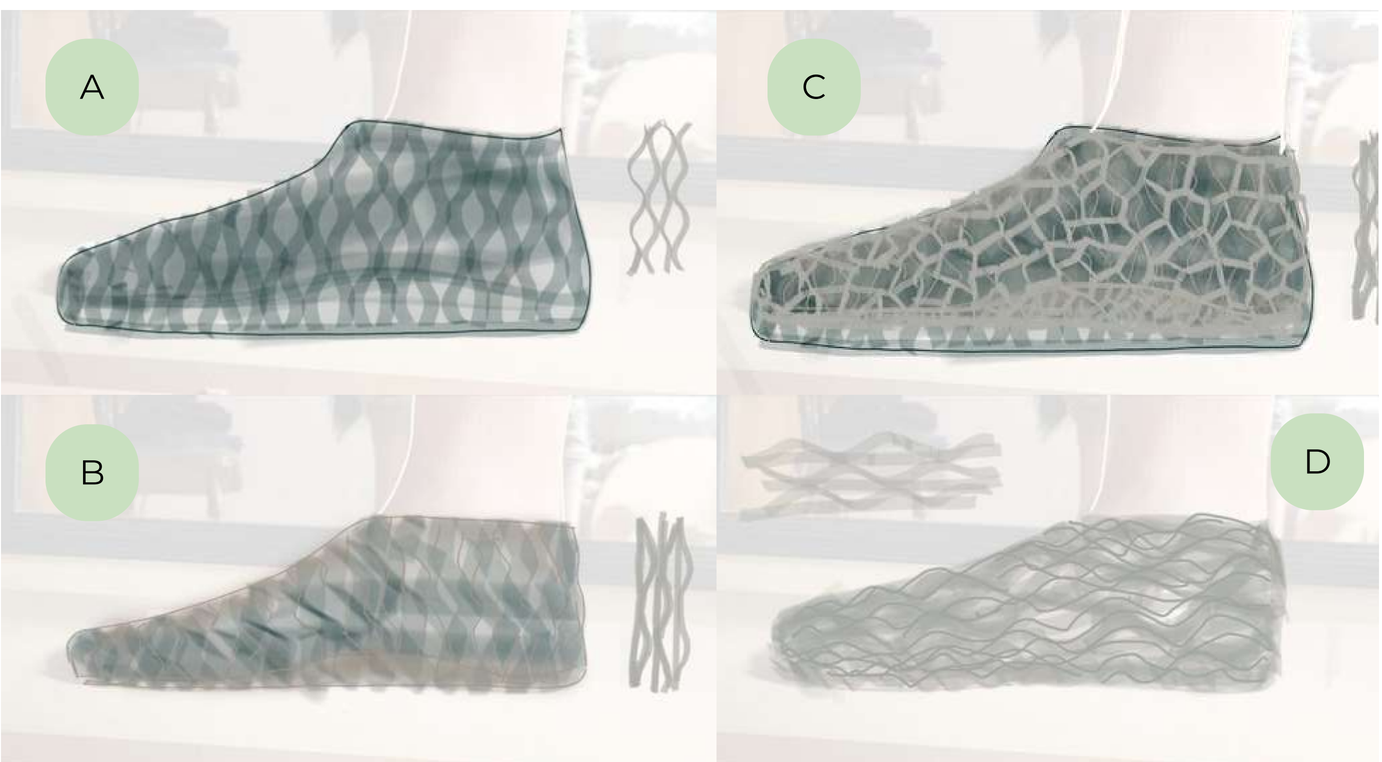
In Proposal A, I started with a defined pattern, but I realized it wasn't bold enough.

In Proposal B, I aimed for a more organic interwoven pattern while maintaining the vertical direction from Proposal A.

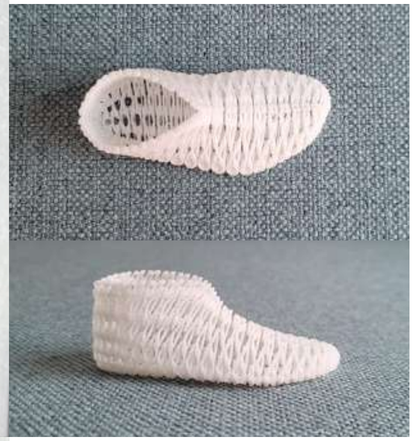
In Proposal C, I incorporated what I had learned about parametric design using the Voronoi tool. This approach introduced a different perspective from my initial ideas, which is why I decided to explore it further.

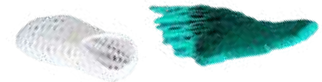
In Proposal D, I applied the same design principles from Proposals A and B but arranged them horizontally.

For the next stage, I will focus on the proposals that best represent the organic variability of unique visual elements—just like unique bodies. With that in mind, I have chosen to move forward with Proposals B, C, and D.

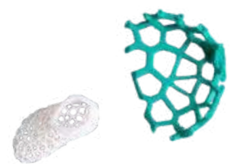


I created this design by following the tutorial from the creator of the 3D Beast channel, who uses parametric design in Grasshopper.





I really enjoyed working on this design. In this version, I experimented with a variation to increase the shoe's width.



I found this design more interesting because the sole elements are closer together, which could potentially provide better weight support.

INSOLE DESIGN

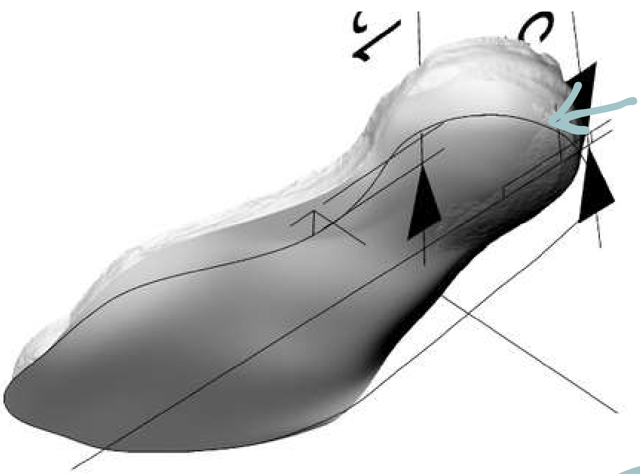
As a starting point, I began designing the insoles by considering the organic shape of my right foot and the following key aspects:

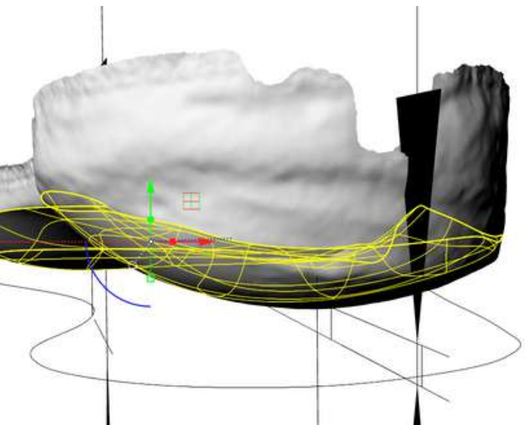
1. Correction for Over-Supination: The insole should maintain the natural shape of the foot while incorporating a 2 mm elevation in the specified area, as recommended by the orthopedist, to correct over-supination.
2. Compensation for Bone Asymmetry: A 5 mm heel elevation and a 12 mm arch will be added to improve alignment and weight distribution.

Heel Anatomy and Its Importance in Walking

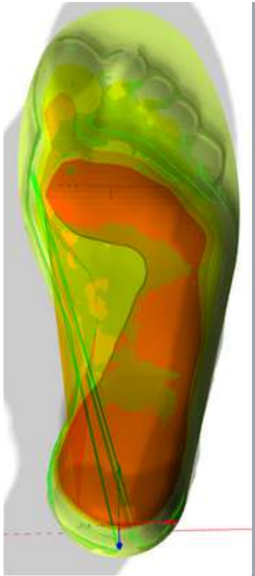
The primary bone of the heel is the calcaneus, one of the seven tarsal bones located in the back of the foot. It plays a crucial role in stability and locomotion by:

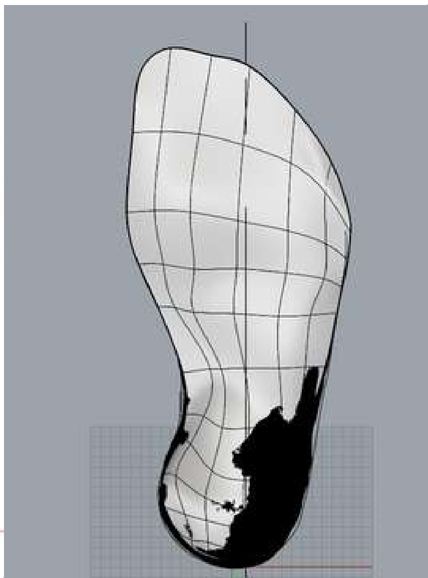
- Forming the base of the heel and absorbing impact while walking or running.
- Providing a large surface for muscle and ligament attachment.
- Acting as the first point of support for the foot during gait.
- Working with the talus to form the subtalar joint, which enables side-to-side movement of the rearfoot.





2 mm external wedge





Foot Arch Structure

The foot arch consists of several tarsal and metatarsal bones that work together to distribute weight and provide stability.

Tarsal Bones That Form the Foot Arch:

Calcaneus: The largest bone in the foot, forming the base of the heel.
Talus: Sits above the calcaneus, connecting the foot to the leg.

Navicular: Located in front of the talus, contributing to arch stability.

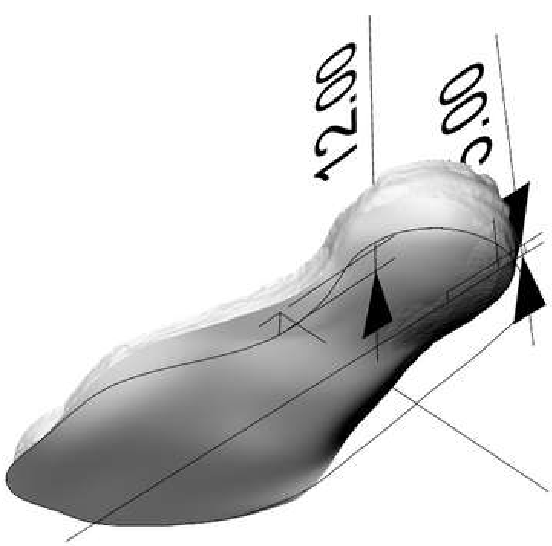
Cuboid: Positioned on the lateral side of the foot, in front of the calcaneus.

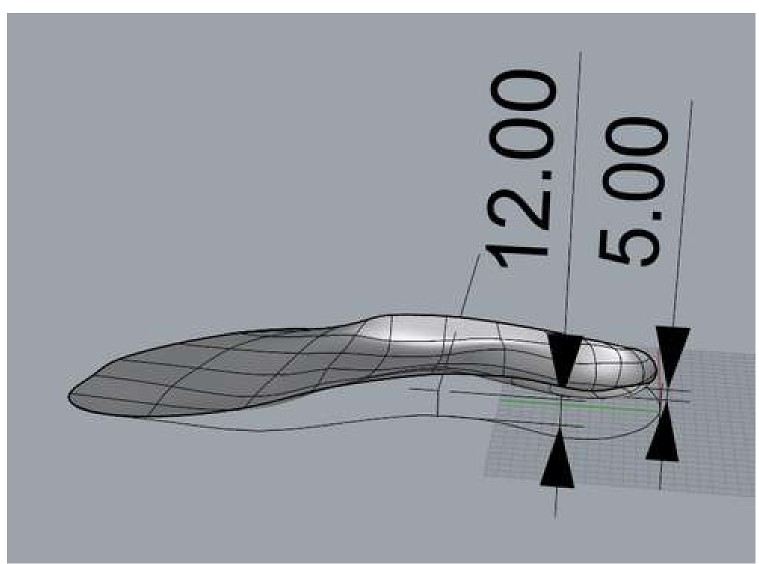
Cuneiforms: Three aligned bones located in front of the navicular.

Metatarsal Bones That Form the Foot Arch:

- First metatarsal
- Fourth metatarsal
- Fifth metatarsal
- Heel Medical Conditions
- The heel is a prominent bony structure that plays a vital role in body stability. However, it is susceptible to various medical conditions, including:
- Plantar fasciitis
- Heel spur
- Heel bursitis

The toes and the arch of the foot can bend while walking due to various conditions. For this reason, the toe area is slightly wider, allowing them to naturally expand when flexing the foot to push off for the next step.



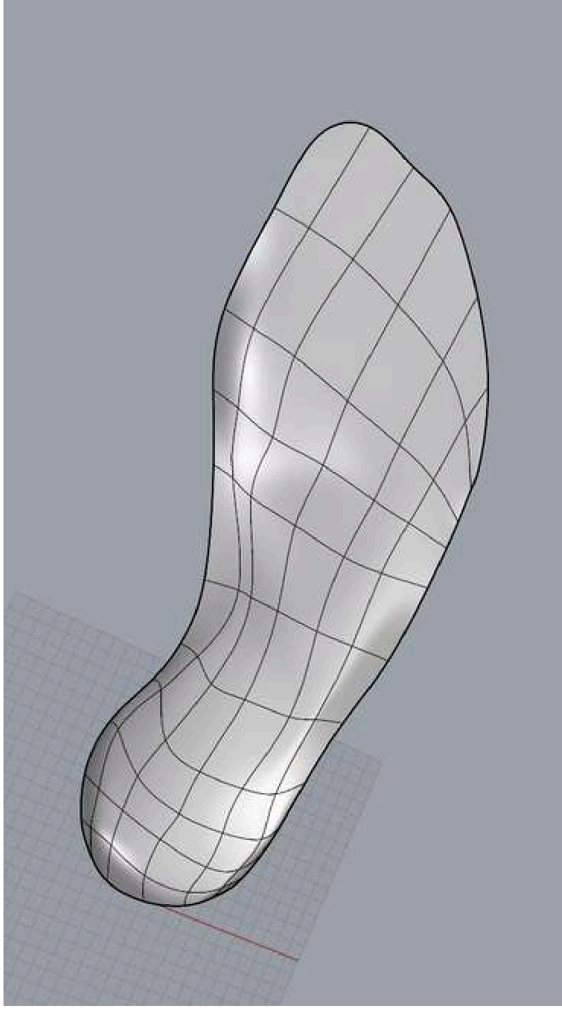


Insole Ventilation

Ventilation was a key aspect of the insole design, as closed shoes tend to trap heat, promoting bacterial growth, which can lead to bad odor or, in the worst case, fungal infections.

To prevent this, I incorporated a system of grooves and strategically placed openings throughout the insole. On the sole, I prioritized more openings in the toe area to enhance breathability, while reducing their size and number in the heel area. This is because the heel bears most of the body’s weight, and large openings could create uncomfortable pressure marks on the skin.

The design was generated in Grasshopper, using a hexagonal gradient mesh to optimize the distribution of the openings.



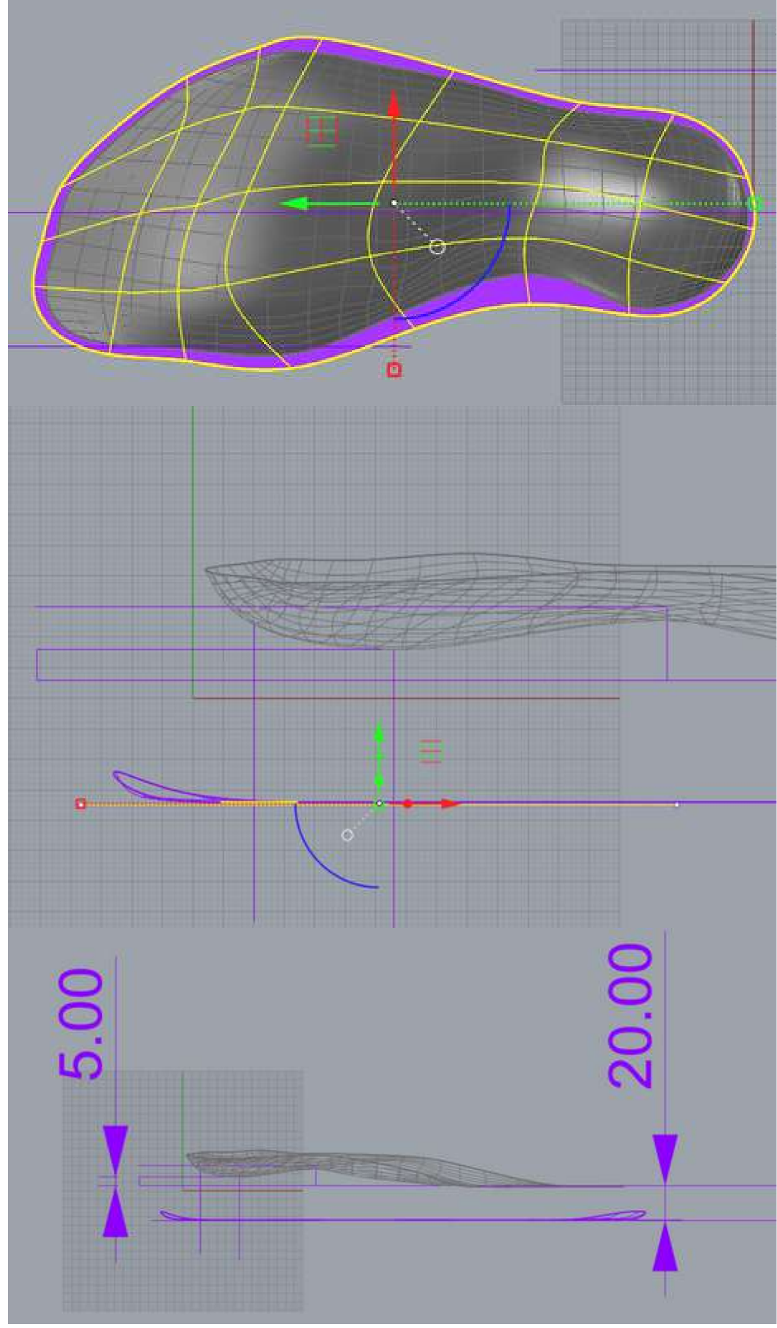
SOLE DESIGN

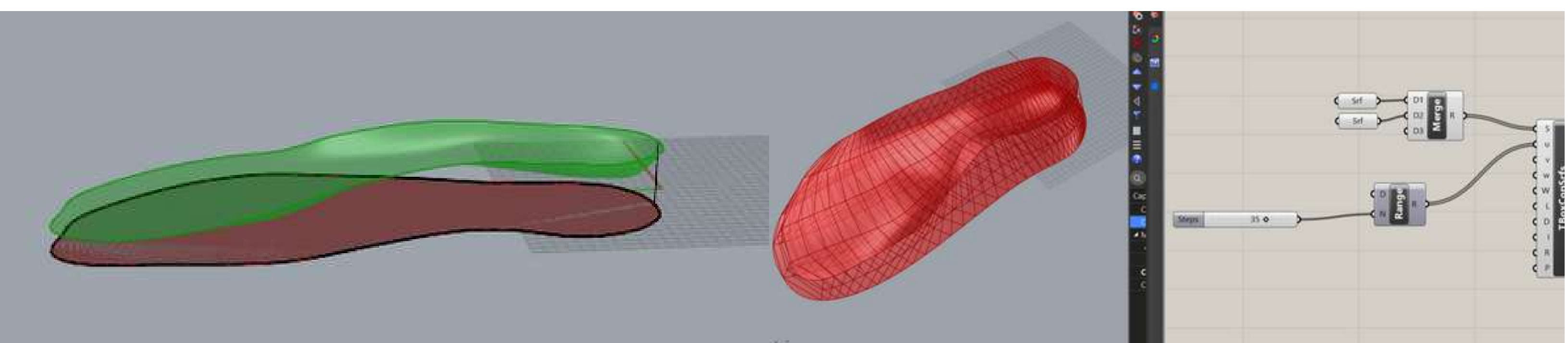
3D Mesh for the Sole

The sole needed to have a resistance similar to the material provided by a bioengineering professor. This resistance is essential for absorbing impact while walking, particularly in the most critical areas: the heel and the metatarsal region. At the same time, the sole had to maintain good flexibility to allow for natural foot movement.

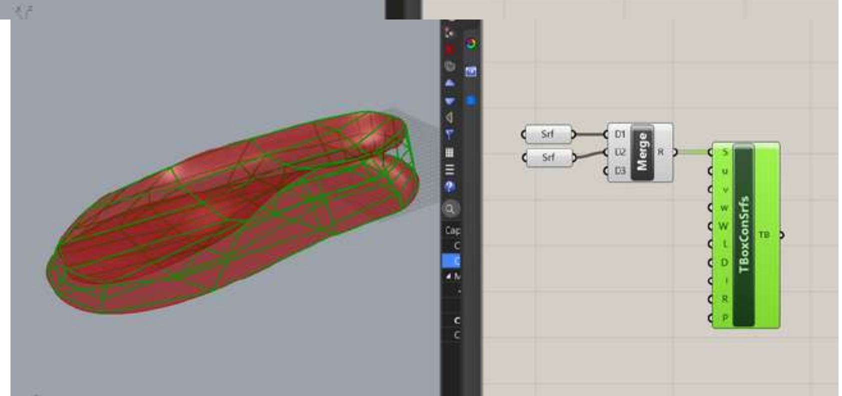
The most important bones for walking include the metatarsals, tarsal bones, and ankle bones. Along with ligaments and muscles, they must provide flexibility while withstanding the impact of the body's weight.

To achieve this, I designed the 3D mesh in Grasshopper, using the insole surface as a base and creating an additional surface to give the sole its thickness. The design remains flat but features a slight curvature at the tips, ensuring stability without affecting the heel’s base. Additionally, the sole is slightly wider to enhance stability while walking and prevent unwanted tilting.



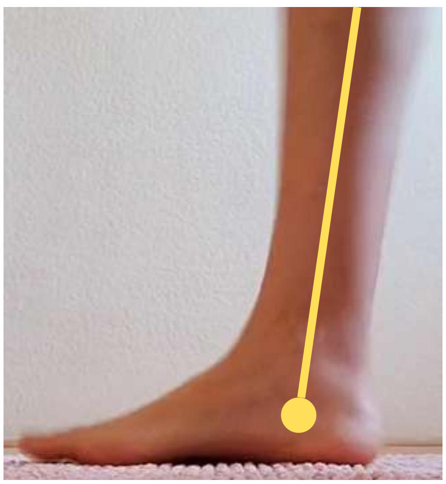


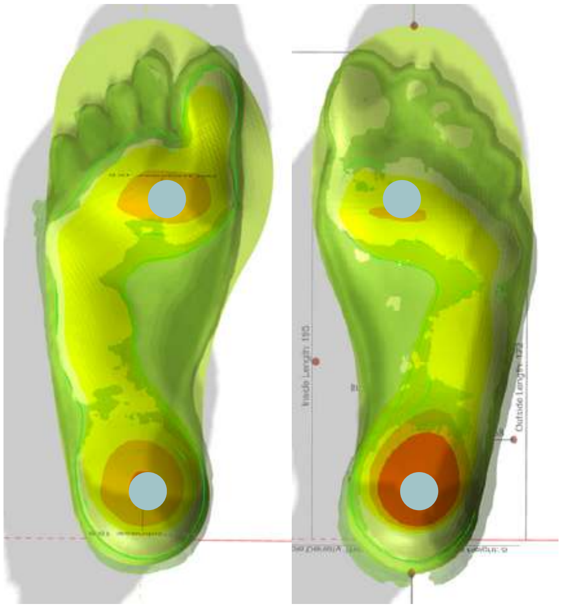
From surface to mesh to link them to Grasshopper components.

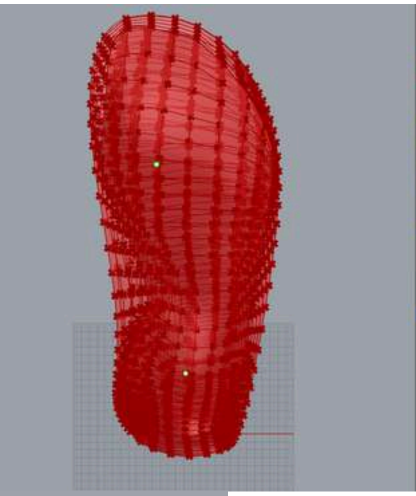


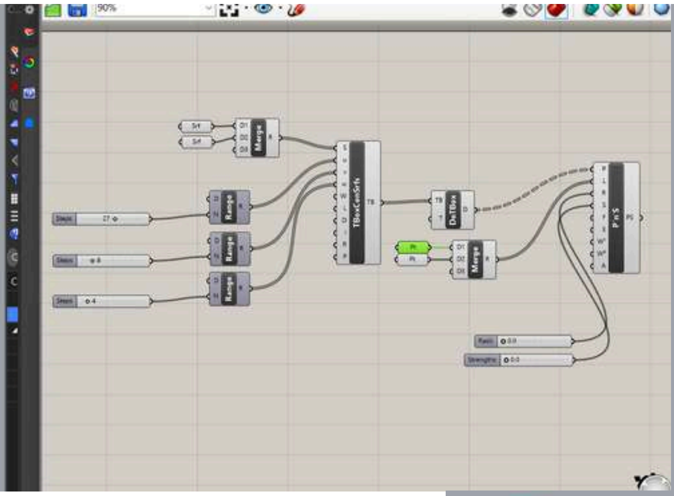
Plantar Peak Pressure Points While Walking

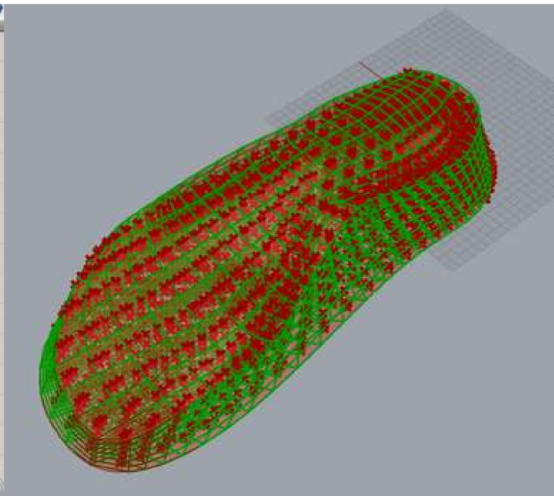
To absorb the impact while walking, it was essential to identify the plantar pressure points that help reduce the load on the foot. A key resource in this process was a video from the YouTube channel Oficina Paramétrica by Leonardo Gindri, an architect and urban planner, in which he uses Grasshopper to design a sole that enhances impact resistance. This knowledge served as a starting point for me, so I turned to baropodometry studies to analyze the areas where I exert the most pressure during the most critical moments of my gait.

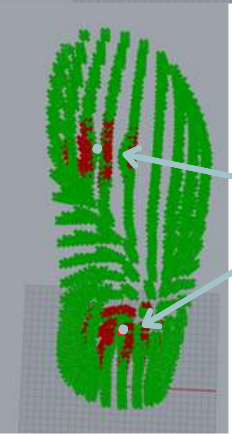




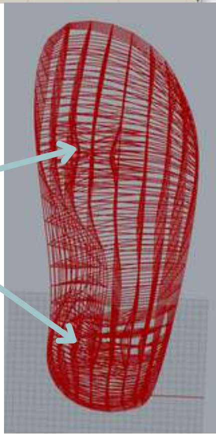


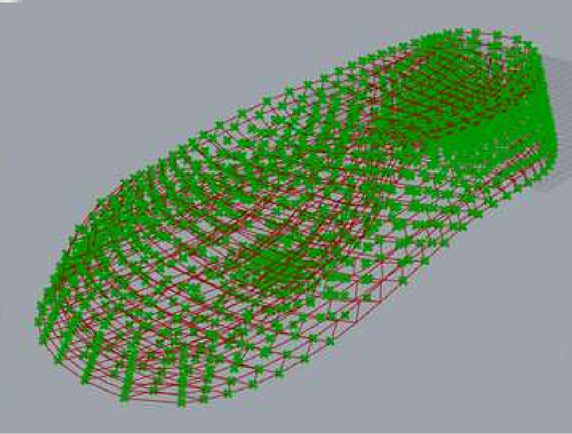






Plantar peak pressure points while walking.

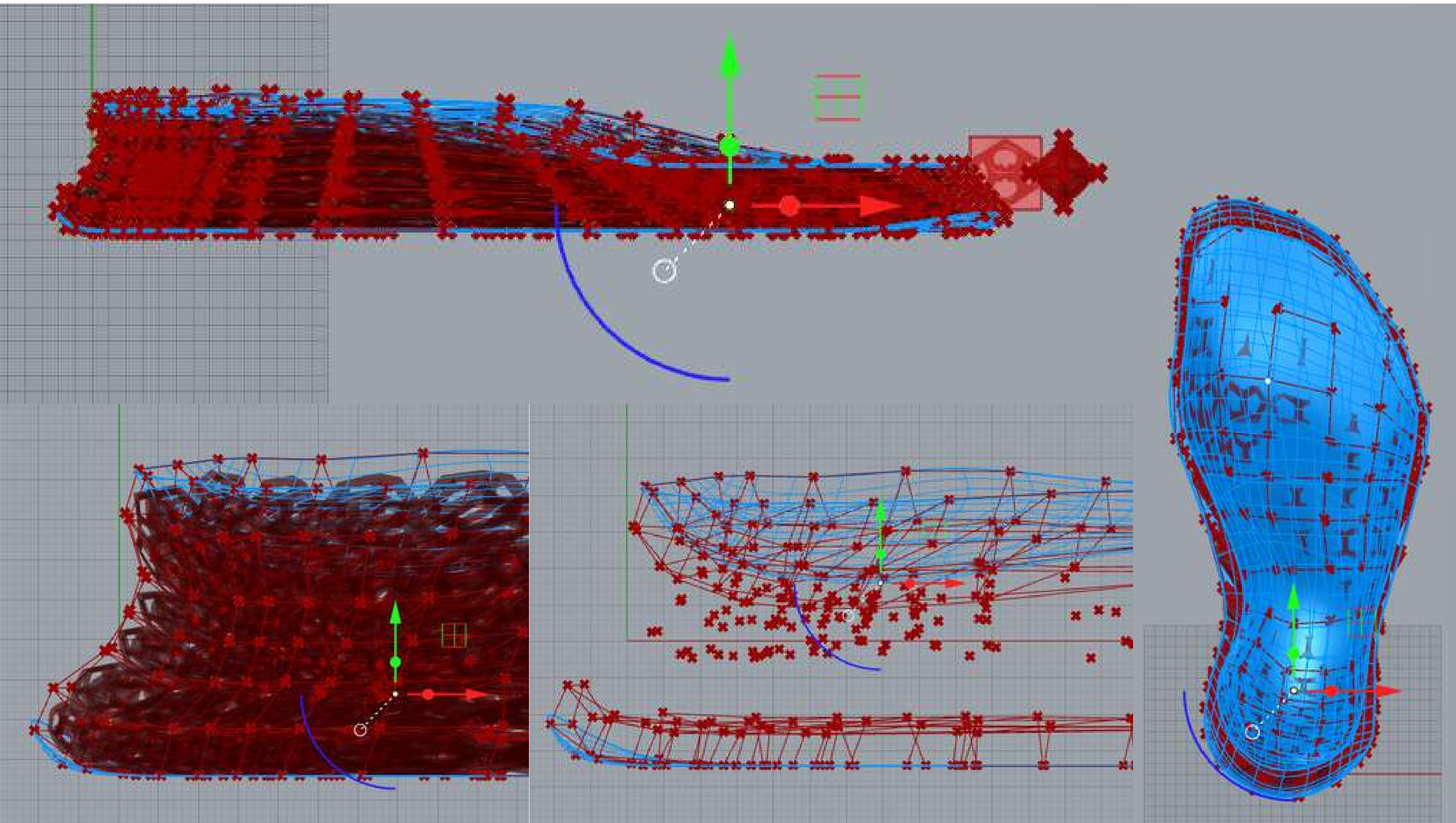




Experimentation in Grasshopper

In this stage, I conducted various tests to create a fill pattern based on a repetitive module within the 3D grid I had previously designed.

1. To achieve this, I developed modules using Solid Mesh in Grasshopper, considering its natural resistance as the main premise.
2. I also created a module in Rhinoceros, which had great strength due to its cubic connection with the other elements.
3. Additionally, I explored the creation of 3D grids using Grasshopper's Preset Cell tool, which allowed me to generate a wide range of iterations to optimize the fill structure of my sole.

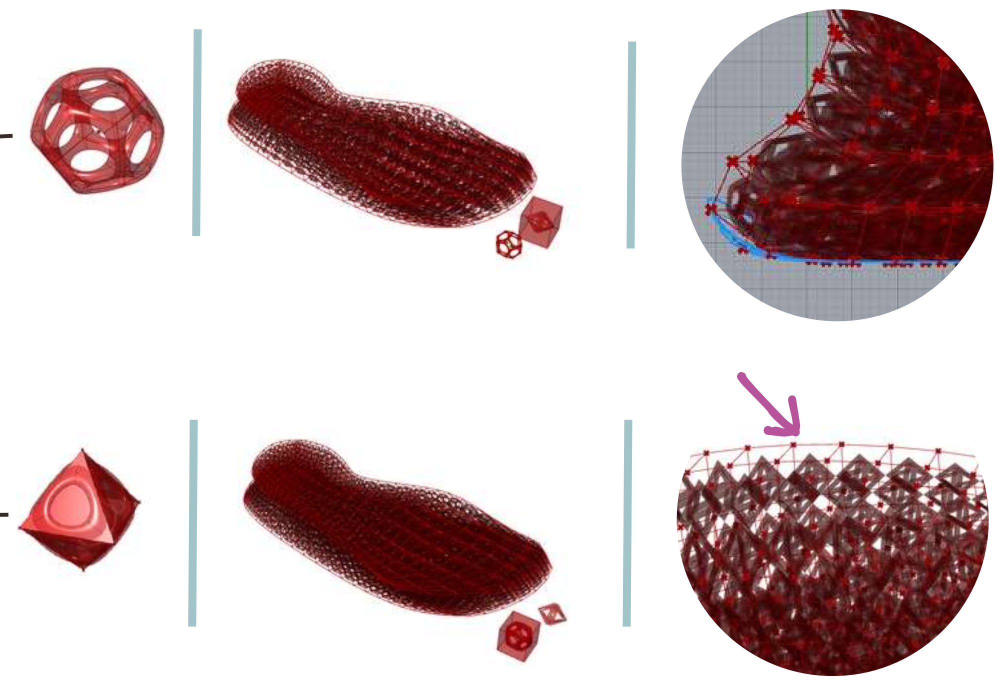


1

Twisted box consecutive surface

+

Platonic (mesh)

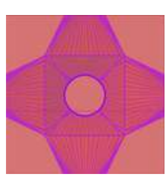


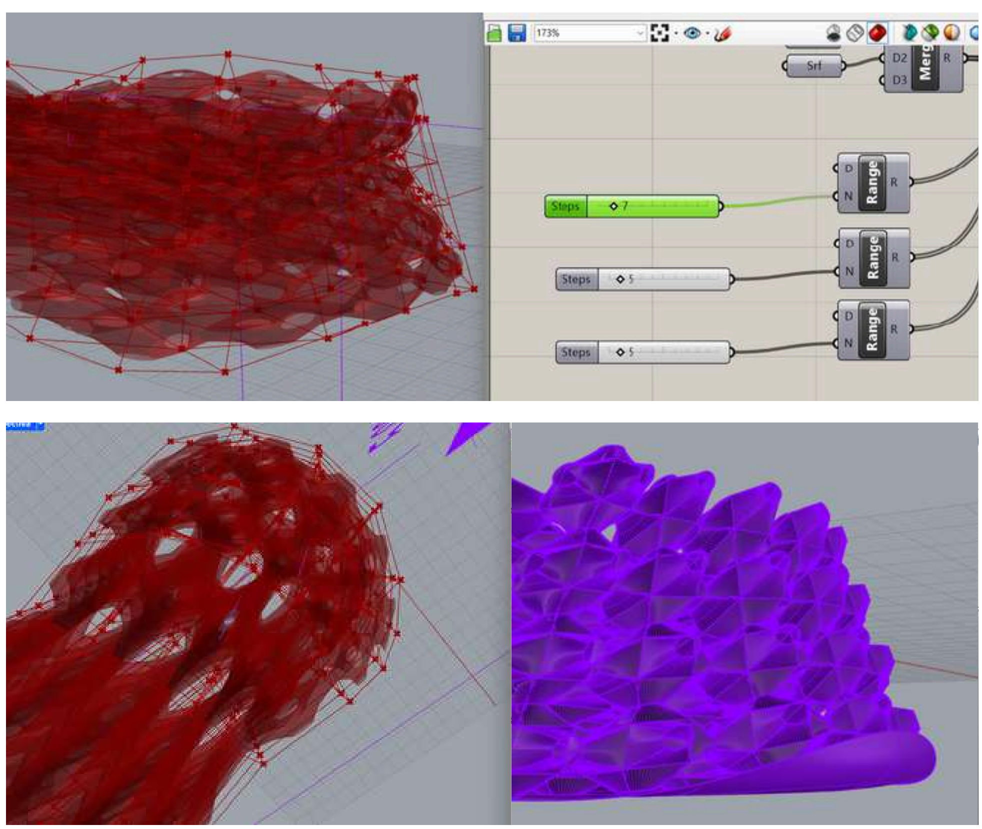
2

Twisted box consecutive surface

+

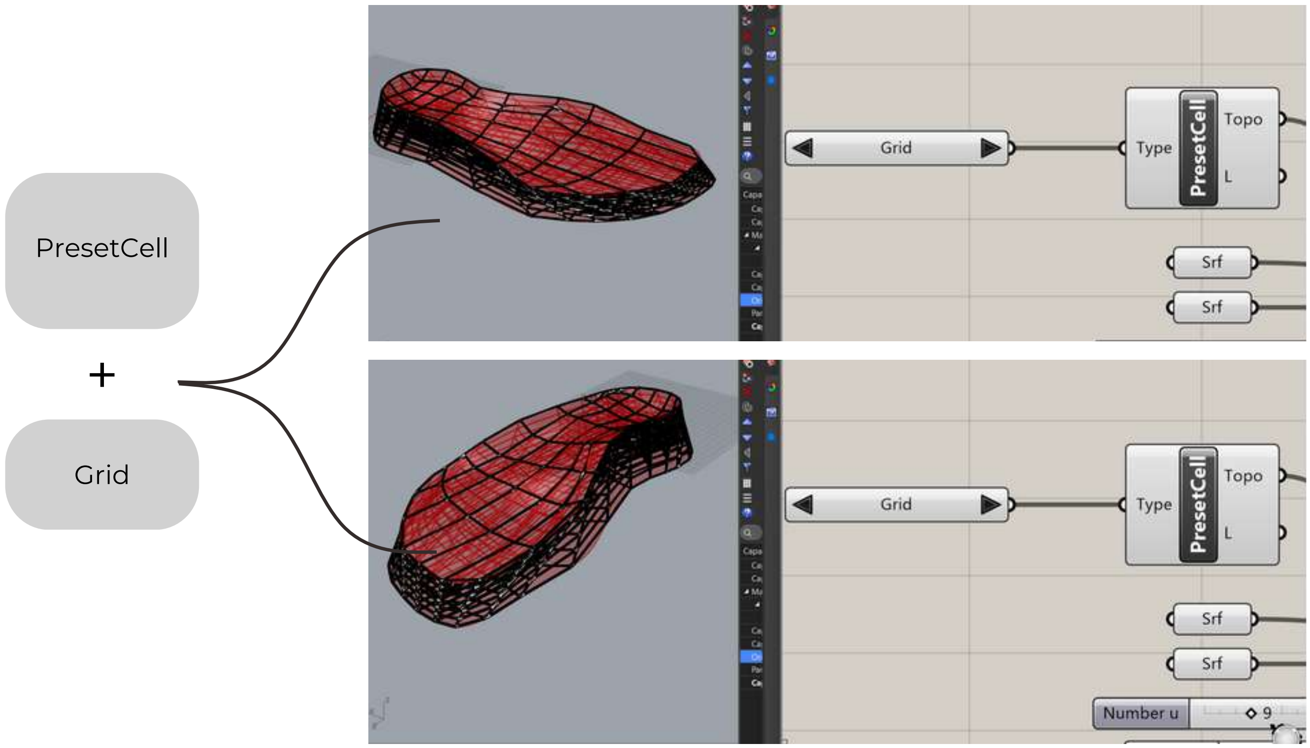
Module (mesh)

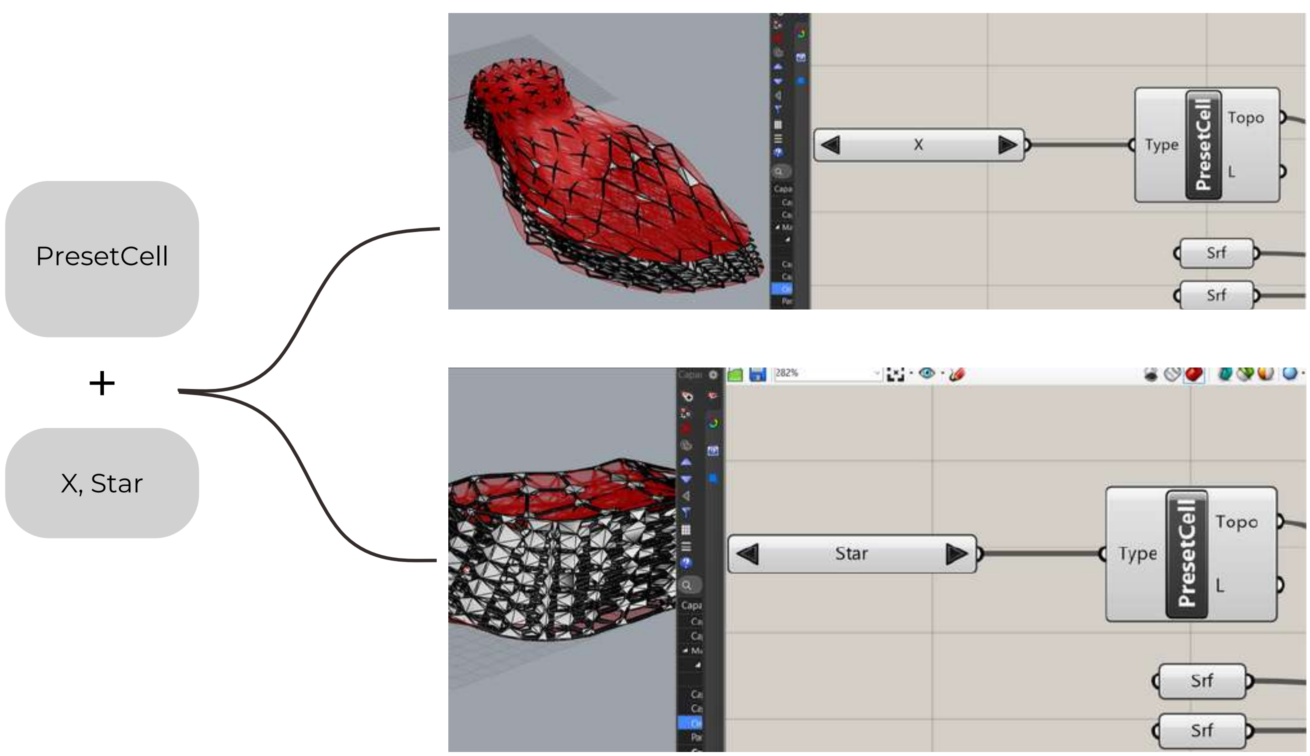




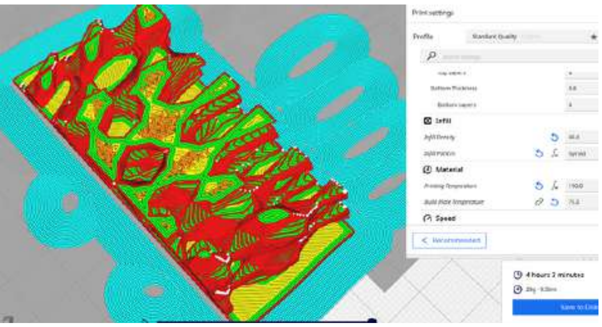
I also explored the networks generated with the Preset Cell tool, using modules like Grid, X, or Star. These configurations created a homogeneous network but lacked pressure points, so I decided to discard them. Additionally, their dimensions were too light and could break easily. Maybe, when I gain more experience with this type of network, I will be able to customize them better.

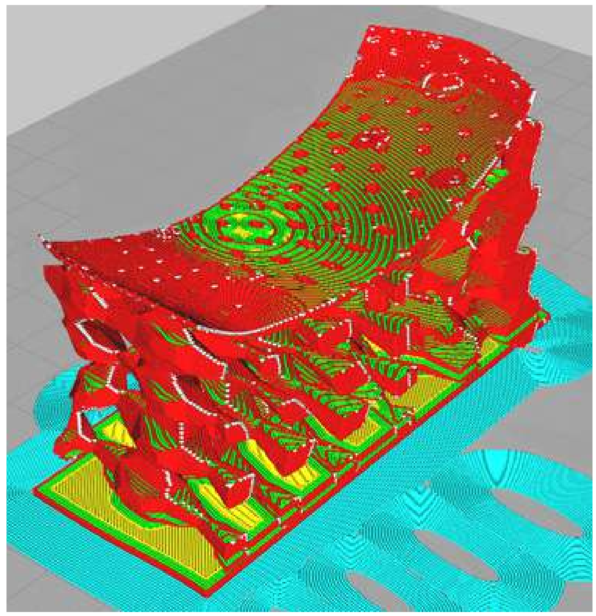
3

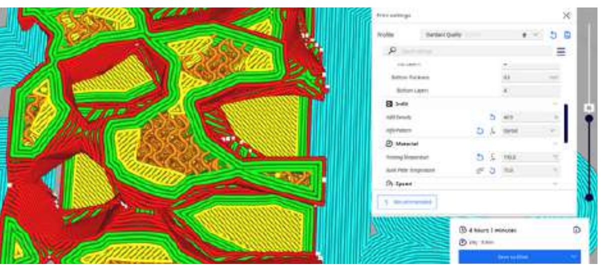


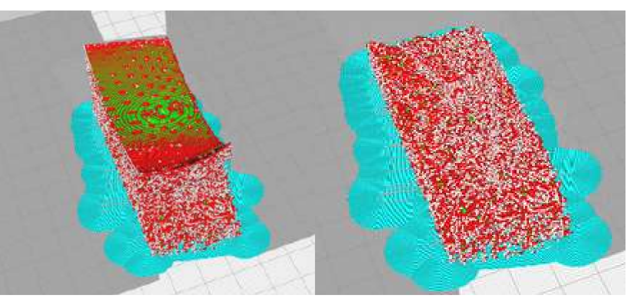


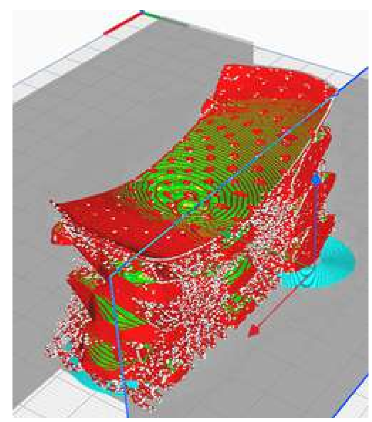
3d print











Filament Selection and Printing Setup

At this stage, the standard (green) filament turned out to be too soft, so I had two options: design a stronger link or try a different material. Fortunately, my colleague Raúl helped by providing me with JAYO TPU Silk filament, which has silk-like properties, offering greater flexibility.
According to its specifications, this filament can be printed without heating the platform if adhesive is used (glue can be unheated). Without adhesive, the recommended bed temperature is 60-80°C. It also has a ±0.03 mm tolerance and a 1.75 mm diameter, compatible with the nozzle I used.

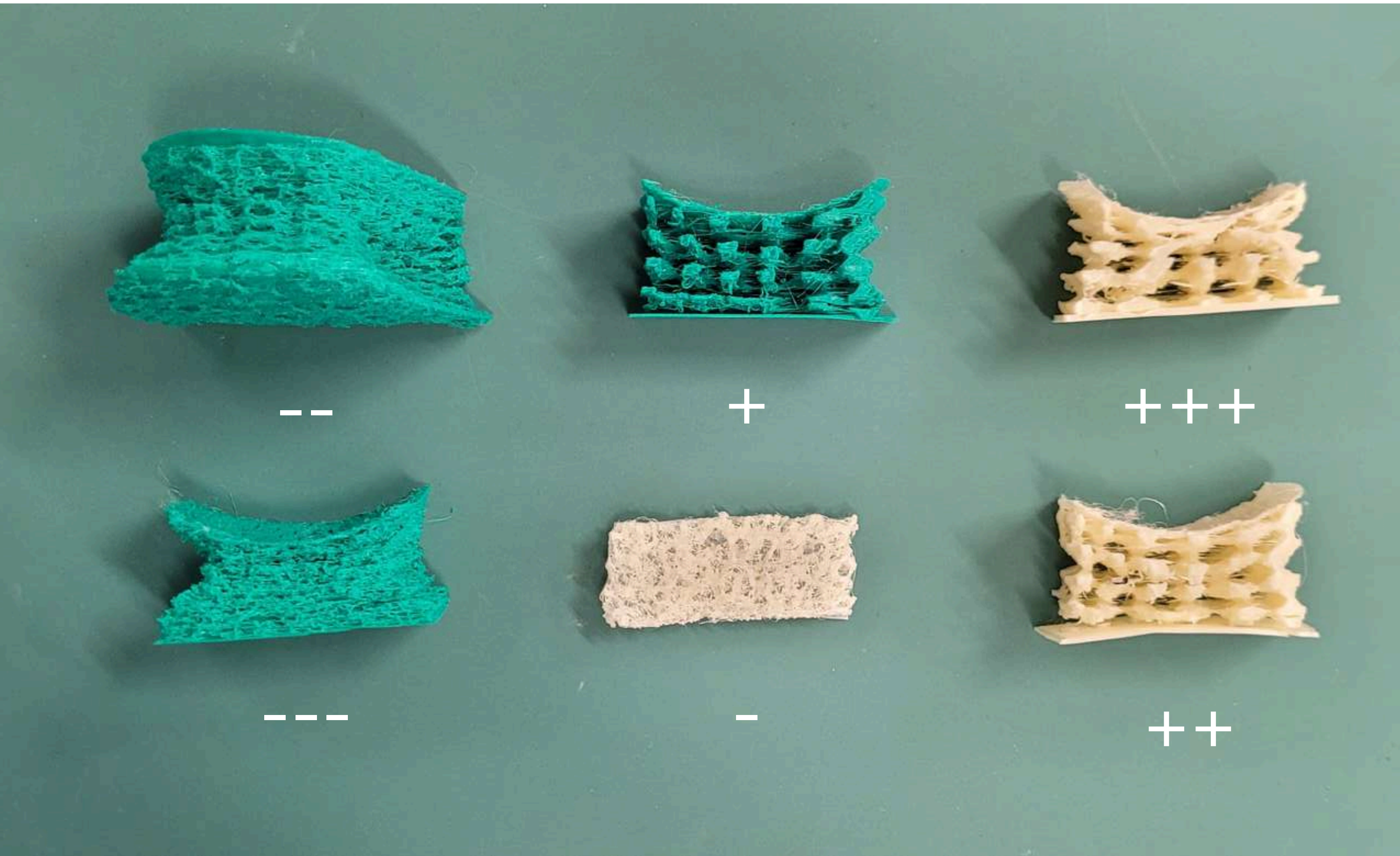
For both filaments, I set the following printing temperatures:

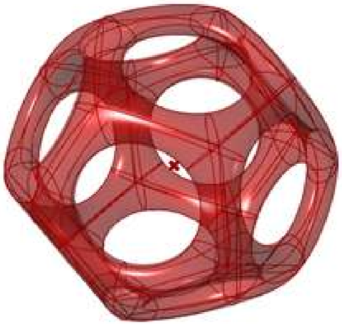
- Nozzle: 230°C
- Print bed: 70-80°C
- No retraction and low speed to prevent deformations in the part's geometry.
-

I used two 3D printers for this process:

- Ultimaker S3 with Ultimaker Cura for small parts.
- Prusa XL with its default slicing software for larger parts.

One important note: the Prusa XL does not allow printing open-curve geometries, so the model must be completely closed before printing.

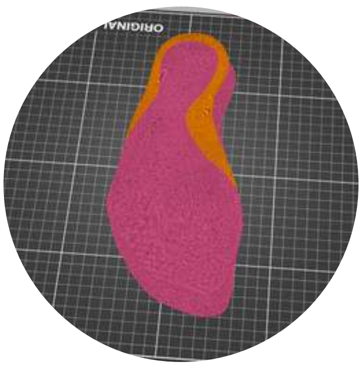




Printing and Evaluation of the Fill Structure

I printed several fill samples and encountered issues with the most resistant option. Therefore, I decided to use the fill generated from a Solid Mesh in Grasshopper (1) to print the first sole and assess its comfort, dimensions, and resistance.

The result was a very comfortable sole. I would describe it as the sensation of stepping on sand since it adapts perfectly to the shape of my foot. However, there are several aspects that need improvement:



Aspects to Improve:

- The module lacks the necessary rigidity to support walking, as it deforms excessively.
- It has no structural flexibility, which causes it to break easily.
- The dimensions in the toe area are too large, while in the heel area, they are exact. However, it would be advisable to enlarge them slightly to account for the thickness of the upper part of the shoe.
-

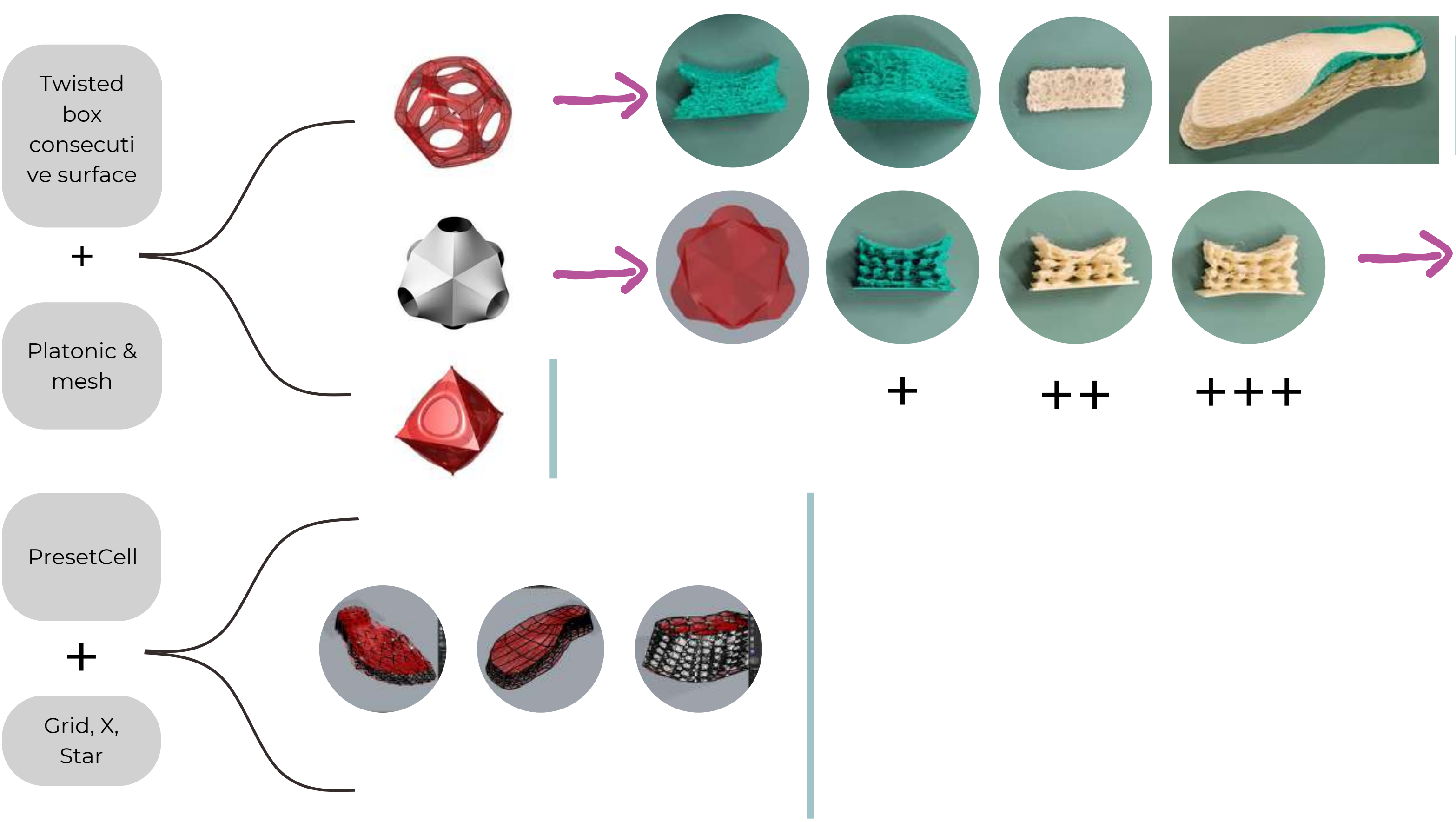
Favorable Aspects:

- Excellent ergonomics, as it adapts well to the shape of the foot.
- Good material fusion; both are TPU but with different levels of rigidity: the green one is standard TPU, while the white one is TPU Silk, which is more rigid while maintaining its flexibility.

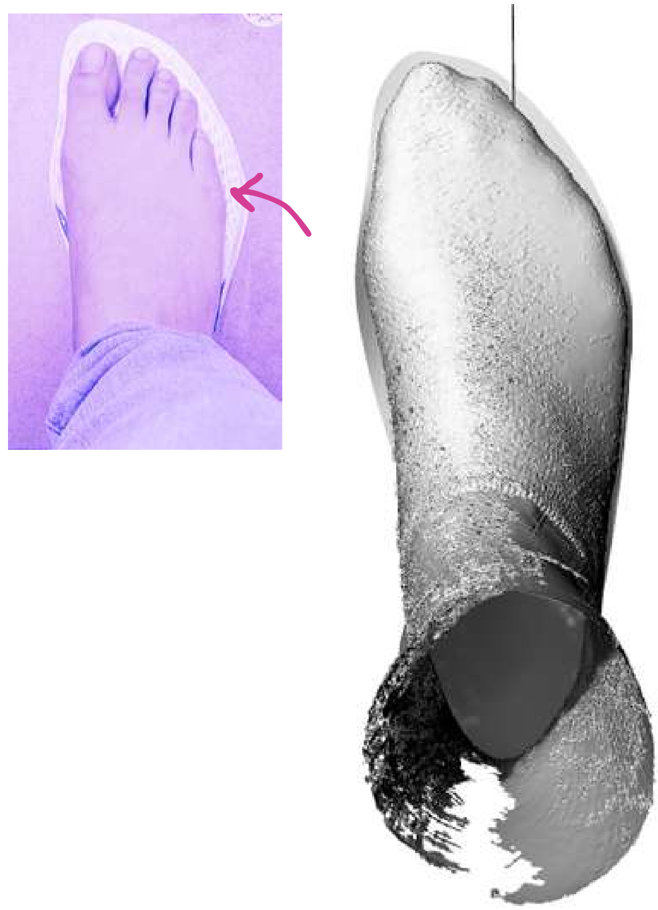



Results

From these results, I concluded that structure (3) needed to be revisited and corrected, as it contained errors due to being an open mesh. This structure was the most optimal for achieving both flexibility and resistance while also providing effective absorption of pressure points when walking.
Below, the different iterations of geometries generated in Grasshopper can be observed. The ones created using the Preset Cell tool were discarded because their structures were too weak.
I ultimately decided to retain the material fusion approach, strategically placing different materials in specific areas of the shoe for optimal performance.



For the final sole design, I corrected the previous issues, starting by adjusting its dimensions.



Then, I researched the differences between mesh and surface in Rhino and found a forum where the same question was discussed.

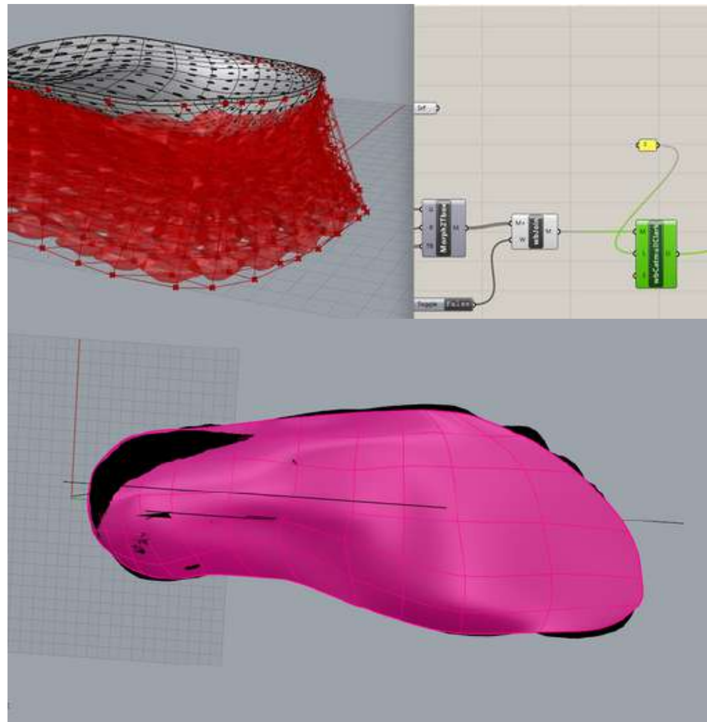
The difference between mesh and surface lies in their mathematical structure and application in 3D modeling:
Mesh

- Composed of a set of vertices, edges, and faces (polygons, usually triangles or quadrilaterals).
- A discrete approximation of a shape, useful for video game modeling, 3D printing, and physical simulations.
- Has a lighter and easier-to-process structure but is less precise for complex geometries.
- Lacks mathematical continuity; it is simply a collection of connected flat faces.

Surface

- Based on NURBS (Non-Uniform Rational B-Splines), allowing for a smooth and continuous mathematical representation.
- Used in industrial design and CAD, as it enables precise curves and parametric edits.
- Ideal for organic surfaces and high-precision manufacturing.
- Can be converted into a mesh for applications like 3D printing, but the mesh quality depends on triangulation resolution.

Once I understood this difference, I realized that the module had to be composed entirely of either surfaces or meshes. If working with surfaces, it was necessary to convert them into mesh using the "To NURBS" tool, ensuring that the module remained completely closed within the sole's network in Grasshopper.



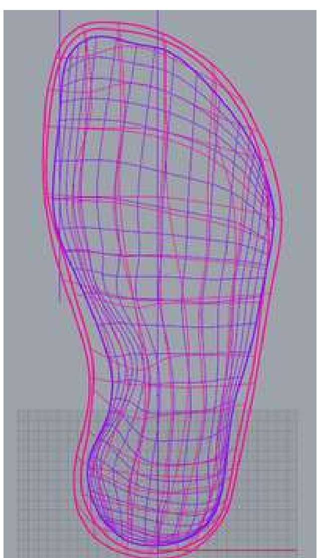
Corrections: Images showing the errors I fixed in the design.

To manufacture the final sole, I focused on two aspects: correcting the ergonomic issues, which were only related to size, and adjusting the module I wanted to use. To achieve this, I verified the following points:

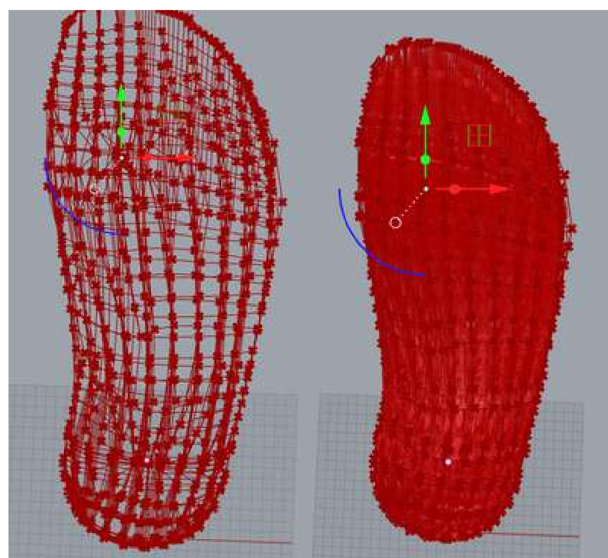
- The module's meshes must always be ready for 3D printing, meeting specific conditions to prevent errors.
- These meshes, known as "watertight meshes" or "manifold meshes", must be completely closed.
- The mesh normals must be oriented outward.
- There should be no intersecting or overlapping faces.
- There should be no duplicated elements.

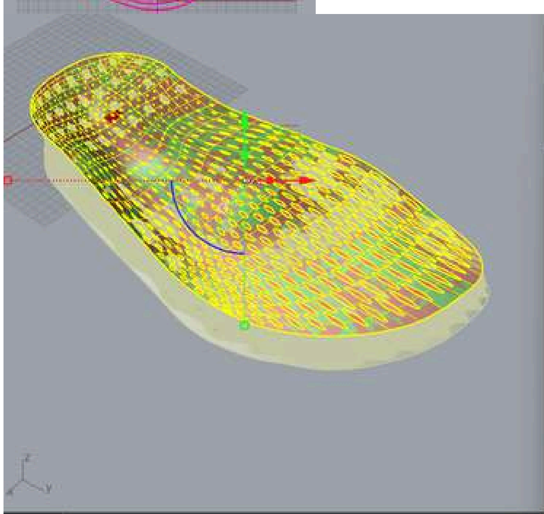
Once these criteria were verified, the module worked correctly within the parametric design in Grasshopper.

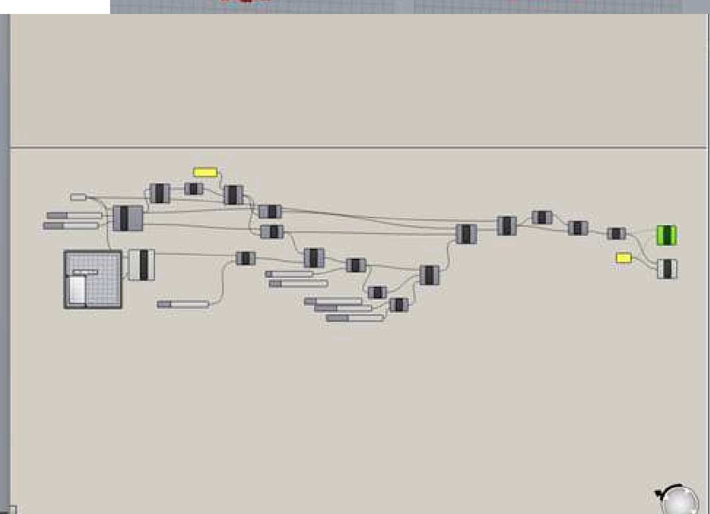
Sealed mesh module



New dimensions







UPPER FOOTWEAR

For the upper footwear section, I considered the following points:

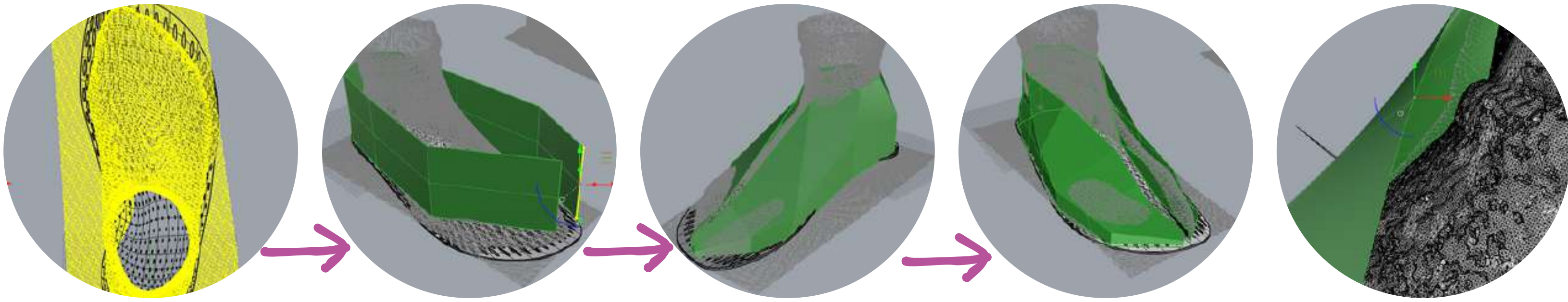
- The shoe needed to wrap around the foot, following its ergonomics based on three different scans: foot tilted forward, foot at rest, and foot flexed at the metatarsal ligament area.
- It had to allow for proper ventilation since I am using plastic.
- The design should incorporate shoelaces, as shoes with laces provide a better fit. They prevent excessive foot movement and tend to wear out less compared to shoes that use elastic or flexible parts for easy slip-on.
- The shoe will have an opening in the instep area to ensure the laces have enough space to be properly secured without overlapping the shoe material.

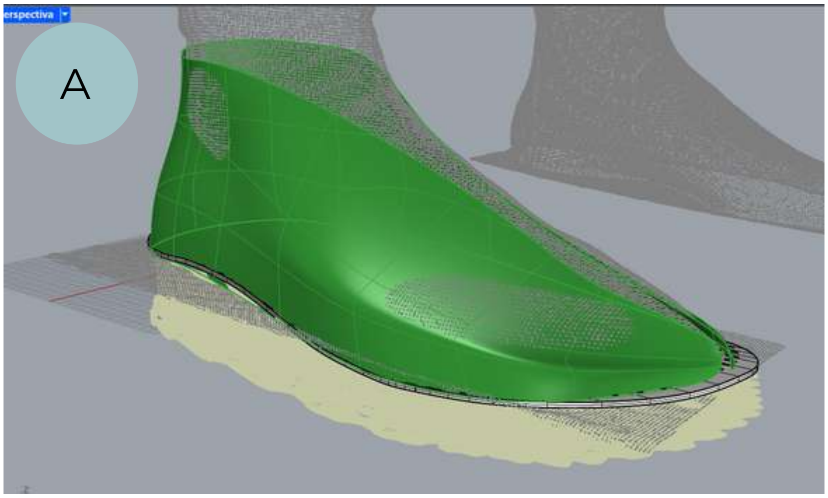
For the upper footwear section, I considered the following points:
The shoe needed to wrap around the foot, following its ergonomics based on three different scans: foot tilted forward, foot at rest, and foot flexed at the metatarsal ligament area.

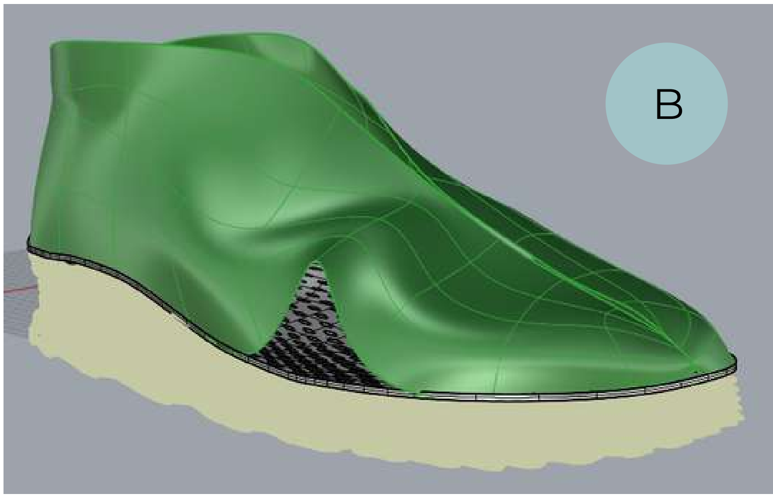
It had to allow for proper ventilation since I am using plastic.
The design should incorporate shoelaces, as shoes with laces provide a better fit. They prevent excessive foot movement and tend to wear out less compared to shoes that use elastic or flexible parts for easy slip-on.
The shoe will have an opening in the instep area to ensure the laces have enough space to be properly secured without overlapping the shoe material.

First Proposals

Taking the previous points into account, I decided to create two design proposals, both based on the shape of my foot. Proposal A would retain only the overall shape, while Proposal B would include an opening at the flexion point, allowing the shoe to bend in that area.

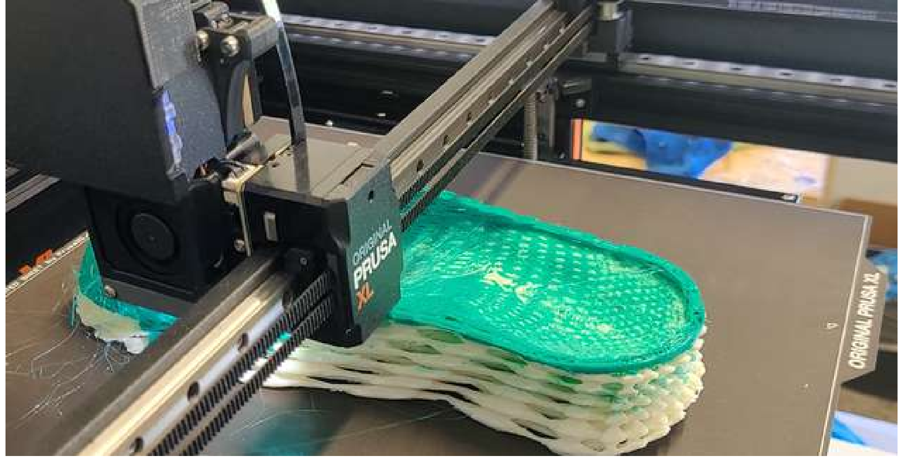




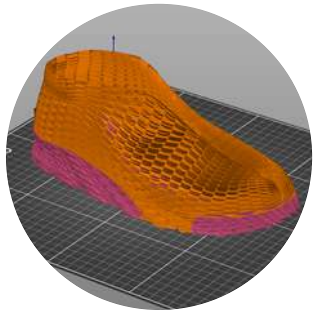


I found both proposals interesting in comparison, but Proposal B could wear out more quickly due to the openings designed for flexibility. For this reason, I decided to move forward with Proposal A.

3D PRINT PROTOTYPE



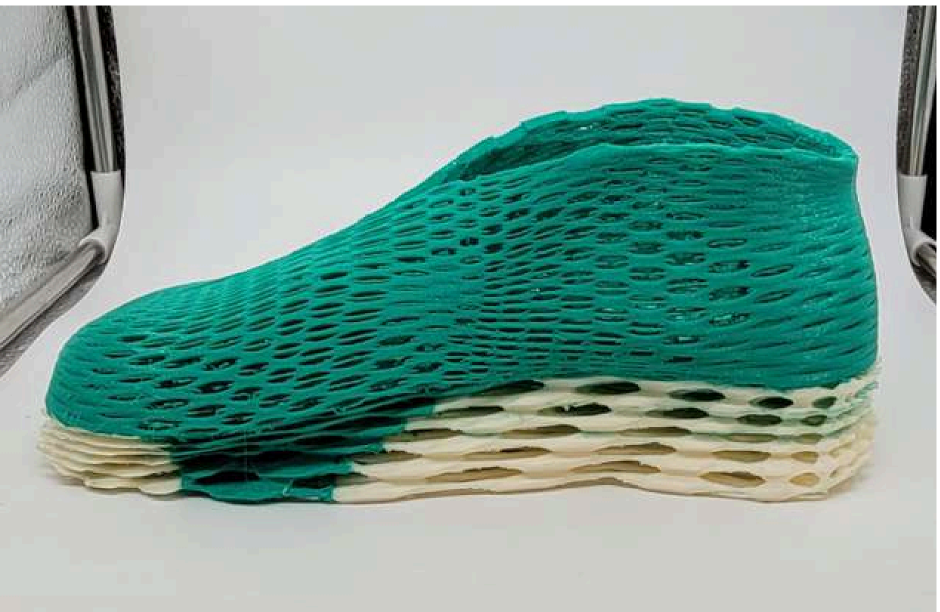
In the first prototype, I combined two types of TPU to improve the firmness of the sole. This first shoe took approximately 2 days and 12 hours to print on the Prusa XL 3D printer. I sliced the model using Prusa software, utilizing the selection tools to define the areas for each material. Additionally, I removed the purge tower, as both time and material were essential resources.

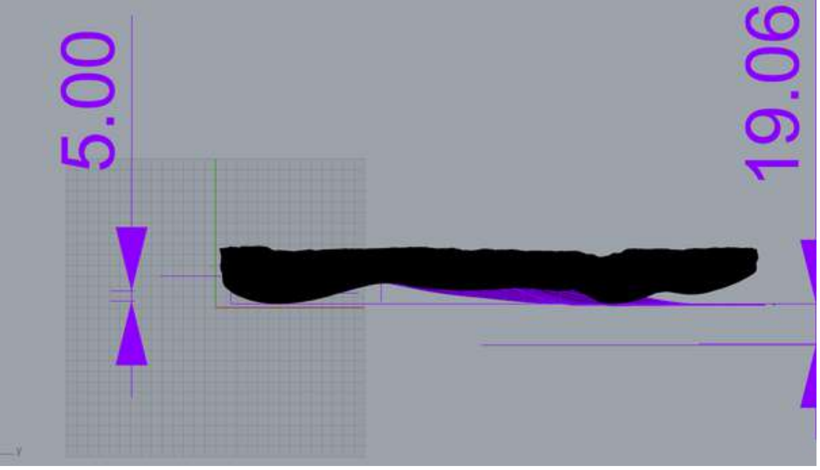


This first prototype was very useful in identifying errors that I couldn't notice in the software. I found that the Silk material was too rigid. As a result, I adjusted the final shoe design, using Silk only for the tips. Adding unnecessary stiffness made the shoe less flexible.

I also noticed that the shoe dimensions had too much looseness around the foot's contour and ankle. Additionally, the lateral malleolus bone didn’t have enough clearance, causing uncomfortable friction.

I initially tested the shoes without socks, but I ruled out this option because the material rubbed too much against the skin. However, since this is a natural result of the printing process, I will use this prototype only with socks.



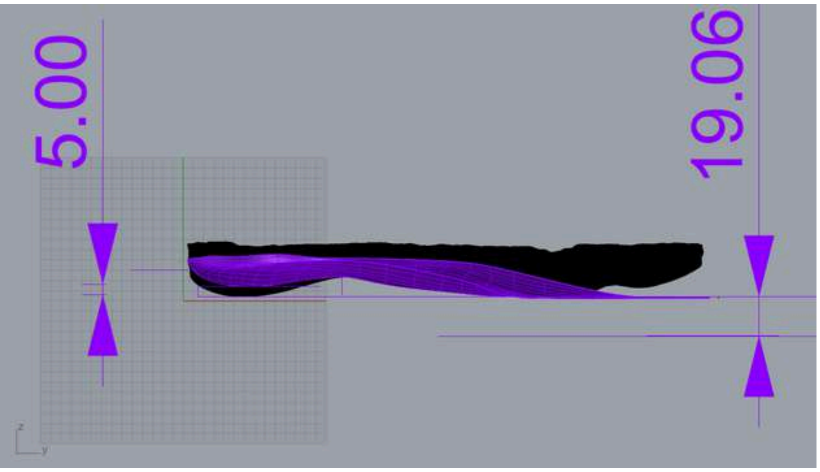


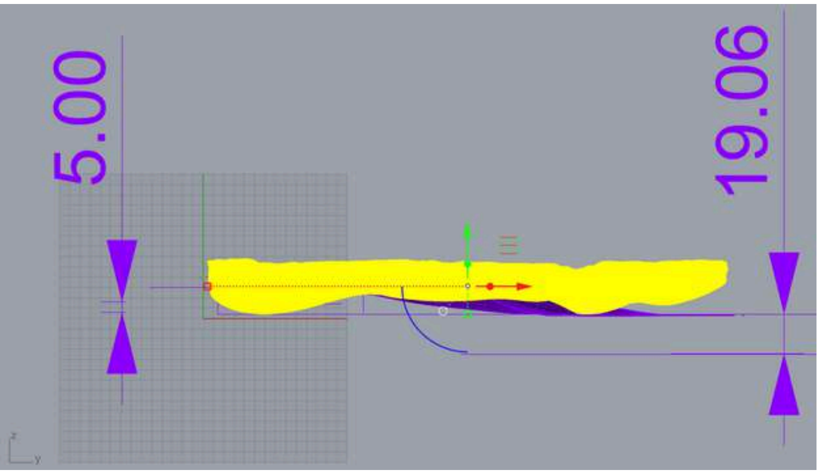
LEFT SHOE

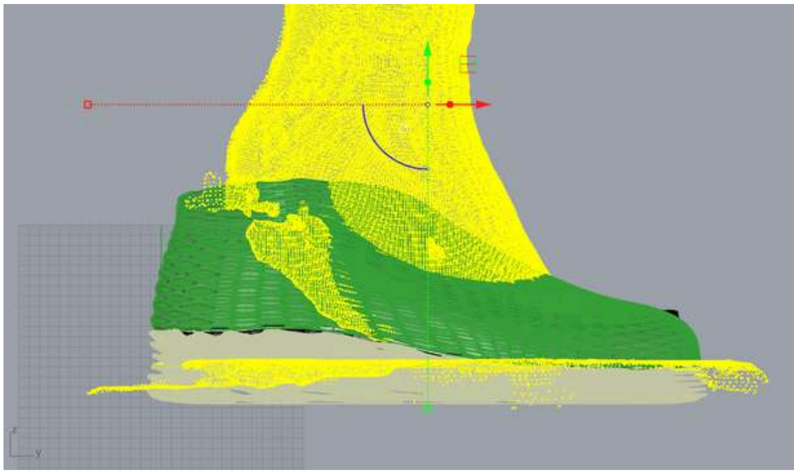
lFor the design of the left shoe, I followed the same process as for the right one.

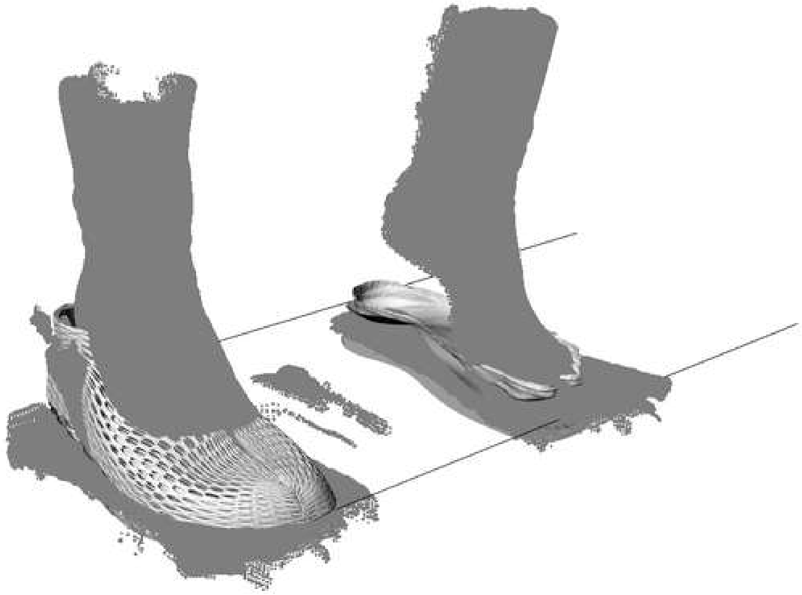
The only difference is that this model does not include the 5 mm heel elevation (This elevation can be seen in the purple-colored mesh.), so the sole maintains the same level at the heel and toe area.

This allows for a more natural stride, similar to walking barefoot.



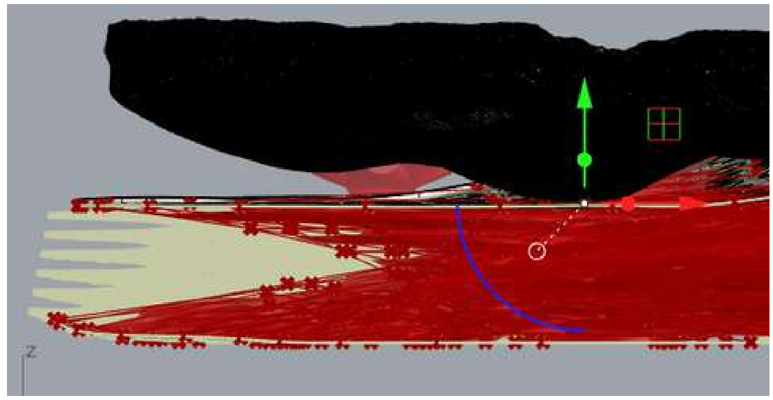




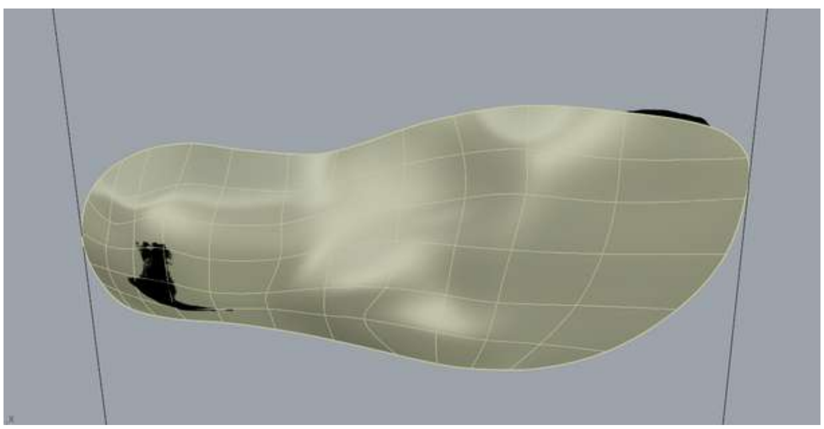


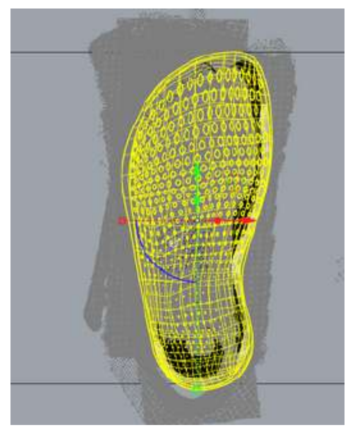
Some issues

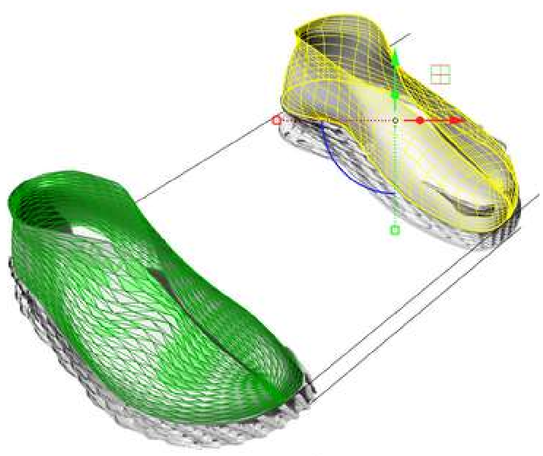
I encountered some issues integrating the Grasshopper pattern into this new mesh, as it appeared different or, in some cases, overlapped, as shown in the image. However, I came up with the idea of mirroring the model to avoid recognition problems, which worked successfully.

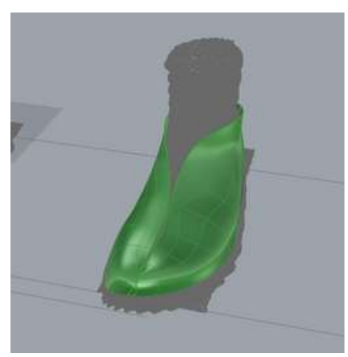


For the design of the upper footwear, I followed the same process as with the right shoe, adjusting the ergonomics to fit this new model. Although my feet are similar, they have subtle differences, so the shoes are not just mirrored copies. Instead, each one is uniquely designed to match the specific shape of each foot.

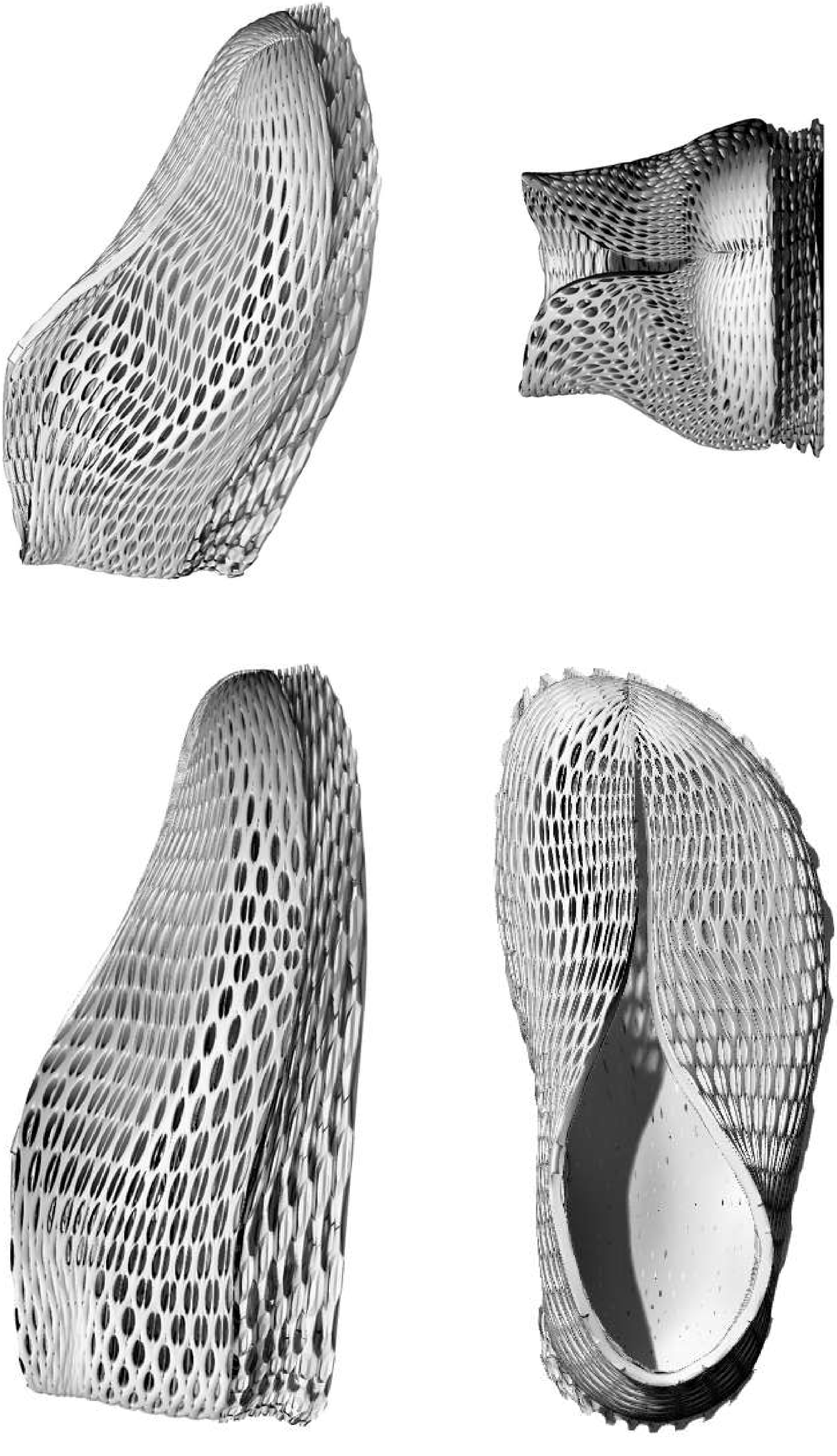


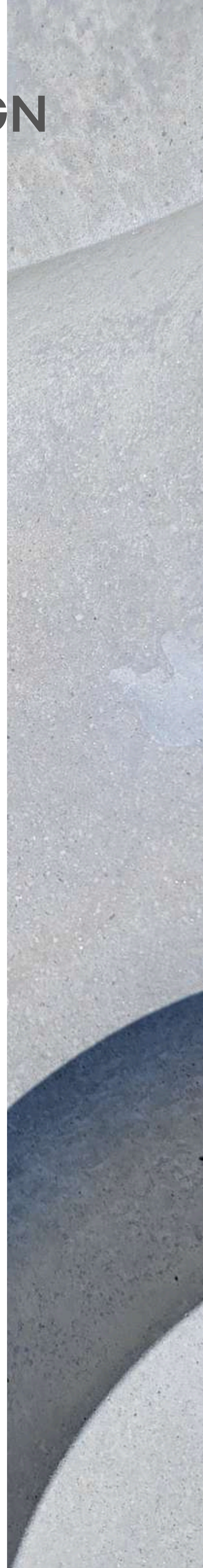




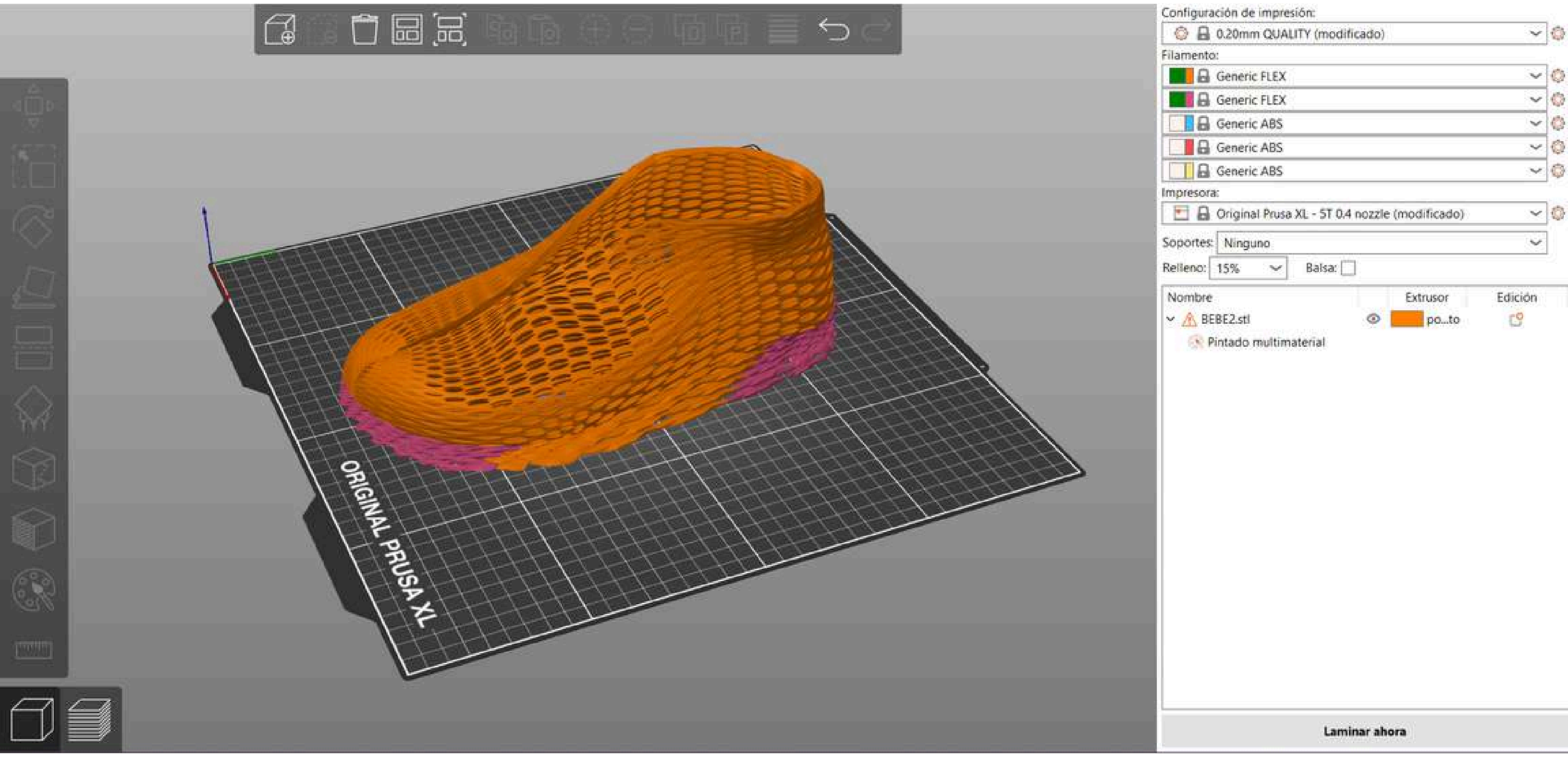


FINAL DESIGN



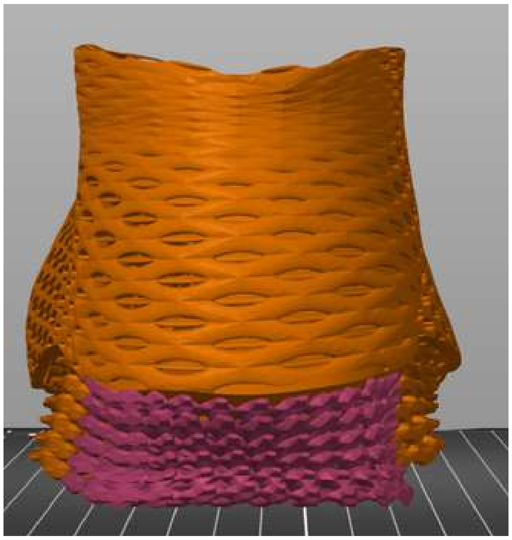


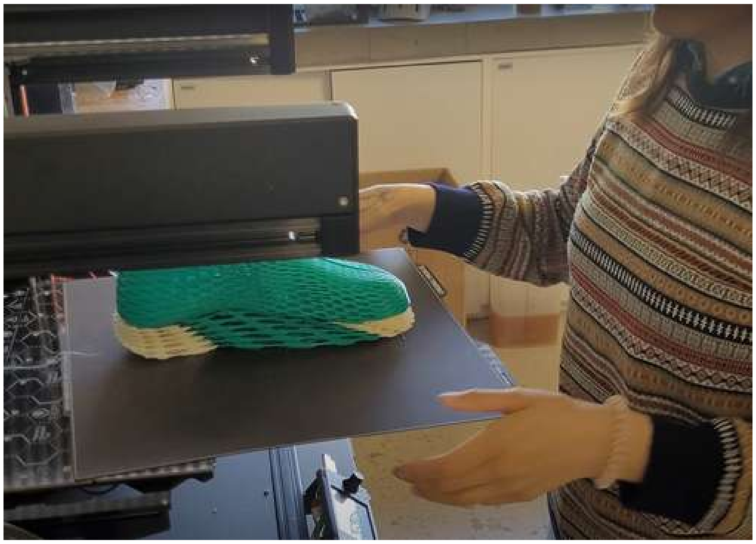

PROCESS

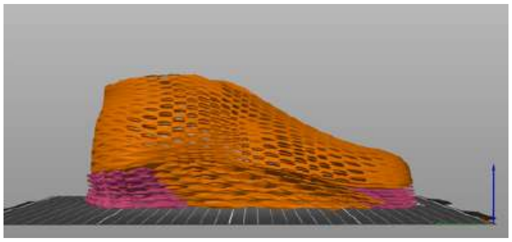


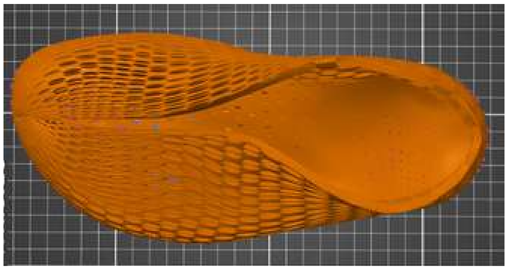
3D PRINT

The 3D printing of each shoe took approximately 2 days and 11 hours, a considerable amount of time that makes me reflect on possible improvements to optimize the process. Even so, this technology is well-suited for manufacturing footwear designed to meet specific needs, as in this project.

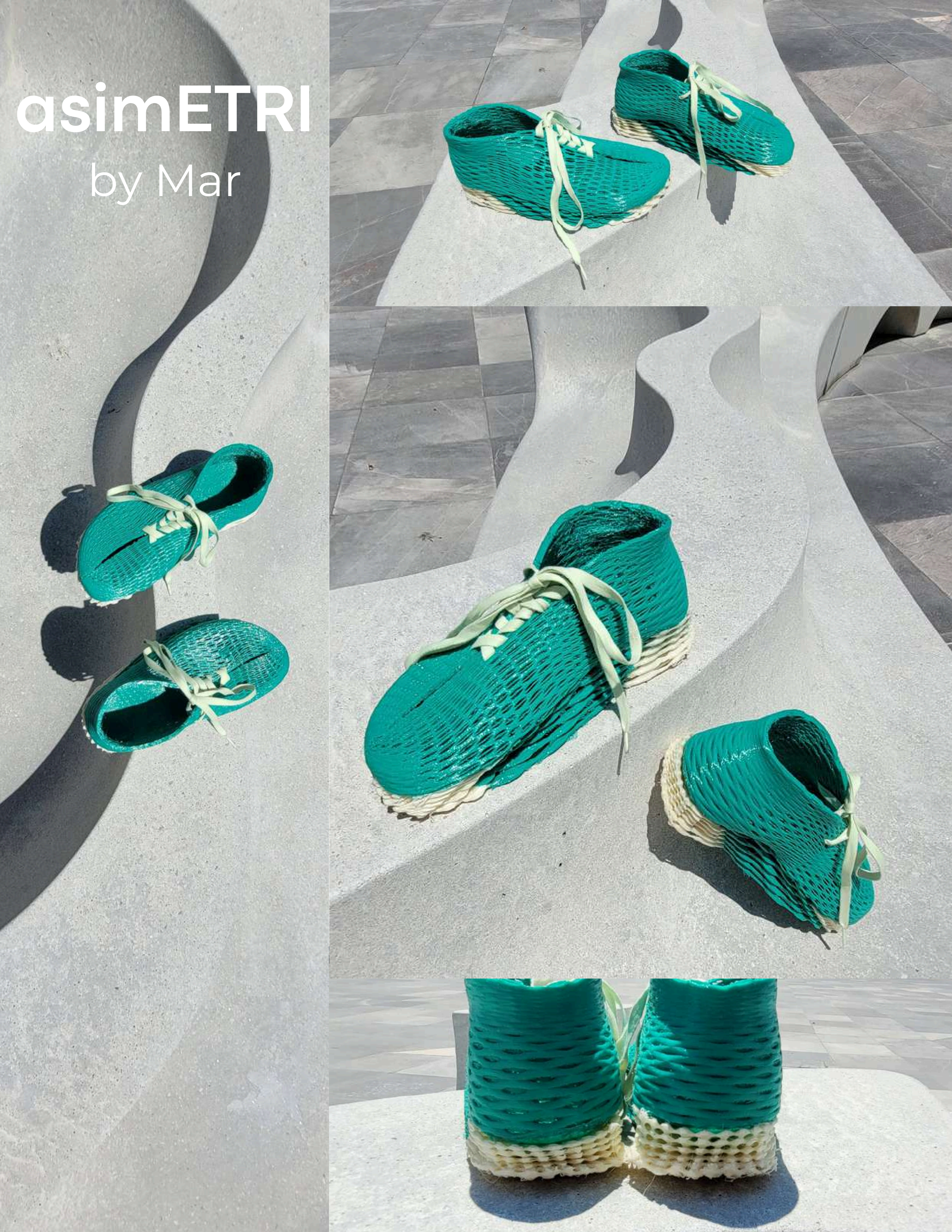








RESULTS


asimETRI
by Mar

asimETRI

by Mar

CONCLUSION

The solution proposed in **asiMETRI** is an orthosis specifically designed for the sacral bone, aimed at correcting postural imbalance and relieving the associated pain. This project combines industrial design knowledge and digital fabrication to develop a personalized device that adapts to the individual needs of the user.

It is essential to highlight the importance of professional evaluation in cases of leg length discrepancy, as an accurate diagnosis allows for the implementation of appropriate treatments and the prevention of long-term complications. **asiMETRI** not only represents a personalized solution to a physical challenge but also demonstrates how technology and design can converge to improve quality of life.

Moreover, it is crucial to continue testing and evaluating in collaboration with health and orthopedic specialists, as their feedback will be vital to improve the design and ensure the device's effectiveness. Working closely with experts will help refine the orthosis, ensuring it is perfectly suited to the medical and functional needs of the user. Therefore, continuing to strengthen and expand this project with the support of professionals will be key to ensuring its long-term success and sustainability.

In conclusion, 3D printing not only facilitates the creation of customized devices but also opens up new possibilities in the design and optimization of products focused on health and well-being. In asiMETRI, this technology has enabled a physical challenge to be transformed into an innovative and accessible solution.