

From Shoe Lasts to Printed Molds: An Evolving Rhino Workflow in Footwear

A shoe begins with the last: the form that gives it its shape and helps determine its fit. When [René Medel](#) modeled his first shoe in [Rhino](#) in 1999, translating that form and its surrounding components into three dimensions was already a substantial design task. Decades later, he uses the same environment to develop internal structures, run analyses, and design manufacturing tools.

Following that progression reveals a broader change in what a footwear model can do. It can describe the shape of a shoe, but it can also carry decisions about how its components behave and how they will be made.

That evolution also reflects Medel's work at *fram*, a German footwear components manufacturer whose history began with shoe lasts in 1948. Within its Innovation department, he develops digital workflows that connect product geometry with prototyping, analysis, and production across the company's international operations. The challenge is not simply to model increasingly complex forms, but to make them useful within industrial manufacturing processes.

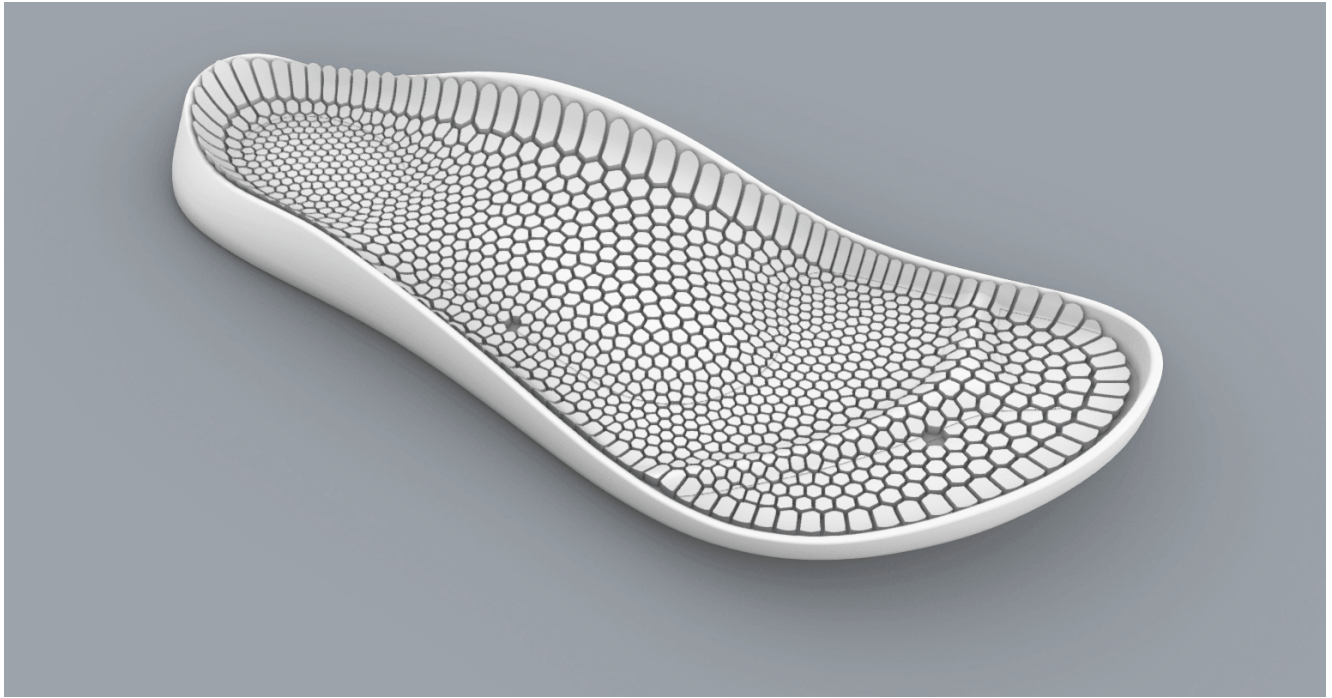


Exploded view of a sneaker modeled in Rhino, separating the last, upper, heel counter, insole, midsole, and outsole to show how each component is built from a native SubD shoe last.

MODELING FOOTWEAR SURFACES

Medel's early Rhino work relied on [NURBS](#) to develop lasts, soles, and other curved components. This gave him control over the surfaces that define a shoe, while allowing designs to be refined digitally before physical samples were made. Rendering helped test and communicate material and color options; CAD patterning and engineering brought the geometry closer to production.

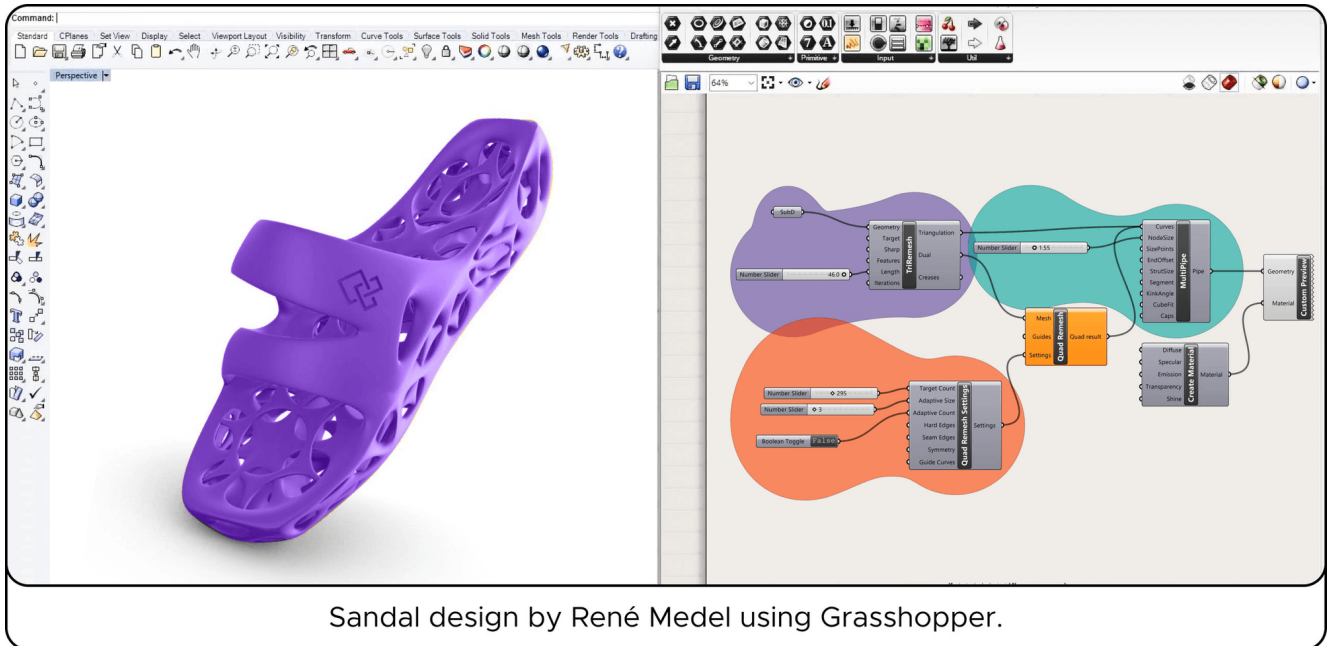
The last remained a useful test of the workflow. Traditionally produced through subtractive machining, it became the subject of Medel's 2015 research into additive manufacturing. Instead of treating 3D printing solely as a way to make a visual prototype, he examined its use in producing the form on which a shoe is built.



Footbed with a graded Voronoi pattern generated in Grasshopper, where the cell size changes across the surface according to rules rather than being modeled element by element.

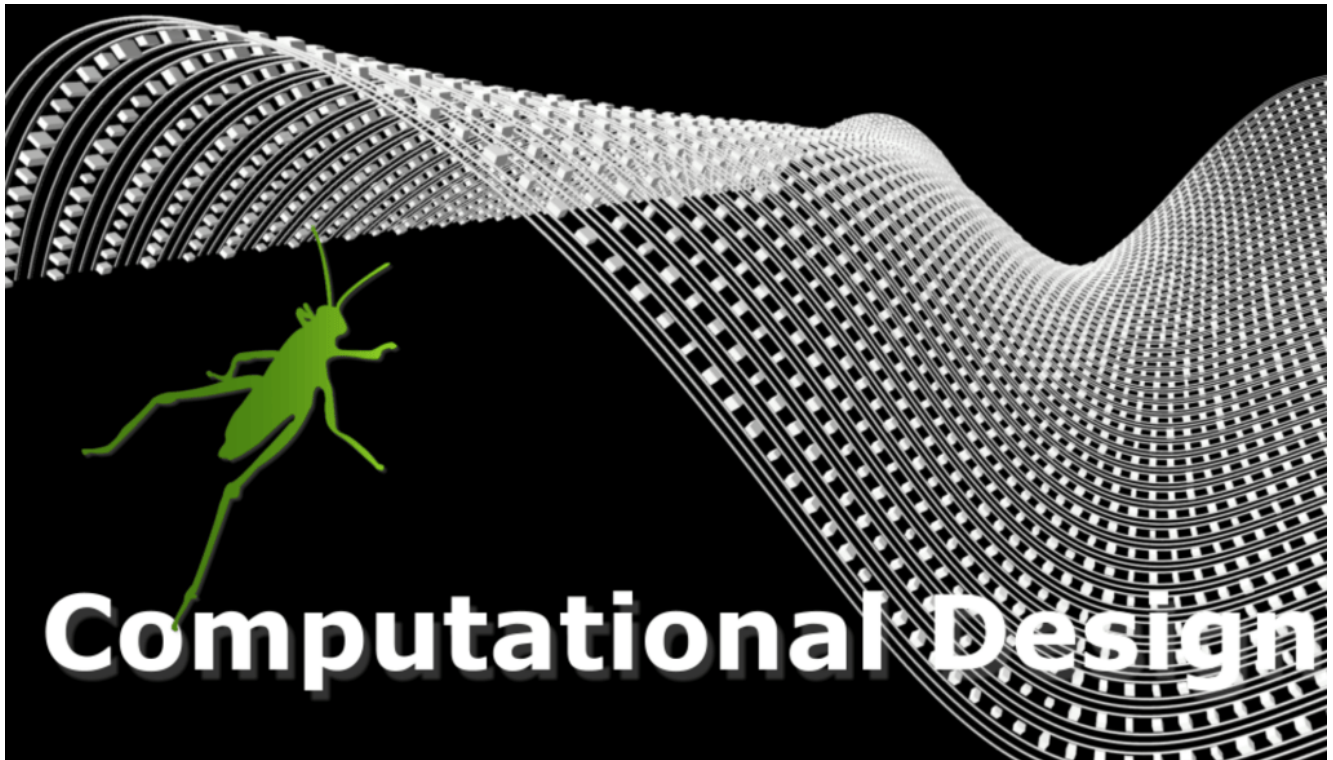
WORKING WITH RULES & SURFACES

As digital fabrication methods expanded, the design problem moved beyond the shoe's outer shape. A footbed, for example, needs a surface that follows the contours of the foot, but its internal structure can also be designed. In work on footbed reconstruction and ventilation, Medel had to consider both controlled surface transitions and the geometry within the component.



Sandal design by René Medel built with Grasshopper: a SubD base is remeshed with TriRemesh and Quad Remesh, and the resulting edges are turned into a printable lattice with MultiPipe.

[Grasshopper](#) gave him a way to define relationships that could generate and adjust that geometry. His experiments with lattice footbeds and graded Voronoi patterns explored structures that would be difficult to develop by modeling each element separately. For Medel, the question became less “how do I model this?” and more “what rules could generate this?”

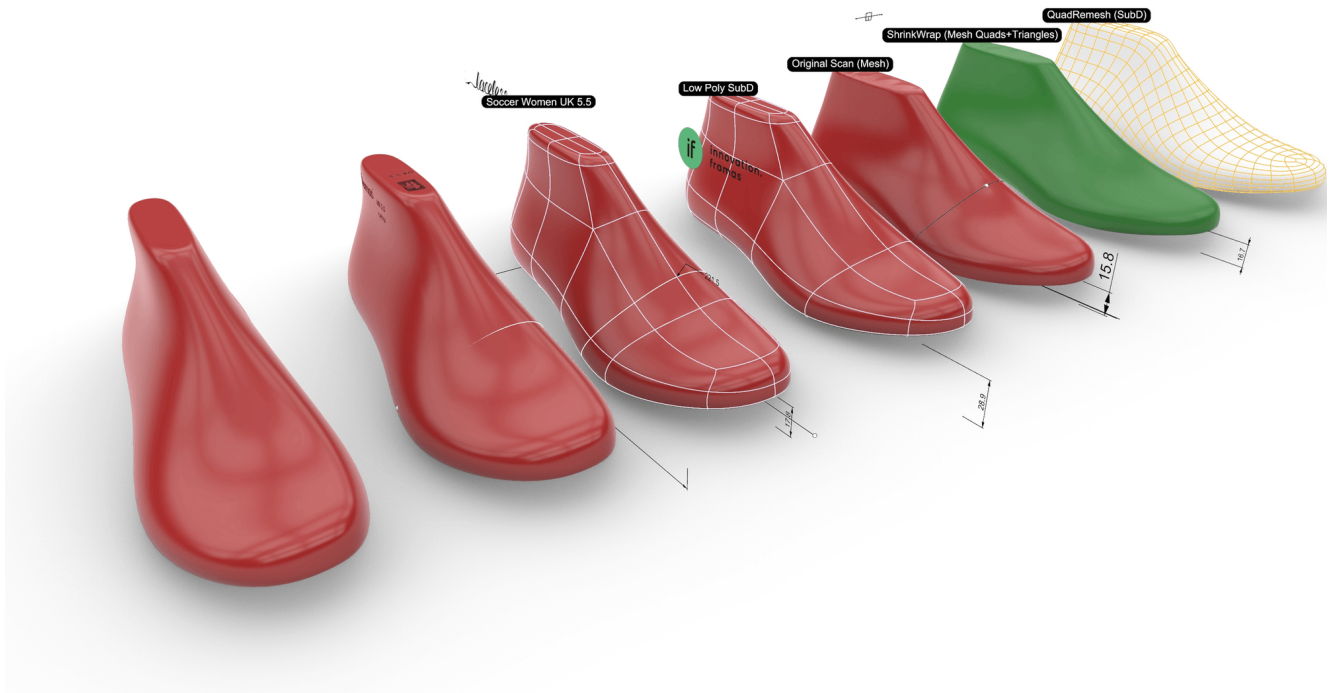


[See Also](#)

[COMPUTATIONAL DESIGN WITH GRASSHOPPER](#)

The significance of these structures goes beyond geometric complexity. Lattices can replace solid volumes with cellular arrangements designed around specific requirements, such as weight reduction, cushioning, or energy absorption. As Medel explained in a 2023 ShapeDiver interview, the challenge is not just generating a pattern, but maintaining the desired mechanical properties as that structure adapts to the shape of a component.

These approaches did not replace careful surfacing. They added another level of control: a designer could shape the component's exterior while developing a system for its internal geometry.



Last development from a scanned mesh through ShrinkWrap and QuadRemesh to a low-poly SubD and a finished last, showing how Rhino 7's SubD tools turn dense scan data into a light control cage that can be refined and converted to NURBS.

THE ROLE OF SUBD

Rhino 7's [SubD](#) tools introduced a more direct way to work with the soft volumes found throughout footwear, including uppers, midsoles, and ergonomic footbeds. With NURBS, producing a flowing form can involve constructing and joining multiple surfaces. SubD lets a designer shape the volume through a simpler control cage, then convert it to NURBS for precise detailing.

For Medel, the value is the connection between those methods. It lets designers explore organic forms quickly without losing the ability to refine surfaces, develop related geometry in Grasshopper, or prepare them for a manufacturing workflow.



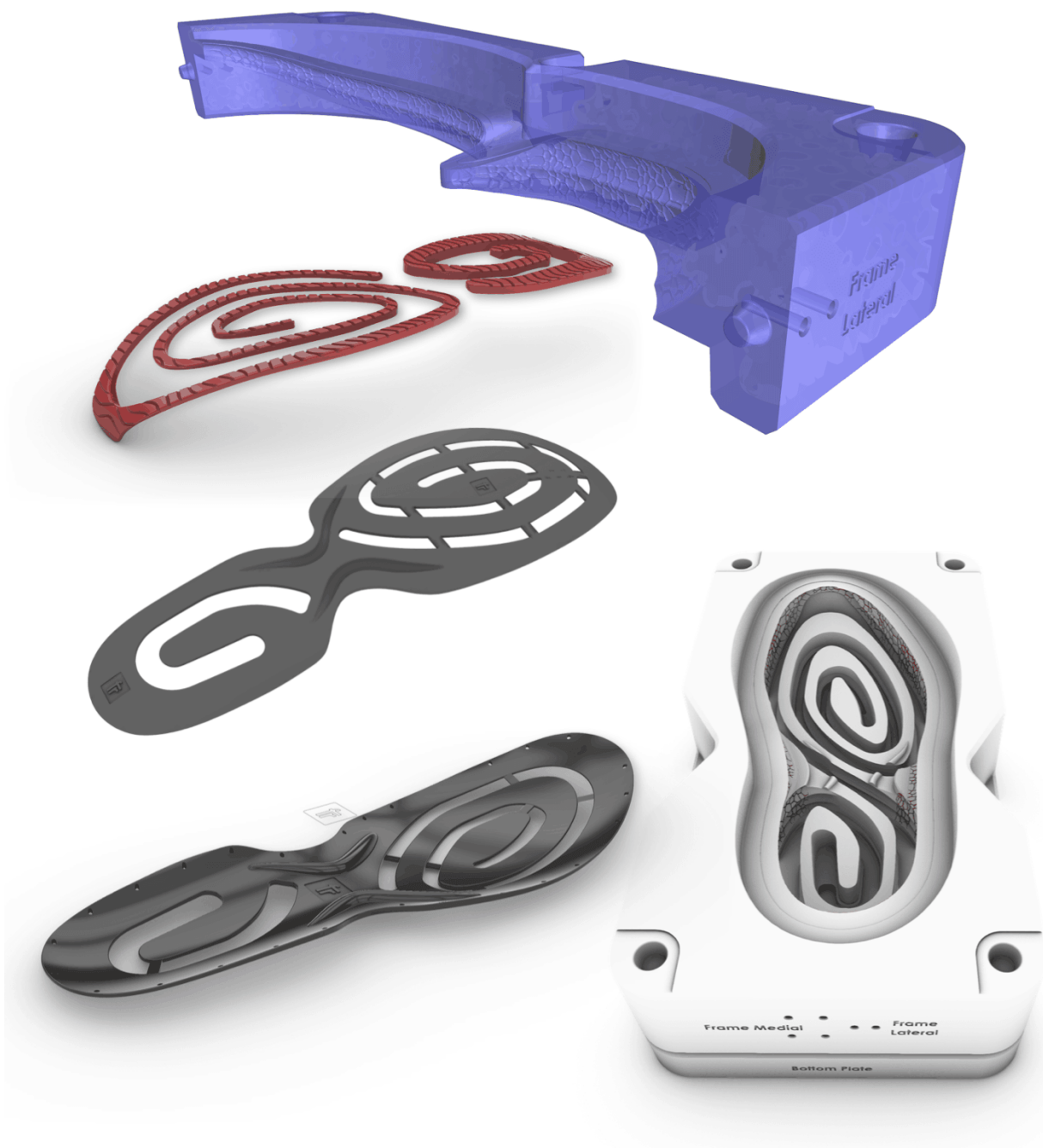
Exploded view of the Light Tube build at framas: last, knit upper, shank, and the co-molded foam bottom unit with its tubular sidewalls and textured outsole.

DESIGNING THE TOOL THAT MAKES THE SOLE

The same principles extend beyond footwear components to the tools used to manufacture them. In Light Tube Foam Sole, a framas project developed between January and March 2026, the challenge was to integrate the components of a co-molded bottom unit within a 3D-printed mold. The digital work therefore extended beyond the sole to the geometry of the tool used to make it.

Digital texturing of the Light Tube sole with the [Botcha](#) plug-in in Rhino, where texture maps are placed and adjusted in a UV editor and applied directly to the sole geometry.

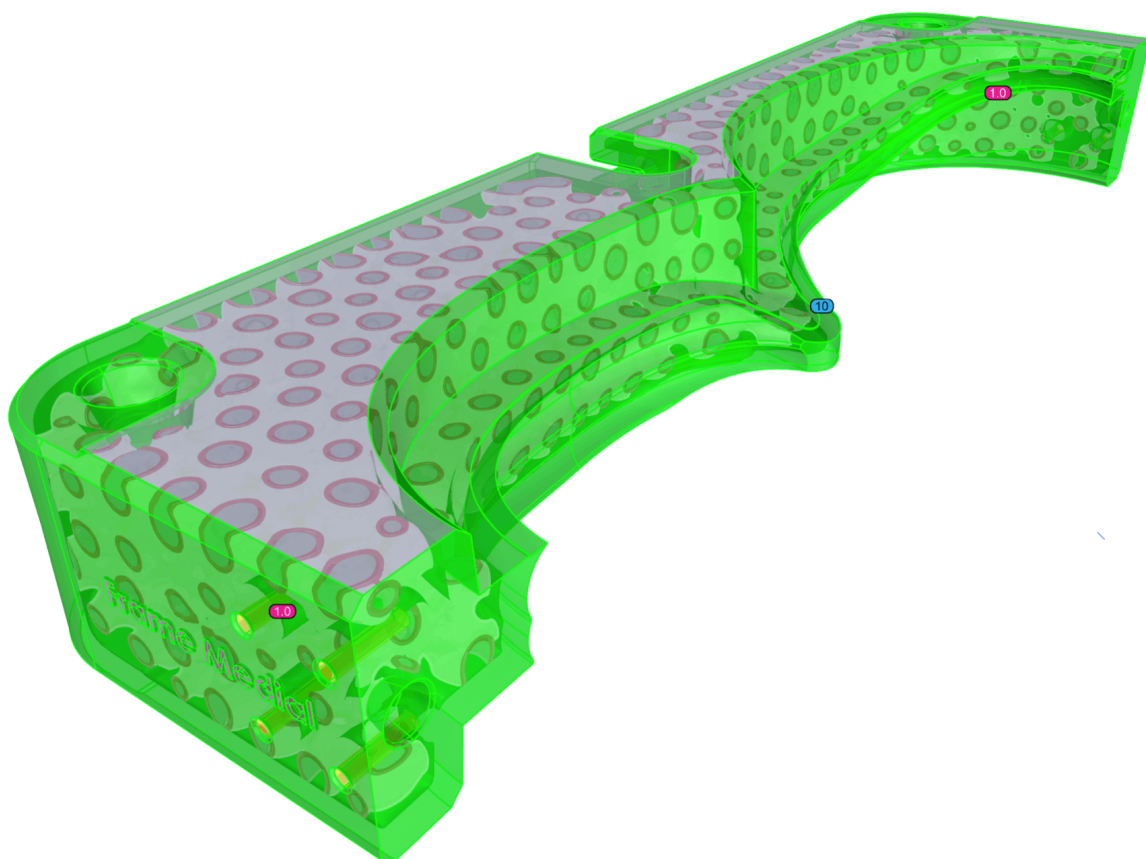
Medel used Rhino across product and mold development. Botcha supported digital texturing; Spherene's Adaptive Density Minimal Surfaces were used to make the mold's internal structure lighter; and Intact.



Light Tube 3D-printed mold and the components it brings together, including the shank and outsole parts integrated into the co-molded bottom unit; the mold was produced in PA11 through selective laser sintering.

Simulation in Grasshopper supported finite element analysis. The mold was produced in PA11 through selective laser sintering, while FDM printed other components in TPU and carbon-fiber-filled nylon.

From the last to the mold, the footwear model has taken on a broader role. Surface design remains essential, but it now sits alongside parametric structures, simulation, and fabrication planning within a connected workflow.



Mold component with an internal structure made using [Spherene](#)'s Adaptive Density Minimal Surfaces, lightening the printed tool, which used about 3 kg of PA compared with roughly 30 kg of aluminum for a milled mold.

The manufacturing comparison helps explain why the tooling approach mattered. According to Medel, a comparable aluminum mold would have required weeks of CNC milling and about 30 kg of material. The printed mold used approximately 3 kg of PA and took one day to print, followed by one day of cooling.

Finite element analysis of the Light Tube shank in bending, run with [Intact.Simulation](#) in Grasshopper supported finite element analysis

CREDITS

LightTube & if Mule – Developed within the Innovation Team at framas Kunststofftechnik GmbH, Germany.

Birkenstock footbed – Developed while working at IP ideas production GmbH & Co. KG, Germany.

Tripstar – Developed for the Sintratec AG Design Contest, Switzerland.