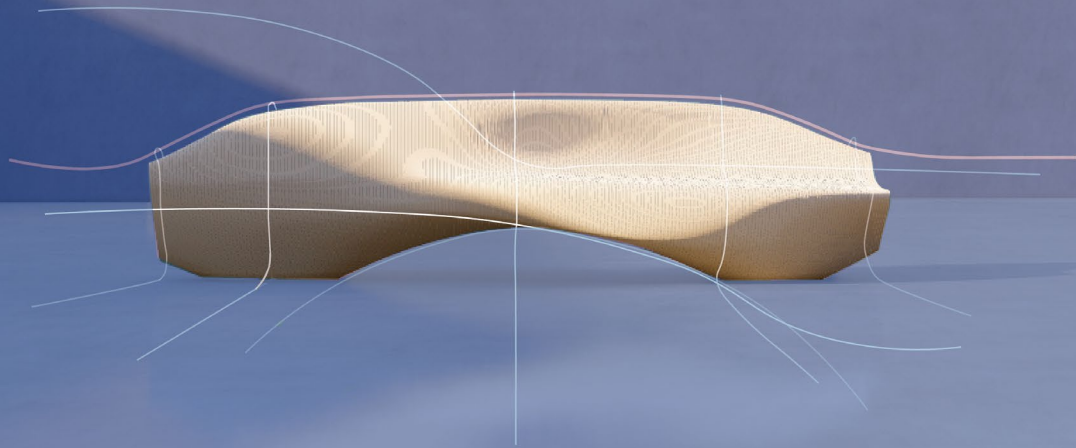




A parametric sculpture that services human comfortability ...

The Helix Bench

DATE OF COMPLETION:
JULY 2022

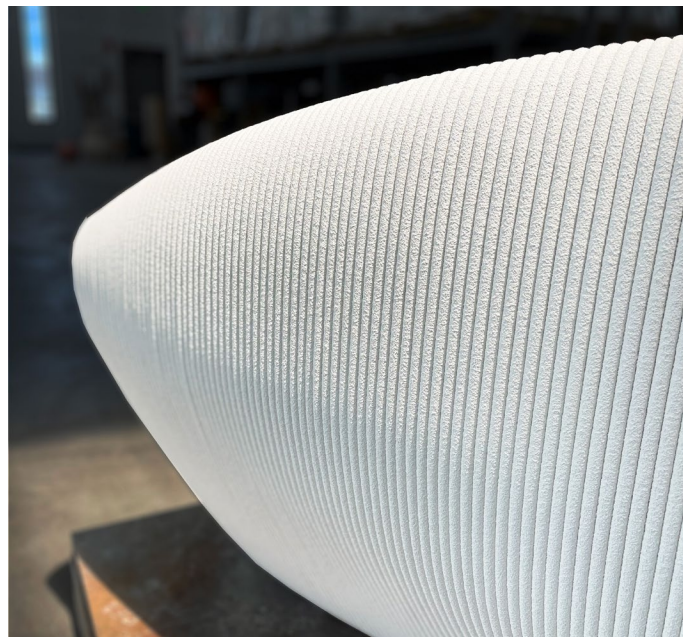
30MM CONCRETE

The Helix Bench

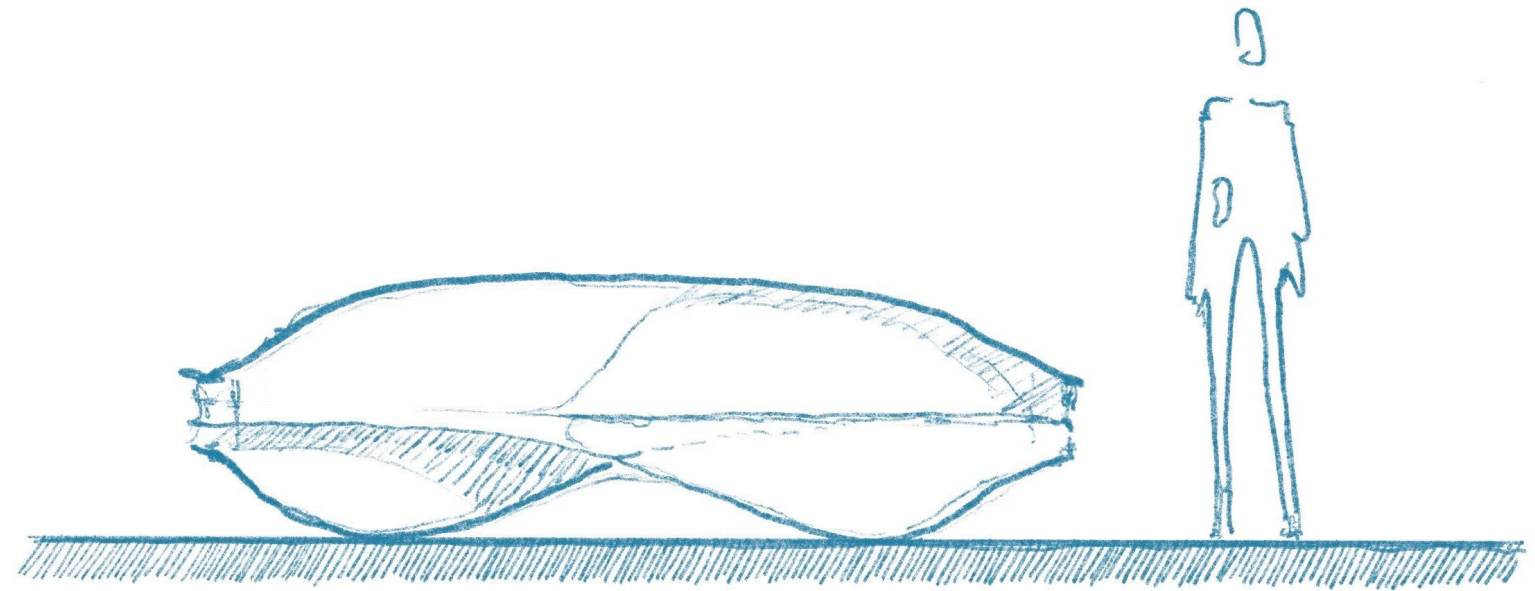
360 W. Aspen Avenue
Salt Lake City, UT

The Helix Bench is a creative collaboration between Method Studio and Pikus 3D. The aim of the project is to test a new mortar chemistry that is designed to improve layer bonding for a monolithic cross section, thus improving overall material strength, durability and precision. The project utilizes parametric design tools to generate and evaluate formal decisions while optimizing for material efficiencies and tool paths. The end result is a “conversation” bench which thoughtfully expresses the elegant potential of 3D printed concrete.





Collaboration

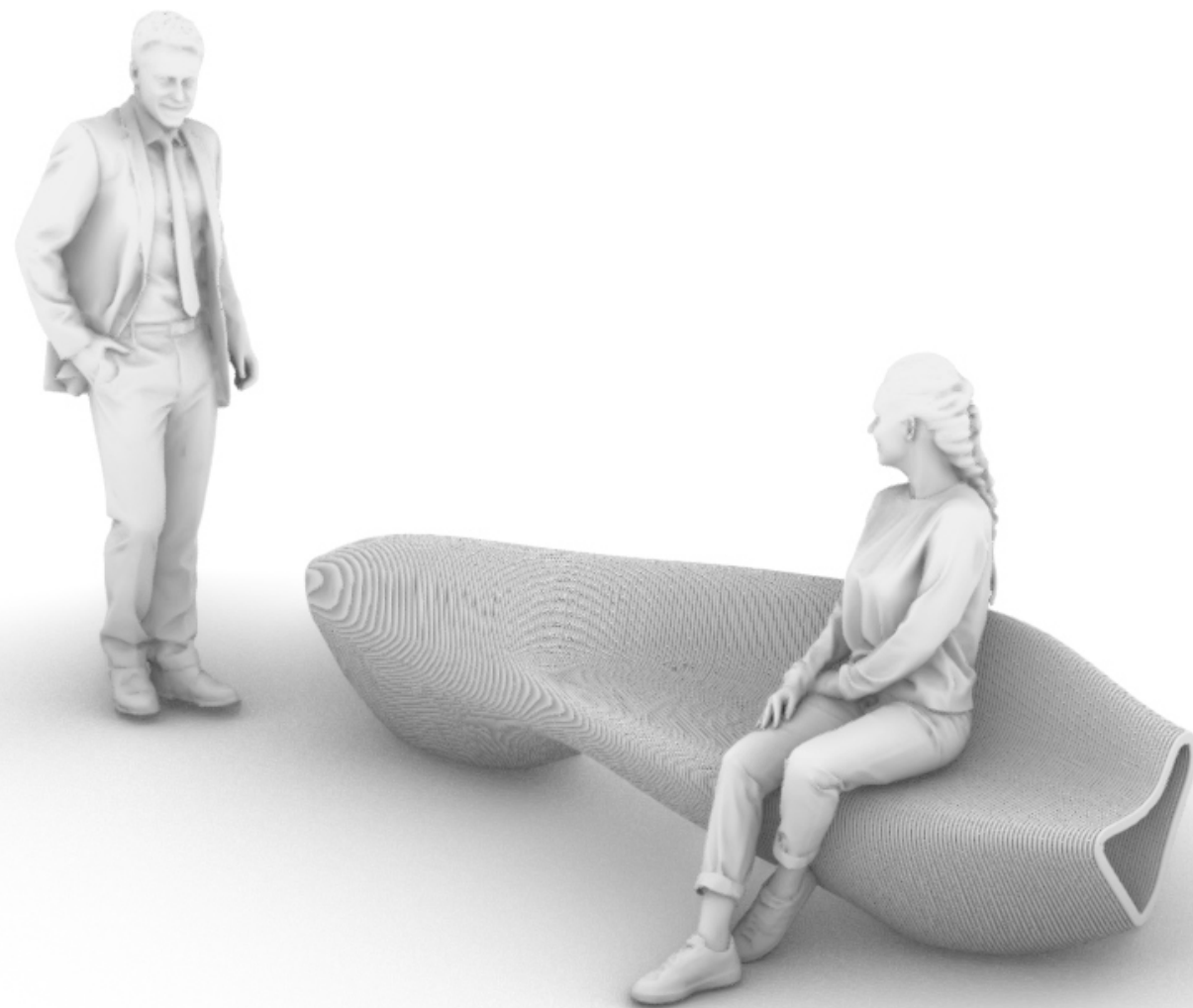
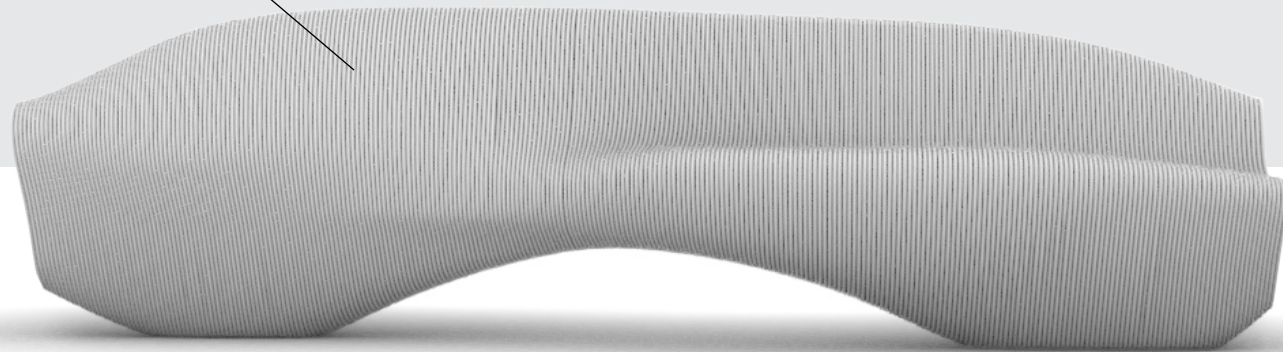


CONCEPTUAL SKETCH

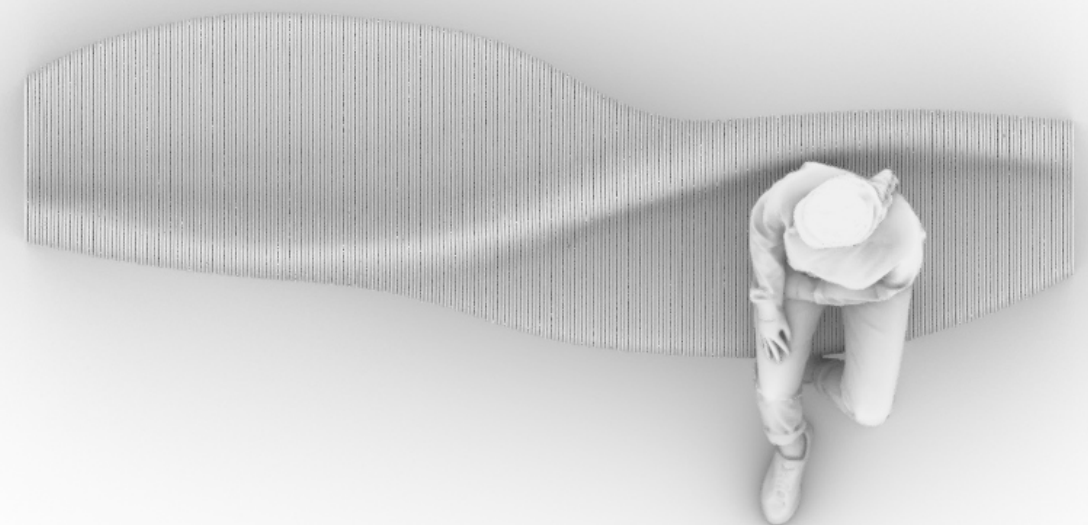
For this project, Method Studios teamed up with Pikus 3D with the backing of Sika scientists and engineers from Switzerland. This allowed the team to begin designing from the molecular level by altering the chemistry of the concrete mortar mix so as to improve material flow, adhesion, structural performance and long-term durability. One primary concern with concrete 3D printing is assuring that each layer is bonded with the previous so as to create a monolithic bond with no joint between the layers. This was achieved through advanced mortar mix design, as well as the fine tuning of printing calibrations.

Design

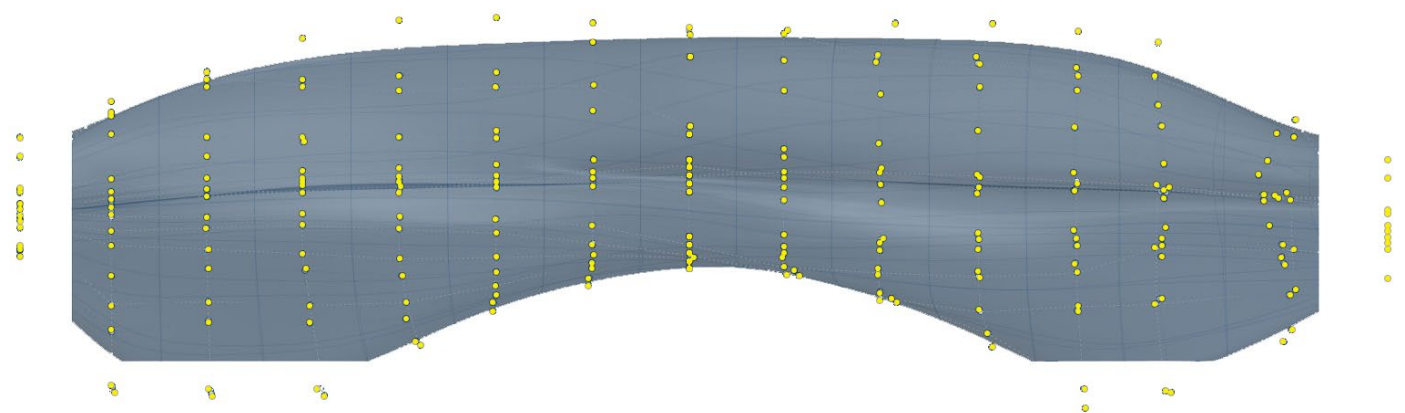
Concrete 3D Printed



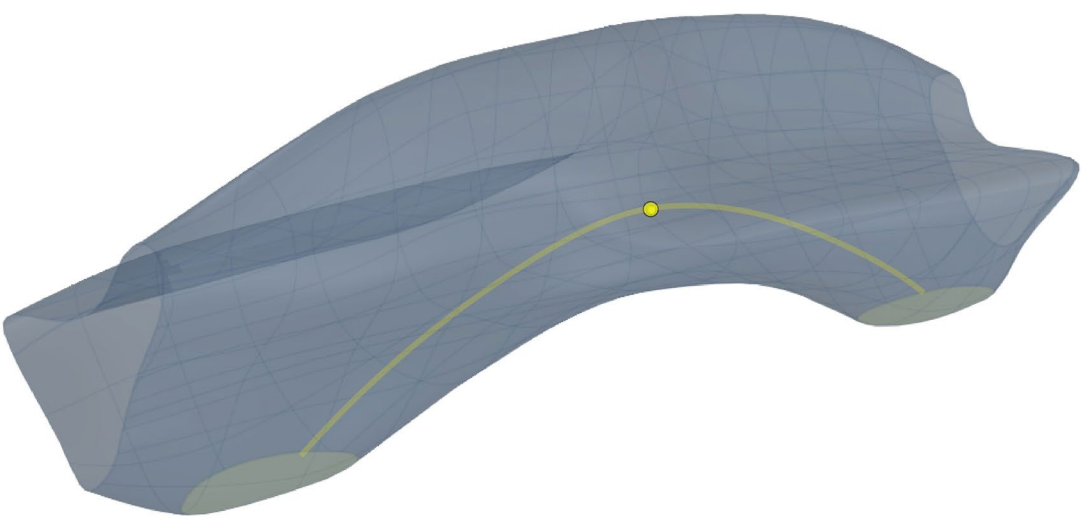
The Helix Bench was conceived as both a conjoiner and a separator – embracing the individual in their singularity while also allowing for connection across and conversation between. The bench's spine rises from either end and gently meanders across its length to form a backrest whose incline is accepting of the human form. The subtle shifting along this boundary keeps occupants on either side of the bench separated yet places them in positions of connection. It was also desirable for the bench to express its material and method of construction by juxtaposing the monolithic form with the thinness of its fabrication. For this purpose, the hollow shell structure is expressed on either end and then capped with steel end-plates recessed from the edge by 5 inches.



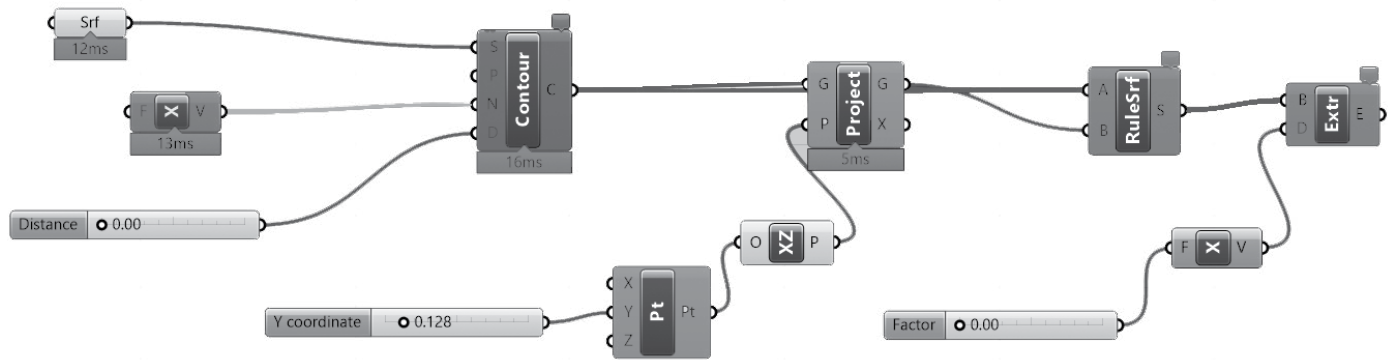
Parametrics



230 GEOMETRY POINTS



CENTER OF GRAVITY



GRASSHOPPER TOOLS

Throughout the design phase, fabrication processes and machine capabilities were used to inform formal explorations. The angle of repose for offset layers of 3D printed concrete was not to exceed 35 degrees. This eliminated any drastic angles and resulted in a smooth, elegant curvature. Determining the center of gravity for the bench was also critical since that point would be continuously shifting during the printing process, resulting in unbalanced forces that might compromise the print. Utilizing Rhino and Grasshopper, points were applied to the model for adjustments to curvature and proper placement.

Date: 13 July 2022
Slicer: V3.62

Dimensions:

Number of Objects: 1
Length X: 0.81 m
Width Y: 0.86 m
Height Z: 2.73 m

Manufacturing

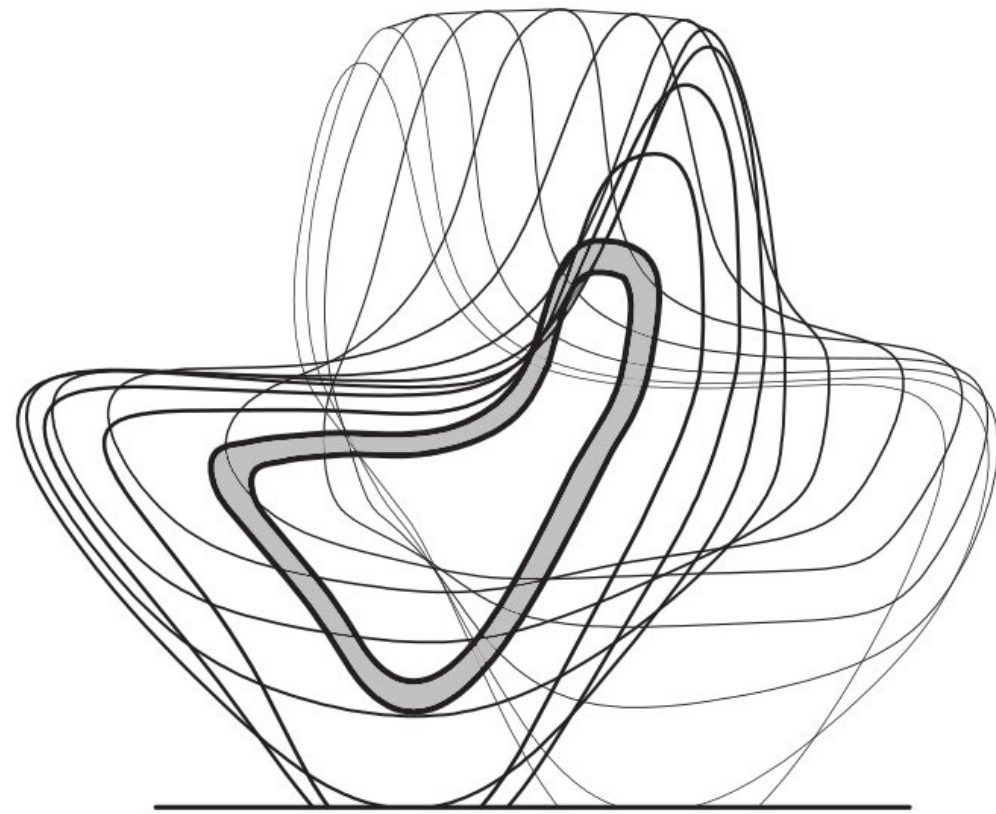
Printing Time: 33 minutes
Weight: 312 kg
Volume: 156 L
Printing Distance: 520 m
Layer Height: 10 to 10.06 mm
Printing Width: 30 mm

Process Configuration

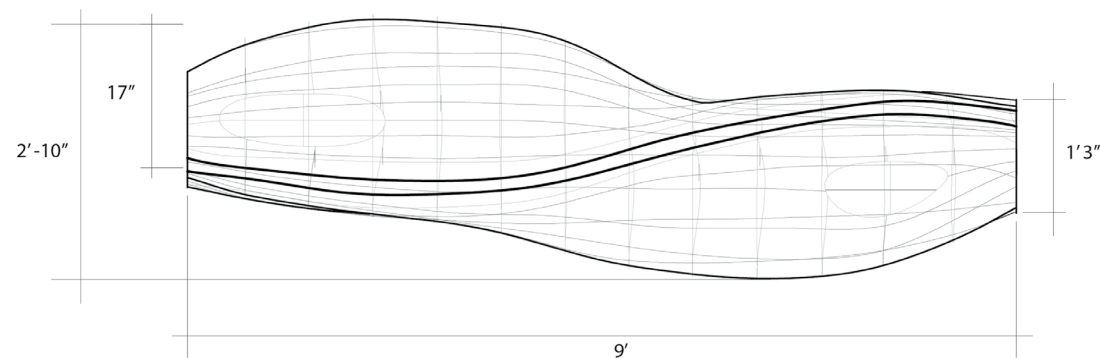
Speed: 15903 to 16000 mm/min
Flow Rate: 9.6 kg/min (4.56 L/min)
Suggested Nozzle Diameter: 25 mm
Max. Acceleration: 5.69 m/s²



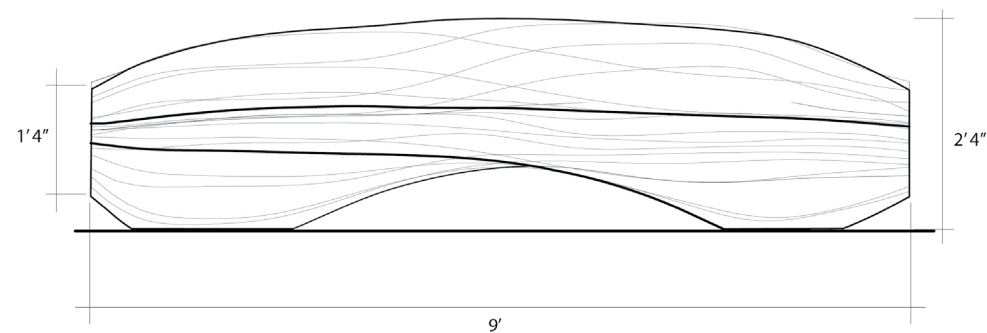
Data Analysis from Pikus 3D software machinery



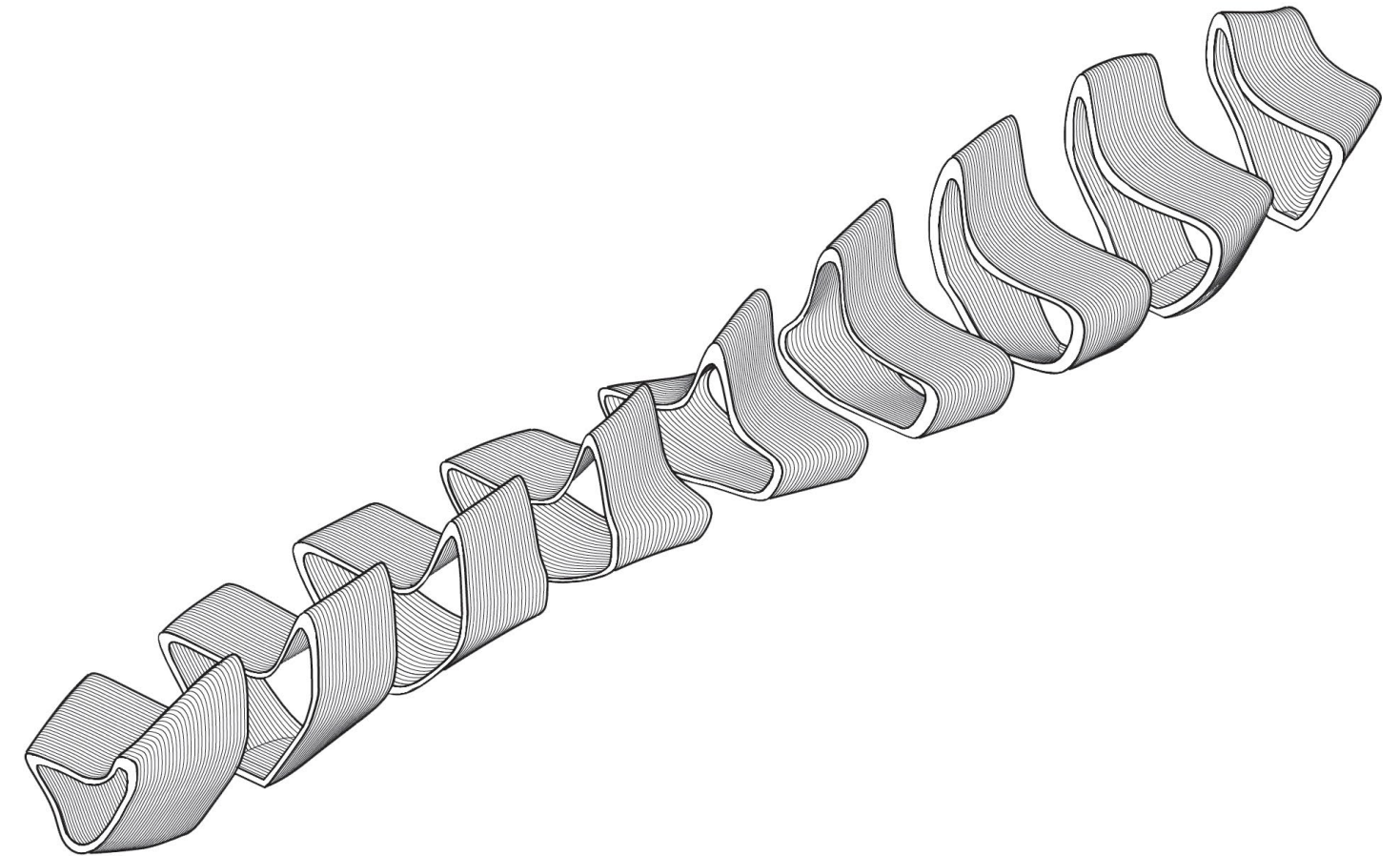
GEOMETRIC ANALYSIS



PLAN VIEW



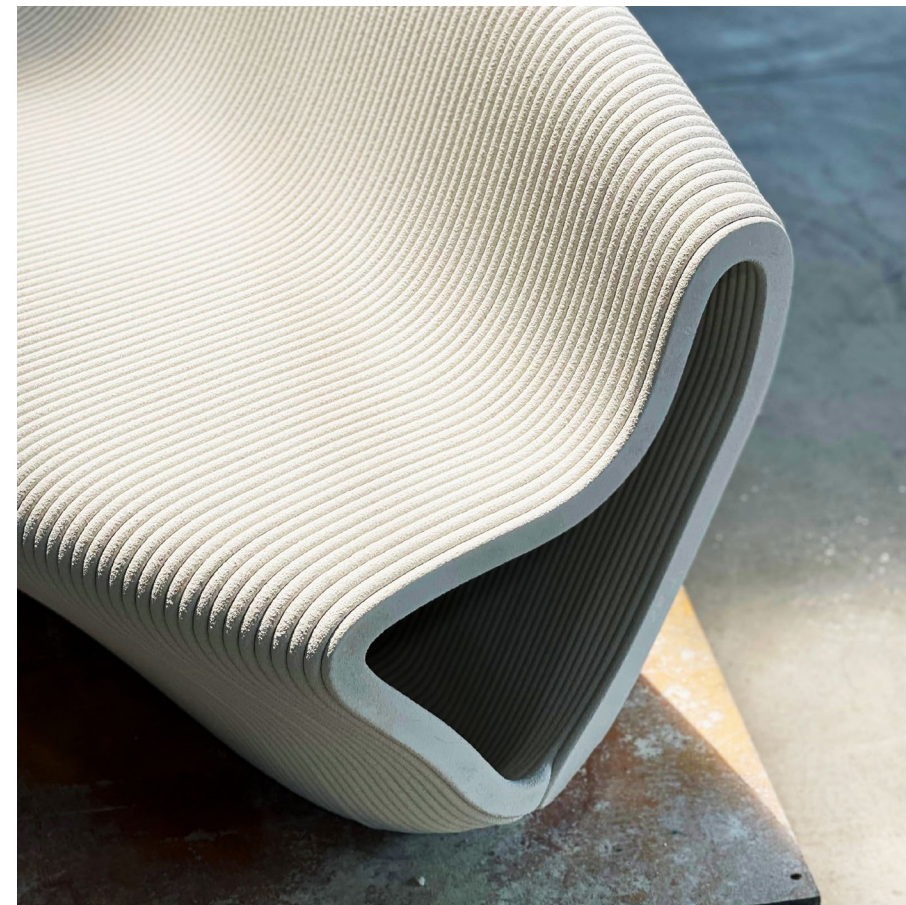
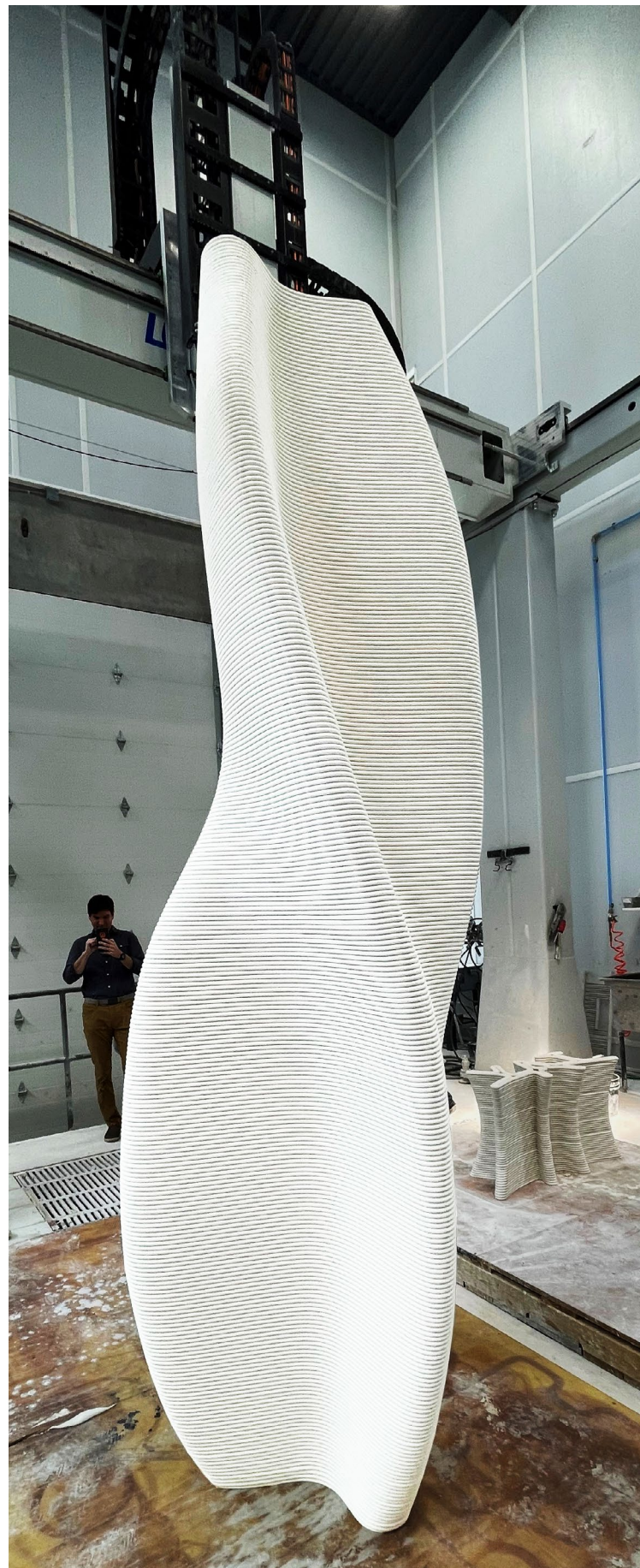
FRONT ELEVATION



SLICED

Geometrics + Printing

The Helix Bench spans 9 feet from end to end, with a total height of 2 foot 4 inches. The seating area is raised 18 inches above the ground for optimal seating. Each end of the bench tapers to roughly 1 foot 4 inches, resulting in a relatively small footprint when printed vertically – this proved challenging but doable. The bench rests on two flat “feet” that are off-axis from each other due to the shifting geometry and resulting in increased overall stability. The Helix Bench was printed using a 30 mm nozzle. At a speed of 16,000 mm/min and a flow rate of 9.6 kg/min, the entire bench was printed in just 33 minutes. The print then rested on the printing platform for 72 hours to allow it to reach maximum strength before prepping for final install.





From the beginning, it was imperative that The Helix Bench appear to rest lightly and effortlessly on the ground, with no visual clues as to how it is secured in place. Prior to installation, ½ inch diameter holes were manually drilled into the two flat feet of the bench. Likewise, the site concrete was pre-drilled and anchor bolts with expanding friction sleeves were installed. Once in place, the bench was lowered, then bolted into place from inside the bench employing an internal steel base plate with neoprene cushion. Next, hot rolled steel plates were attached on either end using a combination of concealed fasteners and magnetic connections. The plates were recessed 5 inches from the edge of the bench, thus expressing the end profile of the concrete. Total time of installation was just under 1 hour.

Installation



The Helix Bench allows for comfortable ergonomic seating for the human body. The option of two-way seating allows for a semi-private experience or a casual conversation. Back posture and leg height were thoughtfully examined and considered within the design process to ensure comfort and practicality. The Helix Bench is not only meant to foster interpersonal communication, but also serves as a sculptural conversation piece. Situated at the building entry, it welcomes employees and guests, and serves as a welcomed respite from the pressures of the day to day.



The Helix Bench will be monitored and evaluated over several months to determine how it performs in an exterior environment. The bench will be exposed to all four seasons where it will come in direct contact with UV exposure, rain, snow and other environmental elements. No additional coatings, sealants or paints were applied to the bench, thus leaving the concrete in its raw form fully exposed throughout the duration of the evaluation period.



Completion

With new and innovative design and fabrication methods emerging, the opportunities for the expressive application of concrete 3D printing are expanding. The Helix Bench is the final product of a joint collaborative effort to test the capabilities of both fabrication and mortar mix design, resulting in an elegant series of curvatures which both inspire and awe.

