

SANCTUM: Parametric Joinery and CNC-Carved Surfaces in a Room for One

A room does not necessarily need walls, doors, or even enough space to stand upright. [SANCTUM: A Room for One](#), designed by architect Rafael Luna of Sydney-based Infra-Architecture Lab, explores how a compact timber structure can create a sense of retreat within a shared environment. Measuring 800 mm wide, 520 mm deep, and 1,655 mm high, the project sits somewhere between furniture and architecture, offering an individual space for rest and reflection.

Its curved plywood enclosure is also a study in digital fabrication. Developed in [Rhino](#) and [Grasshopper](#), SANCTUM brings together parametric joinery, CNC-milled components, and carved interior surfaces within a coordinated fabrication workflow.



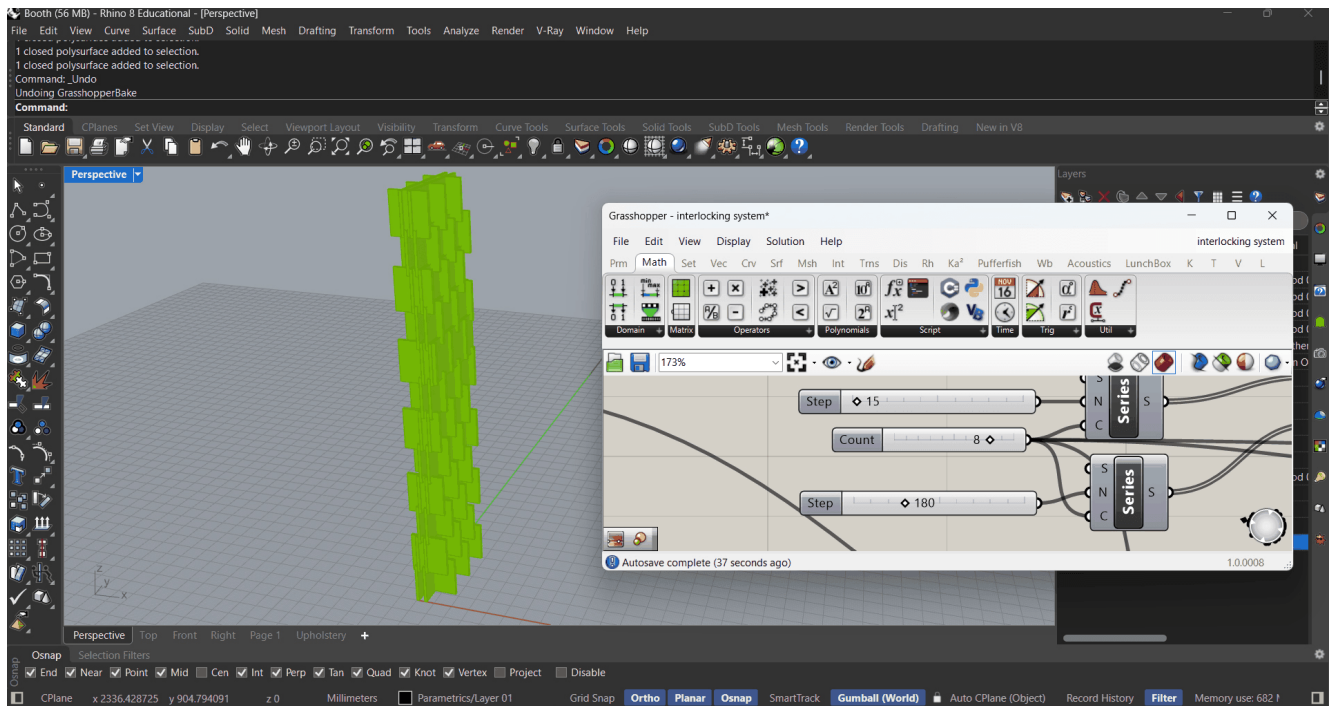
Three-quarter view of SANCTUM revealing the bulging profile of its hollow-wall construction, assembled from interlocking plywood components without adhesives or permanent fasteners.

SHAPING AN INTERLOCKING ENCLOSURE

The structure uses a hollow-wall construction system assembled through interlocking plywood components, without adhesives or permanent fasteners. Rather than treating the curved enclosure as a single surface, Luna developed a system of interconnected pieces that could accommodate its changing geometry.

Rhino provided the environment for developing the overall form, body-scale proportions, and fabrication components. In Grasshopper, Luna controlled the spacing within the cavity wall, the distances between short perpendicular connectors, and the direction of the interlocks.

These parameters allowed him to develop the bulging effect that gives SANCTUM its sculptural profile while coordinating the pieces that form its structure.



The interlocking system in Rhino and Grasshopper, where sliders control the spacing within the cavity wall, the distances between perpendicular connectors, and the direction of the interlocks to generate the enclosure's sculptural form.

The geometry was not simply mirrored around a central axis. Luna used the parametric definition to test different positions for the wall's inflection point, adjusting where the curvature changes direction. This helped him relate the enclosure's shape to the ergonomics of the seated occupant.

The result is a system in which the overall volume and the relationships between its components can be developed together, rather than having to resolve the geometry of each connection independently.

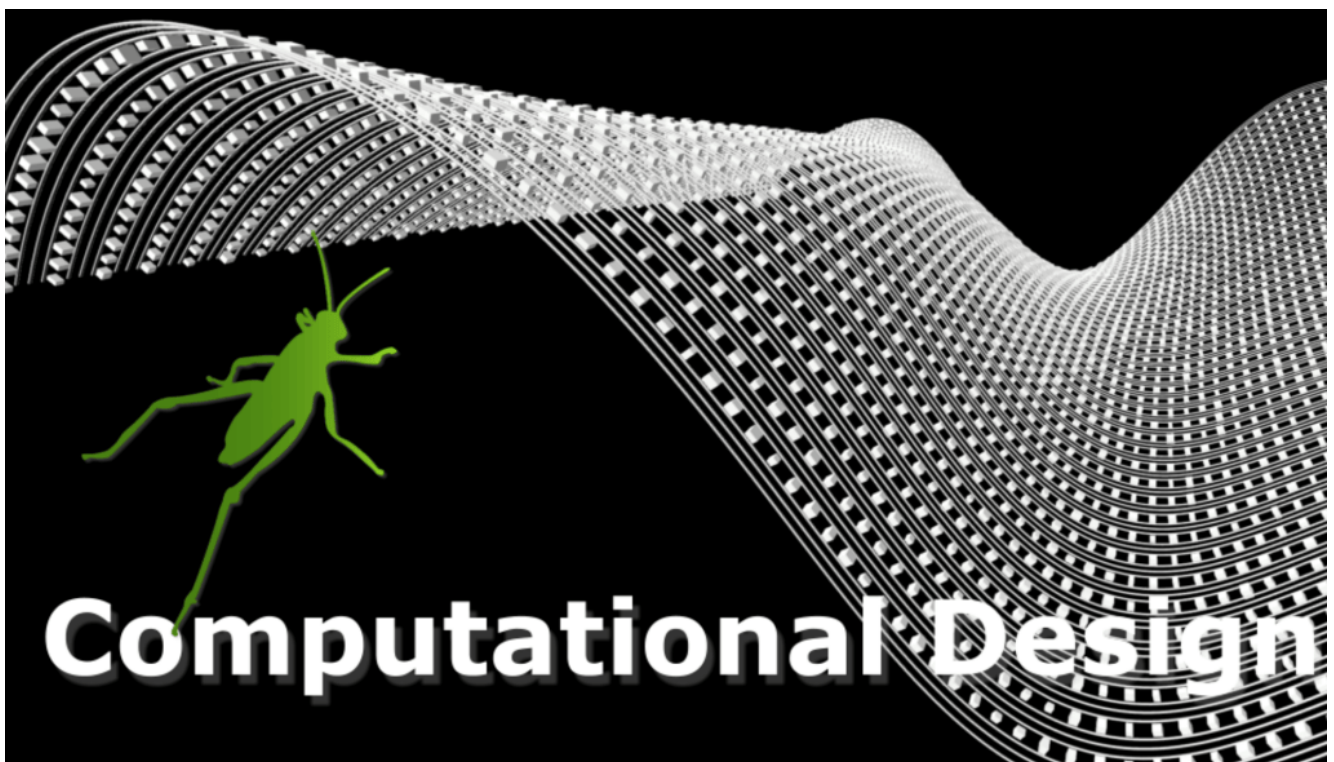


CNC-milled plywood components stacked and labelled after cutting, each slotted piece prepared to fit into the parametric interlocking system that coordinates the structure's changing geometry.

CARVING THE INTERIOR SURFACES

Inside the enclosure, a series of CNC-carved plywood tiles introduces a second layer of geometric variation.

Each tile was developed from 25 mm plywood, with its perimeter edges reduced to 15 mm to create a flush connection with adjacent pieces. This left a 10 mm depth range for carving convex and concave surfaces.



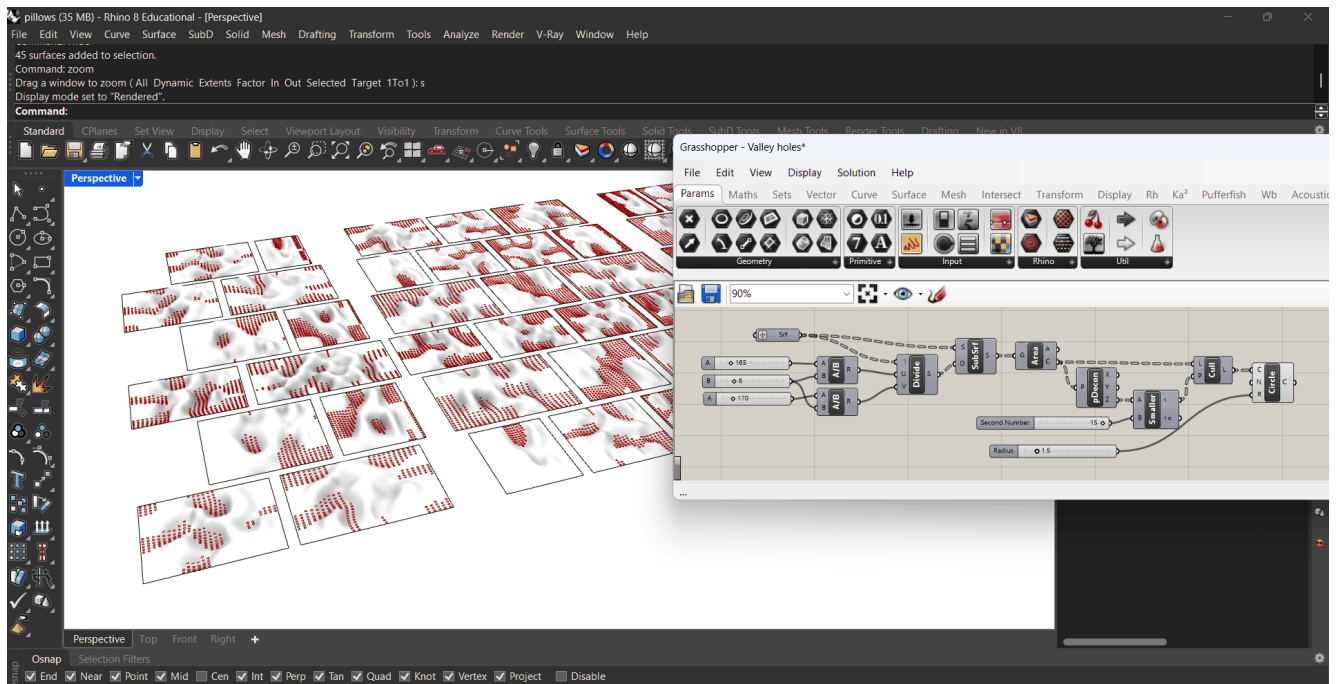
[See Also](#)

[COMPUTATIONAL DESIGN WITH GRASSHOPPER](#)

Using curves and attractor points in Grasshopper, Luna generated variations across the tiles. A depth threshold within the definition also determined the placement of perforations in the concave areas.

The surface geometry explores two acoustic principles: concave areas with perforations intended to contribute to sound absorption, and

convex surfaces intended to scatter sound.



Grasshopper definition for the interior tiles, using curves and attractor points to vary the convex and concave surfaces, with a depth threshold determining where perforations are placed in the concave areas.

FROM DIGITAL MODEL TO CNC FABRICATION

The transition from parametric model to physical assembly introduced another set of constraints.

Luna's workflow moved between Rhino, Grasshopper, physical prototyping, and CNC machining. While the interlocking system coordinated the relationships between components, fabrication required attention to how individual pieces behaved during cutting.



Interior tiles freshly carved on the CNC bed, showing the convex and concave surfaces milled within the 10 mm depth range left after reducing the 25 mm plywood edges to 15 mm.

Smaller plywood elements, for example, were vulnerable to vibration during CNC machining. To keep them stable, Luna used pins to restrain the pieces during cutting, an approach previously employed in his Sydney prototyping work.

These practical considerations form part of the project's development alongside the digital geometry. The model establishes how components fit together, but physical prototyping helps determine how those components can be manufactured and assembled.



The full set of carved plywood tiles laid out together, displaying the geometric variation generated in Grasshopper and the perforations intended to contribute to sound absorption.

REFINING THE ACOUSTIC APPROACH

The next stage of SANCTUM's development will focus on acoustic testing and refinement.



Rafael Luna hand-finishing a carved tile, part of the physical prototyping and fabrication work that accompanied the digital model throughout SANCTUM's development.

The existing carved surfaces establish the interior's visual and

tactile character, while providing a starting point for evaluating its acoustic behavior. Luna plans to use the Grasshopper model to adjust the depth and distribution of the surface's hills and valleys, together with the number and diameter of the perforations, in response to test results.



The assembled SANCTUM structure in the studio, with the carved interior tiles arranged on the floor before installation inside the enclosure.

Presented as part of [Venice Design Week 2026](#), SANCTUM demonstrates how a small inhabitable structure can bring several scales of design into the same digital workflow, from the overall relationship between body and enclosure to the geometry of individual joints and carved surfaces.



Detail of the finished interior, where perforated concave areas and convex surfaces explore two acoustic principles (absorbing and scattering sound) while defining the space's visual and tactile character.

Its development also illustrates the role of parametric modeling beyond formal exploration: connecting geometric decisions to fabrication constraints while leaving room for further testing and iteration.



An occupant seated inside SANCTUM, illustrating the body-scale proportions Rafael Luna developed in Rhino and the relationship between the curved enclosure and the ergonomics

of the seated user.

CREDITS

Project: SANCTUM: A Room for One

Design: Rafael Luna

Studio: Infra-Architecture Lab, Sydney, Australia

Exhibition: Venice Design Week 2026