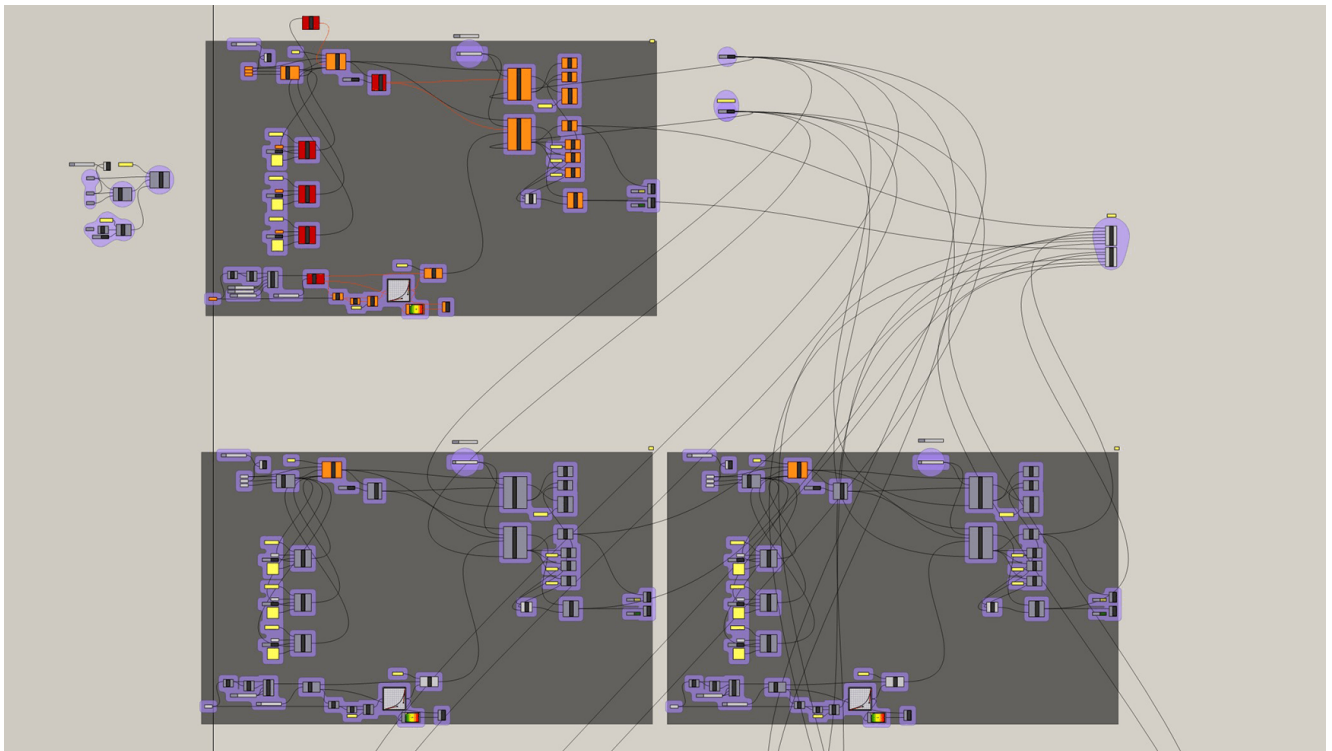


Casa Fratelli: Generative Growth within a Historic Ruin

Located within a decaying 19th-century structure in Bucharest, [Casa Fratelli](#) explores the tension between heritage and computation through a large-scale parametric installation. Developed by [BIOMORPH DESIGN](#) in collaboration with [TWINS STUDIO](#), the project transforms a fragile historical interior into a dynamic spatial system where generative design, additive manufacturing, and lighting converge.

At the core of the intervention is a parametric “liana”, an artificial growth system designed to mimic the way vegetation colonizes abandoned architecture. Rather than treating the ruin as a static container, the project leverages computational design to simulate a living process that adapts, climbs, and occupies the space.

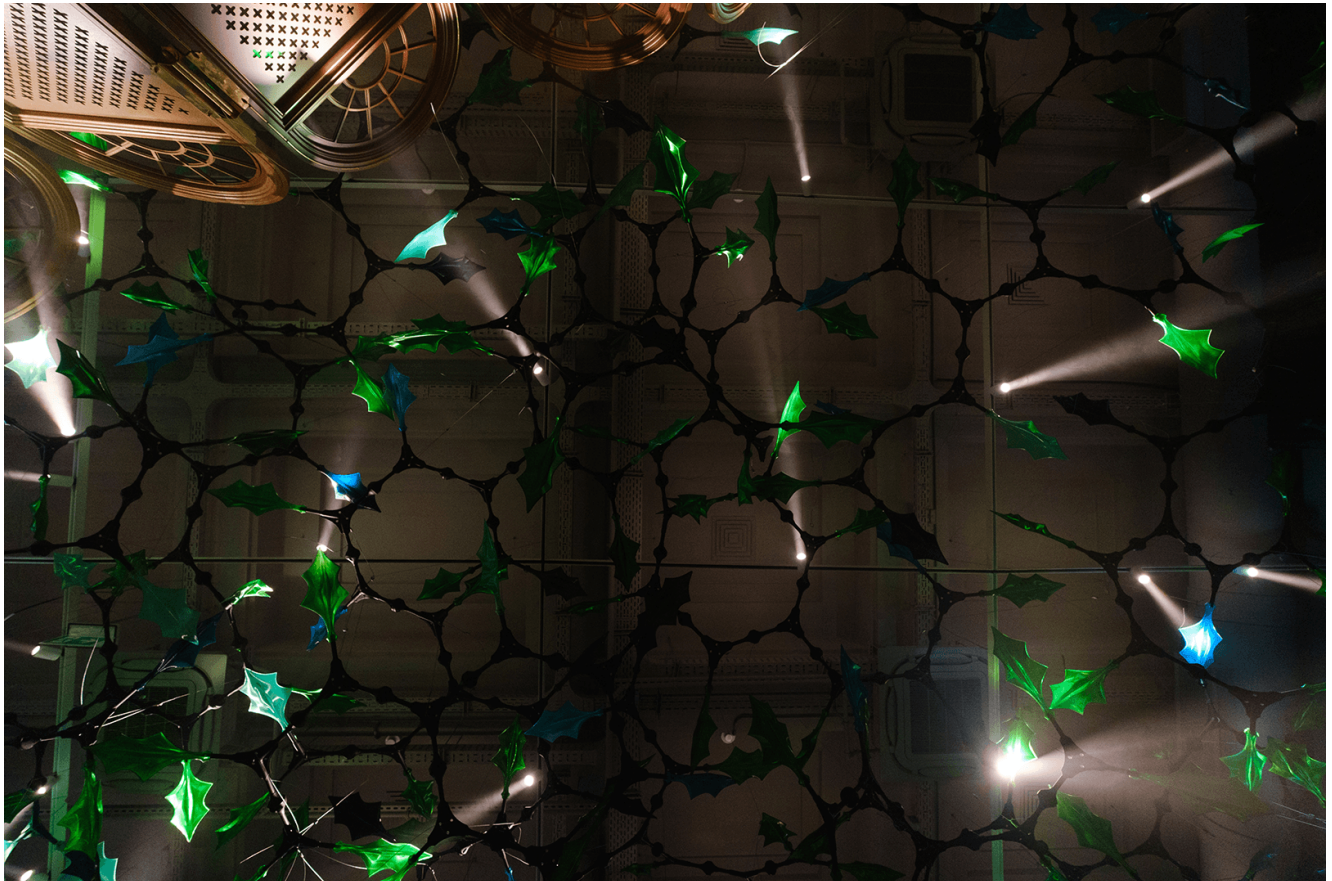


Grasshopper definition using WASP to control stochastic aggregation and rule-based growth of the system.

FROM MODEL TO SYSTEM: DISCRETE

AGGREGATION LOGIC

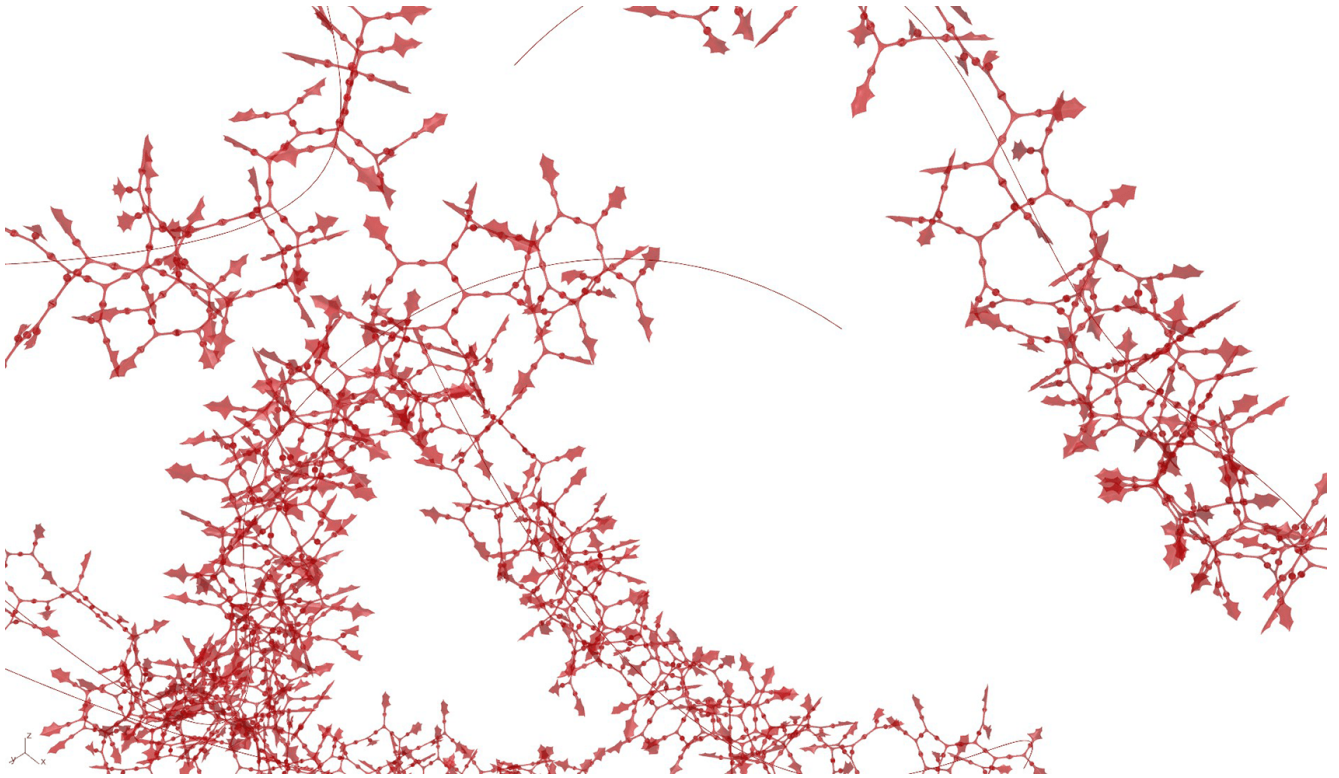
The entire system begins with a single component: a 3D-printable leaf module. This element was carefully designed to operate as a discrete unit within a larger aggregation logic, balancing geometric expressiveness with fabrication constraints.



Aggregated modules forming a self-supporting canopy adapting to the existing structure.

Using [Rhinceros](#) and [Grasshopper](#), the team implemented a rule-based growth system driven by the [WASP plugin](#). This allowed for the controlled generation of 1,000 unique elements through stochastic aggregation, ensuring the resulting structure maintains both structural coherence and an organic unpredictability.

Rather than relying on traditional structural systems, each module was programmed to respond to local conditions, enabling the liana to “navigate” the irregular geometry of the ruin. This approach reframes discrete assembly as a spatial strategy, in which global form emerges from localized interactions among components.



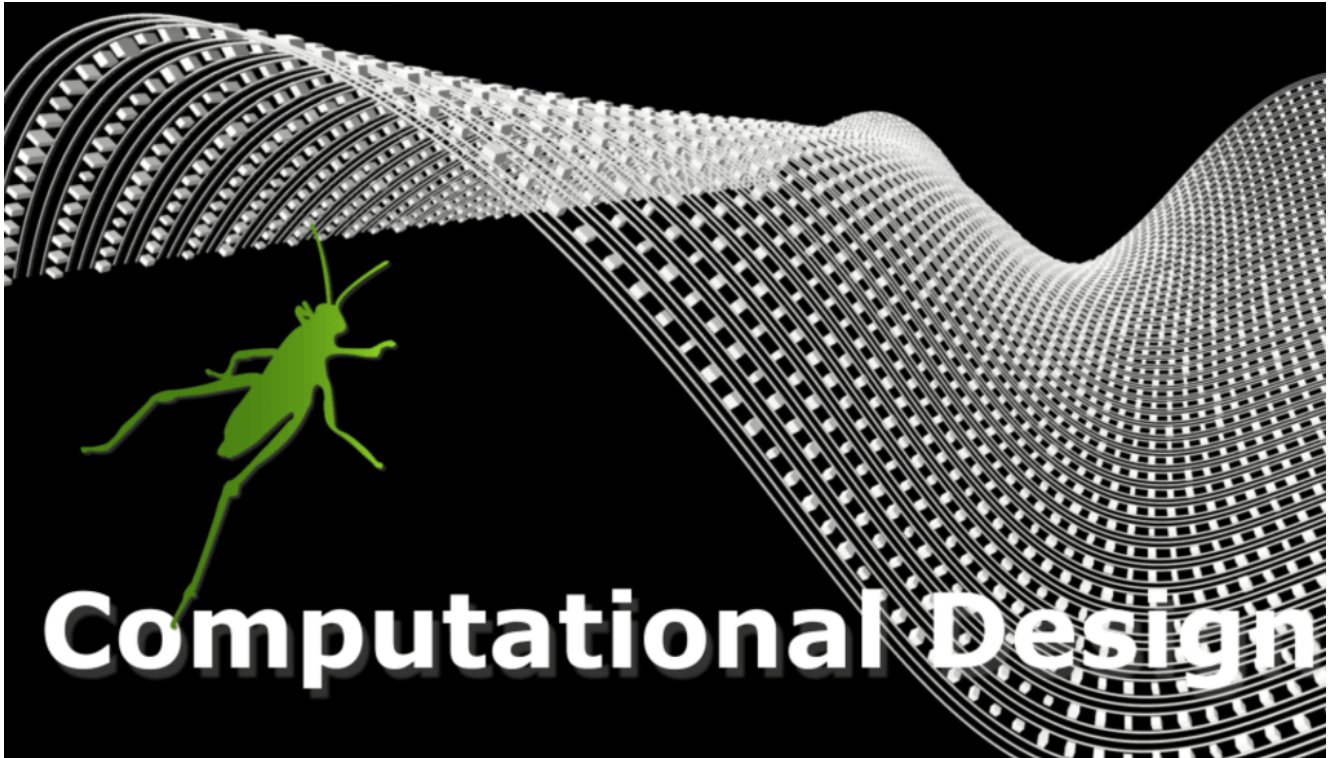
Global aggregation geometry generated through discrete growth logic across the spatial field.

FEEDBACK BETWEEN GEOMETRY & FABRICATION

A key aspect of the workflow was the continuous feedback loop between digital modeling and fabrication constraints. Grasshopper was used not only to define geometry, but also to embed manufacturing logic directly into the design process.

Parameters such as maximum overhang angles, nozzle diameter, and material behavior were integrated early, allowing the geometry to evolve in direct response to the realities of FDM printing. This ensured that every generated component was immediately buildable, eliminating the gap between design intent and production.

To achieve this level of control, the team developed custom [Python scripts within Grasshopper](#) to generate optimized G-code. This enabled a direct-to-machine workflow where design decisions translate seamlessly into fabrication instructions.



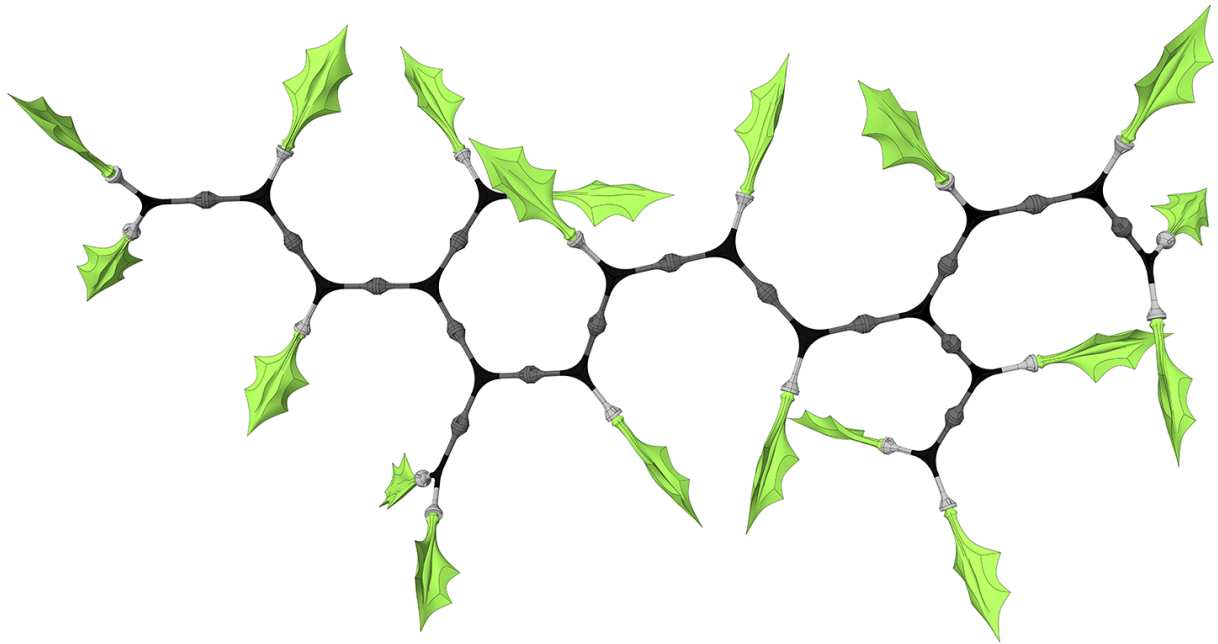
[See Also](#)

[COMPUTATIONAL DESIGN WITH GRASSHOPPER](#)

ADVANCED FDM STRATEGIES: VASE MODE & EMBEDDED FUNCTIONALITY

The fabrication strategy pushed beyond conventional slicing workflows. Each leaf was produced using spiralized “Vase Mode”, allowing for a continuous extrusion path that results in thin, lightweight, and highly translucent surfaces.

The main technical innovation lies in the integration of a functional internal thread directly within this continuous toolpath. This allowed each element to be screwed onto aluminum support pipes without the need for additional connectors or fasteners.



Discrete leaf module designed for additive manufacturing and structural connectivity.

Achieving this required precise control over layer height, extrusion flow, and path continuity. By bypassing standard slicers and generating custom toolpaths, the team maintained structural integrity while preserving optical performance.



Close-up of semi-transparent printed leaves interacting with controlled lighting conditions.

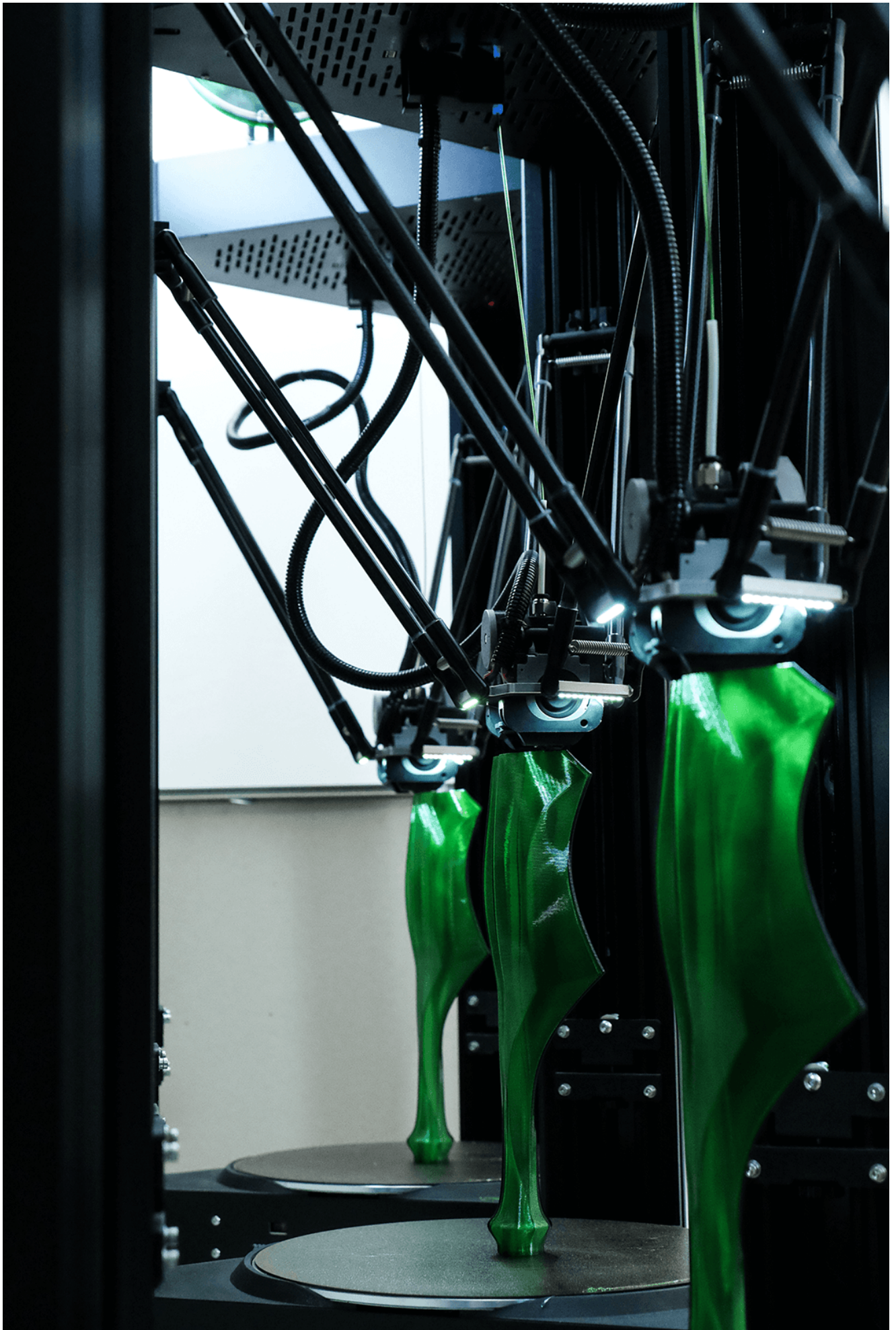
MATERIAL PERFORMANCE & LIGHT AS A DESIGN DRIVER

All components were fabricated using 99% recycled, fire-retardant PETG, reinforcing the project's material efficiency and sustainability goals. However, the material was not treated as a neutral medium.

Animation of the generative aggregation process, showing rule-based growth and spatial adaptation of the liana system within the architectural context.

By varying shell thickness and path density, each leaf operates as a calibrated optical device. The semi-transparent surfaces interact with static lighting to produce layered depth, internal reflections, and a high-luster finish.

Light was therefore not applied as a secondary layer, but embedded as a primary design parameter. The positioning of each module was optimized to control how light penetrates and diffuses through the structure, transforming illumination into a spatial material.



Large-scale FDM 3D printing process using recycled PETG and optimized toolpaths.

STRUCTURAL STRATEGY WITHIN A FRAGILE CONTEXT

Working within a protected historical environment introduced significant constraints. Traditional mounting systems were avoided to preserve the integrity of the masonry.

Instead, the liana was designed as a partially self-supporting system, anchored only at specific reinforced points. The aggregation logic ensured load distribution across the network, reducing the need for invasive structural interventions.

This approach demonstrates how computational design can operate as a negotiation tool between new interventions and sensitive heritage conditions.



Integration of the liana system within the architectural envelope of the historic interior.

A CINEMATIC SPATIAL EXPERIENCE

The final installation operates as a suspended, immersive canopy that redefines the interior atmosphere of Casa Fratelli. The interplay between geometry, light, and material creates a constantly shifting visual field, where the artificial growth appears simultaneously controlled and spontaneous.

Rather than simply occupying space, the system activates it. The project positions generative design not only as a form-making tool, but as a means to choreograph perception, transforming a static environment into a responsive, experiential landscape.



Suspended network of printed elements creating depth through layered translucency.

CREDITS

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