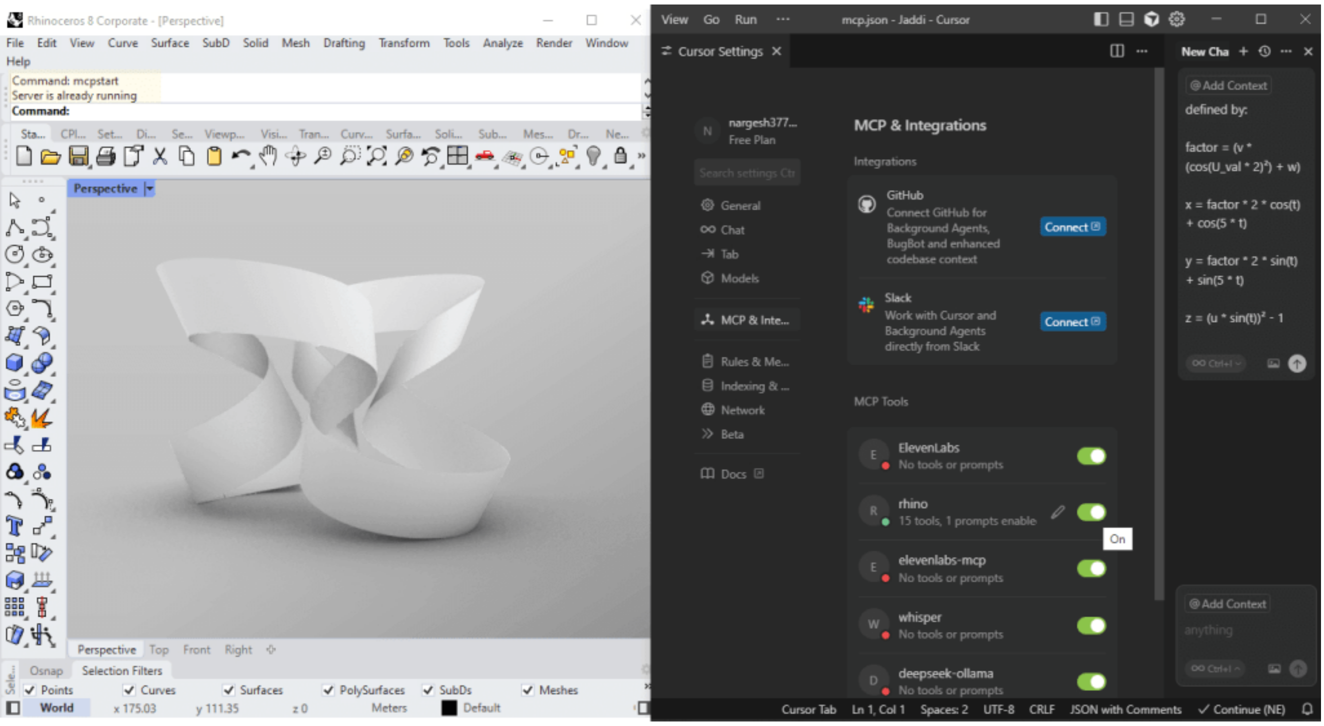
Epicycloid Blossom: A Parametric Lighting Piece Shaped by Geometry, Python, and AI-Assisted Design

In recent years, academic design studios have become experimental laboratories. In these spaces, emerging technologies increasingly converge with traditional architectural and industrial workflows. Epicycloid Blossom, developed within the Deep Design Studio at the [Iran University of Science and Technology](), exemplifies this shift. The project explores how mathematical curves, Python scripting, and AI-assisted tools can act together to produce intricate spatial geometries with fabrication-ready precision.



Connection to MCP

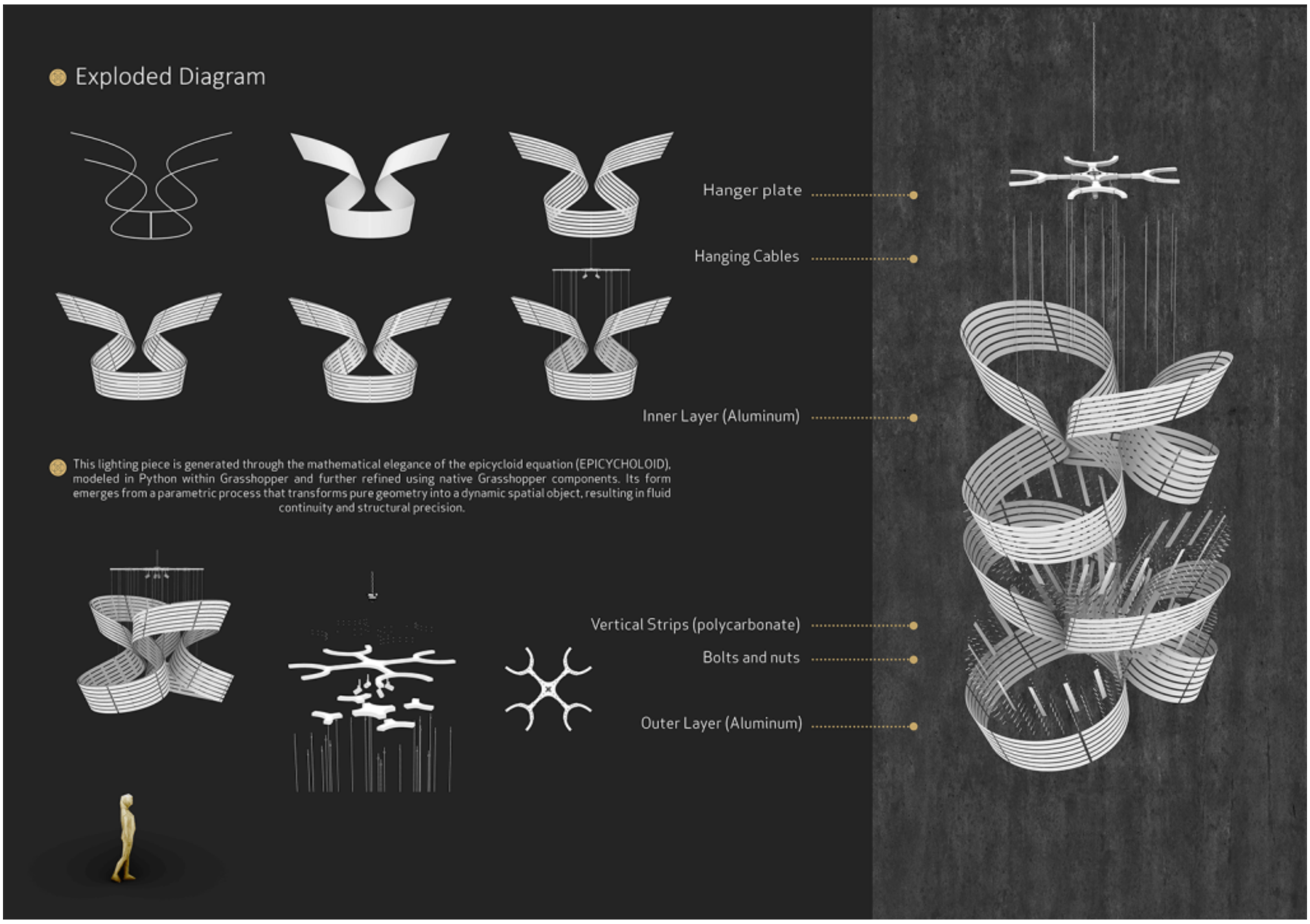
DESIGNING AT THE INTERSECTION OF

MATH & MACHINE INTELLIGENCE

Rather than functioning solely as a formal exercise, the team approached the project as a complete digital prototype: from parametric logic and geometric behavior to material strategy, segmentation, and assembly documentation. The result is a sculptural lighting concept that lives in the digital realm but is resolved down to the last fabrication detail.

A BLOSSOM EMERGING FROM AN EPICYCLOID

Epicycloid Blossom was conceived through the exploration of the epicycloid equation. The design team redefined the original formula, introducing variations in coefficients and trigonometric parameters that produced a wide spectrum of curvatures. Through iterative refinement, the geometry evolved into a balanced, organic, blossom-like structure.



Exploded diagram

This mathematical approach provided precise control over rhythm and symmetry, while preserving the natural expression that characterizes the piece.

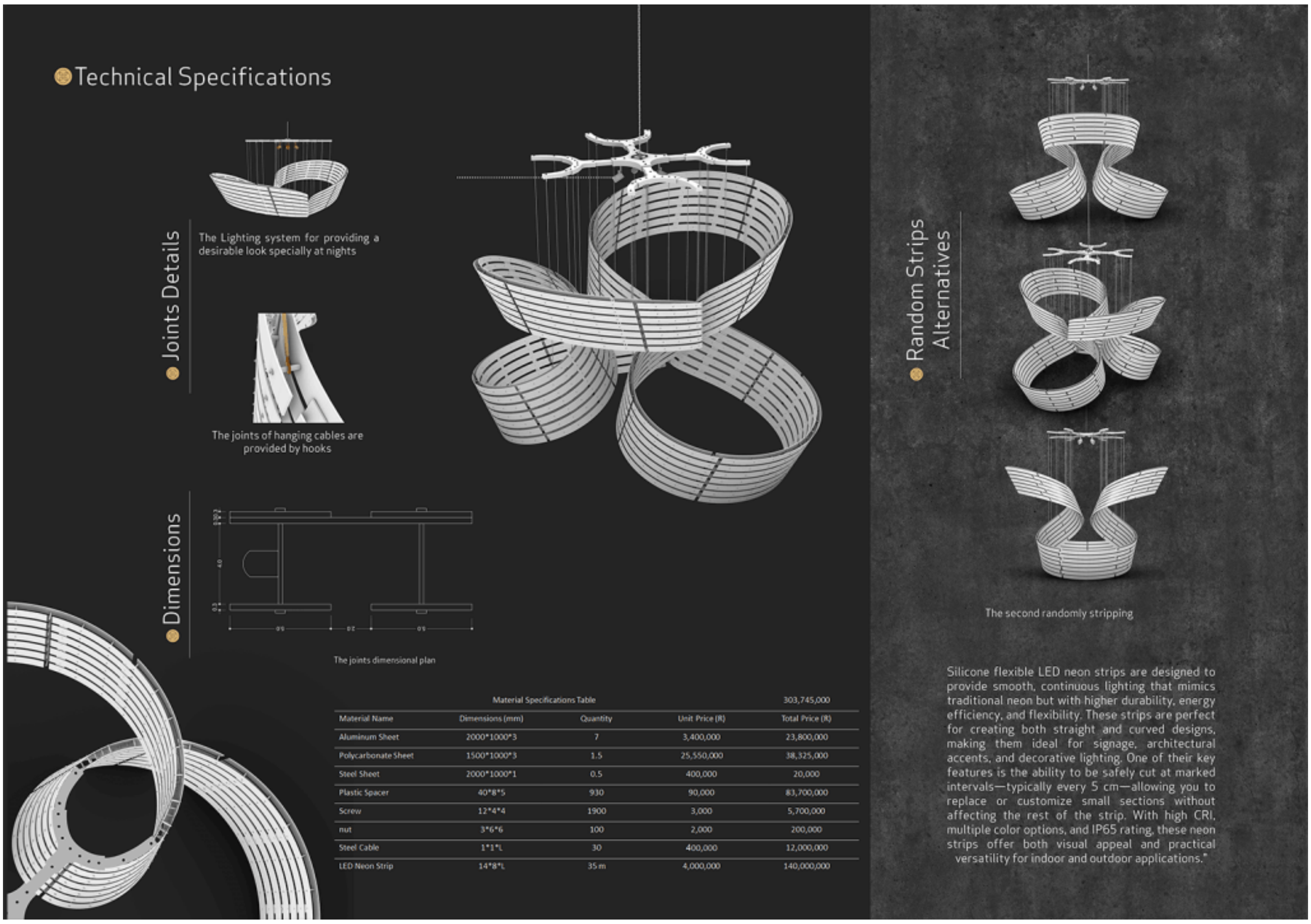
[See Also](#)

GHPYTHON

SCRIPTING, PARAMETRIC LOGIC, & AI-DRIVEN ITERATION

The project's development combined Python scripting, Grasshopper, and AI-supported workflows. Through Model Context Protocol (MCP) integration, the designers established a live communication channel between Cursor AI, GPT, and Rhino. This allowed the team to exchange code seamlessly, test geometric behaviors, and accelerate the exploration of design variations.

Grasshopper played a central role in defining the parametric logic, generating the base curves, guiding mesh relaxation, positioning spacers, and automating segmentation for fabrication.



Material Name	Dimensions (mm)	Quantity	Unit Price (R)	Total Price (R)
Aluminum Sheet	2000*1000*3	7	3,400,000	23,800,000
Polycarbonate Sheet	1500*1000*3	1.5	25,550,000	38,325,000
Steel Sheet	2000*1000*1	0.5	400,000	20,000
Plastic Spacer	40*8*5	930	90,000	83,700,000
Screw	12*4*4	1900	3,000	5,700,000
nut	3*6*6	100	2,000	200,000
Steel Cable	1*1*L	30	400,000	12,000,000
LED Neon Strip	14*8*L	35 m	4,000,000	140,000,000

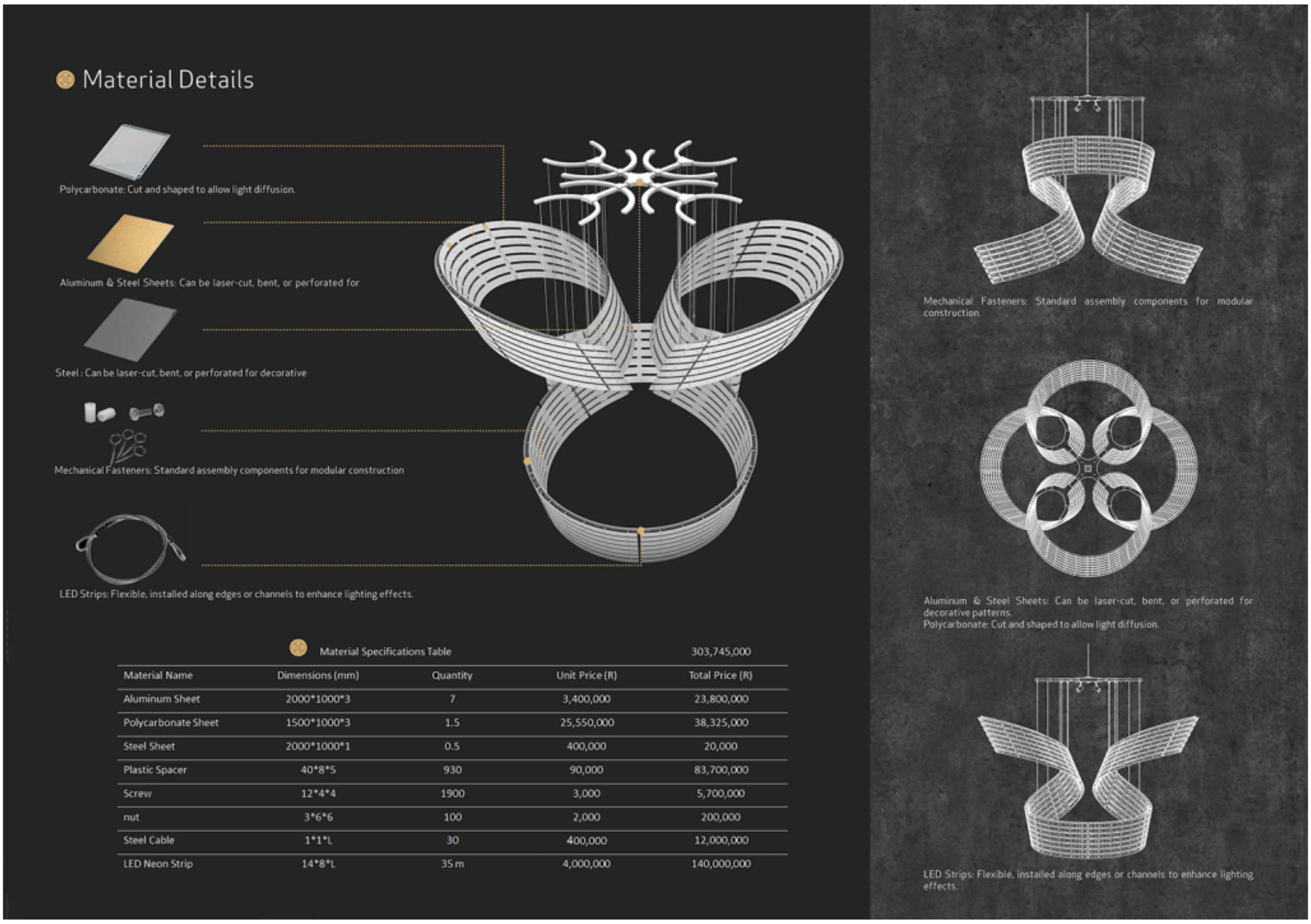
Technical specifications

PREPARING A DIGITAL DESIGN FOR REAL-WORLD FABRICATION

While the piece remained digital, the entire fabrication logic was fully resolved. The structure was designed as a dual-layer system of 3 mm gold-anodized aluminum ribbons combined with an inner 3 mm transparent polycarbonate layer. Plastic spacers (40 mm) and metal fasteners were positioned to provide structural stiffness and create a cavity for LED light diffusion.

A strip-based segmentation method was used to divide the surface into numbered components ready for CNC or laser cutting. The [OpenNest](#) plugin supported unrolling and nesting, ensuring efficient material organization.

All production drawings, numbering strategies, and assembly steps were completed, demonstrating that the piece could be fabricated without further geometric development.

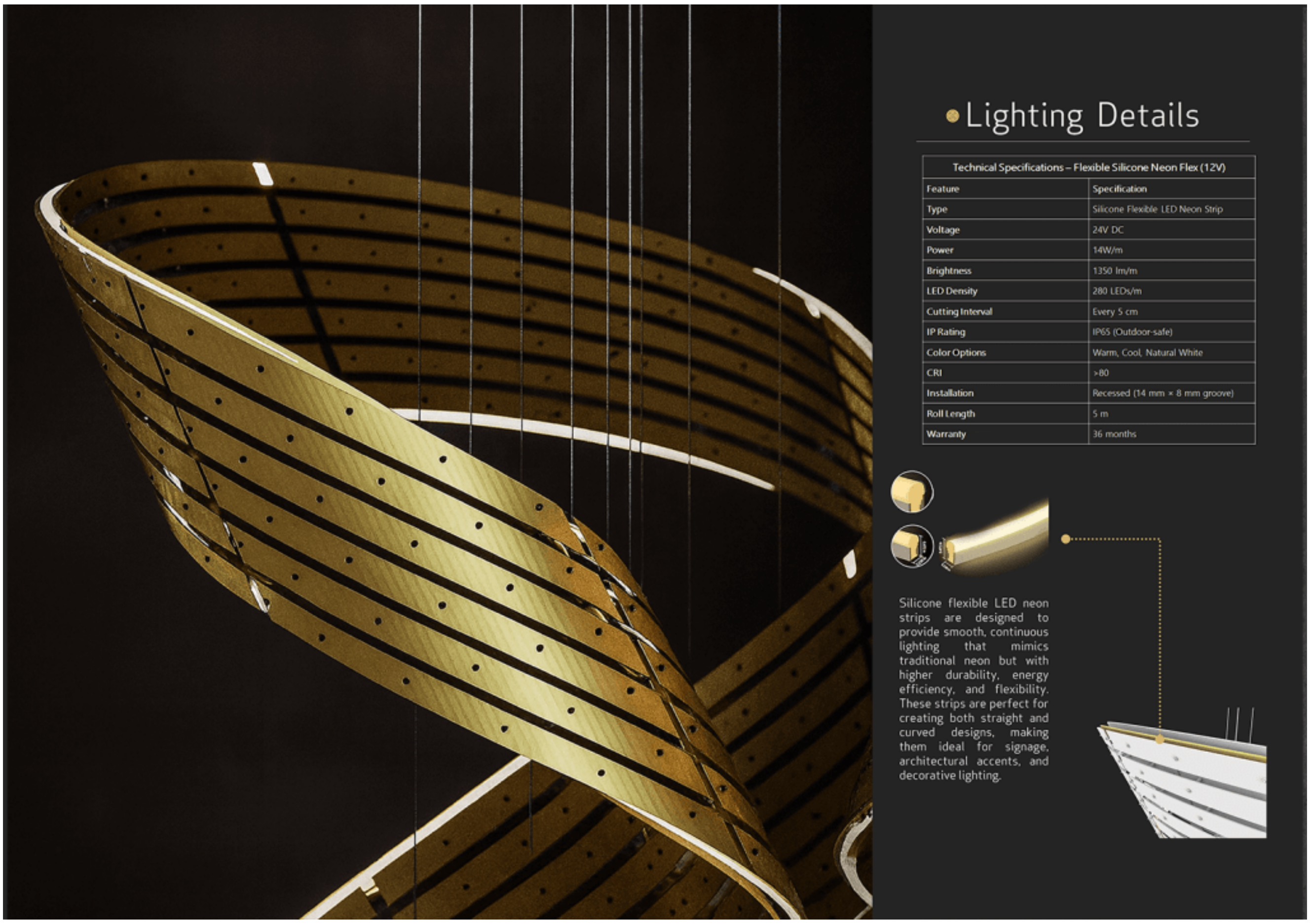


Material study

TECHNICAL TOOLS & WORKFLOW

The project was developed using Rhinoceros 8 SR16 and Grasshopper, with the parametric logic scripted in Python through Cursor (v1.5.11). The workflow incorporated AI-assisted iterations via MCP integration, enabling quick testing of geometric variations and refinement of the overall design. Lumion was used for the final rendering and visualization of the sculptural lighting piece.

Potential fabrication methods considered included CNC milling and laser cutting. The rendering workflow was also optimized using *ArqAI*, an AI-powered platform for architectural visualization.



Lighting details

CHALLENGES & INSIGHTS

One of the main challenges was establishing an effective communication channel between the MCP environment and Rhino.

This was achieved using Cursor AI and the RhinoMCP plugin, which enabled smooth code exchange and real-time parametric updates. The integration provided the team with an accelerated design process and contributed to a deeper understanding of how AI can support geometric exploration.

Detailed view of the structure

IMPACT & EDUCATIONAL VALUE

Epicycloid Blossom functioned as a research-driven academic project, contributing to the team’s development in algorithmic design, AI-assisted workflows, Python-based geometry generation, and digital fabrication strategies.

The project received strong positive feedback and was showcased on the supervisor’s page, the university’s design lab platform.

Detailed view of the structure.

A brief summary of the parametric design development and the technical detailing of the
Epicycloid Blossom lighting piece.

CREDITS

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Institution: Iran University of Science and Technology
Course Context: Architectural Design Workshop II – Deep Design Studio.