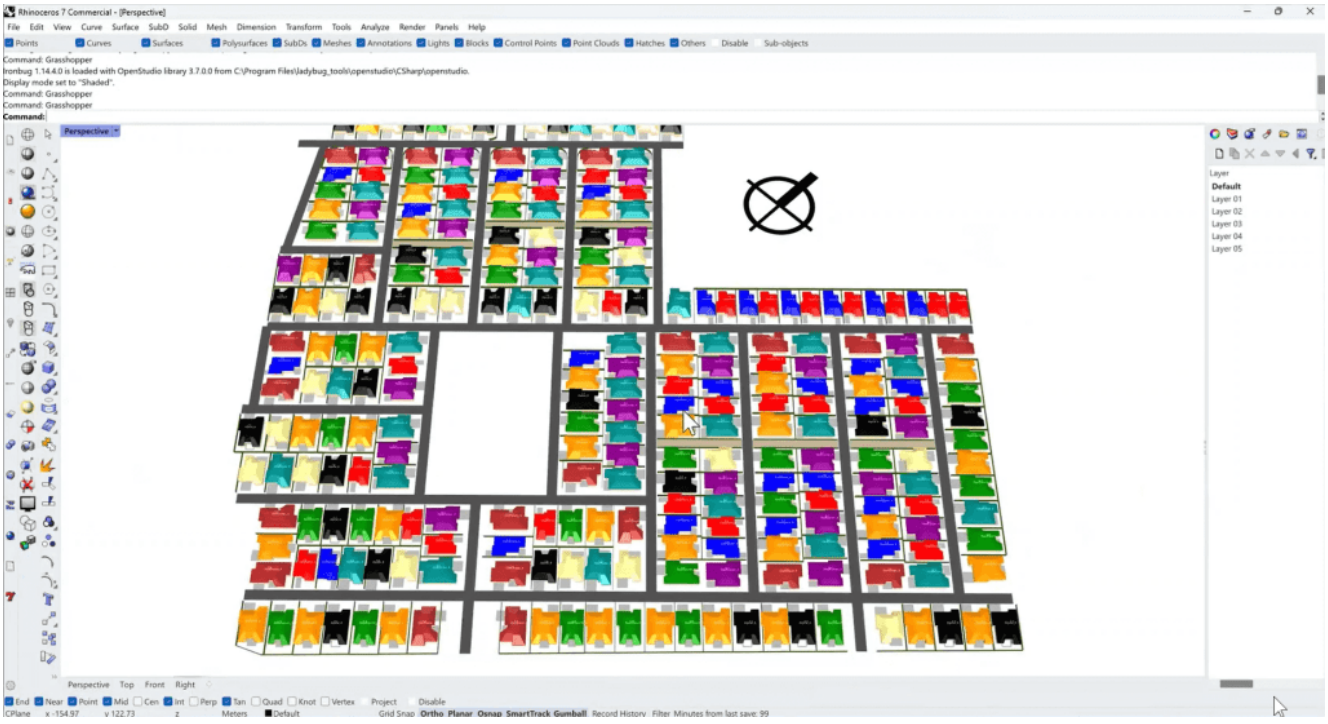
Optimizing with Grasshopper and DefinitionLibrary: Arup's Solar-Efficient Community

Arup, a global collective of designers and engineers, recently completed a master plan project in collaboration with Ingenia and Buildlab for a gated community with approximately 260 residential blocks. The project aimed to maximize passive solar performance and solar PV yields to deliver affordable, energy-efficient homes.

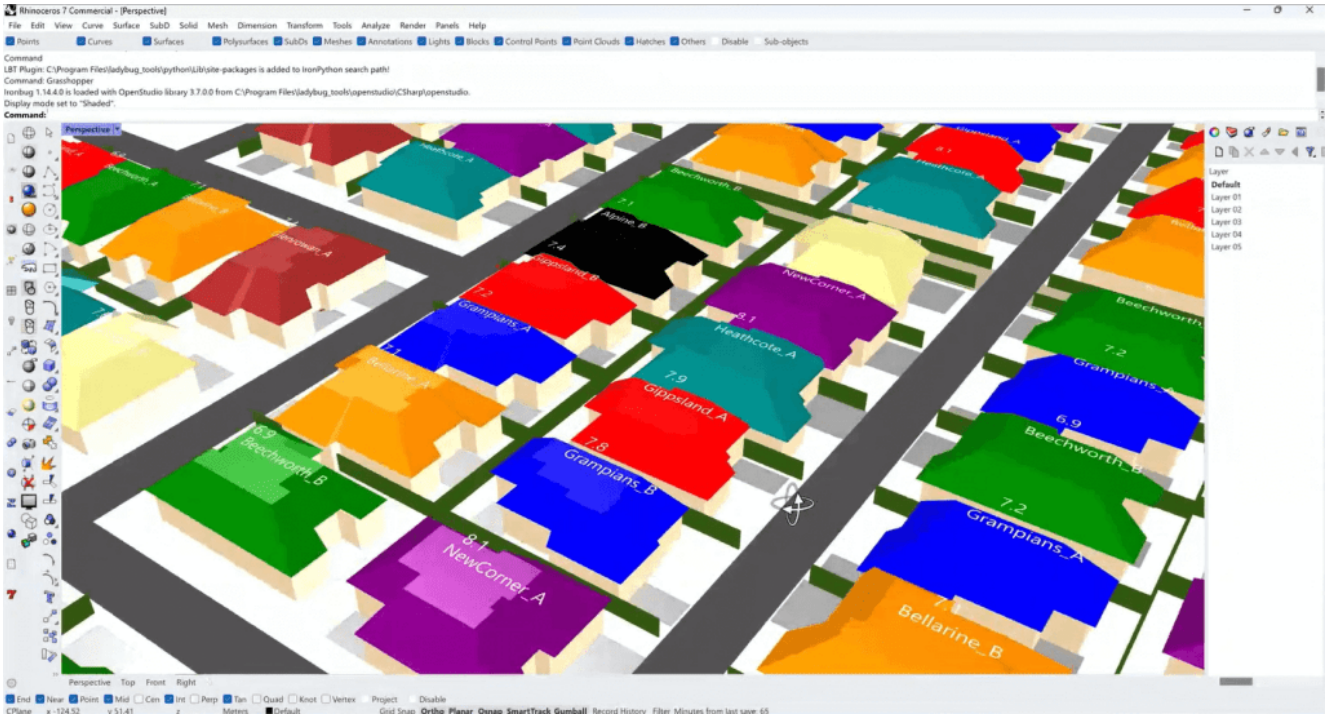
The community follows a land lease model, where residents own the homes but lease the land. The client had nine different home designs and mirror images that needed to be distributed across the site based on a predetermined product mix. The challenge was optimizing these homes' placement and orientation to improve their passive solar performance while adhering to the design constraints.



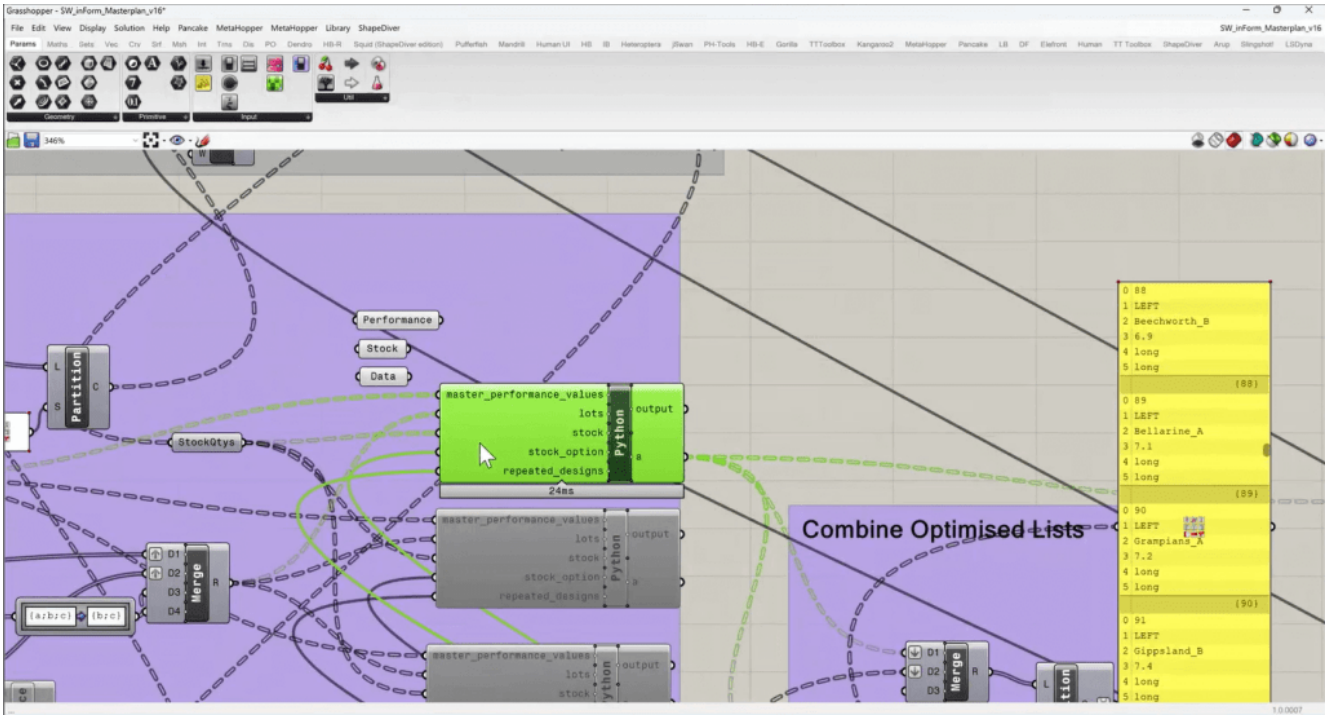
ADDRESSING SUSTAINABILITY IN HOME PLACEMENT

The goal was to develop a tool that could evaluate and suggest optimal

house placements to enhance passive solar performance. Although the client had specific preferences for the house mix, they hadn’t defined how each design should be positioned on individual blocks.

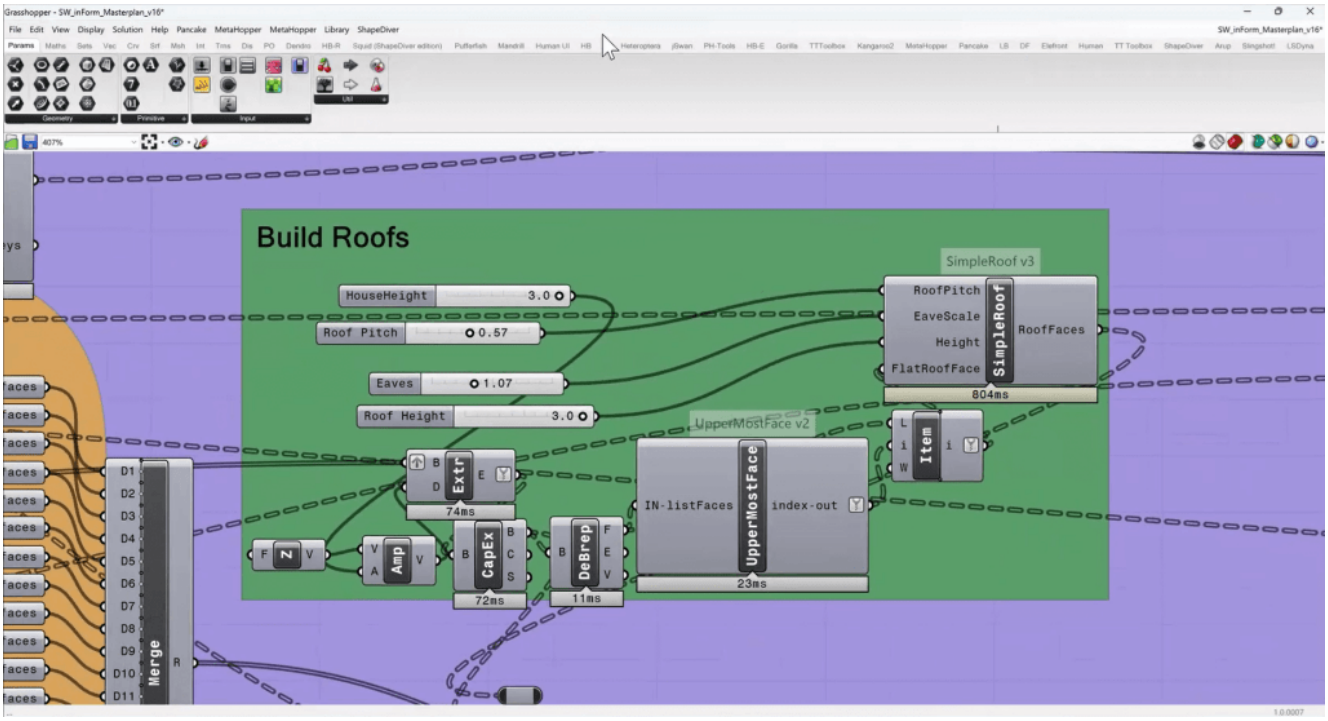


This provided Arup’s sustainability team the opportunity to explore how different placements and orientations could improve energy efficiency. The team brought the master plan into Rhino and developed an algorithm in Grasshopper to optimize the positioning of the homes.



By starting with the best-performing house design on a well-oriented block, the algorithm radiated outward, placing homes in a way that maximized aggregate solar performance across the development. All

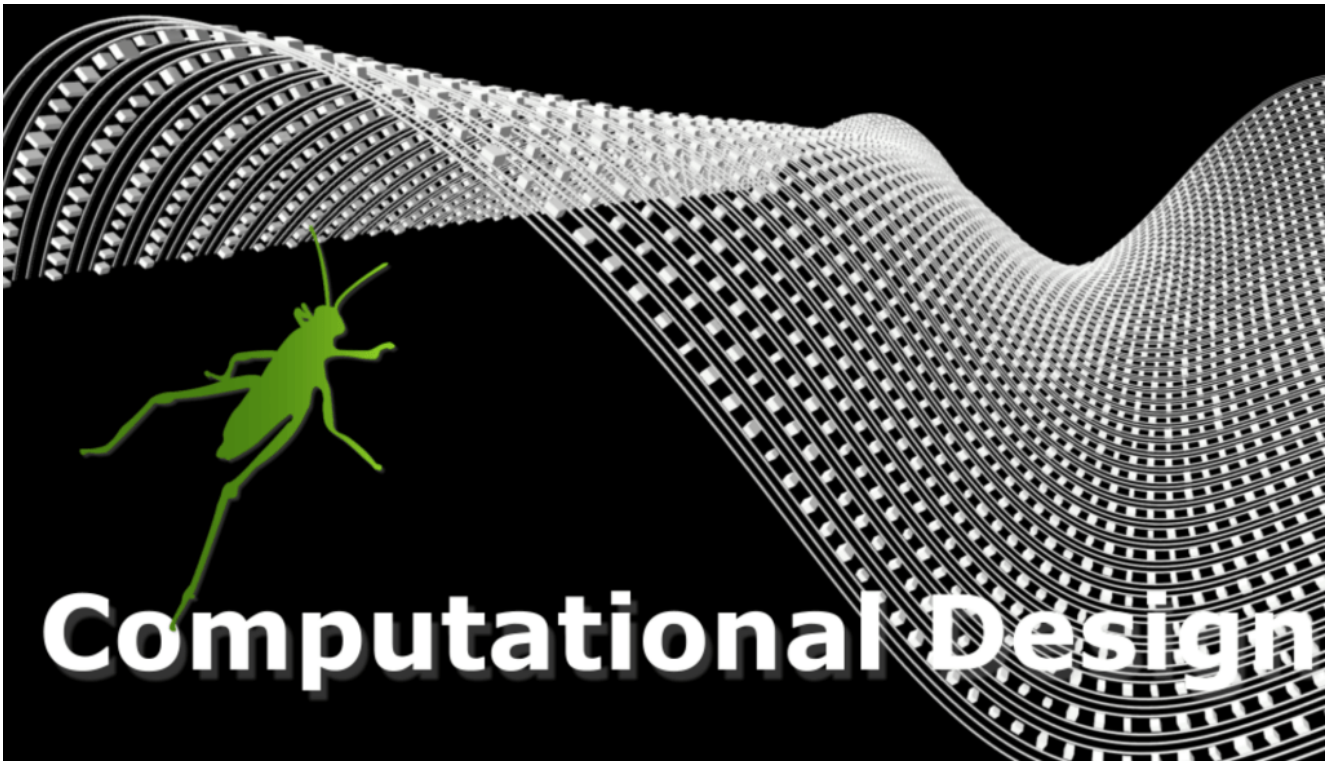
homes were categorized into block types such as corner or narrow, and constraints like avoiding adjacent identical designs were considered.



The sustainability team used passive solar performance data for each house design and orientation, which was calculated externally and imported into Grasshopper as a reference.

TOOL DEVELOPMENT & COLLABORATION

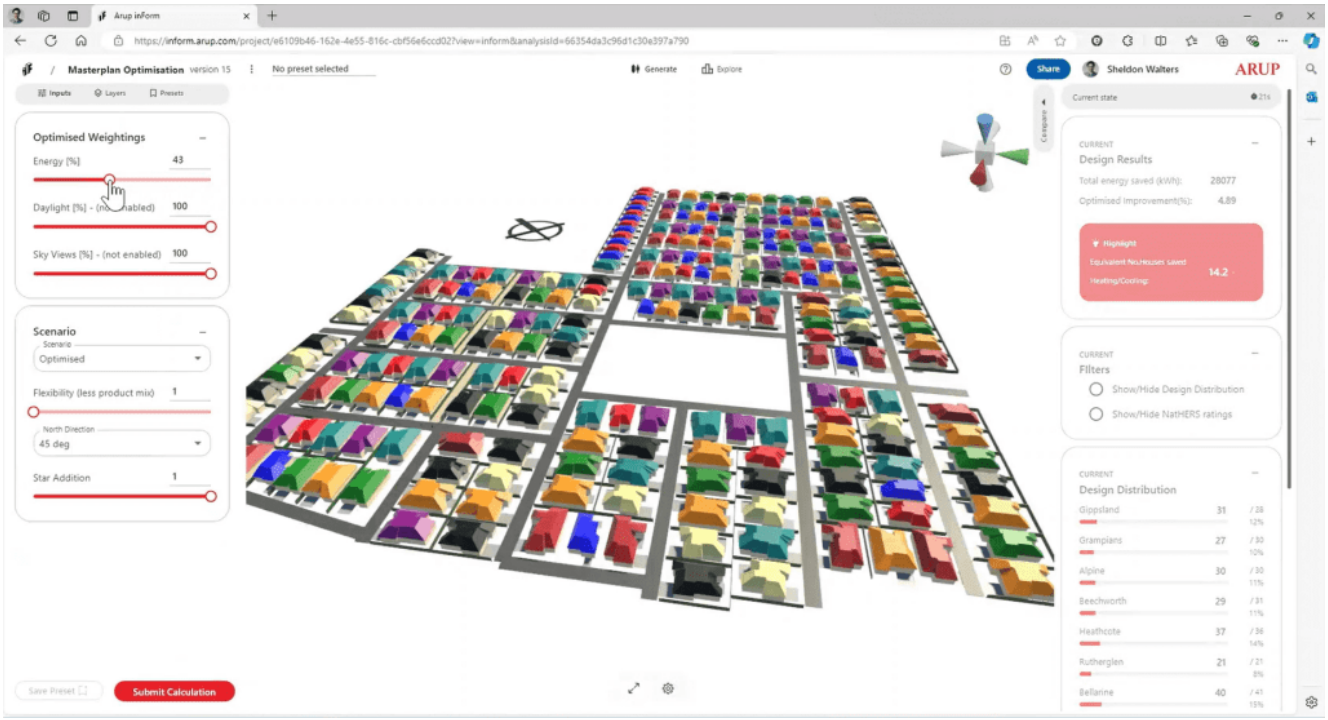
The team, led by Sheldon Walters, Sustainability Consultant/Engineer and Acting Computational Design Skills Network Manager for Australia, used Grasshopper's visual programming combined with Python to create the optimization tool.



See Also

COMPUTATIONAL DESIGN WITH GRASSHOPPER

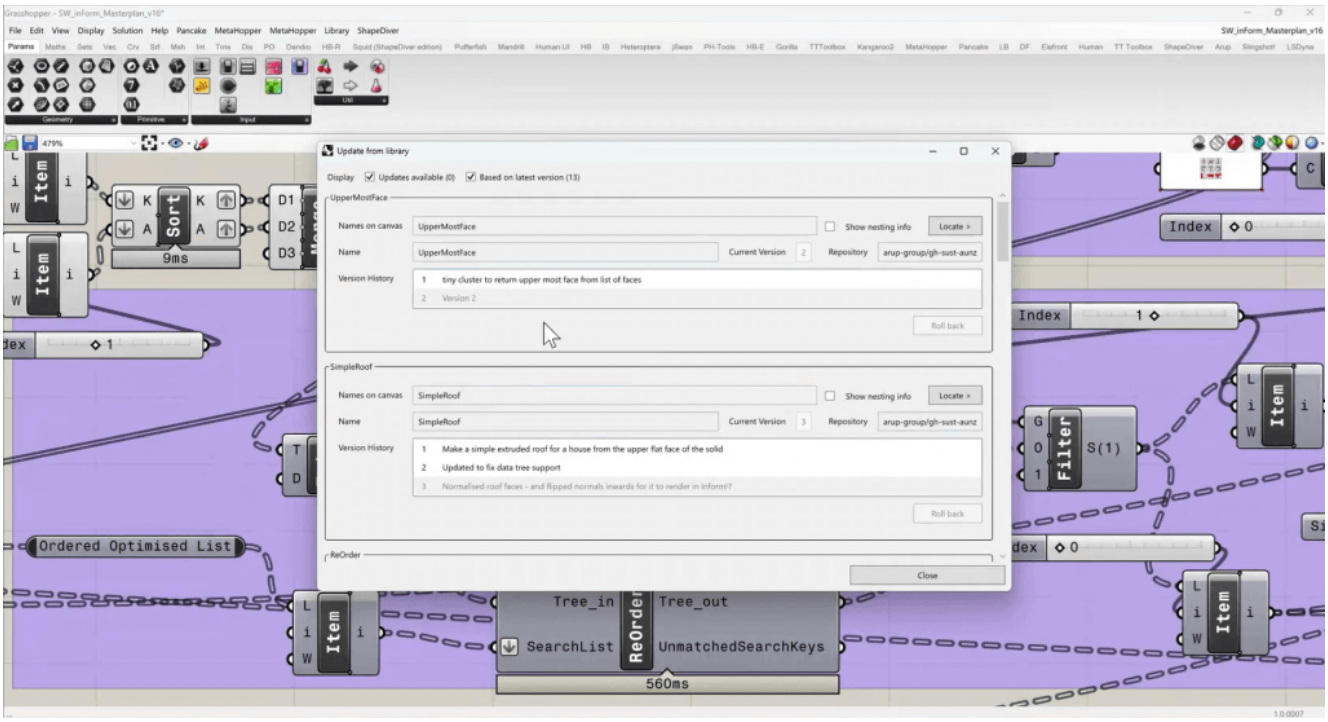
Grasshopper allowed for the rapid development of algorithms that considered geometric constraints and house orientations. The results were visualized using Arup InForm, a web app powered by Rhino Compute, which enabled the client to view and interact with the proposed house placements in real-time.



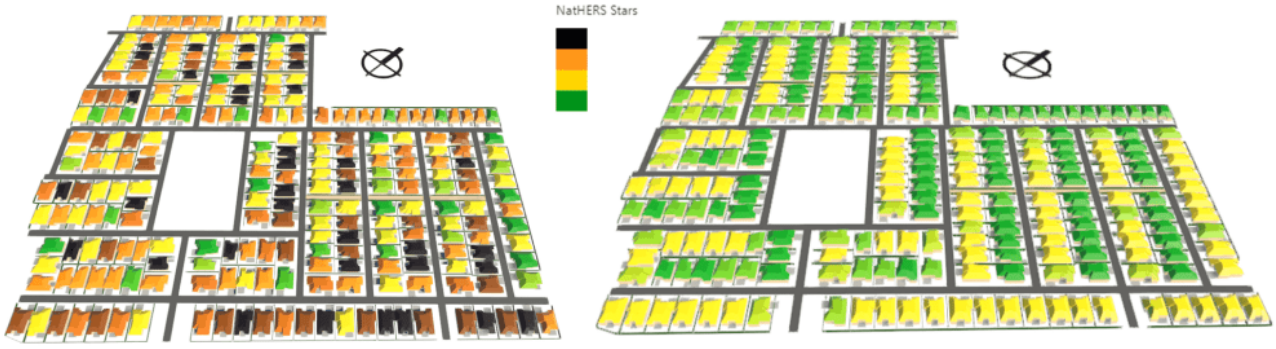
Reflecting on the process, Walters commented, “We were able to leverage data-driven design tools to find a balance between the client’s design preferences and the potential energy savings. Grasshopper’s adaptability allowed us to flexibly optimize the layout, ensuring a sustainable and efficient solution.”

DEFINITIONLIBRARY FOR REAL-TIME COLLABORATION

To manage the complexity of the project, the team utilized DefinitionLibrary, a plug-in for Rhino3D and Grasshopper. This tool allows users to store and version Grasshopper files and clusters in GitHub repositories, making it easy to search, retrieve, and update components.



DefinitionLibrary's real-time collaboration features were essential in this project, as multiple team members worked on different parts of the master plan simultaneously. Each contributor could publish updates to clusters in real-time, ensuring a streamlined workflow without interrupting others' progress.



One of the key benefits of DefinitionLibrary was its rollback capability, which allowed the team to revert to previous versions of clusters if an update caused issues. "The ability to roll back changes gave us the confidence to experiment and push the design further, knowing we had a safety net in place," Walters added.

FUTURE POTENTIAL & EXPANSION

While the current focus is on optimizing passive solar performance, Arup envisions expanding the tool to incorporate additional sustainability factors, such as solar PV yield and daylight analysis.

By continuously refining the tool, the team aims to push the boundaries of sustainable residential development, creating smarter and more energy-efficient communities.

In this project, Arup leveraged digital tools like Grasshopper, Rhino Compute, and DefinitionLibrary to create a master plan that balances design preferences, energy efficiency, and practical constraints—providing the client with a robust and flexible solution for their gated community development.

CREDITS

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Jeet Parmar, Development Manager at Ingenia