Paper Title: A Novel Multi-Criteria Workflow Based on Reverse Solar Envelopes for the Design of Residential Clusters

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1 Summary

1.1 Motivation

In order to balance competing objectives in urban residential clusters, such as optimizing floor area ratio (FAR) and guaranteeing sufficient sun access (SA), the paper suggests a "Reverse Solar Envelopes (RSE)" approach. RSE can meet minimum sun access criteria for all residences and still obtain a FAR, according to the theory.

1.2 Contribution

This paper introduces the RSE concept along with an eight-step semi-automatic workflow that makes use of Grasshopper and Rhinoceros technologies. This contributes to sustainable urban design for healthy living environments by optimizing building designs for a balance between (FAR) and sun access (SA), providing trade-off options for various solar access thresholds.

1.3 Methodology

There are multiple essential steps in the RSE workflow. It starts with the site and context definition, then generates possible building shapes that respect the FAR limitations. The computation of solar access for every shape is the third stage, which culminates in an iterative process of shape optimization. The process then assesses trade-off options and, if necessary, involves users in order to modify the design. Notably, this study validated and tested the suggested strategy in real-world urban settings at two distinct latitudes by applying the methodology to those sites.

1.4 Conclusion

In conclusion, compared to conventional methodologies, the RSE workflow successfully produced design solutions that achieved over 20% higher FAR and 57% windows with appropriate solar access. For different needs for sun access, it provides a variety of trade-off possibilities.

2 Limitations

2.1 First Limitation

The main subjects of the study are SA and FAR. While these are critical elements, the RSE workflow does not yet fully incorporate other significant elements like views, privacy, and wind comfort. This might make it less applicable in some situations.

2.2 Second Limitation

The RSE procedure was only validated in two case studies; more research is needed to see whether it can be applied to other urban locations and building typologies. Furthermore, a thorough assessment is required to determine the long-term effects of RSE-designed clusters on energy efficiency and resident well-being.

3 Synthesis

The RSE concept prioritizes living space and sunshine access, which has the potential to completely transform urban home design. Improved workflow development leading to complete automation and integration with other design goals can greatly increase the process's applicability. To improve and solidify this process as an important instrument for sustainable urban planning, future studies should examine the long-term performance and social effects of RSE-designed clusters.