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A generative parametric tool for daylight driven early-stage design decision making

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Building design is an iterative process that requires balancing aesthetic quality and building performance, often necessitating multiple design iterations before an acceptable solution is achieved. Of the building performance criteria, access to adequate daylight has emerged as a key consideration given its role in supporting occupant wellbeing and improved workplace productivity [1]. However, early-stage daylight assessment is often limited to Window to Wall Ratio (WWR), which does not account for factors such as sky condition, position, context and daylight distribution within a space.

This research addresses the challenge of integrating dynamic daylight performance into early-stage design decision-making through the development of a computational design exploration tool that generates design options based on daylight requirements. It uses spatial daylight autonomy (SDA) metric for simulation. SDA is a widely used, climate-based daylight metric. Developed using parametric modelling and a generative algorithm within a simplified box model, it enables performance-based design exportation. It allows users to explore different design options for window configurations and shading systems by defining fixed and flexible parameters and assessing them based on daylight performance goals.

This research proposes a daylight driven design exploration framework that combines parametric modelling, generative design, and daylight simulation to generate, assess and optimize design alternatives. With rapid generation of design alternatives, the tool streamlines the design development process while enabling the integration of daylight performance from the early design stages. The framework achieves a minimum 50% reduction in design development time. This contributes to more informed decision-making while advancing research on daylight studies and its application in the real world.

The presentation will outline the development of the framework and demonstrate its application through a prototype implementation.

Keywords
Daylight, design decision, generative algorithm, parametric modelling.

References

1. Woo, M., et al., *Access to Daylight and Views Improves Physical and Emotional Wellbeing of Office Workers: A Crossover Study.* Frontiers in Sustainable Cities, 2021. **3**.