Expert decision support for early design stage of facades for office buildings in Belgium: A parametric

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ABSTRACT

Design decision-making during the early stages of facade development has an influence on the final performance of buildings. Moreover, nowadays, the role of the architects is to integrate their design with the energetic analysis. Thus, this increases the design decision fatigue and requires considerable time to work through a building simulation tool, especially when there are many choices and possibilities.

This study investigates a parametric design for façades of office buildings in cities with a climate similar to that of Belgium. In addition, a focus on the most influential parameters that we should be aware of during the decision-making is discussed.

In conclusion, this thesis helps to reduce design decision fatigue and guide architects and designers towards a better decision.

KEYWORDS

Design tools, energy approach, Daylighting, Window-to-wall ratio, Grasshopper, simulation.

PROBLEM

It can take a long time to accomplish a well-defined facade. Moreover, there is a need to have a user-friendly interface that simultaneously, considers the environmental aspect inside buildings and facilitates façade decision-making when there are many choices regarding the norms and climate in Belgium.

OBJECTIVES

Try to make better decisions at the early design stage of a project.

Reduce the design decision fatigue.

Save energy and time.

AUDIENCE

Façade engineers, architects, architectural engineers, students.

RESEARCH QUESTION

- How to simplify the decision-making of facade's design during early design stages without using building performance simulation?
- To which extent do the facade criteria influence the energy performance, visual and thermal comfort?
- What are the most influential design parameters?
- How do designers perceive the developed design support?

ORIGINALITY

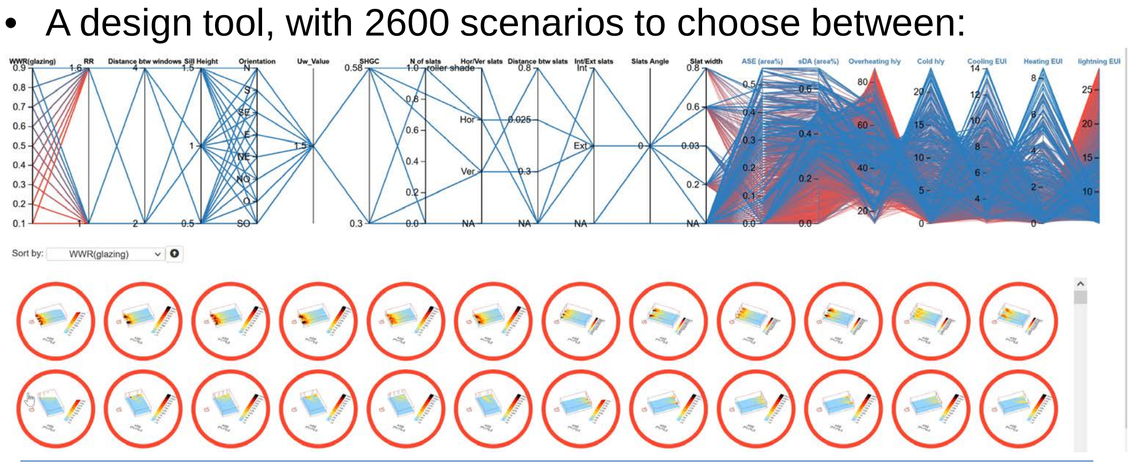
- The proposed design tool takes into account two new daylight metrics: Annual Sunlight Exposure (ASE) and spatial Daylight Autonomy (sDA).
- Envolve the daylight study, energy consumption and comfort together.

METHODOLOGY

- The adapted methodology is to develop a parallel coordinator graph for facades in a user-friendly tool (Design Explorer) passing by a parametric design tool (Grasshopper) with environmental plugins (Honeybee and Ladybug) and based on European standards.
- Use usability testing to ensure the simplicity of the developed tool, to check the interaction between potential users and this design tool, and how effective the tool is.

RESULTS

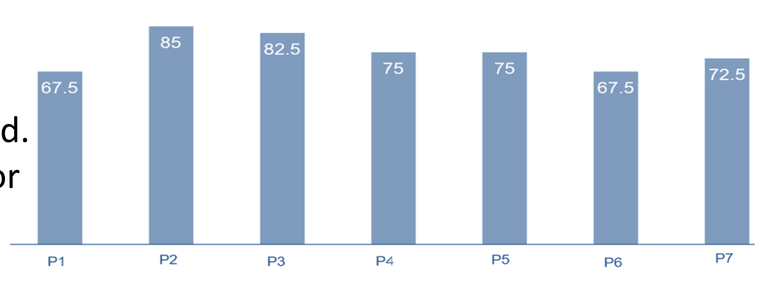
- A design tool, with 2600 scenarios to choose between:



- Ranking of facades configurations regarding the need:

- Usability testing:

SUS score by participants. The average is 75/100
→ Users are satisfied.
→ Tools needs minor improvements



CONCLUSION

This study helps to reduce design decision fatigue, understand the influence of each parameter on the results. Thus, guide architects and designers towards better decisions.

RESOURCES

Data for this study can be accessed online at the link below:
http://tt-acm.github.io/DesignExplorer/?ID=BL_3iQzicX

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