Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Daniël Koster
Student number	4553780

Studio		
Name / Theme	Building technology graduation studio: Daylighting	
Main mentor	Dr. Eleonora Brembilla	AE+T: Environmental and climate design
Second mentor	Dr. Azarakhsh Rafiee	AE+T: Digital technologies
Argumentation of choice of the studio	Daylighting has a large impact on everyday life. Therefore, research in this field interests me the most out of all BT topics.	

Graduation project	
Title of the graduation project	Integrating context and non-visual effects of light in current daylighting evaluation methods: design consequences in Dutch urban areas.
Goal	
Location:	Urban areas in the Netherlands
The posed problem,	In the Netherlands, daylight performance in urban areas is not protected by building regulations which results in insufficient daylighting in new buildings.
research questions and	Main RQ: What are the design consequences in Dutch urban areas when context and non-visual effects of light are integrated in current daylighting evaluation methods? Sub RQ1: What daylight metrics are currently used to evaluate daylighting performance, and what are the requirements for buildings in Dutch urban setting?

	Sub RQ2: To what extent does urban context affect daylighting performance and how can it be integrated with current assessment methodologies? Sub RQ3: What is an effective design strategy to increase daylighting performance in Dutch urban areas?
design assignment in which these result.	The design assignment is to run daylighting simulation and to integrate urban context and non-visual effects of light in current evaluation methods. After that, this research will examine which parameters in Dutch urban context suggest a correlation with daylighting performance, and therefore can be used as an urban indicator for daylighting performance.

Process

Method description

To answer the main research question, a combination of literature research and model simulation is used.

First, by literature research, daylighting performance is defined and a sufficient level of photopic & circadian-effective light is determined. This will be done based on current building codes, green-label certificates, and state-of-the-art research on melanopic/circadian-effective illuminance.

Secondly, daylighting metrics will be chosen that accurately expresses performance and reflect real-world practice. These daylighting metrics will be used as output metrics for simulation work. Strengths and weaknesses of each daylighting metric will be discussed, as well as the method on how to calculate them (static or CBDM simulation & photopic or melanopic).

Thirdly, different aspects of urban context are evaluated based on daylighting performance in a standard residential tower. The research will focus on a limited number of locations in Dutch cities that are representative for the typical urban context in the Netherlands. The parameters of each location vary in floor-space-index (FSI), Ground-space-index (GSI) and open-space-ratio (OSR) and layer (L). Both static (daylight factor) and CBDM simulation will be performed to calculate the daylighting performance in the different locations. Then, all data on daylighting performance is collected and compared to different parameters to see if there is a reliable urban/building indicator for performance.

Finally, the worst performing residences in their respective urban context are simulated for circadian-effective illuminance metrics. These results can be used to assess how a real-world situation can unfold if daylighting is not optimized for urban context. In the final thesis, it will be discussed what this means for our wellbeing and what we can do to improve these situations.

As a result, the research will produce relevant data on daylighting performance in different urban settings throughout the Netherlands. Analysis will be performed by plotting the results in graphs, to show the relationship between urban parameters and daylighting performance. To give answer to the main research question, performance threshold values can be derived from the data and design recommendations can be made for different urban situations.

Literature and general practical preference

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Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

Within the Building Technology master track, we are constantly looking for ways to improve indoor comfort whilst also increasing the sustainability of the indoor spaces we design. In the Netherlands, minimizing the amount of glass in our facades has been an effective strategy, but it puts a penalty on daylighting performance. Especially in dense urban areas, obstruction can cause significantly lower daylighting performance than intended. This research is done to better understand the effects of urban context on daylighting performance.

This research is in search for reliable urban parameters that affect daylighting performance in Dutch urban areas. This is relevant to all designers in the building industry, since it is in everyone's interest that the quality of what we create today is sufficient for our chronobiological needs, no matter where we build or what we build.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

This paper can be used by architects, (day)light designers and urban planners to inform them of the effects of urban context on daylight performance. Considering urban context and non-visual effects of light in daylight simulation is not mandatory in current evaluation methods, and certainly not easy to do, but I feel like we have a responsibility to create the best performing buildings we can, not the minimum performing building. This research will try to show that we can improve daylighting performance significantly in urban areas, up to a healthy recommended level. Research has shown that daylight exposure improves our overall health, our mental state and alertness. Therefore, this research is important in understanding the impact of our building designs on our wellbeing.