**Thesis: Sunspace design solutions based on daylight performance in a multi-storey residential building.**

**Author: Stephanie Jenny Angeraini**

**Examiner: Åke Blomsterberg**

**Supervisor: Marie-Claude Dubois**

## Heading

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## Introduction

Having a spacious sunspace in a newly-built low energy multi-family housing might be everyone's dream, since it provides extra living and cultivation space. But, behind all of these luxurious benefits there can be major daylighting and energy issues caused by the sunspace if it is not designed wisely from climatic and functionality point of view.

## Main text

Previous research pointed out that poorly designed and miss intended usage of sunspace can escalate the energy demand of the whole studied space, as well as reduce the daylight received in the adjacent space. But as a matter of fact, there is actually a lack of study that explains the daylighting impact of adding sunspace into buildings, especially in the residential sector. This thesis is a part of daylight and energy research project, which focused mainly on the impact and parametrizations of sunspace and balcony design on the daylight performance of Greenhouse, a newly-built, Miljöbyggnad Gold and Feby-Passive House certified, multi-family housing in Malmö, Sweden. Four apartments with different orientations and floor heights were studied, simulated using advanced daylight simulation tools and analysed to find sunspace's daylighting impacts and develop sunspace design solutions to improve the daylighting conditions in the adjacent living spaces.

Studying the impact of the actual sunspace and balcony on the daylight performance in the adjacent living spaces (living room, kitchen and workshop), the results showed that the daylight received in the adjacent living spaces was reduced by at least 50% compared to the apartments without sunspace and balcony. Having this large reduction of daylight in the adjacent living space, parametric studies with different sunspace and balcony design parameters, such as geometry, glazing-wall-ratio (GWR) and light reflectance value (LRV), were investigated and optimized to improve the daylight conditions in the adjacent living spaces. The parametric studies results showed that geometry was the most important factor affecting the daylighting conditions in the adjacent spaces, followed by the GWR and LRV of the sunspace and balcony. Orientation, floor heights and site's obstructions had larger impact on the daylight autonomy (DA) of the adjacent spaces. This thesis revealed that the least depth and the shortest length of the sunspace and balcony gave the highest average daylight factor (DF) and average daylight autonomy (DA) in all living spaces of the four studied apartments.

From this study, it is recommended to design a sunspace and balcony considering the geometry, with the least depth and length, while also considering the function of the sunspace and balcony. As an extra living and cultivation space, a sunspace and balcony should also still provide enough space but also not reducing most of the daylight that comes into the adjacent space. This is why the iterative process of the geometry of the sunspace plays important role in this study.

In the future, this thesis will contribute to a larger research project, where the simulated daylight conditions results will be compared with the actual measured values on site and discussed further more with the energy performances. The findings of this thesis will also contribute to the research sector, especially in the building and residential sector, by adding knowledge about the daylighting impact of sunspace design in residential buildings.

All in all, in designing a functional and high-performing sunspace and balcony that do not cause issues to the adjacent space should always take into account all the determining aspects, climatically and functionally.