

# Adaptive reuse assessment of an industrial warehouse building

Case study of different building programs on daylighting and thermal comfort performance

Students: Panna Rózsavölgyi, Elena Tsvetanova Boyadzhieva

Examiner: Ulla Janson (Division of Building and Services)

Supervisors: Niko Gentile (Division of Energy and Building Design), Oscar Palmgren (Division of Building Physics) and Maryam Fakhari (Division of Energy and Building Design)

This degree project examines whether a historic industrial warehouse in Malmö Varvsstaden can be adaptively reused by preserving its original envelope and constructing a new interior structure. The study evaluates how well such building can meet contemporary requirements for daylight and thermal comfort when assigned new functions. The existing envelope is kept preserved as a shell, while a new interior layout is assessed for three potential uses: office, educational and residential. The work addresses the challenge to achieve satisfactory performance according to current standards for adaptively reused buildings, which façade is preserved.

Adaptive reuse is a sustainable strategy, which aim to retain embodied energy and reduce demolition waste. However, heritage buildings impose strict limitations, particularly regarding façades and window openings, which complicate the compliance with current daylight regulations. The project investigates not only the performance of the proposed layouts but also the suitability of existing standards for unconventional building typologies such as building within a building.

The results show that daylight availability is the most restrictive factor. The façade cannot be altered, window size and placement remain fixed, and the depth of the warehouse limits daylight penetration. The simulations demonstrate that upper floors benefit from skylights and achieve acceptable daylight levels in several zones, with daylight factor median values reaching above the threshold. However, the ground floor performs significantly worse, particularly on the north side, where daylight rarely meets the thresholds defined in EN 17037 or BBR. Residential layouts are the most affected, with only a small number of apartments achieving minimum daylight provision. View-out requirements are also difficult to satisfy, as they depend on external conditions that cannot be modified. Meeting current standards for indoor environmental quality remains a challenge, especially when assigning new uses, which is confirmed by the simulation outcomes.

Thermal comfort presents a different pattern. The existing envelope provides stable indoor temperatures, and overheating is limited on the ground floor. Overheating occurs primarily on the first floor, where skylights and larger window areas increase solar gains. Educational layouts show higher overheating percentages due to greater internal heat loads from occupants and equipment. Despite these issues, the overall thermal performance is more favourable than

the daylight performance, indicating that thermal comfort is less constrained by the preserved façade.

When comparing the three programs, office and educational uses are more compatible with the building's limitations than residential use. Offices and classrooms can tolerate deeper floor plans and lower daylight uniformity, whereas residential units require higher daylight autonomy and better view conditions. The findings therefore suggest that the warehouse is more suitable for public functions if the façade remains unchanged.

The study highlights a broader issue: current daylight standards may not be fully applicable to heritage buildings undergoing adaptive reuse. The current standards do not account for the constraints imposed by preservation requirements. Adequate daylight performance is not achieved based on the current daylight standards thresholds, yet several spaces still offer acceptable environmental quality in practical terms. This indicates a need for more context-sensitive assessment methods that acknowledge the limitations of historic structures while still ensuring occupant well-being.

The project demonstrates that adaptive reuse can extend the lifespan of industrial buildings and support sustainable urban development, but it also shows that regulatory frameworks may require adaptation to accommodate heritage contexts. The findings can inform architects, planners and policymakers when evaluating the feasibility of similar projects. They also contribute to ongoing discussions about how daylight standards should evolve to better reflect the diversity of building types and constraints encountered in practice.