科学直接

第11届北欧建筑物理研讨会，NSB2017，6月11-14日，特隆赫姆，挪威

最优化的立面设计 - 能效、舒适和日光在早期设计阶段

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摘要

多功能和先进的建筑外壳可以提供能源效率和经济价值的显著改进，同时改善建筑的舒适度。

这工作旨在分析不同窗型的性能，以及室内气候和识别最有效的策略。

这项工作探讨了不同的策略，以提高隔热舒适，通过优化对冲策略，使用自然通风和自动控制遮阳设备。

该研究以一单栋家庭住宅位于挪威山区地区。该结果集中在夏季温度和过度冷却，以及各个房间的日光水平。有四个房间被发现是过度冷却的关键，这些房间在夏季和结果中确认大量时间的具有操作性，温度高于27°C。这些结果说明，几个房间在夏天，即使使用遮阳玻璃（类型2和3）和外部屏幕（类型4和5），冷却通过自然通风，通过打开窗户表明良好的效果，并证明在提供良好的夏季舒适条件方面，有重要意义。这将影响为设计和选择遮阳和遮挡在住宅建筑。”

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10.1016/j.egypro.2017.09.666
1. Introduction

Multi-functional and advanced building envelopes can provide step-change improvements in the energy efficiency and economic value of new and refurbished buildings, while improving the wellbeing of building occupants. They therefore represent a significant and viable contribution to meeting the EU 2020 targets [1]. Advances in building performance design of nZEB, buildings that produce more energy than they use, clearly show the need for more focus on the building performance design which minimizes total energy needs in the operation of the building and with minimal material use.

In highly insulated and airtight residential buildings, a dedicated outdoor air ventilation system with a balanced mechanical ventilation system with heat recovery is used for providing air. The need for window ventilation is supposed to be substantially reduced or even eliminated [2; 3]. Changes in heating and ventilation strategy and require a thorough investigation and evaluation of the impact on the indoor climate, which comprises of the indoor air quality and thermal comfort. Recent studies found that there are higher temperatures in new residential buildings [3].

A central role can be dedicated to the building skin that needs to be to the highest degree responsive to their environment. This requires new approaches of adaptive building skins that instead of providing static performance parameter are able to adapt the physical properties and in that way optimize the overall performance of the building. One option for adaptation could be the use of automatically controlled shading devices that control heat fluxes through the window in dynamic way [4]. But also opening windows to allow for ventilative cooling can be considered a dynamic adaptive strategy [5; 6; 7]. Previously reported results confirm that shading of windows and opening windows can help to reduce discomfort during summer periods [11].

1.1. Objectives

The scope of this work was to analyze the performance of different window configurations on indoor climate and to identify the most effective strategies for improvements. The main focus was put on controlling solar shading and natural ventilation. For a single-family house, for different glazing types and different external screens operative temperatures and daylight levels needed to evaluated.

2. Methodology

This work investigated different strategies to improve thermal comfort in a newly designed single-family house by applying a responsive and adaptive building skin based on:

- Use of automatically controlled shading devices
- Applying control strategies for Natural ventilation

Daylight factors (DF) will not be affected as they are calculated for deactivated screens (overcast sky). It will however still reduce daylight availability in the zones since the screen is activated as a solar shading. The effect of daylight availability has been calculated. The hourly illuminance values for a 80 cm high working surface were plotted for each zone.

Table 1. Areas of building elements and their thermal properties.

<table>
<thead>
<tr>
<th>Building element</th>
<th>Area, A [m²]</th>
<th>Thermal transmittance, U [W/(m² K)]</th>
<th>Heat loss, U*A [W/K]</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>walls</td>
<td>299.56</td>
<td>0.13</td>
<td>39.63</td>
<td>27.04</td>
</tr>
<tr>
<td>roof</td>
<td>99.21</td>
<td>0.15</td>
<td>15.01</td>
<td>10.24</td>
</tr>
<tr>
<td>floor towards ground</td>
<td>87.17</td>
<td>0.07</td>
<td>6.16</td>
<td>4.20</td>
</tr>
<tr>
<td>floor towards outside</td>
<td>6.65</td>
<td>0.10</td>
<td>0.66</td>
<td>0.45</td>
</tr>
<tr>
<td>windows</td>
<td>63.04</td>
<td>0.83</td>
<td>52.54</td>
<td>35.85</td>
</tr>
<tr>
<td>doors</td>
<td>4.53</td>
<td>1.09</td>
<td>4.91</td>
<td>3.35</td>
</tr>
<tr>
<td>thermal bridges</td>
<td></td>
<td></td>
<td>27.64</td>
<td>18.86</td>
</tr>
</tbody>
</table>
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