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Optimizing Window Design in Extreme Cold Climates with 360° Assessments

Windows play a crucial role in enhancing daylight, providing views, and ensuring occupant comfort in buildings. However, their benefits come at the expense of increased energy consumption. This research aims to address this challenge by combining 360° image-based lighting assessments with 360° thermal imaging in post-occupancy environmental (POI) evaluations, specifically targeting extreme cold climate regions.
In this paper, we present multiple examples, which involved conducting multiple thermal imaging assessments alongside High Dynamic Range (HDR) visual image captures in various indoor spaces located in Arctic regions. The data collection took place during March 2022 in Cambridge-Bay, Nunavut. The lighting conditions are visualized though calculated integrative lighting effects including melanopic and photopic luminance false-color presentations as human references for lighting quality. This research puts light on novel approaches in window optimization through studying operating buildings through presenting potentials of 360° thermal-lighting assessments.The integration of 360° image-based lighting and thermal assessments enhances our understanding of the interactions between daylighting, thermal conditions, and occupants' photobiological safety. The results of this study contribute to the development of strategies visualization of thermal and lighting conditions in built environments for optimization of window design in future energy-efficient buildings in in extreme cold climate regions, ultimately supporting sustainable and comfortable indoor environments.

Keyword 1

Window optimization

Keyword 2

Energy optimization

Keyword 3

Daylighting

Keyword 4

Environmental assessment

Keyword 5

Arctic architecture

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