



NUMERICAL INVESTIGATIONS OF THE THERMAL PROPERTIES OF WINDOW SYSTEMS: A REVIEW

PRZEGLĄD NUMERYCZNYCH METOD OKREŚLANIA WŁAŚCIWOŚCI CIEPLNYCH OKIEN

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Abstract

Windows are an essential part of building envelopes since they enhance the appearance of the building, allow daylight and solar heat to come in, and allow people to observe outside. However, conventional windows tend to have poor U-values, which cause significant heat losses during the winter season and undesired heat gain in summer. Modern glazing technologies are therefore required to improve thermal resistance and comfort of the occupants, whilst mitigating the energy consumption of buildings. In the present work, a comprehensive review of the numerical investigations of the thermal properties of window systems and glazed buildings partitions is presented. However, the proposed models to predict the thermal performance most often concern only specific cases of window systems related to geometry and used material solutions, focused on specific physical processes, thus they contain a lot of simplifications, such as omitting the influence of radiation, temperature changes or velocity profiles.

Keywords: windows, windows thermal resistance, thermal transmittance, heat transfer coefficient, mathematical modelling

Streszczenie

Istotnymi elementami budynków są okna, które wpływają na ich wygląd, umożliwiają dostęp światła dziennego i ciepła pochodzącego z promieniowania słonecznego, a także pozwalają na obserwowanie otoczenia. Jednakże w porównaniu do pozostałych przegród budowlanych konwencjonalne okna charakteryzują się zwykle gorszymi wartościami współczynnika przenikania ciepła U, generując znaczne straty ciepła w sezonie zimowym i niepożądane zyski ciepła w lecie. W związku z tym konieczne jest poszukiwanie nowoczesnych rozwiązań w technologii okiennej, które poprawią opór cieplny i komfort mieszkańców, jednocześnie zmniejszając zużycie energii przez budynki. W niniejszej pracy przedstawiono przegląd numerycznych metod określania właściwości cieplnych okien i przeszklonych przegród budowlanych. Analiza literatury pokazuje, że proponowane modele dotyczą jednak najczęściej tylko konkretnych przypadków systemów okiennych, związanych z określoną geometrią i zastosowanymi rozwiązaniami materiałowymi, w których uwzględnia się jedynie wybrane procesy fizyczne. Skutkiem tego jest przyjmowanie podczas modelowania wymiany ciepła szeregu uproszczeń, takich jak pomijanie wpływu promieniowania czy nieuwzględnianie zmian temperatury i prędkości.

Słowa kluczowe: okna, opór cieplny okien, przenikalność cieplna, współczynnik przenikania ciepła, modelowanie matematyczne

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