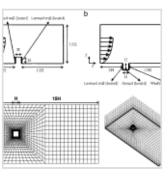
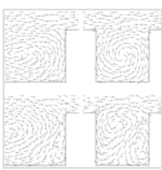
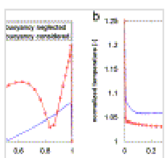
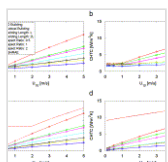
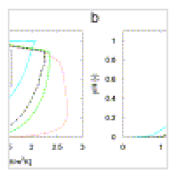
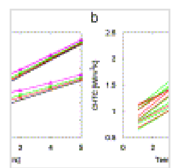
Outline

Figures (12)

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Analysis of convective heat transfer at building façades in street canyons and its influence on the predictions of space cooling demand in buildings

Jonas Allegrini[a], Viktor Dorer[a], Jan Carmeliet[a, b]

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Abstract

An important part of the world's energy is used for space cooling of buildings. Minimisation of space cooling, especially in hot urban environments, has great energy-saving potential. An important part of the heat exchange between buildings and the ambient surrounding is due to convective and radiative heat flows. The impact of these heat flows on energy consumption for cooling is much more important in urban areas compared to rural areas. This study aims at quantifying the influence of the urban radiation balance, the urban heat island effect and urban convective heat transfer coefficients (CHTC) on the space cooling demands. CHTC correlations were determined using computational fluid dynamics (CFD) for different geometries including stand-alone buildings and street canyons of different lengths. Buoyancy was accounted for by considering differences between building surface and surrounding air temperature. It was found that the building geometry has a large impact on the CHTC correlations and that the effect of buoyancy cannot be neglected when wind speeds are low. These CHTC correlations were used for Building Energy Simulation (BES) predictions of the space cooling demand. Space cooling demands for a building in a street canyon differ up to a factor of 1.8 depending on the CHTC correlations used. Therefore, for accurate predictions of the space cooling demand, adequate CHTC correlations have to be used adjusted to the actual building configuration.

Highlights

► Building energy simulations use convective heat transfer correlations. ► Convective heat transfer coefficients for urban street canyons were established. ► Convective heat transfer is dependent on building geometry and strength of buoyancy. ► Large differences result in space cooling demand for rural vs. urban building. ► Accurate demand predictions depend on correct convective heat transfer coefficients.

Abbreviations

BES, building energy simulation; CFD, computational fluid dynamics; CHTC, convective heat transfer coefficient; UHI, urban heat island

Keywords

Convective heat transfer coefficient; Computational fluid dynamics; Building energy simulation; Space cooling; Street canyon; Urban heat island

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