

公益財団法人 セコム科学技術振興財団
研究成果報告書

研究課題名

流体数値シミュレーションによる個別住宅の屋根雪危険度判定

Assessment of Hazard caused by Roof Snow on Detached Houses
based on CFD Simulation Model

研究期間

平成 23 年 4 月 ～ 平成 24 年 10 月

報告年月

平成 24 年 10 月

研究代表者

東北大学大学院 工学研究科 都市・建築学専攻
教授 持田 灯

Professor, Dept. of Architecture & Building Science Graduate School of Engineering,
Tohoku University
Akashi Mochida

Abstract

In every winter, many casualties occur during work to remove roof snow in Japan. In order to decrease such accidents, it is important to preliminarily assess the degree of hazard associated with roof snow and take countermeasures such as making the roof shape simpler or choosing a proper method of snow removal. However, it is very difficult to predict snow distribution on roofs of detached houses, because snow does not accumulate uniformly on their roofs. The snow distribution on the roofs is strongly dependent on the geometry of buildings, surrounding conditions, wind direction and other factors, and therefore the level of hazard due to roof snow cannot be properly determined only by geometric configurations. The aims of this study are to develop a prediction system for the snow distribution on roofs of detached houses with arbitrary geometries using CFD (Computational Fluid Dynamics) simulation with snowdrift model, also taking into account the influence of surrounding buildings, and to validate the accuracy of the prediction system in terms of assessment of the hazard caused by the roof snow.

Firstly, a prototype of the simulation model predicting roof snow distribution was developed. The simulation model is based on the existing knowledge on wind and snowdrift simulations used in the research fields of architecture and civil engineering. In addition, for improving the accessibility of end-users, a pre-processing system, which can easily handle terrain and building geometry data, and a post-processing system, which can comprehensively visualizes the results of calculations, were also developed.

Next, an accuracy of the developed model was verified by comparing with results of field measurements. In this study, roof snow distributions on actual detached houses were measured in Sapporo City and Shimokawa Town for the validation data, in order to demonstrate the applicability of the prediction system to the climate conditions in Hokkaido. As a result of comparing the calculated roof snow distribution with the measured one, good quantitative correspondence between the results was observed. However, it can be pointed out that further investigations are necessary on detailed observation of actual snowdrift phenomenon on the roofs and the modeling of snow cornice development, etc.

Finally, the prediction system developed in this study was evaluated by third-party authorities. Interviews and questionnaire investigations were conducted to administrators of building division for several local governments in Hokkaido, building engineers and architects worked in Shimokawa Town and ordinary residents in the suburbs of Sapporo City. As a result, potential needs for the prediction system of the roof snow distribution for assessing roof snow hazard were confirmed. It was also confirmed that a required cost will be an important factor for practical use. Because a detached house is privately purchased in the usual case, it is difficult to cover extra expenses in design stage. Therefore, it is necessary to consider how to reduce the costs and establish a funding framework. In addition, some issues to be more investigated were revealed, i.e., clarification of the role and rules of the prediction system during practical planning or design stage, consensus on cost for the values of the outcomes, etc.