

Optimization of residential indoor airflow by investigating wind patterns through comparison of field surveys and environmental simulation

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[Purpose and content of research]

Purpose of the research: The passive design regarding natural ventilation in housing can benefit occupants with a comfortable and healthy living while promoting energy saving. Despite not being mandatory, the Japanese government is promoting this passive architecture to combat climate change and implement sustainable development. This design strategies optimize wind patterns for cooling and airflow while safeguarding against strong winds, particularly vital for waterfront housing. Despite this importance, residents often close windows or opt for fixed ones due to concerns about wind damage and a limited understanding of indoor wind patterns' potential. Hence, this study investigated the characteristics of the indoor airflow of waterfront buildings in Matsue City by field measurement, thermal comfort evaluation and comparison with results from CFD (computational fluid dynamic) simulations. Also, there is not yet a regional design guideline in Matsue City and San-in region for waterfront construction that takes advantage of these natural resources so this research could contribute to this aspect.

Content of research: Due to its complexity: Research is divided into two phases:

First phase: The research collects wind data from rooms with windows facing the direction of water (such as lakes, urban canals, and rivers) during January in different locations and asks inhabitants to rate their thermal comfort during the survey. At the same time, the recorded data on temperature will be collected for one month from the end of December until the beginning of February to prepare a database for simulation. There is also a necessity to build an urban model of the building situation to

simulate the actual situation of wind flow in terms of surroundings such as water surface air and neighborhood buildings. Second phase: Simulation using CFD software performed on 3D models of housing case studies based on the standard for thermal comfort according to the PMV (predicted mean vote) rating. The result will provide a database for comparison between simulated data and recorded data, which will give insights into the effect of airflow on inhabitant comfort.

【Research achievement (acquired knowledge, results, research papers, conference presentations, potential applications for external research grants through this research project)】

Results of research: The first phase of research was completed. Three buildings represent the typology of housing, offices and shops with windows facing the waterfront of Shinjiko Lake, Kyobashi River and Horikawa Canal. We have collected three days of data of wind flow in each of the six rooms of these three buildings, in terms of air circulation when windows were open and closed. We also collected 112 answers from questionnaires among the residents, office workers and visitors of the three buildings. Furthermore, the 3D models of these three buildings, along with their surroundings and landscape of water bodies were built within the BIM-CAD environment. The first phase laid out a database that necessary for the study and data analysis. The second phase is planned to start at the beginning of May. The outcome of this study can firstly represent characteristics of waterfront housing in Matsue city, especially on the building exterior layers that promote the relationship between people and nature. The results can suggest solutions for elements such as windows, overhang, and balcony features to help optimize natural ventilation strategies, reduce energy consumption, and enhance housing comfort levels. It can be potentially a suitable topic to apply for the "Technology Seeds Development Support Project".