Assessing the Ventilation Effectiveness of Naturally Ventilated Livestock Buildings under Wind Dominated Conditions Using Computational Fluid Dynamics

Biosystems Engineering
Pages:
78-99
Volume:
103
Issue:
1
Date:
Friday, May 1, 2009
DOI:
http://dx.doi.org/10.1016/j.biosystemseng.2009.02.007

A computational fluid dynamics (CFD) model was developed to investigate the natural ventilation of a climatic livestock building under different wind incidences (WIs) for three different inlet opening areas. A ½ scale experimental duopitch building was employed to validate, both qualitatively and quantitatively, the CFD predictions of airflow distribution. To improve the applicability of CFD to building design, a thermal comfort index called the ?minimum comfort temperature? was used in this study. Results showed that ventilation rates were not at their highest when wind was blowing normal to the building because a considerable quantity of the flow exited the building via short-circuiting. However, the greatest ventilation homogeneity was experienced when the wind was blowing normal to the building, because of the formation of two wind-driven vortices within the building. Results also showed that the highest level of environmental heterogeneity occurs at WIs of 10?40° because the primary vortex only occupies a portion of the total building volume. It was also found that in some circumstances the ventilation rate determined from the flow rate through the building openings may not accurately represent the actual ventilation rate of a building, and measurements/simulations of contaminant decay may form a more accurate measure of ventilation rate.

Author Name:
T. Norton
J. Grant
R. Fallon
D.W. Sun
Industries:

Products:

CD-adapco is the world's largest independent CFD focused provider of engineering simulation software, support and services. We have over 30 years of experience in delivering industrial strength engineering simulation.
