

中文摘要

本研究為開發一演算法以預測農業建築自然通風開口有效性。本演算法乃依據變形尺度理論 (Distorted Scale Theory) 並藉由巴金漢 π 理論 (Buckingham Pi Theorem) 決定無因次參數變數間之關係。本研究選用之無因次變數有雷諾數 (Re)、風的入射角度(f)、開口高度與長度比(h/l)及屋頂斜率(q)等。在一等溫狀況下之風洞中進行模式驗證，實驗中改變風之入射角度 ($10 \sim 90^\circ$)，風速 ($1.5 \sim 4.5 \text{ m s}^{-1}$)，開口高度與長度比 ($1 \sim 1/3$ 及 $1/2 \sim 1/6$) 及屋頂斜率 ($10 \sim 30\%$)。設施模型有一般型及太子樓型兩種型式，並為了瞭解開口比率與演算間的變化關係，將太子樓開口高度與長度比分為 $1 \sim 1/3$ 及 $1/2 \sim 1/6$ 兩種型式做演算。由實驗數據演算結果發現除屋頂斜率的變化一般型與太子樓型差別不大外，其餘如入射角度及開口高度與長度比，在相同的開口有效性演算之下太子樓型優於一般型。經由本實驗數據及演算法驗證下期能提供日後農業設施環境之設計參考，以利畜舍內部環境品質的控制。

關鍵詞：自然通風；開口有效性；風洞；農業設施

Abstract

The aim of this research is to develop an algorithm in order to predict the effectiveness of openings in naturally ventilated agricultural buildings. The method is based on distorted scale theory with the Buckingham Pi Theorem to determine the relationship among the nondimensional parameters. In this work, we choice Reynolds number (Re), wind angle incidence (f), ratio of height to width (h/l), and roof slope (q) as nondimensional parameters. Model validation was conducted in a wind tunnel using a scaled model under an isothermal condition. During the experiments, wind angle incidence varied from $10 \sim 90^\circ$, wind velocity varied from $1.5 \sim 4.5 \text{ m s}^{-1}$, ratio of height to width varied from $1 \sim 1/3$ and $1/2 \sim 1/6$ and roof slope varied from $10 \sim 30\%$. To compare the opening effectiveness between different types of natural ventilation system, one sidewall openings (SP) and one covered ridge with sidewall openings (CRSP) were chosen as the scaled models. To understand the opening ratio and effectiveness, the relationship between height with width of the CRSP type was set at $1 \sim 1/3$ and $1/2 \sim 1/6$. The nondimensional equation of opening effectiveness (E)

The experiment reveals that the opening effectiveness of CRSP type is better than that of SP type. This work will offer the designers the practical information to improve the quality control of microclimate in the livestock buildings.

Keywords: Natural ventilation; Opening effectiveness; Wind Tunnel; Agricultural buildings