中文摘要

本文主要目的為探討自然通風農業設施中熱環境溫/濕度便化情形。基本方法乃始用一已開發應用程式：QucikTEMP,該程式主要為一熱環境分析設計及熱負荷計算之電腦軟體。QuickTEMP 可以用來預測一設計空間中熱負荷大小，並根據此計算出之熱負荷設計冷卻系統或增溫系統。本文除敘 QuickTEMP 假設及用法，另外，描述 QuickTEMP,熱力學及通風簡單原理.並以簡單的熱傳路徑描述溫度傳遞情形,配合熱阻的觀念形成熱網路模式進一步描述熱傳遞在室內變化情形。

本文研究之農業設施對象包括豬舍、牛舍、雞舍及溫室，並以自然通風為主要通風系統。熱環境模擬以設施內溫度及相對濕度之 24 小時變化情形為主。模擬結果顯示，不論是牛舍或豬舍，其室內溫度或相對濕度反應,夏季模擬效果較冬季佳.在溫度和相對濕度模擬結果比較下，發現溫度迴歸的判定係數大於相對溼度(溫度迴歸的判定係數約為 0.8 以上,相對濕度迴歸判定係數最低為 0.66)。針對台灣而言過熱的問題較大且溫度影響比濕度大.模擬結果誤差(取標準偏差)為；豬舍：溫度±1.87℃，相對濕度±7.35％；牛舍溫度±1.62℃，相對濕度±10.59％ ；雞舍：溫度±0.34℃；及溫室：溫度±2.04℃.以溫室為例,模擬中亦比較不同大小通風面積對熱環境變化影響，結果可以看出，通風面積愈大者，效果愈佳。因此，整體模擬結果顯示確實可用來預測自然通風下果愈佳。因此，整體模擬結果顯示確實可用來預測自然通風農業設施之熱環境變化。

應用預測溫度及相對濕度，並非僅針對自然通風的情形下，亦可在強制通風，有水牆或是有空調的狀況下做預測模擬。此程式幫助設計者模擬出建築物完成後的微氣候變化，應是很好的工具軟體。

關鍵詞：農業設施；自然通風；熱環境；溫度；濕度；模擬

Abstract

The purpose of this research is to study the temperature/humidity variations of the thermal environment in naturally ventilated agricultural structures. A microcomputer program QuickTEMP is used to implement the thermal simulations. One of the main features of the program is the ability to predict the indoor environment and heat load of a building with a natural ventilation system. TheQuickTEMP but also be use to predict internal heat generation in order to design the cooling or heating system in the design space. The research not only describes the fundamental principles of QuickTEMP including thermodynamics and ventilation. Furthermore, the research also depict the thermal transfer by simple building energy flow pathways and thermal network of a building zonein terms of a thermal resistance theorem.

The agricultural structures to be implemented include one pig house, one diary house, one chicken barn, one greenhouse. The ventilation systems considered are natural ventilation. The results of thermal environment simulation system considered are in terms of the 24 hours responses of indoor temperature are relative humidity (RH). The simulation results show that the responses of indoor temperature and RH in summer are batter than that of in winter for bath dairy and pig houses.

In comparisons of temperature and RH response, the simulation results indicate that the determination coefficient of temperature regression (R^2>0.8)are large than that of RH(R^2=0.6). The errors between measurements and prediction (in terms of standard deviation) are (1) pig house:±1.87℃ and ±7.35%; (2)diary house:±1.62 ℃ and ±10.59%; (3)chicken carn:±0.34℃, and (4) greenhouse: ±0.24℃ for temperature only. The effect of different sizes of ventilated opening in thermal environment responses also analyzed in a greenhouse. The result shows that the large the ventilated

opening, the better the ventilation performance. The evaluation of the QuickTEMP implementation in natural ventilated agricultural structures presented in thisresearch concludes that a good agreement between measurements and predictions is found and validation studies are also presented.

This highly simplified thermal model QuickTEMP for prediction the thermal performance not only can be applied in a naturally ventilated buildings but also can be extended to forced ventilation, pad-fan and air-conditioning system. It is therefore possible for a building designer to evaluate economically the influence of the different design options on microclimate at a very early stage, QuickTEMP therefore is ideal as a design tool for building designers.

Keywords ： Agriculturl structure; Natural ventilation; Thermal environment ; Temperature; Humidity; Simulation