Pressure Differential Analysis of a Laboratory Animal Room[1]

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Abstract: This paper simulated and analyzed the pressure differential of a laboratory animal room by CFD software. Under a certain wind speed, the windward side pressure distribution of laboratory animal room was studied, and the windward side pressure differential distribution function was drawn. The corresponding distribution law and maximum wind pressure point were found. At the same time, the indoor pressure among the laboratory rooms was studied and simulated when the door opened, to learn what pressure differential can prevent air flow from a low pressure region to a high pressure region. We tested whether the differential pressure is reasonable to regulate the code between the indoors and outdoors, and among laboratory animal rooms, so as to provide a certain reference for code, construction and design, and to decrease positive pressure air change and save energy based on inside air environment requirements.

Key words: laboratory animal room, pressure differential, simulation, save energy

1. LABORATORY ANIMAL ROOM PRESSURE DIFFERENTIAL

In order to guarantee the laboratory animal room air environment security, the laboratory animal room must keep a higher (lower) pressure differential to the next room; this is one of the most important characteristic for the laboratory animal room air conditioning to the common air conditioning system, and its also one of the most important part of its cleanness. Table 1 is the pressure differential request of the laboratory animal.

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2. PRESSURE DIFFERENTIAL SIMULATION BETWEEN INDOORS AND OUTDOORS

When the wind flow on the windward side, the wind pressure would be form on it, reference [2、3] was made some study on it, the aim of this simulation is that through the study on building windward side pressure, find the change rule of the windward side pressure.

2.1 Physical Model

As shown in Fig.1 below, it is the physical model, the building is in center of the area, the volume is $4m \times 5m \times 15m$. it can be known that the width is 5 times of the building and the length is the 10 times of it for the simulation area, it can simulate wind flow to the building in the infinitude space[2、3]. Base on this conditioning, the calculation area can be set as $80m \times 20m \times 80m$. The distance between building and calculation area left border is 38m, take the origin on the left bottom, the coordinate nearest corner to the origin is (38.0, 5.5, 0.0), inlet in the left and outlet in the right.

2.2 Mathematics Model and Boundary Condition

This research is the relate to low velocity of flow , it can be described by turbulent $k-\varepsilon$ equation[4], the vector quantity of differential equation is expressed as follows :

Continuous equation:

$$\frac{\partial u_i}{\partial x_i} = 0 \qquad (1)$$

Momentum equation: