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A preliminary study on passengers' thermal responses when boarding a flight in winter

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Abstract

An experimental research was conducted to study passengers' responses to the thermal environment when boarded aircraft cabins. The results show that passengers adapted to the thermal environment by behavioral and psychological paths. Before entering into the cabin, the Sick symptom, thermal sensation and thermal discomfort was obviously higher at walking state than waiting state. Subjects' thermal comfort were achieved by using personal air outlet (PAO) and adjusting clothes. And after enter the aircraft 10 min -15 min, the difference of subjective responses between different pre-states became small, because of actively adaption.

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Keywords: Aircraft cabin; Thermal environment; Personal air supply; Behaviour.

1. Introduction

As a typical special micro-environment of transportation, thermal environment in an aircraft cabin is quite different with that in buildings, which is recognized by narrow space, high person-density and confined activity inside [1] and extreme environment outside at heights of approximately 12 km [2]. Previous research [3] shown that thermal discomfort in aircrafts (approximate 10% - 30%) is much higher than that in buildings. To create a "health and comfort" environment, there are two air distribution system[4]: the first is the main air distribution system which controls the

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thermal comfort and air quality of the overall cabin environment; the second part is the personal air supply system which supplies conditioned air directly to each passenger. Personal air supply give passengers option to change their micro-environment due to individual difference, not only provide fresh air but also a method of cooling, which reduces the overall percentage of dissatisfaction eventually [5]. Pang et.al [6] survey the thermal comfort conditions on 31 civil flights, and found that thermal comfort was not controlled very well in some flights, especially in some short-haul flights. Thus, this research take series of experiments to study subjects' response when board aircraft.

Nomenclature

AC	air conditioning
NC	naturally ventilated
PAO	personal air outlet
PAQ	perceived air quality
TSV	thermal sensation vote
TCV	thermal comfort vote

2. Methods

2.1. Experimental platform and instruments

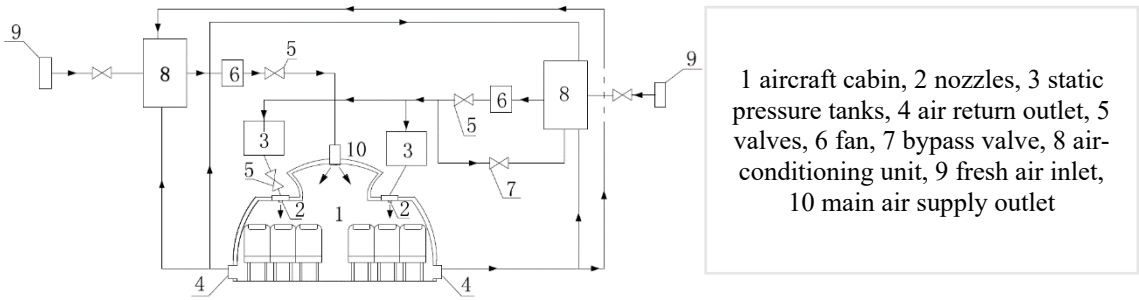

Fig.1: Schematic drawing of experimental platform and system

Experiments were carried out in a three-row (18-seat) aircraft cabin in Chongqing University, whose cross sectional size was based on the Airbus A320, i.e. sized 3.9 m×2.35 m with 4.9 m long. The cabin was placed in an air-conditioned room to create a stable external thermal environment.

The thermal environment in the aircraft cabin was conditioned by the air-conditioning unit as shown in Fig.1 comprised both the main air distribution system and the personal air distribution system. The proportion of fresh air in the main air supply system was controlled through the valve. The personal air supply nozzle was designed to supply mixed air with 50% recirculated and 50% fresh air (isothermal conditions) in this research. The nozzles were placed above the seats as shown in Figure 1, and in the middle of neighbour rows whose distance was approximate 81cm.

Table 1. Specifications of instruments for background environment monitoring.

Instruments	Parameters	Measurement range	Measurement accuracy
	Ta	-25 -150°C	±0.1 °C
LSI (BSU102)	RH	40% - 70%	±1%
	V	0 - 1 m/s	±0.04m/s

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