A Chart for Prediction of Draught

by P. O. Fanger and N. K. Christensen

Draught is defined as an unwanted local cooling of the human body caused by air movement. It is a serious problem in many ventilated or air conditioned buildings. Often draught complaints occur although measured velocities in the occupied zone may be lower than prescribed in existing standards. This is frustrating for the ventilation engineer and a threat to the image of the ventilation and air conditioning industry in general.

Earlier studies have investigated draught when subjects were exposed to laminar flow. However the air flow in ventilated spaces is turbulent as shown in Fig. 1 (2, 3), and Fanger & Pedersen (4) have shown that turbulent is more uncomfortable than laminar flow. In the present study, one hundred subjects were exposed to air flow with a turbulence as occurring in typically ventilated spaces. The research is described in detail in ref. (1).

Each subject, dressed to obtain a neutral thermal sensation, participated in three experiments at air temperatures of 20, 23, and 26°C. In each experiment subjects were sedentary and exposed to six mean air velocities ranging from 0.05 to 0.40 m/s. The turbulence intensity ranged from 30 to 60 per cent. The subjects were asked whether and where they could feel air movement and whether it felt uncomfortable. Based on the results, the draught chart in Fig. 2 has been evolved. The chart identifies the percentage of subjects dissatisfied due to draught as function of the mean air velocity and the air temperature. The turbulence of the air flow in real spaces makes people more sensitive to draught than was found in previous studies with laminar flow. A reduction of velocity limits specified in existing standards is required to diminish complaints. The head region was the most draught-sensitive part of the body for persons wearing normal indoor clothing. No significant differences were found between the draught sensitivity of men and women.

The draught chart may be used to establish new limits for allowable velocities in ventilated spaces. Based on measured or calculated air velocities and temperatures in the occupied zone of a space the draught chart may also be used to predict the percentage of dissatisfaction due to draught for the entire space. Such a figure would provide essential information on the quality of the air distribution system in the space.

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N.K. Christensen received his M.S. degree in mechanical engineering from the Technical University of Denmark in 1982. His thesis work comprised studies required to establish the present draught chart. He has worked with Bruel & Kjaer Inc. and from 1986 with Vestas Inc., Denmark.

References

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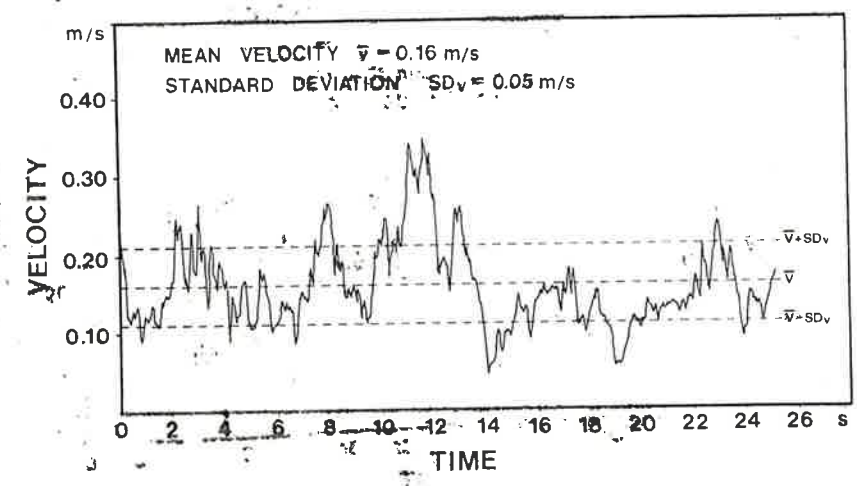

Fig. 1: Fluctuations of the air velocity in the occupied zone of a typically ventilated space. The turbulence intensity is the standard deviation divided by the mean value of the air velocity.

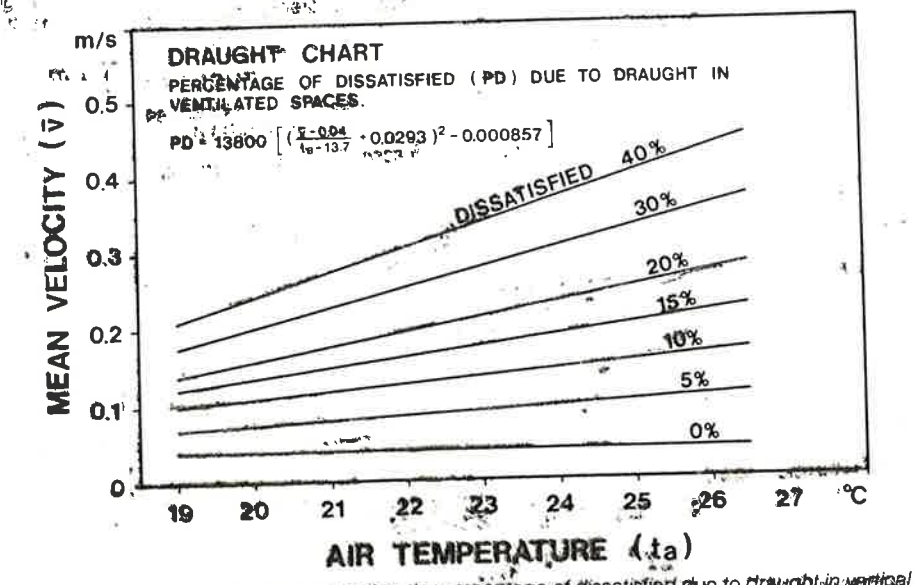

Fig. 2: The new draught chart. It predicts the percentage of dissatisfied due to draught in ventilated spaces.