SUMMARY

Dr.L.Bánhidi et al:About a Special Question of Local Discomfort Effect of Draught. Airflow resulting either from artifical or natural ventillation in a closed space has a rather slow velocity in general, 0.1-0.25 m/s though often causes certain local discomfort. As a result of tests carried out in the Hungarian Institute for Building Science Microclimate Laboratory the PMV and PPD values were determined given in case of laminar and turbulent airflow ranging between the above mentioned air velocity values, the temperature limit values producing airflow ranging from percieving airflow to discomfort.It was stated that turbulent airflow always causes more discomfort i.e. is more percivable than linear airflow.

RESUME

Dr.L.Bánhidi et ses compagnons: Quelques questions spécial de la sensation discomfort causes par le couranter.Lescourats d'air se produisant d'une aeration naturelle ou artificielle dans une piece fermée ont une vitesse rélativement petite - d'une valeur 0.1-0.25 m/s généralement - mais malgré cela causent des plaintes accompagnantes souvent par une sensation disconfort.C'est au Laboratoire Microclimatique de l'Institut Scientifique de la Construction - où - au cours d'une série d'essai - on a défini entre ces valeurs limites de la vitesse d'air les valeurs PMV et PPD qui se montrent en cas de courant d'air turbulent et laminaire et les valeurs limites de température d'air donnantes les influences de thermosensibilité désagreables et d'observation du courant d'air. On a constaté, que le courant turbulent est toujours plus désagreables ou plus observable que le courant d'air laminaire.

KURZFASSUNG

Dr.L.Bánhidi und mitarbeiter:Einige spezialische Frage des druchten Luftzug verursachten lokalen Diskomfortsgefühl. Die im geschlossenen Raum durch natürliche und künstliche Lüftung entstehenden Luftbewegungen sind von einer verhältnismäßig kleinen Geschwindigkeit; im allgemeinen ist sie 0.1-0.25 m/s. Trotz dieser Eigenschaft rufen sie aber oft örtliche.Diskomfortsgefühlbeschwerden hervor.Als Ergebnis einer Experimentreihe,die in dem Ungarischen Institut für Bauwissenschaft, Mikroklimatischen Laboratirium durchgeführt wurde, bestimmte man die zwischen den vorhererwähnten Luftgeschwindigkeitgrenzwerten,bei laminaren und turbulenten Luftströmungen entstandenen PMV und PPD Werte, diejenige Grenzwerte der Lufttemperatur, bei denen die Wahrnehmungsgrenze und die Grenze des unangenehmen Wärmegefühls der Luftströmung liegt. Es wurde festgestellt ,daß die Turbulentströmung immer besser wahrgenommen wird, als die laminare Luftströmung, also die turbulente Luftströmung von dem Gesichtspunkt des Temperaturgefühls aus betrachtet,ist ungünstiger als die laminare.

ABOUT A SPECIAL QUESTION OF LOCAL DISCOMFORT EFFECT OF DRAUGHT

Dr.L.Bánhidi, J.Besnyő, A.Somogyi, G.Kintses

Hungarian Institute of Building Science

Introduction

Draught can be an important local discomfort factor that may effect our sense of general well-being.Its effect has primarily been analysed for relatively greater air velocity - v = 0.3 m/s - while the influence of slower air movement within both dwelling houses and public buildings is less well known. Even within this latter field of investigation the basic question still remains to be answered: is there any difference in our perception of heat experienced under laminar or turbulent conditions of air circulation, and if there is, what's the degree of difference involved?

The thermal comfort effect of draught has been dealt with by many authors like e.g. Azer et al (1), Fanger (2), McIntyre (3, 4), Dickson (5), Fishman and Underwood (6), Pedersen (7), but there are still several open questions. Such is among others, the case we are investigating.

The article deals with a special question related to this topic, the description of the laboratory analysis of the problem is given. Experiments were conducted in the Microclimate Laboratory of the Hungarian Institute for Building Science.

Case study of the effect of slow air movement on thermosensitivity

Experiments were conducted in a measurement space of 5x3 m basic area in our Microclimate Laboratory. The 3x5 m sized back wall of the measurement space was divided into two section.Two people at a time could sit here next to the wall. Air circulation originated from the back wall i.e. it was received horizontally.

During our investigations short, 1,5 hour long exposition was provided under 6 types of condition for both laminar and turbulent air movement,participants sat facing the air current:

1. Condition of measurement: planned PMV = +1, v = 0,25 m/s, t_h = 29,4°C (temperature of the room), I_{cl} = 0,5 clo
2. Condition of measurement: planned PMV = -1, v = 0,25 m/s, t_h = 25,5°C, I_{cl} = 0,5 clo
3. Condition of measurement: planned PMV = -1, v = 0,25 m/s, t_h = 21,3°C, I_{cl} = 1,0 clo
4. Condition of measurement: planned PMV = -1, v = 0,25 m/s, t_h = 17°C, I_{cl} = 1,5 clo
5. Condition of measurement: planned PMV = -1, v = 0,1 m/s, t_h = 23,3°C, I_{cl} = 0,5 clo
6. Condition of measurement: planned PMV = -1, v = 0,1 m/s, t_h = 19,4°C, I_{cl} = 1,0 clo.

During the investigation period two or three cases were studied, since after each session of 1,5 hour in the measurement space participants spent one hour in the adaptation area. This enabled them to readjust themselves and be prepared for the next period of exposition.

The day of measurement began with the filling in of questionnaires in the adaptation area, next the weight of the participants was measured together with their blood-pressure, pulse and reaction time. During the end of the day these procedures were repeated.

Participants were asked to work on some multiplication problems for five minutes in every half hour, while they stayed in the measurement space. Their subjective heat perception and skin temperature was registered on a 12 point scale, at these times. The rest of the time was spent by reading or studying. Sixteen persons took part in the study, half of which were woman and the other half men. Within both groups half or the participants were university students i.e. of collage age, between 18 and 24 years of age, while the other half consisted of retired people i.e. woman were older than 55 and men older than 60.

Investigation results

Results of our investigations are the follows:

a/ The CTV values were given in accordance with subjective thermal votes which were the fixed (interrogated) values of the 7 points subjective scale. However the CDP values were the percentage of dissatisfied belonged to this CTV values.

b/ LM marks the mean value of votes about the perception of air movement. These questions were asked simultaneously with those concerned with heat sensitivity. Participants were requested to mark its value on a linear scale divided into 10 parts that ranged between insignificant to very significant.

c/ E stands for the so called sensitivity (or perception) value, while K marks the so called discomfort limit. People were specially asked about the unpleasantness or disturbing effect of air movement in relation to heat sensitivity and in our assessment the following categories were introduced:

- heat sensitivity does not deviate from normal — 0
- heat sensitivity deviates from normal perception, however
  - the effect of draught is not disturbing — ±1
  - the effect of draught is disturbing and
    - slightly discomforting — ±2
    - discomforting — ±3

±1 values were considered as votes registering some from of air movement, while values equal to ±2 were taken to be discomforting. Further results are shown on Figures 1 - 4.

Evaluation of measurement results

a./ In spite of the fact that lower temperatures were "compensated" by clothing (see measurement situation) at an air velocity of 0,25 m/s lower CTV values were obtained for both laminar and turbulent air circulation (Fig.1). Differentiating further between laminar and turbulent airflow, we find that CTV values are less favourable for the latter.

0 CTV value were obtained at 25°C for laminar airflow, while for turbulent flow it was 26°C.

At an airspeed of 0,1 m/s CTV values hardly ever change, and there is no significant difference in these values for laminar or turbulent airflow.

b./ Subjective declarations of heat sensitivity for an airspeed of 0,25 m/s were as follows: (see also Fig.2)

- in case of laminar flow they decreased from 1,5 to 1, for temperatures between 18 and 30°C.
- for turbulent flow the basic value was greater, (2), and the change was also more marked (1).

Values remained more or less constant between 19 and 23°C at an airspeed of 0,1 m/s, though they were slightly greater for turbulent flow.

c./ Figure 3 indicates that at an airspeed of 0,25 m/s the percentage value of people noticing air movement increases, it being directly related to temperature rize.

More precisely, it increased from 25 to 66%, between 22 and 24°C in case of laminar flow, and from 15 to 45% for turbulent flow.

At the airspeed of 0,1 m/s perception ratio varied between 40 and 50% for both types of airflow, and it slightly decreases between 19,4 and 23,4°C.

d./ Figure 4 depicts that under the given set of parameters the ratio of people who consider airflow discomforting changes as follows:

- the number of complaints markedly decrease at an airspeed of 0,25 m/s with the rize of temperature, for laminar flows it decreases from 65 to 20%, for turbulent flows from 80 to 30%.
- the percentage value of heat perception does not change with temperature at an airspeed of 0,1 m/s, it varies roughly between 30-35% for turbulent flows and 45-50% for laminar flows.

This follows logically since our thermosensitivity is more favourable influenced by an increase of convective heat adsorbtion.

Conclusions

1. People perceive (E) turbulent airflow more readily than laminar flows, hence the values obtained for subjective heat sensitivity (CTV) and for air movement (LM) are greater, and so is the number of declarations stating a feeling of subjective discomfort (K).
2. The rize of temperature is accompanied in both cases of turbulent and laminar flow by a decrease in PMV values for subjective heat sensitivity (CTV) and in general a similar drop is noticable for the subjective perception of airflows and in the number of those who consider these situations discomforting.

5. However a greater number of people notice (E) air movement as temperature rizes.There is a particularly sharp increase between 22 and 24°C for both laminar and turbulent flows.

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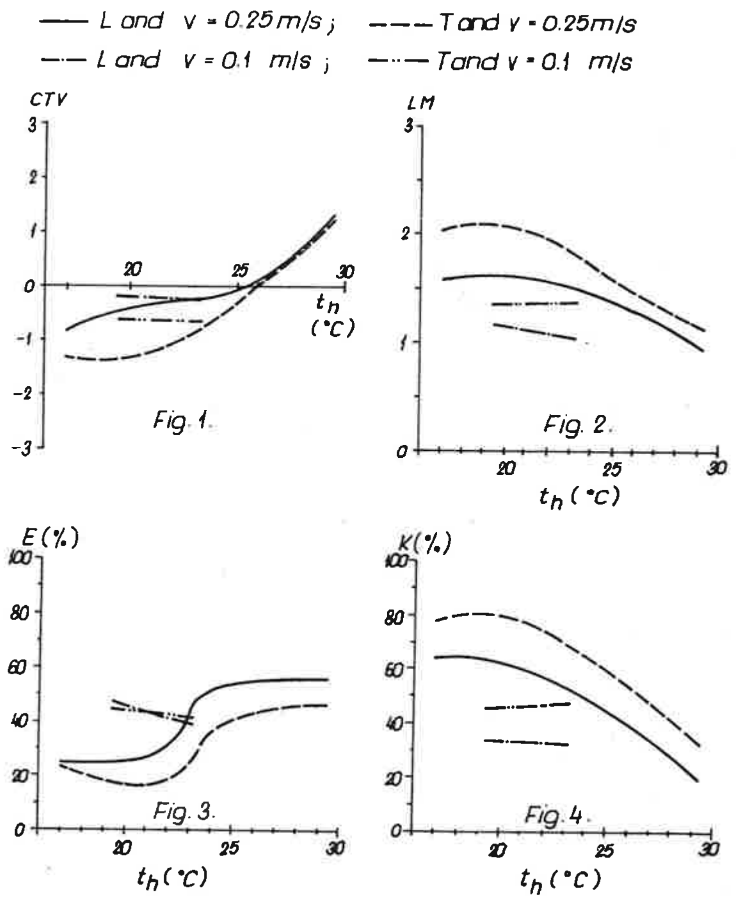

Fig. 1. Changes in the subjective thermal comfort vote (CTV) in relation to room temperature (t_h) in the case of different air velocity (v) under laminar (L) and turbulent (T) draught effects.

Fig. 2. Changes in the votes about air movement (LM) in relation to room temperature (t_h) in the case of different air velocity (v) under laminar (L) and turbulent (T) draught effects.

Fig. 3. Percentage changes in the number of votes perceiving airflow (E) in relation to room temperature (t_h) in the case of different air velocity (v) under laminar (L) and turbulent (T) draught effects.

Fig. 4. Percentage changes in the number of votes about the discomfort limit of airflow perception (K) in relation to room temperature (t_h) in the case of different air velocity (v) under laminar (L) and turbulent (T) draught effects.