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THERMAL COMFORT STUDIES AT HUNGARY

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1. INTRODUCTION

Thermal comfort investigations have been carried on in Hungary from the second half of the '70s, chiefly in laboratories, with living humans and thermal manikins.

The most important series of measurements have been made in the following fields

- comparsion of different heating systems from the point of view of thermal comfort, energy consumption, and local discomfort,
- determination of different clothing, among them e.g. the clo values of polar suit,
- comparsion of different sunshine protection solutions,
- checking of different kinds of ventilation,
- examination of the thermal comfort conditions of disabled persons.

2. METHODS

Examination methods can be divied into three main types

- laboratory examinations on living subjects,
- site examinations on living subjects, and
- examinations on maniquins.

Measurements on manikins can actually also be divided into laboratory and site ones, but there was no difference in the measurements (methods) in their cases.

2.1. Laboratory examinations on living subjects

The "classical" methods of thermal comfort examinations in laboratories on living subjects is well known from many researchers (Gagge, Rohles, Fanger, Wyon etc.). The Hungarian method has not essentially changed, but there are differences in some points of view. The most important ones are summed up as follows:

a/ selection of the subjects and the situations,

b/ adaption time for the measurements,

c/ duration of measurements.

ad a/ Selection of the subjects is always decided by the task. If the examination of general thermal comfort parameters is aimed at, the measurements are always made with college age young ones and subjects above 60. If the optimal or still acceptable thermal comfort parameters in case of certain surroundings or activities is to be determined, then either the real surroundings are simulated, or subjects who carry out such types of activity in real life are selected. Thus e.g. when examining office surroundings, employees in administration are selected, and a real office situation were simulated.

ad b/ The examination means for the subject in the experiment a stress effect in any case, whose loosening takes a longer time. Therefore the subects are made to practice the measurements for a day or two and, though the measurements are taken during this time, too, in the final evalution these data are not taken into consideration. In the majority of cases there is a significant difference between the parameters of the initial stage and those of the already practiced activities.

ad c/ In deciding the time of measurement the daily biorythm and the duration of the real activity is always taken in consideration. Therefore, as a rule, the examinations extend over the full time of a shift, usually 6 to 8 hours. The examination data ere not measured consinuously, with fixed sensors, but momentary measures are fixed at intervals of 15-30 minutes.

2.2. Site examinations on living subjects

Aim of such examinations is

- either the determination of initial basic values for the laboratory examinations, or
- site checking of laboratory examinations.

In both cases the examinations were made with dateiled thermal technology, partly with physiological, subjective thermal comfort and psychology in connection with living subjects.

In the course of examinations of thermal technology it was usual to measure the temperature of air and its distribution is space, the surface temperature of bordering structures, the globe temperature, the relative humidity and velocity of air. This instrumental measuring technology includes further the Comfy-test measurements, as well as, in a given case, the checking of the consumption of heating or cooling energy, too.

In the course of examinations on living subject partly the physiological parameters of the subjects (skin temperature, blood pressure etc.), partly the subjective data of the subjects were taken by using various types of questionnaires and test papers.

2.3. Examinations with thermal maniquin

In the examinations a SIBMAN type maniquin built in cooperation with Swdedish experts and with the help of UNIDO was used. The description of such type of maniquins and mode detailed data can be found in numerous professional sources.

Among the measured data it was chiefly the heat transfer of different parts of the body, the insulating capacity of the clothing in clo value and the EHT value calculated for the thermal sourroundings was used. [1, 2, 3]

3. RESULTS AND DISCUSSION

The examinations results and their evaluation for the five topics mentioned in the Instroduction are individually summed up.

3.1. Comparsion of different heating systems from the point of view of thermal comfort, energy consumption and local discomfort. [4, 5, 6.]

In these examinations the basic principle already mentioned in the Introduction was applied: a combination of examinations with maniquins and living subjects. In the course of maniquin examination the heating solutions which are most favourable for the heat transfer of the human body and the energy consumption were determined; afterwards, these parameters were used for the series of examinations on living subjects.

It is characteristic of Hungary that

- up to recent years the panel-type buildings made of house-factory elements were widely used,
- the heat insulation capacity of such, usually district-heated buildings was rather inadequate, especially at the beginning (U-value is 1-1,2 W/m^{2}K).

This resulted in several cases in users' complaints classed among the types of asymmetric radiation as a local discomfort factor.

In the course of examinations extending over radiators, panel-heaters, ceiling, floor and side-wall heating systems it was ascertained that the heating systems where radiant heat transfer is the dominant element are of the most favourable character. A comparsion of heating systems in this way also gave possibility for the comparsion of energy economy. Investigations of this character have also been made in Hungary with the cooperation of researchers from other countries.

As for the draught factor, we partly made measurements of laminar and turbulent air flows to get a thorough checking of international values in this country, partly we determined the permissible and ecceptable airflow-air velocity values for different airheating types.

3.2. Determination of different clothing, among them e.g. the clo values of polar suit

Some of the examinations served the determination of classical clo values (e.g. the real clo values of the "East European businessman's clothing"). A seperate group of the examinations was given by the special cases, such as, e.g.

- the determination of the real clo values of the GDR polar suit, [7]
- the examination with the aim of determining the wearing comfort and clo values of Sudanese national dress.

3.3. Comparsion of different sunshine protection solutions [8]

Site examinations with maniquins were made for Vienna Technical University in passive solar houses for the comparsion of different sunshine protection solutions as well as on various sites in passive solar houses differing from those in Hungary.

3.4. Checking of different kinds of ventilation [9]

These examinations in effect formed a part of the draught measurements described earliner in point 3.1.; making a comparsion, e.g. of the blow of air under the windows and on the opposite walls in the case of air-heating, their influence on the heat transfer of the human body and the changes in such cases of the subjective comfort feeling of humans.

3.5. Examination of the thermal comfort conditions of disabled persons [10, 11]

In recent years a new field of investigation has appeared for the case of disabled people to determine the permissible optimum interior air and operative temperature values from the point of view of thermal comfort. These investigations were carried out in cooperation with Japanese researchers, and are in fact still going on. The finding that for disabled persons it is not necessary to ensure a 2°C higher temperature, as has benn perscribed till now, seems to be the first result of the series of examinations.

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