Draught and Cold in Industrial Buildings

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Introduction

In Scandinavia draught, cold and temperature changes are very general problems. About 50–70 % of responders in the questionnaires have reported about these adverse effects and this trend has increased during last decades. These problems are related to discomfort, accident risks and also indoor air quality. Reason behind problems in industrial buildings is mostly related to climate, draught at outer door openings and problems with ventilation. Recommendations and regulations of these problems related to cold are also undeveloped, because the biological adverse effects of cold environment are not well understood. In this study we have measured thermal parameters in industrial halls to describe the seriousness of draught and main reasons for the problems.

Methods and Results

The studied eleven industrial buildings are located in Northern Finland. Description of the buildings is presented in table 1.

Table 1. Description of the studied buildings.

	description of the halls	volume (m^3)	door opening width (m)	height (m)
1	roller polishing hall	80000	4	4,2
2	repairing shop	60000	5	5
3	metall workshop	45000	4,5	5
4	machine hall	90000	4,4	3
5	electrolycis hall	17000	3	3,4
6	chemical hall	4100	4,2	4,5
7	bakery	7000	0,8	2,3
8	boiler building	100000	3,3	4,4
9	roasting hall	50000	2,7	4
10	paper mill	110000	4	4,5
11	test hall	93000	4,5	5,5

Measuring instruments related to ventilation measurements were hot wire anemometers. Also climatic parameters, air velocity and temperatures inside in the buildings were measured around the outer door openings (at the distance of 0.5 m, 1 m and 2 m). The leakage airflows were measured with a trace gas method.

The main results are presented in figures 1 and 2. The draught was seldom problematic in the buildings when the doors were closed. The main problem was the cold airflow through the doorways at the height of 0.1 m above the floor level (<12 °C).

When the doors were open the adverse effects were observed (figure 1). The temperature changes varied from 1 to 19 °C, if the measuring site was at the distance less than 5 m from the door opening. If we calculate the chill temperatures in these cases, we can see temperature changes more than over 24 °C. The used recommendations were exceeded in 50 % of the cases (ISO 7730).

In figure 2 we can see temperature changes at the door line, which are much higher than the changes outside the door line. The thermal conditions could be even more severe near the door openings than outside the buildings. The reason for this was the higher air velocities at the door; even higher than 5 m/s. If the doors remained open for a longer period, the recovery time of thermal conditions was four times was compared with the door open time.

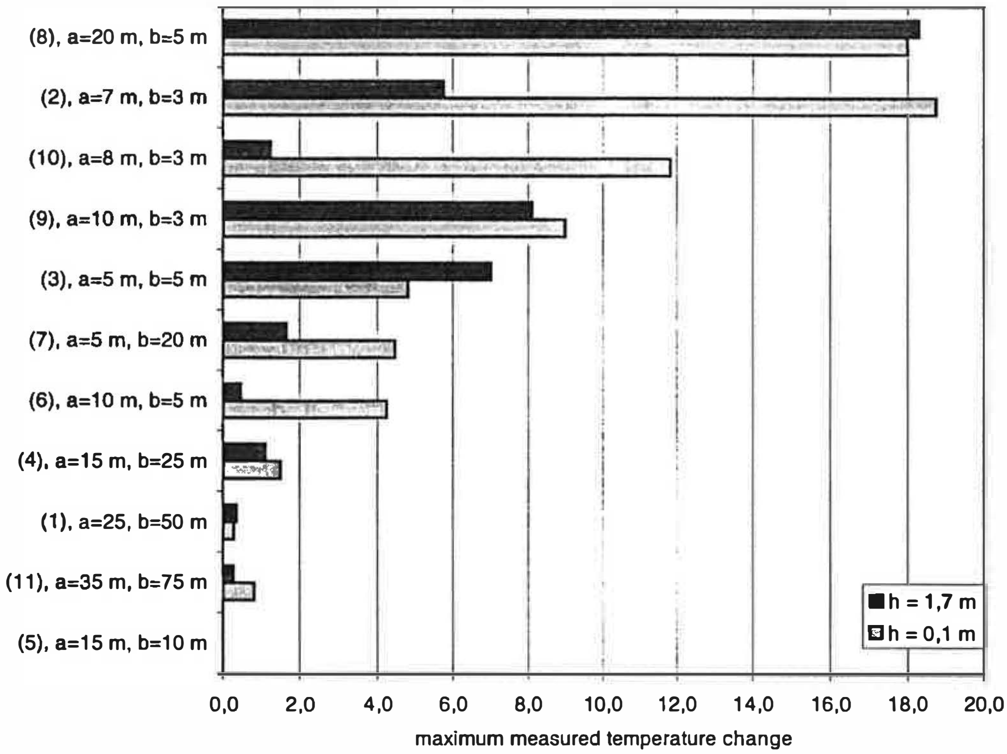

Figure 1. Maximum measured temperature changes at the work places at different heights (a = distance from door, b = distance from door line).

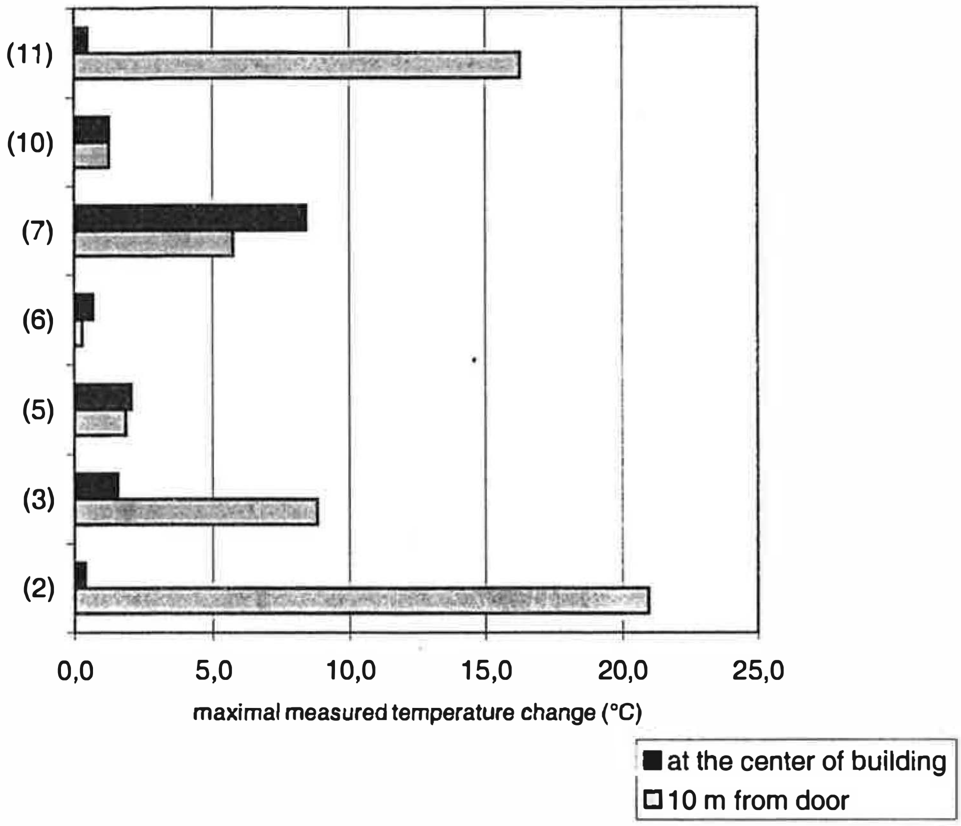

Figure 2. Maximum temperature changes at the distance of 10 m from the doorway (at the height at 1.1 m from the floor) and at the center of building.

Conclusion

Cold airflows through the doorways were remarkable and they effected on large areas of the measured industrial halls. The supply and exhaust ventilation rates and the air leakage paths at the buildings envelope effect on the pressure difference across the leakage paths and doorways and also the cooling of workers. For example effective air curtains are needed to prevent penetration of cold airflows in high traffic doorways.

References

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