Design of Good Indoor Climate in Commercial Kitchens

Heinonen J S [1], Heinonen J [2], Kosonen R [3], Seppänen O [1]
[1]Helsinki University of Technology, Espoo, Finland
[2]Olof Granlund Oy, Helsinki, Finland
[3]Halton Oy, Vantaa, Finland

Introduction

Indoor climate affects occupational safety and comfort. When indoor climate conditions are on an optimum level, the number of accidents decrease while productivity and quality of the work increase. A new design guide for good indoor climate in commercial kitchens is a result of the project "Research and Development Project of Commercial Kitchen Ventilation" started in 1996. Research pointed out that indoor climate conditions in commercial kitchens are not on an acceptable level (1).

Classification of Indoor Climate

The new guide for good indoor climate of commercial kitchens classifies the indoor climate into three different categories. The classification applies to all types of commercial kitchens. Categories are labelled Sk1, Sk2 and Sk3. In category Sk1 the aim is to achieve excellent indoor climate conditions for new "best practice" kitchens. Category Sk2 represents good existing design practise. The design values in Sk2 are not so stringent as in Sk1. Also workers themselves can affect the indoor climate less than in class Sk1. Indoor air temperature level in class Sk3 fulfils the minimum requirements of the Finnish regulations of occupational health.

Target Values

Each category is defined by target values presented in Table 1. The aim of the target values is that they are basis for the design of indoor climate and they help building owner or user to understand the difference between categories. The target values are different for cooking and dish washing areas. The target values presented in Table 1 are based on a national survey and measurements in existing commercial kitchens as well as data presented in literature.

Table 1. Target values for indoor climate in cooking and dish washing areas

	Unit	Category Sk1	Sk2	Sk3
Cooking area				
Indoor temperature, winter	°C	19-21	19-21	19-22
Indoor temperature, summer	°C	19-23	19-25	19-28
Controllability of indoor temperature	°C	± 2	± 2	-
Vertical temperature gradient	°C/m	<2	<3	<4
Radiation asymmetry	°C	<10	<20	<30
Indoor humidity	%	<70	<70	<70
Maximum air velocity	m/s	0.20 or according to the Figure 1		
Dish washing area				
Indoor temperature, winter	°C	18-20	18-20	18-21
Indoor temperature, summer	°C	18-22	18-24	18-28
Controllability of indoor temperature	°C	± 2	± 2	-
Vertical temperature gradient	°C/m	<2	<2	<3
Radiation asymmetry	°C	<5	<10	<15
Indoor humidity	%	<70	<70	<70
Maximum air velocity	m/s	0.20 or according to the Figure 1		

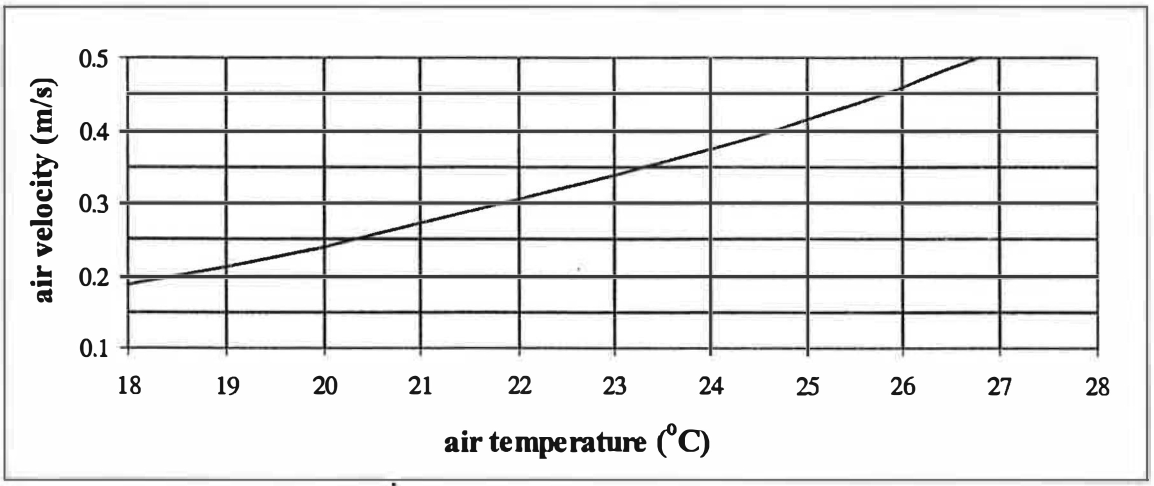

Figure 1. Maximum air velocity and indoor air temperature (2)

Design Principles

Air Flows

Common practice for many spaces is to give minimum or normative ventilation rates per floor area. This is not adequate to ensure an acceptable indoor climate in commercial kitchens, due to the variation of loads caused by kitchen equipment. Ventilation rates in commercial kitchens should always be selected according to the heat and moisture loads caused by the kitchen equipment. These loads and air flows can be calculated for example with a method based on VDI 2052 (3).

Exhaust Air

The type of exhaust must be selected individually for each kitchen. In most of the kitchens both ventilation principles, extracted from hoods or extracted from ventilated ceiling, will perform well. The ventilated ceiling works best if high local heat loads do not exist. When the loads are high, for example, if cast-iron ranges or grills are used, hoods should be used. Dish washing machines must also be equipped with exhaust, preferably also with hoods. Accurate dimensioning of the hood is important in order to assure clean air in the breathing zone. The overhang of the hood must be adequate. The ventilated ceiling must be installed at a high of at least 2.5 m. The proper lay-out of kitchen devices is important to assist the performance of the ventilated ceiling.

Air Distribution

Traditional mixing ventilation does not perform well in commercial kitchens, because with traditional mixing ventilation loads caused by kitchen equipment are also mixed with the breathing zone of the workers. Supply air of commercial kitchens is usually colder than indoor air. To minimize the risk of draught and to assure clean air in breathing zone, low velocity devices are recommended to use in commercial kitchens. Air distribution should be designed individually for each kitchen. In commercial kitchens where air is distributed from floor level or from ceiling level with low velocity devices, it is possible to achieve good indoor climate. The benefit of air distribution from floor level is better in respect of pollutant removal effectiveness. The benefit of air distribution from ceiling or from front face of the hood is smaller vertical temperature gradient in the space than with displacement flow. It is possible to use adjustable individual air supply nozzles installed in the front face of the hood for cooling, in order to compensate thermal radiation from the kitchen equipment.

Control of Indoor Air Temperature

The maximum temperature of indoor air presented in Table 1 is used in dimensioning the air flows and cooling system. The maximum temperature of indoor air should not be exceeded when the outdoor air conditions are below the design. In Sk1 the aim is to control conditions in individual working positions. Because of this, several different control zones are needed. The number of control zones depends on the kitchen layout. In Sk2 cooking and dish washing areas should have control zones of their own.

Design Process

Indoor climate should also be considered in structural and architectural design. Therefore it is important that the HVAC designer is in co-operation with other designers from the beginning of the project.

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Reference

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