

## M502: THERMAL ENVIRONMENT

### STUDENT EXERCISE 4

A shopping centre has received numerous complaints from one of its major tenants in regards to the thermal environment within the store. Upon investigation it is established that the store receives daily complaints from its employees (total workforce 300) that the store is too hot in summer and too cold and has draught issues in winter.

The store in question consists of two levels (ground floor and first floor) with the ground floor being divided into a non-food and a food area. The ceiling in the ground floor areas is high (10 m).

The first floor has a non-food speciality area and offices. The floor to ceiling distance is low (3.1 m) compared to the rest of the store.

The level of internal lighting is highest on the first floor, similar in the non-food ground floor areas and lowest in the ground floor food areas.

The shop is located in a temperate climate (summer typically 18–25°C, winter 8–14°C), is of old design and has no mechanical ventilation except in the food section where there was a need to remove excess heat from the refrigeration systems.

The only ventilation in the rest of the store is natural ventilation due to airflows between the various entrance and exit doors of the store which are equally distributed around the store.

The centre management employed a consultant who conducted a thermal comfort survey of the shop employees by questionnaire. The data was analysed using the ASHRAE Psycho-Physical Sensation Scale with the following results (mean values only presented).

Area	Summer	Winter
Ground Floor - Non-Food	+0.14	-0.62
Ground Floor - Food	-0.11	0.28
First Floor	2.44	-1.45

The consultant also conducted some air temperature measurements and found that the mean internal air temperature is 8–9°C higher than the outdoor temperature in summer and 3–4°C in winter. The interesting discovery is that even outside of working hours (eg at night and Sundays), the mean indoor temperature is still higher than outdoors.

## **QUESTIONS**

1. Given the above situation, what are the possible factors causing the complaints?
2. What could be reasonably done (keeping in mind the age of the store) to overcome these issues?