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Airpak software-based thermal simulation of a living room in the Bethe building

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Abstract
In order to investigate whether the occupants are working in a comfortable environment, we use Airpak software to generate a model of the envelope and indoor heat sources, and then perform the meshing, boundary condition parameter setting and numerical solution of the occupants, air vents and furniture in the room, and finally post-process the simulation results. The degree field distribution, air age map, airflow distribution, and velocity distribution analysis are obtained to know that it meets the requirements of thermal comfort. The results are expected to provide a theoretical approach and comparative analysis for the investigation of indoor thermal comfort in similar office buildings. Key words: Interior; Airpak software; Numerical simulation; Thermal comfort

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I. INTRODUCTION

Located in Wuhan City, Hubei Province, Bethe building has 23 floors, with a construction area of 32,640 square meters and a maximum height of 80.4 meters, an air-conditioned area of 30,520 square meters and an air-conditioning system with a cooling load of 1,236kw. As for the building maintenance structure, the north and south sides of the building are mainly glass curtain walls, and the east and west sides of the building are mainly solid brick walls. In this paper, we investigate whether the occupants are working in an environment that meets the comfort standards by taking a room in the Bethe building as the research object.This paper will discuss in detail the analytical process of numerical simulation of the thermal environment of a living room in the Bethe building.

1.1.1 Architectural Overview

The light ends produced by cracking reaction are removed in the stripper column. The off -gas from the stripper is sent to the fuel gas, but flared if it is under high pressure. And the paraffins and olefins in the column bottom stream are fed to the linear alkyl benzene alkylation unit. In order to recover enough heat from the bottom stream, it is necessary by passing where the paraffin stream is heated.The first floor contains a lobby, a rest area, an on-duty area, a marquee, an elevator room, an office, a property management room, a utility room, a fresh air room, a locker room, a rest room, a reception room, a management office, a network room, a toilet, a guard room, a security center and a communication room. The second floor contains a large conference room, office, office, security center and communication room. The second floor contains a large conference room, office, fresh air room, meeting room, toilet, lobby. The fourth floor to the 23rd floor contains office, fresh air room, and waiting lobby. The top floor, which is the 24th floor, is the observation floor.

1.1.2 Heating and cooling designs

The heating and cooling design area is from the 1st to the 23rd floor, and the 24th floor can be equipped with split type air conditioners in individual areas that need to provide heat and cooling. The heat and cold source plant room is located on the first floor. Lithium bromide direct-fired unit, the design scheme of fan coil plus fresh air is used in the rooms below 150m2, and the other rooms above 150m2 apply the all-air system. All designs are strictly in line with the design specifications, in line with the national green environmental protection index requirements, and at the same time fully consider the economy of operation, reduce the whole equipment cycle operating costs and maintenance costs.

1.2 THE SIMULATION

1.2.1 Unit selection

The fan coil is selected from the bedroom type concealed fan coil of Midea, the unit model (FP-51wa), the cooling capacity: 2730~2205W, the maximum air volume is 510(m3/h) under the rated air volume in high wind condition, the outlet size is 585mm*180mm, so the outlet air speed is 1.36m/s.Ceiling pattern as shown in Figure 1

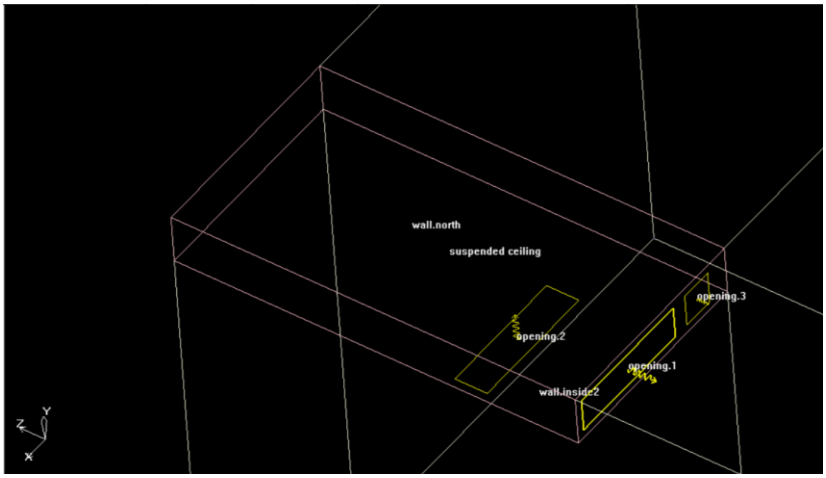

Figure 1: Ceiling pattern of a living room in the Bethe building

1.2.2 Air supply design requirements

According to the civil building heating ventilation and air conditioning design code GB50736-2012, the relative humidity of the hottest month in Wuhan is 67%, and the dew point temperature is 19~20°c due to the calculated interior design temperature of 26°c. The air supply temperature is taken as the machine dew point is taken as 20°c.

1.2.3 Physical model and basic parameters

The research object of this paper is a south-facing room in Bett Tower, with a south-facing design and a glass curtain wall and external windows in the south direction. The area of the room is 24m2 and the height is 3m, and the size of the fresh air outlet is 20cm * 20cm, so the wind speed is 0.5m/s. Wuhan's summer air conditioning outdoor calculated temperature of 35.2 ° c in the air-conditioning season, indoor ventilation using the same side of the air supply, up to return air supply mode, air supply volume of 1600 m3 / h, air supply temperature of 18 ℃, Jinan City, the outdoor dry bulb temperature of 34.8 ℃ in summer, the indoor size of the main objects, the number and boundary conditions set

The dimensions, number and boundary conditions of the main objects in the room are shown in Table 1.

Table 1:Indoor object parameters and boundary conditions.

Name		Parameter	Number	Boundary condition
1.	People	*0.4 m×0.3 m×1.75 m*	4	75W
2.	Lamps	*1.2 m×0.2 m×0.15 m*	4	40W
3.	Computers	*0.4 m×0.3 m×0.3 m*	4	160W
4.	Air supply outlet	*0.5 m×0.2 m*	2	2.3m/s
5.	Return air outlet	*0.5 m×0.2 m*	2	2.3m/s
6.	Bed	*1.5 m×0.5 m×1 m*	4	0W
7.	South facade	*1.4 m×1.6 m*	1	Constant wall temperature

2.2.4 Fresh air design requirements

1. Fresh air volume of not less than 30m3 per person per hour
2. The number of air changes per hour is not less than 1 time

1.3 THE SIMULATION

The research object of this paper is a living room in the Bett Building, the room structure and personnel composition are shown in Figure 2

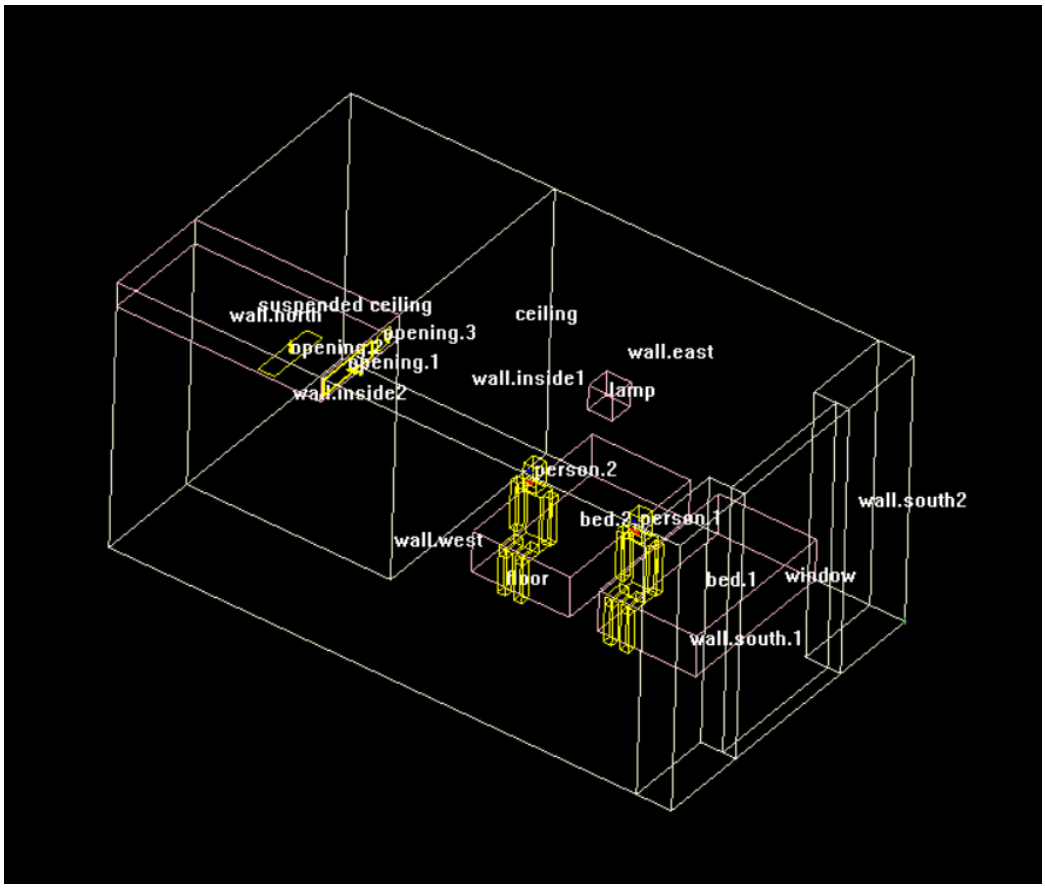

Figure 2:Spatial Structure of a living room in the Bethe building

1.3.2Analysis of the airflow field when the occupant is sitting (Z=1.3m)

From the simulation of the indoor environmental parameters at Z=1.3m in the sitting posture of thegraduate students.The wind velocity is within 0.05 m^3/s~1.55 m^3/s and the wind speed is less than 1.55 m/s.The Airflow field of a living room in the Bethe building is shown in figure 3

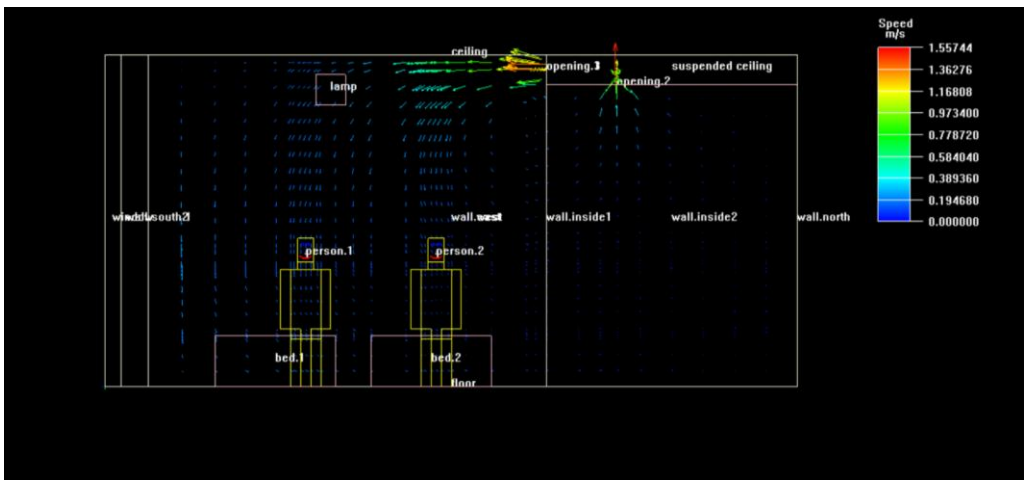

Figure 3: Airflow field of a living room in the Bethe building

1.3.2Analysis of the temperature field when the occupant is sitting (Z=1.3m)

From the simulation of the indoor environmental parameters at Z=1.3m in the sitting posture of the graduate studentsThe temperature of the respiratory zone of the four graduate students in the sitting position is in the range of 26.0℃~27.5℃.The Temperature field of a living room in the Bethe building is shown in figure 4

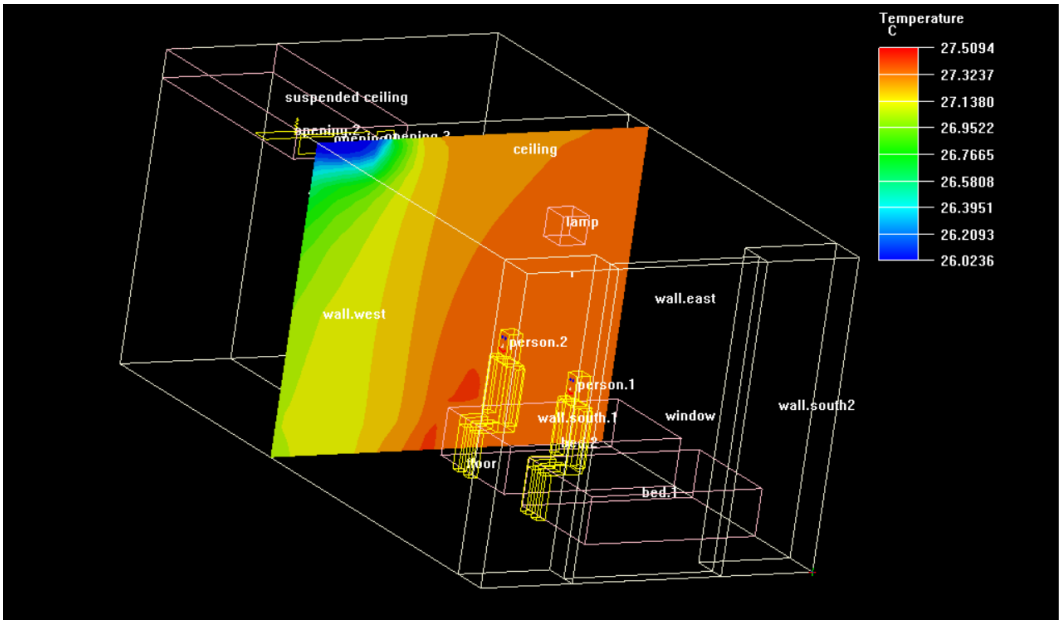

Figure 4:Temperature fieldof a living room in the Bethe building

II. CONCLUSION

(1) Under summer working conditions, the thermal comfort of the living room basically meets the requirements, providing a good habitat for the occupants to rest
environment.

(2) There are various indoor thermal comfort evaluation indexes, such as temperature, air volume, air speed, etc. Each environmental parameter plays an important role in the evaluation of indoor thermal comfort.

(3) The results of the numerical simulation of indoor thermal environment based on Airpak software have high credibility, and the simulation results are vivid and easy to understand, which provide reliable materials for comparison and analysis for the experimental researchers.

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