Airflow Pattern Genereated by Three Air Diffusers

Experimental and Visual Analysis

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Airflow pattern generated by three air diffusers: Experimental and Visual Analysis

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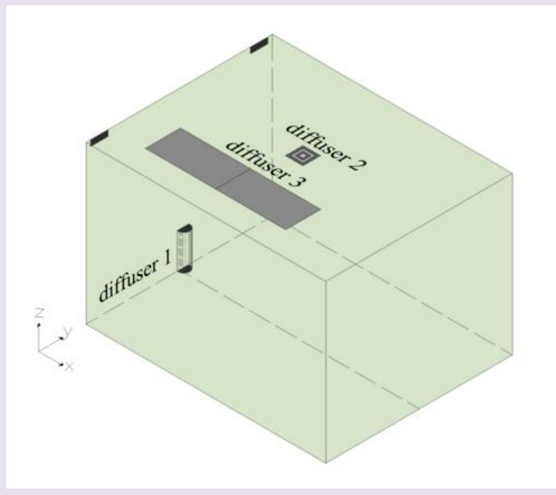
OBJECTIVE

The correct description of air diffusers plays a crucial role in the CFD predictions of the airflow pattern into a room. The numerical simulation of air distribution in an indoor space is challenging because of the complicated airflow pattern generated.
An experimental study has been carried out in a full scale test room, 4.10 m (length), 3.20 m (width), and 2.70 m (height), in order to take velocity measurements of the airflow pattern generated by three different air diffusers: displacement, mixing and a low impulse diffuser. Smoke visualization has been developed to determine the direction of the flow and observe the developed region of the jets
During the experiments the cold air is supplied at a temperature of 16ºC. The air exchange rate is set to 5.6 h^{-1}

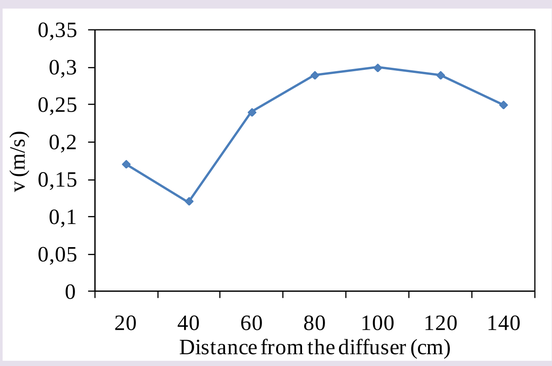


Sketch of the full-scale test room

METHODS AND RESULTS

✓ DISPLACEMENT VENTILATION

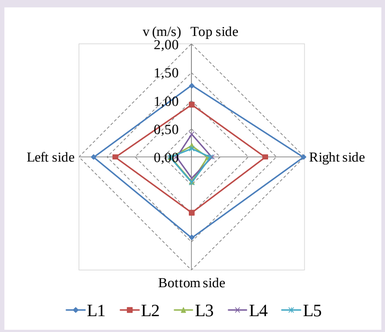
Velocity measurements are taken in order to define the velocity profile generated by the displacement diffuser at 0.01 m from the floor. Seven anemometers were placed along an horizontal line in front of the diffuser and forming a 45º angle with the symmetry axis of the room. Each anemometer is separated by 0.20 m.



Diffuser 1. (a) Smoke visualization of the stratified flow generated by the cold supply air, which is common with a wall-mounted displacement diffuser. (b) Velocity measurements along the horizontal line.

✓ MIXING VENTILATION

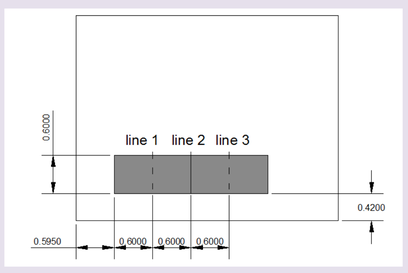
The velocity measurements are taken at five different heights 2.65 m, 2.61 m, 2.57 m, 2.53 m and 2.49 m, which corresponds to L1, L2, L3, L4 and L5 respectively. At each height four anemometers are placed at 0.03 m from each side of the diffuser.

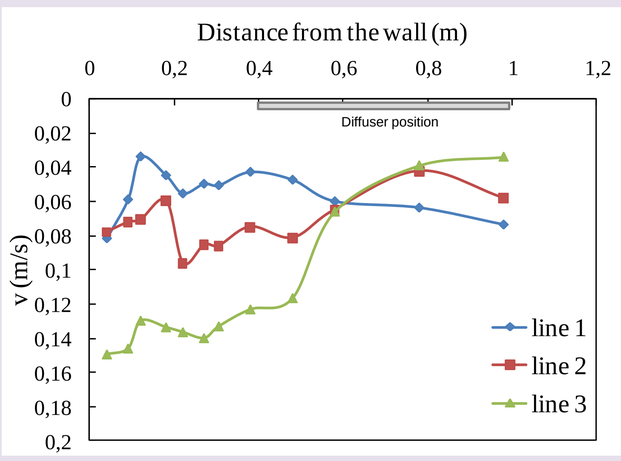


Diffuser 2. (a) Smoke visualization which shows a symmetry in the airflow generated by the diffuser. (b) Velocity measurements at lines L1, L2, L3, L4 and L5.

✓ LOW VELOCITY VENTILATION

Finally a low impulse textile diffuser was also analyzed. The velocity was measured at twelve points along three horizontal lines placed 0.50 m below the diffuser, as it is shown in the next picture.





Diffuser 3. (a) Smoke visualization of the downward airflow pattern.(b) Velocity profile of the textile diffuser at three different lines.

CONCLUSIONS

- ✓The position of the diffuser in the room has a significant influence on the airflow pattern generated. This influence is very large for the low-velocity textile diffuser where the effect of a very close wall to the diffuser has been observed, provoking a Coanda effect.
- ✓Smoke visualization is a very useful tool in order to study the airflow pattern generated by different air terminal units.
- ✓The hypothesis of quasi-symmetry can be acceptable for the mixing ventilation case which has been validated by experimental measurements and smoke visualization.

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