ICUC9 - 9th International Conference on Urban Climate jointly with 12th Symposium on the Urban Environment

Indoor comfort and air quality in spaces equipped with eco-ventilations systems

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ABSTRACT

Development of a HVAC system based in healthy eco-ventilation for seniors. This HVAC system is based on radiating surfaces (placed on floor, walls or ceiling) and vertical jets (located in the walls corners). This system guarantees high thermal comfort and air quality levels, low energy consumption and low Draught Risks levels. In the radiant surfaces the solar radiation in winter and the geothermal energy in summer conditions are used.

NUMERICAL SIMULATION

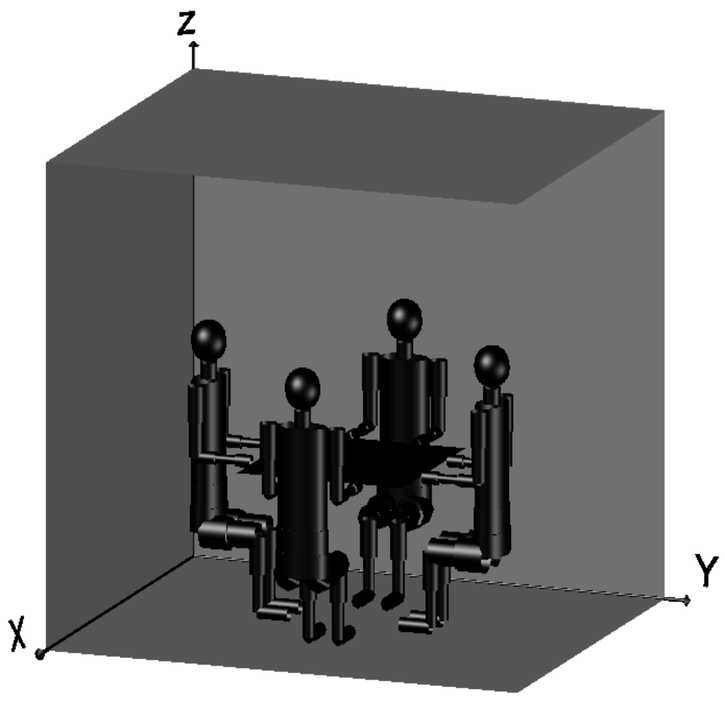
One virtual space, four virtual seniors manikins and seats, four vertical ducts and one virtual desk are used. A coupling of the Human Thermo-physiology (HT) and a Computational Fluid Dynamics (CFD) numerical models, are used. The thermal comfort level in non-uniform environments is evaluated by the HT, while the air quality level, the local thermal discomfort level and the airflow around the occupants are evaluated by the CFD.

CONCLUSIONS

This HVAC system guarantees an uniform distribution of air velocity around the occupants. The air temperature is higher around the occupant' body. The thermal comfort in spring/autumn conditions is acceptable for lower inlet air velocity. The carbon dioxide concentration moves towards the ceiling, where the exhaust is located. In future work, the radiating surfaces (placed on walls) will be combined with the vertical jets.

METHODOLOGY

In this study the air quality, the thermal comfort and the local thermal discomfort levels, that 4 seated seniors are subjected in a space equipped with radiant surface and vertical jets systems, are evaluated.



HTC CFD

Fig. 1 – Grid generation used in Human Thermo-Physiology (HTC) and Computational Fluid Dynamics (CFD) models.

VIRTUAL SPACE

- One virtual space equipped with radiant surfaces and vertical jets system;
- four virtual seniors manikins with summer and winter clothing;
- four virtual seats and one desk;
- four virtual vertical ducts located in the wall corners.

Human Thermo-Physiology

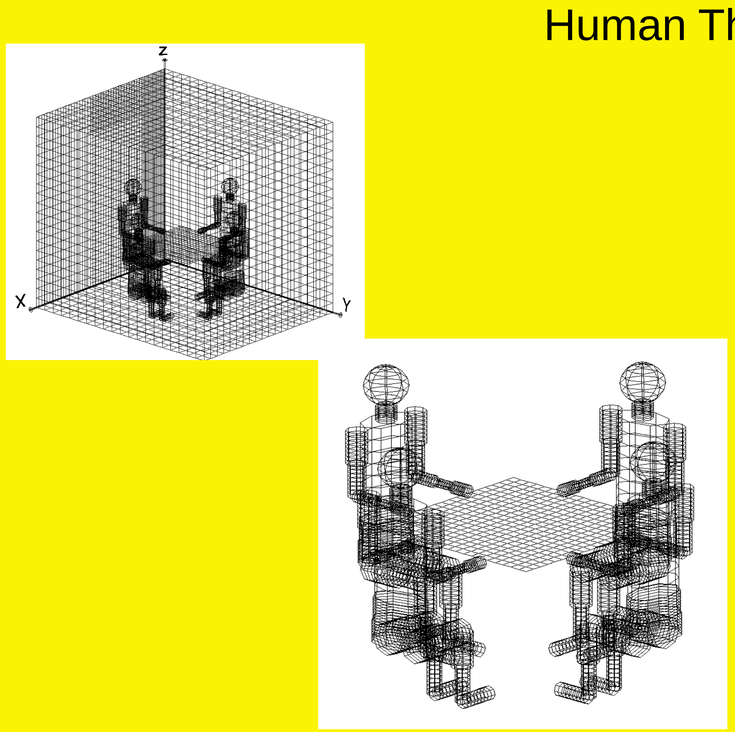


Fig. 2 - Grid generation used in the Human Thermo-Physiology numerical model.

Computational Fluid Dynamics

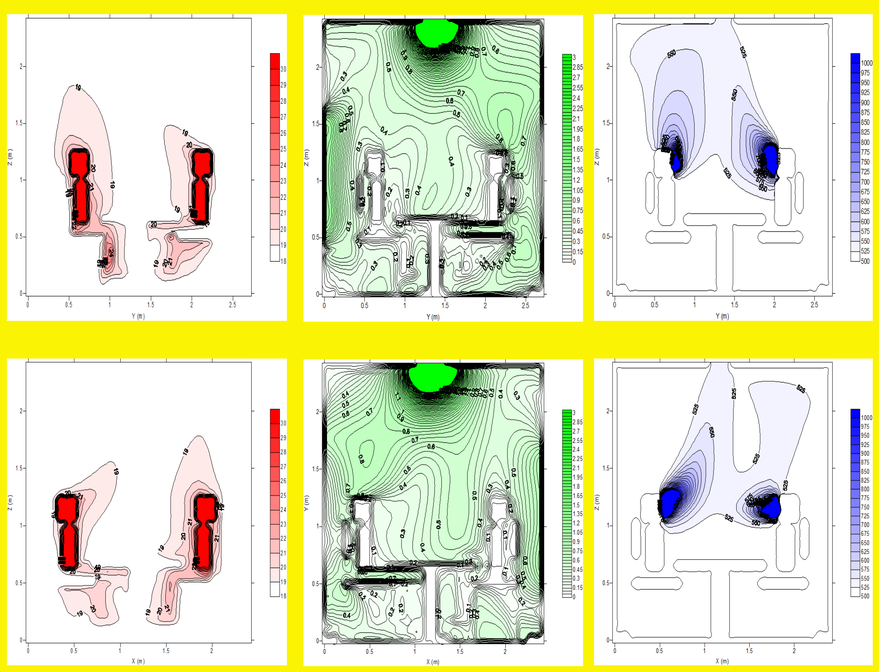


Fig. 3 – Representation of air temperature, air velocity and carbon dioxide concentration around the ocuppants.

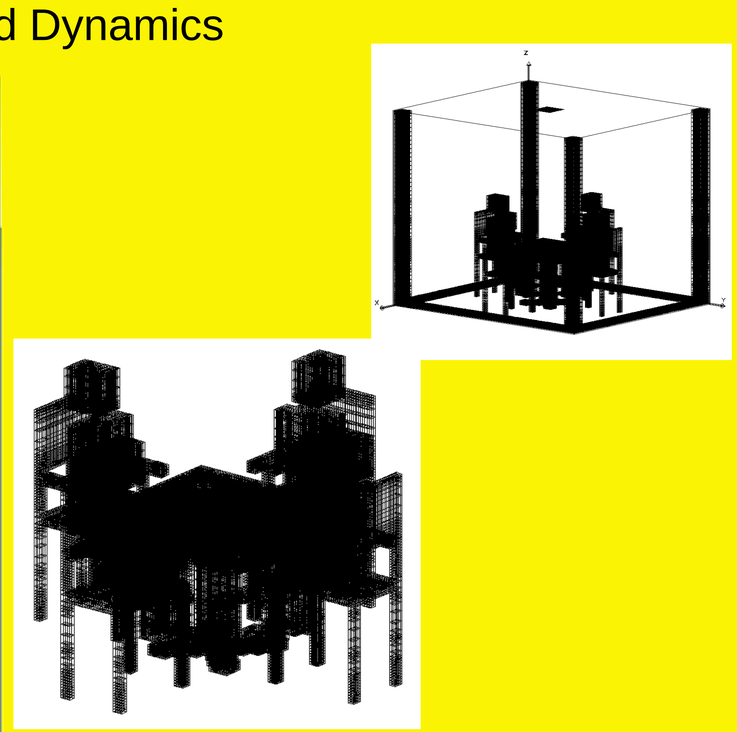


Fig. 4 - Grid generation used in the Computational Fluid Dynamics numerical model.