CFD Manikin
Benchmark Test - Mixing Ventilation

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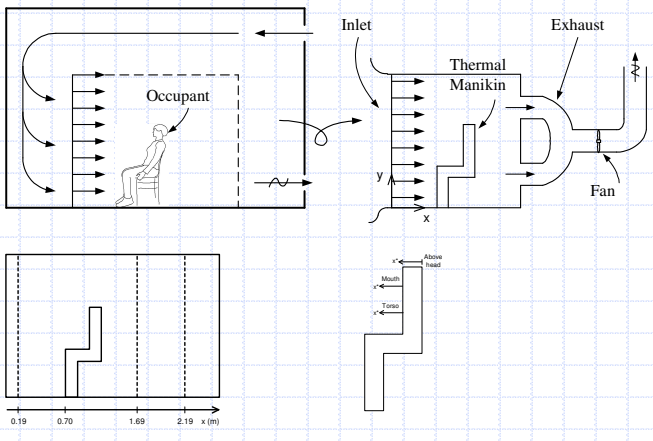
Workshop on CFD Manikins
ROOMVENT 2004, Coimbra, Portugal

Experimental setup
Mixing Ventilation



Test Conditions

CFD code

- Software: Fluent 6
- Turbulence model: Low-Re k-ε model
- Algorithm: SIMPLE
- Scheme: First order upwind

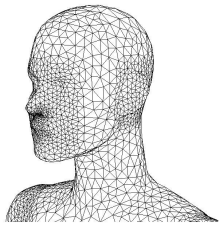
Computer Simulated Person

- Heat flux: 38 W, convection
- No breathing
- Seated height: 1.38 m
- Surface area: 1.52 m^2

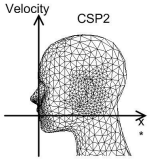
Grid

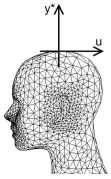
- CSP surface grid: 10,000 triangular elements
- Room grid: 292,421 tetrahedral cells
- Non-dimensional wall distance, y^+, to the centre of the first cell was below one across most of the surfaces

CFD manikin (CSP)



- Corresponds to manikin used in measurements
- CSP surface grid: 10,000 triangular elements
- Seated height: 1.38 m
- Surface area: 1.52 m^2



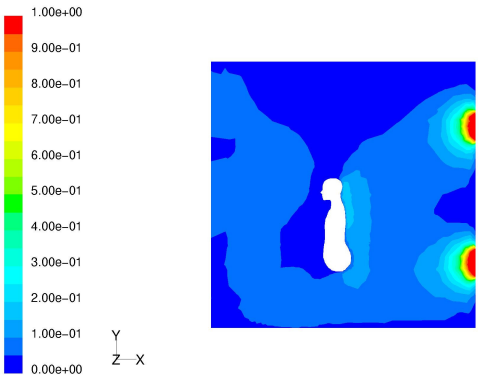


Boundary conditions

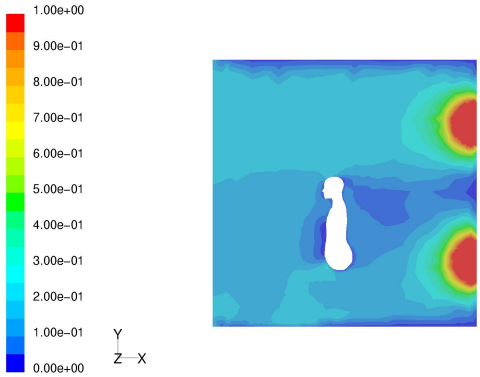
	U_o (m/s)	T_o (°C)	K_o (m^2/s^2)	ε_o (J/kgs)
Case 1	0.05	22	6.0E-04	4.8E-06
Case 2	0.20	22	9.6E-03	3.1E-04
Case 3	0.50	22	6.0E-02	4.8E-03

Floor: Surface concentration c_s of 200 g/m^3 with a density of ρ = 1.2 kg/m^3 (different from benchmark case!)

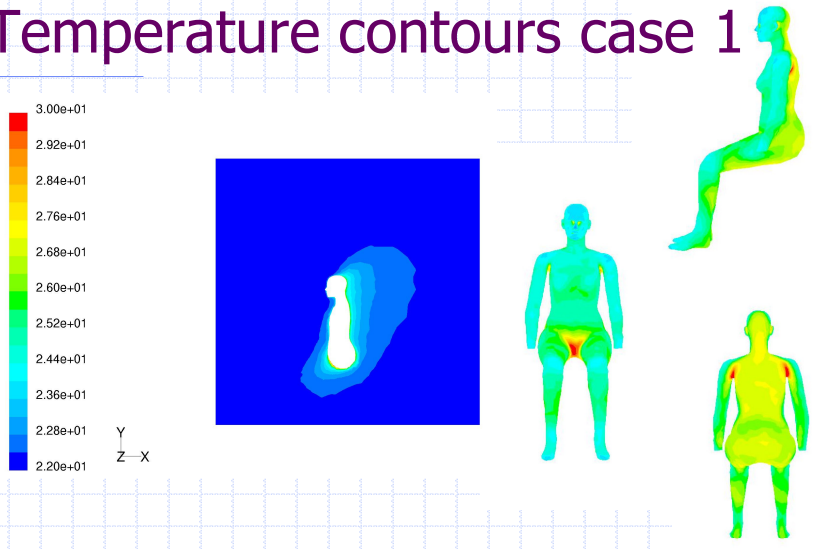
Velocity contours case 1



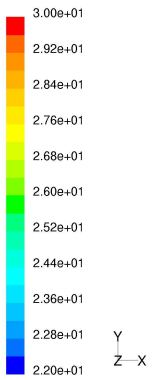
Velocity contours case 2

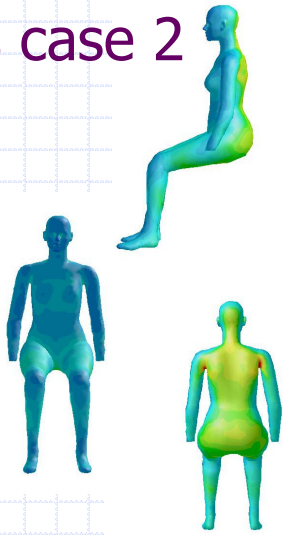


Temperature contours case 1

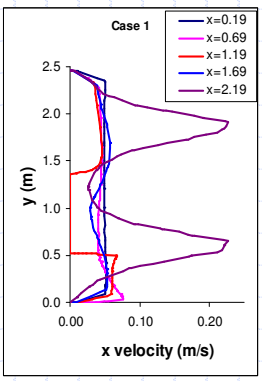


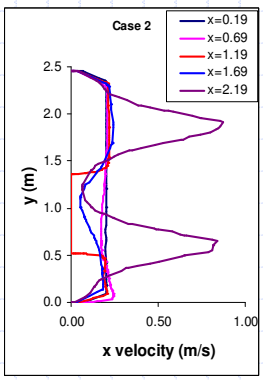
Temperature contours case 2

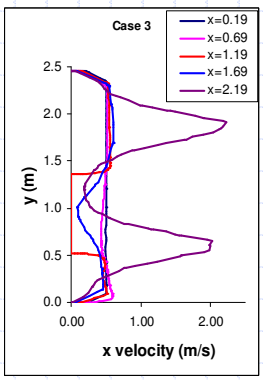




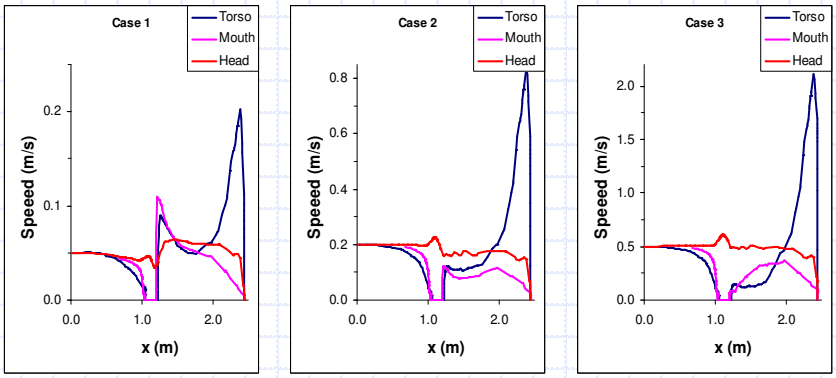
Vertical velocity profiles



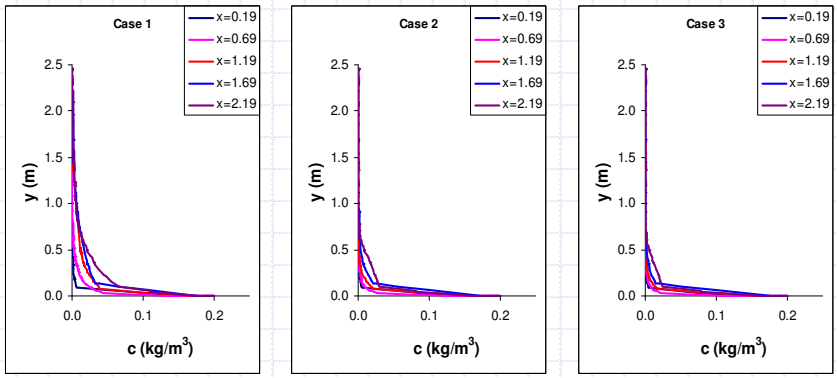




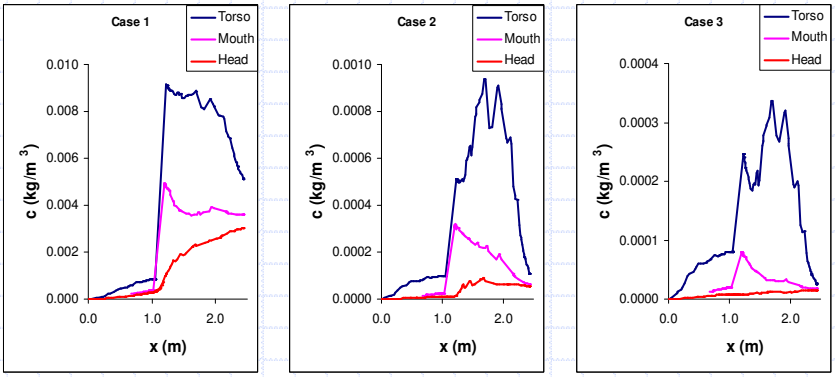
Horizontal velocity profiles



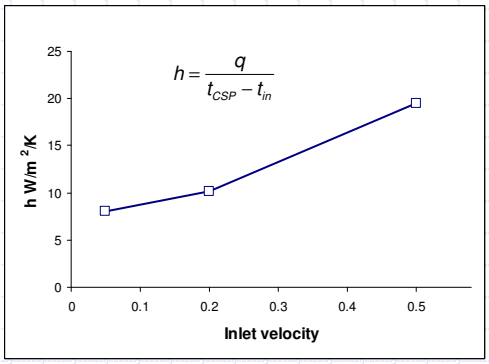
Concentration gradients



Concentration profiles



Convective heat transfer coefficient



h = convective heat transfer coefficient (W/m²K)
q = heat flux (W/m²)
t_{CSP} = surface temperature of CSP (°C)
t_{in} = inlet temperature (°C)

Papers

Topp, C., Hesselholt, P., Trier. M. R. and Nielsen, P. V.
Influence of Geometry of Thermal Manikins on Concentration Distribution and Personal Exposure
Proceedings of Healthy Buildings 2003, Singapore, 2003.

Topp, C., Hesselholt, P., Trier. M. R. and Nielsen, P. V.
Influence of Geometry of Thermal Manikins on Room Airflow
Proceedings of Healthy Buildings 2003, Singapore, 2003.

Topp, C.
Influence of Geometry of a Computer Simulated Person on Contaminant Distribution and Personal Exposure
Proceedings of ROOMVENT 2002, Copenhagen Denmark, 2002.

Topp, C., Nielsen, Peter V. and Sørensen, D. N.
Application of Computer Simulated Persons in Indoor Environmental Modeling
ASHRAE Transactions, Vol. 108 (2), p. 1084-1089, 2002.