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Date : 4/2/2000

PART 1 – CONTROLLED TEST SETUP

Test case : **Steckler Room Fire – volumetric heat – 2000/2/1**
Document Version 1.0

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Case: **Steckler Room Fire – volumetric heat – 2000/2/1**

User details	
Run by: Date: Phone no: email:	Address:

Fire modelling Software

SMARTFIRE	CFX	PHOENICS			

Version/build number____________
Date of release__________________

Operating System

Windows 95/98/2000	Windows NT	Unix	Dos	

Version/build number______________________

Machine

PC	Unix Workstation	

CPU:
Memory:

Case description

The experimental data obtained from Steckler's fire tests* which have been used as part of the validation process for both zone and field fire models. The data represents non-spreading fires in small compartments. The non-spreading fire was created using a centrally located (position A in Figure 1) 62.9kW methane burner with a diameter of 0.3m and a height of 0.3m. The experiments were conducted by Steckler et al. in a compartment measuring 2.8m $\times$ 2.8m in plane and 2.18m in height (see Figure 1) with a doorway centrally located in one of the walls measuring 0.74m wide by 1.83m high. The walls and ceiling were 0.1m thick and they were covered with a ceramic fibre insulation board to establish near steady state conditions within 30 minutes.

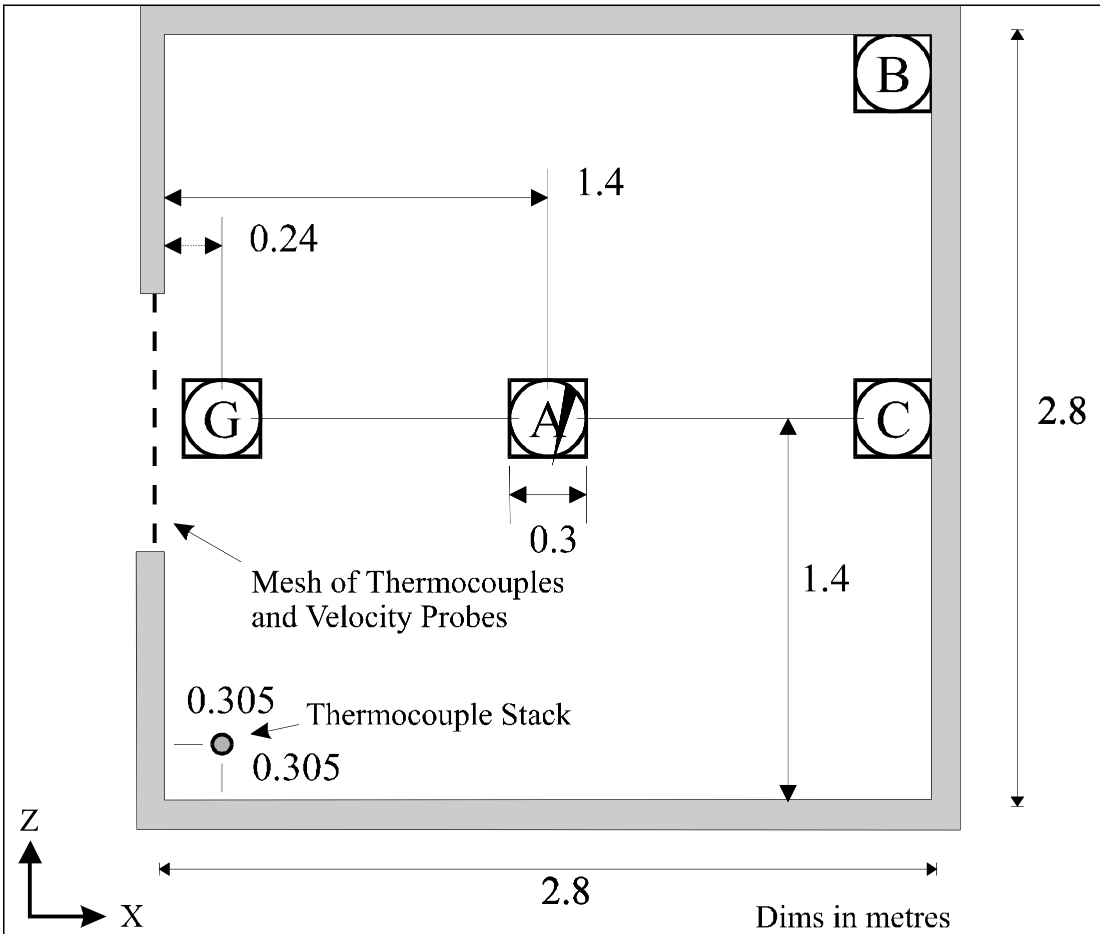


Figure 1 – Configuration of Steckler room

The door measures 0.74m wide and 1.83m high and is centrally located in one of the walls.

*Steckler, K.D, Quintiere, J.G and Rinkinen, W.J.[1982], "Flow induced by fire in a compartment", NBSIR 82-2520, National Bureau of Standards.

Required Results

The results should be supplied as graphs and as Excel97 worksheets

Vertical Corner Stack temperatures at 0.305 from the front and side walls.

Vertical Doorway temperature profile in the middle of the doorway.

Horizontal velocity profile for a vertical stack in the middle of the doorway.

These should all be plotted with height of the variable on the y-axis and the variable value (temperature or horizontal velocity) on the x-axis.

CFD set up

1D	2D	3D

Transient	Steady State

The case needs to be run for 200s using 1s timesteps. This effectively gives a steady state result.

Differencing Schemes

Temporal:

Fully Implicit	Crank-Nicolson	Explicit	Exponential	

Spatial:

Hybrid	Central Difference	Upwind		

Notes:

Physical Models

Radiation Model *(if not listed please specify in the space provided)*

None	Six flux	Discrete Transfer	Monte Carlo	Radiosity	

Notes:

(1) If the fire modelling software does not possess the six-flux model, a discrete transfer model may be used in place of the six-flux model. If the discrete transfer model must be used instead of a six flux model then the discrete model must be made to emulate the behaviour of the six-flux model. This can be achieved by using 6 rays in the co-ordinate directions. If a radiation mesh needs to be specified, this should be identical to the flow mesh. If this is not possible, then at least the same number of cells in each direction must be specified. The details of the mesh must also be provided with your results.

Parameters

The absorption coefficient (a) assumed the following form: a = 0.315 It is assumed there is no scattering so s = 0.0.

Turbulence model *(if not listed please specify in the space provided)*

Laminar	k- ε	buoyancy modified k-ε	RNG	

Notes:

Turbulence Parameters*:

C_μ	σ_k	σ_ε	$C_{1\varepsilon}$	$C_{2\varepsilon}$	C_3
0.09	1.0	1.3	1.44	1.92	1.0

*If different parameters are being used please specify in the table above.

Combustion Model *(if not listed please specify in the space provided)*

none	Volumetric heat source	Mixed is burnt	Eddy break up
Magnussen soot model			

Combustion Parameters:

The volumetric heat source is assumed to be centrally located within the room with dimension of 0.3m x 0.3m x 0.3m with a total heat source of 62.9kW.

Compressibility

Incompressible	Boussinesq	Weakly compressible	Fully compressible

Compressibility Parameters:

External Pressure 1.01325e+05 Pa

Buoyancy

Yes	No

Gravity	-9.81m/s in the v-velocity direction.

Material Properties

Material Name	Air
Density	Determined by compressibility (Ideal Gas Law) Molecular Weight of air is 29.35
Viscosity (dynamic)	Laminar 1.798e-005 kg/m.s
Conductivity	0.02622 W/m.K
Specific heat capacity	1007.0 J/kg.K

Initial Values

U-VELOCITY	0.0
V-VELOCITY	0.0
W-VELOCITY	0.0
PRESSURE	0.0

TEMPERATURE	293.75
KINETIC ENERGY	0.01
DISSIPATION RATE	0.01

Boundary conditions

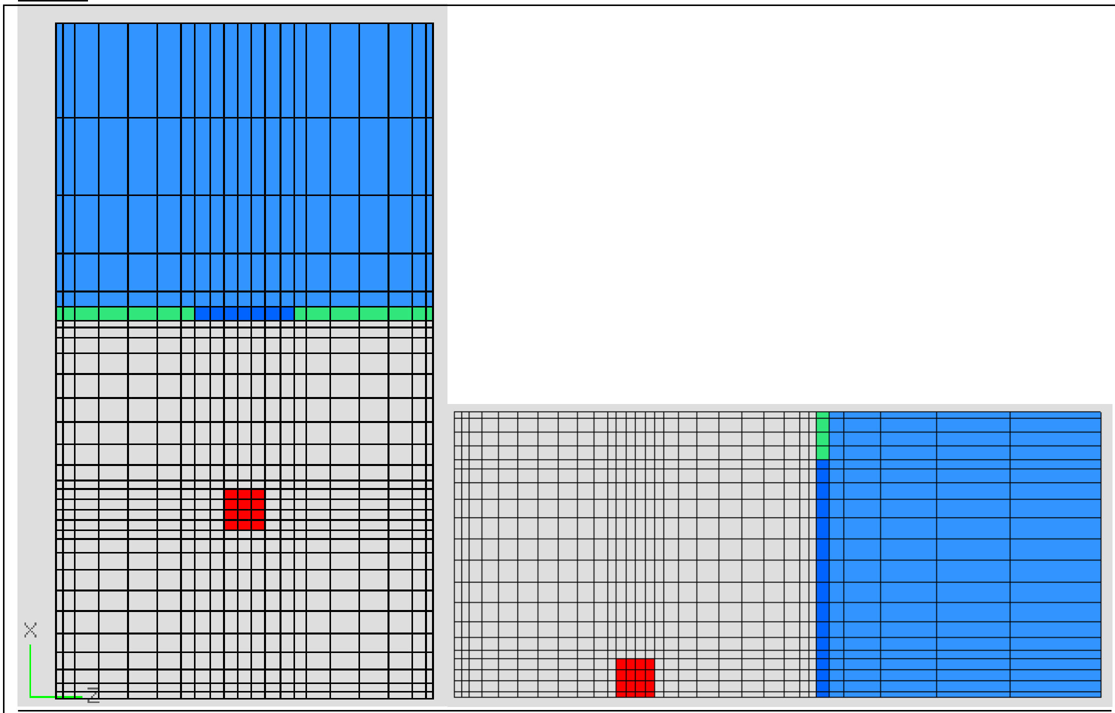
All walls are assumed to be adiabatic for the first phase of the validation process. In the first phase of validation the walls are perfect reflectors of radiation, i.e. the emissivity of the walls is 0.

The doorway measures 0.74m wide and 1.83m high and is centrally located in one of the walls. This doorway is modelled using three solid non conducting obstructions to create the walls around the doorway. An extended region for this doorway is required to ensure that the airflow in the door is correctly modelled.

On the extended region all the boundary patches are fixed pressure (outlet) boundaries set to 0.0 Pa apart from the floor which is adiabatic.

The fire is modelled as a volumetric heat source which is assumed to be centrally located within the room on the floor with dimensions of 0.3m x 0.3m x 0.3m with a total heat source of 62.9kW.

Mesh



31 20 21

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X
0.0 0.056 0.1157 0.2137 0.3407 0.4872 0.6438 0.8011 0.9498
1.0805 1.1837 1.25 1.325 1.4 1.475 1.55 1.6163 1.7303
1.8787 2.0481 2.2252 2.3966 2.5491 2.6694 2.744 2.8 2.9
3.0115 3.2949 3.7272 4.2979 5.0
Y
0.0 0.044 0.1293 0.2147 0.3 0.3638 0.4612 0.5858 0.7308
0.8896 1.0555 1.222 1.3824 1.53 1.6582 1.7605 1.83 1.9387
2.0473 2.156 2.2
Z
0.0 0.056 0.142 0.3151 0.5328 0.7527 0.9326 1.03 1.14 1.25
1.35 1.45 1.55 1.66 1.77 1.856 2.0291 2.2468 2.4667 2.6466
2.744 2.8
```

Model Definition files

Convergence

Please specify your convergence criteria including type of error estimator and tolerance value for each variable

Runtime

Results files/Archiving:

Document cross-reference:

User Guides, etc

Comments