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PART 1 – CONTROLLED TEST SETUP

Test case : **Radiation in 3 dimensional cavity 2000/1/5**
Document Version 1.1

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Case: **Radiation in 3 dimensional cavity 2000/1/5**

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

Fire modelling Software *(if not listed please specify in the space provided)*

SMARTFIRE	CFX	PHOENICS			

Version/build number_____
Date of release_____

Operating System *(if not listed please specify in the space provided)*

Windows 95/98/2000	Windows NT	Unix	Dos	

Version/build number_____

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

PC	Unix Workstation	

CPU:
Memory:

Case description

This test case tests the fire modelling software's radiation model. The cavity is a unit cube (1m x 1m x 1m) with three walls with planes x=1, y=0 and z =0 set to an unit emissive power and the three other walls set to zero emissive power. All the walls are considered radiatively black have unit emissivity and the fluid has a unit absorption coefficient. Scattering is neglected. No fluid flow is considered

Required Results

The results should be supplied as graphs and as Excel97 worksheets

The results will be compared with analytically derived results[1,2] and between the codes.

The emissive power variation with x must be provided for the following locations
y= 0.1, 0.3, 0.5, 0.7, 0.9 on the planes z = 0.5, 0.9.

1) Larsen, M. E., "Exchange Factor Method and Alternative Zonal Formulation for Analysis of radiating enclosures containing paticipating media", PhD thesis, University of Texas, Austin, 1983.

2) Fiveland, W. A., "Three dimensional Radiative Heat-Transfer Solutions by Discrete-Ordinate Method", Journal of Thermophysics, Vol. 2, No. 4, October 1988, pp 309-316.

CFD set up

1D	2D	3D

Transient	Steady State

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

a = 1.0

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:

Compressibility

Incompressible	Boussinesq	Weakly compressible	Fully compressible

Compressibility Parameters:

External Pressure 1.01325e+05

Buoyancy

Yes	No

Gravity	

Material Properties

Material Name	Optical Fluid
Density	N/a
Viscosity	N/a
Conductivity	1E-100
Specific heat capacity	0.1

Initial Values

TEMPERATURE	0K

Boundary conditions

All the walls have an emissivity of 1.0

The walls at x=1, y = 0 and z = 0 have a temperature of 64.8052186K, all the other walls have a temperature of 0K.

Mesh

11 11 11
A uniformly meshed cube.
X, Y and Z
0.000000 0.090909 0.181818 0.272727 0.363636 0.454545 0.545455 0.636364 0.727273 0.818182 0.909091 1.000000

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