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PART 1 – CONTROLLED TEST SETUP

Test case : **Two-dimensional turbulent flow over a backward facing step - 2000/1/1**

Document Version 1.0

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Case: **Two-dimensional turbulent flow over a backward facing step - 2000/1/1**

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

This test examines the CFD fire modelling software's turbulence model. The flow is incompressible, fully turbulent and isothermal. The fluid has a density of 1.0 kg/m^3 and a laminar viscosity of 1.101E-5 kg/ms. The geometry of the case is illustrated in Figure 1. The upper and lower surfaces are walls and there is a solid obstruction below the inlet. The fluid enters the chamber at 13.0 m/s.

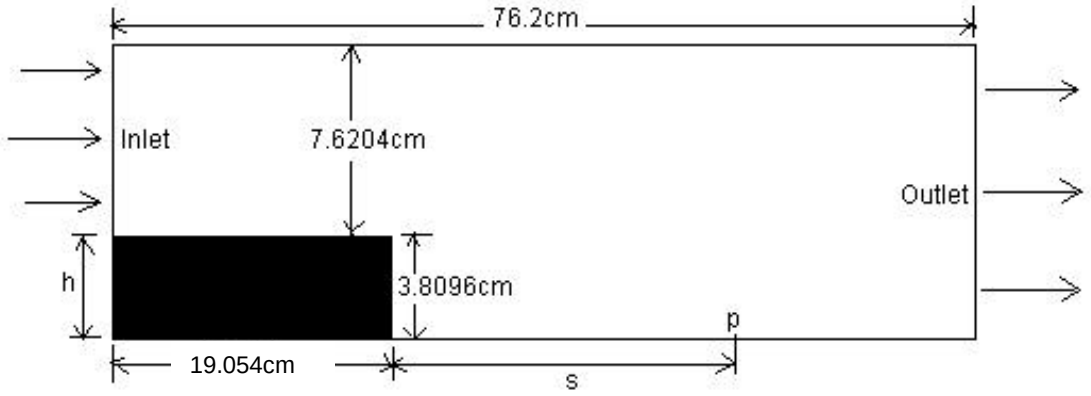


Figure 1 - Backward facing step configuration

Required Results

The results should be supplied as graphs and as Excel97 worksheets

This case will be compared to experimental results[1,2] and across the codes

The reattachment point is the downstream location in the x direction where there is no longer any flow re-circulation due to the backward facing step.

In **Error! Reference source not found.** the reattachment point is denoted by P and the distance from the step to point P is s. The ratio of s to the height of the step needs to be provided.

Graphs

A u-velocity component profile should be provided at the outlet (the last cell centre value) and also 0.285m downstream from the inlet.

A velocity vector field plot must be provided**.**

1) J. Kim, S. J. Kline and J. P. Johnston, "Investigation of a Reattachment Turbulent Shear Layer: Flow over a Backward-Facing Step", Transactions of the ASME, Journal of Fluids Engineering, 102, 302-308, 1980.

2) J. K. Eaton and J. P. Johnston, `A Review of Research on Subsonic Turbulent Flow Reattachment', AIAA, Paper AIAA-80-1438, 1980.

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:

Parameters

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	0.0 m/s

Material Properties

Material Name	Air
Density	1 kg/m^3
Viscosity	1.101E-5 kg/ms
Conductivity	0.0
Specific heat capacity	0.0

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

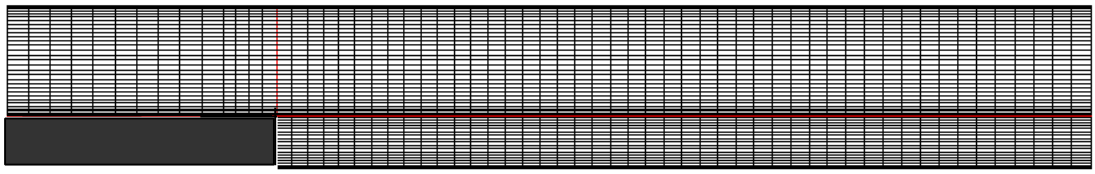
Inlet
Velocity: 13.0 m/s,
Kinetic energy: 0.7605 m^2/s^2,
Dissipation rate: 31.78 m^2/s^3.

Outlet
Pressure 0.0 Pa

Stationary Walls

Turbulent wall functions

Mesh



60 50 1

X
0.0 0.01524 0.03048 0.04572 0.06096 0.0762 0.09144 0.10668
0.12192 0.13716 0.1524 0.160645 0.170073 0.180007 0.19054
0.200822 0.211576 0.222511 0.233604 0.244837 0.256195
0.267668 0.279246 0.290921 0.302686 0.314536 0.326464
0.338468 0.350543 0.362684 0.37489 0.387157 0.399483
0.411865 0.424301 0.436788 0.449326 0.461912 0.474545
0.487223 0.499945 0.51271 0.525515 0.538361 0.551246
0.564168 0.577128 0.590123 0.603154 0.61622 0.629318
0.64245 0.655613 0.668808 0.682034 0.69529 0.708575
0.721889 0.735232 0.748602 0.762
Y
0.0 0.000955 0.002351 0.003982 0.005789 0.007737 0.009806
0.011982 0.014253 0.016612 0.01905 0.021488 0.023847
0.026118 0.028294 0.030363 0.032311 0.034118 0.035749
0.037145 0.0381 0.03896 0.040369 0.042103 0.044088 0.046284
0.048664 0.051208 0.053902 0.056735 0.059697 0.06278
0.065977 0.069283 0.072692 0.0762 0.079708 0.083117
0.086423 0.08962 0.092703 0.095665 0.098498 0.101192
0.103736 0.106116 0.108312 0.110297 0.112031 0.11344 0.1143
Z
0.0 1.0

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