3rd Workshop on CFD Uncertainty Analysis

Lisbon, 23rd and 24th of October 2008
Instituto Superior Técnico
Lisbon

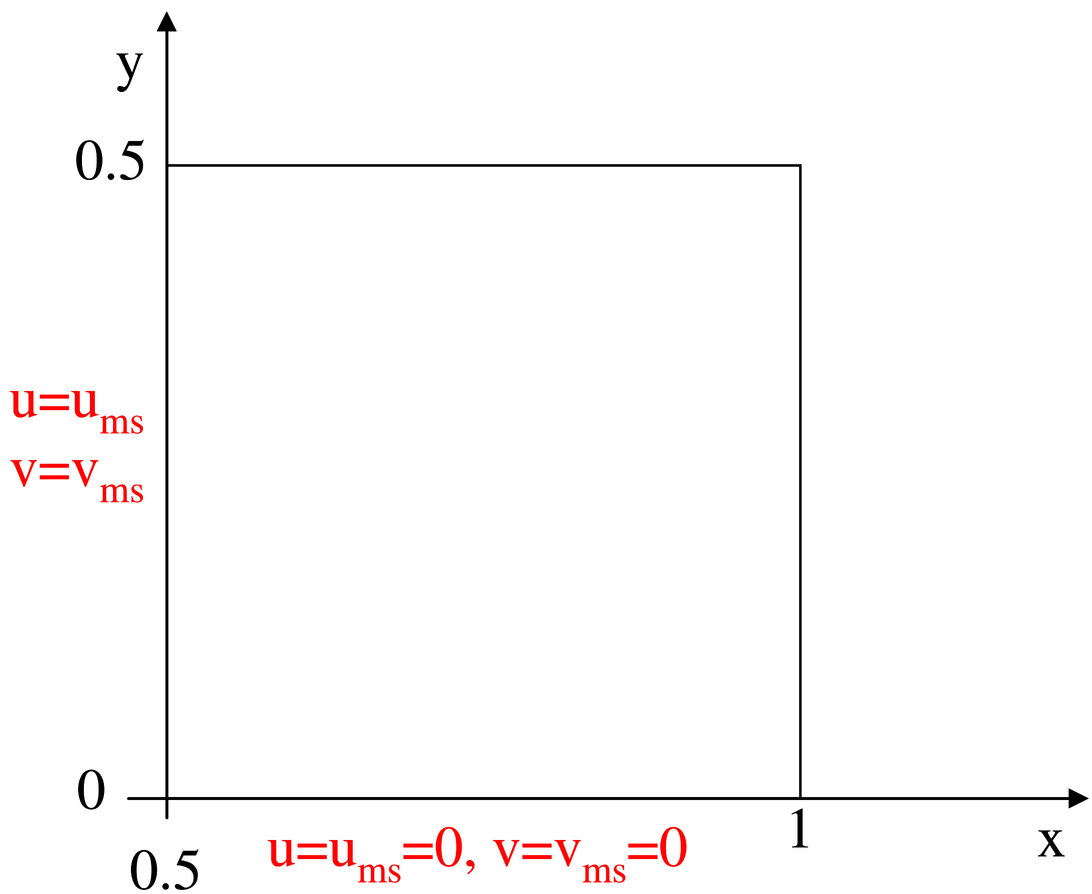
Test Case 1: Manufactured solution

Using upper case symbols for dimensional quantities, and lower case symbols for dimensionless quantities, we have:

$x=X/L$, $y=Y/L$, $u=U/U_{ref}$, $v=V/U_{ref}$, $p=P/(\rho U_{ref}^2)$

where L is the reference length, U_{ref} the reference velocity, while the Reynolds number is set to 10^6 (i.e. $\nu=10^{-6}\, U_{ref}L$).

Computational domain for the calculation: $0.5 \le x \le 1$, $0 \le y \le 0.5$



Manufactured Flow Variables:

$$\eta = \frac{\sigma y}{x}$$

$$u = \mathrm{erf}(\eta)$$

$$v = \frac{1}{\sigma\sqrt{\pi}}\left(1 - e^{-\eta^2}\right)$$

$$p = \frac{P}{\rho (U_1)^2} = 0.5\ln\left(2x - x^2 + 0.25\right)\ln\left(4y^3 - 3y^2 + 1.25\right)$$

$$\sigma = 4$$

Manufactured eddy-viscosity and turbulence quantities fields available for the following turbulence models:

1. Spalart & Allmaras one-equation model. (Recommended)
2. BSL k-ω model. (Recommended)
3. Menter one-equation model.
4. Standard k-ε model.
5. Chien's k-ε model.
6. TNT k-ω model.

Boundary Conditions:

- Mandatory boundary conditions are in red.
- Remaining boundary conditions can be selected conveniently, but must be reported.

Requested Information:

- Demonstration of the order of accuracy of the method by grid refinement studies.
- u, v, p and ν_t at three selected locations.
- Friction resistance coefficient of the bottom boundary.

Numerical uncertainties required for all the requested flow quantities.

Fortran90 functions, including the complete Manufactured Solution and the source functions required for the solution of the momentum equations and of the turbulence quantities transport equations, are available by request to eca@marine.ist.utl.pt

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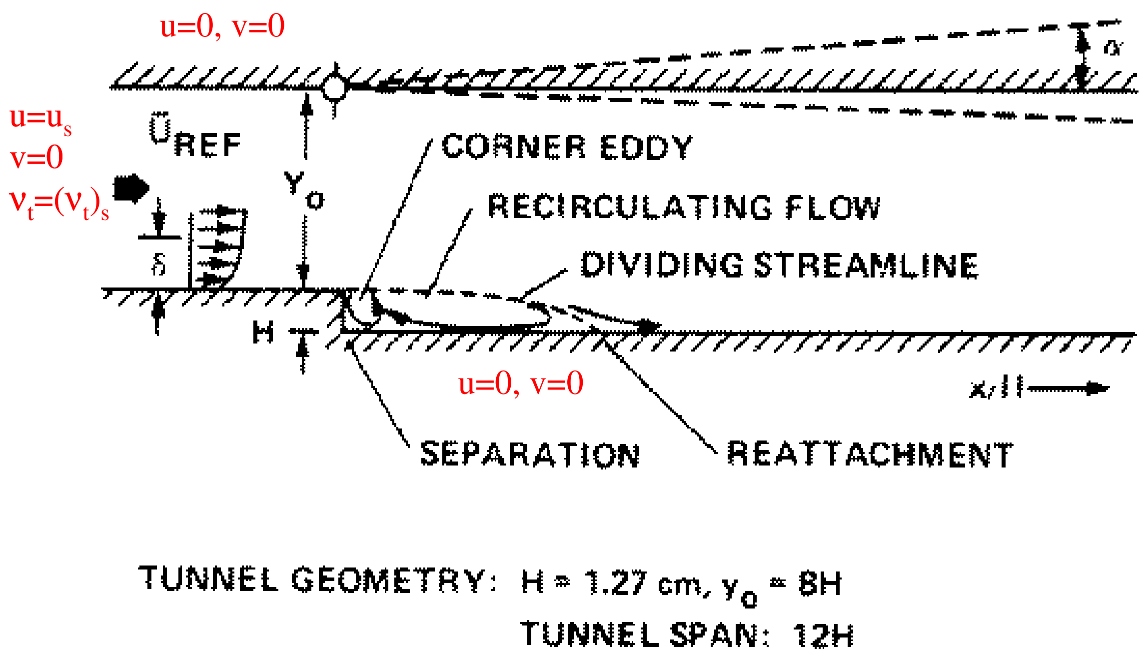
Test Case 2: Backward Facing Step, Ercoftac Classic Database C-30



Reference length : H=1.27cm (H is the step height)

Reference velocity : U_{ref}=44.2m/s

Reynolds number : 50000 ($Rn=U_{ref}L/\nu$)

Cartesian reference coordinate system of the flow over a backward facing step:

- Origin of the coordinate system at the low corner of the step.
- Inlet boundary located at x=-4 (X=-4H)
- Outlet boundary located at x=40 (X=40H)
- Top boundary located at y=9 (Y=9H)

The choice of the grids is free.

Inlet profiles are available for the longitudinal velocity component and for turbulence quantities for the following turbulence models:

1. Spalart & Allmaras one-equation model. (Recommended)
2. BSL k-ω model. (Recommended)
3. Menter one-equation model.
4. Standard k-ε model.
5. Chien's k-ε model.
6. TNT k-ω model.

Boundary Conditions:

- Mandatory boundary conditions are in red.
- Remaining boundary conditions can be selected conveniently, but must be reported.

Requested Information:

- u, v, C_p and ν_t at (x=0,y=1.1), (x=1,y=0.1) and (x=4,y=0.1)
- Location of re-attachment point.
- Friction resistance coefficient of the top and bottom walls.
- Pressure resistance coefficient of the bottom wall.

Numerical uncertainties required for all the requested flow quantities.

$Cp=(p-p_{outlet})/(½\rho U^2)$

Fortran90 functions with the inlet profiles are available by request to eca@marine.ist.utl.pt