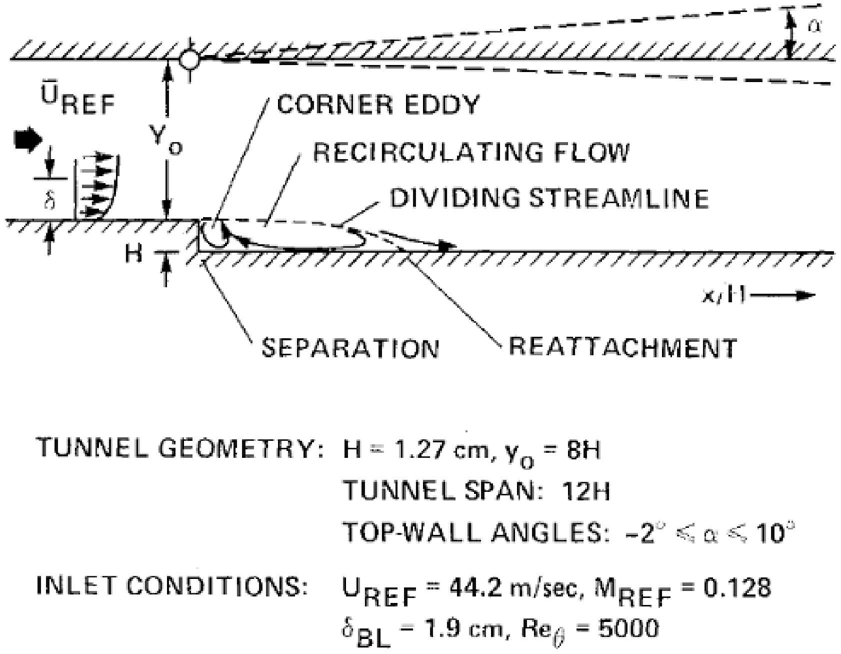
# Problem definition

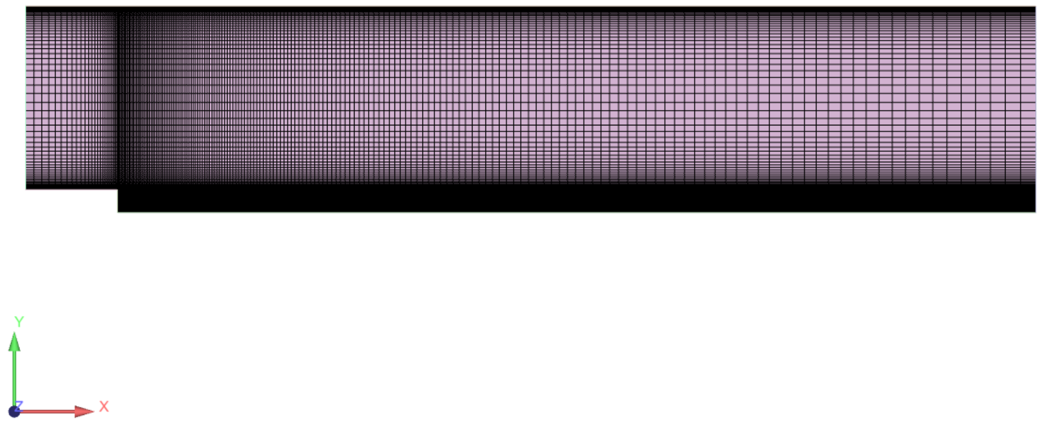
## Turbulent flow past a backward facing step




- This is a classical validation case in turbulence modeling.
- There is plenty of experimental and numerical data available.
- **A few references:**
  - https://turbmodels.larc.nasa.gov/backstep_val.html
  - http://cfd.mace.manchester.ac.uk/ercoftac/doku.php?id=cases:case030&s[]=driver&s[]=seegmiller
  - D. Driver, H. Seegmiller. Features of Reattaching Turbulent Shear Layer in Divergent Channel Flow. AIAA Journal, Vol. 23, No. 2, Feb 1985, pp. 163-171.

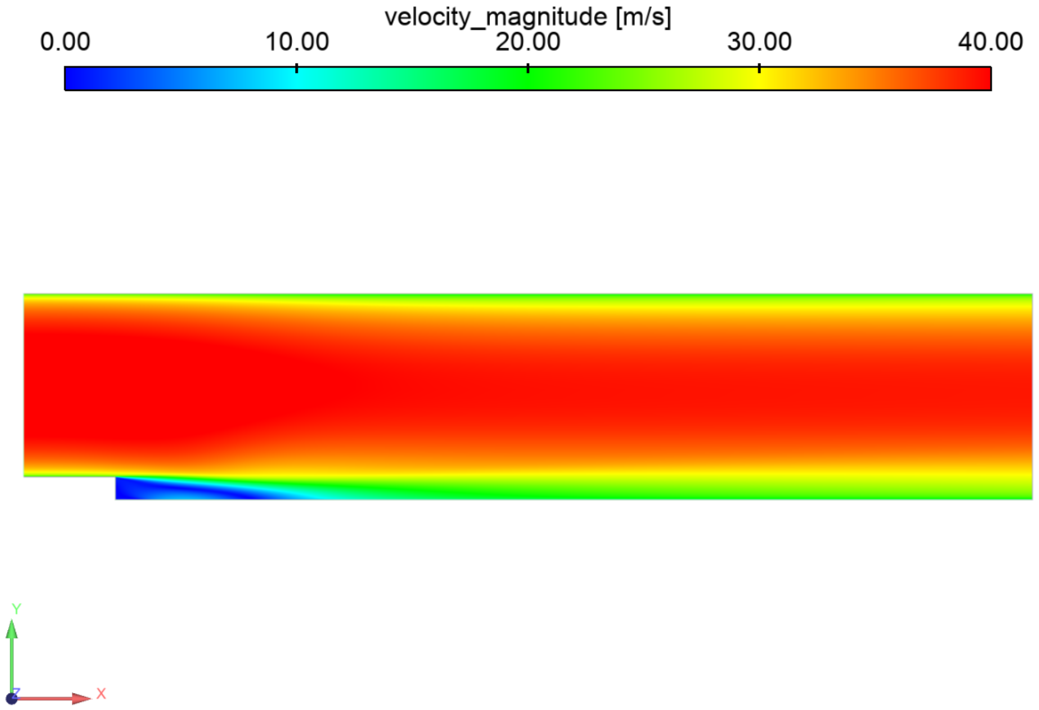
# Problem definition

## Geometry and mesh


- The mesh illustrated is a structured one – Fine mesh.
- This case can be used to test the accuracy of different turbulence models using different meshes and wall modeling approaches.

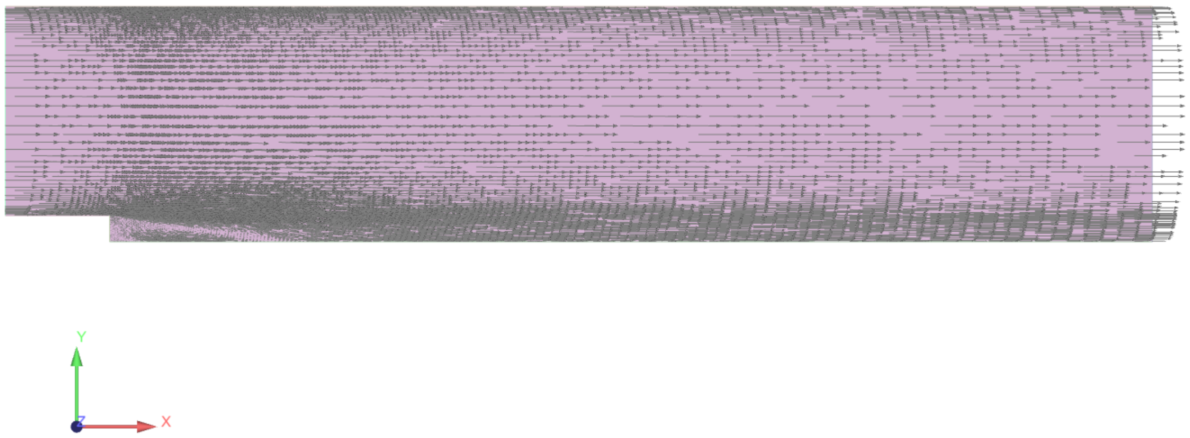
# Qualitative and quantitative results



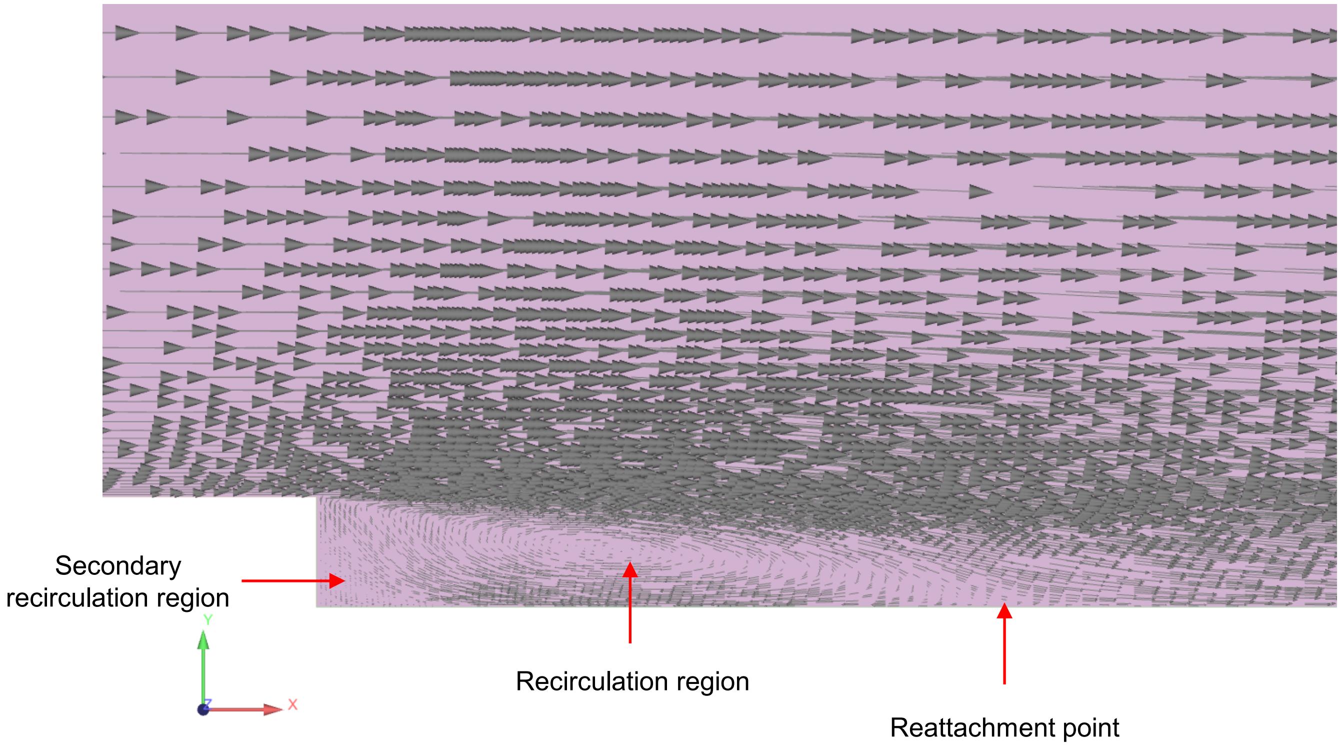

Velocity magnitude contours


Surface streamlines

# Qualitative and quantitative results

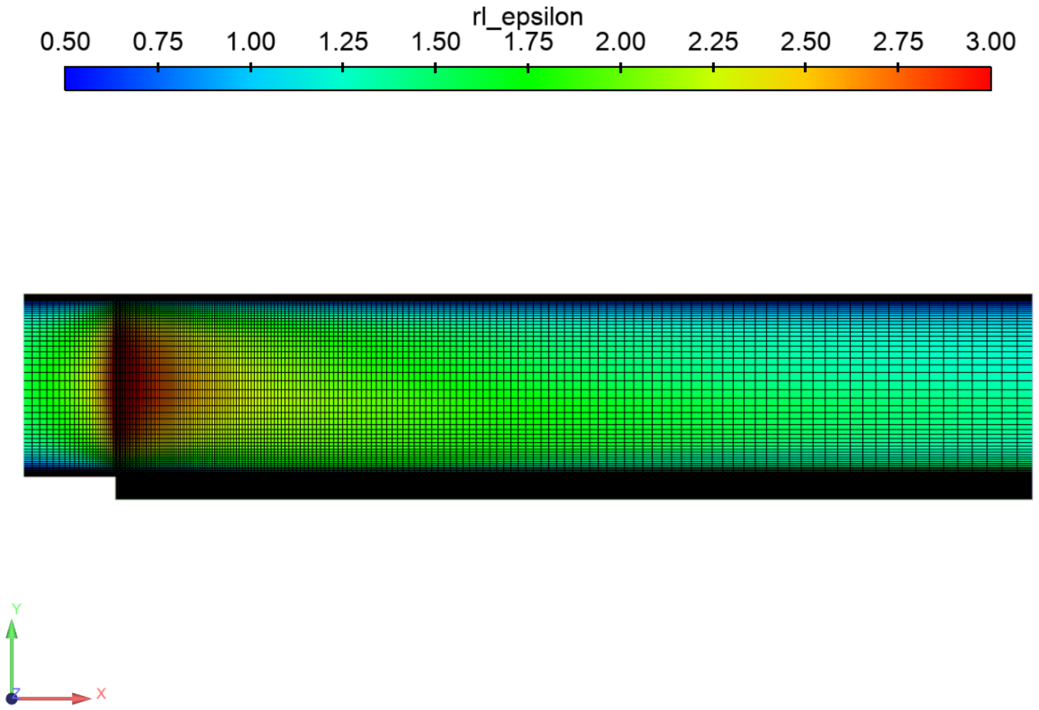


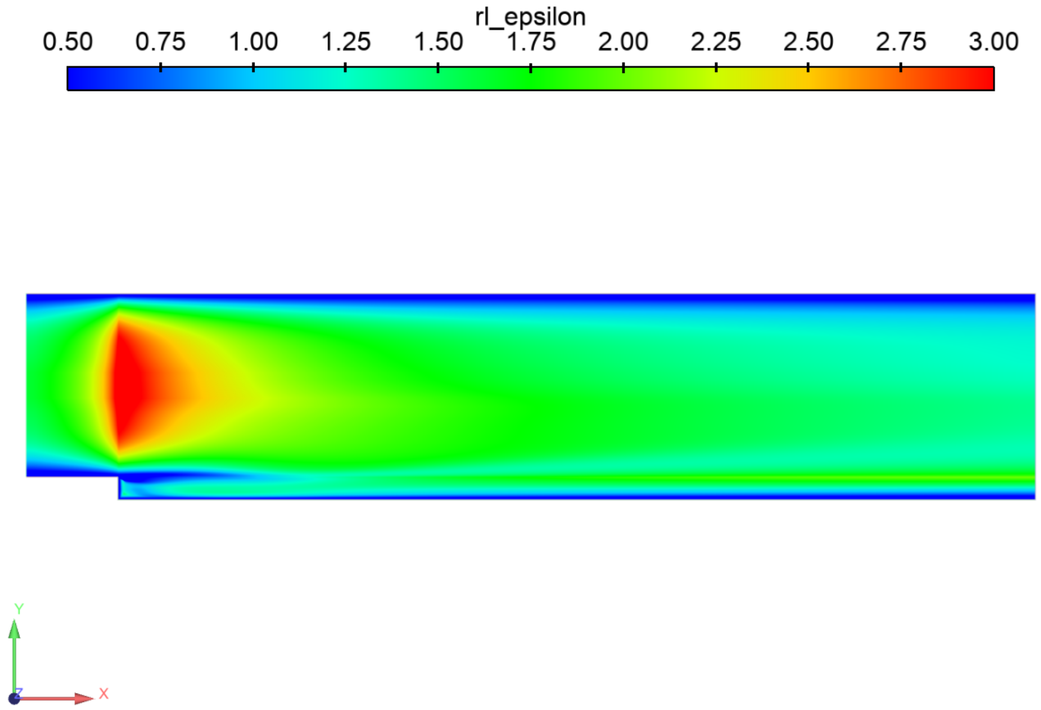

Velocity vectors




Velocity vectors

# Qualitative and quantitative results

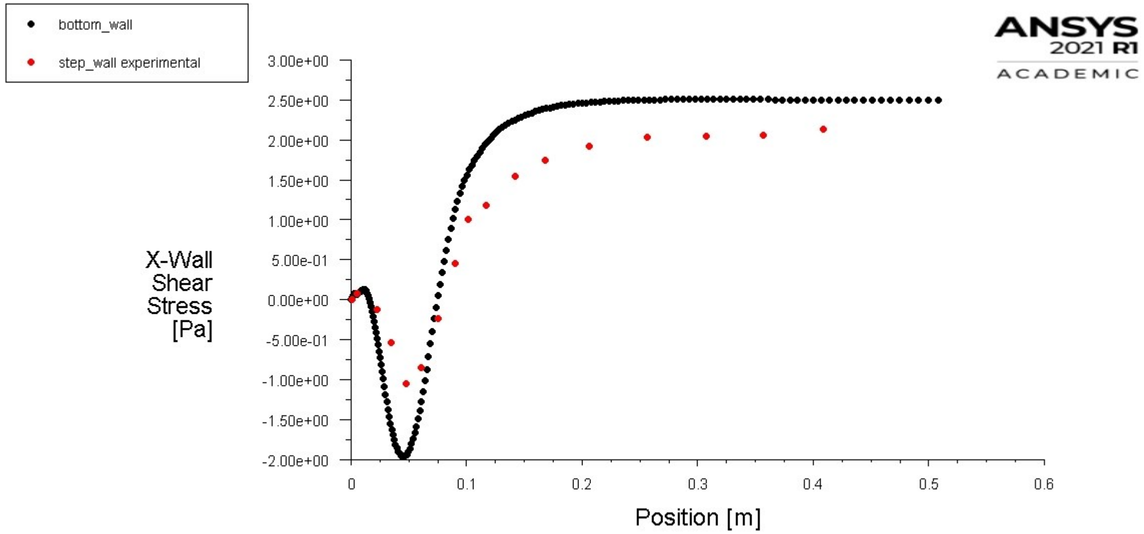


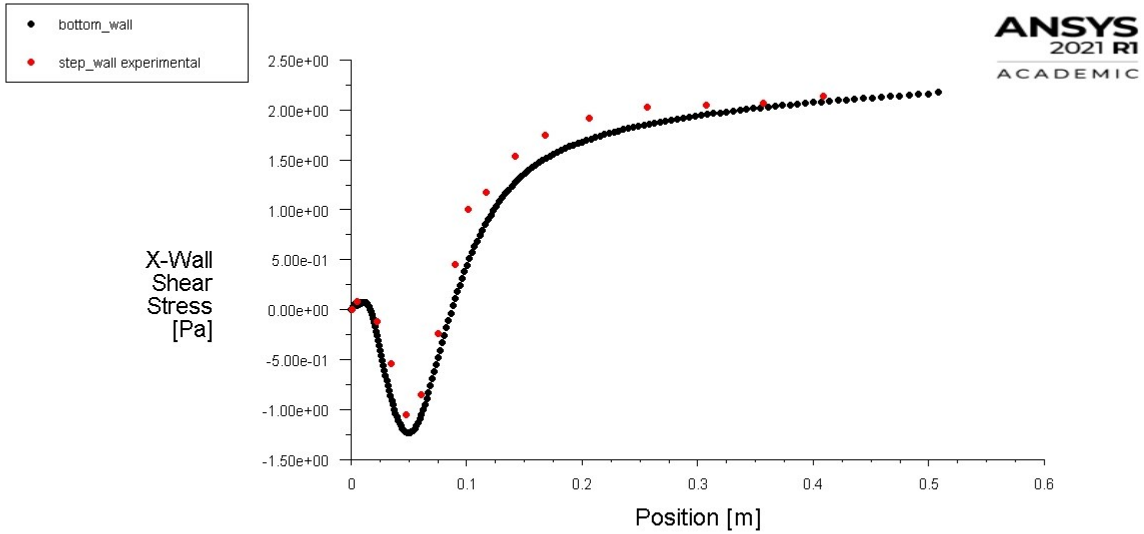

- Integral length scales and grid refinement ratio $R_L$ computed using the values or TKE and turbulent dissipation rate.
- The recommended values of grid refinement ratio are $R_L$ > 5-10.
- In regions where this value is lower than the recommended one, the mesh can be refined.
- Use this criterion only in the core of the flow, towards the walls use $y^+$.

$$l_0 = \frac{k^{1.5}}{\epsilon} \qquad R_l = \frac{l_0}{\Delta} \qquad \Delta \approx \sqrt[3]{\text{cell volume}}$$

# Qualitative and quantitative results



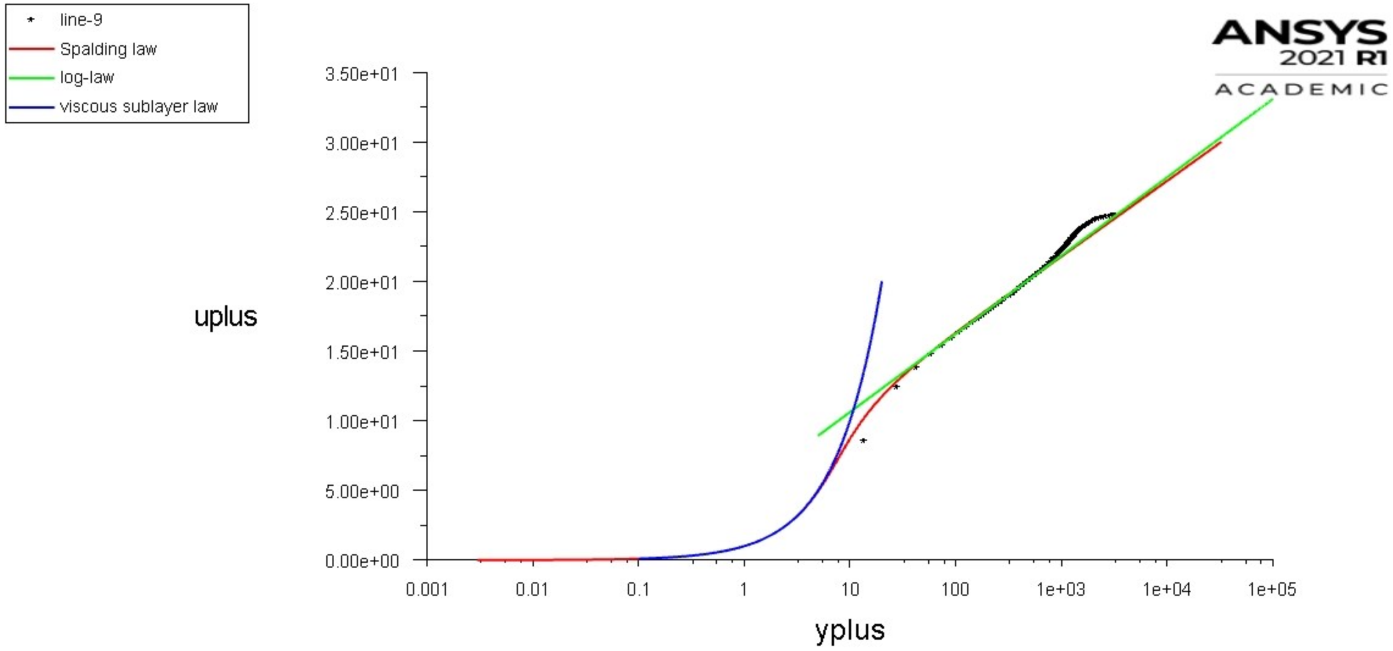

Wall shear stresses (x component) at the bottom wall
Boundary conditions 1.



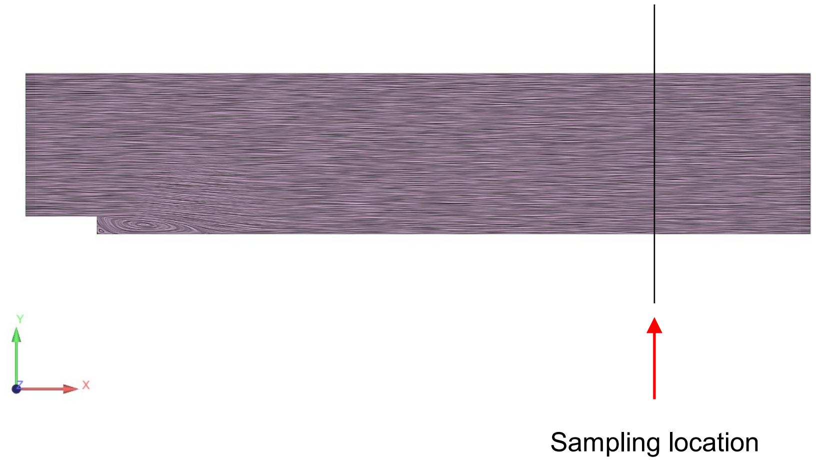

Wall shear stresses (x component) at the bottom wall
Boundary conditions 2.

- Influence of boundary conditions on the final solution.

# Qualitative and quantitative results




Normalized velocity in function of $y^+$




- Remember, to do this plot you must sample the velocity and wall shear stresses in location where the flow is fully developed and attached.
- It is also recommended to sample the averaged solution.