

1 Overview

Figure 1 depicts a cylinder of diameter d in a duct of width d and length $16d$.

The cylinder is hollow

The geometry, boundary conditions, and mesh are created in STAR-Design. The solution in the two-dimensional domain is obtained with STAR-CCM+. In STAR-Design a three-dimensional version of the domain is created with symmetry boundaries on the $\pm z$ planes. The model is then imported into STAR-CCM+, where the surface mesh in the (x, y) plain is converted to a two-dimensional mesh for simulating the flow.

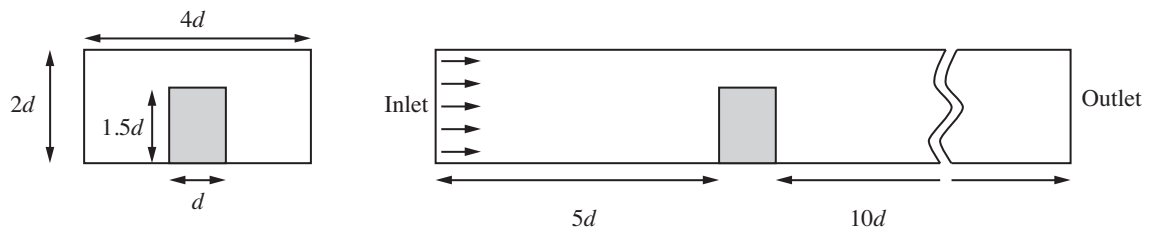


Figure 1: Location of the heated cylinder in a duct.

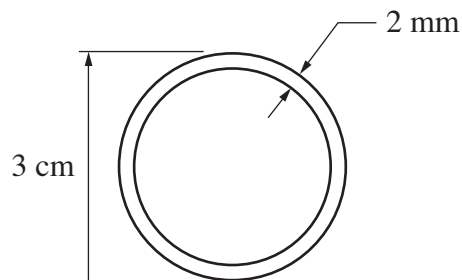


Figure 2: Dimensions of the cylinder.

Solid Model

The geometry of the duct and cylinder are created as an assembly in Solidworks. Only half of the duct is modeled because the flow is presumed to be symmetric about the vertical center plane.

A half-cylinder is created as a separate part. One half of the duct is created as a separate part. The duct is a rectangular block with a hole that just matches the cylinder.

The half-cylinder and the half-duct are combined in an assembly. A version of the assembly is saved as a Parasolid file, which is imported into STAR-CCM+.

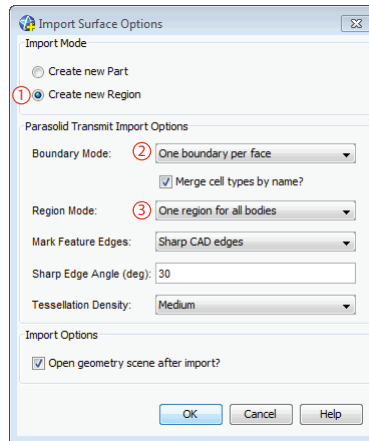


Figure 3: Settings in the dialog box for importing the surface mesh.

Mesh

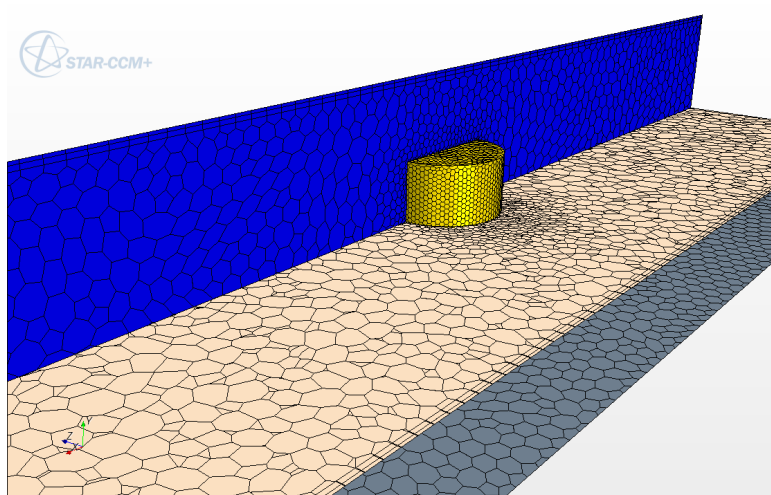


Figure 4: Medium mesh. The tan plane is at the midpoint of the cylinder height.

2 Post-Processing the Solution

Figure 4 shows the convergence history for 1000 iterations when the coupled solver is used.

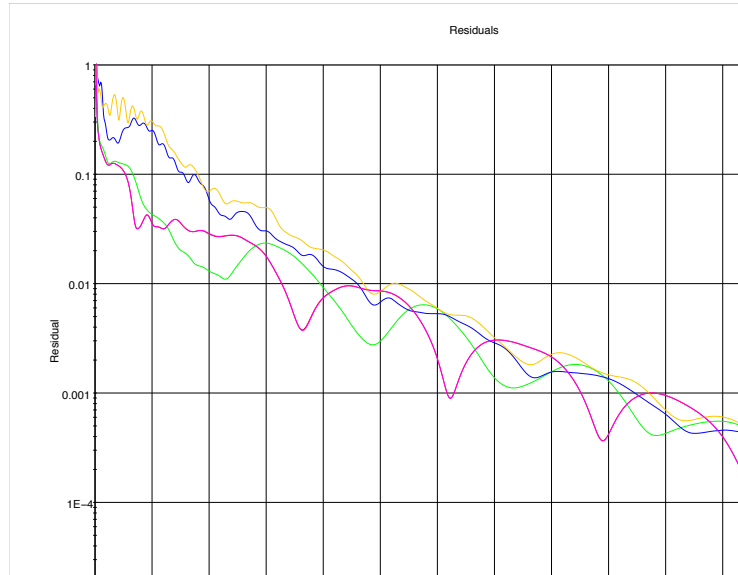


Figure 5: Residual plot.

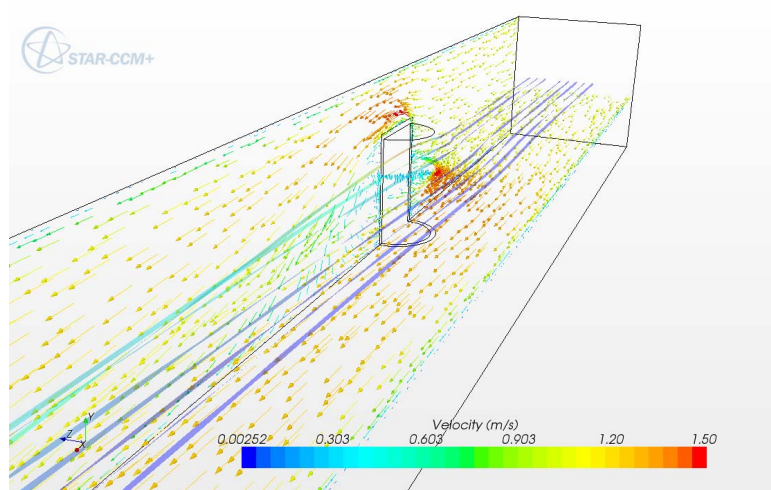


Figure 6: Velocity field on the symmetry plane and on a horizontal plane located below the top of the cylinder.

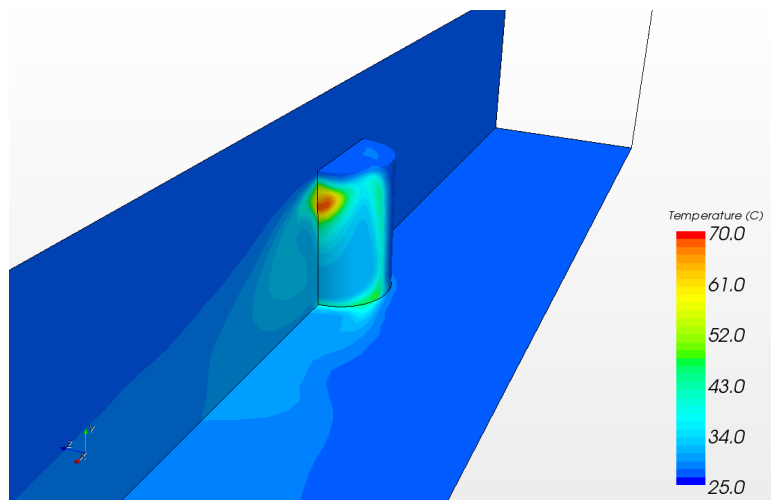


Figure 7: Temperature on the symmetry plane, the cylinder surface, and duct wall. The view is looking toward the inlet.