How to Setup Peripheral Swirling Inlet Flow in ANSYS Fluent?

Problem/Description:

In some applications like jet milling and flow separation equipment, simulation setup may demand a peripheral swirling inlet from a cylindrical surface. The solution below explains the setup of the in-built boundary conditions (mass-flow-inlet or velocity-inlet) in such a scenario.

Solution:

Consider a requirement as shown in Fig.1, wherein the flow enters the domain from a peripheral surface and has no axial component.

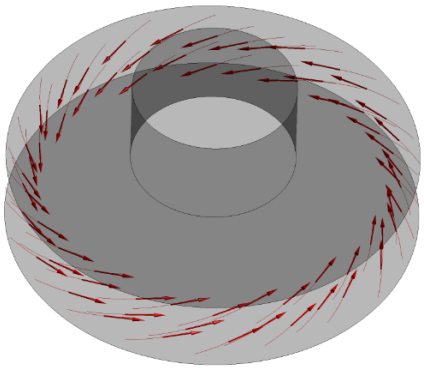


Figure 1: Peripheral inlet flow into the domain (demo case)

Inputs required to setup such a boundary condition include:

- Orientation of the circular face axis (direction vector and a point on the axis)
- Net velocity or mass flow rate
- Cylindrical direction components or vector (Fig.2)

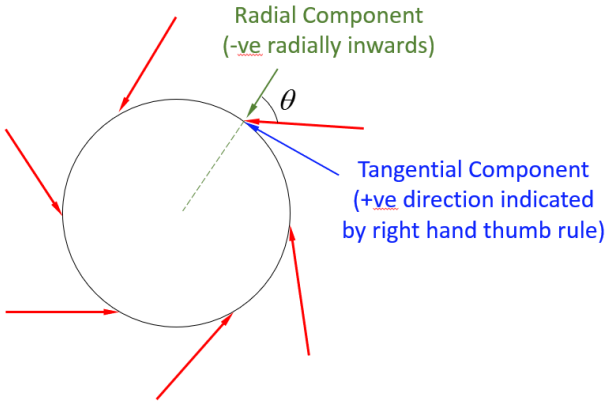
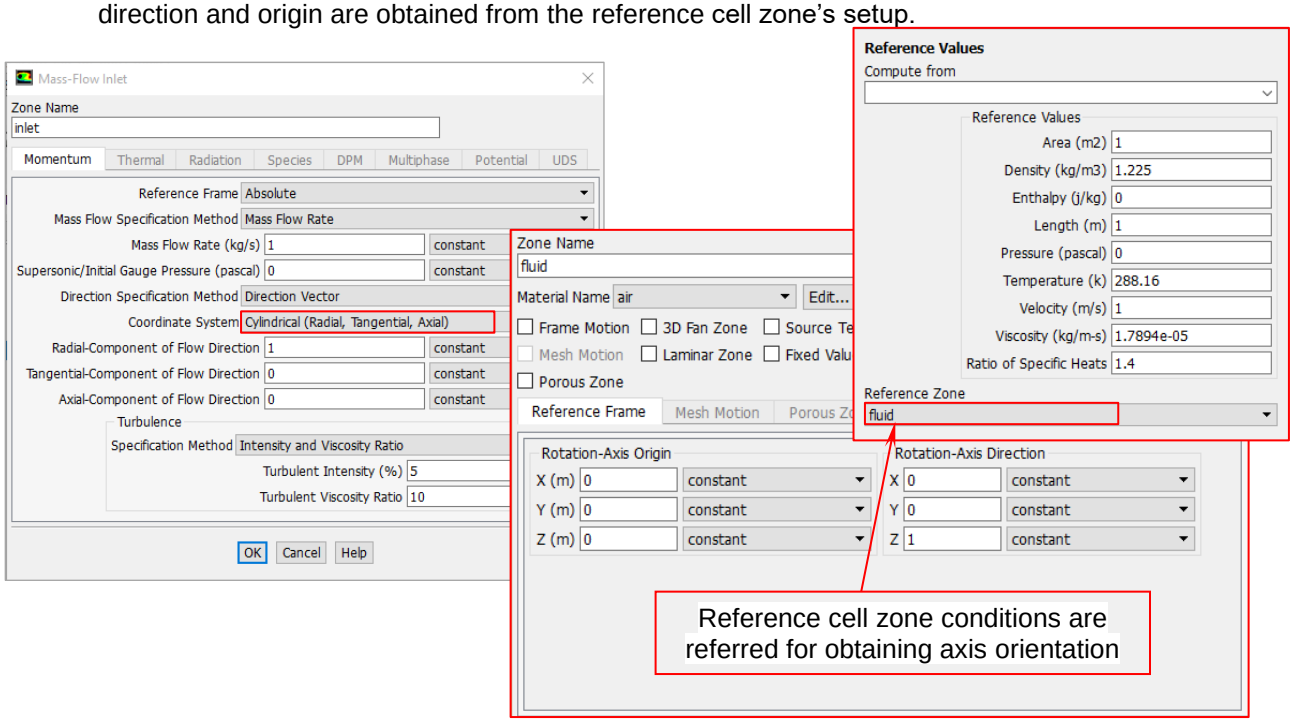


Figure 2: Schematic of velocity direction components provided in the demo case

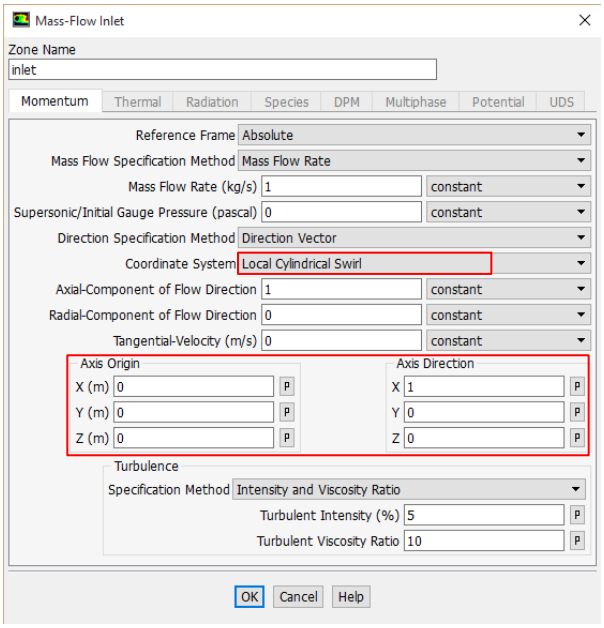
Setup using mass-flow-inlet:
There are three options available within the mass-flow-inlet boundary condition to setup cylindrical inlets:

1. **Cylindrical (Radial, Tangential, Axial)** requires the input of each of these components. The axis direction and origin are obtained from the reference cell zone's setup.

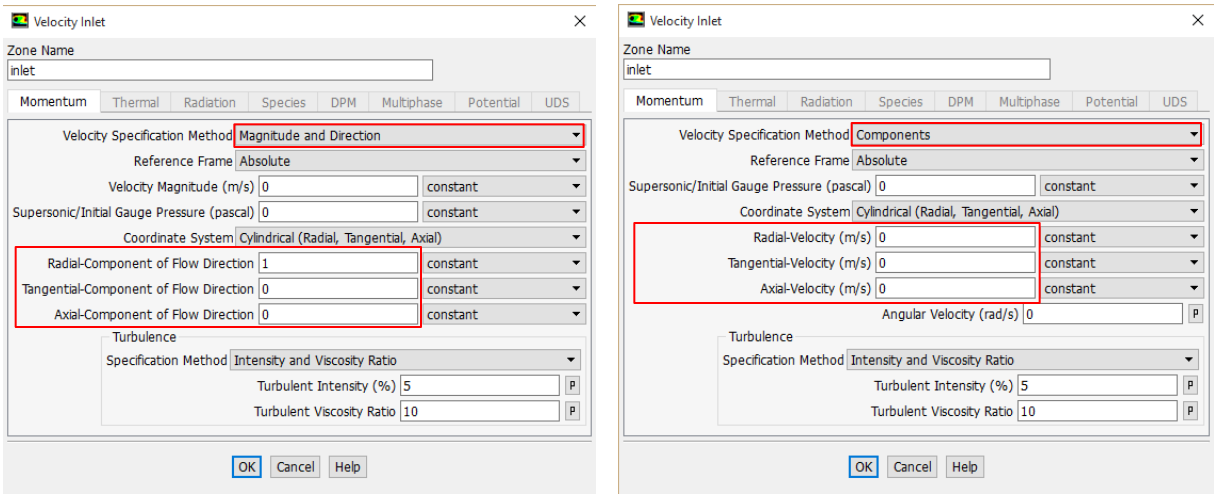


2. **Local Cylindrical (Radial, Tangential, Axial)** requires an additional input of axis orientation; the reference cell zone setting is disregarded in this case.

3. **Local Cylindrical Swirl** differs from option 2 by allowing a direct input of tangential velocity in [m/s] rather than its directional component. Note that the radial or axial components are the ones that effectively amount to a mass flow into a cylindrical surface or a circular face. Therefore, this option is provided for an easy input setup if swirl velocity is explicitly known in addition to total mass flow.



Setup using velocity-inlet:
velocity-inlet boundary condition provides similar input options as the mass-flow-inlet. Additionally, it provides an alternative to direction vector with directional components itself in [m/s] (see the snapshots below).



Note: Direction vectors may not necessarily be unit vectors.

Demo case setup and results:

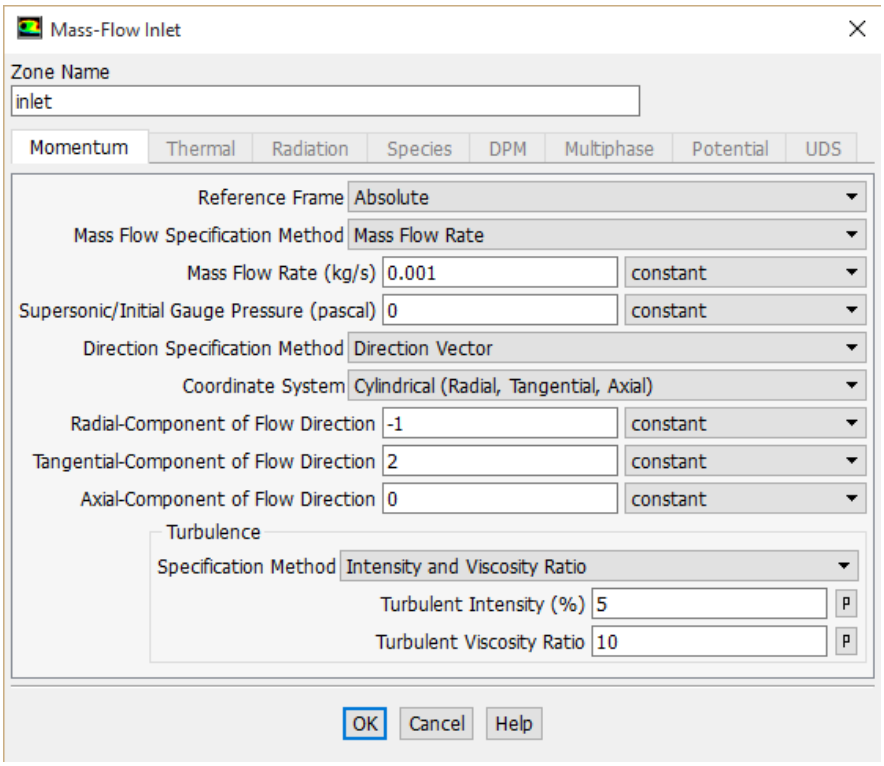


Figure 3: Mass flow inlet setup

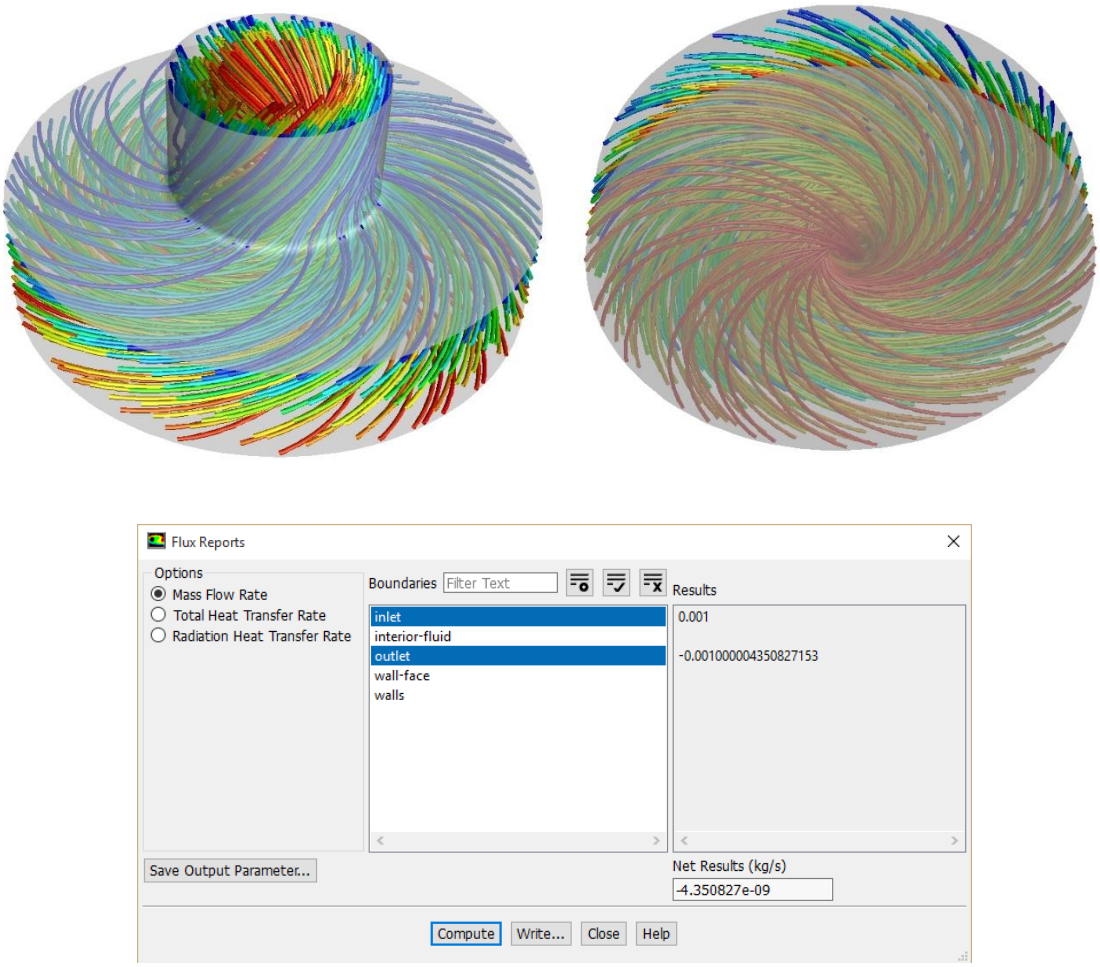


Figure 4: Pathline plots and mass balance obtained in the converged case

Attachments:

1. 2053479-demo.cas.gz
2. 2053479-demo.dat.gz