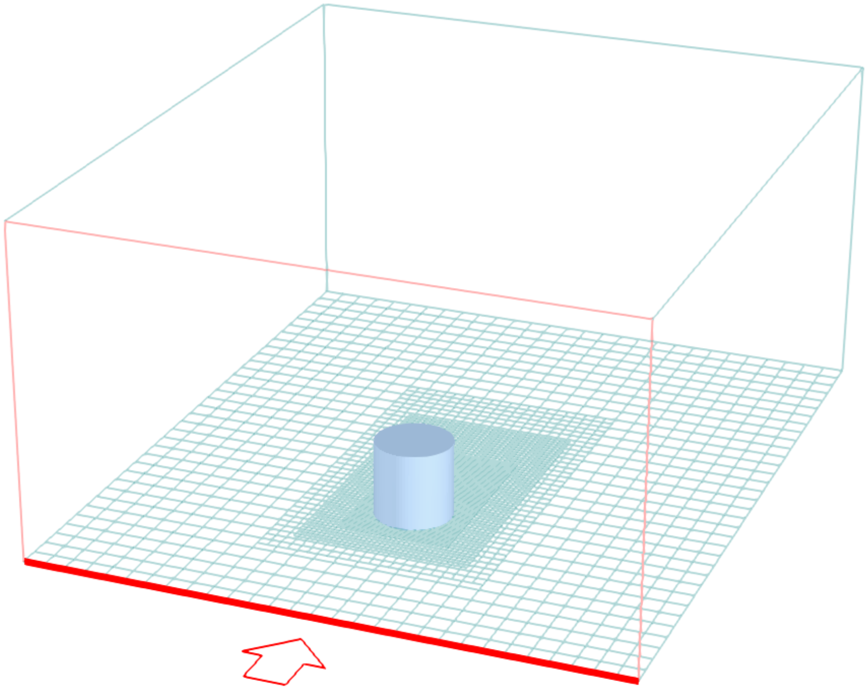
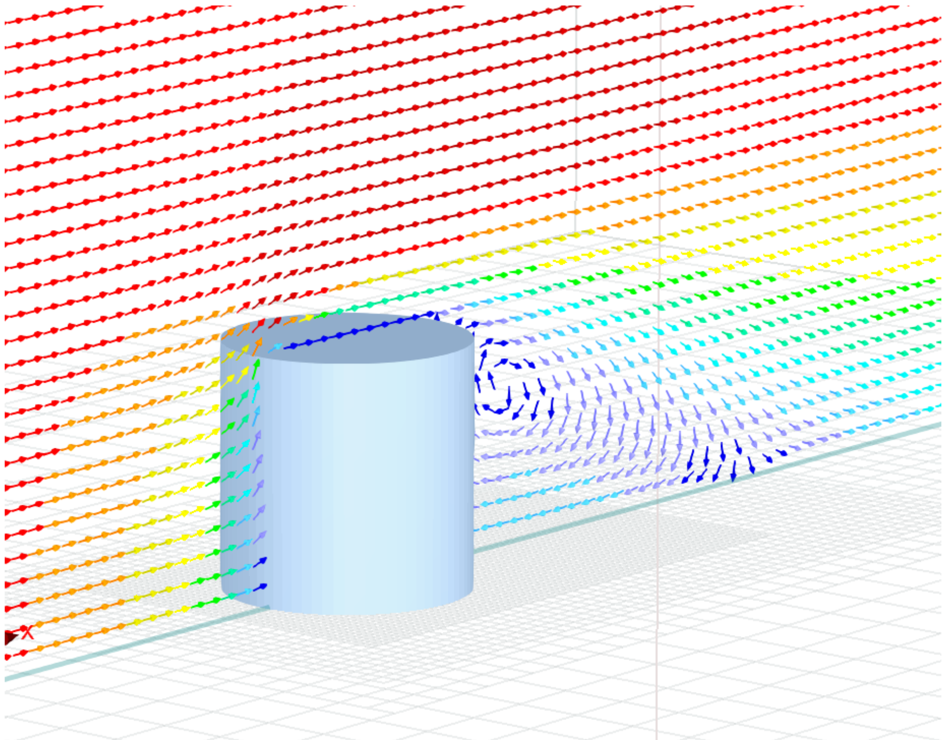
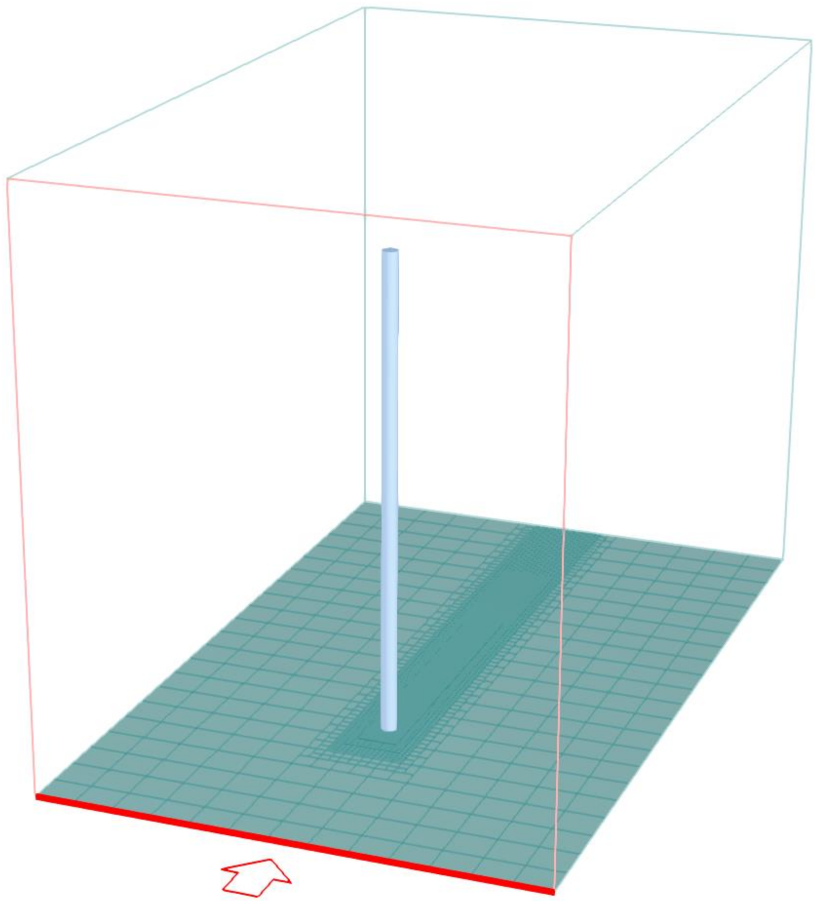
1. Simulation of Karman Vortex Street in 3D

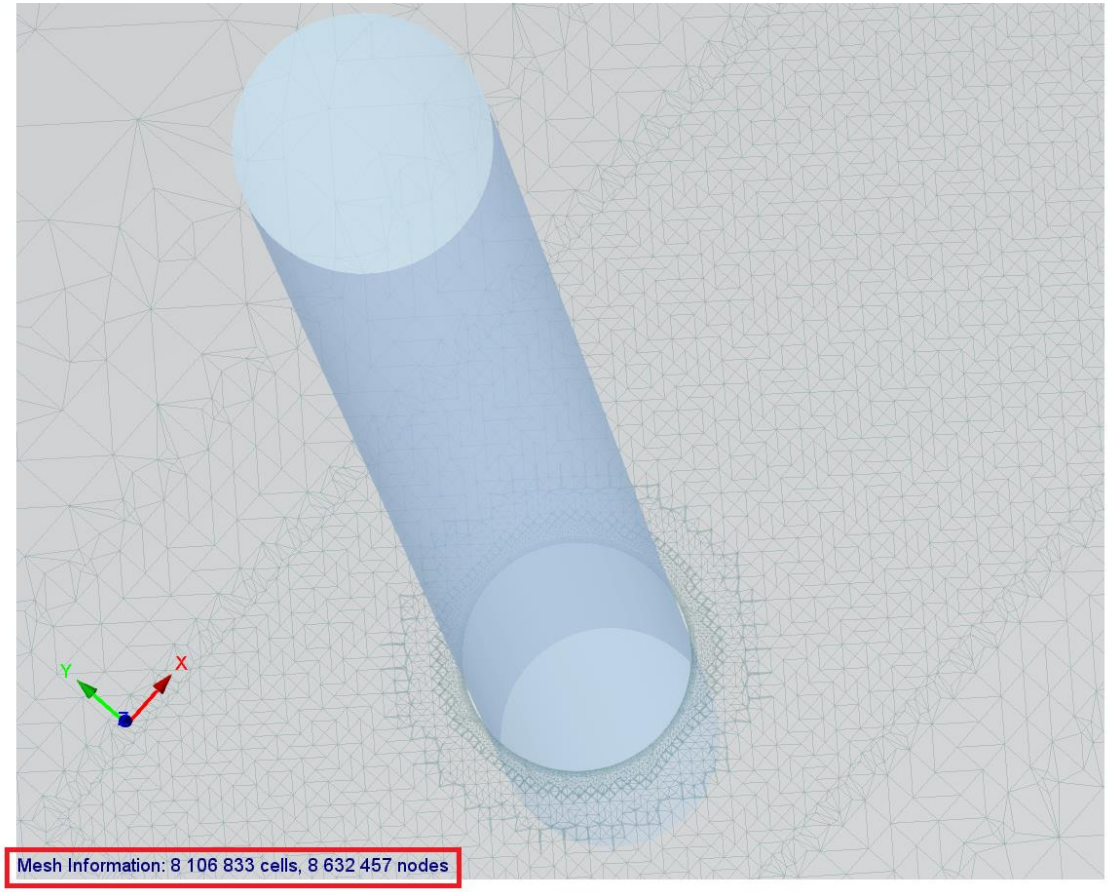
1.1. Low Cylinder. Unlike buildings with sharp edges (see e.g. demo-example M03_Campus_Transient), periodic oscillations of Karmán vortices do not occur for low cylindrical buildings. The likely reason is that the vertical vortices behind the cylinder do not allow that.



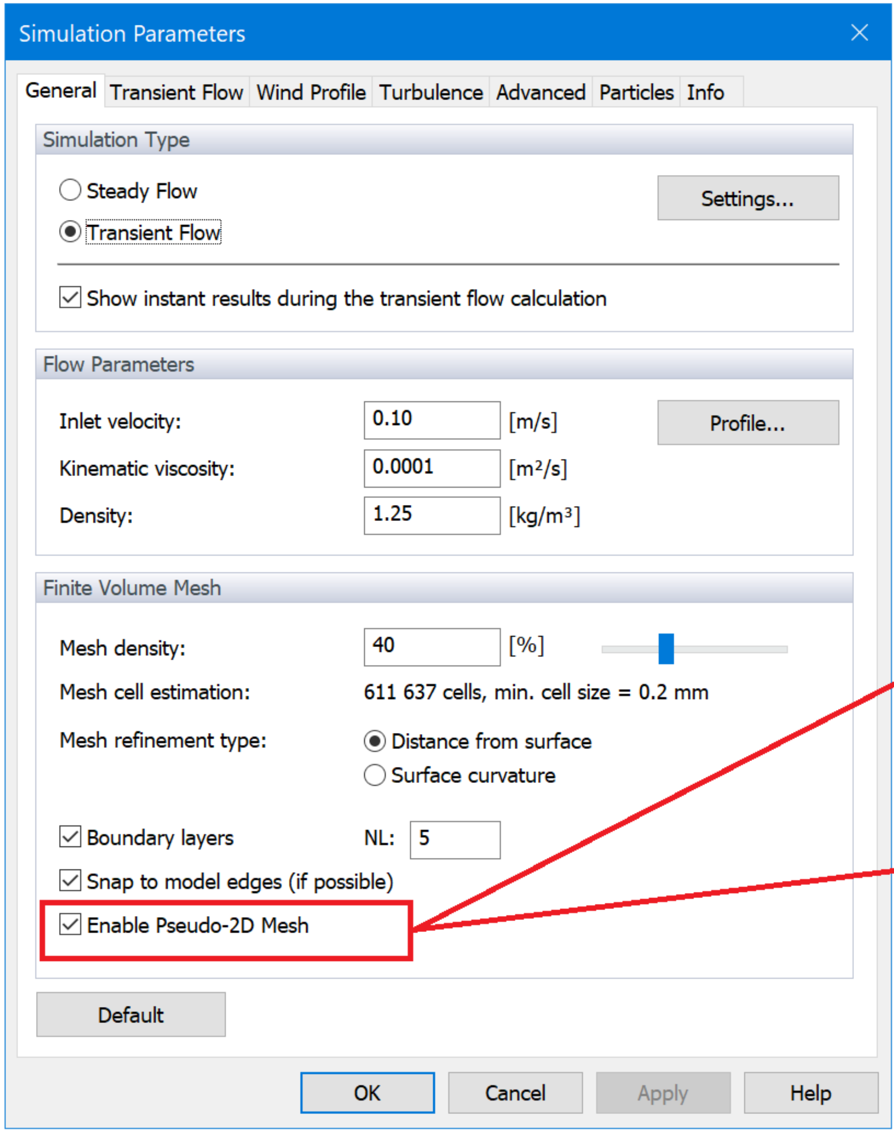


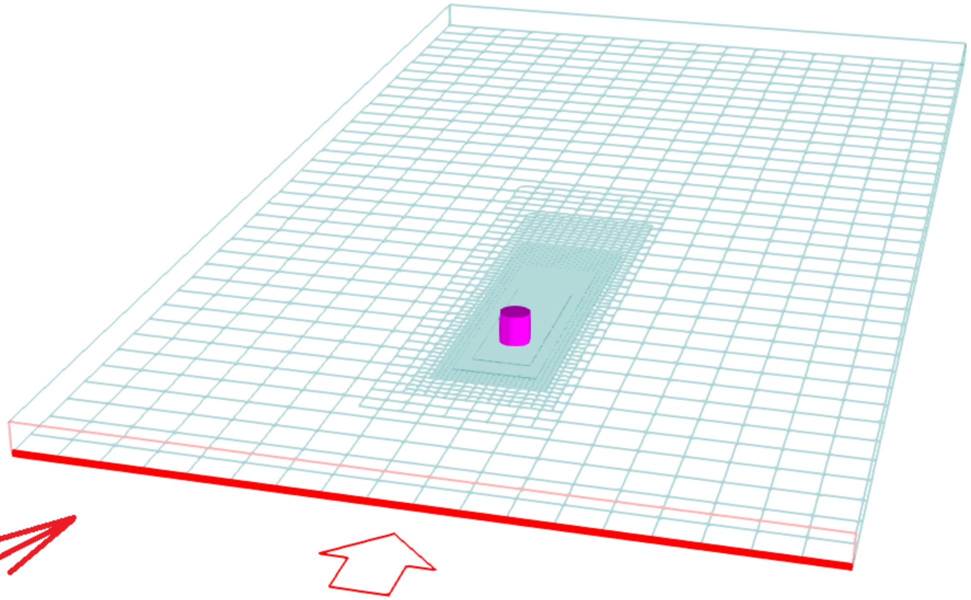
1.2. Very tall cylinder. Kármán eddies can be simulated, but it requires a very fine mesh around the cylinder and in the space behind it. This mesh should have at least 10 - 100 million cells, and calculating the transient flow with the Karman vortex street would take several days on a high-end PC.





1.3. Pseudo-2D simulation. It is well known that Kármán eddies can be easily simulated in 2D. In 3D we can do a similar simulation using a wind tunnel with a very low height (manually set) and a special 3D mesh for this pseudo-2D case.





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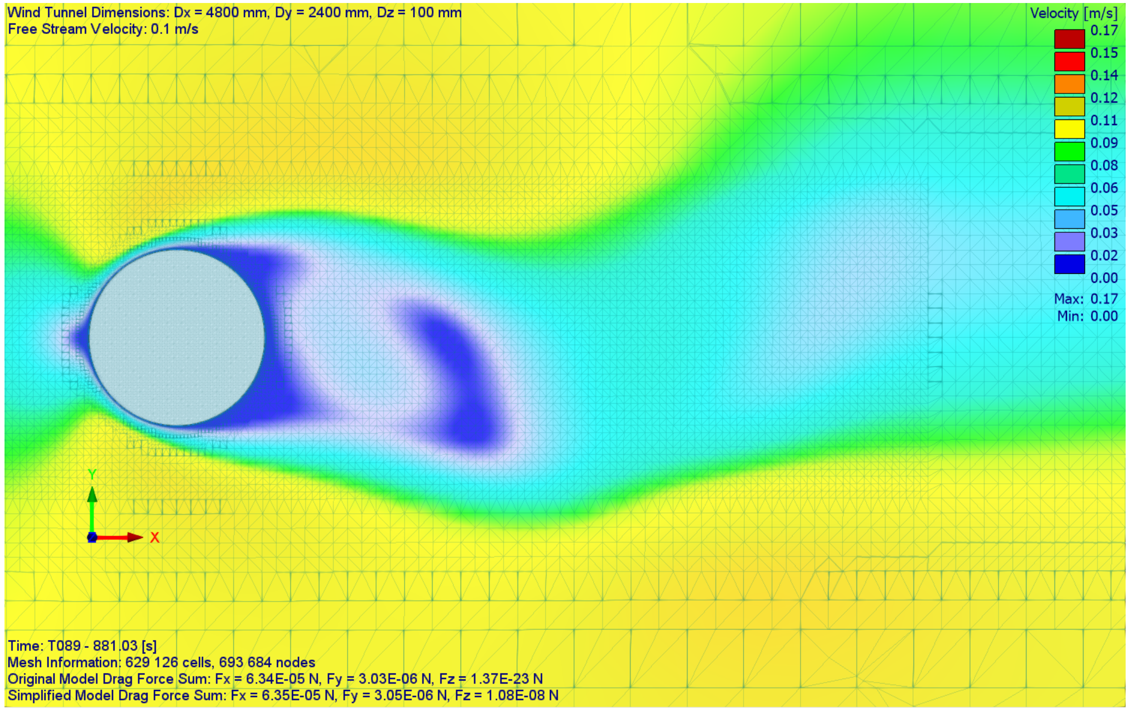
- DeveloperKey = 1

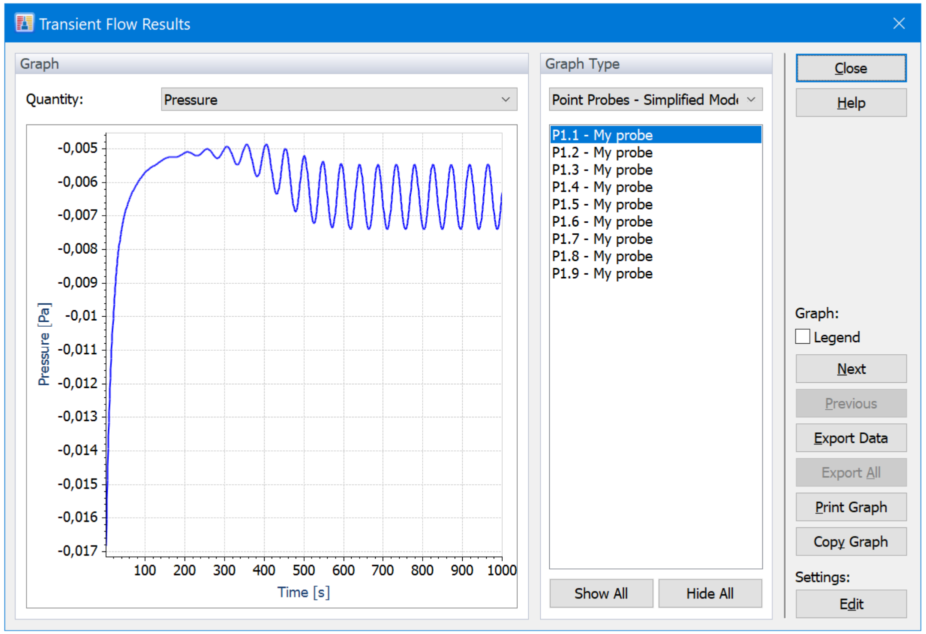
2. Results of the Karman Vortex Street simulation.

When using a pseudo-2D mesh (see previous point 3.1), Kármán eddies can be simulated quite easily even on 3D meshes with 50,000 cells. We performed several tests on meshes with different densities (from 50,000 to 1,500,000 cells) and always got periodically oscillating Karman vortices. However, it turned out that the frequency of oscillations depends on the density of the mesh - the denser the mesh, the higher the frequency. This is probably related to the different accuracy with which the eddies are simulated. An interesting question is whether there is a certain mesh density from which the oscillation frequency does not change when the density is further increased. CFD Support has promised to run a few test calculations and provide the results of this analysis.

Downloads:

- Video: http://www.pc-progress.com/Downloads/Tmp/RWind/Projects_2022/KarmanStreet/KarmanVortexStreet.mp4
- Project: http://www.pc-progress.com/Downloads/Tmp/RWind/Projects_2022/KarmanStreet/Karman_M05_Medium.zip (1 GB)





4. Other important issues – problems with low speed flow and the turbulence model

One of the test examples (Master-Thesis, Erik Andresen) had a very low velocity (U = 0.1 m/s). It turned out that such a low velocity causes problems in the calculation of steady flow with RWIND standard parameters. We could then observe strange unreal eddies and backflows - see attached image. After further analysis, we came to the following conclusions:

1/ For such low velocities, it is advisable to turn off the consideration of turbulence for stationary flow. Then the calculation work without any problems.

2/ When calculating transient flow, it is good to set only one iteration for the calculation of the initial condition using the steady flow solver. Then the initial condition is calculated using only the potential flow model (potentialFoam), which gives a quite acceptable result.

3/ CFD Support promised to prepare an analysis to find out from what low velocity value these problems can arise. Once we know the result of this analysis, we will add a warning to RWIND for users if their calculation parameters could cause similar problems.