Simulation of von Kármán Vortex Street

Vortex shedding from bluff bodies is a very important industrial flow problem and has numerous applications. Students will simulate the development of von Kármán vortices from various objects placed in a uniform stream. The (two-dimensional) shapes to be considered are:

a) Rectangular prism (varying the aspect ratio from 1 (square) to 3)
b) Triangular prism (varying the aspect ratio from ½ to 2)
c) Flat plate (varying the angle of attack from 0° (head on, |) to 60° (sloped, /))
d) Circular and elliptic cylinder (varying the eccentricity from 0 to 0.7)

The quantities to be varied are **geometry** and **Reynolds number**. *All simulations will be transient*.

You will select a geometry from the above, for which you should consider at least three cases including the bounding limits of the range given above. The Reynolds number values you will simulate are 25, 60, and 100. You will also need to simulate and discuss the effect of mesh resolution and demonstrate that your mesh is sufficiently fine.

While none of these simulations are particularly challenging, transient simulations can take a long time to converge, and I suggest that you start early for that reason; the Citrix remote connexion service may be useful to you. *You may work in pairs if desired*, but each partner should contribute equally to the development of the models and submit their own report (although you may reuse graphics).

You will document the simulations in a 10–12 page report (with figures) containing sections:

a) Problem description (shape, grid, etc.)
b) Details of the simulation (settings and capabilities of Fluent)
c) Numerical parameters (laminar flow, grid size, boundary velocity, initialization, etc.)
d) Computational times (iterations and CPU time to complete)
e) Observations of numerical behavior (residual convergence rate, mesh behavior, etc.)
f) Discussion of the flow physics such as static images of vortices shed (contours of vorticity), pressure contours, and instantaneous velocity vectors at three or more time indices
g) Verification and validation (to extent possible; compare to experimental results); this will require a literature search on your part

Include the following plots in your report, with data from each case you will study:

a) Convergence of mass, momentum residuals (and expected sawtooth behavior)
b) Streamlines at four time intervals
c) Line plots of x and y velocities as a function of time at a single point in the wake
d) Contours of velocities and pressure at four time intervals

Your report should resemble the parameters given in earlier homework assignments.In addition, you should submit a movie of your transient simulation.Since these are often quite large, I suggest uploading the video to Box and sharing a link with the teaching assistant.