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January 31, 2012

Dr. Andrew Hamilton, Ph.D.
Mechanical Engineer
Monterey Bay Aquarium Research Institute (MBARI)
7700 Sandholdt Road
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Re: Reaction Plate Modeling ASC Letter L-12-MDP-01

Dear Andy,

This letter details computational fluid dynamic (CFD) simulation results for six parametric simulations of a reaction plate experiencing a normal free stream flow of sea water. As you know the reaction plate is composed of six rectangular tubes attached together with two square tubes. The solid model provided by MBARI was used to generate the computational mesh. The symmetry of the reaction plate geometry was used to reduce the computational domain to ¼ of the overall domain.

For each of the six simulations the free stream water velocity was varied along with the mean turbulence quantities. The local turbulence was assumed to be 2% of the local free stream velocity for each parametric simulation and the mean velocity was taken as 0.25, 0.5, 0.75, 1.00, 1.25, 1.5 m/s.

The reaction plate was placed in a virtual wind tunnel for sea water with a cross section of 94 x 94 ft and a length of 156.875 ft. Note only one quarter of the tunnel was actually modeled. The mesh topology near the surface of the reaction plate was meshed using hex elements with a length scale of about ¼ of an inch. A combination of hex and tetrahedral elements were used to transition to the free stream portion of the domain where a 12 inch mesh length scale was used. A sample of the mesh topology used is shown in Figures 1 and 2. A total of ~ 2.9 million computational volumes were used to fill the computational domain.

CFD simulation results for the 0.75 m/s case are detailed in Figures 3-6. Figures 3 and 4 detail the velocity patterns as the sea water passes around and through the plate. Figures 5 and 6 detail the pressure distribution on the front and back side of the plate.

The drag coefficient for this velocity range is invariant with a value of ~2 using the projected area of the slats as the reference area for the drag coefficient calculation. A spreadsheet has been provided with this letter with the exact force and drag coefficient calculations for your reference.

This letter concludes the reaction plate drag study. If you have any questions please feel free to contact me or Andy Banka.

Regards,

Jeffrey D. Franklin, Ph.D., P.E.
Senior Engineer

Quarter Model Freestream Velocity 0.75 m/s

Overall Mesh View

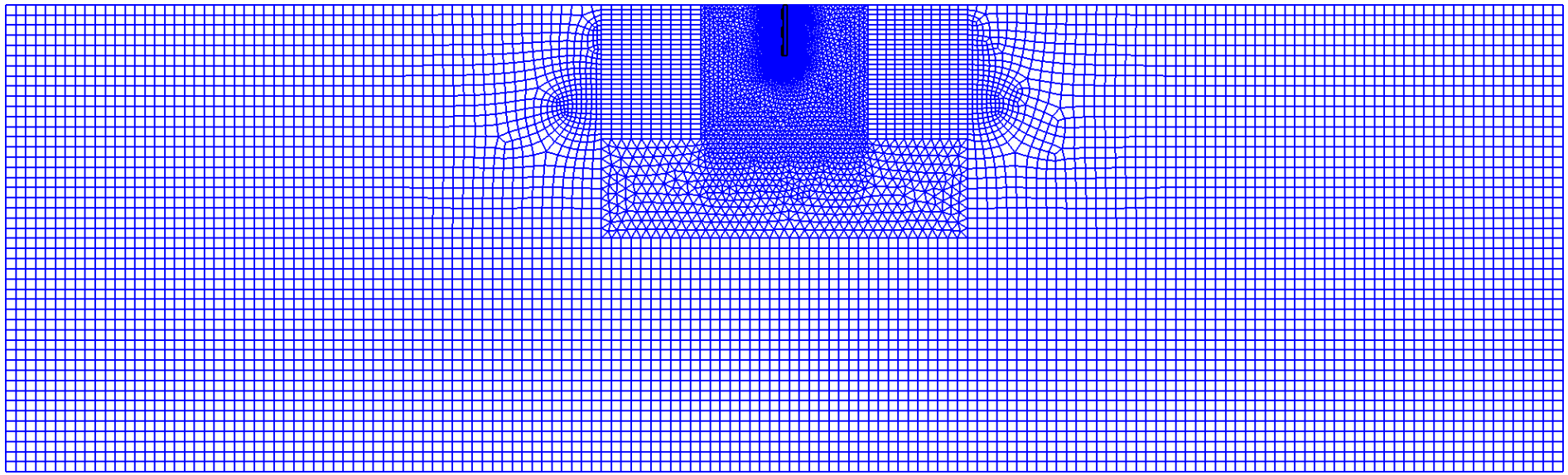

Figure 1

Quarter Model Freestream Velocity 0.75 m/s

Near Plate Mesh View

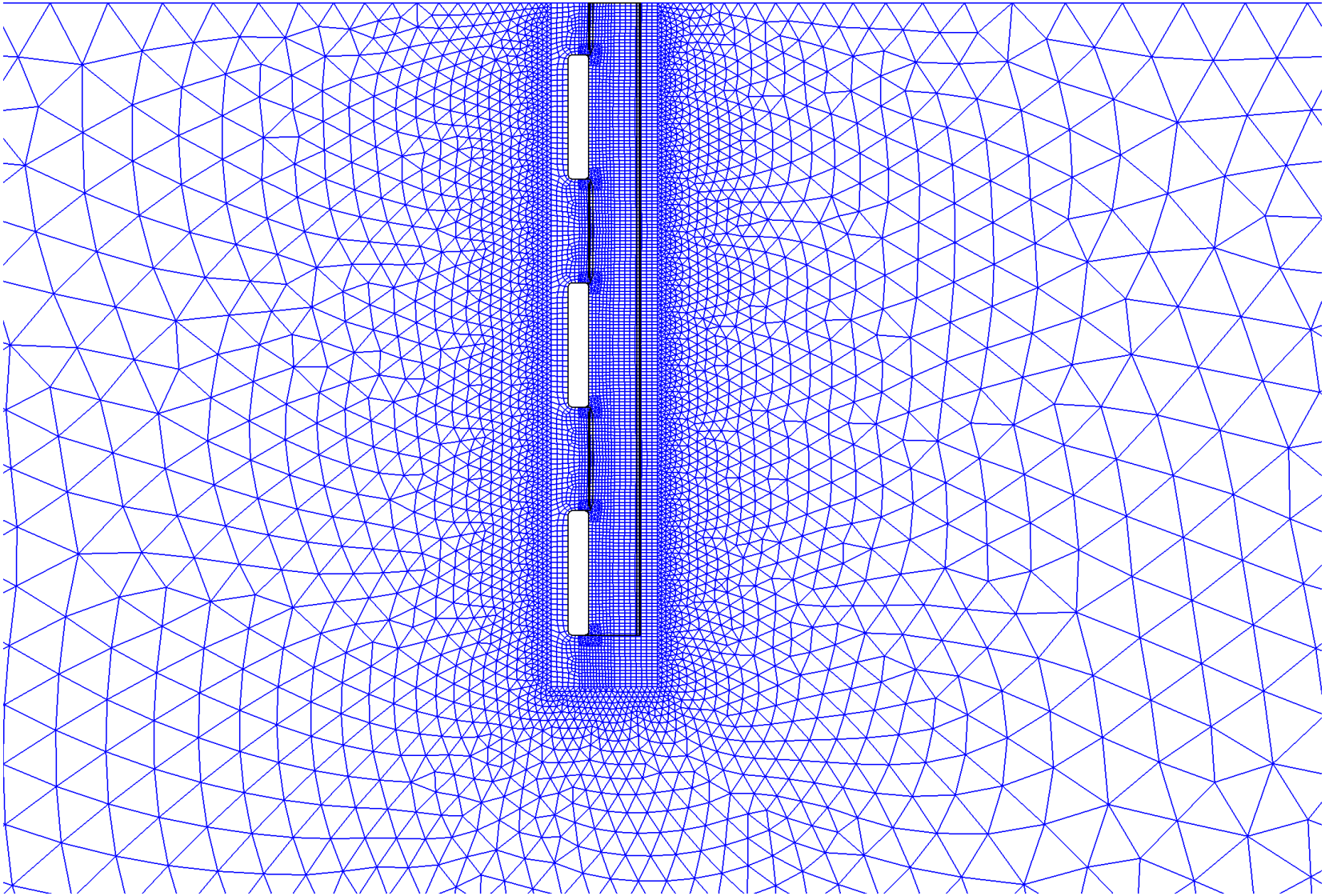

Figure 2

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Quarter Model Freestream Velocity 0.75 m/s

Plate Width Centerline

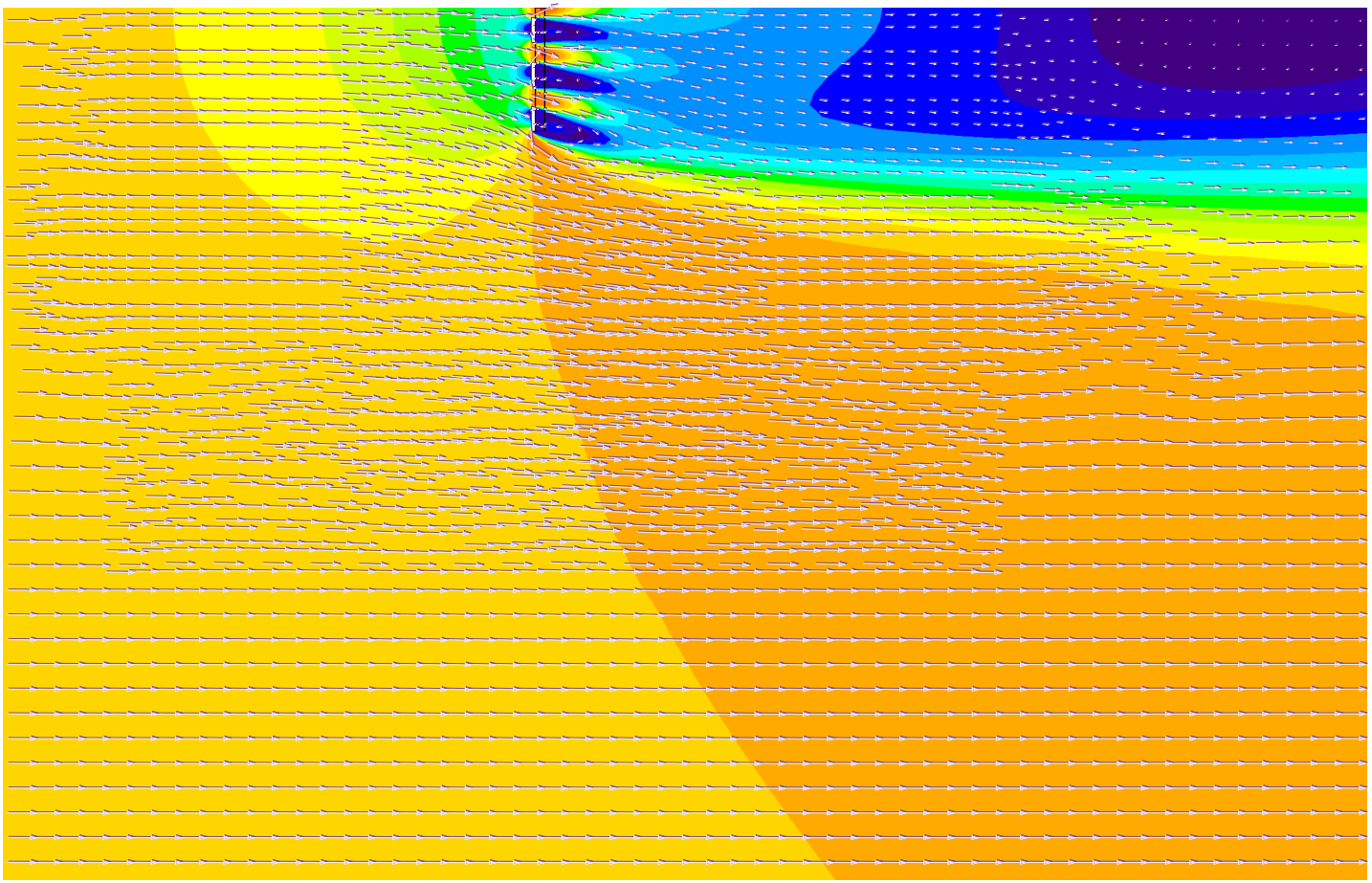

Figure 3

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Quarter Model Freestream Velocity 0.75 m/s

Plate Height Centerline

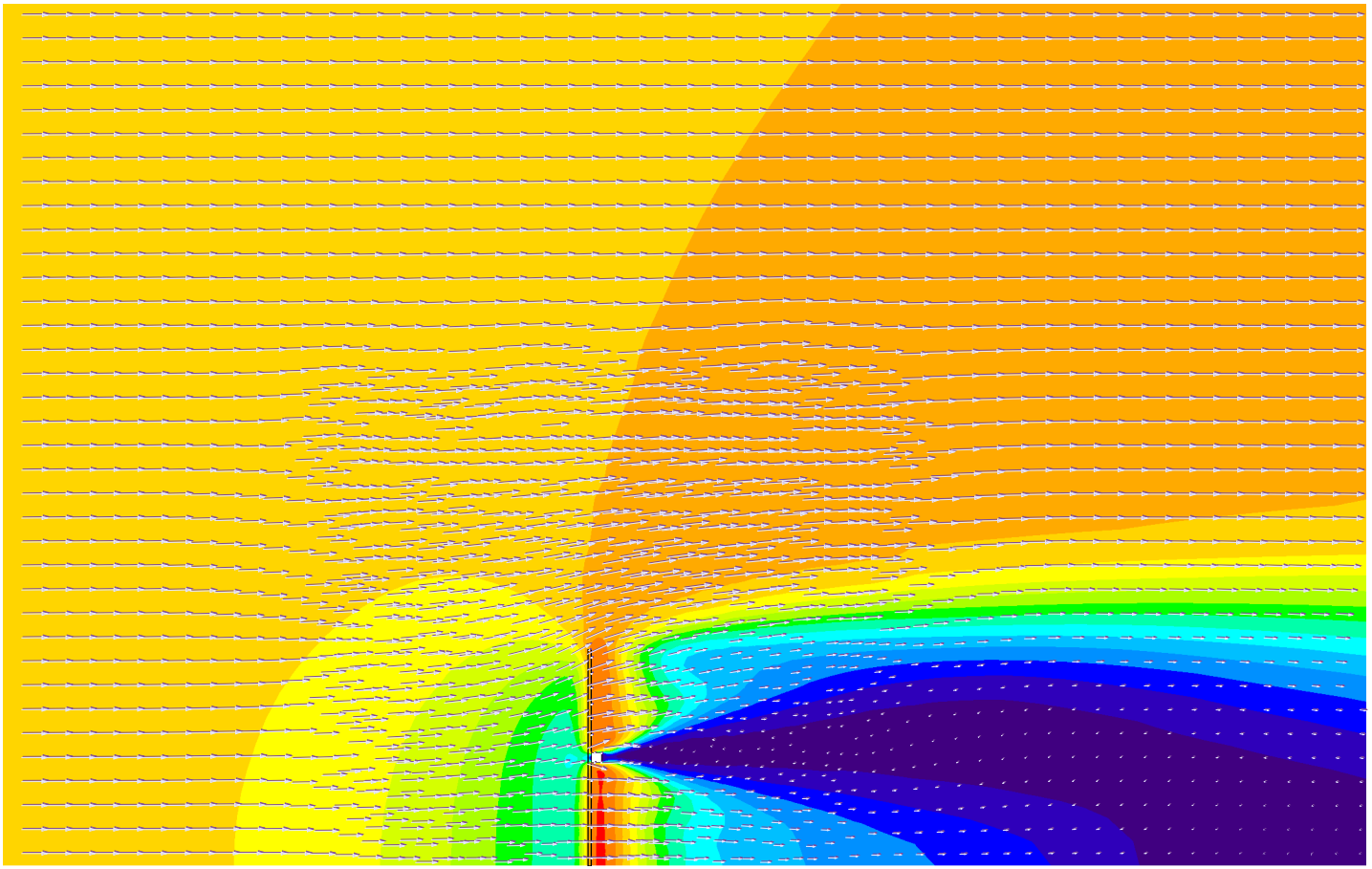

Figure 4

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Quarter Model Freestream Velocity 0.75 m/s

Plate Front Pressure Distribution

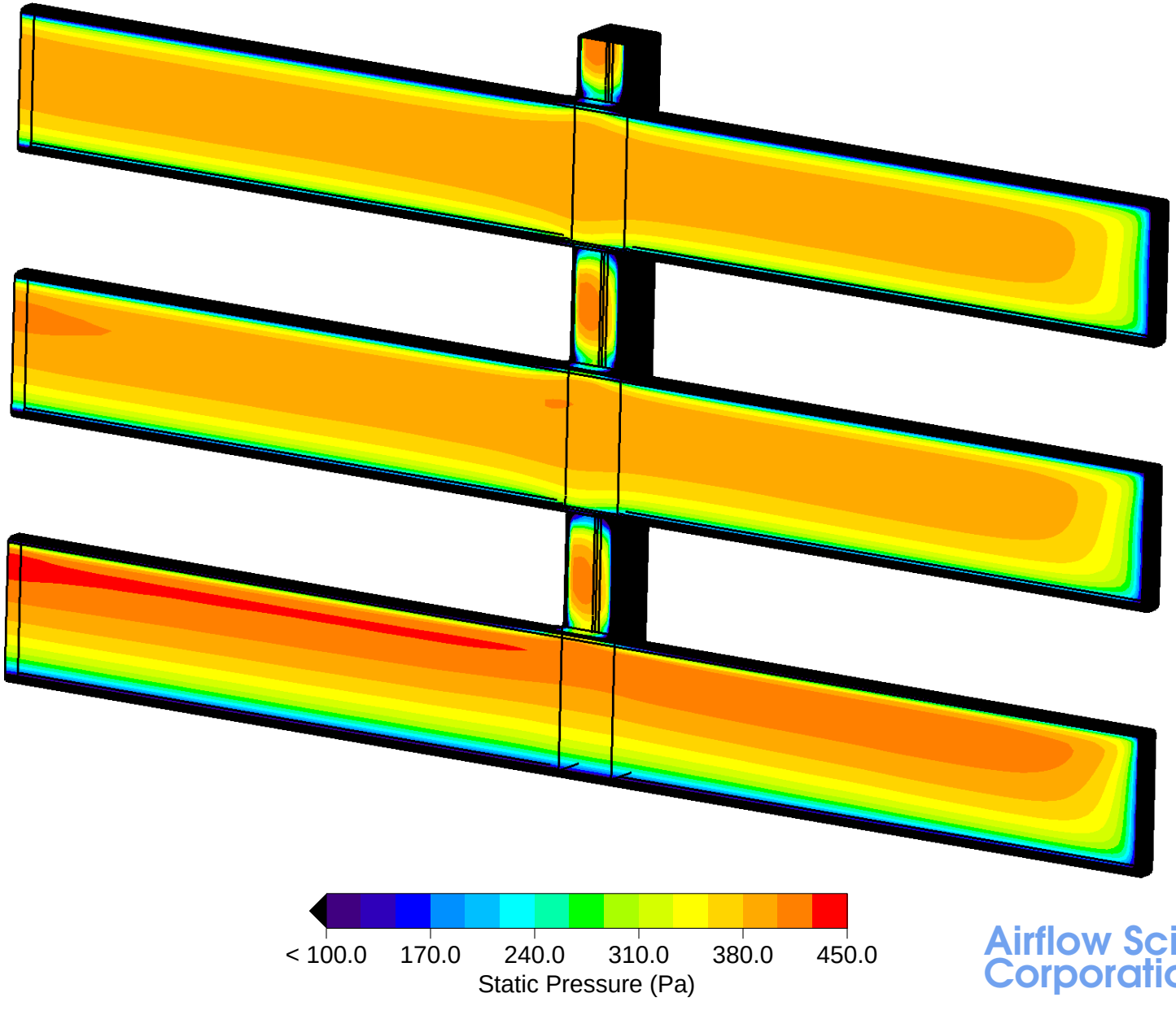

Figure 5

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Quarter Model Freestream Velocity 0.75 m/s

Plate Back Pressure Distribution

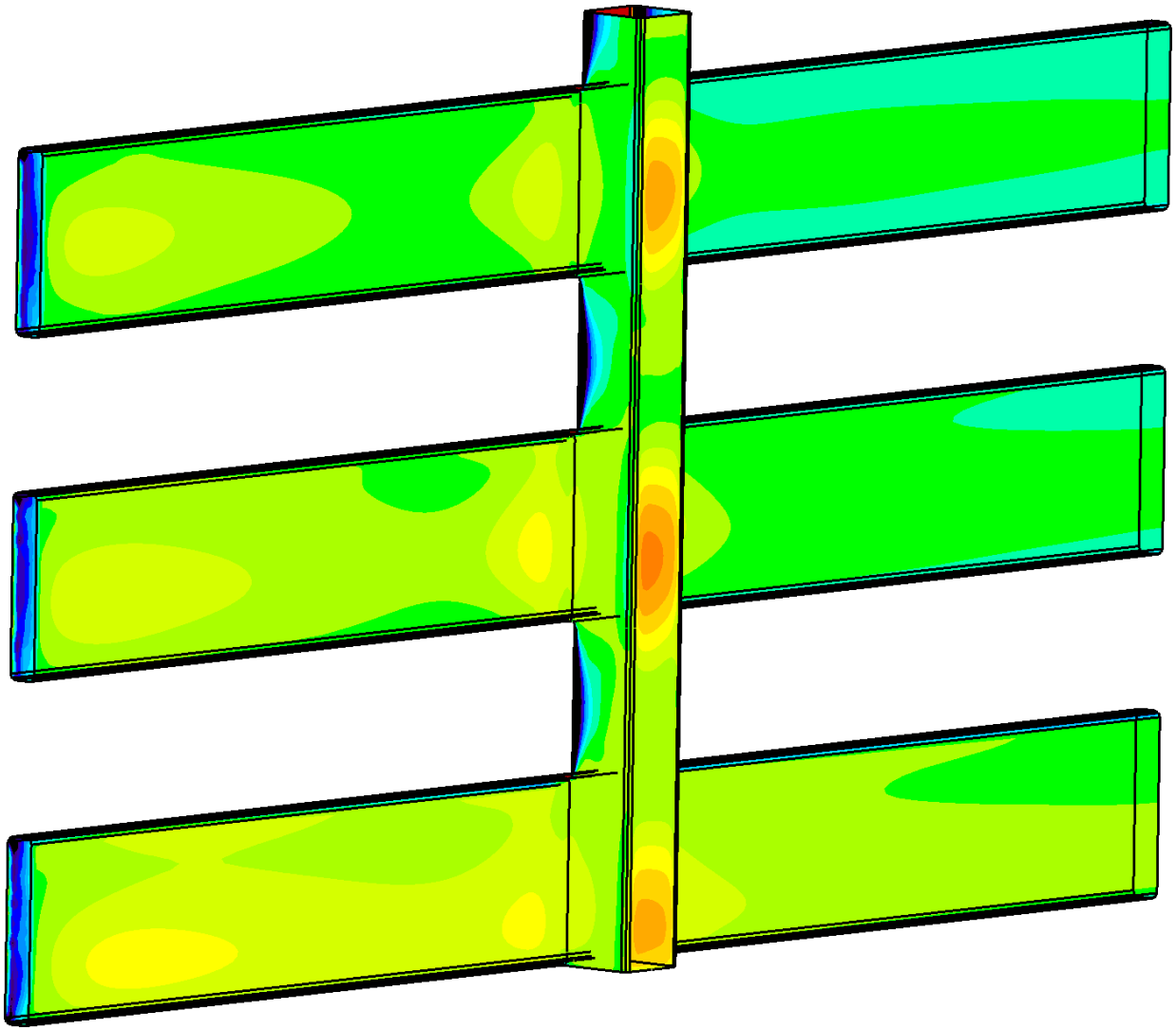

Figure 6

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