Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

A model of the trajectory of an inclined jet in incompressible crossflow ROBERT BREIDENTHAL, University of Washington, YANYAN FENG, YANPING SONG, Harbin Institute of Technology — A simple model of the flow field induced by an inclined jet into an incompressible cross-flow is proposed. In general, such a jet generates an asymmetric pair of vortices, with a larger one farther from the wall. The model accounts for the influence of the jet pitch angle (with respect to the wall), skew angle (with respect to the freestream direction), and velocity ratio (the jet velocity to the freestream velocity) on the jet trajectory in the transverse plane in the far field. From the model, the increase of the jet penetration (the jet edge distance from the nozzle exit plane) component s in the transverse plane to the downstream distance x obeys to the same one-third law in the case of normal transverse jet. The circulation of the large vortex in the transverse plane decreases with a power of one-third of x. The effect of velocity ratio on the jet trajectory is also similar with that in the case of normal transverse jet. Penetration and circulation in the transverse plane both increase as the jet pitch angle increases, and they reach a maximum at a skew angle of 90 degrees. Data from the literature are normalized and compared to the model. While there is considerable scatter, the normalized data are generally in accord with the predictions of the model. However, for low velocity ratios ≤ 1.0 when skew angle is near 90 degrees, the effects of jet entrainment as well as horseshoe and wake vortices may create a low-pressure region on the wall, and hence alter the jet trajectory and vortex circulation.

Robert Breidenthal
University of Washington

Date submitted: 28 Jul 2017 Electronic form version 1.4