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Viscous Eddy Structures in an Oscillating Cylinder with Sharp Corners

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The two-dimensional flow of a viscous fluid contained in a cylinder which is subjected to rotational oscillatory motion is considered. The instantaneous flow relative to the cylinder is driven by a Poincaré-type force which provides a uniform rate of production of vorticity. The problem may be linearised when the viscosity is sufficiently large and the amplitude of oscillations is sufficiently small; the Reynolds number of the instantaneous flow relative to the cylinder is then small, and the Strouhal number is large. If the cross-section of the cylinder has any sharp corners, the nature of the flow near these corners may be analysed through comparison of the 'driven' component of the flow, and the eigenfunction ingredients of the corresponding homogeneous problem which are inevitably present. A sufficient condition for the appearance of oscillatory eddy structures emerging from the corners is obtained and confirmed numerically for various geometries of the boundary.

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