V-shaped wings and a central body in a supersonic flow

© M.A. Zubin[1], F.A. Maksimov[1, 2], N.A. Ostapenko[1]

[1]Institute of Mechanics, Lomonosov Moscow State University,
Moscow, 119192, Russia
[2]Institute for Computer-Aided Design, Russian Academy of Sciences,
Moscow, 123056, Russia

We present results of a numerical investigation of flow structure around V-shaped wings featuring a central body in the form of a truncated cone. The investigation assumed the ideal gas model, with a shock wave attached at the leading edges. We determined the cone half-angle for the case when inviscid vortex structures arise in the shock layer when the flow around the body is symmetrical. These structures are known as Ferri vortex singularities. We found that their appearance and existence are in good agreement with criteria derived previously. These criteria are related to the intensity of the contact discontinuity originating in branching points of the leading shock wave and to the Mach number of that component of the undisturbed flow velocity vector that is perpendicular to the conical coordinate system ray passing through the same branching point.
For a wing featuring a 180° aperture angle and a 90° angle between cantilevers (half-cone on a plate) we determine the angles of the half-cone, attack and yaw that cause inviscid vortex structures to appear. We confirm that it is possible to predict them using the criteria determined previously.
We investigated the way the cone affects the aerodynamic fineness of its composition with the V-shaped wing when the Mach number M = 6. We found that optimum body geometry depends heavily on the value the lift coefficient takes. When this value increases, the composition may comprise a central body and feature the aperture angle of the V-shaped wing $\gamma > \pi$; it may be a flat triangular wing and a V-shaped wing with the angle $\gamma < \pi$.

Keywords: *V-shaped wing, supersonic flows, simulation, vortex singularities*

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Zubin M.A., Cand. Sc. (Phys.-Math.), Leading Research Fellow, Lomonosov Moscow State University, Institute of Mechanics. Specialises in aeromechanics and gas dynamics, supersonic and hypersonic flows, interaction between shock waves and boundary layers. e-mail: zubinma@mail.ru

Maksimov F.A., Dr. Sc. (Eng.), Leading Research Fellow, Institute for Computer-Aided Design, Russian Academy of Sciences, Lomonosov Moscow State University, Institute of Mechanics. Specialises in aerodynamics, numerical simulation, mathematical modelling of natural phenomena. e-mail: f_a_maximov@mail.ru

Ostapenko N.A., Dr. Sc. (Phys.-Math.), Deputy Director for Research and Development, Institute of Mechanics, Lomonosov Moscow State University. Honoured Research Scientist of Lomonosov Moscow State University, Laureate of the M.V. Lomonosov and N.E. Zhukovskiy awards. Specialises in theory of supersonic conical flows, interaction between shock waves and boundary layers, aerodynamics of three-dimensional bodies and wings at supersonic and hypersonic speeds, penetration and dynamics of bodies in dense media, optimum profiling problems. e-mail: ostap@imec.msu.ru