Study on a concept of a business jet with high passenger comfort

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Market surveys show that demand for comfort, in particular a large cabin, is critical to the success of business-jet. In order to satisfy this demand the wing is moved usually outside the fuselage in a typical business-jet configuration leading to the need of large belly fairing (Fig.1). Such a configuration is a typical unfavorable aerodynamic interference example with poor drag-rise characteristics because a wing itself works in an accelerated flow region. On the contrary putting a wing in a zone of decelerated flow where a local Mach number is less than free stream value may postpone drag-rise to higher velocities. Well-known "area rule" for near sonic aircraft is based on this principle but for subsonic speed vehicles it is expedient also.

Fig.1 – Typical business jet layout

Original "area ruling" has been used by the authors at designing of a new layout of a small business jet "Tadpole" (Fig.2) designed for 4-8 passengers. The drop-shaped fuselage allows to improve considerably comfort of passengers (the maximum altitude of interior H=1.9m - the greatest among analogues) and to receive favorable aerodynamic wing-fuselage interference. Additional deceleration of the flow in a wing root region is obtained by traditional placing of the engines on the fuselage near the trailing edge. All of this makes it possible to reach the maximum speed corresponding to M=0.8 with entirely unswept wing having usual relative thickness distribution (t/c=15-11% in root and tip sections accordingly). Use of a straight wing simplifies and lightens the design, allows obtaining high lift in the absence of slats and promotes natural laminar flow of a wing at speedy cruise.

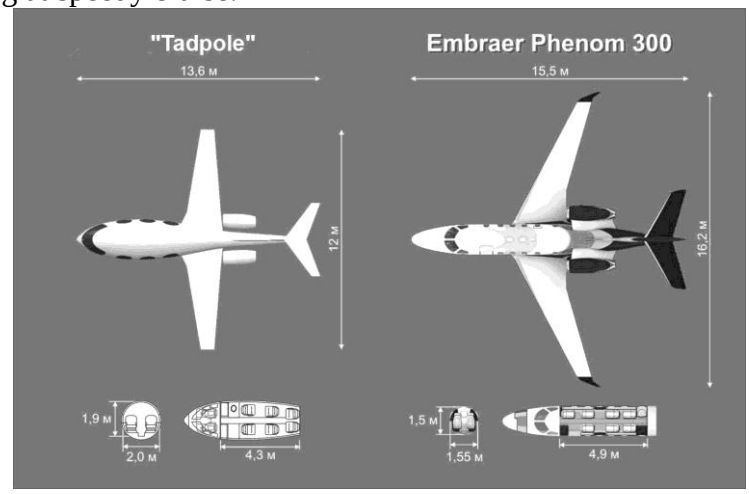

Fig.2 – A comparison of general dimensions and cabin volume

Aerodynamic configuration of the airplane was designed with the help of CFD and CAD methods. The 1:8 scale aerodynamic model of the business jet has been manufactured and tested in the TsAGI's low-speed wind tunnel T-102 and large transonic wind tunnel T-128. The results obtained are discussed together with a comparison with preliminary CFD data.