# WingCoef

## Wing Alone Aerodynamic Coefficients

#### PURPOSE

Preliminary aerodynamic design, quick and easy estimation of aerodynamic coefficients.

### DESCRIPTION

Program calculates non-linear static coefficients and their derivatives and linear dynamic coefficients of the wings alone. The program is based on following sources: Russian literature (Lebedev<sup>1)</sup> and Belocerkovski<sup>2)</sup>), and western literature (Martin-Marietta<sup>3)</sup> and Wing<sup>4)</sup>). The calculation procedure could be done as a function of Mach number or of angle of attack for various shapes of wings: delta wings, rectangular and clipped delta wings. Aerodynamics characteristics of wing alone obtained by the program can be used as input data for programs which calculates aerodynamic coefficients of whole configuration.

#### LIMITATIONS

Limitations of input parameters depend on method to be used and are listed in the above table

Source	Mach number	Aspect ratio	Angle of attack [deg]
Lebedev <sup>1)</sup>	0÷5	$0$ ÷ $\infty$	0÷20
Белоцерковский <sup>2)</sup>	0÷5	$0$ ÷ $\infty$	0÷6
Martin-Marietta <sup>3)</sup>	0.8÷3	0.5÷2.6	0÷180
NEAR/Nielsen <sup>4)</sup>	0.8÷3	0÷2.6	0÷90

## **INPUT DATA**

Geometrical and aerodynamic characteristic of trapezoid shapes wings (aspect ratio, leading edge sweep angle, taper ratio and airfoil thickness to chord ratio.

<sup>&</sup>lt;sup>1)</sup> Лебедев, А.А., Чернобровкин, Л.С.: Динамика полета беспилотных летательных аппаратов, Машиностроение, Москва 1973.

<sup>&</sup>lt;sup>2)</sup> Белоцерковский, С. М., Скрипач, Б. К., Табачников В. Г.: *Крыло в нестационарном потоке газа*, Наука, Москва, 1971.

<sup>&</sup>lt;sup>3)</sup> Aielo, G. F., Batewan. M. C., "Aerodynamic Stability Technology for Maneuvrable Missiles", ADA 070250. 1979.

<sup>&</sup>lt;sup>4)</sup> Nielsen, J.N., Hemsch, M.J., Smith, C.A.: "A Preliminary Method for Calculating the Aerodynamic Characteristics of Cruciform Missiles to High Angles of Attack Including Effects of Roll Angle and Control Deflections", ONR-CR215-226-4F (ADA 054349), Nielsen Engineering & Research, Inc. Mountain View, California 94043, 1977.

## **OUTPUT DATA**

Output results are placed in next files: *TABLE.DAT* and *DRAW.DAT* with wing normal force coefficient and axial and lateral position of wing normal force if table form and in form prepared for obtaining picture of results. All data are also plotted on graphs.



Nonlinear normal force coefficient - comparison of two methods.



## **COMPARISON WITH EXPERIMENTS**

For wing with following characteristics: aspect ratio -2.26, taper ratio -0.018, airfoil thickness to chord ratio -0.025, leading edge sweep angle -60 degree. Results of calculation are compared with experiment and shown on following diagrams:



Nonlinear lift coefficient - comparison of two methods.