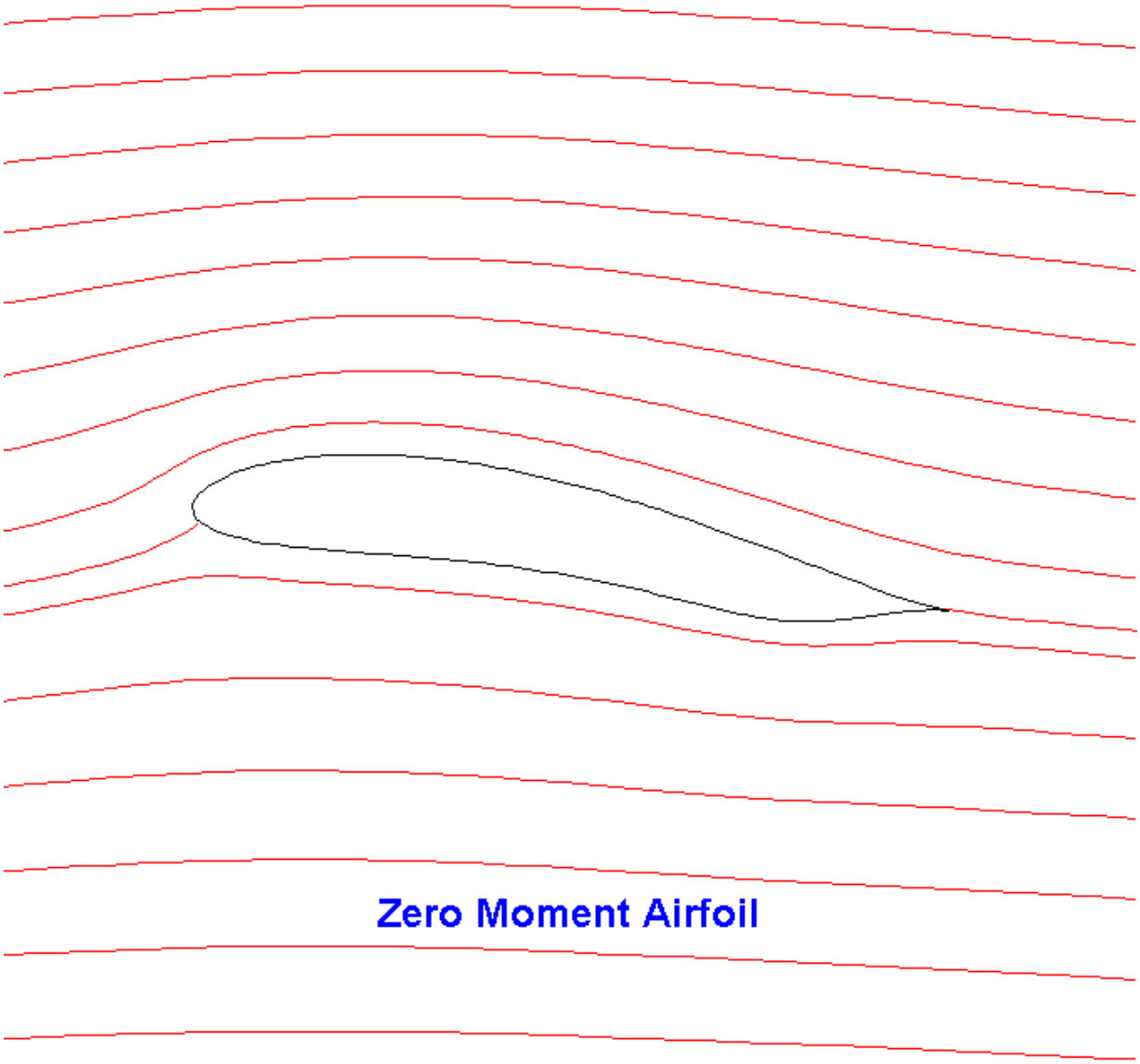
Low Speed Optimum Airfoil



by

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Complex Potential Airfoil Theory

Airfoils can be described - according to Richard von Mises - by the following formula:

$$z = z_1 + \frac{a_1}{z_1} + \frac{a_2}{z_1^{\,2}} + \frac{a_3}{z_1^{\,3}} + \ldots + \frac{a_n}{z_1^{\,n}}$$

Hereby all variables designate complex numbers and z_1 describes a circle in the complex plane.

Optimization

The determination of the airfoil for a certain combination of criteria like airfoil thickness, camber and moment coefficient is solved by the suitable choice of the complex constants a_i in the formula. Unambiguous and exact solutions for optimization tasks can so be found.

The here presented airfoil as shown in Fig. 1 is an example of such an unique, optimized airfoil. It is the only complex theory airfoil of that kind that fulfills the criteria of

a thickness of 13% of the airfoil chord length,
a camber of 4% of the airfoil chord length and
a moment coefficient of zero ($|c_m| < 0.004$)

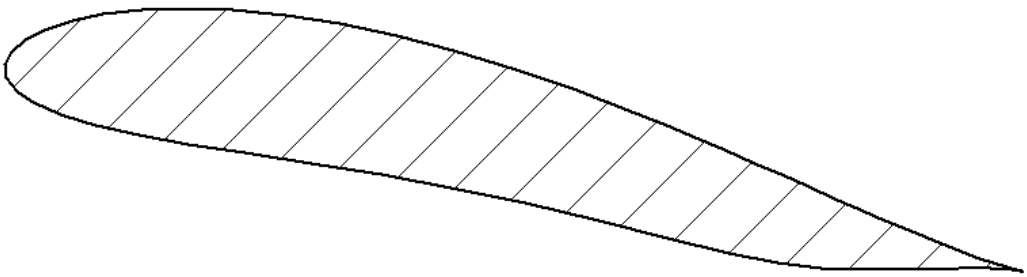

Fig. 1 Optimized Airfoil

This is the optimum solution from complex potential airfoil theory: A slow speed airfoil that does not stall! Compare to the airfoil of the front page.

Properties of the Optimized Airfoil

The computation according to the method of the German professor Richard Eppler of the aerodynamic characteristics of the optimized zero-moment airfoil of Fig. 1 shows:

- a laminar flow up to angles of attack of about 11° (Fig. 2 and 3).
- a moment coefficient that stays close to zero and goes up significantly only when the angle of attack exeeds 20° (Fig. 4).
- a good-natured behavior at higher angles of attack up to 20°: The airfoil does not stall (Fig. 3).
- a large airfoil area that permits the construction of big volume wings and facilitates internal reinforcement of the wing.

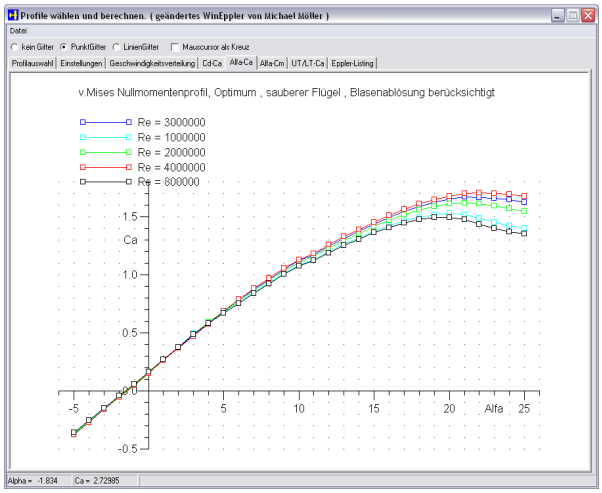

Fig. 2 Ca-α Diagram of the Optimum Airfoil

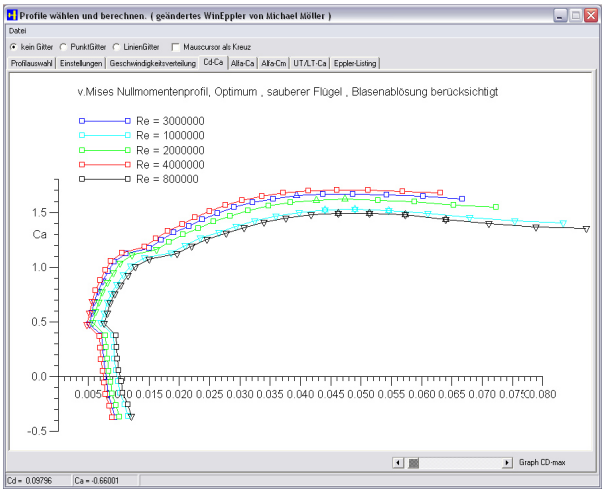

Fig. 3 Ca-Cd Polar Diagram of the Optimum Airfoil

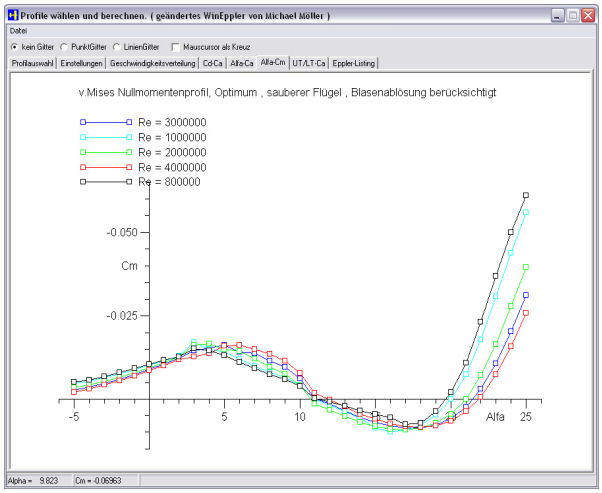

Fig. 4 Cm-α Diagram of the Optimum Airfoil

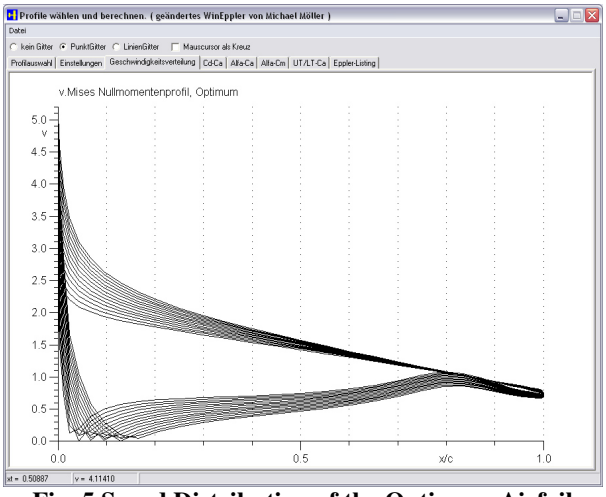

Fig. 5 Speed Distribution of the Optimum Airfoil

Usage of the Optimized Airfoil

The here described optimum airfoil is particularly suitable for:

- **Slow flying Aircrafts**
  of all kinds
  such as

- **Lightweight General Aviation Aircrafts**
  The flow about the airfoil at higher angles of attack may be characterized as good-natured. Wings, which are equipped with this airfoil, are therefore ideal for slow speed flight.

- **Flying Wings**
  Use of the airfoil in slow speed flying wings makes the solution of stability problems of flying wings easier and reduces the moment related part of the induced drag because of the zero moment coefficient.

- **Transport Aircrafts**
  The airfoil has a large lift at low speeds and a high lift/drag ratio while at the same time it does not stall.

  And all other types of slow flying aircrafts:

- **UAVs**
- **Model Aircrafts**
- **Experimental Aircrafts**
- etc.

Legal Rights and Use

The airfoil described above is part of a German Registered Design owned by the author (Gebrauchsmuster 20 2005 018 086.6, IPC B64C 3/14 (2006.01)).

If you want more information or want to use the described airfoil, please contact

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