FACHHOCHSCHULE REGENSBURG
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Labor Windkanal/Strömungsmesstechnik

Aerodynamic optimization of a wing-fuselage combination of a wind tunnel model

(Reduction of the interference drag caused by a wing-fuselage combination)

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1. The content of the thesis

Content of this thesis is the aerodynamic optimization of a wing- fuselage combination of a wind tunnel model.

The main focus is the reduction of drag caused by this wing/- fuselage combination. By using constructive methods this drag should be decreased and the aerodynamic performance should be increased.
With the aid of force measurement technique the resulting drag forces are logged over different wind speeds und angles of attack. This enables an evaluation of the different optimizations measures regarding to their success. The unmodified wing- fuselage combination is used as a reference. All tests are made in the Regensburg Wind Tunnel (RWT) of the HS Regensburg with the aid of a self designed test rig, which was a part of this thesis as well.

As a constructive modification the following methods were used:

Fig. 1: drag reduction with corner arc

Fig. 2: drag reduction with roughness stripes

Fig. 3: drag reduction with guiding plates

2. The test rig

The first step was to construct a working test rig. It is important that the test rig offers the following properties:

- Variable angle of attack (-5° to +20°)
- Enough stability during operation
- Easy to assemble and disassemble
- Stable holding fixture for the wind tunnel model
- Loading cells out of the wind flow
- Repeatable results of measurements

Fig. 4: mounted test rig

Holding fixture:

It is made out of commercially available U-profiles and PU-foam. This enables mounting the wind tunnel model on the test rig. The foam causes a form closure of the wing to the holding fixture which is important for repeatable results.
The device for the adjustability for the angle of attack is also mounted on the holding fixture.

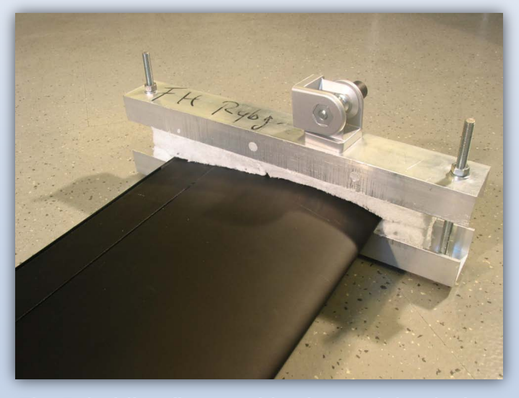

Fig. 5: holding fixture with wing and the device for the adjustability of the angle of attack

3. Test result of the unmodified model

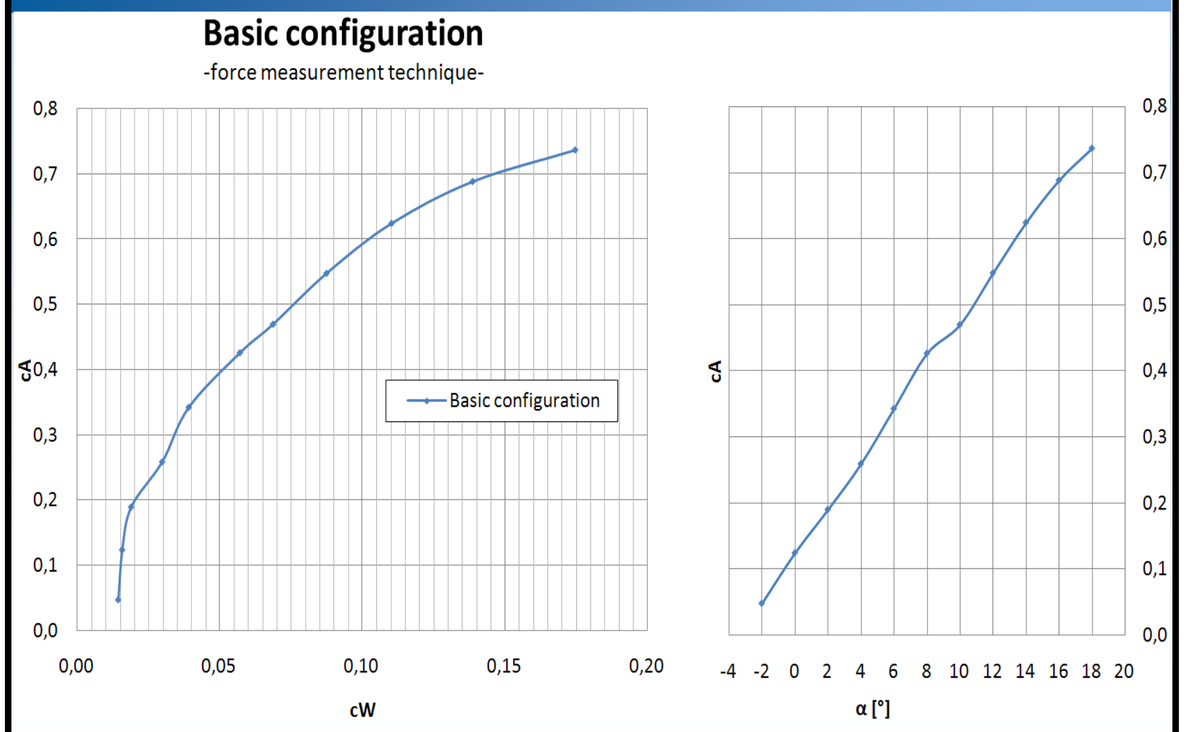

Fig. 6: drag/lift relationship of the unmodified wing / fuselage combination

The wind tunnel model has been analysed over different angles of attack and wind speeds. As a result you get a so called Type2-Polar and a lift/- angle of attack relation. It is obvious that in the area around 4° angle of attack an increase of drag can be observed mainly caused by flow seperation. The aerodynamic performance of the wind tunnel model has to be improved by the use of aerodynamic modifications.

4. Test result with guiding plates

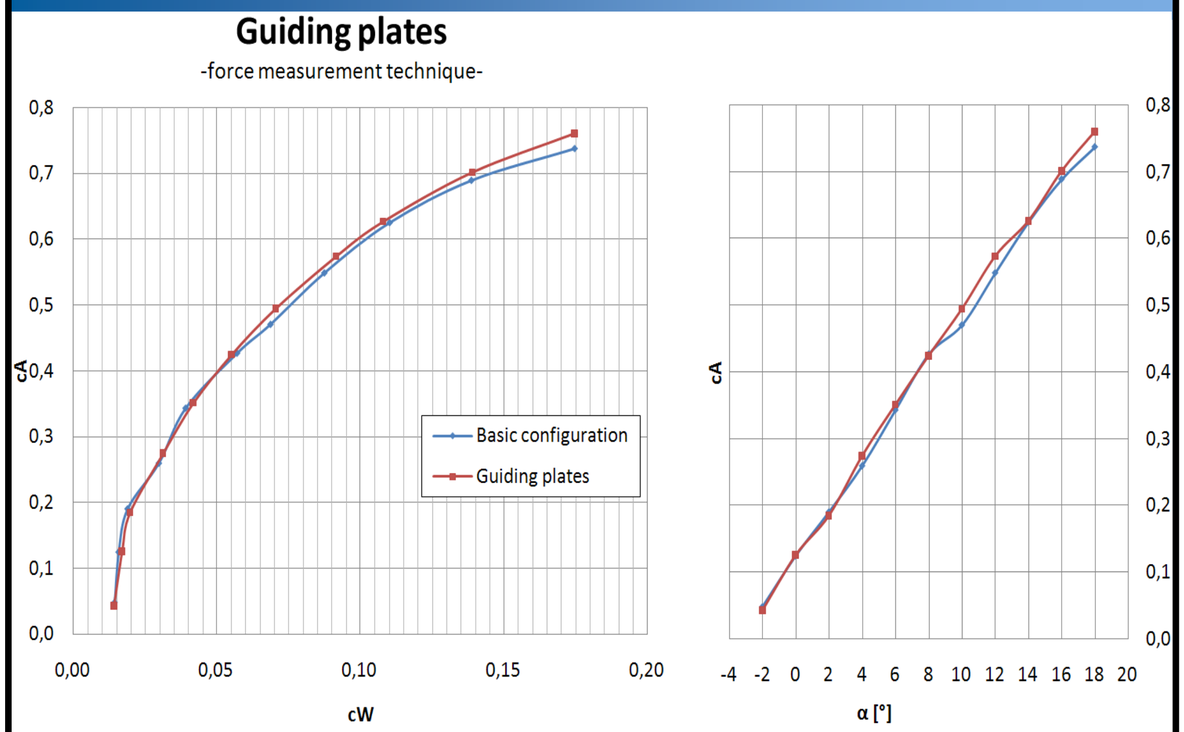

Fig. 7: drag/lift relationship of the wing / fuselage combination modified with guiding plates

The wind tunnel model has also been analysed after some aerodynamic modifications. With guiding plates installed in the rear area of the wing the aerodynamic drag can actually be reduced up to 9% of the face value without modifications. By the use of other modifications the drag could be decreased in some areas as well. These basic results can be used for extensive research in the future.