Influence of the transititon of the boundary layer on airfoil SL09-150

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1. Project target

The aim of the bachelor thesis is the aerodynamic optimization of the airfoil SL09-150 trough the use of transition trips. These trips achieve the transition of the boundary layer from laminar flow to turbulent flow. Thereby a laminar separation bubble can be prevented and the overall wind resistance can be reduced.

Inside the closed test section of the windtunnel in Regensburg drag and lift of different airfoils can be measured. The drag und lift coefficients are calculated fully automated and merged into polar curves.
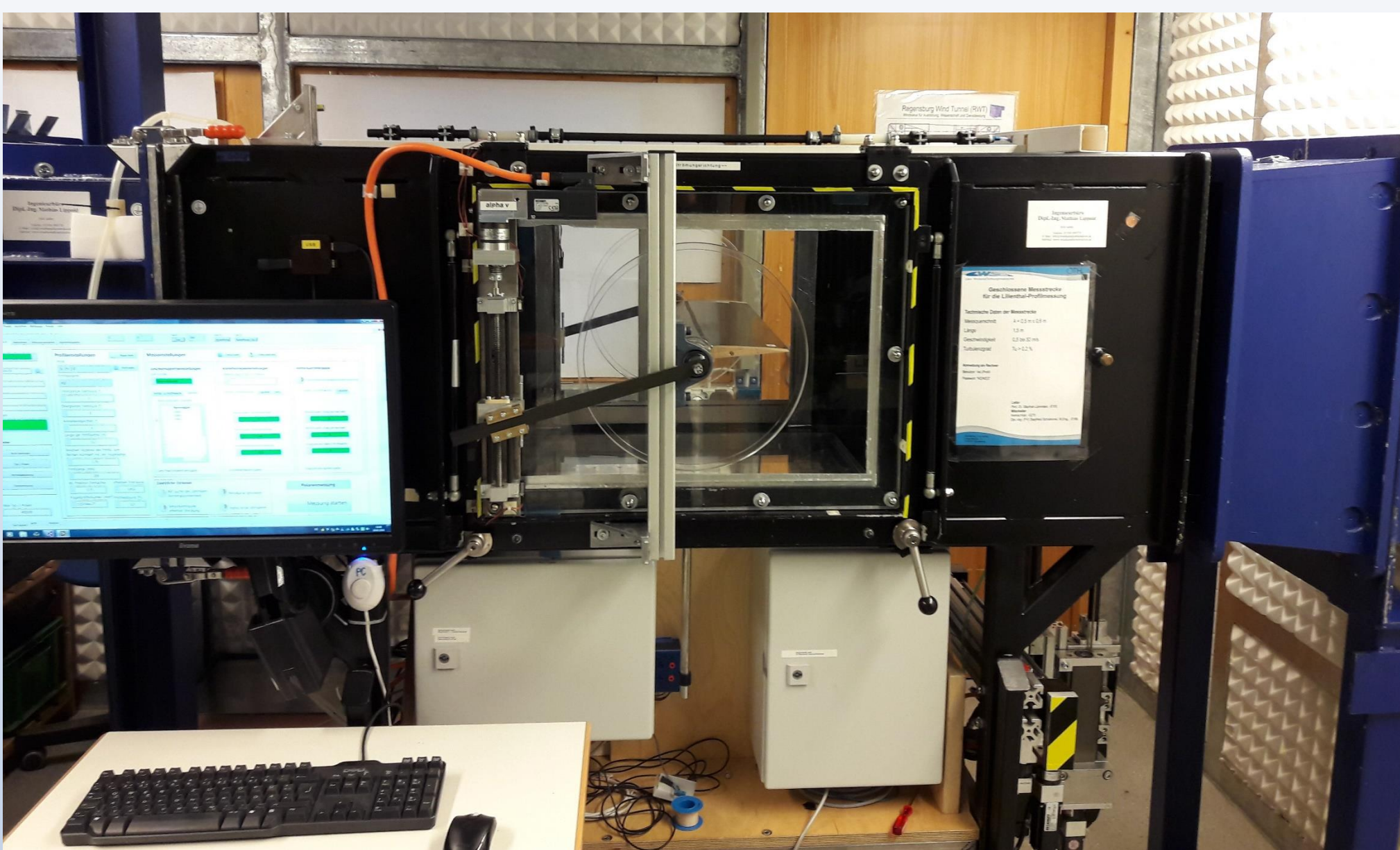

Fig. 1: Closed test section of the windtunnel at the OTH Regensburg

2. Simulations

Before the experimental measurements, simulations are performed. The simulations with Profili and XFoil produce first results of different turbulatorpositions. With these programs for boundary simulations the approximately position of the transition stripes has been detected and localized, as well as the theoretical potential of performance increasing.
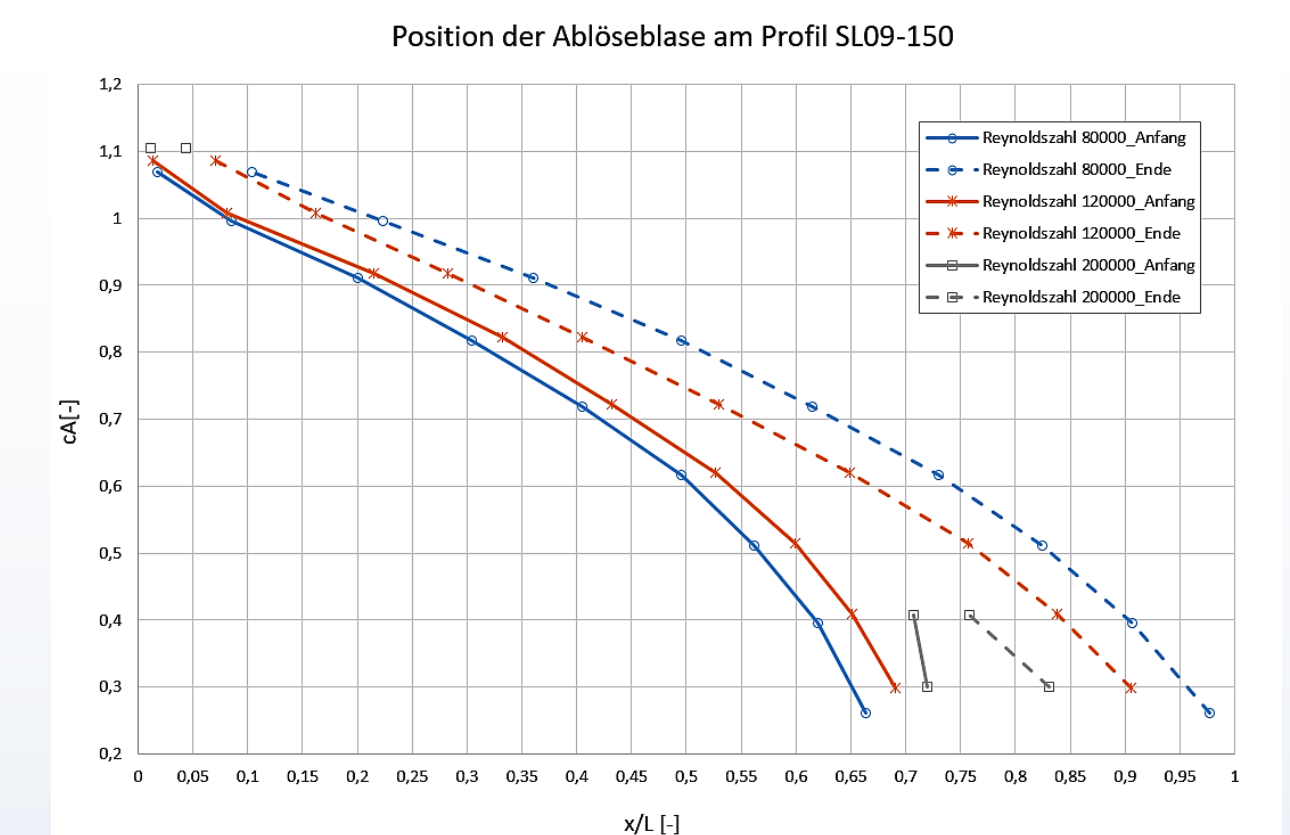

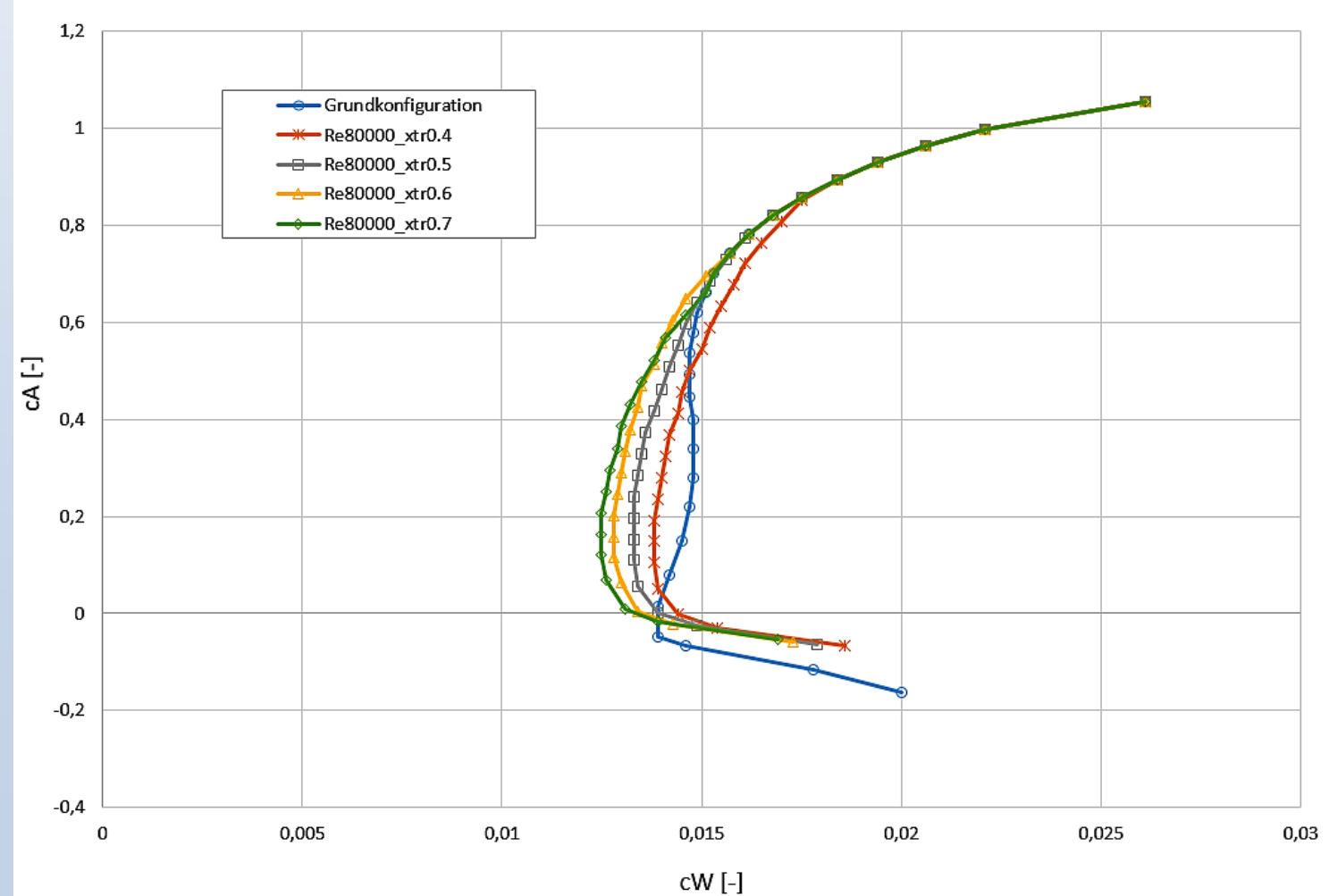**Fig. 2:** Size and position of the laminar separation bubble

Fig. 3: Simulation of type-1-polars for different turbulatorpositons

3. Turbulator production

There are many different types of transition trips or turbulators, which are used by measurements. These are produced by a laser cutting machine. The turbulators consist of a varnish protection layer, it is self-adhesive and easy to attach on the airfoil.
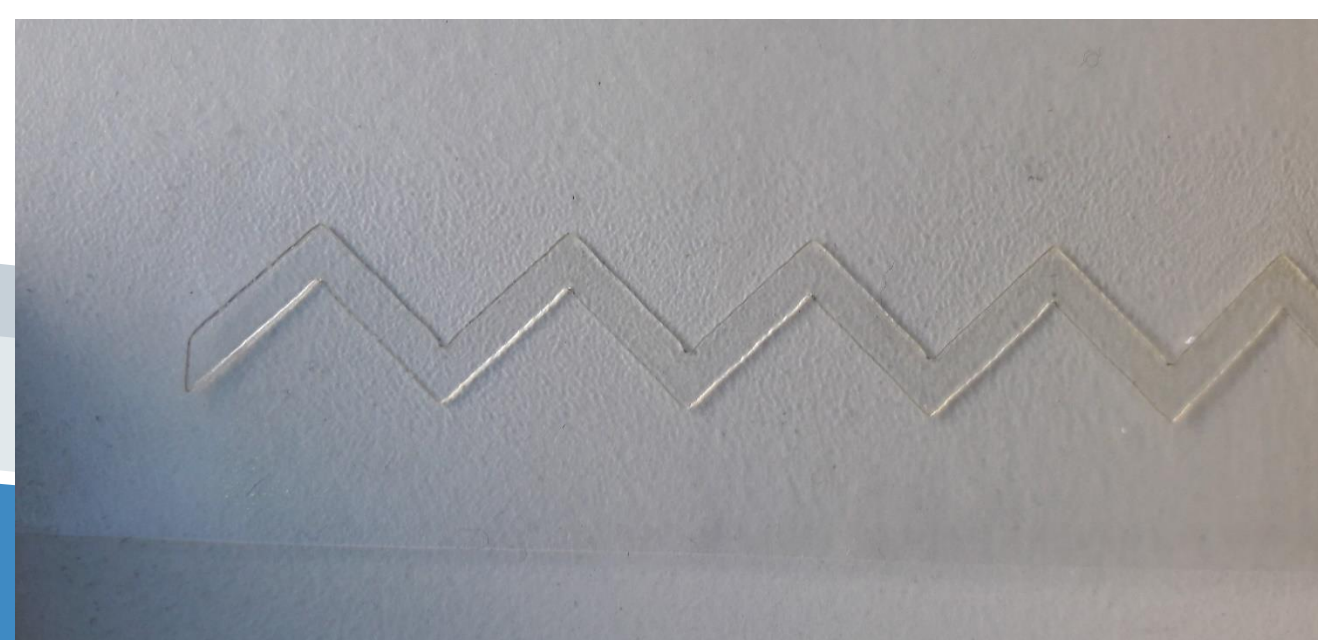

Fig. 4: Laser cutting machine in the LWS

Fig. 5: Example of a turbulator uses by measurements

4. Measured results

The goal of the test series is to find an optimal configuration of the turbulators which show the best aerodynamic properties. To get a result, many type-1- and type-2- polars of the airfoil SL09-150 have been performed.
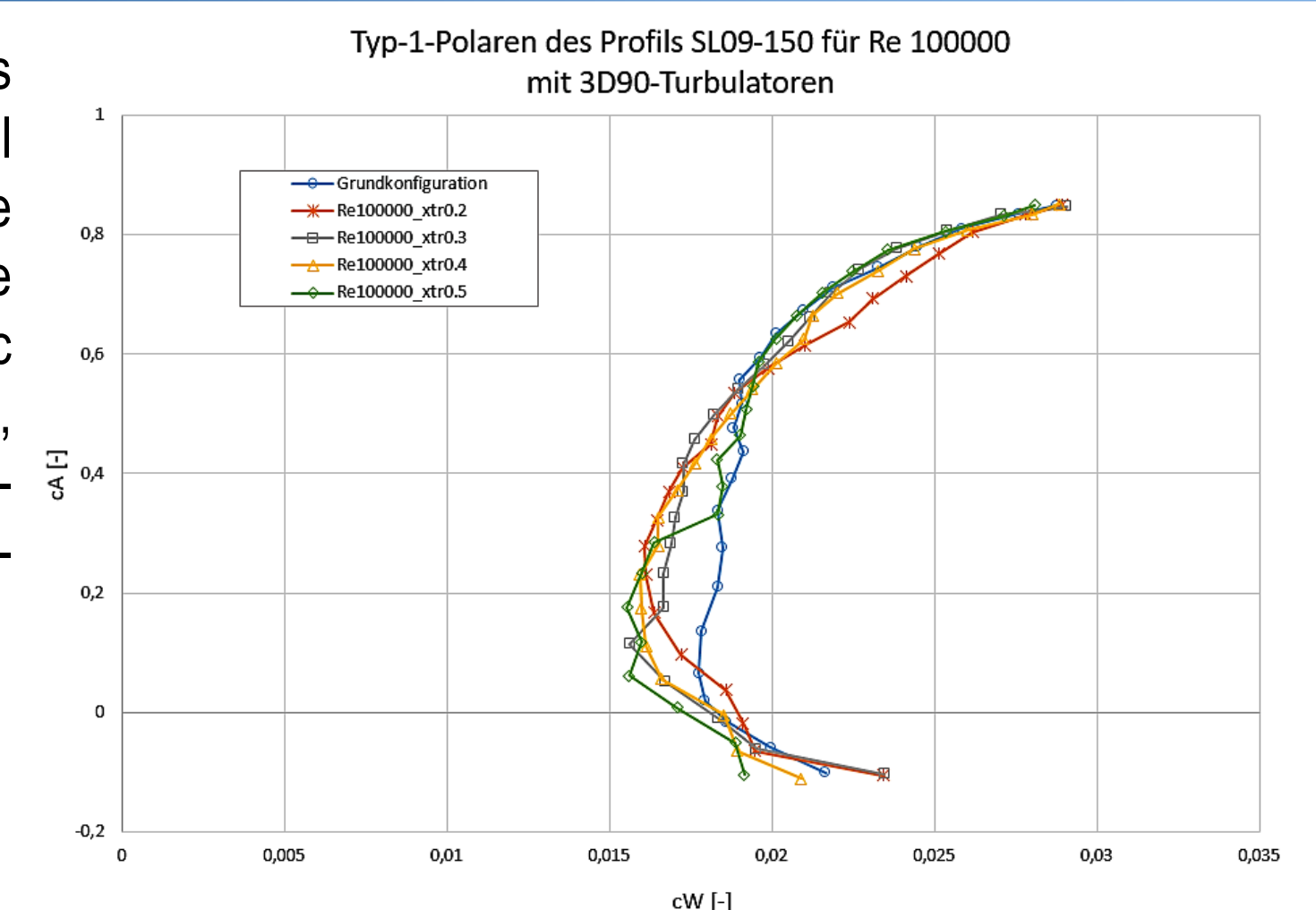

Fig. 6: Type-1-polars of different positions of the 3D90-turbulator

2D-turbulators (straight type with 3mm) and 3D-turbulators (zigzag pattern) with angles of 60° and 90° and a thickness of 0,2mm were measured. The measured results show, the optimal configuration is the 3D90-turbulator at a position of 0.4 based of the leading edge.
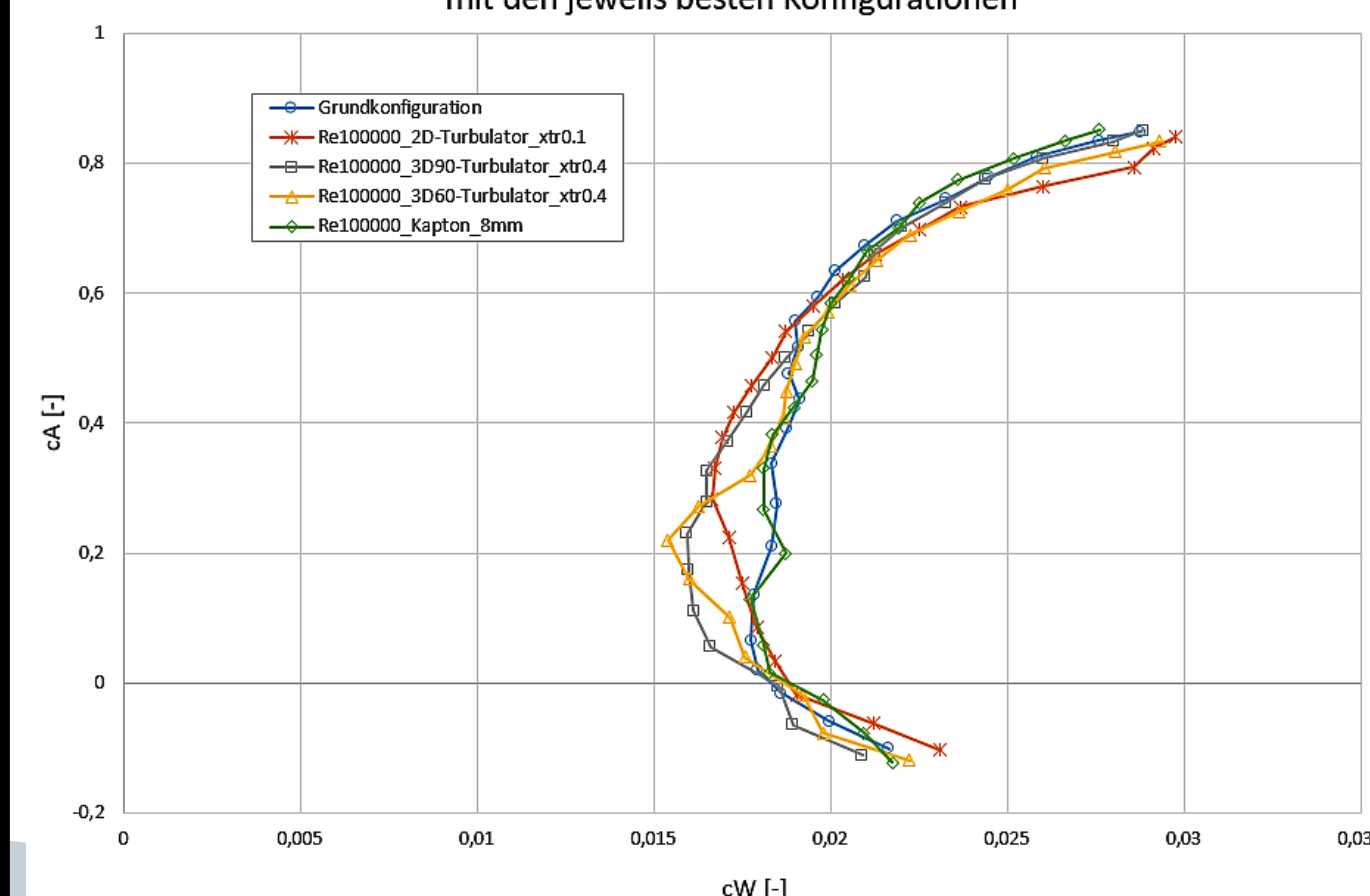
Fig. 7: Comparison between basic configuration and different optimized configurations