Bachelor's Degree in Aerospace Technology Engineering

Bachelor Thesis - Document: REPORT ATTACHMENT

Project of designing and manufacturing a small wind turbine using fused deposition modeling technology

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Chapter 1

Aerodynamic design

1.1 Airfoil selection

In this section the polar curves obtained from XFLR5 will be presented. The data retrieved from each graph will also be shown.

Each value has been obtained using the following criteria:

1. Maximum efficiency E: The mean of the maximum efficiency for each Reynolds.
2. $\Delta\alpha = \alpha_s - \alpha_{opt}$: The mean of difference between optimal and stall angle of attack for each Reynolds.
3. $\frac{d\alpha_{opt}}{dRe}$: The mean of angle of attack variation from $Re = 1.2 \cdot 10^5$ to each other Reynolds.
4. $\frac{dE}{dRe}$: The mean of efficiency variation from $Re = 1.2 \cdot 10^5$ to each other Reynolds.
5. $\frac{dE}{d\alpha}(\alpha = \alpha_{opt})$: The mean of efficiency variation at $\alpha = \alpha_{opt} \pm 2$ for each Reynolds.
6. Thickness t/c: Maximum airfoil thickness.
7. Cl_{opt}: The mean of lift coefficient at maximum efficiency point for each Reynolds.

Airfoil 1: SG6040

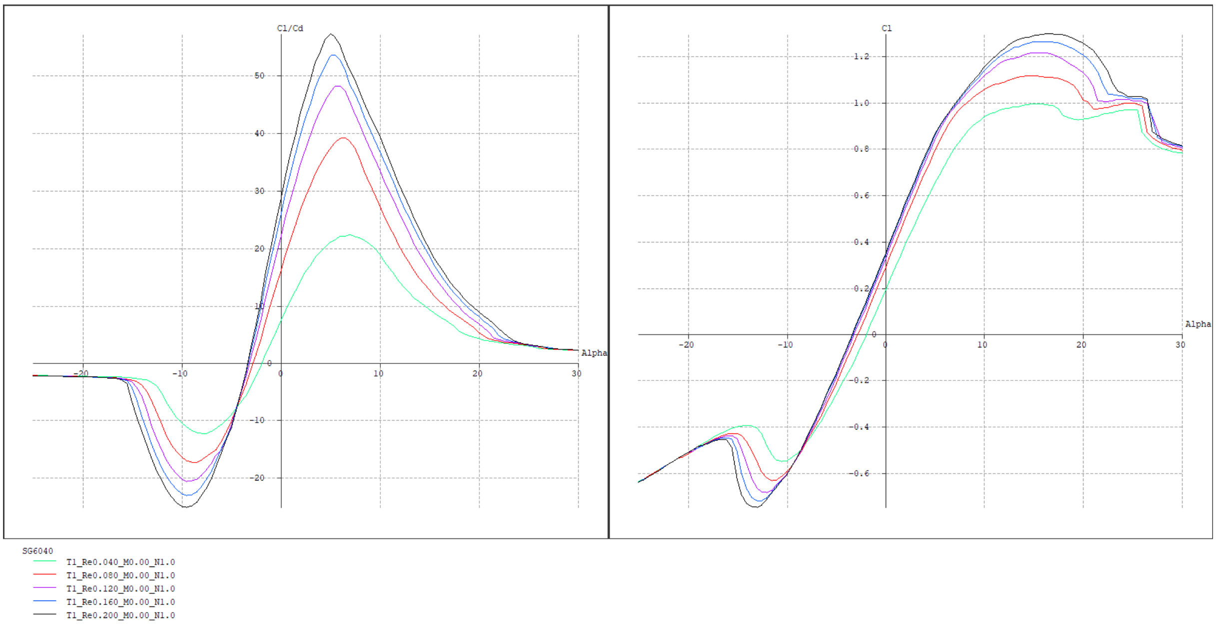

Figure 1: SG6040 polar curves.

Code	Parameter	Value
1	Maximum efficiency E	44.11
2	$\Delta\alpha = \alpha_s - \alpha_{opt}$	10.81
3	$d\alpha_{opt}/dRe$	0.55
4	dE/dRe	9.86
5	$dE/d\alpha(\alpha = \alpha_{opt})$	4.66
6	Thickness t/c	16.00
7	Cl_{opt}	0.87

Table 1: SG6040 data (Airfoil nº 1)

Airfoil 2: SG6041

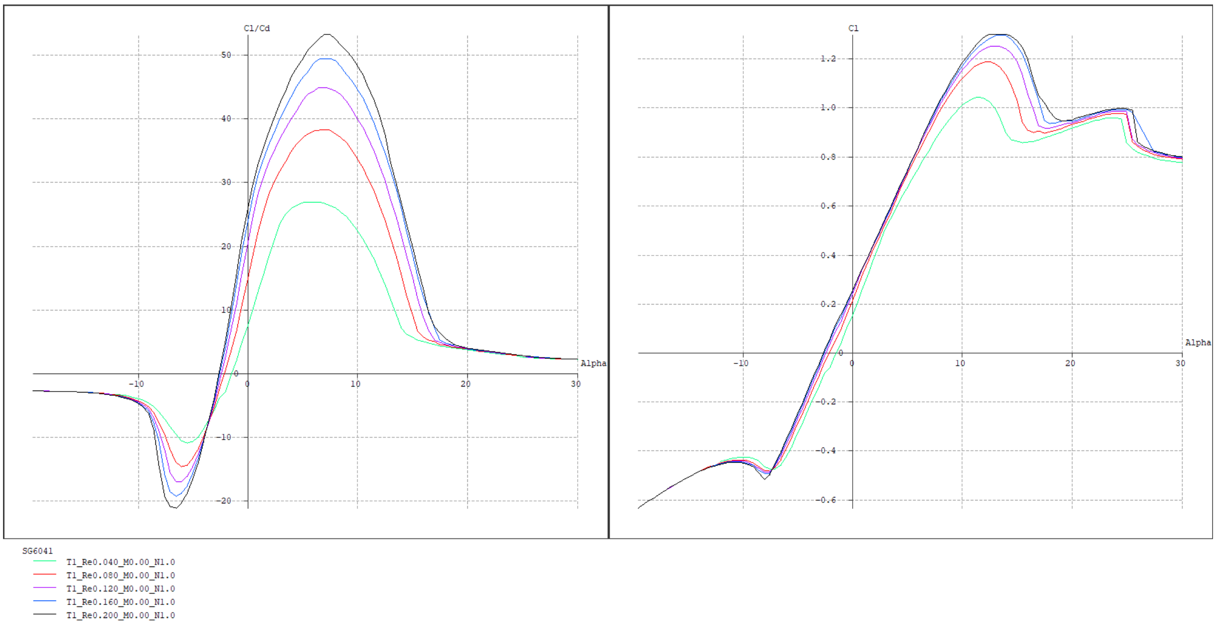

Figure 2: SG6041 polar curves.

Code	Parameter	Value
1	Maximum efficiency E	42.46
2	$\Delta\alpha = \alpha_s - \alpha_{opt}$	6.02
3	$d\alpha_{opt}/dRe$	0.36
4	dE/dRe	7.50
5	$dE/d\alpha(\alpha = \alpha_{opt})$	2.14
6	Thickness t/c	10.00
7	Cl_{opt}	0.89

Table 2: SG6041 data (Airfoil nº 2)

Airfoil 3: SG6042

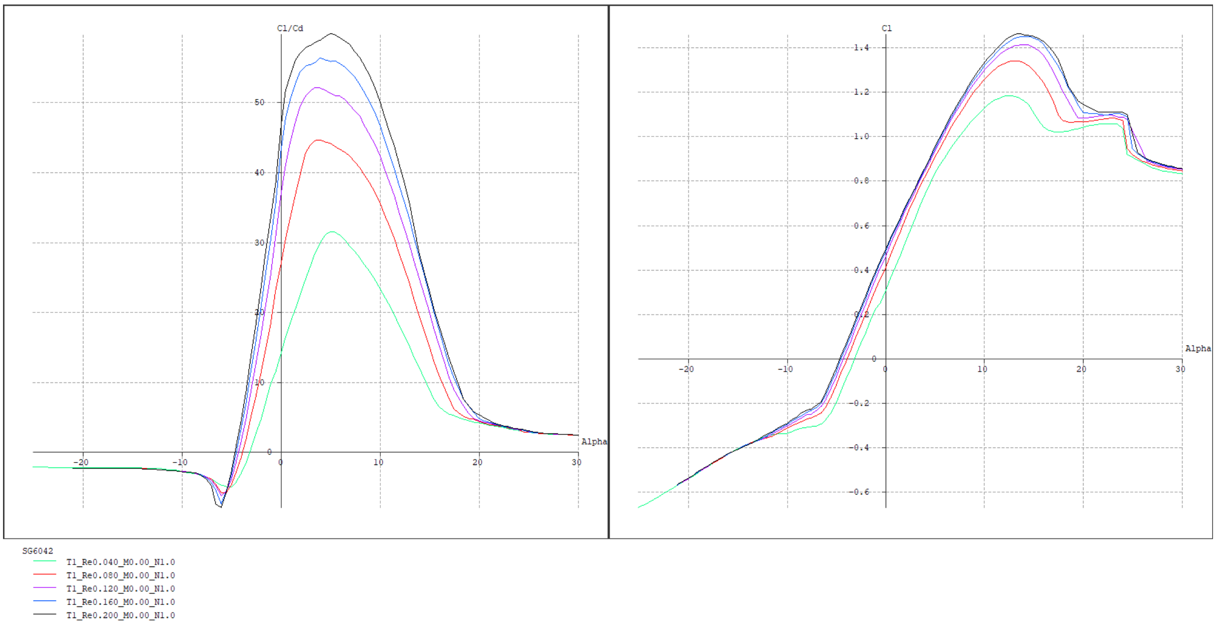

Figure 3: SG6042 polar curves.

Code	Parameter	Value
1	Maximum efficiency E	48.89
2	$\Delta\alpha = \alpha_s - \alpha_{opt}$	9.24
3	$d\alpha_{opt}/dRe$	0.64
4	dE/dRe	8.01
5	$dE/d\alpha(\alpha = \alpha_{opt})$	2.57
6	Thickness t/c	10.00
7	Cl_{opt}	0.85

Table 3: SG6042 data (Airfoil nº 3)

Airfoil 4: SG6043

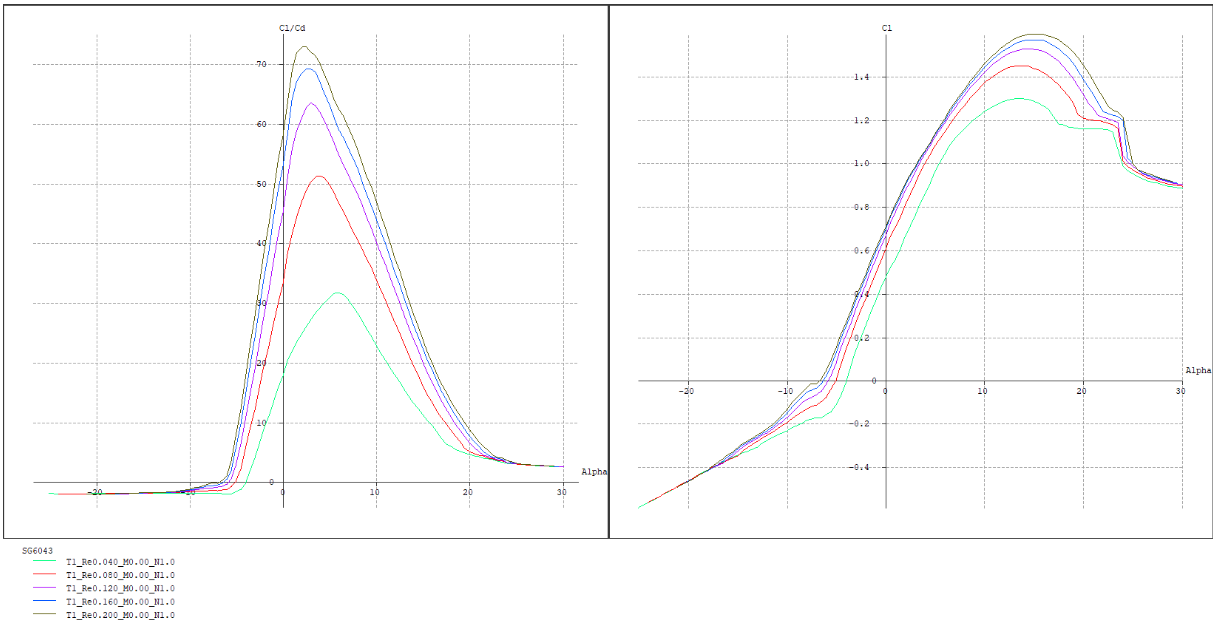

Figure 4: SG6043 polar curves.

Code	Parameter	Value
1	Maximum efficiency E	57.73
2	$\Delta\alpha = \alpha_s - \alpha_{opt}$	10.96
3	$d\alpha_{opt}/dRe$	0.94
4	dE/dRe	11.87
5	$dE/d\alpha(\alpha = \alpha_{opt})$	5.59
6	Thickness t/c	10.00
7	Cl_{opt}	0.97

Table 4: SG6043 data (Airfoil nº 4)

Airfoil 5: S833

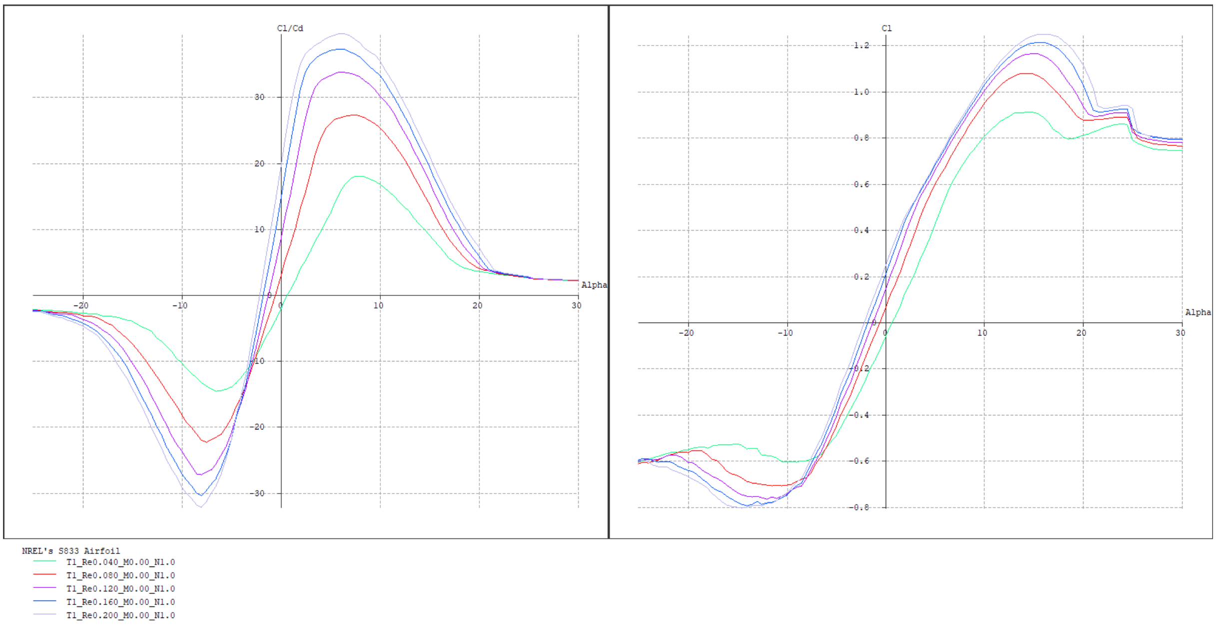

Figure 5: S833 polar curves.

Code	Parameter	Value
1	Maximum efficiency E	31.13
2	$\Delta\alpha = \alpha_s - \alpha_{opt}$	8.59
3	$d\alpha_{opt}/dRe$	0.69
4	dE/dRe	6.32
5	$dE/d\alpha(\alpha = \alpha_{opt})$	1.32
6	Thickness t/c	18.00
7	Cl_{opt}	0.75

Table 5: S833 data (Airfoil nº 5)

Chapter 2

Structural design