Concept, How did we get here?

Everything starts with an idea. Our team wanted to create something different—something new for us. That's how the idea for *Szczerbatek* was born.

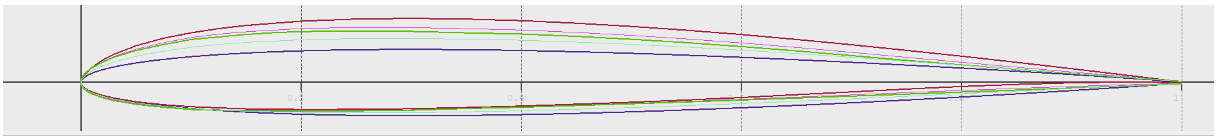
Aerodynamic Analysis.

After planning and initial discussions, it was time to start designing. We aimed to create an airframe that was as aerodynamically efficient as possible within the limits of our knowledge, budget, and time.

The critical parameters we targeted while optimizing the aerodynamics were:

- Optimal airspeed in the range of 40–70 miles per hour
- Maximum efficiency at around 55 miles per hour
- Compact size
- Maximum take-off weight of 4.2 kg (approximately 9.3 pounds)

To achieve this, our team designed a set of airfoils. After many hours of performance optimization, we finalized five airfoils: three entirely of our own design, one transition airfoil, and the well-known NACA 0006.



	Name	Thickness (%)	at (%)	Camber (%)	at (%)	Points	TE Flap (°)	TE XHinge	TE YHinge	Show	Centerline	Style
2	NACA 0006	6.00	29.03	0.00	0.00	99	0.00	0.00	0.00	×		
3	SP 07 -8.18/1.74	8.18	25.03	1.74	35.04	64	0.00	0.00	0.00	×		
4	SP 07 7,5	7.51	25.12	1.28	40.04	64	0.00	0.00	0.00	×		
5	SP 07- 7.2/1.1	7.23	25.03	1.08	39.94	66	0.00	0.00	0.00	×		
6	SP 07/0006	6.73	25.43	0.64	40.24	64	0.00	0.00	0.00	×		

Fig 1.1 Developed Airfoils

This is the thickest airfoil with the highest camber, as it is located near the fuselage. It is also the most lift-generating airfoil in the set.

The middle airfoil, located at approximately 60% of the wingspan, is **SP 07-7.5**.
It has a maximum thickness of 7.5% and a camber of 1.28%. The camber value is not included in the name because this was the first airfoil developed, from which the others were derived. It serves as the wing's main airfoil.

The last custom-developed airfoil is **SP 07-7.2/1.1**, positioned around 90% of the wingspan. It is the final clearly lift-producing airfoil before transitioning to a non-lifting section. The fourth airfoil is a transition airfoil, and the fifth is symmetric.

SP 07/0006 serves as the transition between the custom airfoils and the symmetric **NACA 0006**. This transition was necessary because the NACA 0006 has a much thicker lower surface compared to our designs. The transition airfoil helps blend the surfaces more smoothly, resulting in improved aerodynamic performance.

The **NACA 0006** is used as the tip airfoil. It was chosen to equalize surface velocities on the upper and lower sides of the wingtip, thereby minimizing tip vortex formation and improving the aircraft's handling characteristics.

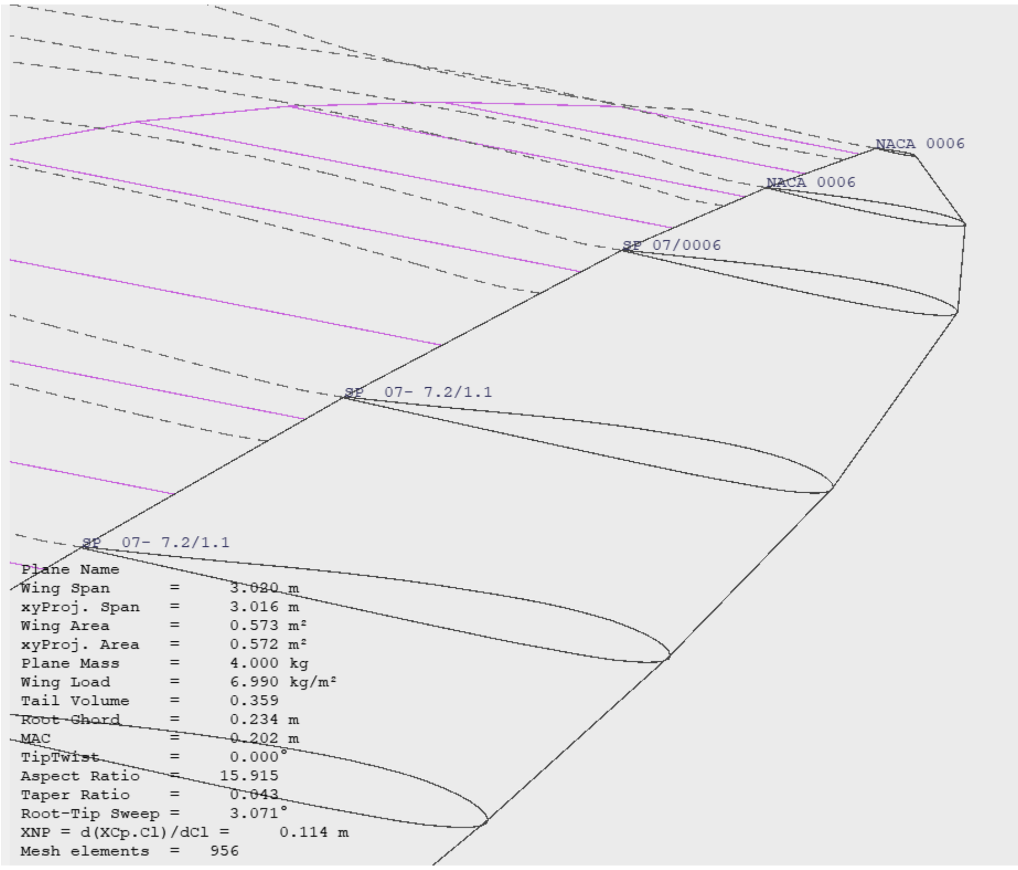


Fig 1.2 Symmetric airfoil wingtip stream and drag visualization

Minimizing wingtip vortex formation was a crucial step, as it effectively improves stall behavior—one of the main drawbacks of the developed airfoils. However, within the appropriate speed range, these airfoils result in a very stable, easy-to-control aircraft with excellent performance.

The next step in the analysis was the design and optimization of the tail section.

The team chose a **V-tail** configuration, as it offers several advantages for our design:

- lower drag compared to standard tail of the same efficiency
- Easy construction
- Lightweight
- less potent to damage while landing
- good looking

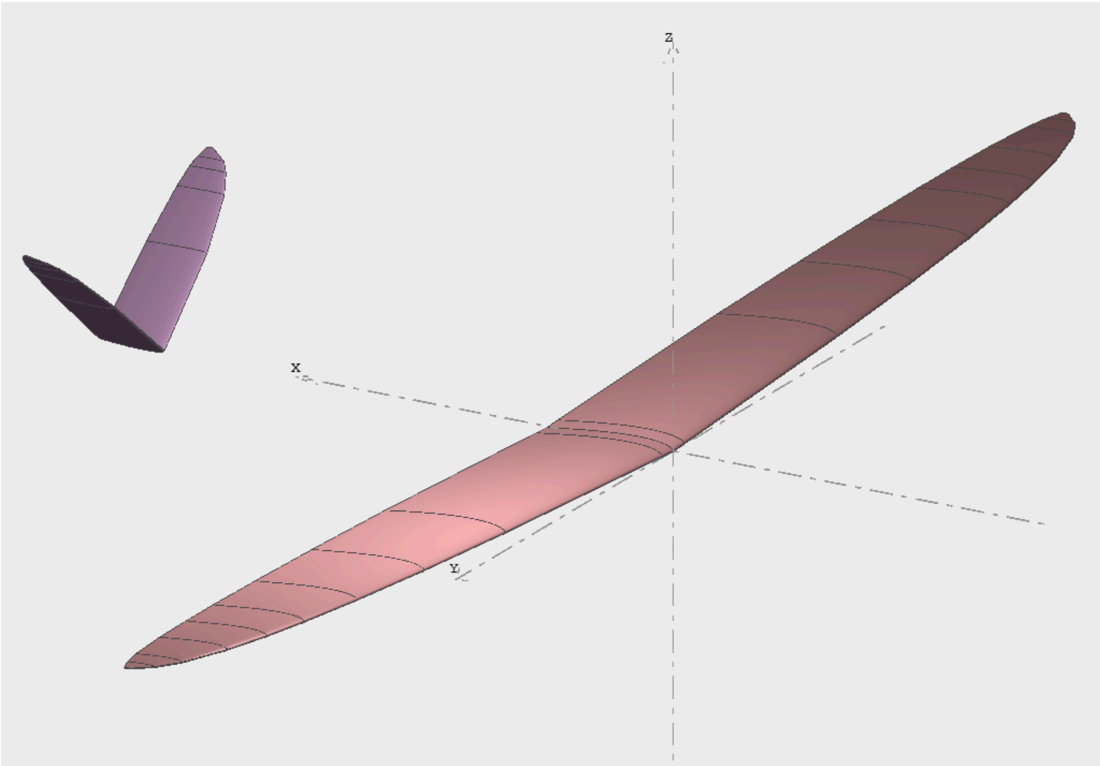


Fig 1.3 Final UAV configuration.

Final aerodynamic parameters:

Wingspan	119 in
Main chord	9,21 in
Wing area	884 in^2
Tail angle	102°
Tail volume	0.359
XNP (Neutral Point)	4,45 in
CG	3,9 in