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BLENDED WING BODY AIRCRAFT: DESIGNING, MANUFACTURING AND FLYING



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During the last few months:

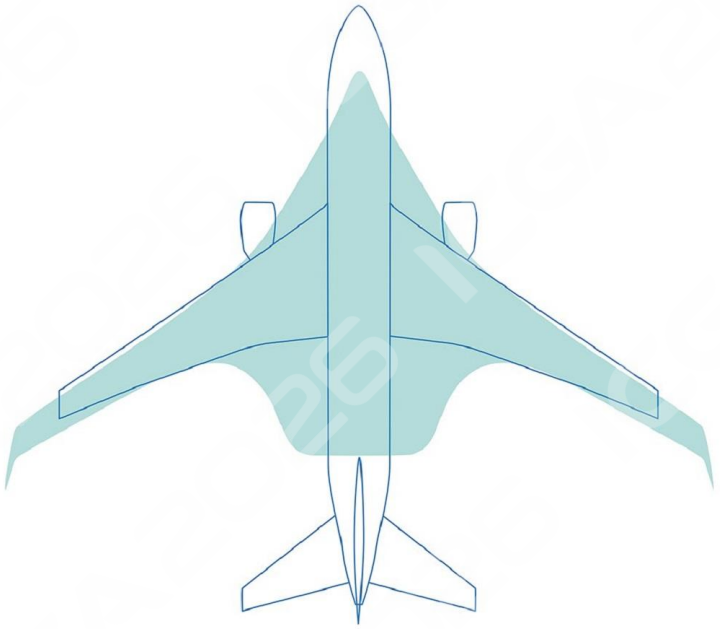
- Designed the first Blended Wing Body (BWB) aircraft prototype.
- Manufactured the prototype.
- Successfully conducted flight tests of the prototype.
- Established the foundation for developing larger-scale flying demonstrators.
- Started moving forward with the development of larger BWB aircraft.
- Established a long-term vision for advancing toward supersonic and hypersonic aircraft.

What is Bleded Wing Body Aircraft?

A Blended Wing Body is an aircraft design where the airplane's body and wings are smoothly mixed together into one single shape.

Advantages:

1- More Lift
2- Less Drag
3- More Space



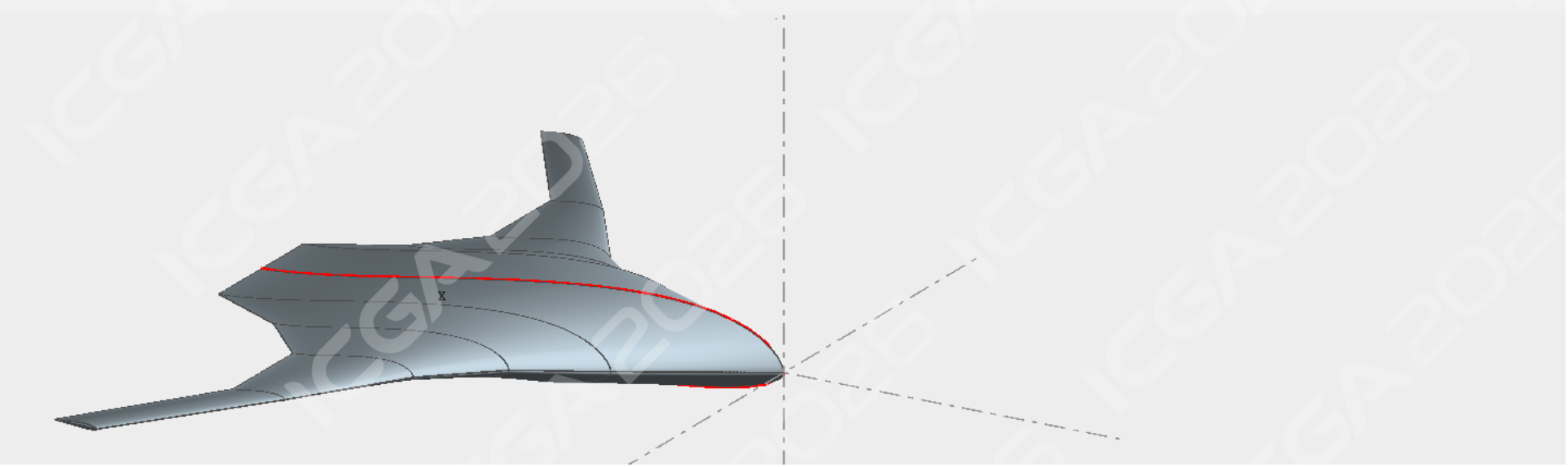


Project Process:

1- Literature Review
2- Hand Calculations
3- Preliminary Design
4- Optimization
5- Detailed Design
6- Analysis
7- Manufacturing
8- Test

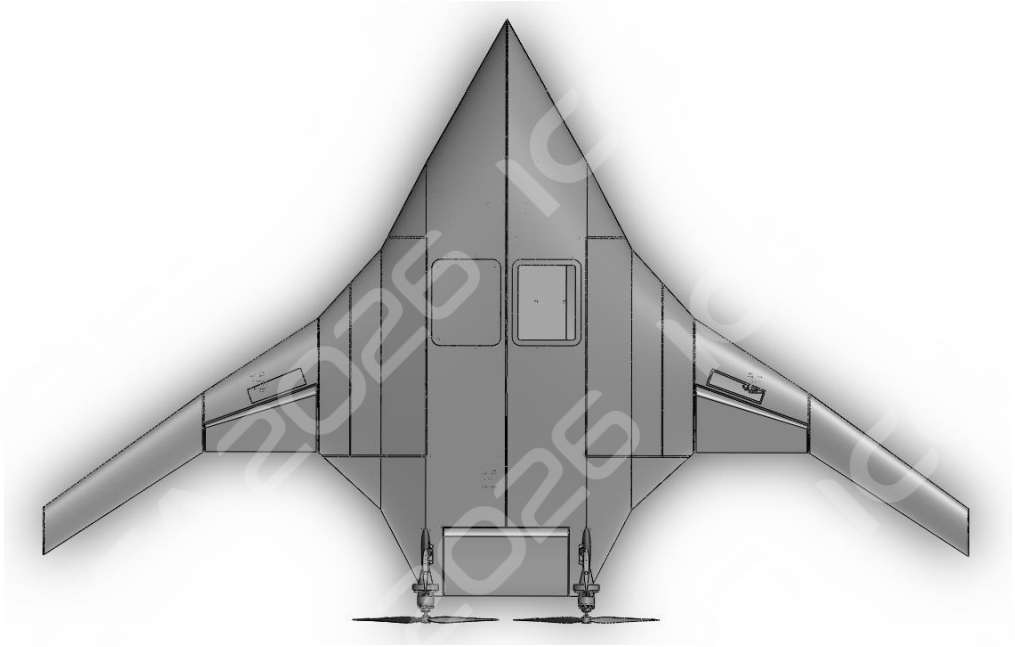
Final Design Optimization

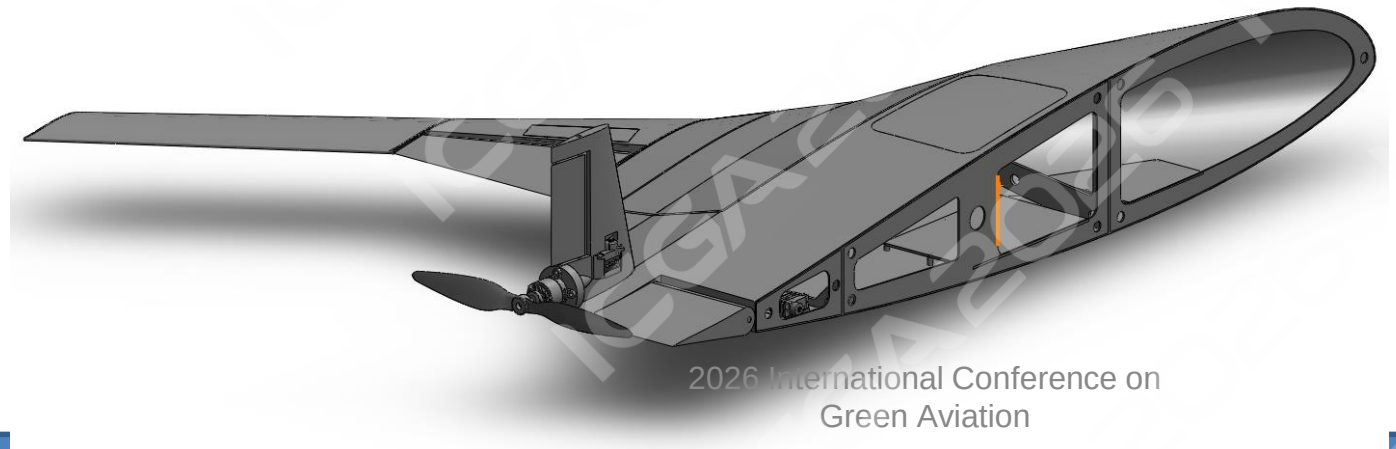
	y ()	chord ()	offset ()	dihedral(°)	twist(°)	foil	X-panels	X-dist	Y-panels	Y-dist
1	0,000	1,000	0,000	0,0	0,00	MH 91 14.98%	13	Cosine	19	-Sine
2	0,140	0,750	0,250	0,0	0,00	MH 91 14.98%	13	Cosine	2	Uniform
3	0,218	0,450	0,400	0,0	0,00	MH 91 14.98%	13	Cosine	2	Uniform
4	0,327	0,230	0,520	0,0	0,00	MH 91 14.98%	13	Cosine	2	Uniform
5	0,527	0,100	0,650	0,0	0,00	MH 60 10.08%	13	Cosine	4	Uniform
6	0,805	0,080	0,850		-2,00	MH 60 10.08%				



Wing Span	1.61	m
Area	0.53	m²
Projected Span	1.61	m
Projected Area	0.53	m²
Mean Geom. Chord	0.33	m
Mean Aero Chord	0.60	m
Aspect ratio	4.90	
Taper Ratio	0.08	
Root to Tip Sweep	37.60	°
Number of Flaps	0	
Number of VLM Panels	754	
Number of 3D Panels	1534	

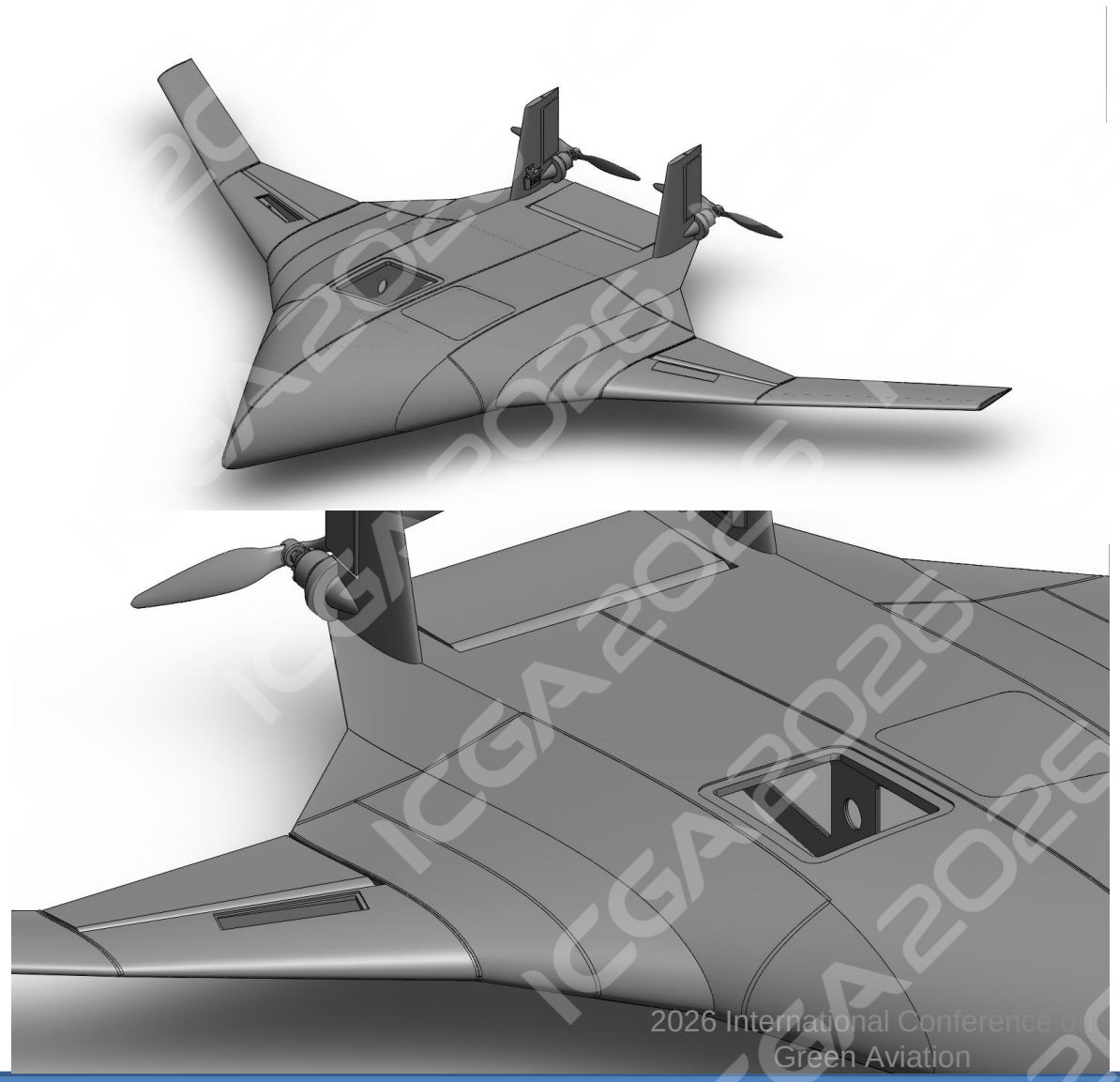
Design Parameters

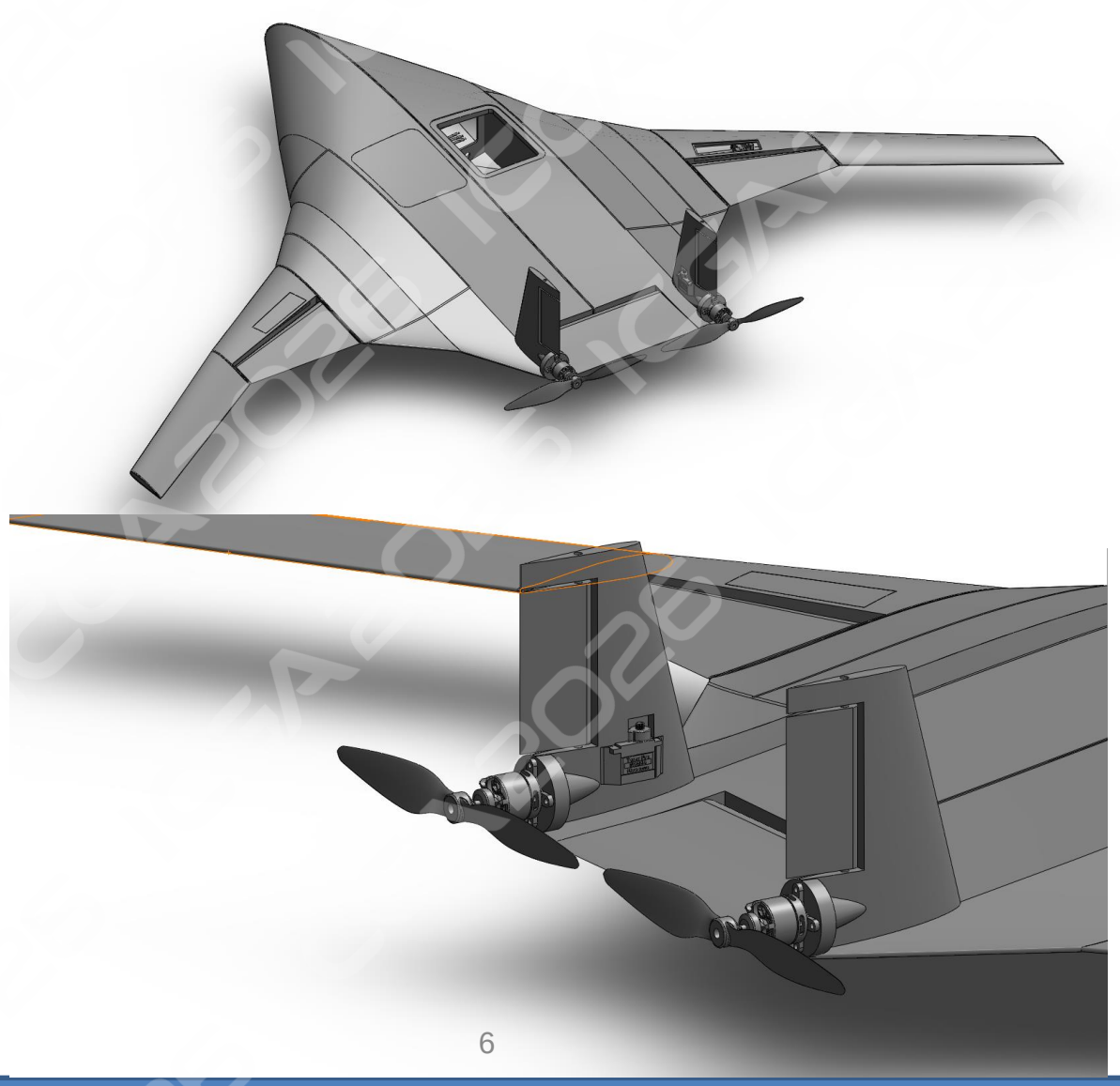




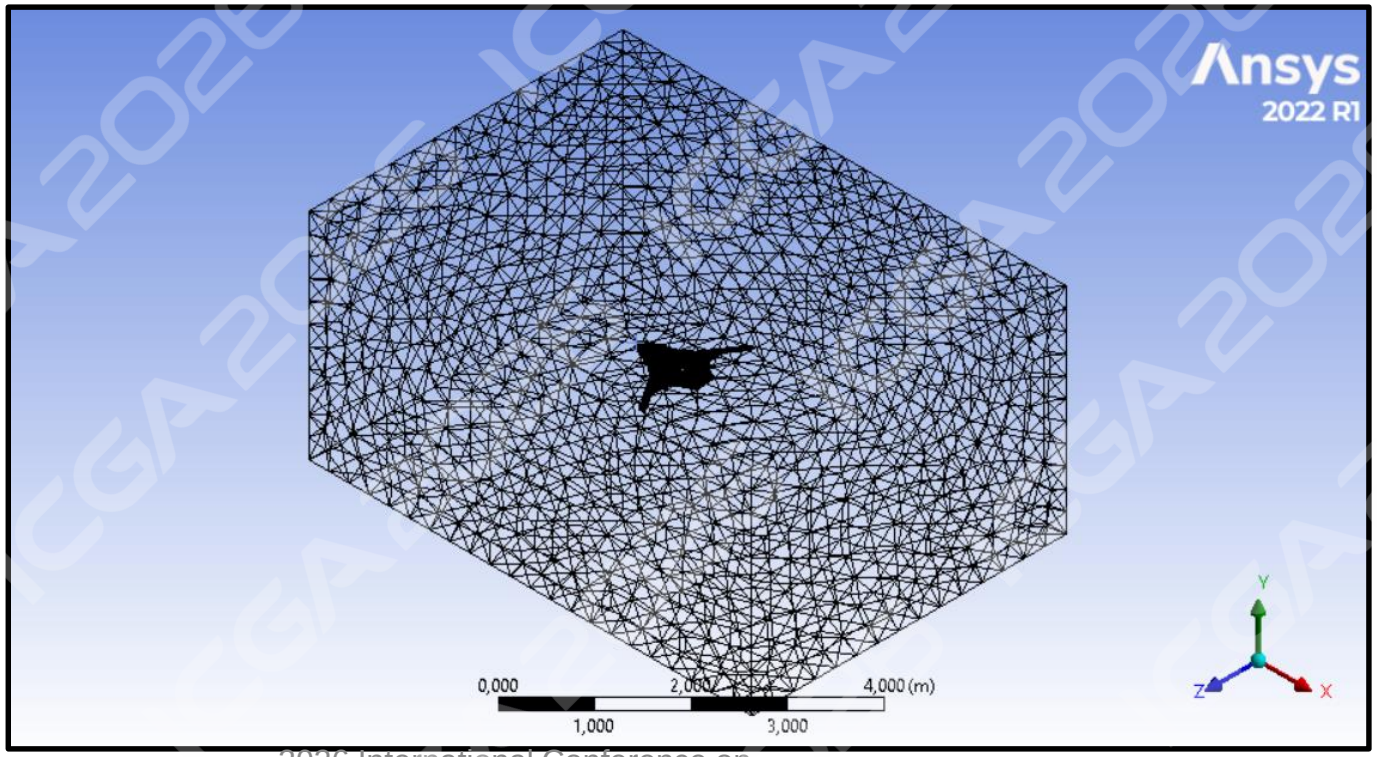
Length	1 m
Wing Span	1.61 m
Total Area	0.53 m
Aileron Area	0.0275 m^2
Elevator Area	0.02239 m^2
Rudder Area	0.00818 m^2

External Design

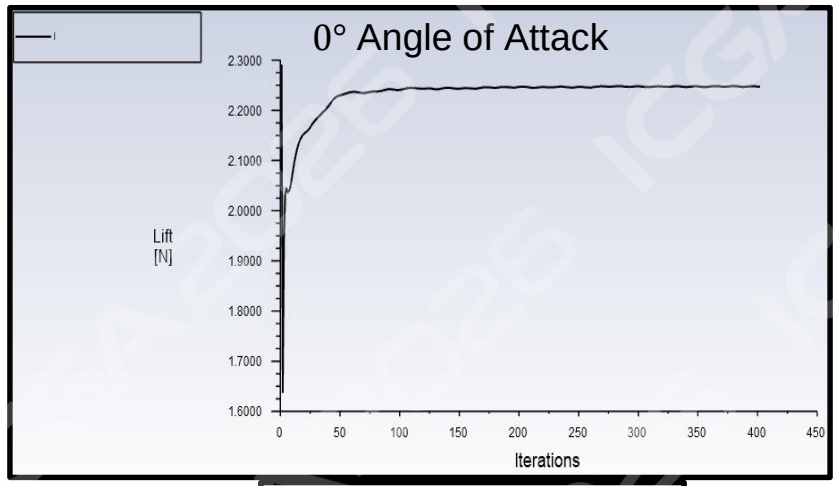




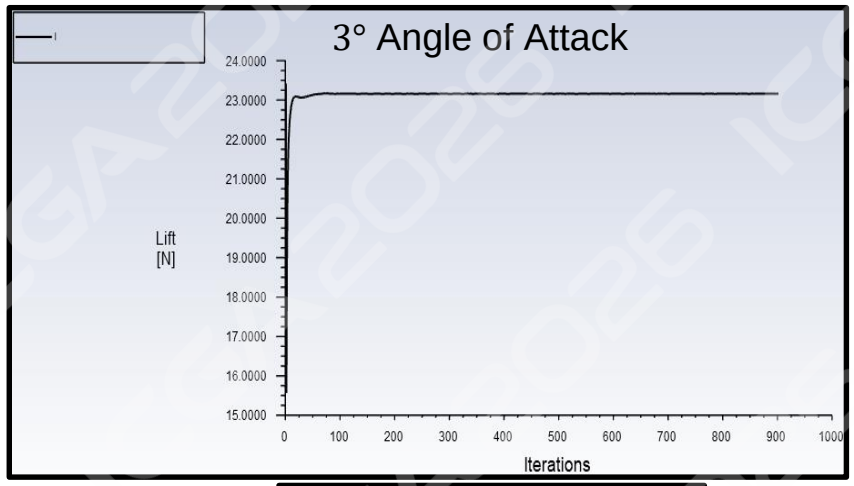
Flow Analysis



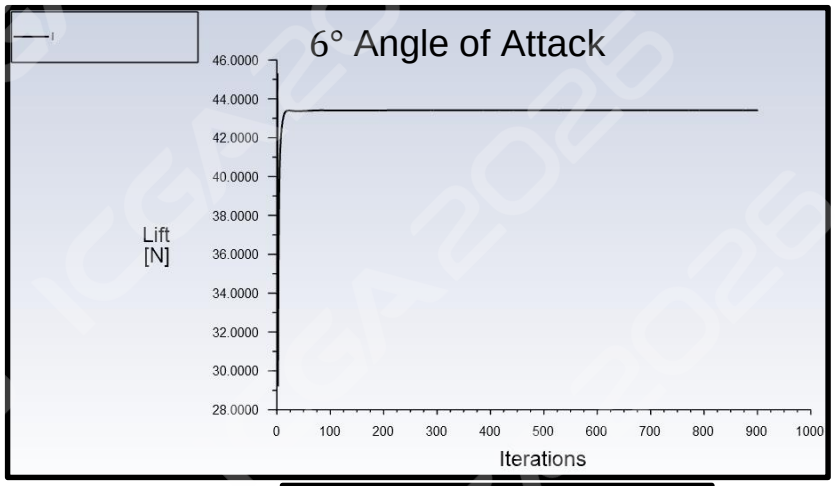
Analysis Graphs – Lift Force & Lift Coefficient



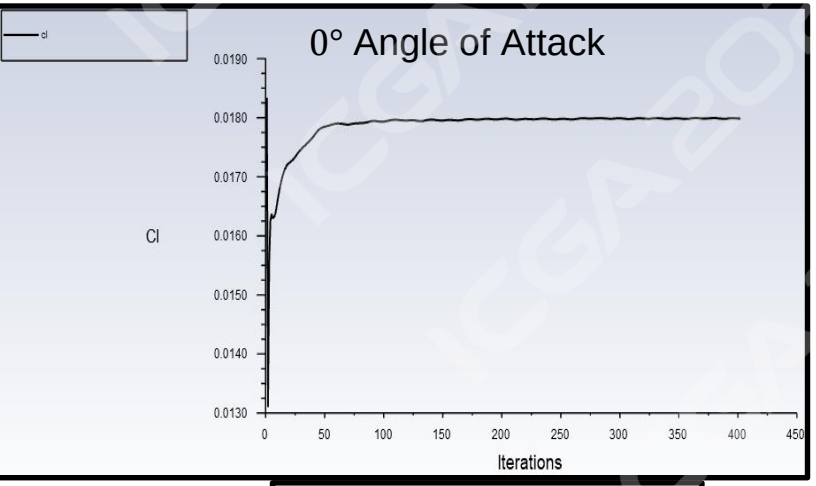
Lift	[N]
wing	2.2467316



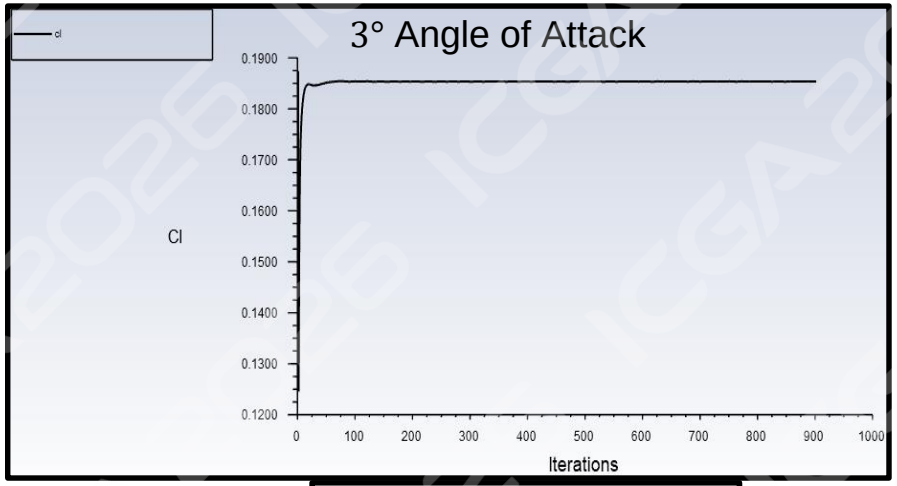
Lift	[N]
wing	23.162326



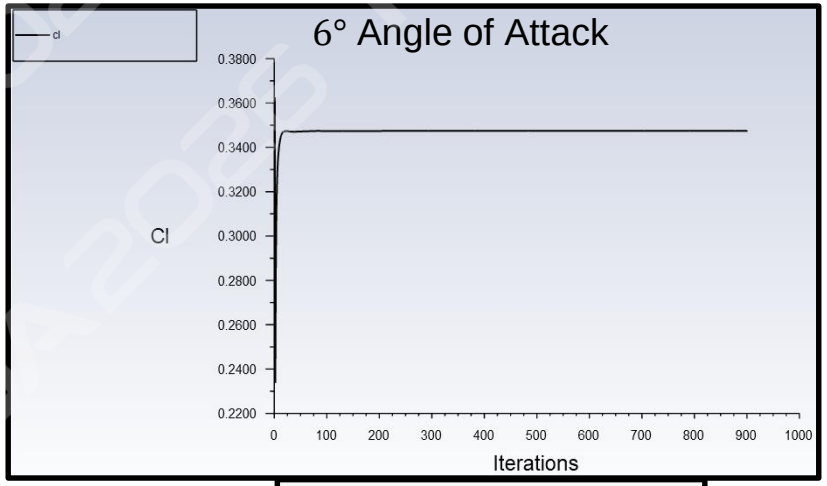
Lift	[N]
wing	43.413744



Cl	
wing	0.017981046

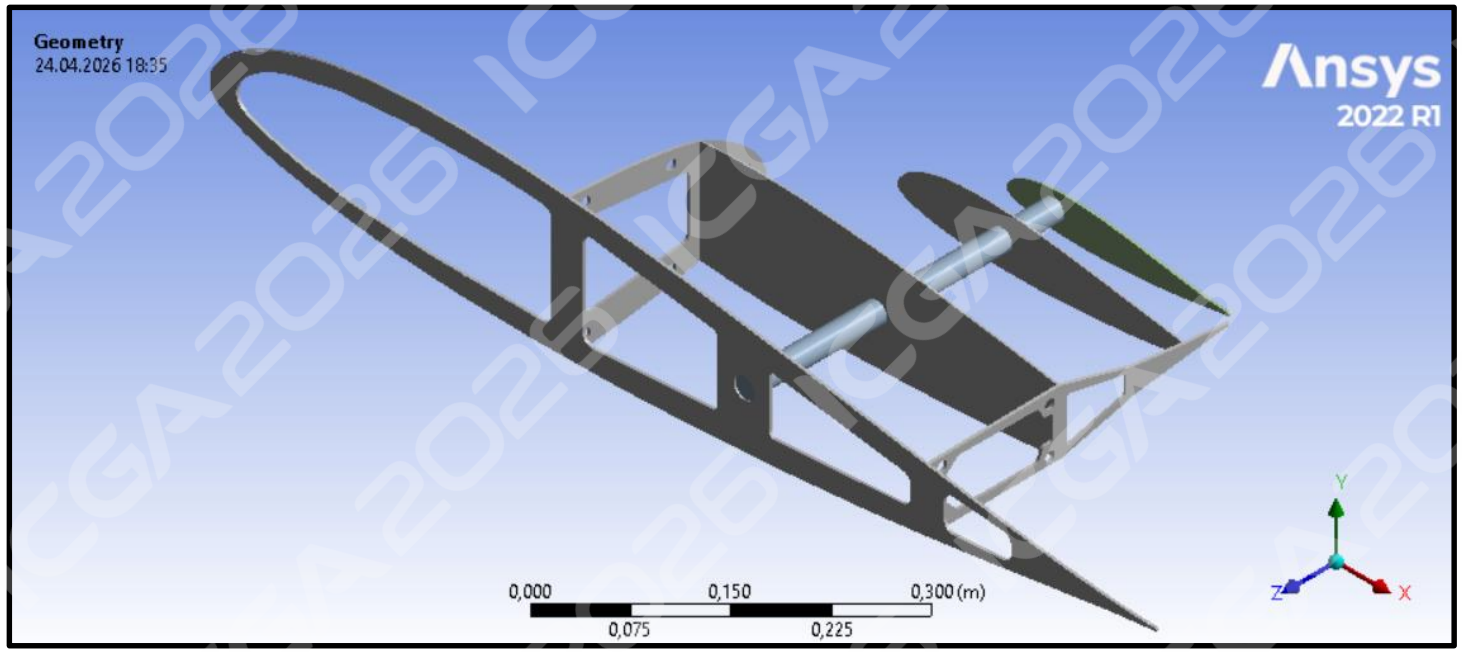


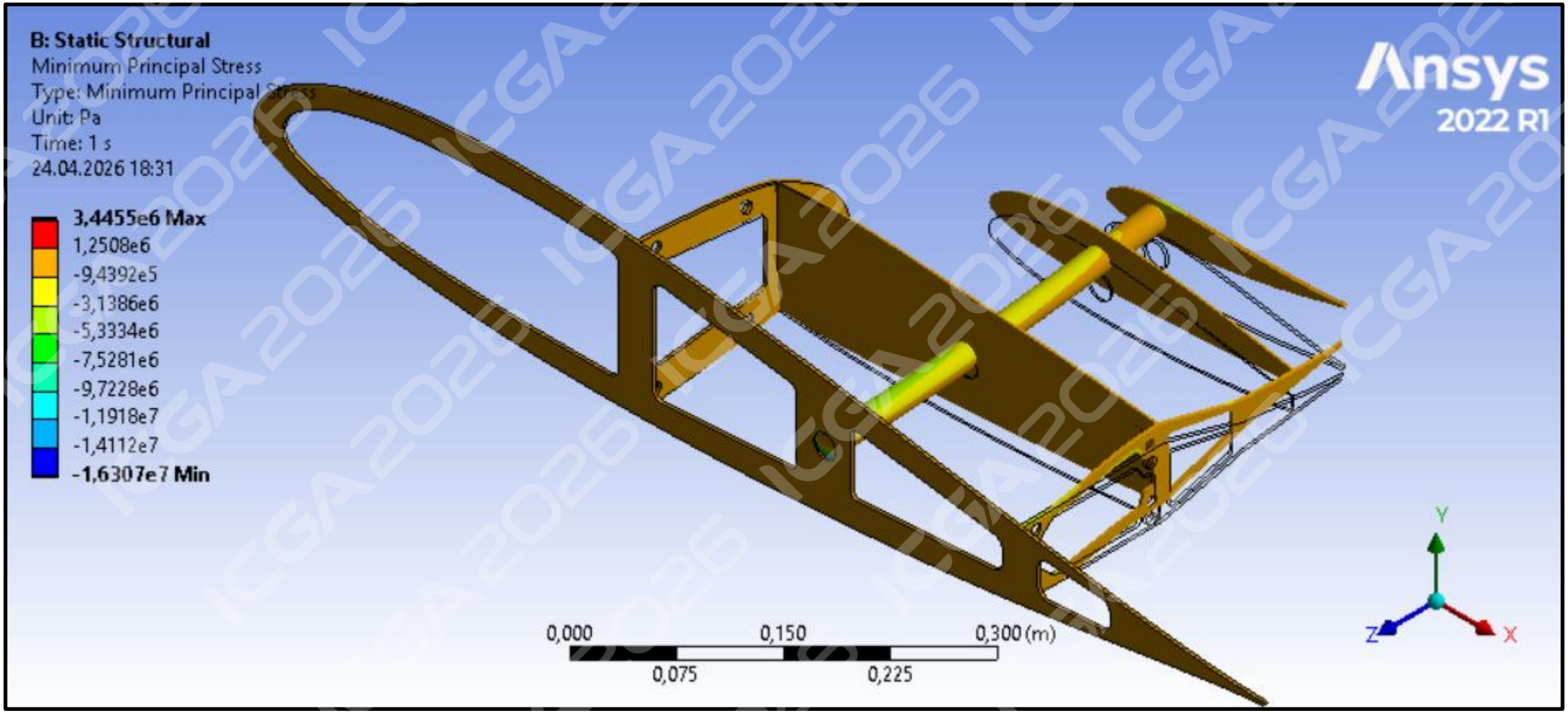
Cl	
wing	0.18537276



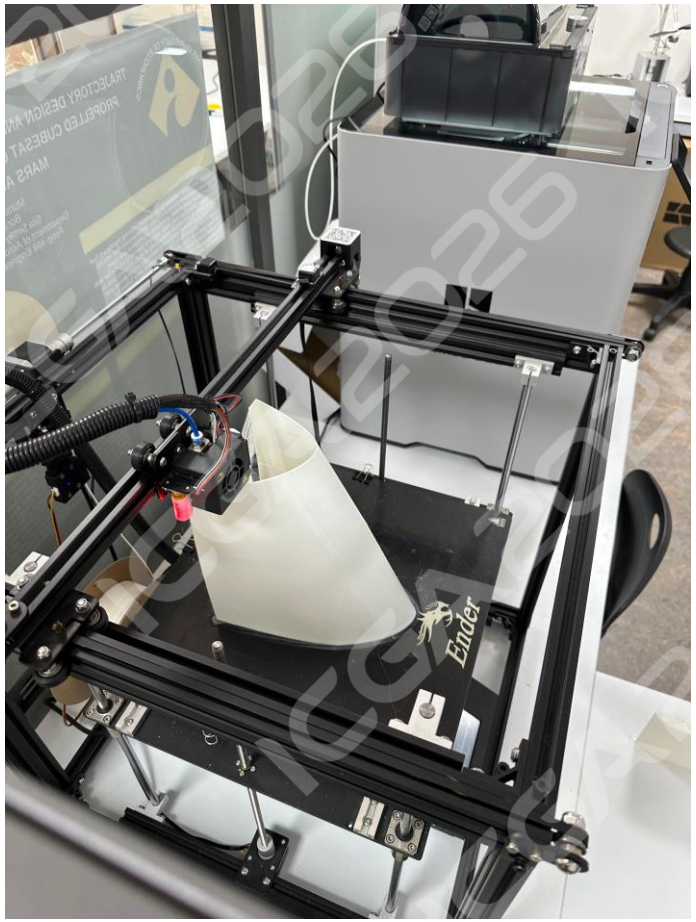
Cl	
wing	0.34744894

FEM Analysis




B: Static Structural
Minimum Principal Stress
Type: Minimum Principal Stress
Unit: Pa
Time: 1 s
24.04.2026 18:31
3,4455e6 Max
1,2508e6
-9,4392e5
-3,1386e6
-5,3334e6
-7,5281e6
-9,7228e6
-1,1918e7
-1,4112e7
-1,6307e7 Min
Ansys
2022 R1
0,000
0,150
0,300 (m)
0,075
0,225
Y
Z
X

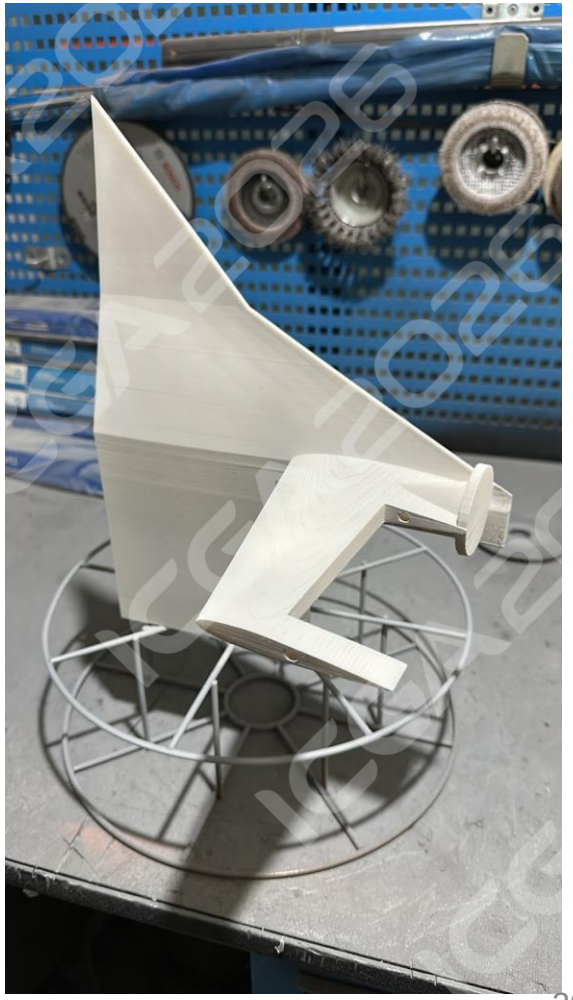
3D Printing







Base Coat & Paint







Assembly





Assembly

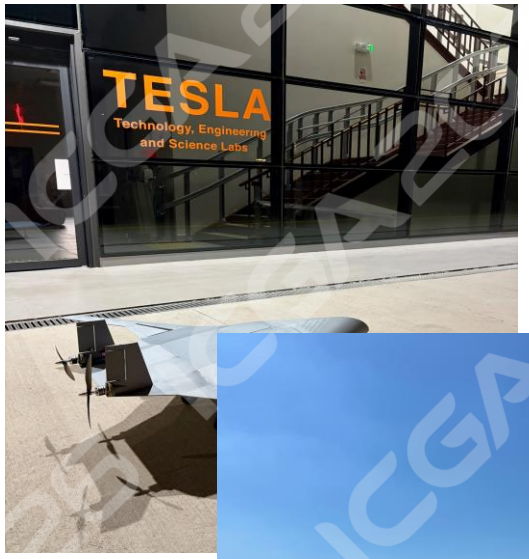






Results

- We have successfully completed the first phase of the BWB aircraft project.
- We designed, manufactured, and assembled the first BWB aircraft prototype.
- The prototype completed its first flight test in Izmir airport, approximately validating our aerodynamic design, stability, and flight control concept. The some stability issues should be solved by changing CG point of aircraft
- This phase demonstrated that our design methodology and manufacturing process are feasible and can provide a solid foundation for our future development.





We believe:

- This project can only grow through collaboration between universities, and industry.

- Every partner will have different expertise, and we would like each partner to contribute according to its strengths.

- Establishing an international consortium to develop the aircraft

- Establish joint research center on advanced aircraft

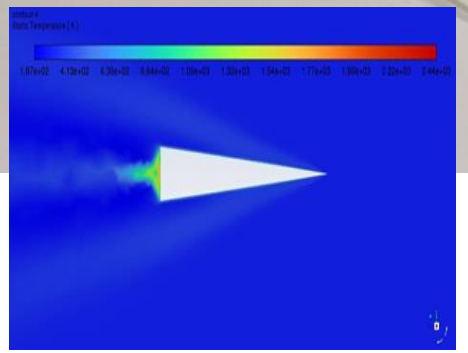
Ongoing Projects:











Phase 2 – Large-Scale BWB Flying Demonstrator (Current Phase)

This step is to design and manufacture a much larger BWB aircraft with significantly improved capabilities.

This stage requires advanced manufacturing technologies, high-precision tooling, large 3D stitching composite structures, structural testing facilities, and sophisticated avionics integration.

These requirements go beyond the capabilities of our university in Turkey and any university in Europe region as well. Therefore, collaboration with industry is essential for us.

****The first meeting was held in Madrid, Spain, followed by visits to Italy and Bulgaria to discuss the project in more detail.

Phase 3 – Supersonic BWB Aircraft

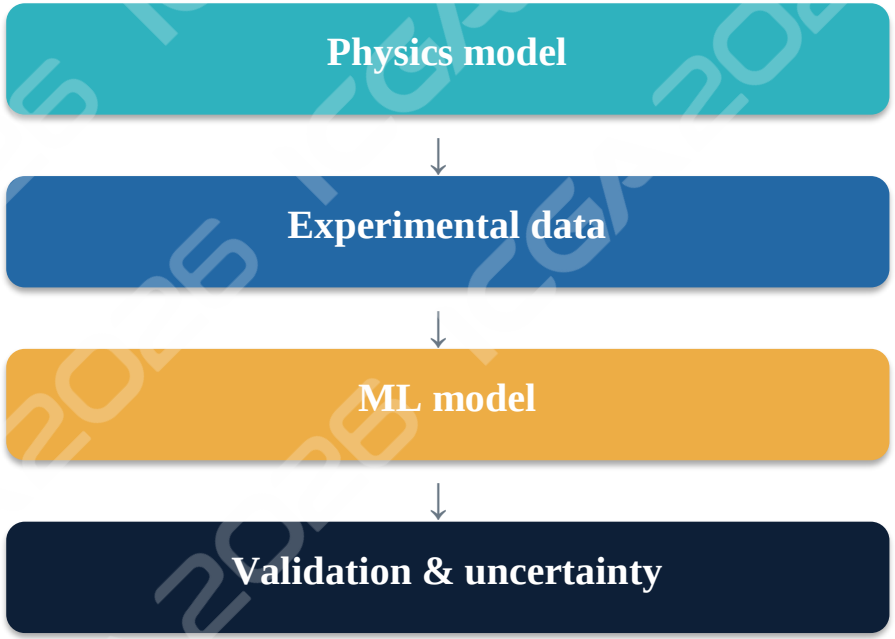
- After validating the large-scale subsonic aircraft, the project will advance toward a supersonic BWB configuration. Surely flying at supersonic speeds introduces new engineering challenges, including shock wave formation, increased aerodynamic drag aerodynamic heating, higher structural loads. Definitely the current aircraft geometry and configuration will need to be redesigned and optimized for supersonic flight.

- New lightweight, high-temperature-resistant 3D composite materials will be required to withstand the thermal loads generated during high-speed flight.

- CFD analysis, structural optimization, and supersonic wind-tunnel testing will play a major role during this phase. We will try to find collaborator for this matter

AI-assisted BWB aircraft design

- Machine learning for rapid prediction of stitched composite structure response.
- AI-assisted identification of damage and crack propagation subject fatigue and impact loading.
- Substitute models to accelerate computationally expensive simulations.
- Hybrid AI–FEA frameworks combining physical models and data-driven predictions.
- Uncertainty quantification and experimental validation for safety-critical applications.





Thanks for your attention!

Special thanks to the conference organizers in China, especially Professors Chong Pan, Bingjun Zhu, and Mao, for their kind support

&

my sincere appreciation to my research team memebers in Turkey in paticualr Umut Aydoğdu, Kevser Erdoğan, Başar Erden, Berkay B. Toker for their valuable contributions.