STRUCTURAL ANALYSIS REPORT: SWEPT WING

Prepared By :

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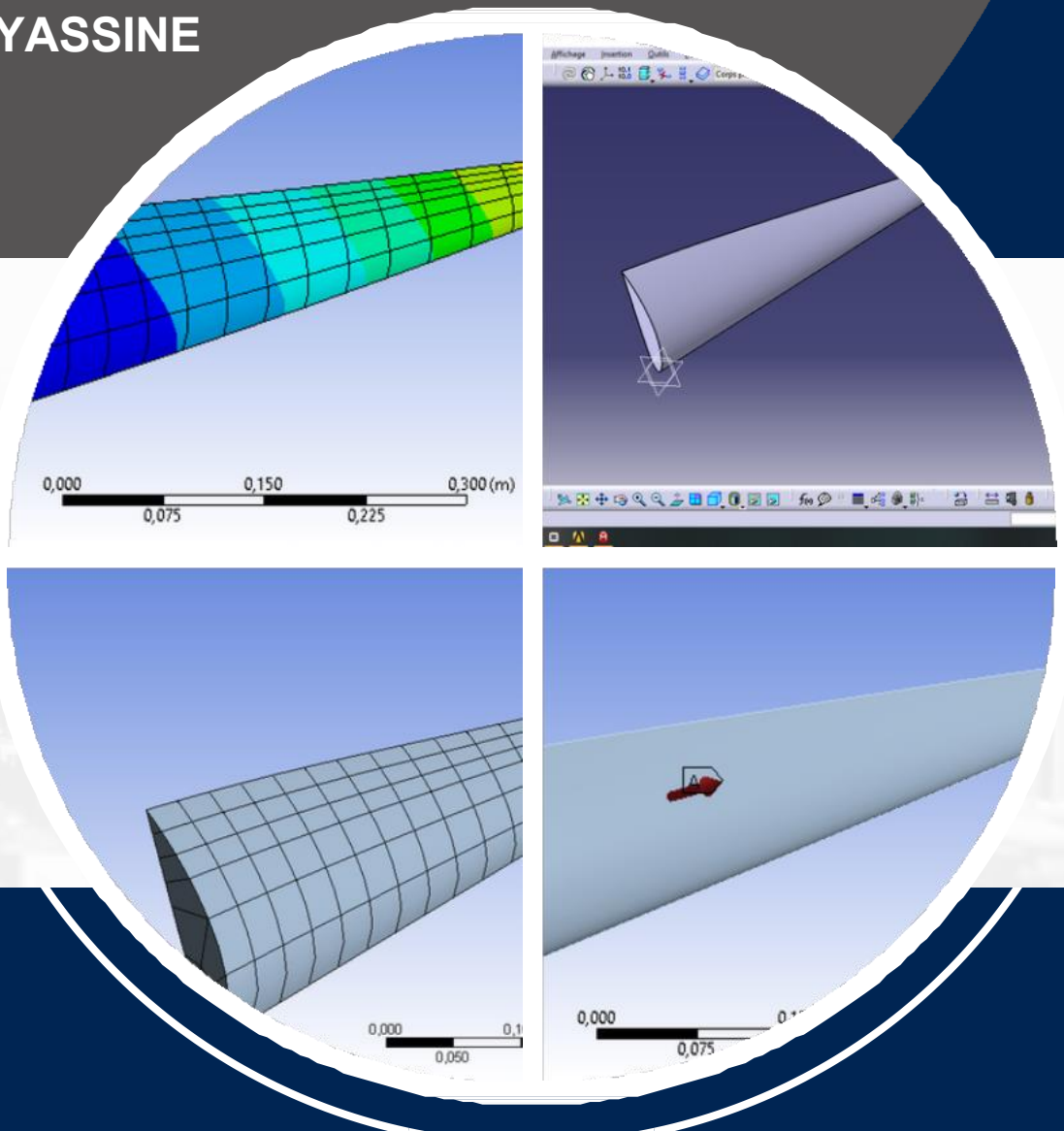


1. Introduction and Objectives

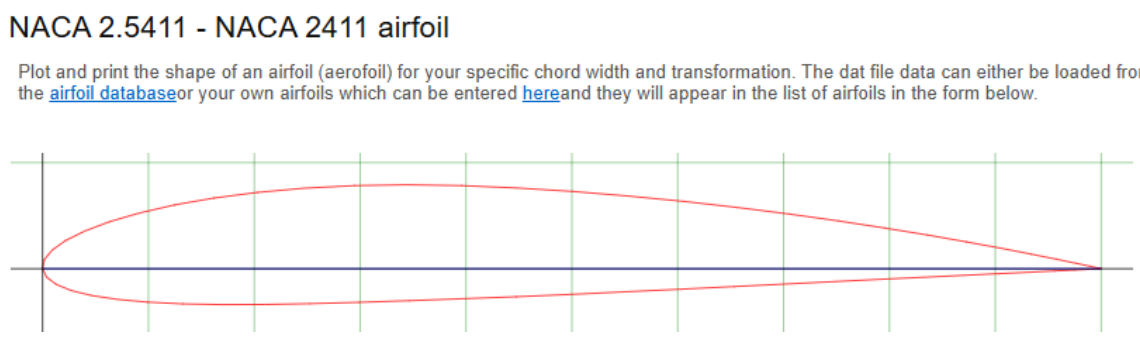
• **Context :** Structural resistance study of a swept wing subjected to static aerodynamic loads.

• **Objective :** Validate the mechanical integrity of a solid titanium alloy wing model and evaluate its overall sizing .

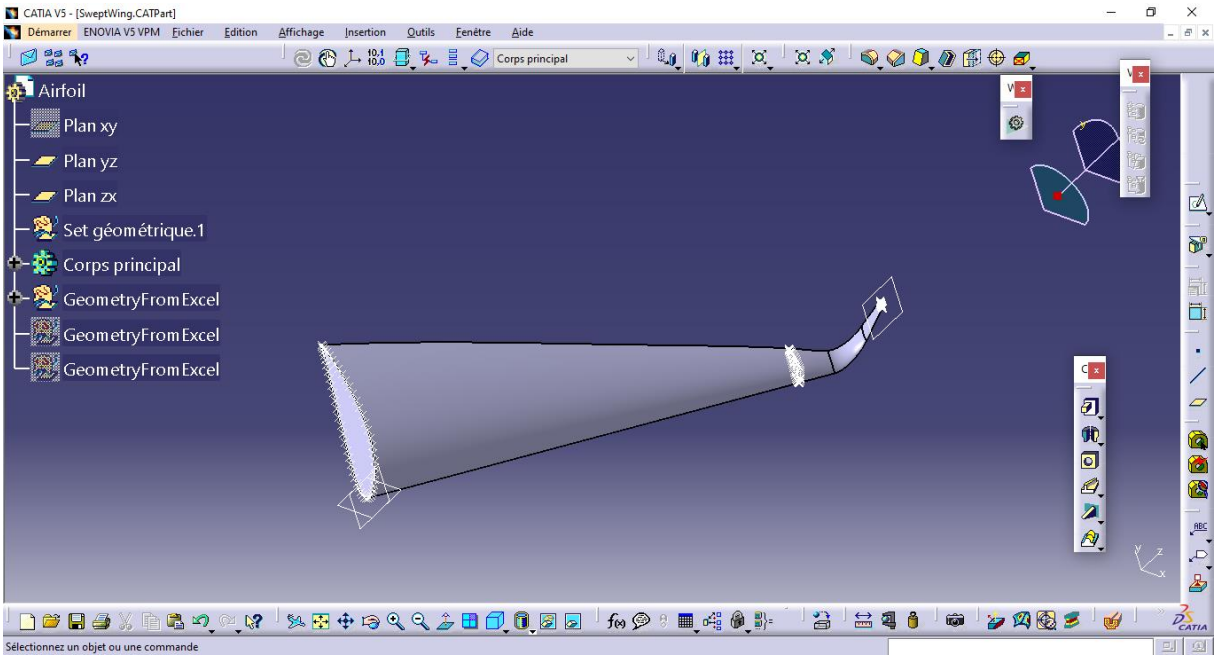
2. CAD Design

- **Tool Used: CATIA V5.**
- **Methodology:**

a. Rigorous import of aerodynamic profile (Airfoil) coordinates via an Excel file.



b. Generation of surfaces and volume (Main Body) through sweeping/lofting between the profiles.

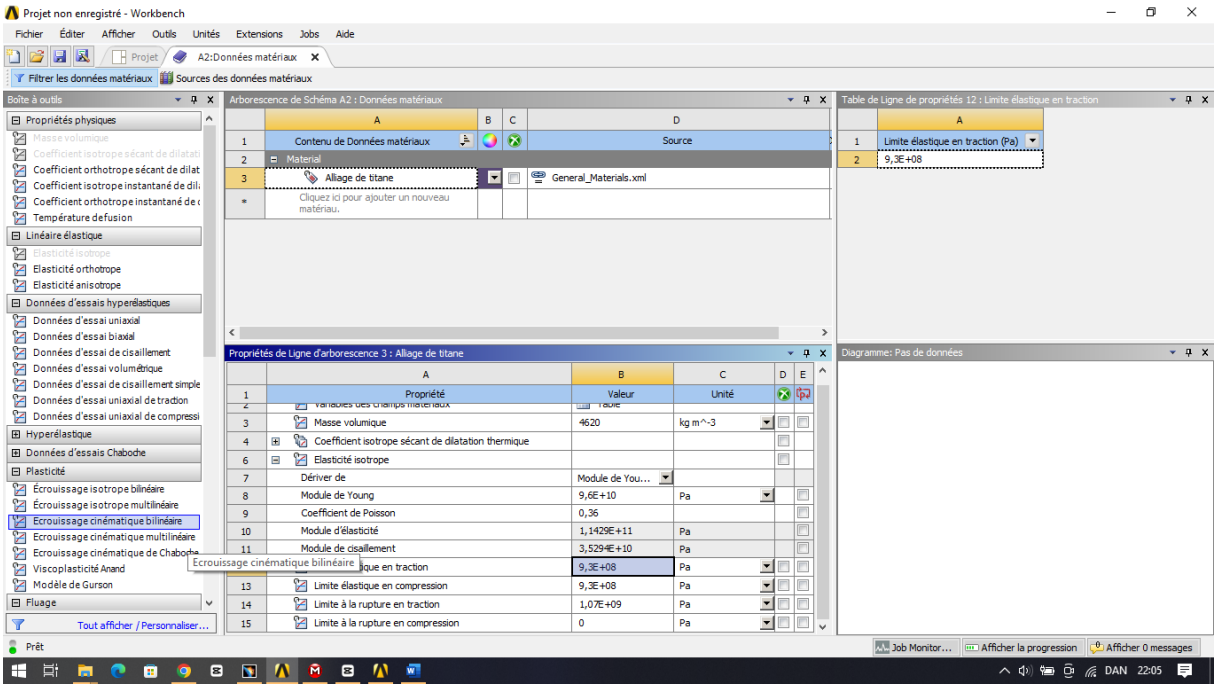


c. **Simulation Preparation:** The geometry was exported in STEP (.stp) format to ensure the import of an exact volumetric body and to avoid face selection errors typically associated with faceted models (like STL).

3. Simulation Parameters (Pre-processing)

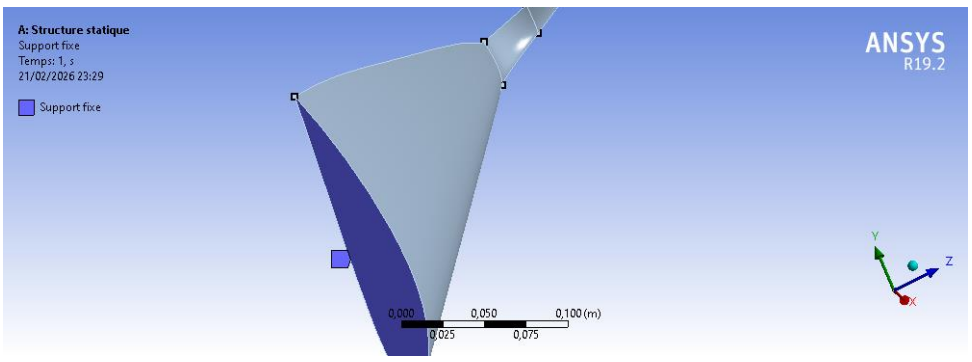
- **Tools Used**: ANSYS Mechanical (via SpaceClaim for geometric verification).
- **Material:** Titanium Alloy.

  Tensile Yield Strength: **930 MPa** (9.3E+08 Pa).

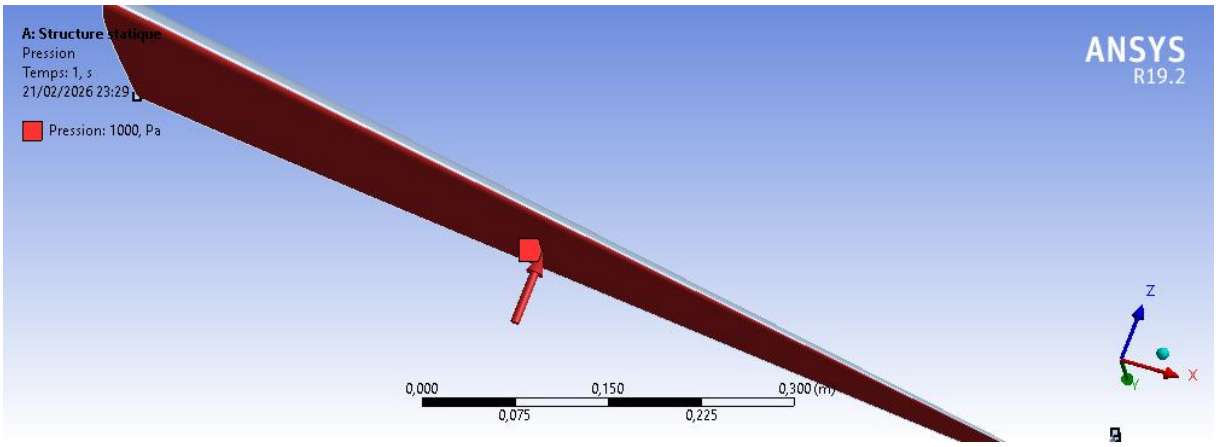


- **Boundary Conditions:**

1. Fixed Support: Applied to the root face to simulate a rigid attachment to the aircraft fuselage.



2. Load Type: Normal pressure of 1000 Pa (0.001 MPa), simulating the lift force under baseline flight conditions (generating a global upward force of approximately 96 N on this wing section).



4. Static Analysis Results

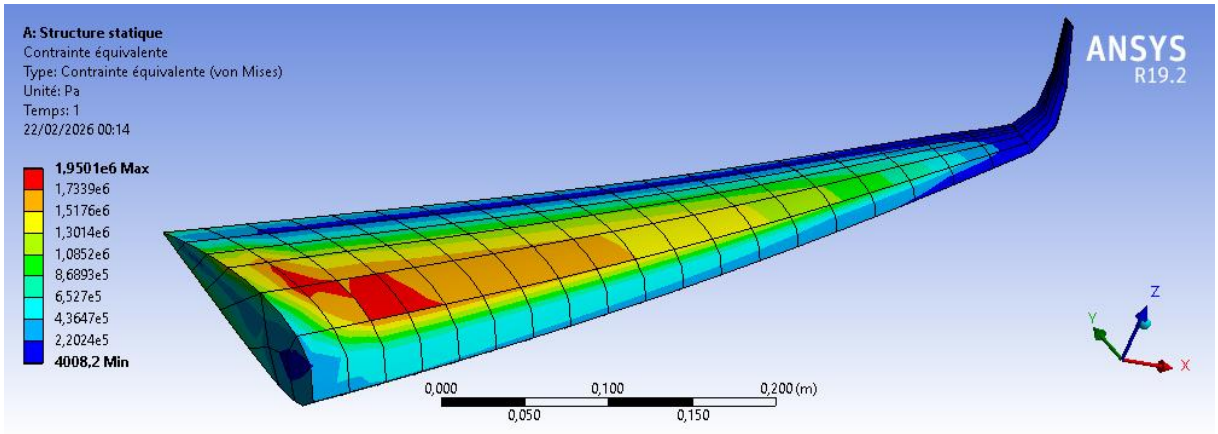
Visualizing the stress distribution, strain, and deformation is critical for validating the wing's structural integrity.

The following contour maps highlight the structural response under the 1000 Pa aerodynamic load.

- **Equivalent Stress (Von Mises)**

Maximum stress observed: 1.95 MPa (1.95E+06 Pa).

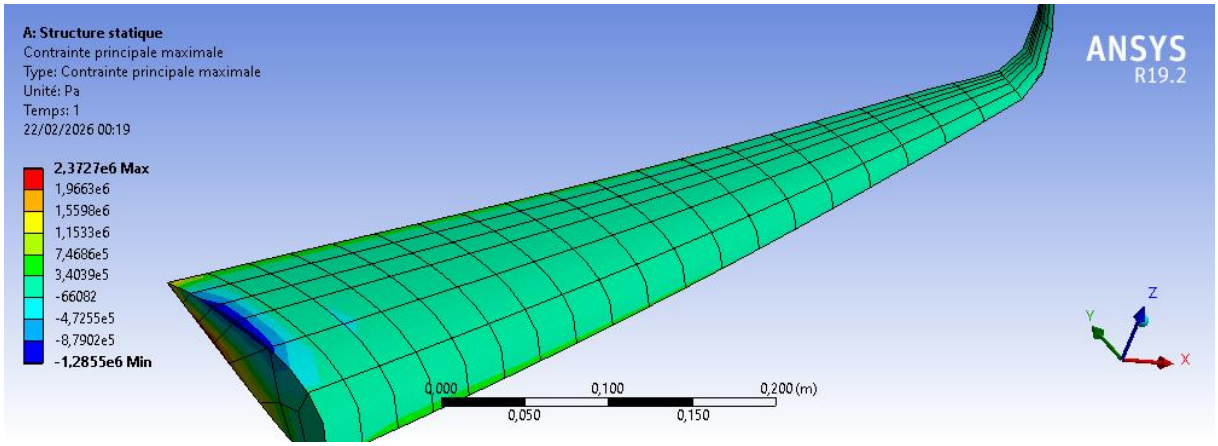
Location & Behavior: As illustrated below, the stresses are logically concentrated at the root of the wing (the fixed support area). The rest of the wing experiences near-zero stress (blue zones), which is characteristic of a cantilever beam behavior under a uniformly distributed load.



- **Maximum Principal Stress**

Maximum value: 2.37 MPa (2.37E+06 Pa).

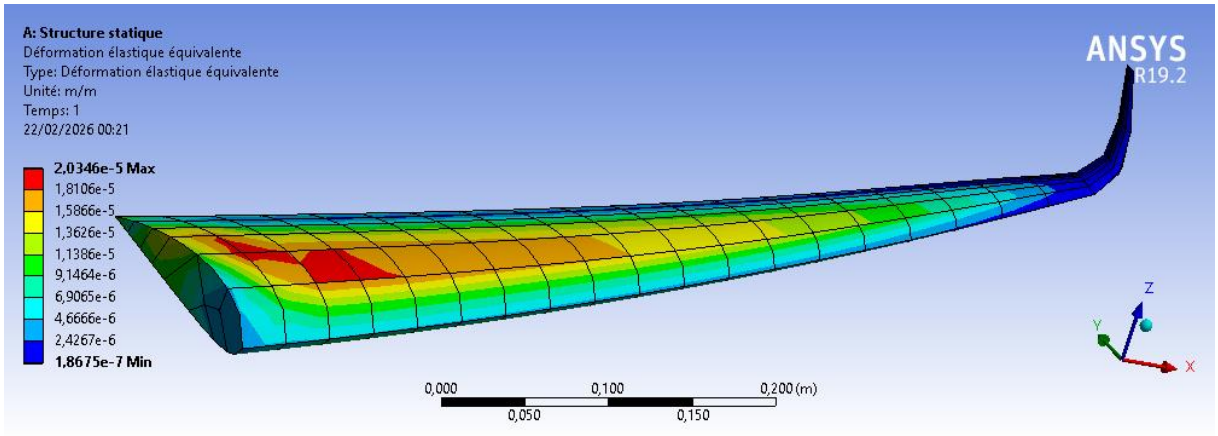
Analysis: This confirms that the peak tensile stresses are located at the upper and lower surfaces near the root constraint, remaining extremely low for a titanium structure.



- **Strain Analysis**

Maximum Equivalent Elastic Strain: 2.03E-05 m/m.

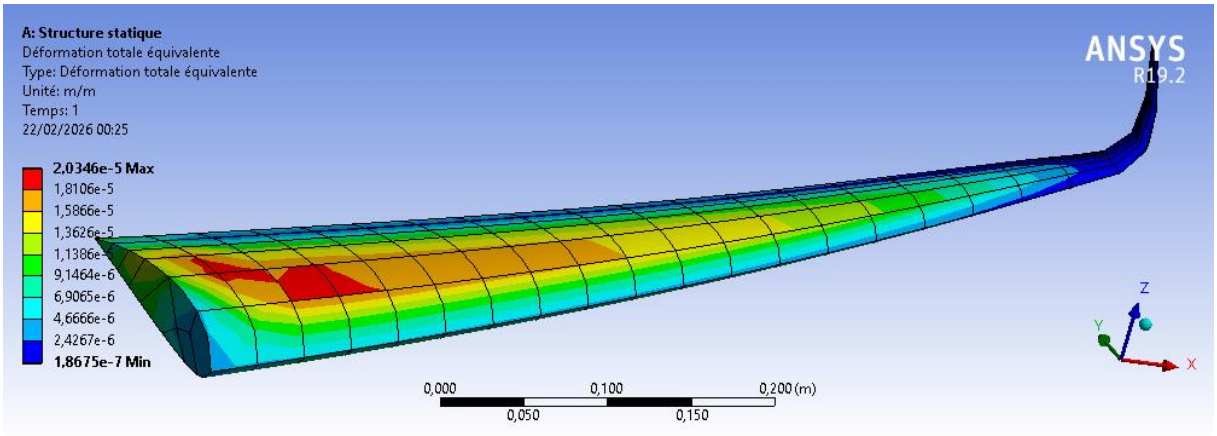
Analysis: The strain distribution perfectly mirrors the stress concentration at the root. The intrinsic stretching of the material is completely negligible, confirming the structure remains deeply within its elastic domain.



Total Deformation (Geometric Deflection)

Maximum displacement: 0.5 mm (5.0463E-04 m).

Location & Behavior: The deformation gradient confirms a completely rigid structure. The maximum deflection occurs at the wingtip (red zone), while the root remains perfectly static (blue zone).



5. Conclusion

The static structural analysis confirms that the solid titanium swept wing perfectly withstands the 1000 Pa aerodynamic load. With a maximum equivalent stress of only 1.95 MPa and a negligible tip deflection of 0.5 mm, the structure operates entirely safely within its elastic limits.