A Report on Thermal Analysis of an Aircraft Wing

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Date:

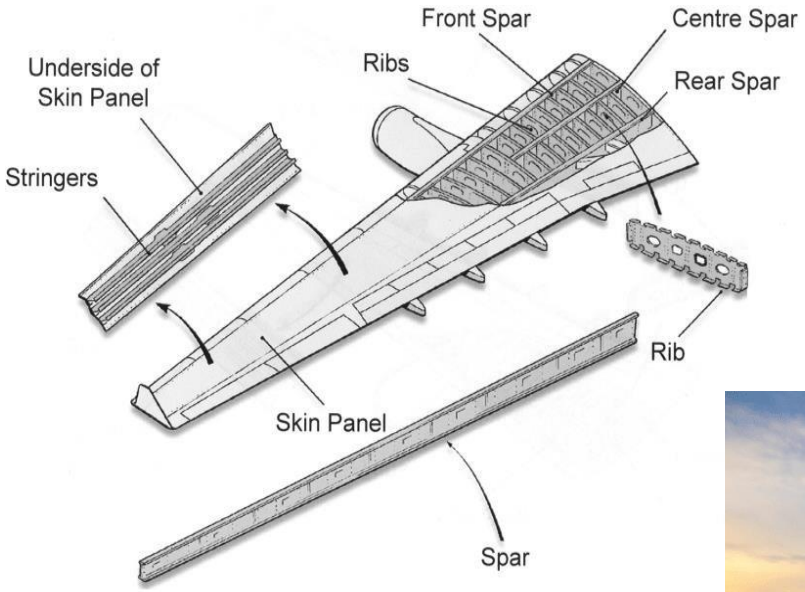
Steady State Thermal Analysis of an Aircraft Wing using Ansys

Description:

A wing of an aircraft is one of the major parts contributing to lift of an aircraft. They also contribute to banking of aircraft while flying. They are of various shapes and sizes. The wing is mainly made of ribs and spars all connected by stringers to have an equal load distribution while flying.

A wing may be rectangular, tapered, swept back wing or delta wing depending upon the type of the aircraft manufactured. For a commercial aircraft, swept back wing is used and for a military jet delta wing is used.

Steady State Thermal Analysis is done on a wing to know the maximum temperature or heat flux a wing generates as to not structurally damage the wing due to high temperature.



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Objectives of Analysis:

To perform a Steady State Thermal Analysis of an aircraft wing and to find Temperature Distribution and Total Heat Flux.

1. Wing:
    a. Swept back tapered wing section
    b. Thick aerofoil section

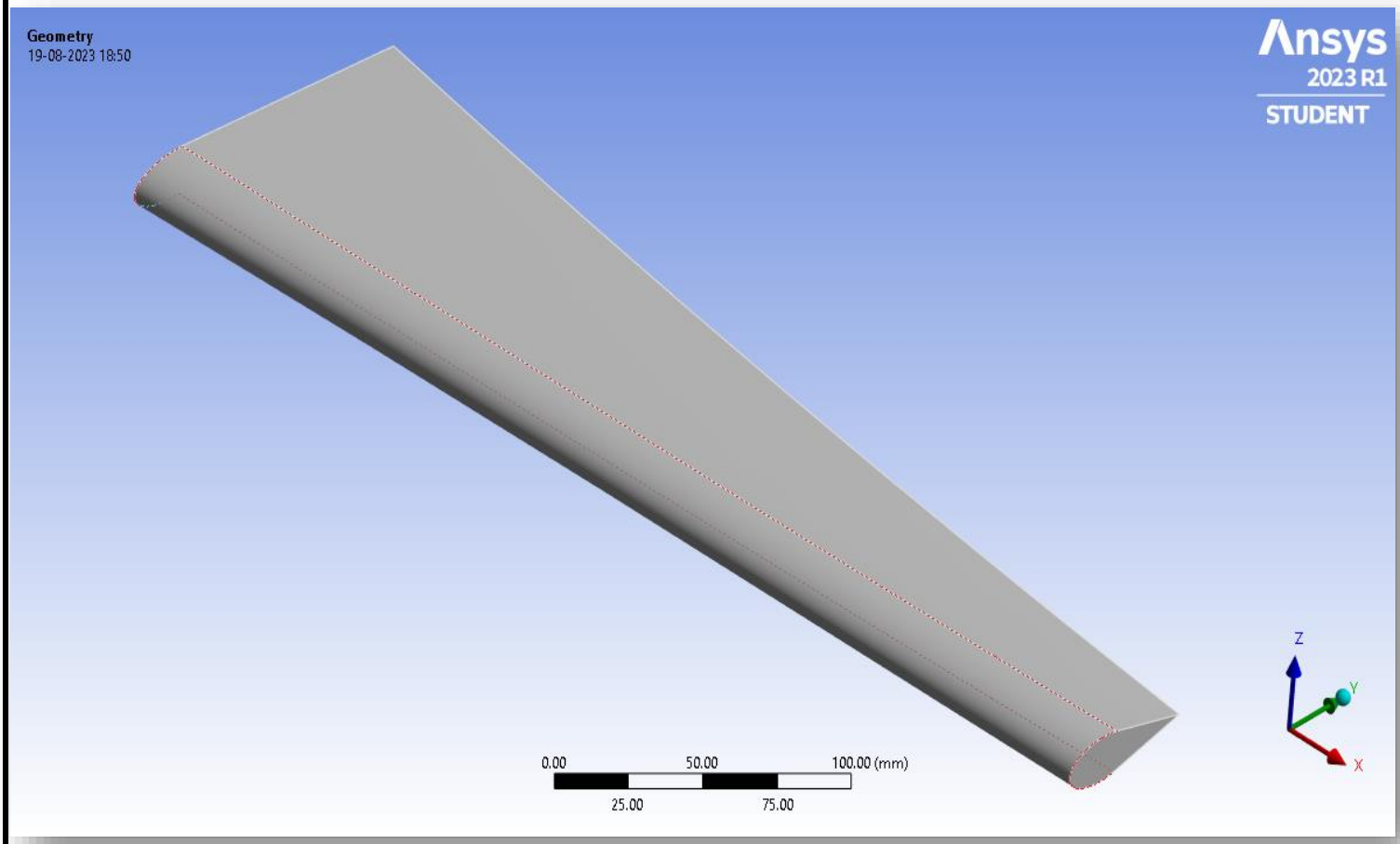
2. Analysis Conditions:
    a. Initial Temperature: 22˚C
    b. Temperature at Leading edge: 60˚C
    c. Type: Convection
    d. Film Coefficient: 15 W/mm^2.˚C

3. Material Used: Titanium Alloy

Design Focus:

Primary focus of the design is to know about the temperature distribution and total heat flux generated by given temperature condition.

Design Model



Tapered wing geometry

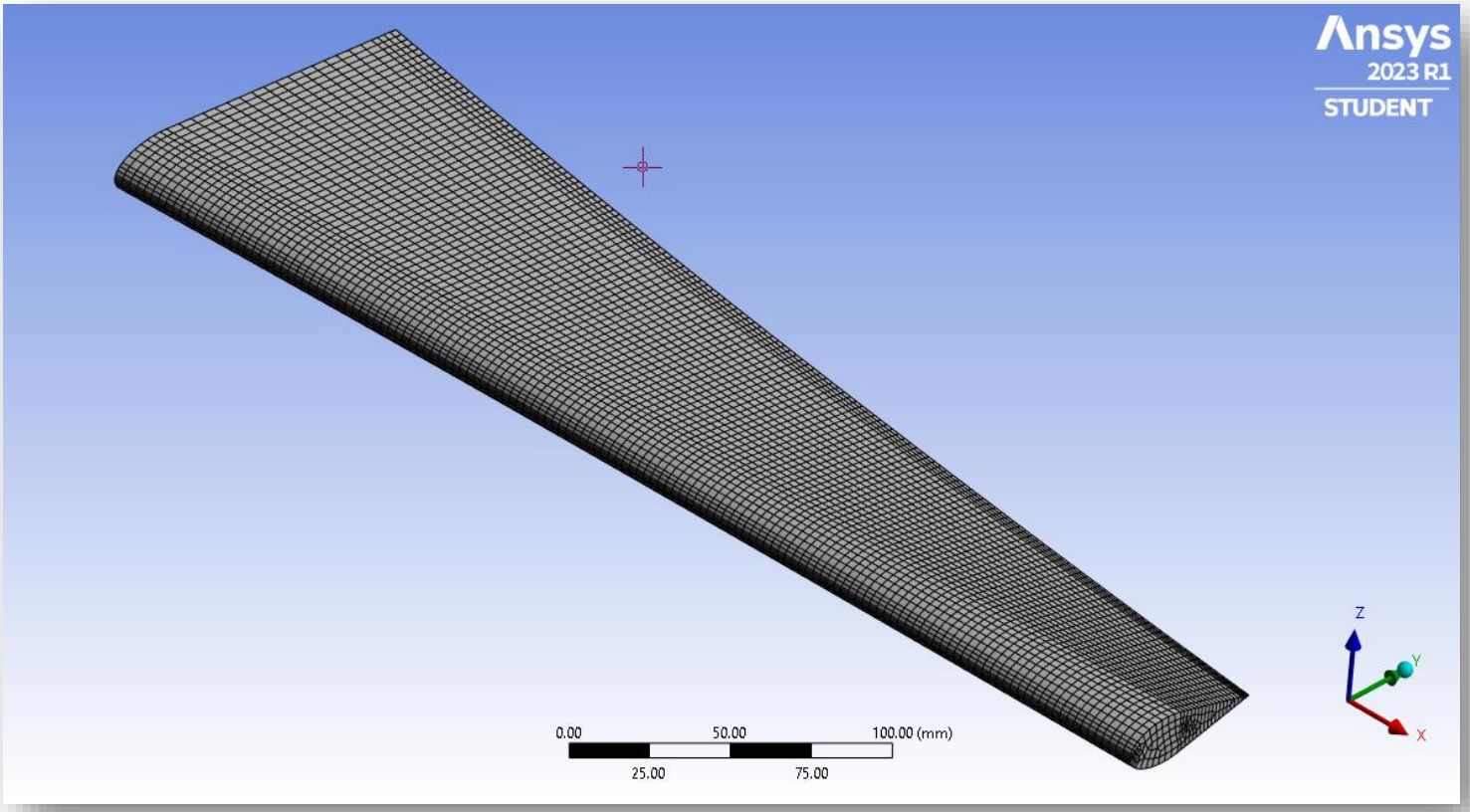
Meshing

The meshing was done in Steady-State Thermal for the wing geometry.

- **Wing Geometry:**

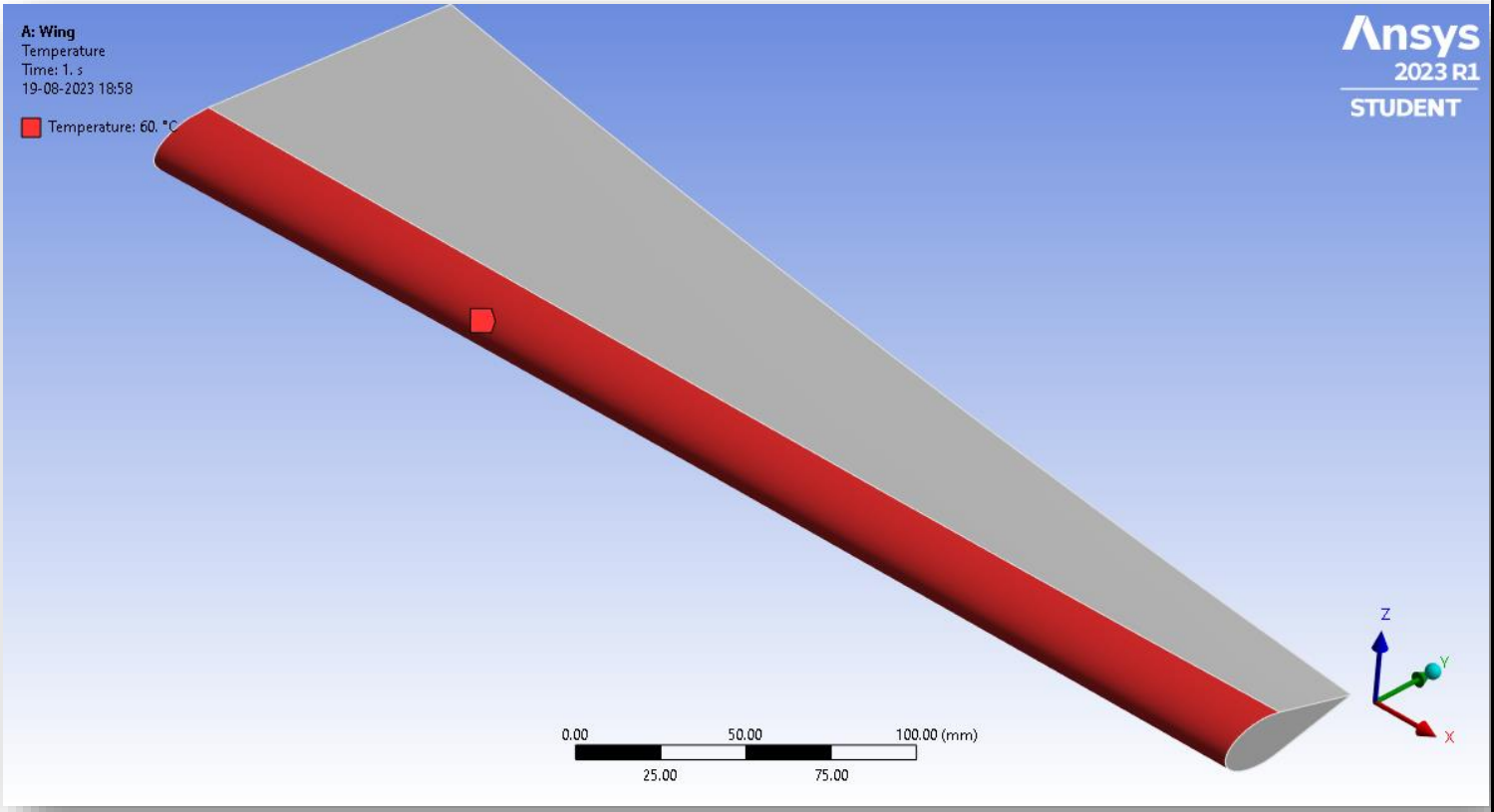
For Meshing, **sweep method** sizing was used and **free face mesh type** to **Quad/Tri.** The **element size** was taken as **3mm**, **Adaptive sizing** was used, **Span Angle Centre** was set to **Fine**, **Smoothing** was set to **high** and all other conditions to default to get accurate results in the analysis.

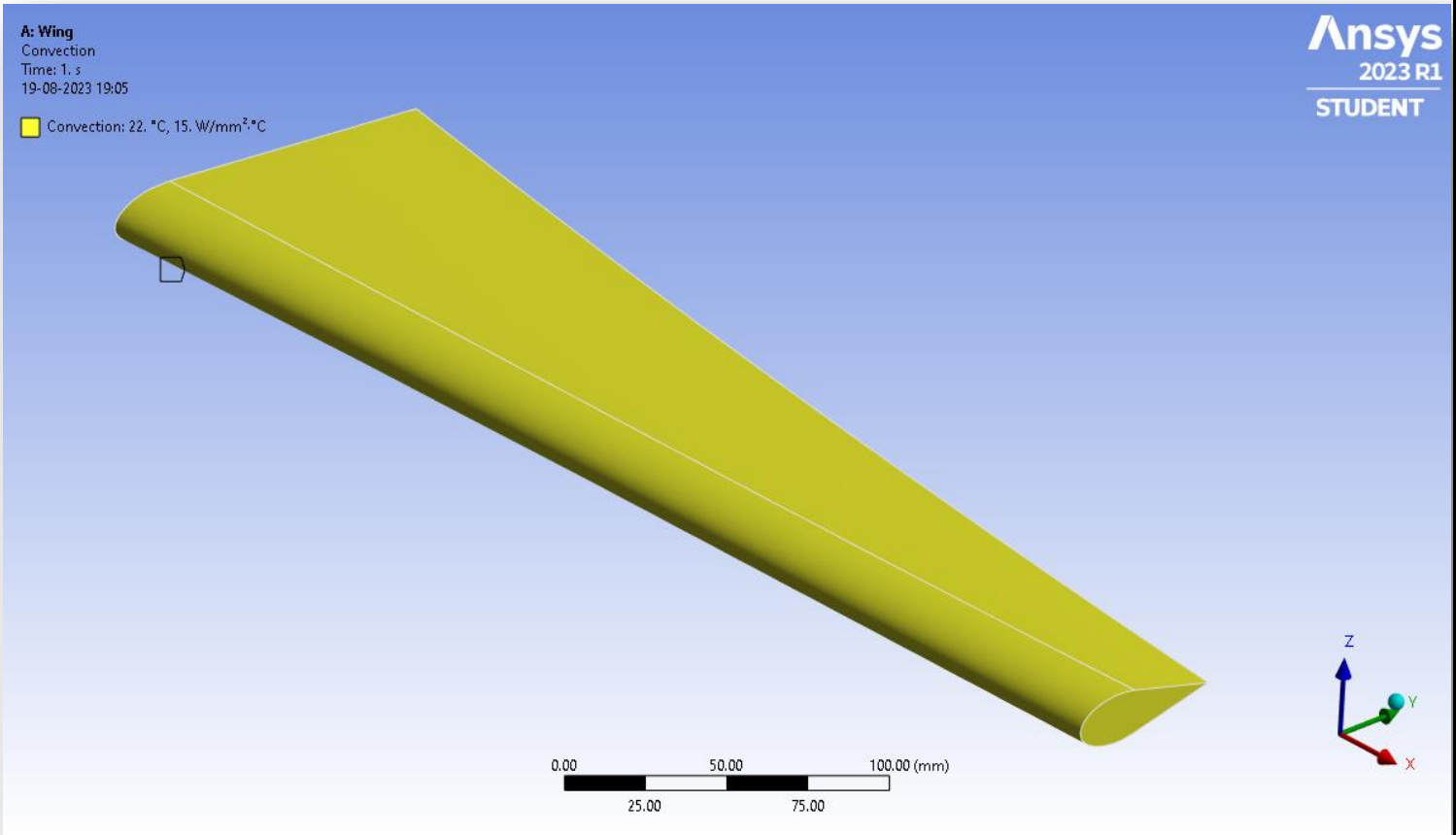
  - Total number of nodes: **85092**
  - Total number of elements: **17875**



Sweep Mesh Method

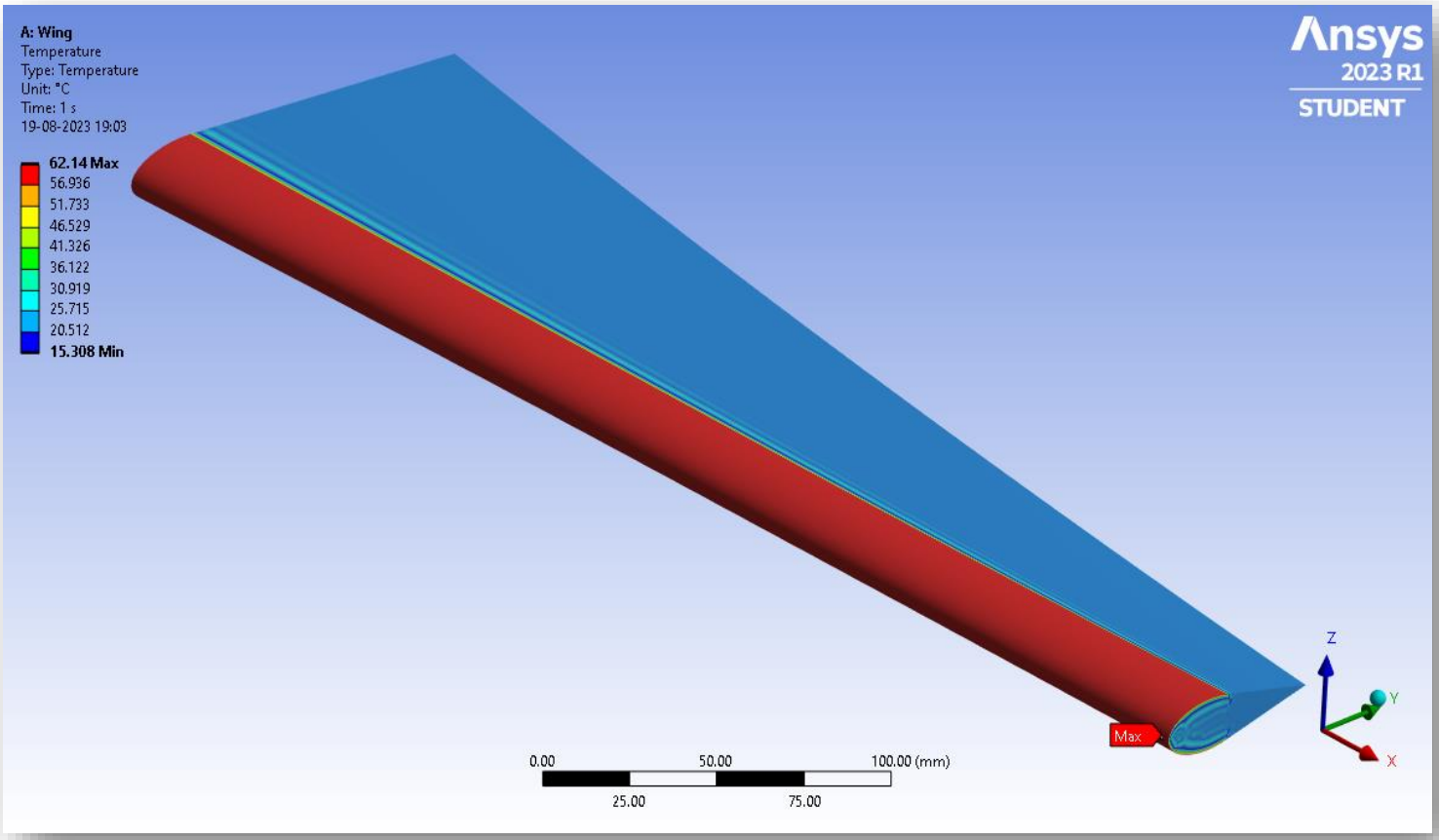
Analysis


A: Wing
Temperature
Time: 1. s
19-08-2023 18:58
Temperature: 60. °C
Ansys
2023 R1
STUDENT
0.00
50.00
100.00 (mm)
25.00
75.00
Z
Y
X


A: Wing
Convection
Time: 1. s
19-08-2023 19:05
Convection: 22. °C, 15. W/mm².°C
Ansys
2023 R1
STUDENT
0.00
50.00
100.00 (mm)
25.00
75.00
Z
Y
X

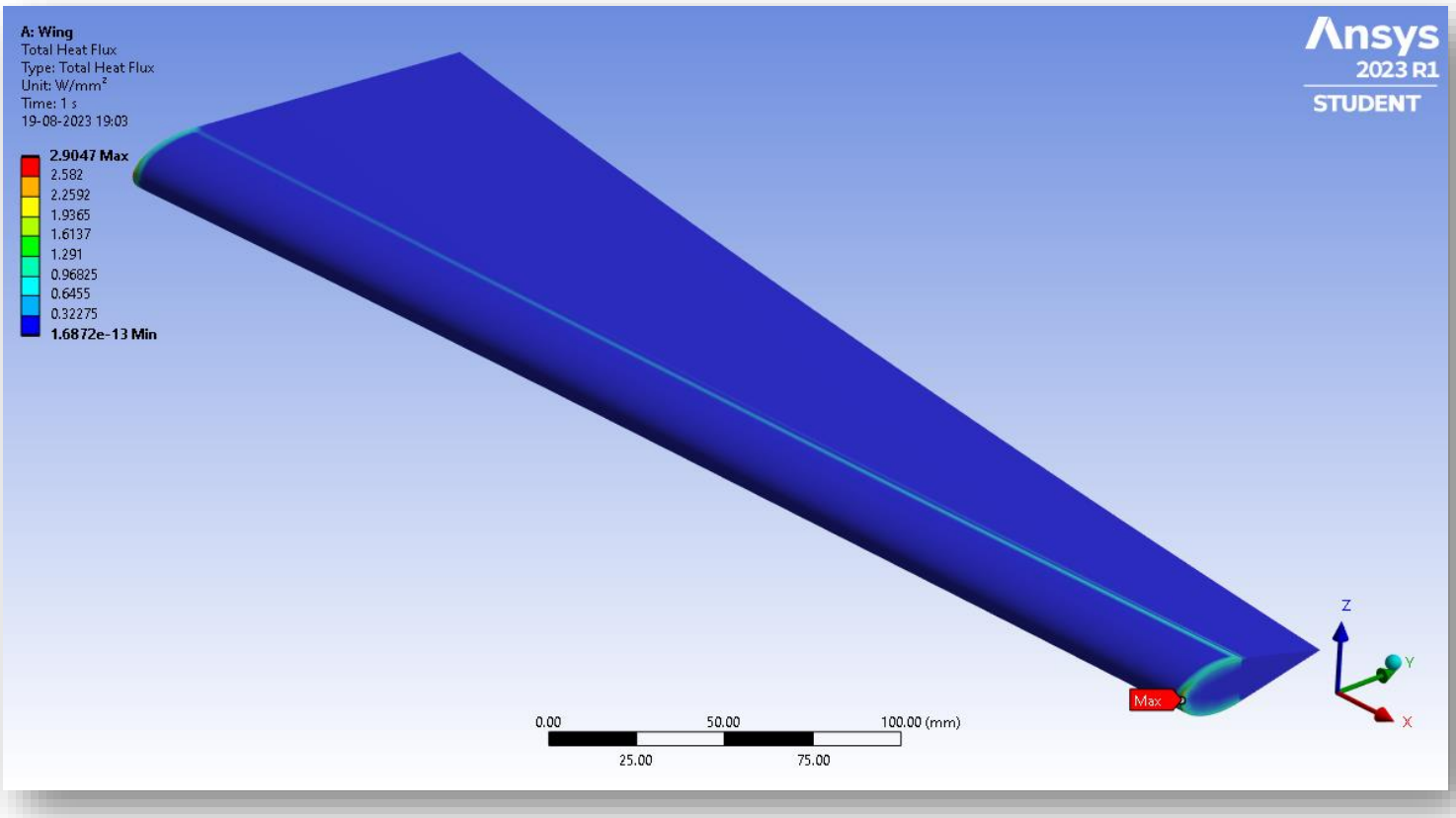
Solution

The analysis was done by the Ansys software and the solutions were obtained as follows:

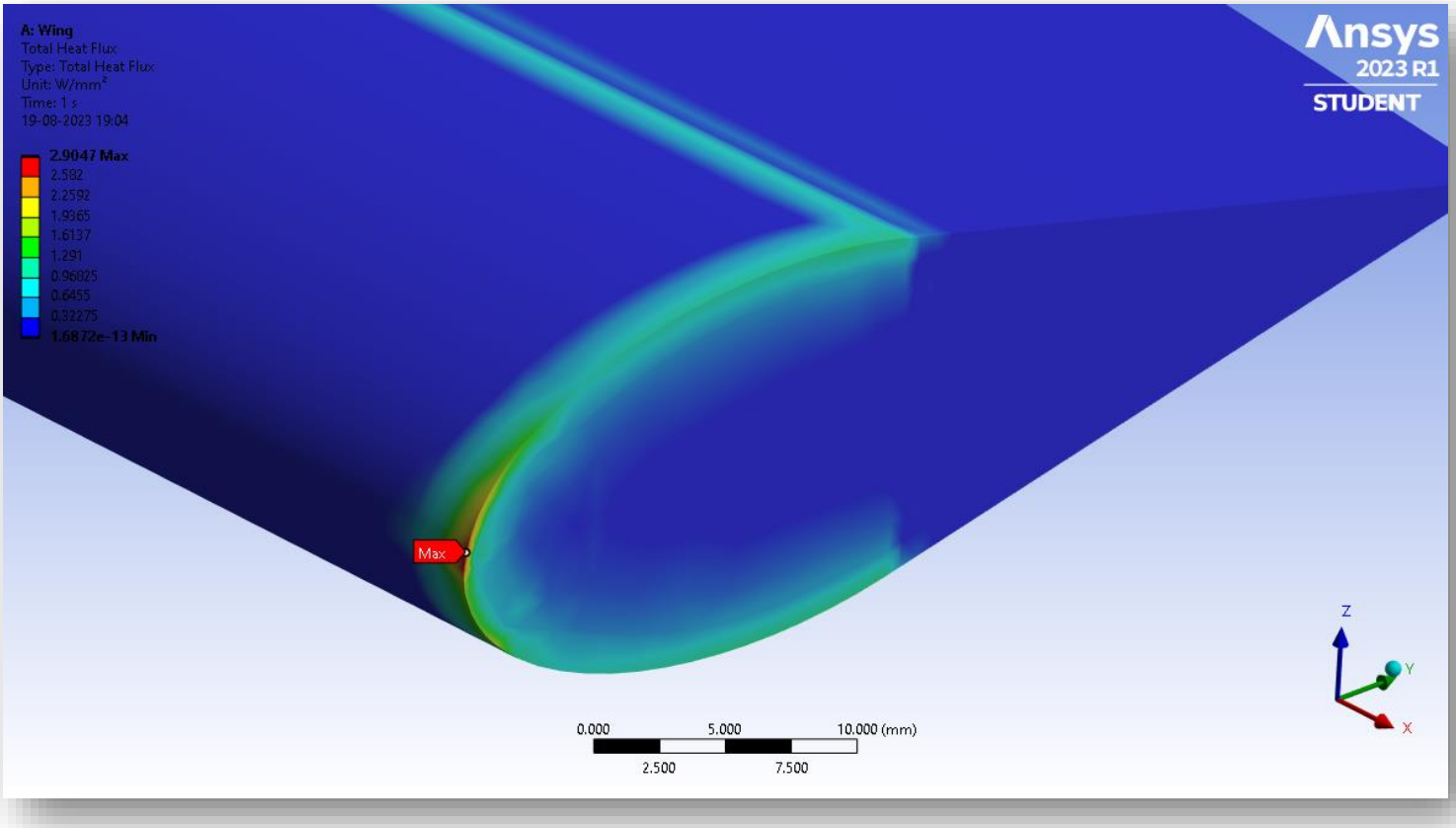


Temperature Distribution

The total temperature is found to be **62.14°C**



Total Heat Flux



Zoom View

Result

Wing:

Total Temperature (˚C)	62.14
Heat Flux (W/mm^2)	2.9047

Conclusion:

From the analysis, the Total Temperature and Heat Flux of the wing geometry is found to be maximum at the leading edge of tip chord of the wing.