Introduction to Aerospace Engineering
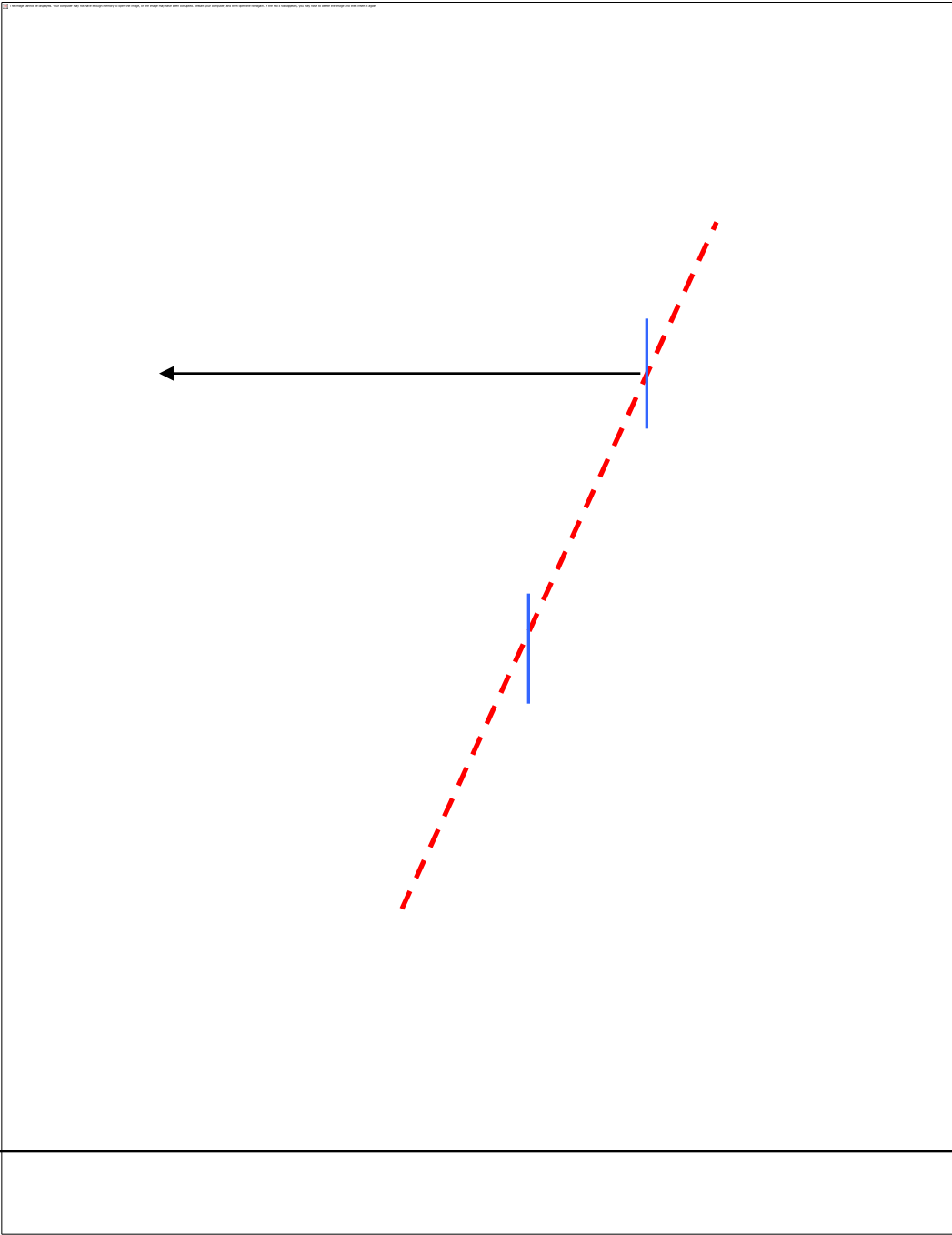
Studio classroom session II - NL

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Consider the following wing:

- A=5
- Assume airfoil is NACA 65-210 (see next slide. Use the red line)
- Wing efficiency factor =0.9
- Profile drag coefficient =0.004 for 6°

If the wing is at 6 degrees, calculate the lift and drag coefficient

- An airplane flies with a speed V = 200 km/hour in standard atmosphere at an altitude h = 3000 m. In certain point A on the wing upper surface, just outside the boundary layer, the air velocity relative to the wing V_A = 75 m/s. At 3000 m altitude in standard atmosphere
  - The pressure is: p_h = 70121 N/m2.
  - The air density is: ρ_h = 0.90926 kg/m3.
  - The temperature is: T_h = -4.5° C.

- Make plausible that the compressibility of air in this case can be neglected
- Calculate the pressure in A.
- Calculate the pressure coefficient C_p in A

3

It is your task to design a supersonic wind tunnel with a Mach number M = 3 and standard sea level atmospheric conditions at the end of the test section (see figure below)

The ratio of the specific heat coefficients: $\gamma = c_p/c_v = 1.4$

- Calculate the required reservoir pressure, p_0
- Calculate the reservoir temperature, T_0
- Calculate the test section velocity
- Calculate the velocity in the throat
- Calculate the contraction ratio A^*/A_e

Reservoir

P_0
T_0

Throat

T_e Test
section
(exit)

A^*

A_e

Supersonic wind tunnel

TUDelft