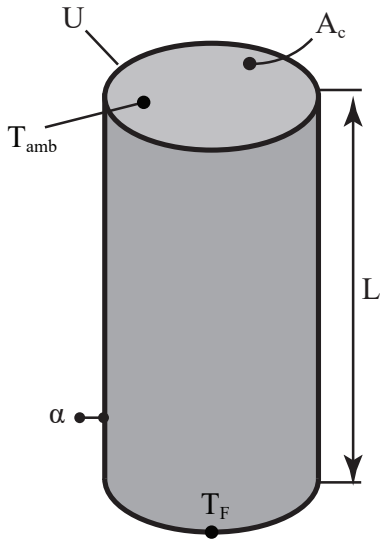
Exercise II.7 (Pin-fin cooling on gas turbine blades ⋆⋆)**:**

A rod fin is used for pin-fin cooling on gas turbine blades. The rod-fin of length L, with a tip temperature equal to the ambient T_{amb}, is given.



Given parameters:

- Fin geometry: U, A_{c}, L
- Fin material properties: λ
- Surface heat transfer coefficient: α
- Fin base temperature and environment temperature: $T_{\mathrm{F}}, T_{\mathrm{amb}}$

Tasks:

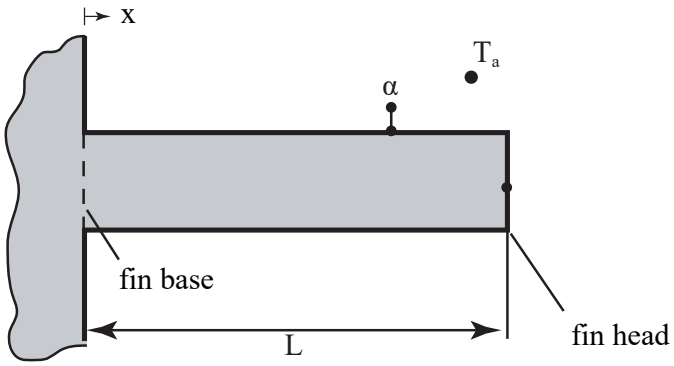
a) Derive the heat conduction equation for the given problem.

b) Derive the function of the temperature profile inside the fin.

c) Give the expression for the rate of heat loss in terms of the given parameters.

Exercise II.8 (New fin material ⋆⋆)**:**

An electric motor manufacturer is using fins for cooling purposes. He is considering changing the material used for the fins from copper to aluminum. Because the length L of the fin is also modified, the temperature at the fin head remains identical for both materials. However, he does not understand the impact of such a change on the performance of cooling.



Given parameters:

- Thermal conductivity of copper: λ_C
- Thermal conductivity of aluminium: λ_A

Hints:

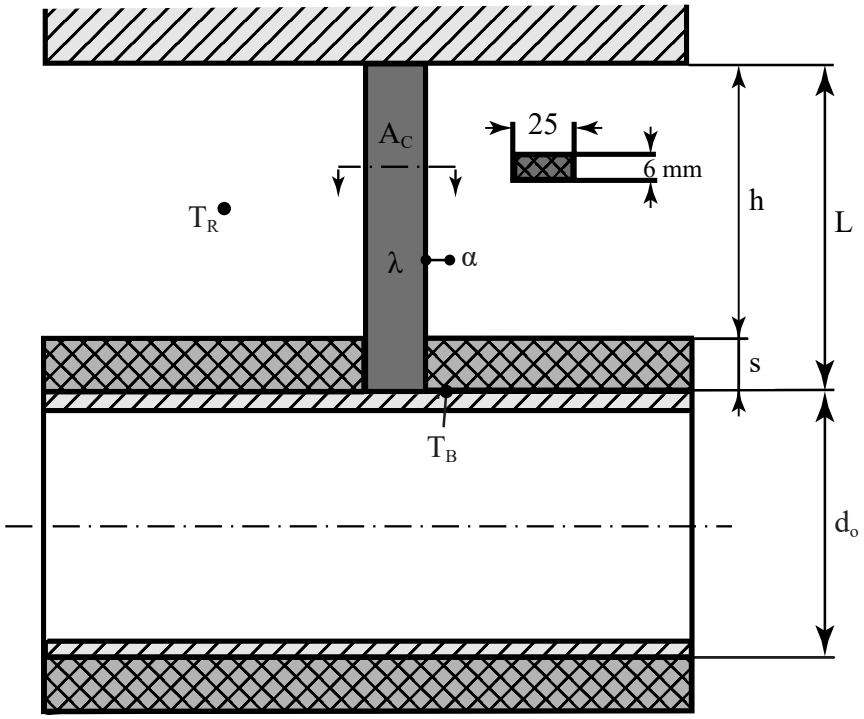
- The cross-section and the thickness remain unchanged.
- There is no change in the convective heat transfer coefficient.
- The temperature at the fin base does not change.
- For both fins, the heat flow through the head is negligible.

Tasks:

a) Determine the ratio between the heat flow of the aluminum and the copper fin in terms of given parameters.

Exercise II.9 (Pipe fastening ⋆ ⋆ ⋆)**:**

A pipe containing brine is insulated with cork and fastened to the ceiling with steel bands welded to the pipe.



Given parameters:

- Outer diameter of the pipe: $d_o = 50$ mm
- Insulation thickness: $s = 40$ mm
- Cross-section of the steel band: $A_c = 25 \times 6$ mm
- Length of the steel band: $L = 290$ mm
- Heat transfer coefficient at the steel band's surface: $\alpha = 6$ W/m^{2}K
- Thermal conductivity of the steel band: $\lambda = 58$ W/mK
- Temperature outer wall of the brine pipe: $T_B = -23.5$ °C
- Temperature of the room: $T_R = 20$ °C

Hints:

- The temperature distribution in the steel band's cross-section is homogeneous.
- The heat fluxes from the steel bands into both the ceiling and the insulation are negligible.

Tasks:

a) Calculate the heat $\dot{Q}$ from one steel band absorbed by the brine.

b) Up to which height h_0 does frost form on the steel ban (h_0 is the distance from the surface of the pipe's insulation layer), if the steam content of the air in the surrounding room is above the saturation vapor pressure for the maximum steel band temperature?