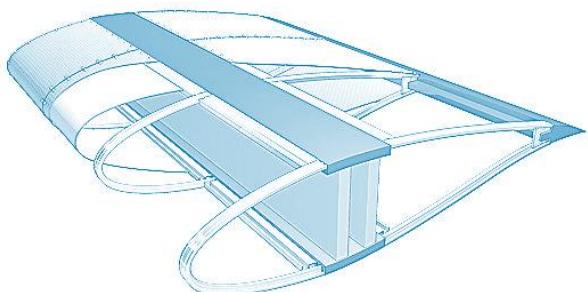


# Wing Spar

Mini-project  
Task



Mechanics of  
Aerospace Structures

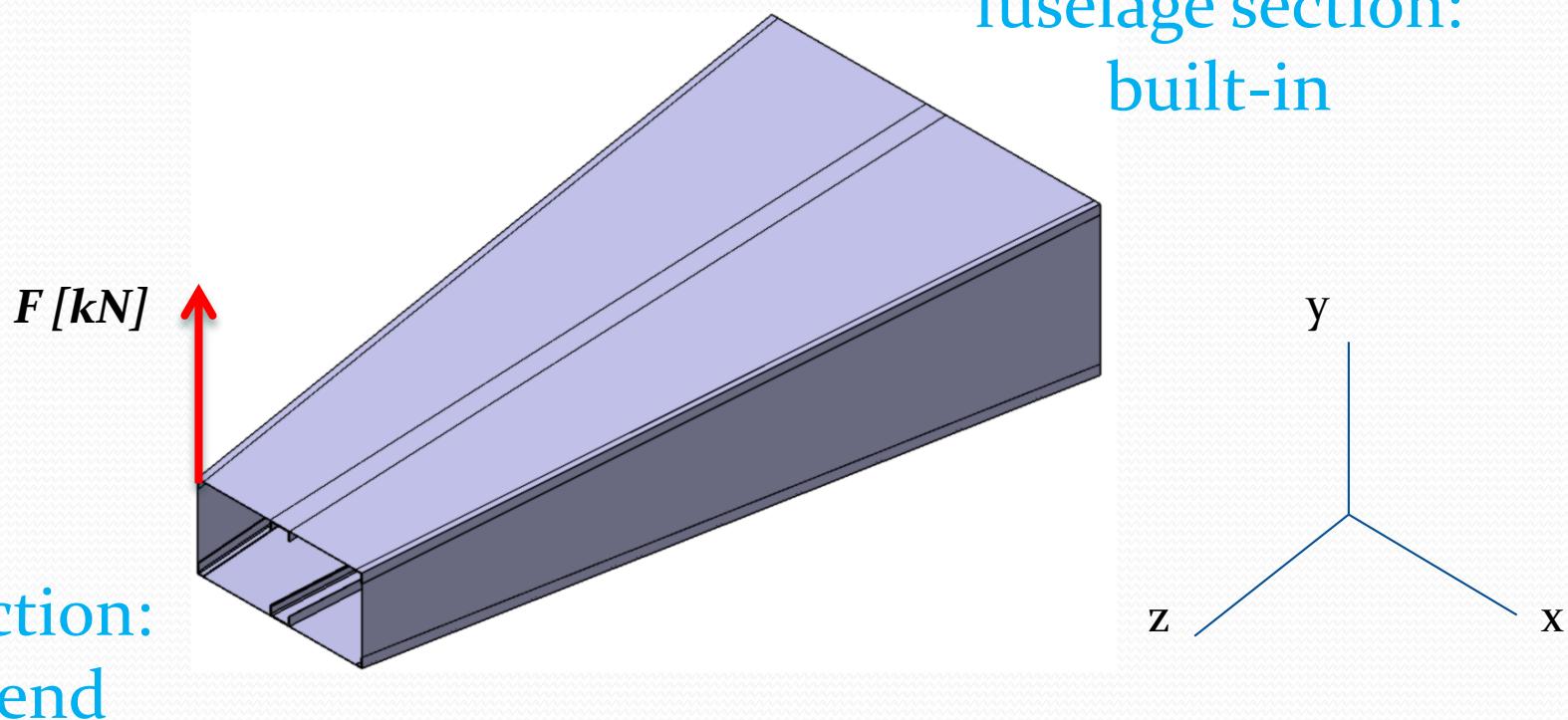
2021

# Primary aim

- Find stress distributions in the wing spar by analytical calculation based on structural idealization

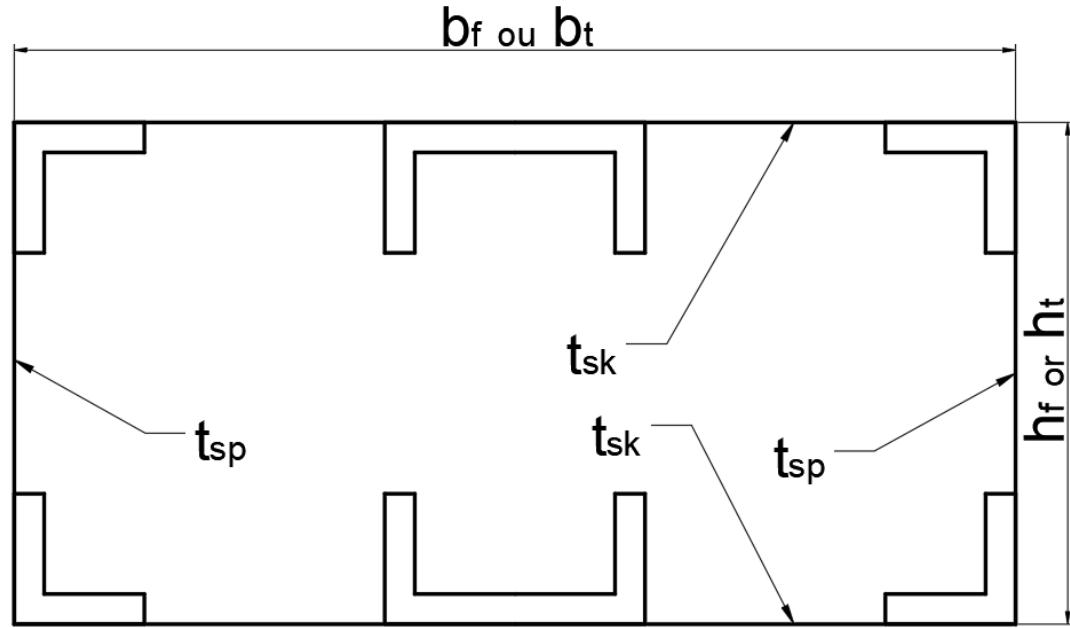
# Initial data

- The cantilever beam (wing spar) shown in the figure below is uniformly tapered along its length in both  $x$  and  $y$  directions carries a vertical load  $F$  upwards at the left spar of its free end.

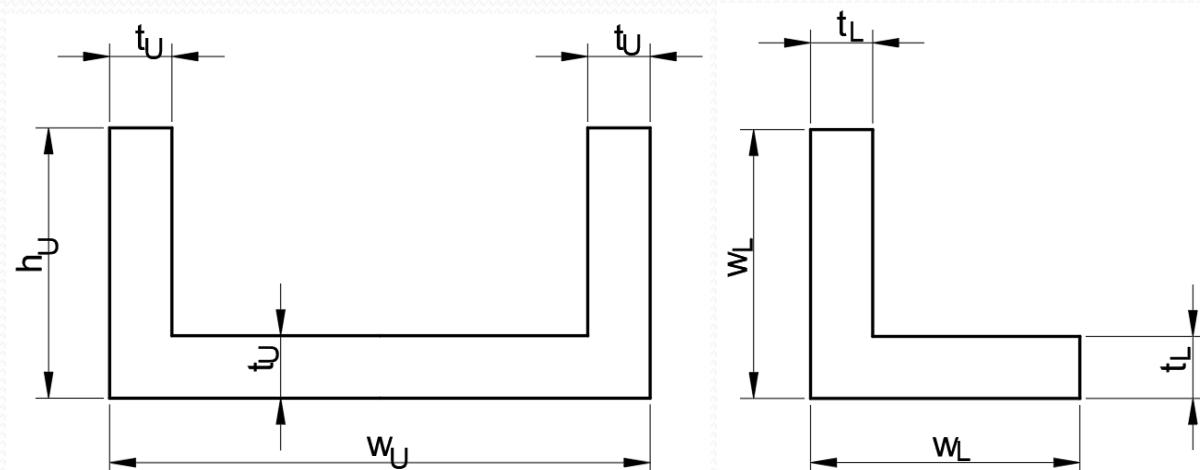


# Initial data

- Design of the wing spar
- Length of the spar 1
- Horizontal skin thickness  $t_{sk}$
- Vertical spar thickness  $t_{sp}$

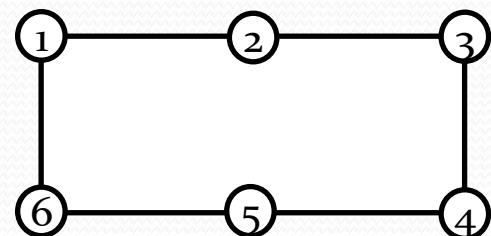


Fuselage/tip section:  
subscript  $f$  – fuselage section  
subscript  $t$  – tip section



Stringers geometry

Boom positions:



# Initial data

# Objectives

1. Idealize a section midway along length of the given wing spar into an arrangement of direct stress carrying booms and shear stress only carrying panels. Position of the booms should be at junctions of stringers with spars/skins.
2. Calculate 1) the direct stresses, 2) forces in the booms and 3) the shear flow distribution (together with shear stress distribution) in the walls at the same section (midway along length of the given wing spar) if the booms resist all the direct stresses while the walls are effective only in shear.

# Requirements

- The report of the mini-project must be prepared with use of the following pattern [ptrn\\_prj.docx](#).
- The report includes the following sections:
  - **Introduction** (Gives a description of the products of interest including purpose, functions, conditions of exploitation. One page only.)
  - **Problem** (Provides a description of the problem. The current presentation with images can be used.)
  - **Solution** (Includes 2 sub-sections)
    - **1.1 Structural idealization** (Objective 1)
    - **1.2 Stress distribution calculation** (Objective 2)
    - (In both items the progress of work should be given by analogy with the examples provided in [\[Megson, 2007\]](#). )

# Requirements

- The report includes also two sections:
  - **Conclusions**
  - **Literature**
- The report can be prepared in either English or Portuguese.
- All descriptions and conclusions should be brief, clear and comprehensible. Appropriate graphics and figures should be provided. References on tables and figures should be in the text.
- pdf or docx-file of the report must be delivered through aprender3.

# Requirements

- An insertion of the figures with distribution of all stresses into report is obligatory (minus 50% from the total number of points in case of its absence)! The figures can be done manually on a clean sheet and then digitalized and inserted into file.
- A detailed calculation with demonstration of formulas, data and tables (for instance, like it shown in example 21.2 of Megson, 2007) is obligatory. Noncompliance costs minus 50% from the total number of points.
- In case if the final result has discrepancy with the correct answer more then 5% the final mark is zero. Errors in structural calculations may cost human's life.

# Recommendations

- Use the theory and examples described in [Megson, 2007] in chapter 20 to fulfill objective 1.
- Use the theory and examples described in [Megson, 2007] in chapter 21 to fulfill objective 2.
- Material properties may be found in the open resource <http://www.matweb.com/>.