Fuselage
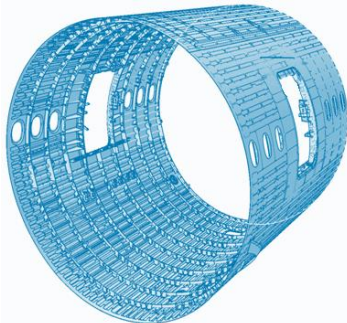
Mini-project
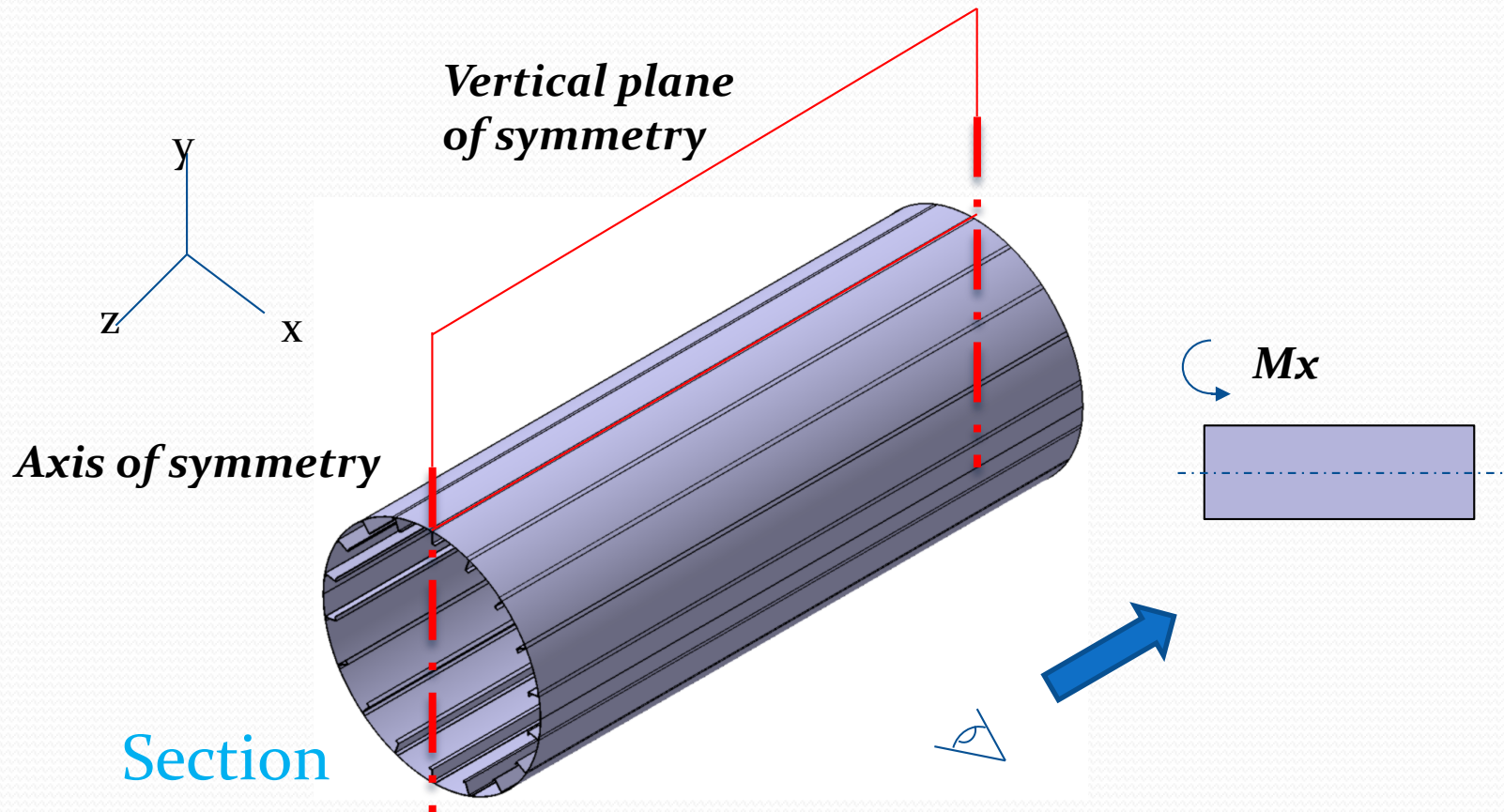Task

Mechanics of
Aerospace Structures
2017

Primary aim

- Find stress distributions in the section of fuselage by analytical calculation based on structural idealization
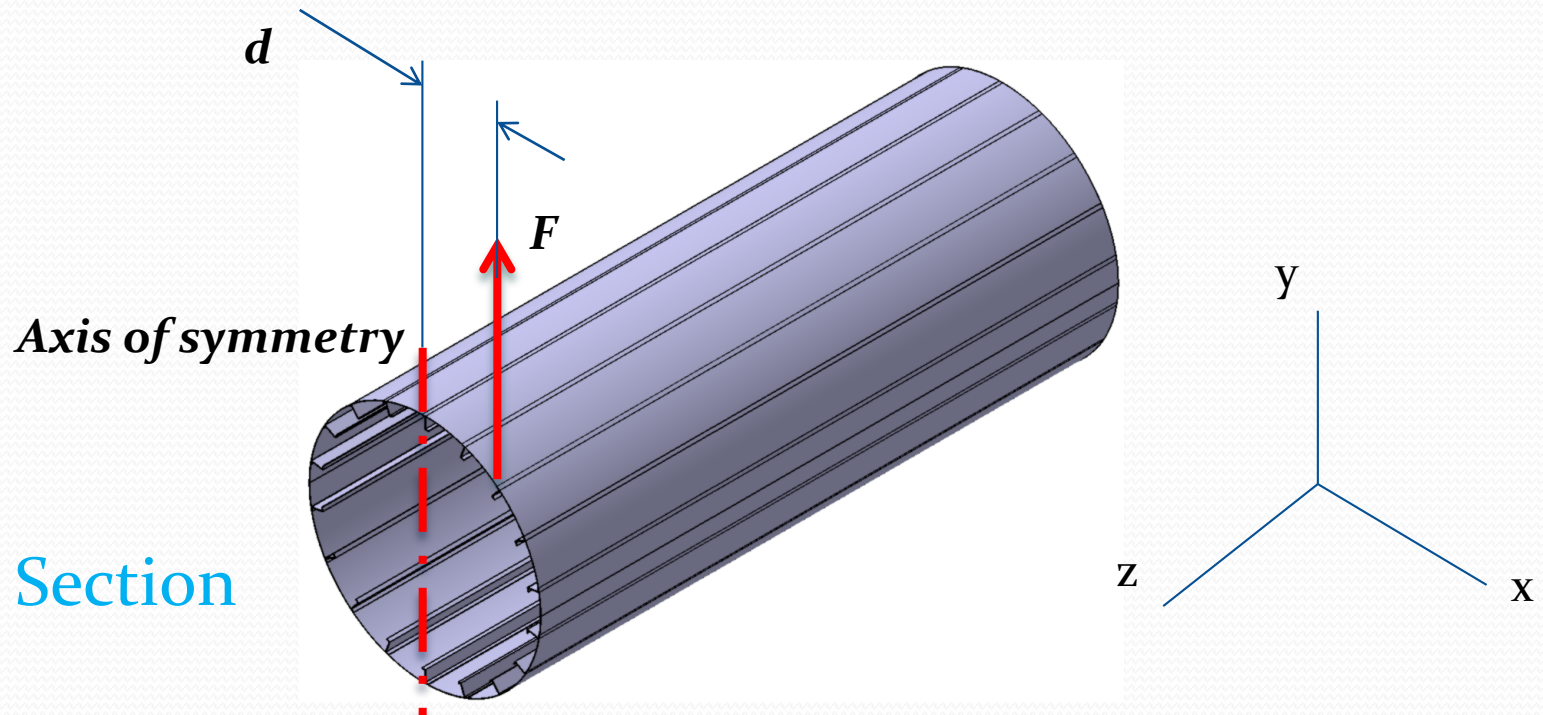
Initial data

- The fuselage's section of internal diameter D mm is subjected to a bending moment Mx applied in the vertical plane of symmetry as shown in figure below.

Vertical plane of symmetry
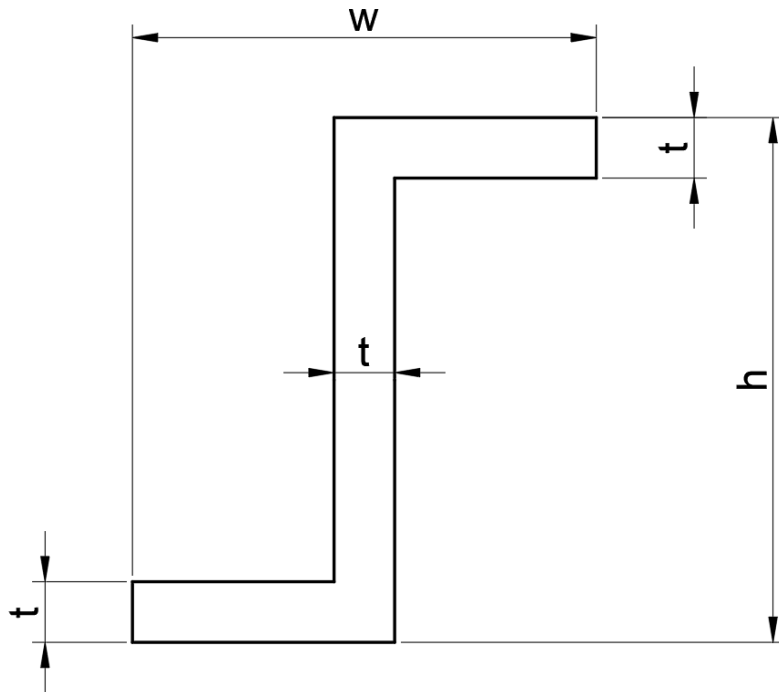
y

z   x

Axis of symmetry

Mx

Section

Initial data

- The fuselage section is also subjected to a vertical shear load F applied at a distance d from the vertical axis of symmetry as shown in figure below.
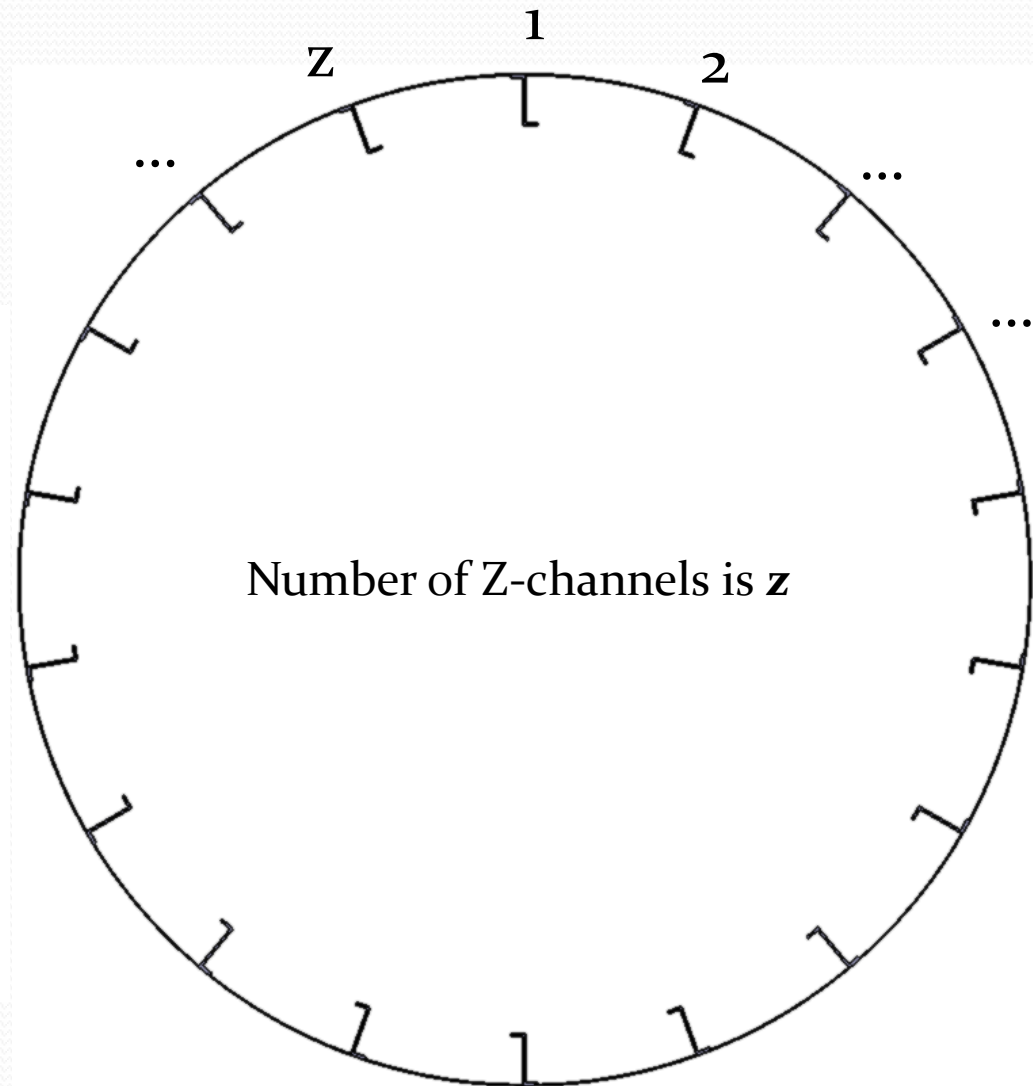
Initial data

- **Design of section**
- Skin thickness t_{sk}

Stringer geometry

Number of Z-channels is z

Initial data

Parameters, units	Options									
	1	2	3	4	5	6	7	8	9	0
Diameter of fuselage D, mm	720	730	740	750	760	800	820	840	860	880
Moment Mx, kN·m	190	195	200	205	210	215	220	225	230	235
Load F, kN	75	80	85	90	95	100	105	110	115	120
Distance of load application d, mm	142	144	146	148	150	162	164	166	168	170
Number of z-sections z	16	16	16	16	16	16	16	16	16	16
Skin thickness t_{st}, mm	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Width of z-section w, mm	24	24	24	24	24	26	26	26	26	26
Height of z-section h, mm	28	28	28	28	28	30	30	30	30	30
Thickness of z-section t, mm	2	2	2	2	2	2	2	2	2	2

Objectives

1. Idealize the section into an arrangement of direct stress carrying booms and shear stress only carrying panels suitable for resisting bending moment in a vertical plane. Position of the booms should be at junctions of stringers with skin. Calculate the direct stress distribution.

2. Calculate the distribution of shear flow and find the maximal shear stress in the section. Take a notice that panels (skin) do not carry direct stresses.

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 have to be brief, clear and comprehensible. Appropriate graphics and figures should be provided. References on tables and figures must be in the text.
- Pdf-file 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 22 to fulfill objective 2.

- Material properties can be found in the open resource http://www.matweb.com/.