Project 9 – Wing loading

Lifting surface loading:

The project consists of following tasks:

- Calculations of lift force spanwise distribution by Schrenk method,
- Calculations of mass unloading,
- Calculations of maximum load case according to regulations,
- Calculations of shearing force, bending and twisting moment,
- Calculations of loading of main wing-fuselage joints.

Distribution of lift force

Distribution of the lift force for the wing should be calculated for unit lift coefficient equal C_L=1. The Schrenk method is presented in lecture No. 12 and in many handbooks on aircraft design, and first of all in the Original Schrenk's report.

Mass unloading

Assume, that the wing transmits total lift force. The total lift force is equal to:

$$P_z = n\,mg$$

where:

n – load factor

m – mass of aircraft

g – gravity acceleration

Except lift force, the mass forces acts on the wing structure. They decrease total lift acting on the wing structure and are equal to product of wing weight and load factor. The weight of wing means the weight of wing structure and all aircraft components built in wing, for example a fuel tanks.

Distribution of mass forces should be calculated. It may be assumed, that distribution of mass structure is proportional to the volume of structure. To find critical case several cases with different fuel weight and take off weight should be considered.

Maximum wing loading

The lift coefficient distribution which was calculated by Schrenk method should be multiplied by maximum load factor value, according to load envelope. Next the loading should be reduced taking into account all mass forces. Remember to apply the safety factor defined in airworthiness regulations.

Distribution of loading components

The result of this part should be spanwise distribution for total wing load (max. case):

- Shearing force,
- Bending moment,
- Twisting moment.

Discuss with Your supervisor how to apply influence of control surface (aileron) and high lift devices (flaps) on wing load.

Loading of main fittings

Scheme of transmitting of loads from the wing to the fuselage should be proposed. The solution should correspond to the airplane breakdown from project No. 7. For the proposed scheme the statics of main wing-fuselage joints should be presented.