Delft University of Technology / Faculty of Aerospace Engineering		
Project	: AE2111-I System Design - Essay	curriculum year : 2nd
Date	: 14 January 2014	10.00-12.00 hrs
Remark: Please mention your name and ALL YOUR INITIALS on your work. If you use more than one set of papers, fill out the heading on each set and **also include your group number next to the TUDelft logo.**		

Assessment of the effect of a higher cruise altitude

In the future air traffic will continue to increase with 5% per year. Although this does not seem like a lot it means that worldwide air traffic will double in about 15 year. This air traffic will have to be accommodated in the available airspace. Some time ago the vertical separation between aircraft has been reduced from 2,000 ft to 1,000 ft. Another reduction in vertical separation will probably not be the most likely scenario for the future.

It will be more likely that we will try to extend the flight levels used to higher altitude. You are therefore required to analyse what will have to change to your design if we decide that the maximum cruise altitude of your aircraft has to increase by 6,000 ft

You are required to assess the changes of the wing design as well as the maximum take-off weight of the entire aircraft. The mission (range and payload) of your aircraft must stay the same. In your essay you have to report the following results:

1. Change in your wing design
2. Change in your maximum take-off mass

Note: simply writing something will change is not sufficient! You have to point out how / in what direction (bigger –smaller, higher-lower, etc.) and why.

Essay January 2014 - Aircraft

Grading guidelines

For every step in the reasoning the student can earn points, given between parenthesis.

If you want to fly higher you have to take into account that the density decreases (1 point). First assume that the aircraft mass does not change. You then have to lift the same mass. According to the lift formula you can play with the parameters C_L, V and S (1 point for showing that you use the lift formula and two more points for the insight that you have to look at the three parameters C_L, V and S). When you choose to play with the speed you will encounter limits in the Mach number which has been set for your aircraft. This is thus not the way to go (1 point for this sub-conclusion). Changing the lift coefficient will make you fly at another lift-to-drag ratio. Most probably you are already cruising at the best C_L or very close to that. This is thus also not the way to go (1 point for this sub-conclusion). The last resort is then to increase the wing surface (1 point for this sub-conclusion).

What you will most likely do is to increase the wing surface a bit, thereby lowering the wing loading (using the term wing loading gives one point). Your wing will become less efficient. As a consequence of this the mass of your aircraft will go up (1 pt for this sub-conclusion). Then the snow ball effect starts taking over. More mass will require more lift – more lift will give you more drag – more drag requires more thrust – more thrust requires a) a bigger engine => more mass and b) more fuel => more mass, etc., etc. (2 points for the correct explanation of the snow ball effect, 1 point if only the effect is mentioned)

The two most important items that the students must be able to find are the bigger wing and the snow ball effect. This should be clear form their reasoning. In case they miss one of these two points they may fail the essay, unless they have compensation . In case they mention them both the grade will be 7 or 8 when good reasoning is given. In case they can further elaborate the details their grade can go up further to 9 or 10.)

Compensation

With the points mentioned above the maximum is 10. If the student has a relevant / smart remark (+0.5) this could compensate for lost points somewhere else in the essay.