Hochschule für Angewandte Wissenschaften Hamburg
Hamburg University of Applied Sciences

DEPARTMENT OF AUTOMOTIVE AND AERONAUTICAL ENGINEERING

Conceptual Design Optimization of Passenger Box Wing Aircraft in Biplane Layout

Background

The first step in conceptual aircraft design consists of finding consistent aircraft parameters that ensure the aircraft meets given requirements. Subsequently, this first set of aircraft parameters is varied such that an objective function is optimized. The objective function most often applied in civil aviation are Direct Operating Costs (DOC) which are to be minimized. The optimization involves – even in conceptual design – so many parameters that an aircraft specific optimization algorithm has to be used. The program Optimization in Preliminary Aircraft Design (OPerA) is available for this purpose at Hamburg University of Applied Sciences. A Box Wing Aircraft (BWA) could have a potential replacing today's short-medium range aircraft (like A320 or B737). The box wing reduces induced drag without increasing (limited) wing span. Typically, a diamond shape wing is applied in design studies of box wing passenger aircraft. Unfortunately, the diamond wing arrangement has a number of disadvantages (e.g. ensuring static longitudinal stability with shifting cg, ensuring efficient ground handling). Here, the biplane box wing layout with conventional horizontal and vertical tail seems to be advantageous.

Task

Task of this Master Thesis is to investigate the so called "Low-High" (L-H) and the "Low-Super High" (L-SH) box wing biplane configurations and to optimize aircraft parameters. Task is further, to carefully compare the results with other competing designs (Optimized A320, Strut Braced Wing Aircraft, Folding Wing Aircraft, Diamond BWA and Smart Turboprop). These steps should be followed when working on the thesis:

- Description of the reference aircraft (based on the A320).
- Brief review of the box wing aircraft (BWA) concept including a brief discussion of different box wing types and wing span limitations at airports.
- Brief introduction to OPerA including cg calculation and longitudinal wing placement.

- Extending OPerA to enable conceptual design calculations for biplane BWA in L-H and L-SH layout.
- Conceptual design and optimization of biplane BWA in L-H and L-SH layout.
- Discussion of optimum high-to-span (*h/b*) ratio for biplane BWA in L-SH layout.
- Final proposal of the best (and possibly also second best) BWA layout and a) presentation as an electronic 3-D model e.g. with OpenVSP, b) description in AERO's standard aircraft presentation scheme.
- Comparison of the biplane BWA designs with other competing designs.

The report will be written in English based on German or international standards on report writing.