18 - Wings for Aid

Wings for Aid is a company that aims to solve the "last mile" problem in humanitarian aid delivery. This last mile represents the distribution of lower quantities of aid to people or communities that are isolated due to natural or man-made disasters. The approach to solving this problem utilises pinpoint accuracy air dropping of standardised boxes that contain up to twenty kilograms of humanitarian aid each. The main driver for this project is cost, therefore the aid should be delivered at a monetary rate that is as low as possible. An indication for the rate is two to four times the cost per kilogram of payload delivered by a truck. For transportation purposes, the aircraft shall fit in a forty foot ISO container. The use of a transport configuration, in which parts are disassembled, is allowed to meet this requirement.

Mission Objective

The objective of this project is to design an aircraft that can deliver ten to twelve standardised boxes of aid with pinpoint accuracy over a range of 250 kilometres. The target unit cost of a single aircraft €25000 or less and the cost per kilogram of payload delivered shall be less than €0.96. One of the customer needs for the project is a payload delivery capacity equal to that of a C130 Hercules aircraft. This means 20 to 30 aircraft shall be deployed every operation. The mission objective therefore also entails the design of an operation with multiple of these aircraft. This includes everything from the deployment decision and on-site assembly to the end of the mission, disassembly and storage.

System Design

The first step in the design process consisted of project organisation and planning. This laid the foundation upon which the project was based. Subsequently, the design options were generated. The trade-off that was performed between the design options showed that the options for certain subsystems were limited. For example, due to loading and terrain considerations, the wing could only be placed on top of the fuselage. In the end, the configuration that was chosen is a tractor configuration aircraft with a high, braced wing. The empennage is mounted on a boom and full moving horizontal tailplanes are utilised. A render of the concept can be seen in the figure. A truss structure was selected for the aircraft structure, as it better facilitates the dropping of the boxes. As it stands, the aircraft uses around 60 litres of fuel for a sortie. The sortie time for a range of 250 kilometres is around three hours, with a cruising speed of 100 to 110 knots. This is dependent on the flight profile that is flow in the sortie. The flight profile depends on the number of drops that are to be performed and the cruising altitude between the drops. During an operation, 20 to 30 aircraft are assembled on site. Assembling includes mounting the wings and the horizontal tailplanes. When assembled, the aircraft flies sorties until the mission is over. The loading of the boxes is performed via hatches that cover the side of the aircraft. Small maintenance, like oil changes, can be performed on the ground base. The dropping of the boxes is performed with a human in the loop. A drop site operator is present to confirm a safe drop zone to the aircraft. The boxes are dropped using gravity and have self-deploying flaps that stabilise and slow the box to ensure an impact within limits. In the coming weeks, the design details, like wiring and hardware placement, will be integrated into the design. These will be designed to accommodate the modularity of the design.