

Aerospace Case Study (Swift Engineering Inc. – Blended Wing UAV)



The underside of the Killer Bee



A Killer Bee ready for launch



A Killer Bee approaches the recovery net

Swift Engineering Inc. (www.swiftengineering.com) of San Clemente, California, produced one of the more innovative tactical unmanned aerial vehicles (UAVs) on the market, the compact (10-ft/3m wingspan) “blended wing” Killer Bee Unmanned Aircraft (KB-UA).

Swift was the first to develop a blended wing UAV, which is similar to but subtly different from the “flying wing,” a design that has existed since the early days of aviation. The KB-UA differs in that it has a distinct fuselage, which is flattened to form an aerodynamic airfoil. Its aft-swept wings merge smoothly with the fuselage body to form a tailless, arrowhead-like shape with slender, downturned outer wings.

Swift adopted this concept for the KB-UA for several reasons: merging the wings and fuselage into a single airfoil significantly reduces aerodynamic drag, improving fuel economy; then the KB-UA is considered a “thick” airfoil when compared to traditional thin-skinned, fragile flat wings, giving it better structural efficiency; last, the design maximizes the aircraft’s volume-to-wingspan ratio, allowing a disproportionately large payload capacity — comparable to UAVs with a 30 to 50 percent larger wingspan — in a compact package.

The Swift team had to meet several key project objectives: a manageable system for launch and recovery in the field; a lightweight airframe to maximize the aircraft’s long-term loiter capabilities in day or night operations; and structural durability to withstand extreme environments. A suite of software was used to optimize the KB-UA’s shape, aerodynamics and composite structure: SolidWorks 3-D CAD software helped define the craft’s initial shape, while NEi Nastran, supplied by NEi Software Inc., was used to size and develop the airframe structure and laminate schedule to meet anticipated loads.

Between 15 and 20 “strenuous” load cases were developed, incorporating launch and recovery accelerations/decelerations of 15 Gs and safety factors ranging from 1.3 to 3. When the model showed that stresses were too high on areas of the airframe, like the outer wing joints, the layup was adjusted, and plies were added, then the FEA analysis was rerun. To minimize weight yet obtain the highest strength and stiffness for sustained operations, the airframe was designed with carbon/epoxy composites, using a combination of cored and solid laminates made from unidirectional and plain-weave prepreps.

Swift created a system that is very functional and modular for field operation. Moreover, the Killer Bee is strong and robust enough that it could be dropped from a moving aircraft.

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