Analysis of Various Wing Structures for Hovering Capacity

Ludgate, Drake (School: Brush High School)
Miner, Nathaniel (School: Brush High School)

The purpose of this research is to test various researcher-designed two/three dimensional wing models with varying surface areas using an oscillating air column apparatus for determination of hovering capacity between five and fifty Hertz. A vertical oscillating wind tunnel was designed and built. Ten two dimensional (flat) and twenty-two three dimensional (pyramidal) shaped objects were designed and constructed out of Japanese tissue. All shapes were tested at frequencies between 5 and 50 Hertz and various amplitudes. Some of the pyramidal shaped objects included flaps for testing. Flapped and non-flapped three-sided pyramids were tested of various surface area and constant mass. Results indicated that it takes a greater amplitude to induce hovering at lower frequency for any designed pyramid, whether they have flaps or not. The research presented in this paper indicates that there exists an inverse relationship between surface area and air speed necessary to induce hovering. The largest pyramids (flapped and non-flapped) showed the smallest range of air speeds and frequency required to induce hovering. A three-sided pyramid-shaped object is capable to hover freely in an oscillating background airflow with zero mean component, provided the amplitude of the oscillation is sufficiently large. The required amplitude to induce hovering at a given frequency is dependent upon the body size (surface area) and geometry (flapped vs. non-flapped) when mass is held constant.

Awards Won: