

Human Powered Helicopter Competition

The regular monthly meeting of Vancouver Branch in 1999-2000 in March was held on Monday, March 27 at the University of British Columbia (UBC). The meeting began with opening remarks by Ms. Bethany Foote, Chair of the Vancouver Branch of CASI.

Our guest speaker for the evening was Mr. Mike Georgallis who is a PhD candidate in the Department of Mechanical Engineering at UBC. Shortly after his arrival at UBC he started the Thunderbird Project with the help of many undergraduate and graduate students. He has worked in the Aerospace Industry for several years in the Montreal area and holds a B.Eng. and M.Eng. degree from Concordia University.

As mentioned, the topic presented was on the Thunderbird project underway at UBC, which is an effort to design and build a Human Powered Helicopter. The UBC-HPH group officially began work in June of 1998. The construction of a 32m (105 ft) diameter machine has started; its estimated weight will be 40 Kg (88 lb).

The Human Powered Helicopter Project is indeed a world wide competition established by the American Helicopter Society in 1980. The Igor I. Sikorsky Human Powered Helicopter Competition is presently offering \$20,000 U.S. for a successfully controlled flight of an HPH. Although the competition calls for a one-minute hover and a momentary reach of 3 meters, no one has claimed the prize yet. In recent years, there have been 17 HPH's built worldwide (in the United States, Japan and England) but only two have flown. The official world record at present is just under 20 seconds of flight and only inches off the ground.

Various subprojects of the UBC-HPH work described in the presentation included design and construction of a test rig for small and full-scale rotors, design and construction of a human factor rig, and baking of the composite spars in modified household ovens. These subprojects are briefly elaborated below.

EXPERIMENTAL TEST RIG

Both small and full-scale rotors are being tested for lift and power requirements. The test rig includes a 16'x16' base for In Ground Effect (IGE) experiments for use with the small-scale rotor.

TEST RIG FOR PILOTS

A rig has been built for testing pilots in four configurations. These are the vertical cycling position (with and without hand cranking) and the recumbent position (with and without hand cranking). Preliminary testing was carried out with some very interesting results. Hand cranking was eliminated from both positions. Although preliminary, results also

show that for the pilots tested in both vertical and recumbent positions, power output was very close. This has led to the use of a recumbent position with no hand cranking in order to take advantage of In Ground Effects (lower support structure).

WING CONSTRUCTION

Five household ovens have been modified for the purpose of baking the composite spars for the full-scale rotor wings. CFRP is laid-up on a collapsible mandrel. After vacuum bagging, 6-meter (19-foot) sections are baked in the ovens.

The largest wing section chord length is 2 meters (6.5 ft). Expanded polystyrene makes up the wing cross-sections. They are locally reinforced with fiberglass. Additional leading edge, trailing edge and suction side sections are added so that the shrink-wrap follows the DAE-11 geometry.

BENEFIT TO ALL

There was no doubt that the largest benefit to starting and being involved with this project, as emphasized in the presentation, has been the academic merit. At UBC there have already been over 100 students actively involved in the project. Involvement includes students from the Departments of Mechanical Engineering, Metals and Materials Engineering, Engineering Physics, and Civil Engineering.

COST AND FUNDING

The cost of the project is estimated at \$21,000 Cdn. This does not include the cost of the composite material. The Boeing Company has generously donated CFRP to UBC. The material is estimated to be worth approx. \$30,000 US when fresh. A list of all sponsors to date is included below.

Funding from UBC:

- The Innovative Projects Fund of the Alma Mater Society
- The Walter H. Gage Memorial Fund of the Alumni Association
- The Department of Mechanical Engineering
- The Department of Metals and Materials Engineering
- The Faculty of Applied Science
- The School of Human Kinetics
- The AMS Bike Co-op
- The Composites Group

Funding from External Sources:

- The Boeing Company
- The Society for the Advancement of Material and Process Engineering
Student Chapter Project Fund
- Pratt & Whitney Canada Inc.
- SAE, The Engineering Society For Advancing Mobility Land Sea Air and Space, BC Section

It was pointed out that the plan is to assemble and test the machine in late 2000. Following the presentation, the chair of the Vancouver Branch, Ms. Bethany Foote, presented Mr. Georgallis with a token of appreciation and thanked him for his interesting and informative description of the Thunderbird project at UBC.