Design and Drawing

Syllabus Number 2F208
Special Subjects
Elective 2 credit
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1. Course Description

The students will create a conceptual design of a parachute that will allow a probe to make a soft landing on Mars. You will then design and fabricate a model parachute for simulation of the landing on Earth, perform an actual drop test, and evaluate the drag coefficient and other performance parameters for the parachute. The practical sessions will be performed in groups, but plans, drawings and reports will be submitted individually. However, since a single parachute will be designed and fabricated by each group, it will be essential for the group to discuss and reach a consensus on the design.

2. Course Objectives

Students will acquire an understanding of how the drag characteristics of parachutes depends on fluid mechanics, and the essential role of the Reynolds number in Earth-based performance tests of parachutes that will be employed on Mars. It is essential to make a detailed blueprint of a parachute before fabricating it. Be sure to manage your schedule so that you can systematically proceed from the initial plan through the design, fabrication, performance testing, evaluation, and design feedback phases within the 15 practical sessions.

3. Grading Policy

Students are divided into small groups. It is important to communicate well with group members.
Development plan (level of understanding of simulation, sketch of conceptual design and appeal of engineering content)
Design drawings (Basic design drawing. How clear is the shape of the product.)
Production procedure manual (Accurate instructions to the manufacturing side)
Ground test parachute (detailed drawings, carefully made and assembled based on assembly drawings, performance)
Report of descent test results (intelligibility of drag coefficient, understanding of flow similarity law, how to summarize descent test data, evaluation of difference between plan and result, explanation of improvement point)
The items in ( ) are the items to be evaluated. In addition to this, independence, action, and leadership within the group are also important.
The following feedback is given in this exercise.
We will provide guidance individually and during training. In addition, we will comment on plans, drawings, etc. submitted in the middle stage of the training, and point out the points that need improvement or the good points of each submission.

4. Textbook and Reference

Textbook
The training content will be explained using the handouts.
We will also distribute materials for basic planning and simulations.

5. Requirements(Assignments)

(1) ◆ Important ◆ Please attend from the 1st class. ← It is important in order to organize small groups of students. In addition, please participate in the readiness to accomplish to the end.
(2) A lecture will be given in the 1st class that will give a general explanation of the training and problem setting, and will present the results of the group formation at the end of the 2nd class.
(3) It is presumed that the students who take this course has studied the mechanical drawing, and prepared a compass, a ruler, a protractor, a mechanical pencil for drawing (0.3mm, 0.5mm, 0.7mm of core thickness), eraser, etc.
(4) Plan documents and drawings submitted at each stage of 15 classes / practices must meet deadlines.
(5) Schedule planning and self-management are required to conduct model testing in a short period of time.
(6) Open discussion will be held in the summary of the 15th descent test, so please organize your opinion in advance and participate.
In addition, since ground simulation tests are conducted according to the principle of hydrodynamic similarity using Reynolds number, please do your best to understand this principle, referring to "Nakayama Yasuki, Revised edition-Dynamics of fluid, published by Kenkendo".

6. Note

7. Schedule

[1] Step 1-1 : Project setting for soft landing of Mars Rover on Mars
[2] Step 1-2 : Perform soft landing simulation, determine drag coefficient and basic dimensions
[3] Step 2-1 : Basic Design (Creating and Submitting a Basic Diagram of Parachute)
[4] Step 2-2 : Drawing and Submission of Side-view and Dome Part of Parachuts
[5] Step 3-1 : Detailed design (Drawing of parachute for ground test)
[6] Step 3-2 : Detailed design (Cut figure of fan-shaped sheet for dome part)
[7] Step 4-1 : Cut The Parachute Film
[8] Step 4-2 : Fabrication of Parachute at Dome Part

[9] Step 4-3 : Fabrication of Parachute at Cylindrical Part

[10] Step 4-4 : Weight Measurement and Adjustment of Weight Bottle Filled with Suitable Amount of Water

[11] Step 5 : Confirmation of the interface betwenn the Parachute and the Hang-up Device

[12] Step 6 : Descent Test (first time, grasping motion of descent and measurement of terminal velocity)

[13] Organize Drop Test Data, Calculate Drag Coefficient, Examine The Acquired Data

[14] Descent Test (second time, measurement of terminal velocity)

[15] Step 7 : Presentation of Test Results and Feedback to Original Design by Each Group