

Tohoku University

Windnauts

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What is Windnauts?

- ✈ We make the human powered aircraft for participating in the Birdman rally at Biwa lake.
- ✈ We compete distance from taking off to landing on the water.
- ✈ In 2021, 43 members belonged to our team.



Official name	Human-powered flight club
Team name	Windnauts
Founding	1993
Number of people in each glade (1/2/3)	14/13/16

Goals and Means of Windnauts 2021 Project

✈ Due to the Covid-19 pandemic, our activities at the university was limited.

→ We decided to divert 2020's HPA, sun(燦).
Divert : Main wing, Flame, Drive system ...



✈ Not to be ready for the competition.

→ We withdrew from that. (Apr. 2021)

→ Set goal as Test Flight.

▪ Mainly to take over the method of TF.

Design Concept

“Improve wind resistance”

- ✈ Increased wing loading (smaller wing area)
 - ➡ More tolerant of gusty conditions
- ✈ Refined airfoils and wider wing
 - ➡ Less drag and more range, or higher speed
- ✈ Large area empennage and rigid airframe
 - ➡ Highly controllable in rough wind

This year's aircraft was designed

Hard to be blowing in the wind and controllable

Making Scenery



Tail (Elevator)



Flame jointing

Propeller assembly

CFRP beam



Making Scenery



Avionics : speed meter
cadence meter
altimeter
rudder/elevator angle indicator
GPS
(Real-time data transmission available)

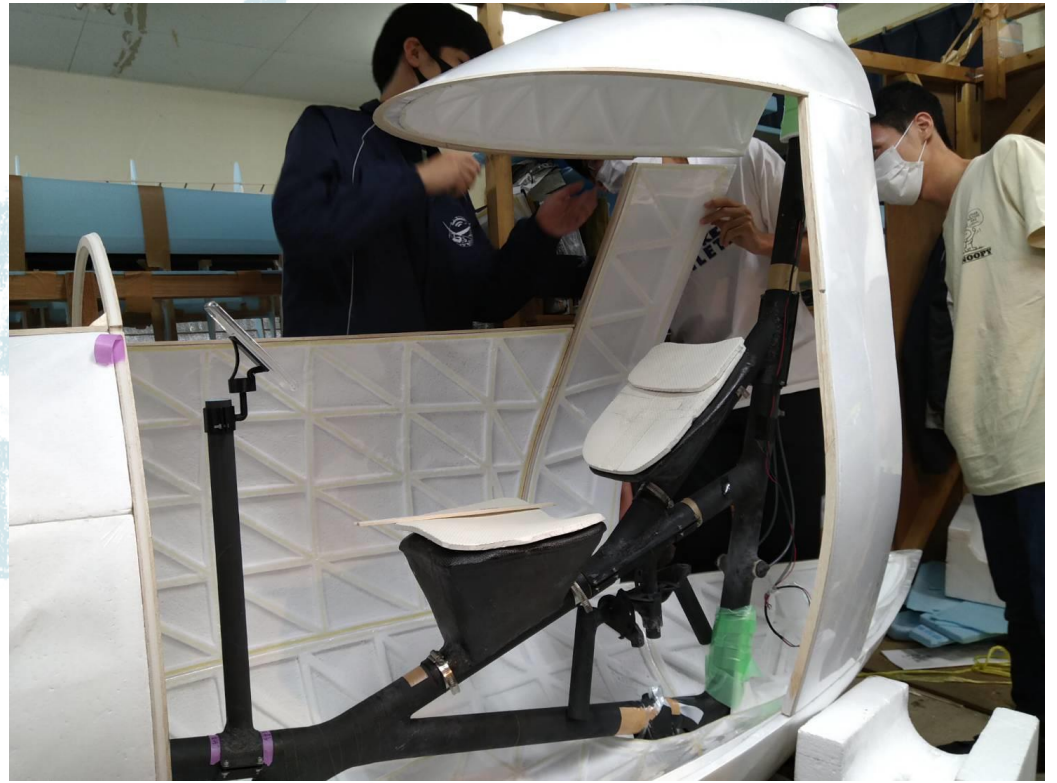


Steering

Making Scenery



Reducing foam for Fairing



Test

Load Test



Ensured airworthiness of wing (1.5G)

Drive System Test



Check operation of
drive system and
propeller

Check and adjust
operation of
control stick and
horizontal/vertical
stabilizer

Steering System Test



Test Flight

- ✈ The purpose of Test Flight is...
- Training of the Pilot and the members.
- Check-up of assembly correctness.
- Training of airplane handling.



Runway maintenance...



Test Flight at Kawauchi camps

Assembly Test



Running Test



Jump Test

- Check safety and center of gravity
- Get the feeling of floating
- Cooperation with the crew

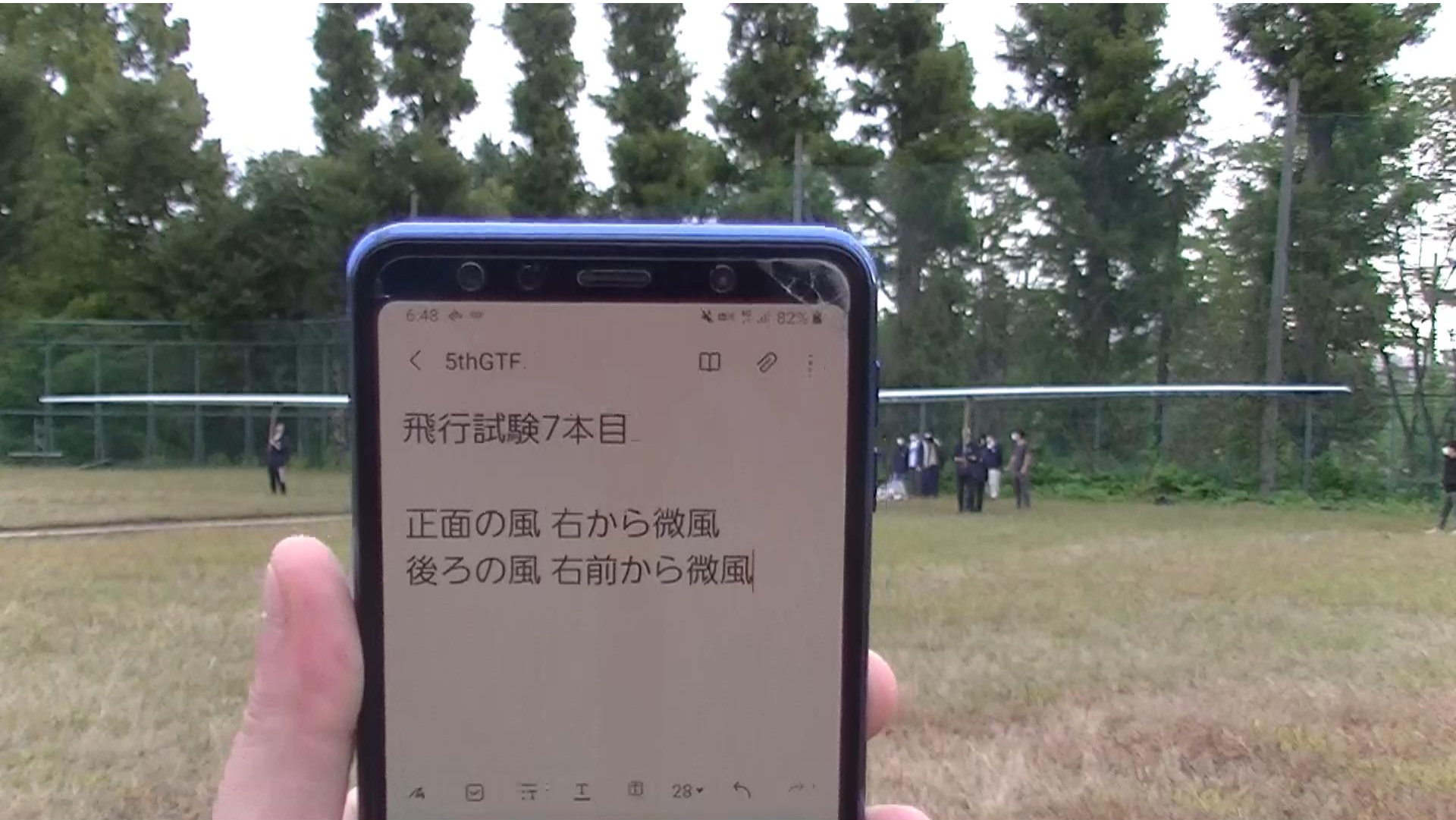
Test Flight at Kawauchi camps

Elevator Test Rudder Test



- Get the feeling of tail control and get used to it.

Test Flight at Kawauchi camps



Test Flight at Kakuda

- ✈ The main purpose is training of airplane handling.
- ✈ Flight relatively long distance and high speed
(design speed : 7.35m/s)

Running Test

Jump Test

Elevator Test

Rudder Test



Test Flight at Kakuda



Accident at Kakuda

✈ Tire buried in the ground, breaking suddenly.

➡ The tip of the propeller broke off.

Downward bending force applied to wing beam.



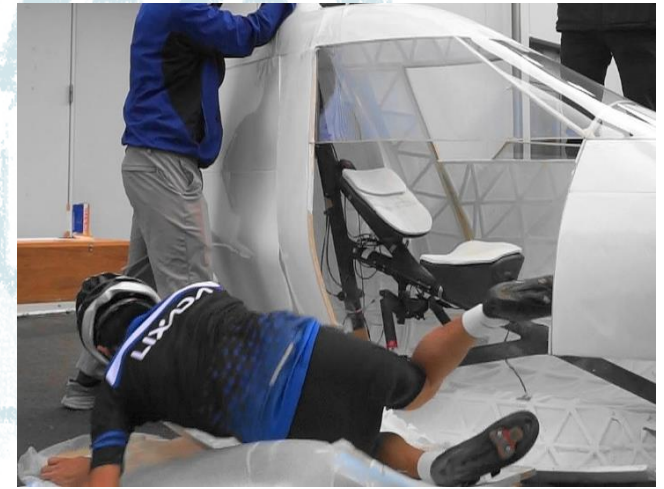
Response to Accident

- ✈ To check the damaged area can withstand the load, we took load test.
- ✈ Decided to use propellers from two years ago, took drive system test.



Test Flight After Accident

- ✈ After safety check, we conducted some TFs and these were successful.
- ✈ With the ejection test, our 2021 project was finished
 - Test to check if pilot can get out of the fairing.



Summary

- ✈ We couldn't create an aircraft from scratch and get into the competition.
- ✈ However, we improved the operation of aircraft to be more effective and safer.



Additional Slides



Specification

Specification	
Gross weight	88.0[kg]
Empty weight	32.3[kg]
Design cruising speed	7.35[m/s]
Need Power	214[W]

Propeller	
Airfoil	Milly-Terry(original)
Rudius	1.60[m]
Rotational speed	131[rpm]
Thrust power	22.1[N]

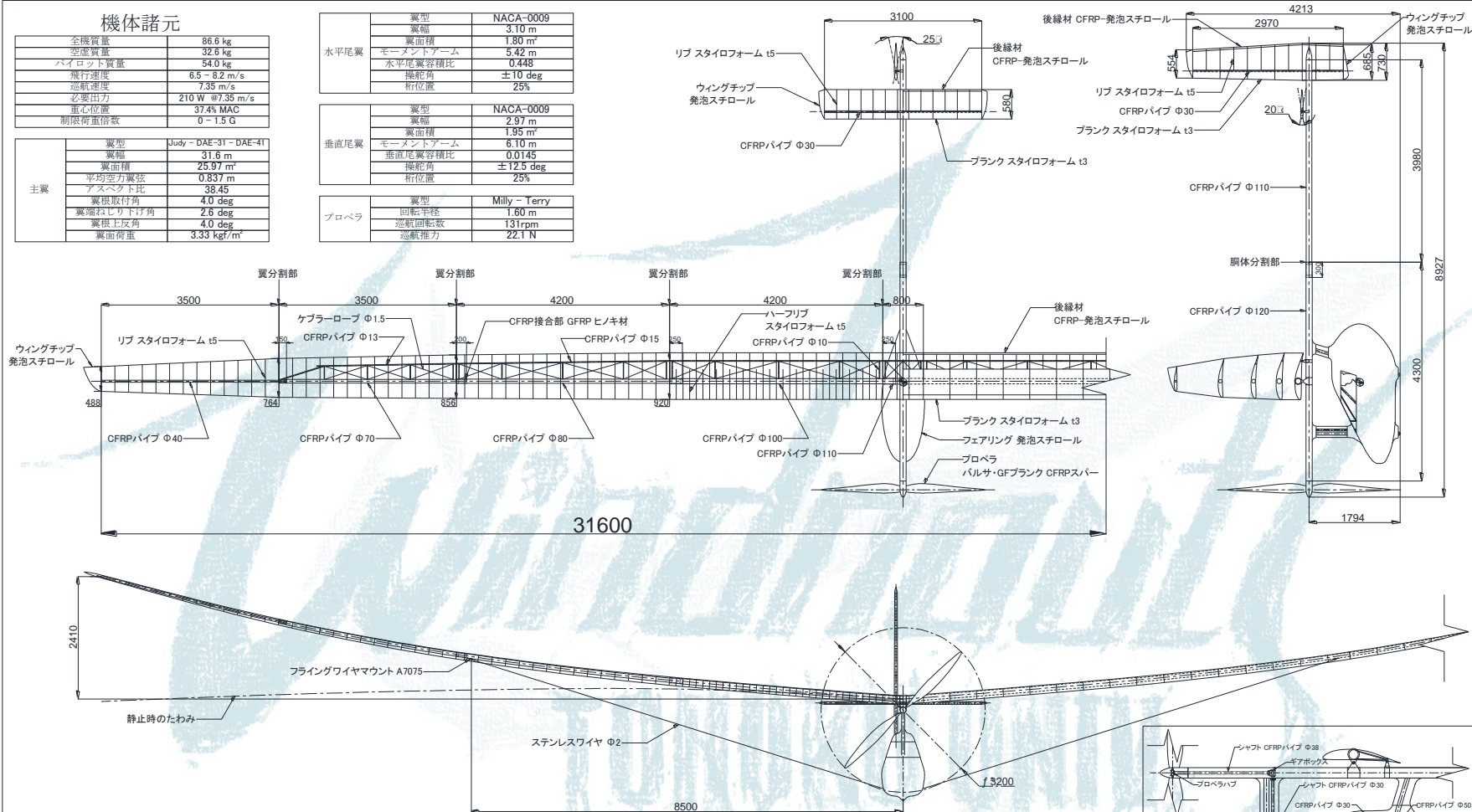
Main wing		
Airfoil	Judy-DAE31-DAE41	
Span of wing	31.6[m]	
Wing area	25.97[m ²]	
Aspect ratio	38.45	
Angle of attack	Judy	4.0[deg]
	DAE-31	4.0-2.7[deg]
	DAE-41	2.7-1.4[deg]
Dihedral angle	4.0[deg]	

機体諸元

全機質量	86.6 kg
空機質量	32.6 kg
パイロット質量	54.0 kg
飛行速度	6.5 - 8.2 m/s
巡航速度	7.35 m/s
必要出力	210 W @7.35 m/s
重心位置	37.4% MAC
制限荷重係数	0 - 1.5 G

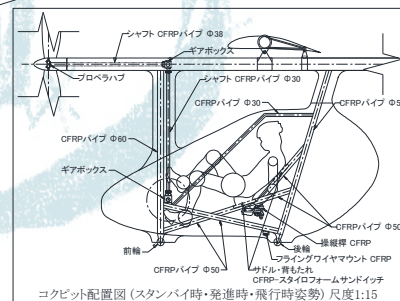
主翼	翼型	Judy - DAE-31 - DAE-41
	翼幅	31.6 m
	翼面積	25.97 m ²
	平均空力翼弦	0.837 m
	アスペクト比	38.45
	翼根取付角	4.0 deg
	翼端ねじり下げ角	2.6 deg
垂直尾翼	翼型	NACA-0009
	翼幅	2.97 m
	翼面積	1.95 m ²
プロペラ	モーター	ミリス - Terry
	回転半径	1.60 m
	巡航回転数	131rpm
	巡航推力	22.1 N

水平尾翼	翼型	NACA-0009
	翼幅	3.10 m
	翼面積	1.80 m ²
	モーメントアーム	5.42 m
	水平尾翼容積比	0.448
垂直尾翼	翼型	NACA-0009
	翼幅	2.97 m
	翼面積	1.95 m ²
	モーメントアーム	6.10 m
	垂直尾翼容積比	0.0145
プロペラ	翼型	Milly - Terry
	回転半径	1.60 m
	巡航回転数	131rpm
	巡航推力	22.1 N



東北大学Windnauts 2021
第43回鳥人間コンテスト選手権
人カプロペラ機部門出場機体
燦然たれ、曙光の如く

燦



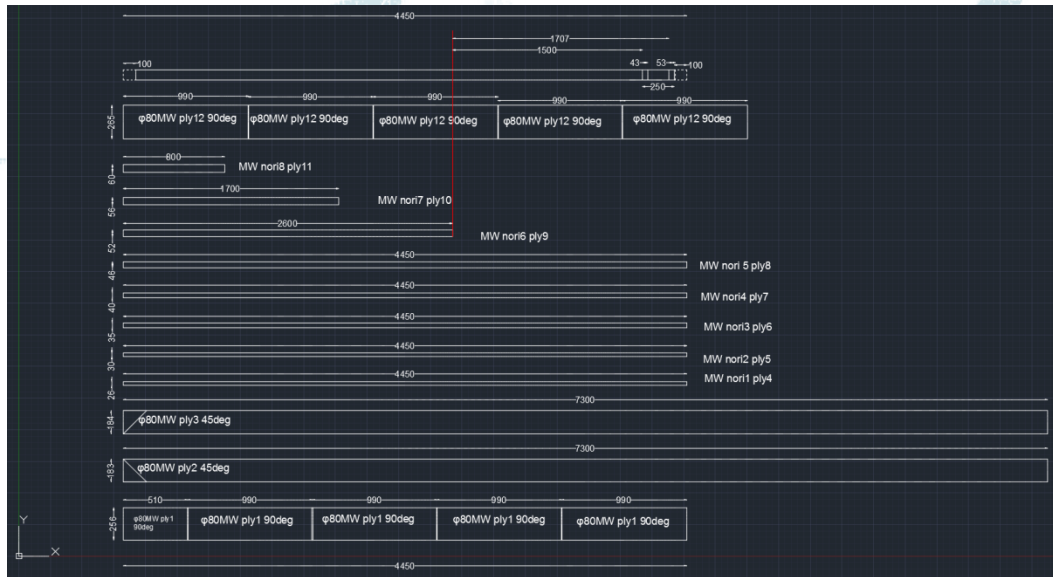
チーム名	東北大学Windnauts	機体名	燦
パイロット	久保隆	尺度	1:25
設計	上野直哉	投影法	第三角法

Columnar beam made by CFRP

Making columnar beam made by CFRP is most important work of all.

So, we set to work it every member.

We spend all weekend on making them.



Designing beam efficiency.

Arranging each lamination parts on prepreg



Drawing line using pencils and ruler.
Cutting follow the line using scissors.

Columnar beam made by CFRP



Lamination

Ply1 90°

Ply2 0°

Ply3 45°

Ply4 -45°

Ply5~ base on
each design

Cloth is overlaid with prepreg.
Cloth absorbs futile epoxy,
and beam become light.
Surface became rough,
and workability are increase.

Columnar beam made by CFRP



Heating with electric heating wire inside to cure epoxy resin.

Cure cycle:
60→130°C 1h
130°C 1h
130→60°C 1h