

Research of paper plane flies much longer

KOBE High School Science Course 1st

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Purpose

We wanted to make the paper plane fly longer so we could do a calculation.

Also we wanted to know the feature of flying paper planes to compare calculation results with actual measurements.

We thought that paper planes need a lifting force and stability to fly better.

So we picked up on three points: Camber, Horizontal Stabilizer, and Vertical Stabilizer.

Experimental Method

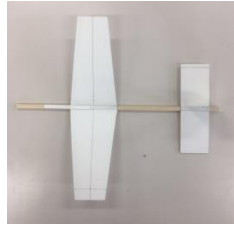
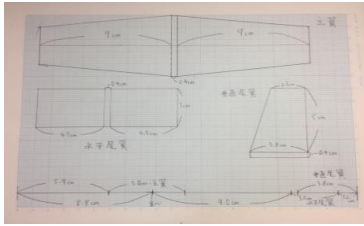
Experiment①

Design the ideal airplane to be based on a formula and make it.

$$V_h = \frac{Sh \cdot Lh}{Sm \cdot Cm} \dots 1$$

$$V_v = \frac{Sv \cdot Lv}{Sm \cdot bm} \dots 2$$

h:horizontal stabilizer v:vertical stabilizer m:main wings
V:capacity S:Area L:moment arm C:MAC b:wing width



↑ Plan of the ideal airplane and the real thing of paper plane.

After that we changed three points, each with 5 elements.

- Camber Position
(20%, 30%, 40%, 50%, 60%)
- Moment arm of Horizontal Stabilizer
(8.3, 8.6, 8.9, 9.2, 9.5[cm])
- Height of Vertical Stabilizer
(3.0, 3.5, 4.0, 4.5, 5.0[cm])

We made a total of 15 paper planes.

And we researched the best value of Camber Position, Moment arm of Horizontal Stabilizer and Height of Vertical Stabilizer and made a graph.

Experiment②

Using the results from experiment ①, we could make a new ideal plane using the best Camber Position, Moment arm of Horizontal Stabilizer, and Height of Vertical Stabilizer.

After that, fly it and compare this data with Experiment①'s data.

Conclusion

Experiment①

As shown in Fig①, variables of each graph is

BLUE: Camber (%)

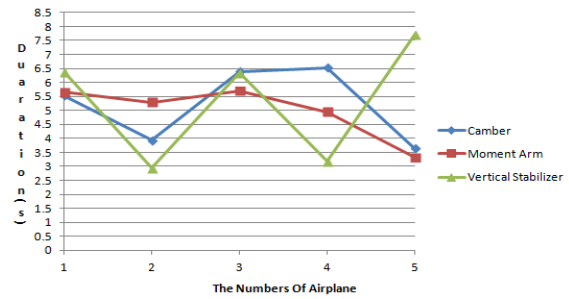
RED: Moment Arm of Horizontal Stabilizer (cm)

GREEN: Height of Vertical Stabilizer (cm)

Each number shows the variables elements from small to large.

After adjusting the planes indoor, we flew each machine 5 times or 10 times.

We wrote down the average score on Fig①.



↑ Fig①

Experiment②

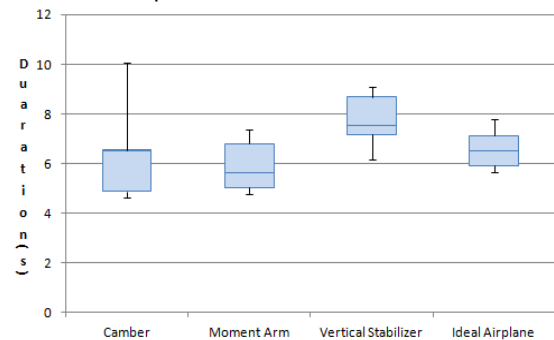
From Experiment①, It was found the ideal airplane in actual measurement has

- Camber position: 50%
- Moment arm: 15cm
- Height of Vertical stabilizer: 5cm.

We suppose that these measurements make the ideal airplane.

And we compared the data of the ideal airplane with the best airplanes in Experiment①.

Then this box plot was made.



↑ Fig②

Consideration

•From Experiment①, It was found that the ideal airplane in actual measurement matched with one on computation.

•The best camber position is 50%

•From Experiment②, we can't say the ideal airplane flew the best. But we can say it is the most stable one.

•From Experiment②, It is assumed the area of the vertical stabilizer influenced duration in three elements.

Future outlook on research

•We could try to change elements like the area of main wing, or the length of the main body.

•Try to make equipment, and adjust conditions to take more accurate data like making launch pad.

•Try to understand the formula, and analyze physically.

•We experimented outside because there were not enough spaces to experiment.

So could consider experimenting inside because wind greatly influences experiments.

Bibliography

「紙ヒコーキで知る飛行の原理」

講談社 BLUE BACKS Akio Kobayashi