Affect the flight time of a balsa wood glider engineering

Contents

- Web sites:

The intent of the survey was to obtain the relation between the flight clip and launch tallness of a balsa sailplane of different flying country. Besides the consequence on flight clip was recorded by altering the place of wings of the sailplanes.

In the first portion of the experiment the sailplanes were launched from four different tallness and the flight clip was recorded. The experiment was conducted in a closed country in order to avoid the consequence of air current. The sailplanes used were of different size and form. The net acceleration moving on the sailplanes was besides calculated by plotting a graph between square of flight clip and launch tallness.

In the 2nd portion of the experiment the wing places for three different sailplanes were changed and the flight clip was recorded in each of the three sailplanes. The launch tallness of the sailplanes was unbroken same.

It was observed that as the launch tallness was increased the flight clip besides increased. The sum of lift could merely be analysed by ciphering the net acceleration in each of the sailplanes.

The fluctuation in the flight clip due to the alteration in the place of wings was interpreted in footings of the addition in the cringles made by the sailplanes i. e. the instability of the sailplanes or the minutes of wings.

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Introduction:

The inquiry about aeromechanicss has great importance in today ' s times and the assorted factors that affect aeromechanicss of an aircraft or a sailplane is necessary in order to better the efficiency. By taking up this experiment I have tried to analyze the playing forces on the flight of a sailplane such as the lift, the retarding force, and the weight besides the theory of projectile gesture plays an of import function in finding the flight clip of a sailplane. Besides maintaining in head the Torahs of natural philosophies that relate to flight and besides look intoing whether they are in conformity with the undermentioned experiment.

Research Question-

How the Wing country and place along with the launch tallness affect the flight clip of a Balsa Wood Glider?

The purpose of this experiment is to analyze how the wing country, flying place and the launch tallness have an impact on the flight clip of a balsa sailplane.

In order to set up the above dealingss balsa sailplanes of different flying countries were manus launched from different highs and the flight clip was recorded.

As for the relation with the flying place and flight clip they were manus launched every bit good from a fixed tallness with different flying places.

Theory

The experiment is based on the theory of projectile gesture, and fluid mechanics.

Projectile Motion-

When a organic structure is projected from a certain tallness with a certain speed, the acceleration on the organic structure acts merely in the downward (along y-axis) way and the acceleration along the horizontal (x-axis) way is zero.

Since the air opposition besides affects the horizontal gesture of the organic structure there might be some slowing, nevertheless it is of a really little magnitude hence it can be neglected in the instance of my experiment.

The same account can be taken for the air current ; there might be some constituent of the force (due to weave) which might impact the horizontal gesture every bit good. This is besides taken attention of in the experiment as it is conducted in closed country.

As the initial speed is in the horizontal way its perpendicular constituent is zero, by taking the perpendicular gesture the flight clip of the sailplane should depend on the tallness from which it has been launched and the net acceleration in the perpendicular way.

By changing the tallness in the experiment the flight clip should besides change proportionally. As the tallness is increased the flight clip should besides increase.

Due to the alteration in the forces moving on the sailplane the net acceleration can besides alter which in bend will impact the flight clip.

Forces

There are three types of forces moving on a sailplane which are:

Weight

The weight of the organic structure ever acts in the downward way.

The weight of a organic structure dependant on the mass of the sailplane and gravitative acceleration which can be taken changeless for a given infinite. By Newton ' s 2nd jurisprudence of gesture, the weight is given by (F = milligram)

It is the force due to the gravitative attractive force of the Earth on the sailplane. But this force weight, which is the gravitative force, is different from the aerodynamic forces, lift and retarding force. The lift and the retarding force are mechanical forces that will move on the sailplane merely when it is in physical contact with air which generates these forces. The gravitative force or weight is a field force ; and is a non-contact force.

The gravitative force (weight) between two objects depends on the multitudes of the two objects and the opposite of the square of the distance between these objects. The more the multitudes of the objects the stronger is the attractive force, and closer the object are the stronger the attractive force.

Lift

Lift is the force that acts on a sailplane upward and helps the sailplane to remain in the air. The lift on the sailplane is chiefly generated by the wings. It is an aerodynamic force produced by the gesture of air fluxing through the sailplane. Lift Acts of the Apostless through the Centre of the force per unit area of the sailplane and is in the way which is normal to the flow of air.

Lift occurs when a flow of air is turned by the sailplane. Harmonizing to Newton ' s 3rd jurisprudence of gesture the flow of air is turned in one way, and the lift is generated in the opposite way. Since air is a gas and its molecules are free to travel approximately, any solid can debar its flow. For an air foil, both the upper and lower surfaces dramas portion in turning the flow of air.

There can be two types of lift inactive and dynamic lift.

Inactive lift

harmonizing to the Archimedes rule whenever a organic structure is immersed in a fluid it experiences an upward force called the floaty force.

The factors on which the buoyant force depends are:

The volume of the fluid displaced and ; the denseness of the fluid.

If the country of the wings increases the magnitude of the lift should besides increase and the net force moving on the sailplane should besides increases which in bend should diminish the net acceleration and hence addition the flight clip.

Dynamic Lift

Harmonizing to Bernoulli ' s rule ; the dynamic lift is due to the difference in force per unit area on the two sides of the organic structure which is due to the difference in the velocity of the air on the two sides of the organic structure.

There are assorted factors that affect lift, these are:

Aircraft flying geometry has a big consequence on the sum of lift generated. The form and size of the wing will hold a important impact on the sum of lift generated.

In order to bring forth lift at that place must be some speed ; hence if the object is moved in air so raise will be generated. Lift besides depends on the mass of the flow. it besides depends in a major manner on the viscousness and squeezability of air.

Syrupy force or Drag

Syrupy force is a mechanical force. The retarding force, like lift, is besides produce by the interaction and contact of a solid organic structure with air. For retarding force to be produce, the solid organic structure must be in contact with the air. If there is no air, there is no retarding force. Drag is generated by the difference in the velocities of the solid object and the air. There must be comparative gesture between the object and the air. If there is no comparative gesture, there is no retarding force. Syrupy force ever opposes the gesture, hence it will be opposite to the gesture of the sailplane.

The most of the factors impacting retarding force is same as that impacting the lift.

The syrupy force can be taken as the aerodynamic clash, and one of the beginnings of this force is the skin clash between the molecules of the air and the solid surface of the sailplane. Since the tegument clash is an interaction between a sailplane and the air, the magnitude of the skin clash depends on belongingss of both glider surface and air. The smooth, waxed surface of sailplane will bring forth less skin clash than a unsmooth surface.

And for the air, the magnitude of skin clash depends on the viscousness of the air.

The comparative magnitude of the syrupy forces to the gesture of the flow of air is called the Reynolds figure.

Besides the retarding force can be taken as the aerodynamic opposition to the gesture of the object through the air. This beginning of retarding force depends on the form of the sailplane and is called signifier retarding force. When air flows around a organic structure, the speed and force per unit area around the semivowel are changed. The force per unit area is a step of the impulse of the air molecules and a alteration in impulse consequences in a force, a alteration in force per unit area will bring forth a force on the organic structure. This constituent of the aerodynamic force that is opposed to the gesture is the retarding force.

Syrupy force straight depends on the mass of the air flow traveling past the sailplane.

Consequence of Height on Flight clip

In this experiment there will be 4 highs taken but the height intervals will non be unvarying in order to look into the tendency and see if there is a clear differentiation in readings of flight clip. As the tallness increases the flight clip should increase as there is more distance to cover for the sailplane and since there are no forces moving as mentioned above, it is merely the tallness that acts as a factor to alter flight clip.

Flying country

In this experiment the flying country should consequence the flight clip of the sailplanes as seen earlier, lift has a direct connexion with flying country. As the lift increases the sailplane goes higher in the air therefore increasing the flight clip.

Every sailplane has a different wing country and this makes a clear differentiation between the flight times for the sailplanes.

Flying place

The flying place whether towards the forepart or back determines the stableness of the sailplane while its flight. The more it is to the forepart of the socket it tends to make be more unstable and has a really loopy flight which increases the flight clip.

The farther behind the wing is in the socket the more stable the sailplane is as the weight is more towards the Centre of mass, doing it more stable and besides increasing the flight clip nevertheless whilst a consecutive and balanced there are other forces moving on the flight that might draw it down to the land.

Experimental Set up

Gliders

In the initial stages the sailplane used were made by manus utilizing a templet to cut out the parts of the sailplanes. However these sailplanes lacked perfect stableness and the borders had to be rubbed and smoothened in order to utilize do them wholly aerodynamic. Even after making so they lacked perfect specification and the stuff used to do them was non the right stuff hence they did non glide as required to.

The sailplanes used in the ulterior phases were bought online from amazon. com. These sailplanes are laser cut and ready to wing. They are made out of balsa wood. There were 3 types of sailplanes that were used, the parts of the sailplanes were exactly cut and good balanced in order to obtain a nice flight. The 3 sailplanes varied otherwise in form, size, and weight and flying country.

Area

The experiment was conducted in a closed environment. The length of the topographic point was about 35meters and width about 12meters. The air current factor was controlled as all doors and Windowss were shut and it was an enclosed country.

Method:

There were assorted stairss that are involved in this experiment.

The sailplane was first flown in an out-of-door environment to look into the flight. Since the air current factor can non be controlled in an out-of-door environment it was non possible to carry on the experiment outside as this affects the flight clip. Hence an indoor country was chosen.

Measuring Wing Area

The sailplanes that will be used which each have different form, size, and flying country. The first variable flying country can non be measured by a given expression as it is non a unvarying form and can non be broken into smaller forms.

The flying country will be measured by maintaining the full wing on a graph sheet whose each square country is known and the lineation of the wing form will be sketched out on the graph sheet. After holding done this the figure of complete squares of the known country that are enclosed by the lineation of the wing will be counted. After this the figure of uncomplete squares and an estimate will hold to be made as it is non executable to cipher country of a fraction of the square. This will be done for each of the three sailplanes and will be noted down.

In order to do certain that the sailplanes, glide decently without any hinderance and proficient trouble a trial flight will be done. If there seem to be any proficient jobs with any of the three sailplanes they shall be fixed at foremost in order to supply accurate and legit readings. If any parts seem to be broken they will be fixed by the particular adhesive which is used to lodge balsa wood.

Establishing and Measuring Flight Time

Keeping in head that there are no holders or establishing devices provided with these sailplanes they will hold to be launched by the free manus as it is non possible to invent a launch method. This is so because doing any changes to the sailplane might falsify its stableness and will do unequal weight balance.

Although establishing from the manus will hold uncertainnesss such as different launch force and height it will be controlled every bit much as possible.

In order to do certain the tallness is changeless a plumb line will be taken and held from the comfy launch tallness. This plumb line will so be measured in conformity with a metre graduated table. Every clip a sailplane is launched it will be launched from the same tallness as the yarn will be held at that tallness while establishing the sailplane. The 2nd tallness from which it will be launched will be after standing on top of a dining tabular array. The tallness of the tabular array will be measured by utilizing another plummet line and will be measured in conformity to the meter graduated table. This tallness of the tabular array will be added to the initial launch tallness and so a plumb line of that tallness will be held while the launch.

The 4th tallness will be from about the first floor. The huge interval difference is taken so that there can be a clear tendency that can be observed for the flight clip. The tallness of the wall will be measured and so the initial tallness of the launch will be added to this. The 4th tallness will be from above a tabular array on the first floor, in order to obtain this tallness the same measure as the 1 for the tabular array tallness on the lower degree will be used.

Taking the readings of the flight clip will be done by utilizing a stop watch. It is non possible for me to make this entirely as get downing the stop watch and establishing the sailplane is non possible at the same clip hence a small aid will be required to mensurate the flight clip. The helper will get down entering the flight clip every bit shortly as the sailplane leaves contact with my manus and will halt every bit shortly as the sailplane touches the land. These readings will so be recorded in a tabular array. There will be 5 readings taken for each sailplane at each tallness.

There are two flying places possible either at the forepart of the socket or the back. Each sailplane ' s wings will be adjusted as forepart and back and for each place there will be 5 readings taken.

Consequence

Flight clip for different launch tallness (Experiment1)

Glider A

Height (metres)

Flight clip

(± 0. 01s)

Average (±0. 13s)

t2 (sec2)

1. 5

1. 64

1. 78

1. 84

1. 81

1. 74

3. 03

2. 24

2. 21

2. 45

2. 53

2. 28

2. 38

5. 68

5. 3

3. 83

3. 94

4. 04

3. 72

3. 91

15. 29

6. 04

4. 81

4. 63

4. 79

4. 84

4. 75

22. 54

As the tallness was increased the flight clip besides increased. Since the sailplane used was the same and the velocity with which it was projected besides remained same the lift experienced by the sailplane did non alteration. The addition in the clip was merely due to the addition in tallness from which the sailplane was projected.

Glider B

Height (metres)

Flight clip

(± 0. 01s)

Average

(±0. 13s)

t2 (sec2)

1. 5

1. 25

1. 5

1. 28

1. 3

1. 32

1. 75

2. 24

1. 54

1. 68

1. 61

1. 59

1. 61

2. 60

5. 3

2. 19

1. 94

2. 4

2. 33

2. 24

5. 02

6. 04

2. 78

3. 01

2. 92

2. 84

2. 87

8. 26

The tendency between the clip of flight and the tallness of launch was same as in the instance of sailplane A.

Glider C

Height (metres)

Flight clip

(± 0. 01s)

Average

(±0. 04s)

t2 (sec2)

1. 5

0. 93

0. 90

1. 01

0. 94

0. 94

0. 88

2. 24

1. 16

1. 21

1. 24

1. 19

1. 19

1. 43

5. 3

1. 57

1. 59

1. 55

1. 6

1. 57

2. 45

6. 04

2. 1

2. 12

2. 11

2. 15

2. 11

4. 47

The tendency between the clip of flight and the tallness of launch was same as in the instance of sailplane A and B. hence in all the 3 instances it was found that the lift experienced by the sailplanes did non depend upon the tallness of projection or the tallness at which the sailplane was winging.

As seen above in the graph the flight clip of the sailplane is straight relative to the tallness from which it has been released i. e. as the tallness increases the clip taken by the sailplane to touch the land besides increases.

Harmonizing to the equation of gesture 2

If we are sing the perpendicular gesture so the initial velocity in the perpendicular way will be taken as nothing so 2. The three forces moving on the sailplane that is the weight (milligram) , the retarding force and the lift are all changeless. Since the retarding force and the lift depend on the velocity of the sailplane it is non altering as the velocity in all the instances are changeless.

The above relation can be made additive by plotting a graph between t2 and H from this graph the net acceleration moving on the sailplane can be calculated by mensurating the incline of the graph.

Since:

2.

Net acceleration = 2/slope of the curve.

Measurement of net acceleration of the sailplane.

Glider A

Calculation

Net acceleration = 2/slope of the curve.

Net acceleration in sailplane A= = 0. 51 m/s2

Glider B

Calculation

Net acceleration = 2/slope of the curve.

Net acceleration in sailplane B= = 1. 62 m/s2

Glider C

Calculation

Net acceleration = 2/slope of the curve.

Net acceleration in sailplane B= = 3. 1 m/s2

The Glider C has the maximal acceleration and Glider A has the least. This besides means that Glider C comes to rest much more rapidly than Glider A, Glider A besides has a longer glide clip and this is because of the light weight and flying span that makes it more stable while in flight. Whereas when compared to Glider C the weight is much more and the sailplane is n't stable plenty to remain in air for a long clip. The flying country besides has a important impact on this as the more wing country means more lift nevertheless when we check Glider C has more wing country but it yet does n't acquire adequate lift ; this explains that this sailplane needs more push when launched in order to remain in air longer than the others.

Flying Position (Experiment2)

Glider A

Flying Position for A

Position

Flight clip

(± 0. 01s)

Average

(±0. 11secs)

Front

1. 72

1. 85

1. 9

1. 68

1. 77

1. 78

Back

1. 56

1. 59

1. 72

1. 6

1. 52

1. 60

As seen above when the wings of the sailplane are moved frontward the flight clip of the sailplane additions.

Glider B

Flying Position for B

Position

Flight clip

(± 0. 01s)

Average

(±0. 11secs)

Front

2. 13

2. 06

2. 24

2. 17

2. 26

2. 17

Back

1. 66

1. 59

1. 63

1. 82

1. 74

1. 69

As in the instance of Glider A when the wings of the sailplane are moved frontward the flight clip of the sailplane additions.

Glider C

Flying Position for C

Position

Flight clip

(± 0. 01s)

Average

(±0. 12secs)

Front

1. 47

1. 59

1. 61

1. 53

1. 42

1. 52

Back

0. 84

0. 79

0. 94

0. 75

1. 03

0. 87

As in the instance of Glider A and B when the wings of the sailplane are moved frontward the flight clip of the sailplane additions.

As we can see in the graphs above the clip taken for the flight when the wings are in forepart is more than the flight clip for when the wings are pushed rearward. This is because the forward wings make the flight of the sailplane much more unstable and do it to loop more. The iteration increases the clip to touch the land as it causes sudden immediate lift and this besides increases the horizontal glide clip.

Whereas on the other manus when the wings are pulled back in order to do the flight more stable but there are still other factors like weight, lift and retarding force that are invariably impacting the flight and doing it to fall.

Decision:

In the first portion of the experiment it was found that the flight clip additions as the tallness from where the sailplane was launched additions. I each of the 3 sailplanes the lift moving on the sailplane did non alter as the country of the sailplane remained same. The alteration in the flight clip was merely due to the alteration in the tallness of the launch. The graph between the tallness of launch and the square of flight clip gave the step of the net acceleration in instance of the 3 sailplanes which in bend could be interpreted in footings of net force moving on the sailplane. The step of net acceleration showed that the lift produced in instance of the sailplanes increased with the flying country. The lift in the instance of Glider A was found to be maximal, as it had the maximal wing country.

In the 2nd experiment the flight clip increased as the flying place was shifted towards the forepart of the sailplane. The tendency obtained in all the three sailplanes was the same. The addition in the flight clip was due to the addition in lift that made the sailplane shoot up and loop in the air. As the sailplane looped in the air the tallness besides increased which in bend increased the flight clip. The addition in the cringle made by the sailplane was due to the instability produced by switching the weight of the wing to the forepart of the plane.

Restrictions:

There were several restrictions while making this experiment. The first and what can be considered as the most of import is the launching technique. This is the most important portion of this experiment and all the readings depend on this. Due to the delicate organic structures of the sailplane there could be no launching technique devised that would do certain the force on each launch is the same. The lift moving on the sailplane depends on the velocity of the sailplane ; if the establishing velocity varies it can impact the lift experienced by the sailplane.

Since it is non possible to neither command the force used for each launch nor step it, it was the biggest drawback.

When the experiment was conducted in the unfastened the air current factor had a great impact on the flight of the sailplanes. The sailplanes being light and really fragile, the air current outdoor was floating the sailplanes into different waies and besides decelerating them down. This alteration in way and clip was random and unpredictable. Since it was non possible to command the air current the experiment was carried out in a closed environment, yet there was some air current that affected the flight and caused little divergence in way which could hold perchance increased the flight clip or even decreased it.

Since the sailplanes were launched several times and had non set downing mechanism every bit good, the unsmooth landing chipped rather a few parts of the sailplanes that made the flight for the ulterior readings comparatively unstable and faulty.

Unresolved Questions:

The consequence of projection speed on the flight clip was non clear as the sailplanes were launched with about same speed and force.

The velocity with which the sailplane moves effects both the lift on the sailplane and the retarding force moving on it. The two forces are really of import in make up one's minding the flight of the sailplanes.

By planing a proper launch mechanism the consequence of velocity or the launch force would had been studied.

Besides the efficiency of the flight could hold been studied by mensurating glide ratio i. e. the ratio of the horizontal distance travelled and the loss of tallness travelled in a given clip.

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