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Case study

Flying bike concept

[1]Amit Singh Dhakad and [2]Pramod Singh

[1]Department of Mechanical Engineering, Christian College of Engneering and Technology, Chhattisgarh Swami Vivekanand University, Bhilia (Durg), C.G, India.
[2]Department of Mechanical Engineering, Siddhaganga Polytecnic, Tumkur Board of Technical Education Banglore-Karnataka, India.

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The flying bike concept is to produce the vehicle to fly in air, generally which we own for moving on road for flying purpose independently. It is simply based on our own motor vehicle/bike with front and rear wings in order to provide lift and a push propeller at the back of the vehicle/bike in order to produce the thrust for the forward movement with the help of driven rear wheel due to arrangement. Using this concept a low cost machine or bike can be modelled in order to fly in air without any other source rather the same source petrol for moving an engine. With these concepts we can fly individually or with one or two passenger extra as per the design of airfoil chosen and developed for the bike. Any how it is cheaper as it only cost for the airfoil arrangement and propeller arrangement on the personal bikes. Also, it gives the passion and feeling for piloting to one who loves flying independently and individually. Hence, it includes the personal air bike or flying bike for the multi utilisation of flying, surveying and traffic free touring. Thus this concept will create a new invention for independent purposes and applications instead of waiting and booking for the flights.

Key words: Flying bike, wings flying, petrol engine, airfoil, Independent.

INTRODUCTION

The flying technology has being since the invention made by Wright brothers in 1903 rather the flying technology has been in our universe a long time ago. As it is believed by the Ancient theory astronauts, philosopher and researchers and also it is true as it is with complete proof in media nowadays with the serial called Ancient Aliens produced by Giorgoi A. Tsoukalos, in which many proofs with documents and ancient pictures, supports proves the ancient technology.

The flying has been a passion for everyone actually for those who likes the height. The basic concept to fly any object is to provide the lift as the birds do with the wing and speed in companion as the speed will be more, it helps in lifting or take off and if less it does help in taking on and this is the concept of flying.

Research Objective

As per the title, it is the dream to let the two-wheeler to flow in air as aircraft does with the help of Wings and motion. Here the motor bike Make: Honda twister is being considered and analysed analytically for the lift with the analytical solved wings calculations with speed and thrust on certain heights following the International Air Density data varying with altitudes. The wing will be mounted on the chassis of both right and left hand side of the bike in front and rear in order to come up with the centre of gravity and sufficient space for the driver to handle the bike casually because if wing will be provided at centre it will not up to the appropriate way of handling bike as it will create problem in crawling the bike before getting in motion, gear shifting and using rear brake. The push propeller arrangement will push the bike in front direction in air, as it is the force called thrust developed by the transmitting rotary motion of wheel through arrangement.

Dynamic Modelling Concept

So, when a plane moves with speed in a ground it will have the contact and when it gains the acceleration and a pressure (relative velocity of air) acted on the airfoil due

*Corresponding Author. E-mail: innovaamit@yahoo.co.in

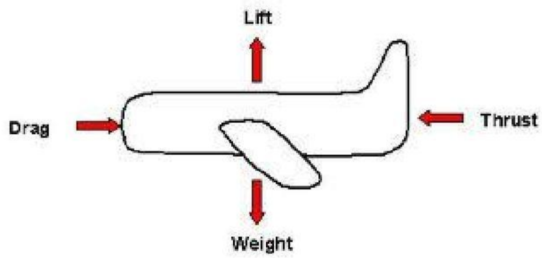


Figure 1. principle of flight

to running plane on its airfoil helps in lifting the plane by overcoming the weight acting on it and fly in the forward motion due to the thrust provided by propeller. Similarly, let see the analytical calculations for lifting of bike in air.

(1) Basically, Lift (L) is the force created in order to overcome the weight i.e., $L = C_L (0.5*\rho* V^2)S$.

Where L- is the lift

C_L- is the lift coefficient

(It is to measure the amount of lift obtained from the airfoil shape)

ρ- Is the density (kg/m^3)

V- Is the velocity (m/s) S- Is the wing area (m^2)

In Figure 1, The four different forces acting in different direction two opposite to each other in order to balance violating the Newton's third law of motion.

Lift is also exploited in the animal world and even in the plant world by the seeds of certain trees. While the common meaning of the word "lift" assumes that lift opposes weight, lift in its technical sense can be in any direction since it is defined with respect to the direction of flow rather than to the direction of gravity. When an aircraft is flying straight and is at level (cruise) most of the lift opposes gravity. However, when an aircraft is climbing, descending, or banking in a turn the lift is tilted with respect to the vertical. Lift may also be entirely downwards in some aerobatic manoeuvres, or on the wing on a racing car. Lift may also be largely horizontal, for instance on a sail on a sailboat. An airfoil is a streamlined shape that is capable of generating significantly more lift than drag. Non-streamlined objects such as bluff bodies and flat plates may also generate lift when moving relative to the fluid, but will have a higher drag coefficient dominated by pressure drag.

(2) A physical body always experiences air resistance when it propels in air and such force is called drag force (D) i.e, $D= C_D (0.5*\rho*V^2)A$

Where, C_D-is the drag coefficient

(It is the measure of dynamic pressure get converted into drag)

ρ-is the density (kg/m3)

V- is the velocity (m/s), A- is the cross sectional area during flow.

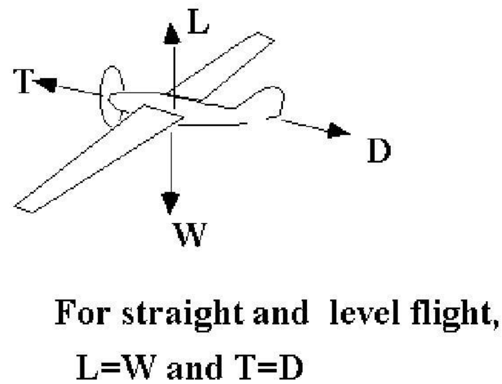


Figure 2. Level Flight.

(3) Weight W=mg

Where m=mass (kg) and g = acceleration due to gravity (m/sec^2)

(4) Force(Thrust) F=ma

Where,

m=mass (kg) and

a= acceleration that is the rate of change of velocity with respect to time (m/sec^2).

*Thrust (T) is produced by accelerating the mass of air and itself it is a force best described by the Newton's second law of motion.

Thus in Figure 2, we see that in a level flight the lift is zero and the flight is in a straight direction. That means here Lift=Weight and Thrust =drag. This is generally to maintain the flight level.

Airfoil

An airfoil is the shape of the wing and it is moved through a fluid which produces an aerodynamic force, thus it moves the aeroplane. The component of this force perpendicular to the direction of motion is called Lift and the component parallel to the direction of motion is called Drag.

Types of Airfoil

1. Semi-Symmetrical Airfoils
2. Symmetrical Airfoils
3. Flat Bottom Airfoils

So, these are the basically types of airfoil and the kind of airfoil chosen for the flying bike is Flat Bottom.

Angle of attack

The angle of attack (α) in figure 3 is the angle between an airfoil and the oncoming air. A symmetrical airfoil will generate zero lift at zero angle of attack. But as the angle

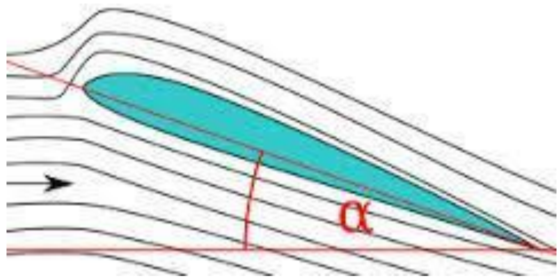


Figure 3. Angle of attack.

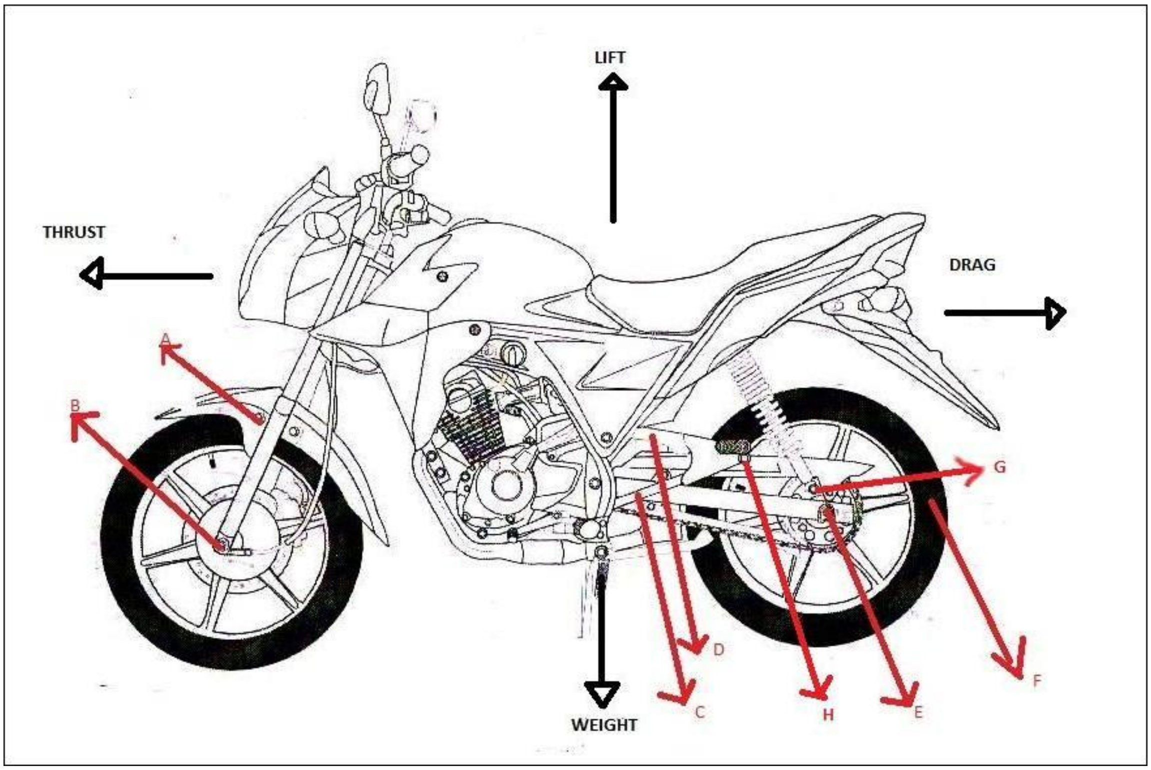


Figure 4 Bike flying concept

of attack increases, the air is deflected through a larger angle and the vertical component of the airstream velocity increases, resulting in more lift. For small angles a symmetrical airfoil will generate a lift force roughly proportional to the angle of attack. As the angle of attack grows larger, the lift reaches a maximum at some angle; increasing the angle of attack beyond this critical angle of attack causes the air to become turbulent and separate from the wing; there is less deflection downward so the airfoil generates less lift. The airfoil is said to be stalled. Cambered airfoils will generate lift at zero angle of attack. When the chord line is horizontal, the trailing edge has a downward direction and since the air follows the trailing edge it is deflected downward. When a cambered airfoil is upside down, the angle of attack can be adjusted so that the lift force is upwards. This explains how a plane can fly upside down and typically, the lift begins to decrease at an angle of attack of about 15 degrees.

Propeller

The blades are made in the shape of an airfoil of an aircraft. When the engine rotates the propeller blades, the blades produce lift. This lift is called Thrust and moves the aircraft forward.

CONSIDERATIONS

So, based on the fundamentals the considerations for the bike to fly were:

1. Selection of Bike:

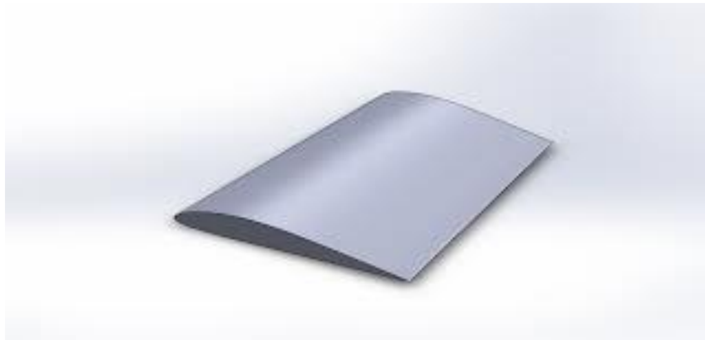


Figure 5. Flat Bottom Airfoil.

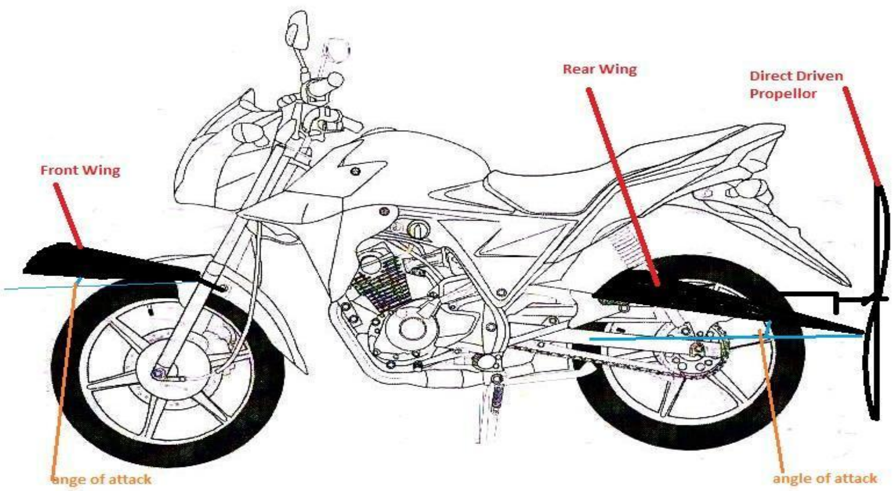


Figure 6. 2D side view with front and rear wings arrangements and propeller.

Make: Honda CB Twister

Specifications

Overall length	1972mm
Overall width	742mm
Overall height	1075mm
Wheelbase	1262mm
Dry weight	102kg
Fuel tank	8 litre
Fuel reserve	1.6 litre
Passenger capacity	operator and one passenger

Maximum weight capacity
170kg
Caster
26 degree
Engine:
Idle speed (In Neutral)
1,400 +/- 100 (rpm)
Max delivery speed
140km/hr=38.88m/s
Max wheel rpm (max crankshaft rpm/top gear ratio)
8000/0.917=8724.10 rpm
Recommended “cold” tyre pressures:
Driver only
Front 175kgf/cm²

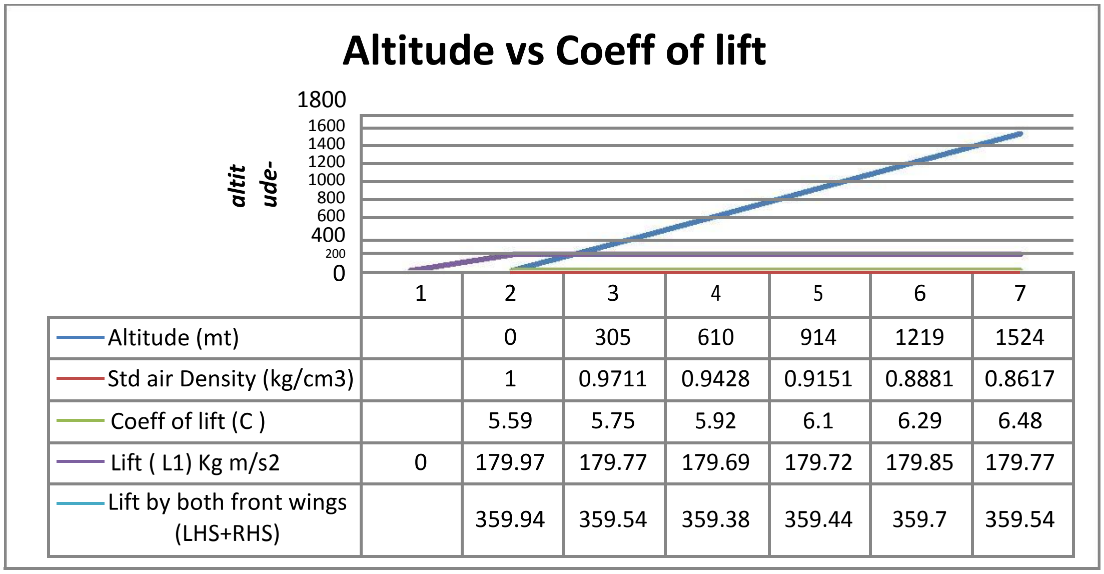
Rear 200kgf/cm²
Driver and one passenger
Front 175 kgf/cm²
Rear 280 kgf/cm²
(1kgf/cm^2 equals 98.0665 kilopascals)
1 bar = 100,000 Pa. 1 bar is therefore equal to: 100 kPa

1 Pa = 1N/m², 1 Bar = 10^5 N/m²

Maximum weight
(Including wings and propeller arrangements on bike)
=280kg
Here Figure 4 shows the fixtures arrangement, where:
A- Fixed Joint

Case I. a. (Front wing Lift) Max Weight, m=180kg, W=L_1 at speed 60km/hr=16.6m/s.
Table 1.

Height (feet)	Altitude (m)	Std air Density (kg/cm3)	Coffs of lift (C)	Lift (L1) Kg m/s2 or N	Lift by both front wings (LHS+RHS)
0	0	1.0000	5.59	179.97	359.94N
1000	305	0.9711	5.75	179.77	359.54N
2000	610	0.9428	5.92	179.69	359.38N
3000	914	0.9151	6.10	179.72	359.44N
4000	1219	0.8881	6.29	179.85	359.7 N
5000	1524	0.8617	6.48	179.77	359.54N



	1	2	3	4	5	6	7
Altitude (mt)		0	305	610	914	1219	1524
Std air Density (kg/cm3)		1	0.9711	0.9428	0.9151	0.8881	0.8617
Coeff of lift (C)		5.59	5.75	5.92	6.1	6.29	6.48
Lift (L1) Kg m/s2	0	179.97	179.77	179.69	179.72	179.85	179.77
Lift by both front wings (LHS+RHS)		359.94	359.54	359.38	359.44	359.7	359.54

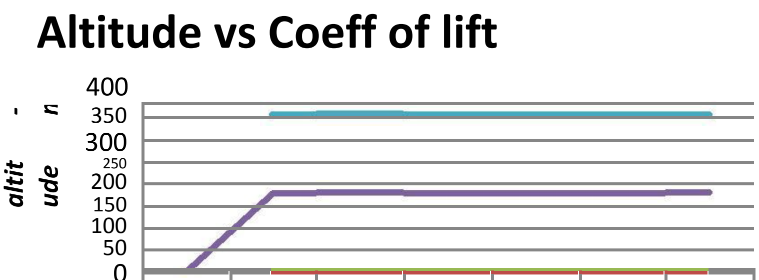
Graph 1.

Case I. b. (Front wing Lift) Max Weight = 180 kg=W=L1 at speed 90km/hr= 25m/s.
Table 2. Lift generation by front wings case 2

Height (feet)	Altitude (m)	Std air Density (kg/cm3)	Coffs of lift (C)	Lift (L1) Kg m/s2 or N	Lift by both front wings (LHS+RHS)
0	0	1.0000	2.48	179.8	359.6 N
1000	305	0.9711	2.55	180.6	361.2 N
2000	610	0.9428	2.63	179.7	359.4 N
3000	914	0.9151	2.71	179.79	359.58N
4000	1219	0.8881	2.79	179.64	359.28N
5000	1524	0.8617	2.88	179.92	359.84N

B- Front wheel axle shaft
C- Chassis part with inclination of 10
D- Chassis
E- Rear wheel axle shaft
F- Rear tyre
G- Suspension Fixture
H- Suspension Fixture

Therefore A,B,C,D,E are the supports chosen for mounting the wing and G,H for the support of propeller arrangement.

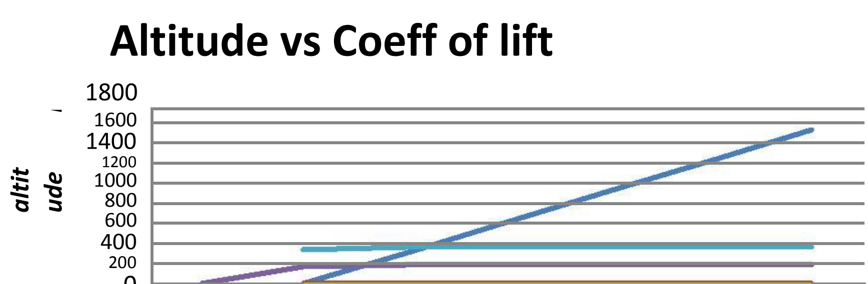


	1	2	3	4	5	6	7
Std air Density (kg/cm3)		1	0.9711	0.9428	0.9151	0.8881	0.8617
Coeff of lift (C)		2.48	2.55	2.63	2.71	2.79	2.88
Lift (L1) Kg m/s2	0	179.8	180.6	179.7	179.79	179.64	179.92
Lift by both front wings (LHS+RHS)		359.6	361.2	359.4	359.58	359.28	359.84

Graph 2.

Case I. c. (Front wing Lift) Max Weight = 180 kg=W=L1 at speed 120km/hr= 33.33m/s.
Table 3. Lift generation by front wings case 3.

Height (feet)	Altitude (m)	Std air Density (kg/cm3)	Coffs of lift (C)	Lift (L1) Kg m/s2 or N	Lift by both front wings (LHS+RHS)
0	0	1.0000	1.3	167.52	335.04N
1000	305	0.9711	1.43	178.94	357.88N
2000	610	0.9428	1.48	179.80	359.6 N
3000	914	0.9151	1.52	179.24	358.48N
4000	1219	0.8881	1.57	179.67	359.34N
5000	1524	0.8617	1.62	179.88	359.76N

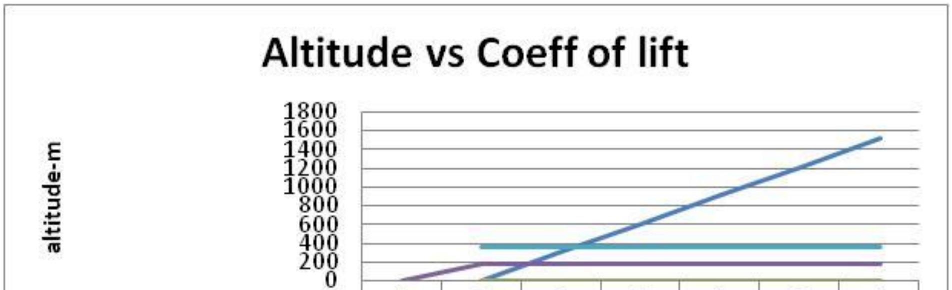


	1	2	3	4	5	6	7
Altitude (mt)		0	305	610	914	1219	1524
Std air Density (kg/cm3)		1	0.9711	0.9428	0.9151	0.8881	0.8617
Coeff of lift (C)		1.3	1.43	1.48	1.52	1.57	1.62
Lift (L1) Kg m/s2	0	167.52	178.94	179.8	179.24	179.67	179.88
Lift by both front wings (LHS+RHS)		335.04	357.88	359.6	358.48	359.34	359.76

Graph 3.

Case I. d. (Front wing Lift) Max Weight = 180 kg=W=L1 at speed 140km/hr= 38.88m/s.
Table 4. Lift generation by front wings case 4.

Height (feet)	Altitude (m)	Std air Density (kg/cm3)	Coffs of lift (C)	Lift (L1) Kg m/s2 or N	Lift by both front wings (LHS+RHS)
0	0	1.0000	1.02	178.85	357.7 N
1000	305	0.9711	1.05	178.79	357.58N
2000	610	0.9428	1.08	178.54	357.09N
3000	914	0.9151	1.12	179.71	359.42N
4000	1219	0.8881	1.16	180.64	361.28N
5000	1524	0.8617	1.19	179.80	359.6 N



	1	2	3	4	5	6	7
Altitude (mt)		0	305	610	914	1219	1524
Std air Density (kg/cm3)		1	0.9711	0.9428	0.9151	0.8881	0.8617
Coeff of lift (C)		1.02	1.05	1.08	1.12	1.16	1.19
Lift (L1) Kg m/s2	0	178.85	178.79	178.54	179.71	180.64	179.8
Lift by both front wings (LHS+RHS)		357.7	357.58	357.09	359.42	361.28	359.6

Graph 4.

Case II. a. (Rear wing Lift) Max Weight = 280 kg=W=L2 at speed 60km/hr=16.6m/s.
Table 5. Lift generation by rear wings case 5

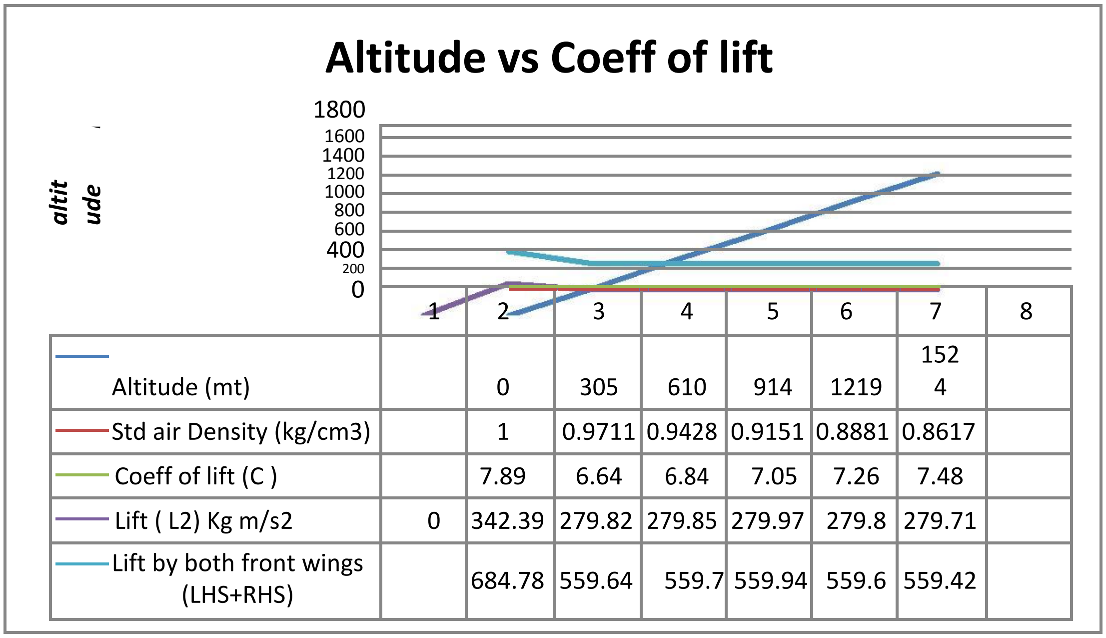
Height (feet)	Altitude (m)	Std air Density (kg/cm3)	Coffs of lift (C)	Lift (L2) Kg m/s2 or N	Lift by both front wings (LHS+RHS)
0	0	1.0000	7.89	342.39	684.78N
1000	305	0.9711	6.64	279.82	559.64N
2000	610	0.9428	6.84	279.85	559.7 N
3000	914	0.9151	7.05	279.97	559.94N
4000	1219	0.8881	7.26	279.80	559.6 N
5000	1524	0.8617	7.48	279.71	559.42N

Wing (Airfoil)

The type of airfoil considered in figure 5 is the Flat Bottom rectangular shaped as it is much helpful in providing the best lift as it covers maximum lift area for short and low speed takeoff and landing. Also it is a good general purpose wing. It can carry a reasonable load and fly at a reasonable speed, but does nothing superbly well. It is ideal for personal aircraft as it is easy to control in the air as well as inexpensive to build and maintain.

Front wing/airfoil

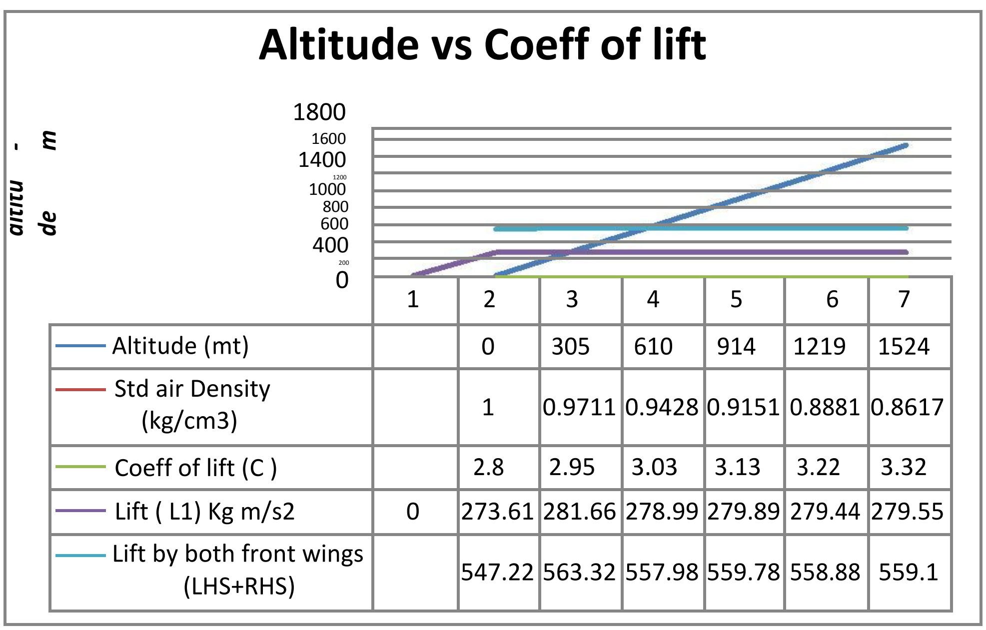
This airfoil is to be mounted on the left and right hand side



Graph 5.

Case II. b. (Rear wing Lift) Max Weight = 280 kg=W=L2 at speed 90km/hr= 25m/s.
Table 6. Lift generation by rear wings case 6.

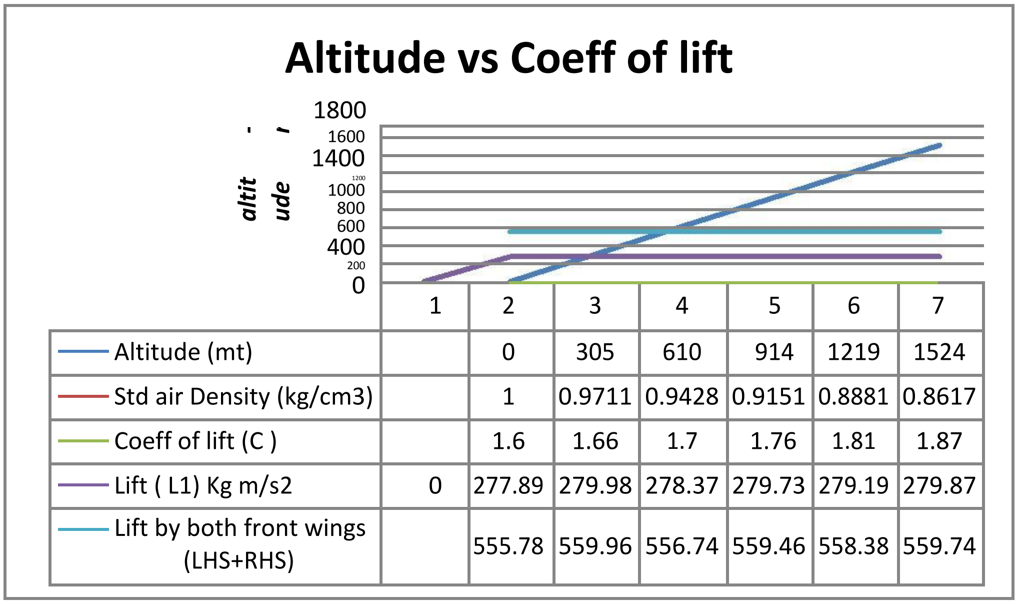
Height (feet)	**Altitude (m)**	**Std air Density (kg/cm3)**	**Coffs of lift (C)**	**Lift (L1) Kg m/s2 or N**	**Lift by both front wings (LHS+RHS)**
0	0	1.0000	2.8	273.61	547.22N
1000	305	0.9711	2.95	281.66	563.32N
2000	610	0.9428	3.03	278.99	557.98N
3000	914	0.9151	3.13	279.89	559.78N
4000	1219	0.8881	3.22	279.44	558.88N
5000	1524	0.8617	3.32	279.55	559.1 N



Graph 6.

Case II. c. (Rear wing Lift) Max Weight = 280 kg=W=L2 at speed 120km/hr= 33.33m/s.
Table 7. Lift generation by rear wings case 7.

Height (feet)	Altitude (m)	Std air Density (kg/cm3)	Coffs of lift (C)	Lift (L1) Kg m/s2 or N	Lift by both front wings (LHS+RHS)
0	0	1.0000	1.6	277.89	555.78N
1000	305	0.9711	1.66	279.98	559.96N
2000	610	0.9428	1.70	278.37	556.74N
3000	914	0.9151	1.76	279.73	559.46N
4000	1219	0.8881	1.81	279.19	558.38N
5000	1524	0.8617	1.87	279.87	559.74N



Graph 7.

Case II. d. (Rear wing Lift) Max Weight = 280 kg=W=L1 at speed 140km/hr= 38.88m/s.
Table 8. Lift generation by rear wings case 8.

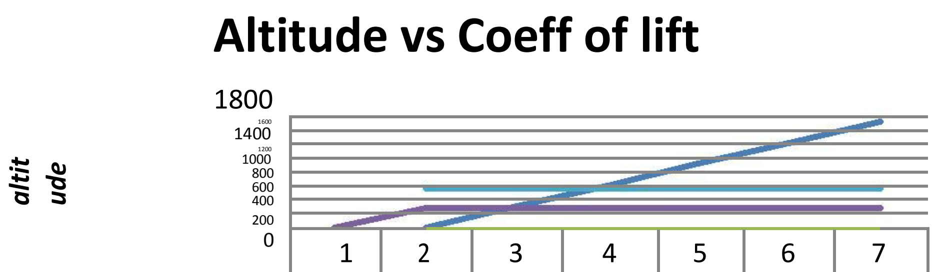
Height (feet)	Altitude (m)	Std air Density (kg/cm3)	Coffs of lift (C)	Lift (L1) Kg m/s2 or N	Lift by both front wings (LHS+RHS)
0	0	1.0000	1.18	278.88	557.76N
1000	305	0.9711	1.21	277.71	555.42N
2000	610	0.9428	1.25	278.53	557.06N
3000	914	0.9151	1.29	279.00	558.00N
4000	1219	0.8881	1.33	279.16	558.32N
5000	1524	0.8617	1.37	279.01	558.02N

of the bike on chassis (rear wing) and front wing (in side of front wheel, shown in the figure 6) with 10˚ angle of attack maximum during design considerations as per the arrangement shown in figure 6.

Type: Flat bottom airfoil (foldable type)
Length: 800mm
Breadth: 290mm
Area: $0.232m^2$ (Wing Surface Area, L=800mm,H=290mm)

DISCUSSION

So, based on the discussed topics of wings, propeller on bike to produce the lift with motion and to get the thrust



	1	2	3	4	5	6	7
Altitude (mt)		0	305	610	914	1219	1524
Std air Density (kg/cm3)		1	0.9711	0.9428	0.9151	0.8881	0.8617
Coeff of lift (C)		1.18	1.21	1.25	1.29	1.33	1.37
Lift (L1) Kg m/s2	0	278.88	277.71	278.53	279	279.16	279.01
Lift by both front wings (LHS+RHS)		557.76	555.42	557.06	558	558.32	558.02

Graph 8.

for forward movement in air through propeller can be seen through *case I* by considering weight = 180 kg(including bike + Driver) with different velocities and *case II* by considering weight =280 kg (including bike+ one driver and one passenger) with different velocities and based on these analytical studies graphs are plotted for different weights considerations with varying speeds to ensure the possible lift produced by the wing/airfoil in air.

Conclusion from front Wing

Here from the calculations of coefficient of lift is determined and the amount of lift obtained by the airfoil/wing of considered area increases as per the speed increases from 60km/hr to 140 km/hr satisfying the possible fly in air overcoming the considered weight = 180 kg as per *Case I.d* because the maximum weight that a both front wing can be lift is 359.6 N in Table 4 at 5000m altitude.

The rear airfoil/wing

It is to be mounted on the chassis at an angle of 10 ˚ (providing the angle of attack) in both left and right hand side, as the overall weight is on chassis.
Specifications:

Type:	Flat bottom airfoil (foldable type)
Length:	590mm
Breadth:	530mm
Area:	0.3127m²

Propeller arrangement: two or three blade composite/wood

Push propeller arrangement at the rear which is to be driven with the help of rear wheel with maximum revolutions of 8724.10 rpm (rear wheel rpm). And the rpm for the propeller will further increase or more than 8724.10 because of the arrangement provided (if the input shaft of the propeller has less diameter than the driver shaft). Here the propeller will be driven directly with the help of rear wheel through the transmission from wheel to the propeller shaft through worm gear arrangement or belt-pulley arrangement.

CONCLUSION

With the analytical value for the parameters Coefficient of lift to lift the bike with operator weighing considered W=180kg and with one operator and one passenger weighing W=280kg, the calculation is produced for varying speeds in order satisfying the concept of flying bike, maintaining the angle of contact between 3 degree to 10 degree because the high angle of contact will help in lifting and overcoming the drag. Also the lift can be controlled by the direct driven two/three blade propeller.

So, from the Table 1 to 8 for *case I to II* it concluded that both the front wing and rear wing are providing the maximum lift compare to the considered weights. Hence both the wings (Front and Rear) will be capable of lifting the considered weights and it can be patented for practical result and analysis.

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