FABRICATION & ANALYSIS OF HOVERCRAFT

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ABSTRACT

A Hovercraft also known as an Air cushion vehicle is a vehicle that flies sort of a plane however will float like a boat, will drive kind of an automotive however can traverse ditches and gullies because it may not be a flat parcel of land. An air cushion vehicle additionally referred to as hovercraft because it will hover over or move across land or water surface whereas being control aloof from the surfaces by a cushion of air. A ground-effect machine will travel over every type of surfaces like grass, mud, muskeg, sand, quicksand, water and ice. Although it prefers gentle terrain, still they're capable of mounting slopes up to twenty percent, relying upon surface characteristics. Modern Hovercraft units are used for several applications where people and equipments have to be compelled to travel at speed over water and are capable of loading and unloading from and towards land. For instance they're used as passenger or freight carriers, as recreational machines and even used as warships. Hovercrafts are terribly exciting to fly and there is a feeling of effortlessly traveling from land to water and back once more is quite exclusive.

Keywords: Hovercraft, All Terrain Vehicle, Traction, Air Cushion and Future Scope.

INTRODUCTION

A hovercraft, also called Air cushion vehicle or ACV is a craft capable of travelling over land, water, mud, ice, and different surfaces both at speed and even when stationary. Hovercrafts are hybrid vessels operated by a pilot as an aircraft instead of a captain as a marine vessel. Hovercraft use blowers to provide an outsized volume of air below the hull that's slightly above atmospheric pressure. The pressure difference between the upper pressure air below the hull and the lower pressure ambient air on top of it produces lift, that causes the hull to float on top of the running surface. For stability reasons, the air is often blown through slots or holes around the outside of a disk or oval formed platform, giving most hovercraft a characteristic rounded-rectangle shape. Usually this cushion is contained among a versatile "skirt", that permits the vehicle to travel over little obstructions without any damage. Vehicles designed to travel close to however on top of ground or water. These vehicles are supported in varied ways, a number of them have a specially designed wings that may raise them simply off the surface and over that they travel after they have reached an adequate horizontal speed (the ground effect). Hovercrafts are sometimes supported by fans that force air down beneath the vehicle to form lift, Air propellers, water propellers, or water jets sometimes offer forward propulsion. Air-cushion vehicles can attain higher speeds than either ships or most other land vehicles can, and use abundantly less power than helicopters of identical weight. Air-cushion suspension has additionally been applied to different types of transportation, in particular trains, equivalent to the French Aero train and the British hover train. Hovercraft may be a transportation vehicle that rides slightly on top of the world surface. The air is endlessly forced beneath the vehicle by a fan, generating the cushion that greatly reduces friction between the moving vehicle and surface. The air is delivered through ducts and injected at the fringe of the vehicle in a downward and inward direction. This sort of vehicle will equally ride over ice, water, marsh, or comparatively level land.

Figure– Air Cushion Vehicle

LITERATURE REVIEW

There have been several attempts to grasp the principles of high atmospheric pressure below hulls and wings. To a huge extent, the bulk of those is termed "ground effect" or "water effect" vehicles instead of hovercraft. The principal distinction is that a hovercraft will lift itself while still, whereas the bulk of different styles need progression to make this lift. These active-motion "surface impact vehicles" are familiar in specific cases as ekranoplanand hydrofoils. The first mention within the historical document of the ideas behind surface-effect vehicles that used the term hovering was by Swedish person Swedenborg in 1716. In 1915 Austrian Dagobert Müller (1880–1956) engineered the world's 1st "water effect" vehicle. Shaped sort of a section of an oversized aerofoil(this creates an occasional pressure space on top of the wing very like associate degreeaircraft), the craft was propelled by four aero engines driving 2 submerged marine propellers, with a fifth engine that blew air underneath the front of the craft to extend the atmospheric pressure under it. Only while in motion, the craft lure air underneath the front, increasing lift. The vessel also needed a depth of water to work and could not transition to land or different surfaces. Designed as a quick war vessel, the Versuchsgleitboot had a prime speed over thirty two knots (59 km/h). It had been completely tested and even armed with torpedoes and machine guns for operation within the Adriatic Sea. It never saw actual combat, however, and because the war progressed it had been eventually scrapped because of lack of interest and perceived want, and its engines came to the Air Force. The theoretical grounds for motion over associate degree air layer were created by Konstantin Eduardovich Tsiolkovskiiin 1926 and 1927. In 1929, Saint Andrew Kucher of Ford began experimenting with the "Levapad" conception, metal disks with pressurized air blown through a hole within the center. Levapads don't supply stability on their own, many should be used along to support a load on top of them. Lacking a skirt, the pads had to stay terribly near to the running surface. He at first imagined these getting used in place of casters and wheels in factories and warehouses wherever the concrete floors offered the smoothness needed for operation. By the 1950s, Ford showed variety of toy models of cars using the system, however mainly projected its use as a replacement for wheels on trains, with the Levapads running near to the surface of existing rails. In 1931, Finnish aero engineer Toivo J. Kaario began planning a developed version of a vessel exploitation associate degree air cushion and engineered an example Pintaliitäjä (Surface Soarer), in 1937 Kaario's style enclosed the fashionable options of a lift engine processing air into a versatile envelope for lift. Kaario never received funding to make his style, however Kaario's efforts were followed closely within the Russia by Vladimir Levkov, who came to the solid-sided style of the Versuchsgleitboot. Levkov designed and engineered variety of comparable craft throughout the 1930s, and his L-5 fast-attack boat reached seventy knots (130 km/h) in testing. However, the beginning of World war II put an end to Levkov's development work. Throughout World war II, an associate degree engineer within the United States of America, Charles John Fletcher, invented a walled air cushion vehicle. As a result of the project was classified by the U.S. government, John Fletcher couldn't file a patent.

METHODOLOGY

1. LAW'S ACTS IN AIR CUSHION VEHICLE

1.1. Archimedes' Principle Or The Law Of Buoyancy

In order to lift the Air cushion vehicle, the pressurized air must now push against the surface of the water. If you tried pushing your hand into a sink full of water, your hand would sink into the water. What keeps the Air cushion vehicle from sinking as well? The answer to this comes from one of the oldest established principles in the history of science: Archimedes' Principle or the Law of Buoyancy. According to legend Archimedes was struck by this principle while taking a bath when he noticed that the volume of water displaced was equal to the volume of his body. Overjoyed by his discovery, he jumped out of the bathtub and ran through the streets naked shouting, "Eureka! Eureka!" (Greek for "I've found it! I've found it!") Developed in 250 BC, this principal explains why some objects floats in water while others sink. The principle states the following:

"When a body is immersed in fluid at rest it experiences an upward force or buoyant force equal to the weight of the fluid displaced by the body".

Notice when you get into a bathtub, the level of the water rises. This is because your body is now taking up some of the space where the water used to be. The water has to go somewhere else when it is pushed out of the way, so it goes up, making the water level rise. You've just displaced that amount of water. Archimedes' Principle says that a buoyant force will push upwards on you when you're in the water, and the strength of the force will be equal to the weight of the water that you pushed out of the way when you got in. The same thing happens with boats. When a boat is placed in water, part of the boat goes beneath the surface of the water and pushes the water out of the way. According to Archimedes' Principle, this results in a buoyant force that pushes up on the boat. The magnitude, or strength, of the force is equal to the weight of the water that would have filled the space that is now taken up by the boat. The boat floats in the water because this upward buoyant force is equal to the downward weight of the boat. In order to do calculations using this principle, we need to know the weight of a certain volume of water that is displaced, or the weight density of water.

Weight Density = Weight ÷ Volume

The weight density of water is about 62.42 pounds per cubic foot (lb/ft^3). A cubic foot is a unit of volume equal to the volume inside a box whose sides are 1 ft long. In SI units (System International), the weight density of water is about 9806 Newton's per cubic meter (N/m^3).

1.2. Newton's Third Law

The third law states that all forces exist in pairs: if one object A exerts a force F_A on a second object B, then B simultaneously exerts a force F_B on A, and the two forces are equal and opposite: $F_A = -F_B$. The third law means that all forces are interactions between different bodies, and thus that there is no such thing as a unidirectional force or a force that acts on only one body. This law is sometimes referred to as the action-reaction law, with F_A called the "action" and F_B the "reaction". The action and the reaction are simultaneous, and it does not matter which is called the action and which is called reaction; both forces are part of a single interaction, and neither force exists without the other. The two forces in Newton's third law are of the same type (e.g., if the road exerts a forward frictional force on an accelerating car's tires, then it is also a frictional force that Newton's third law predicts for the tires pushing backward on the road). From a conceptual standpoint, Newton's third law is seen when a person walks: they push against the floor, and the floor pushes against the person. Similarly, the tires of a car push against the road while the road pushes back on the tires—the tires and road simultaneously push against each other. In swimming, a person interacts with the water, pushing the water backward, while the water simultaneously pushes the person forward—both the person and the water push against each other. The reaction forces account for the motion in these examples. These forces depend on friction; a person or car on ice, for example, may be unable to exert the action force to produce the needed reaction force.

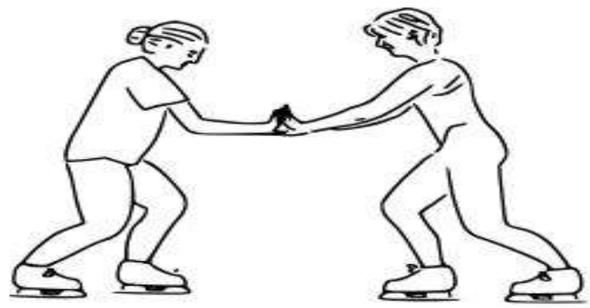


Figure- Newton's third law.

1.3. Aerodynamics

Aerodynamics is defined as the branch of fluid physics that studies the forces exerted by air or other gases in motion. Examples include the airflow around bodies moving at speed through the atmosphere (such as land vehicles, bullets, rockets, and aircraft), the behavior of gas in engines and furnaces, air conditioning of buildings, the deposition of snow, the operation of air-cushion vehicles (hovercraft), wind loads on buildings and bridges, bird and insect flight, musical wind instruments, and meteorology. For maximum efficiency, the aim is usually to design the shape of an object to produce a streamlined flow, with a minimum of turbulence in the moving air. The behavior of aerosols or the pollution of the atmosphere by foreign particles are other aspects of aerodynamics.

2. WORKING PRINCIPLE OF AIR CUSHION VEHICLE :

Hovercraft is one of the most unusual vehicles that you can see. Moves on an air cushion of slightly pressurized air that makes it easily overcomes any slight unevenness and obstacles. Because the hovercraft moves only after air and earth will affect virtually, no matter what the surface flies. It can run on sand, asphalt and the water are no problem for him or swamps and snow. They belong to a group of amphibians. Since the air under the hovercraft is not changed in transit between different surfaces (eg between sandy beaches and water) can not tell any difference. Hovercraft dynamics is more aircraft than ships and automobiles.

Air cushion:

Hovercraft floats on a cushion of air that is chased by a propeller craft. After starting to lift the hovercraft and is ready to ride. The size of stroke ranges from 15 cm in the smallest personal hovercraft to 2.8 meters for large transport machines. The air pocket under the hovercraft is surrounded by plastic to air from leaking out from under the hovercraft. Implementation of the mantle differ may be either in the form of a compact bag or can be divided into individual cells - so-called segments. Most professional hovercraft using Segmented casing, because each piece is in transit through the inequality diverges separately. It is very convenient, because the lifter loses only a very small amount of air.

Movement of Hovercraft:

After the hoist lifter can move forward. It must provide a separate air operator, which takes a hovercraft. Many of the vessels used to move a separate engine, but some have only one engine for both functions - that is, for blowing air under the hovercraft and also to move forward. In this case, the airflow split propeller, which in part drives the flyer for floatability, while majority of the air is used to move the hovercraft.

Control Hovercraft:

Control hovercraft is done through a system of rudders, which are located behind the propeller. The rudders are controlled by the pilot using the handlebars. Another way to significantly modify the movement of hovercraft is carrying weight.

Analysis

Specification of parts:

1-1200KV Brushless DC motor:

RPM/V1200

Weight- 99gm

Pull-1400-1900gm

Max. Volt-15

Max Current-40A

2- 12V DC motor: Weight-100gm

RPM-1000

Torque-5kg-cm at 12V

3-Servo Motor: Weight-55gm

Speed-20sec/60 Degree

(No load)

Operating Voltage-4.8-7.2 V

Stall Torque 4.8V:10kg/cm,

6V :12kg/cm

4-Flysky FS-i6: 6 Channel

2.ghz computer transmitter

Bandwidth-500khz

RF power<20dBm

Voltage<4.2V

5-Battery: 2200mah Li-Po

6-Model Dimension:

Length-14 inch

Width-19 inch

Height-9 inch

Top S.A.-14x19,

Weight-900gm

Propeller Size- 8 inch

7-Body Material: Polystyrene

Testing:

Hovercraft data log indicates the performance of hovercraft that has been tested in multi type of floor condition. There are four types of floor conditions: Tile floor, Cement floor, Grass and Water. For of all these floor test, the constant variable is the Voltage (V), the manipulated variable is the Current (I) and the respond variable is the Speed (S).

1. Hovercraft Performance Result on Tile Floor

- Floor conditions: Tile floor
- Motors: Brushless Motor
- Constant variable: Voltage 11.5 Volts
- Manipulated variable: Current (Ampere)
- Respond variable: Speed of hovercraft (Hovercraft Performance)

No	Voltage (V)	Current (A)	Average time to travel 13.5 meter (s)	Speed (m/s)
1	11.5	0.0	-	-
2	11.5	0.5	13.86	0.974
3	11.5	1.0	7.85	1.719
4	11.5	1.5	6.20	2.177
5	11.5	2.0	5.49	2.457
6	11.5	2.5	4.95	2.725
7	11.5	3.0	4.40	3.068

Table: Result on Tile Floor

2.Hovercraft Performance Result with Cement Surface :

- Floor conditions:Cement
- Motors: Brushless Motor
- Constant variable: Voltage 11.5 Volts
- Manipulated variable: Current (Ampere)
- Respond variable: Speed of hovercraft (Hovercraft Performance)

No	Voltage (V)	Current (A)	Average time to travel 13.5 meter (s)	Speed (m/s)
1	11.5	0.0	-	-
2	11.5	0.5	23.40	0.577
3	11.5	1.0	12.52	1.078
4	11.5	1.5	9.20	1.467
5	11.5	2.0	7.74	1.743
6	11.5	2.5	6.55	2.058
7	11.5	3.0	5.58	2.418

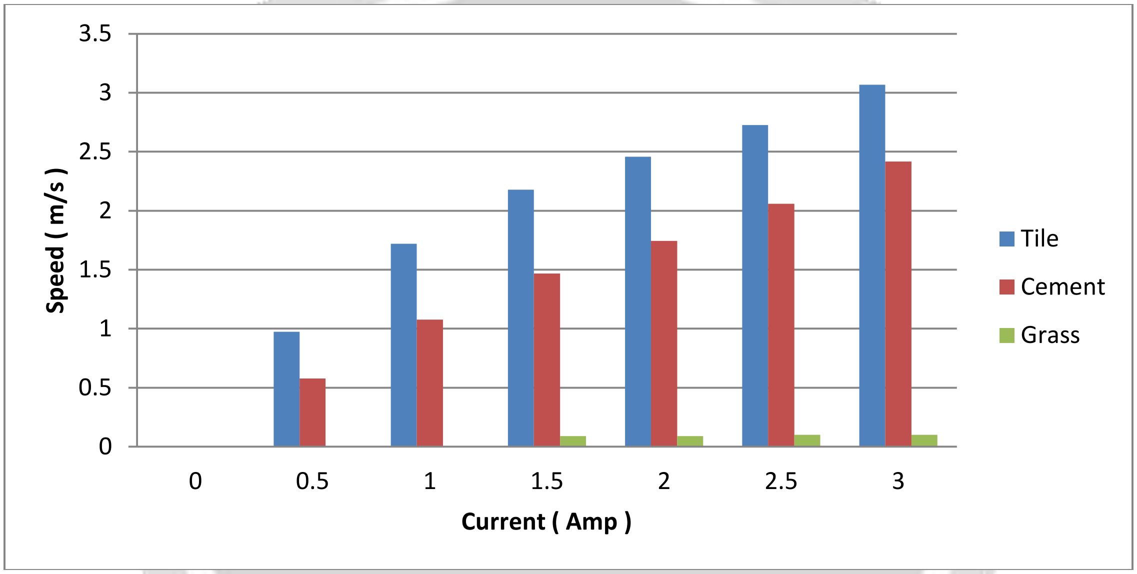
Table: Result on Cemented surface

3.Hovercraft Performance Result with Grass

- Floor conditions: Grass
- Motors: Brushless Motor
- Constant variable: Voltage 11.5 Volts
- Manipulated variable: Current (Ampere)
- Respond variable: Speed of hovercraft (Hovercraft Performance)

No	Voltage (V)	Current (A)	Average time to travel 13.5 meter (s)	Speed (m/s)
1	11.5	0.0	-	-
2	11.5	0.5	-	-
3	11.5	1.0	-	-
4	11.5	1.5	150	0.09
5	11.5	2.0	150	0.09
6	11.5	2.5	135	0.10
7	11.5	3.0	135	0.10

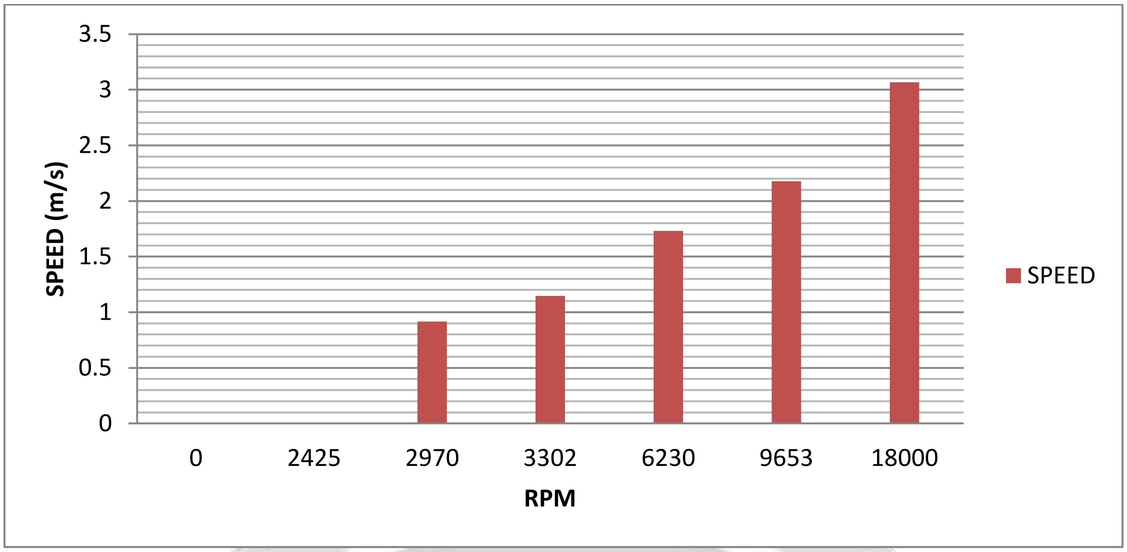
Table: Result on Grass



Graph. Curve depicting variation between Current and Speed

No.	Voltage(V)	Current(Amp)	RPM	Speed(m/s)
1	11.5	0.0	-	-
2	11.5	0.3	2425	-
3	11.5	0.6	2970	0.917
4	11.5	0.9	3302	1.148
5	11.5	1.2	6230	1.730
6	11.5	1.5	9653	2.177
7	11.5	3.0	18000	3.068

Table. Result Depicting Rpm and Linear Speed



Graph. Variation of Speed with RPM

APPLICATIONS

By using Air cushion vehicle no need of change of vehicle according to the land.

1. A hovercraft travel over the surface of water without concern for depth or hidden obstacles.
2. It is safe around swimmer as there is no propeller in water.
3. It can load and unload peoples and equipments on land.
4. It can travel against a current of river with no reduction of speed.

CONCLUSION

The conclusion of our project is that we tend to elevate the weight on top of our expectation and blow of air from the narrow hole with high pressure and high rpm within the skirt to produce the lift. Once the air is blown within the skirt with high pressure, then the air is circulated within the skirt and this air is forced to expel out of the outlet holes that produces the thrust on the surface beneath the skirt, this creates an impact on the terrain surface and creates the required lift, and additionally scale back the friction between the world surface and also the hovercraft. Hovercrafts are typically simple in mechanisms when we consider the theory. However the method from theory to manifestation is quite sophisticated. A plethora of issues exist and should be round-faced so as to realize a well functioning ground-effect machine. The plans and design should be perfect. One must take into consideration the weight and also the shape of every part so as to avoid issues corresponding to instability.

FUTURE DEVELOPMENT

By using the hover principle many designs have arise. One is the hover concept, by replacing the cushion of low pressure air as in form the modern Hovercraft by high pressure pad it was thought that the pads of high pressure could replace the wheels of the car but there are two difficulties.

1. It is difficult to lift
2. New method of propulsion is required

3. Then moved towards Hover train. Here rails provide smooth surface for high pressure air and guidance from the track overcomes the problem of steering. The future of hovercraft seems uncertain, but there is a good chance there will be huge hover ports all over the world, like the one in the picture. Thinner hovercraft might be built so civilians can drive safely on roads. It also seems likely that the larger hover vehicles will become larger than ever! Hovercraft are likely to be capable of high flight.

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