

HYPERLOOP TRANSPORTATION SYSTEM

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1. ABSTRACT

Hyperloop is a new mode of transport that seeks to change this paradigm by being both fast and inexpensive for people and goods. It is new fantastic project represents the transport system consisting of moving on tubes with strongly rarefied air of aluminium capsules. It is the pneumatic capsule transportation. The main advantages of the pneumatic capsule transport are: the high speed, ecological safety and the possibility to fully automate the movement. This model is based on Newton's second law of motion. The capsule passes by one of the ultrasonic detector and starts the timer. The timer goes off when the capsule passes by the second detector. This paper describes the design of Hyperloop trains. Hyperloop consists of a low pressure tube with capsules that are transported at both low and high speeds throughout the length of the tube. The capsules are supported on a cushion of air, featuring pressurized air and aerodynamic lift.

2. INTRODUCTION

Hyperloop is a conceptual transportation system designed to lower costs and travel times relative to California's current high-speed rail project.

In September, 2012 E. Musk compared his project (which is at a development stage) with land "Concorde": for comparison its speed will exceed the cruiser speed of "Boeing-787" on 200 km/h. Hyperloop is something average between "Concorde" and electromagnetic railgun, thus it doesn't demand rails. According to the principle work of Hyperloop, by the words of E. Musk, it is similar to the pneumatic train Aeromovel. doesn't allocate harmful blowouts, almost doesn't rustle and is capable to disperse to the speed of 80 km/h that does it an ideal city and suburban transport.

We will note that the train operated in Porto (Brazil), and also in Jakarta (Indonesia).

A new high speed mode of transport is desired between Los Angeles and San Francisco; however, the proposed California High Speed Rail does not reduce current trip times or reduce costs relative to existing modes of transport. This preliminary design study proposes a new mode of high speed transport that reduces both the travel time and travel cost between Los Angeles and San Francisco. Options are also included to increase the transportation system to other major population centres across California. It is also worth noting the energy cost of this system is less than any currently existing mode of transport. The only system that comes close to matching the low energy requirements of Hyperloop is the fully electric Tesla Model S. The system consists of capsules that travel between Los Angeles, California and San Francisco, California. The total one-way

trip time is 35 minutes from county line to county line. The capsules leave on average every 2 minutes from each terminal carrying 28 people each (as often as every 30 seconds during rush hour and less frequently at night). This gives a total of 7.4 million people per tube that can be transported each year on Hyperloop. The total cost of Hyperloop is under \$6 billion USD for two one-way tubes and 40 capsules. Amortizing this capital cost over 20 years and adding daily operational costs gives a total of \$20 USD plus operating costs per one-way ticket on the passenger Hyperloop.

3. Basic Concept of Hyperloop

Hyperloop is based on a principle of creating our own sky in the tube. When an object is moving, the two types of hurdles found are, Air drag and Friction. So, by using a low pressure tube and levitation, we can overcome these obstacles and achieve cruising speeds.

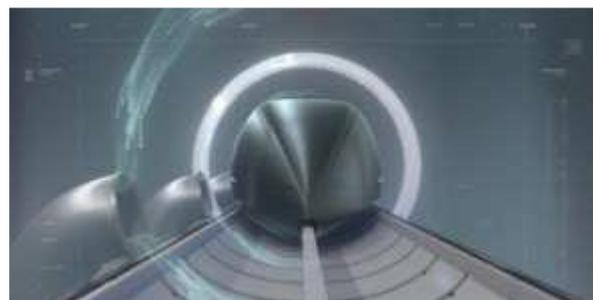


Fig. 1 Concept of Hyper loop

3.1 Linear electric motor

It starts with an electric motor which is broken into two parts; Rotor and a Stator. Rotor rotates the stator which is stationary. Stator is an electromagnet, when electric current passes through it rotor is magnetically attracted to spin unlike a normal electric motor Hyperloop motor isn't circular it's linear. The rotor is on the pod which is propelled magnetically as it moves over the stator, which is more efficient and powerful.

3.2 Hyperloop levitation

Traditional maglev or bullet trains use electromagnets (track) and permanent magnets (bottom of train) to levitate the train above track which requires more energy to maintain electromagnetic tracks.

Whereas in "HYPERLOOP" we place aluminum (passive track) and permanent magnets in Halbach array at the bottom of pod (Bogie), when the pod moves due to forward motion of permanent magnets inducing magnetic fields which levitate the pod and create eddy currents, where these eddy losses can be minimized by silicon steel lamination. By using this technique we can levitate without any power supply to track and we can have a great safety to

passengers as this stops levitating only when the pod comes to static position.

3.3 Green transportation

This system is completely green as we use solar, wind, kinetic energy by regenerative braking and in some climates even thermal energy which do not harm environment. Now it's important not just because it's green but it also produces more energy than it uses and that's a big

benefit along with very low operational costs.

4. Construction

4.1 Tube: The tube is made of steel. There are two tubes which are welded together side by side configuration to allow the capsules travel in both directions. The tube will be supported by pillars. There is a solar arrays are provided on a top of the tubes for the purpose of power to the system.

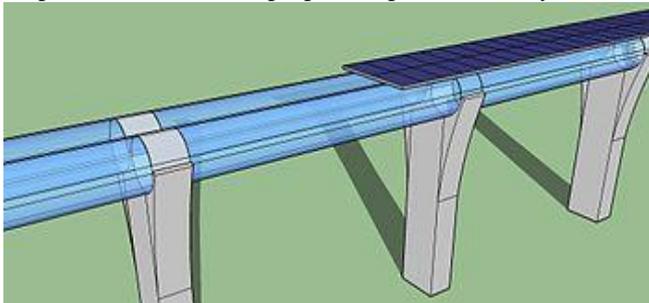


Fig.2 Tube

4.2 Capsule:

The capsule can carry 28 passengers at a time and it send at a very high speed and it is levitated by a high pressure air cushion. The design of capsule is start with the aerodynamic shape. There are two version of capsule are being considered: a passenger only version and a passenger plus vehicle version

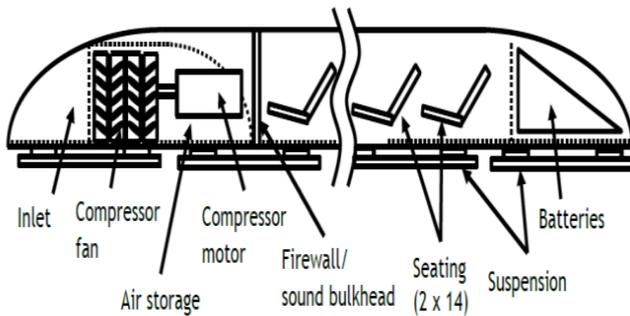


Fig.3 Capsule:

4.3 Pylon

The tube will be supported by pylons which constrain the tube in the vertical direction but allow longitudinal slip for thermal expansion as well as dampened lateral slip to reduce the risk posed by earthquakes. These minimally constrained pylons tube joints will also allow a smoother ride, the average spacing is 100 ft (30 m) and the pillars will be 20 ft (6 m) tall whenever possible but may vary in height in hilly areas or where obstacles are in the way, pylons are not required in all the places.

4.4 Compressor:

The compressor is fitted at the front side of the capsule. It supplies the air to the air bearings which supports the weight of the capsule. The compressor allows the capsule to traverse to the low pressure tube without choking the air flow that travels between tube walls and capsule



Fig-4: Compressor

4.5 Suspension:

Air bearing suspension offers stability and extremely low drag at a feasible cost. A stiff air bearing suspension is superb for reliability and safety. When there is a gap between ski and tube walls is high then it shows the nonlinear reaction and which results in large restoring pressure

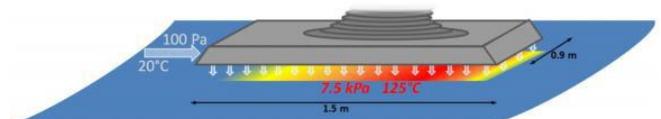


Fig-5: Schematic of air bearing skis that support the capsule

4.6 Propulsions:

To accelerate and decelerate the capsule the linear induction motor is used in hyperloop system. It provides some advantages over a permanent magnet motor. To accelerate the capsules there is linear accelerators are constructed on a length of the tube. Stators are placed on the capsules to transfer momentum to the capsules via the linear accelerators.

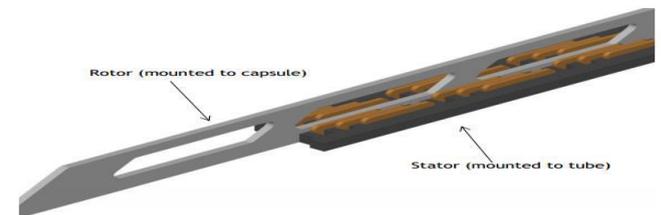


Fig.6 Propulsions:

5. Working of Hyperloop Transportation System

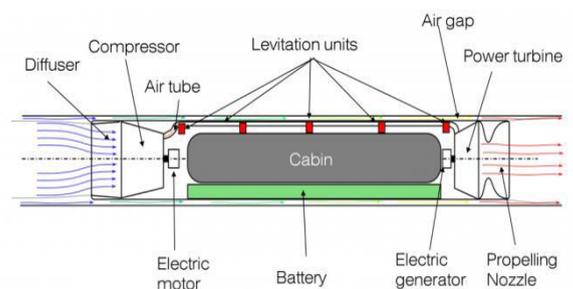


Fig. 7 Hyperloop Transportation System

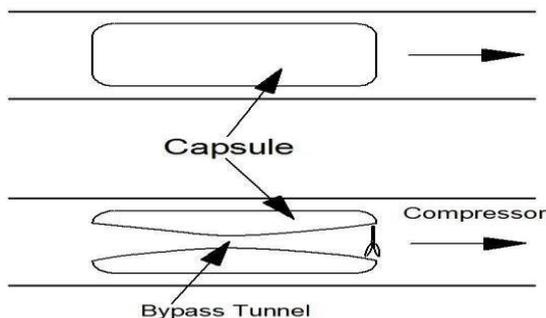
Working of hyperloop system is based on magnetic levitation principle. As we know that the passenger pad travel through low pressure tube which is pylon-supported tube.

In hyperloop system an air compressor fan is fitted on front side of pod which sucks the air. It transfer high pressure air

front side to the rear side of capsule (pod) and it propel the pod. It creates the air cushion around the pod, so that the pod is suspended in air within the tube

On the basis of magnetic levitation principle the pod will be propelled by the linear induction motor. By the linear induction motor the capsule send from one place to another place to a subsonic velocity that is slower than the speed of sound.

The pod will be self-powered. There is solar panel fitted on top of the tube. By this solar panel there is enough energy is stored in battery packs to operate at night and in cloudy weather for some periods. The energy is also is stored in the form of compressed air. The air between the capsule acts as a cushions to prevent two capsules from colliding within the tube.



at the rear end of the capsule. If capsule cover too much area of the tube then, the air is not flow around the capsule and ultimately the entire column of air in the tube is being pushed ahead of the capsule and because of this there is friction between the air and tube walls is increases tremendously. Therefore to avoid this problem the compressor is fitted at the front of the capsule through which the air is flow which will not flow around the capsule and send it to bypass nozzle.

6. Merits and Demerits of Hyperloop Transportation System

6.1 Merits:

1. It saves the travelling time.
2. There is no problem of traffic.
3. It is powered by the solar panel.
4. It can travel in any kind of weather.
5. Cost of hyperloop is low.
6. Not disruptive to those along the route.
7. More convenient.
8. Resistance to earthquake.

6.2 Demerits:

1. Turning will be critical.
2. Less movable space for passenger.
3. High speed might cause dizziness in some passenger.
4. Punctured tunnel could cause shockwaves.

6.3 Future Work

1. Improve the passenger capacity.
2. Detailed station designs with loading and unloading of passenger
3. Safety features improvement.
4. It can be used in material handling deices.

7. CONCLUSION

Hyperloop transportation has a very fast and ecological transportation of small needs, cargo and people.

The ambitious project of absolutely new type of high-speed transport can connect some large cities of the world much more effectively, than the high-speed railroads. Hyperloop is considered an open source transportation concept.

8. REFERENCES

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