ISSN: 2456-236X

Vol. 03 Issue 02 | 2019

Hyper-loop, Electrification of Mobility, & Future of Rail Travel

Arunesh Anil Dongre¹, Numan Rais Shaikh², Shamshad Ashique Ali Khan³, Sharif Sajid Ansari⁴, Iftekar Patel⁵

^{1,2,3,4}Student, Department of Electrical Engineering, Anjuman-I-Islam Kalsekar School Of Engineering, Navi Mumbai, India ⁵Assistant Professor, Department of Electrical Engineering, Anjuman-I-Islam Kalsekar School Of Engineering, Navi Mumbai, India

ABSTRACT

In present time there are only four modes of transport road, rail, water and air. The present mode of transport is either too slow or too costly. The new proposed way of transport is hyper loop which can be both fast as well as inexpensive for both people and goods. Hyper loop is a proposed mode of passenger and freight transportation that propels a capsule-like vehicle through a near-vacuum tube at more than airline speed. The pods would accelerate to cruising speed gradually using a linear electric motor and glide above their track using passive magnetic levitation or air bearings. Hyper loop consist of low pressurized tube or completely vacuum tube with capsule in it that can travel at low or high speed along the length of the tube. Passengers of hyper loop may enter or exit hyper loop at station which are located either at the ends of the tube or branches along the tube length. It's pretty sure that hyper loop is going to change the transportation and road congestion. Hyper loop is going to be eco-friendly as its will minimize the carbon footprint globally. Hyperloop will to lead to rapid growth as it will become possible to travel extremely fast, inexpensive intercity travel for both people and goods.

Key Words: Hyperloop, Propels, Vacuum Tube, Capsule, Passive Magnetic Levitation, Air Bearings

1. INTRODUCTION

Hyper loop is a new way of fastest transportation been proposed by Elon Musk and a team of engineers from Tela Motors and the Space Exploration Technologies Corporation in August 2013. The basic concept of Hyperloop is travelling of people or goods from one place to another in a closed capsule which is propelling at a very high speed through a low pressurized tube. It is driven by linear induction motor and compressor. It includes 28 passenger pods. We can also call Hyperloop as a solar powered transportation system and an alternative for high speed train.

For propulsion, magnetic accelerators will be planted along the length of the tube, propelling the pods forward. The tubes would house a low pressure environment, surrounding the pod with a cushion of air that permits the pod to move safely at such high speeds, like a puck gliding over an air hockey table. Given the tight quarters in the tube, pressure build-up in front of the pod could be a problem. The tube needs a system to keep air from building up in this way. Musk's design recommends an air compressor on the front of the pod that will move air from the front to the tail, keeping it aloft and preventing pressure building up due to air displacement. A one way trip on the hyper loop is projected to take about 35 minutes (for comparison, travelling the same distance by car takes roughly six hours.) Passengers may enter and exit Hyper loop at stations located either at the ends of the tube, or branches along the tube length.

2. MAIN PARTS OF HYPERLOOP

2.1 Low pressurized tube

The tube is made up of steel. The tube is supported by pillars. The tubes are welded side by side so that capsules may travel in both directions. The pressure in the tube is 100pa (equivalent to flying above 150,000 feet altitude). Solar panels are been placed over the tubes so that to provide power to the power system.



Fig. 1 Low pressurized tube

2.2 Capsule

There are two version of capsule one is Passengers only version and another is passengers plus vehicle version. Passengers only version can carry up to 28 passengers and passengers plus vehicle version can carry 3 vehicles in addition to passengers. Capsule is been propelled at high speed and it is levitated by air cushion. Design of capsule is aerodynamic in shape. The capsules travel at 760 mph (1,220 kph).



Fig. 2 Capsule Design

2.3 Axial Compressor

Axial Compressor is situated at the front side of capsule it serves two purposes. 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. It compresses the air at a ratio of 20:1. Some air is been stored for passengers. Onboard water tanks are used for cooling of air.



Fig. 3 Compressor

2.4 Suspension

Suspending the capsule in the tube is a problem as axial wheels can't be use as frictional losses and dynamic instability will come into picture. Therefore air bearing suspension are been used. Air bearings offer stability and extremely low drag at a feasible cost by exploiting the ambient atmosphere in the tube. When the gap between the capsule and tube reduces the flow of air becomes non linear resulting in large restoring pressure. The increased pressure will push the capsule up to the desired ride height. While a stiff air bearing suspension is superb for reliability and safety.



Fig. 4 Suspension

2.5 Propulsion

To speed up the capsule to a desired speed of 760mph (1,220 kph) the advanced linear induction motor is been used. The movingrotor will be situated on capsule while the stationary part (stator) of motor is placed on tube which powers the capsule (vehicle). The rotor of linear induction motor is an aluminium blade 49 ft (15 m) long, 1.5 ft (0.45 m) tall and 2 in. (50 mm) thick. Current flows mainly in the outer 0.4 in. (10 mm) of this blade, allowing it to be Hollow to decrease weight and cost. The gap between the rotor and the stator is 0.8 in. (20 mm) on each side.



3. SAFETY AND REALIBILITY

Design of hyperloop has been considered from the start by keeping the safety point of view in mind. The capsule(vechile) and the propulsion system are place in the tube. The system is immune to rain, cold,fog and ice. The capsule is accelerated to desired speed maintaining the atmosphere in the tube.

All capsule are given radio connection so that during at any emergency situation the passengers can communicate with the station operator. The capsule is provided power through two or more lithium ion battery if any kind of power outrage takes palce after propulsion of capsule in the tube all the linear accelerators will have enough energy to bring all capsules to their destination. In addition to these the capsule will be provided with mechanical braking to stop the capsule at the station during any power outrage.

Safety of onboard air supply in hyperloop is very similar to the aircraft. If any minor leaks takes place then reserved air will be used till the vehicle reaches to a station and if a major leak takes place then oxygen

ISSN: 2456-236X

Vol. 03 Issue 02 | 2019

masks would be deployed similar to that in airplanes. If one of the capsule in the tube becomes stranded then the capsules which willbe ahead of it will reach the the destination but the capsule which are at the back will use mechanical braking, once they come to rest then the capsules will be brought to a station with the help of small onboard electric motor.

During earthquake all the capsules inside the tube will automatically use the mechanical braking and come to rest. The tubes will be design with necessary flexibility without any bend in the tube.



Fig. 6 Working of Hyper loop

4. MERITS and DEMERITS

4.1 Merits

- It is a fast mode of transport and less expensive compared to other mode of transport.
- It is immune to external weather conditions.
- No issues of traffic jam.
- It is self powering system as solar panels are placed over the tubes.
- In this mode of transport passengers will take less time to aboard compared to aboard on airplanes.
- Safety features are reliable during earthquake.

4.2 Demerits

- If any puncture is present in the tube then passengers will experience shock waves.
- Too less movable space for passengers in the capsules.
- Due to too high speed passenger may suffer through dizziness.
- Turning will be critical so construction of tubes must be in straight lines.

5. CONCLUSION

A new mode of fastest transportation is hyper loop which is discussed in this paper presentation. Hyper loop can be used with other mode of transportation for passengers as well as goods too. It is a mode of transport featuring high speed with low cost. In this the pressure inside the tube is too less enables the capsule to reach at top speed in less time and energy. The work has been detailed into two mode one with passengers only and other with passengers plus vehicles. An additional passenger plus transport version of the Hyper loop has been created that is only 25% higher in cost than the passenger only version. This version would be capable to transport passengers, vehicles, freight, etc. The passenger plus vehicle version of the hyper loop is less than 11% of the cost of the proposed passenger. Intend of this paper is to focus on a new mode of transport which is too fast and affordable.

ISSN: 2456-236X

Vol. 03 Issue 02 | 2019

6. FUTURE WORK

Future work is too being done on Hyperloop so that to get rid of all disadvantages. The movable space for passengers should be increased. Turning is going to be critical so the tubes are designed in straight lines. The capacity of capsule is just 28 passengers it should be increased sufficiently. The interval between the capsules is 2 minutes which should be decreased so that more number of capsules may travel at a time in the tube increasing the efficiency of the system.

7. REFERENCE

- [1] Ahmed Hodaib, Samar, et al, international journal of mechanical, aerospace, industrial, mechatronics and manufacturing engineering Vol:10 No:5, (May 2016)
- [2] Chin, Jeffrey C.; Gray, Justin S.; Jones, Scott M.; Breton, Jeffrey J. (January 2015). Open-Source Conceptual Sizing Models for the Hyperloop Passenger Pod (PDF). 56th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference. January 5–9, 2015. Kissimmee, Florida. doi:10.2514/6.2015-1587.
- [3] Paper by Mark Sakowski, "The Next Contender in High Speed Transport Elon Musks Hyperloop", 2016
- [4] N. Kayela, editor of scientific and technical department, "Hyperloop: A Fifth Mode of Transportation", 2014
- [5] Mohammed Imran, international journal of engineering research, 2016
- [6] Musk, Elon (August 12, 2013). "Hyperloop Alpha"(PDF). SpaceX. Retrieved August 13, 2013.