

Hyperloop Transport Technology: A Review

PRIYABRATA GARU

Assistant Professor, Dept. of Civil Engineering, Aryan Institute of Engineering & Technology,
Bhubaneswar

ABHIPSA MOHANTY

Assistant Professor, Department of Civil Engineering, Raajdhani Engineering College, Bhubaneswar, Odisha
NITYANANDA SAHOO

Department of Civil Engineering, NM Institute of Engineering and Technology, Bhubaneswar, Odisha

Abstract

The purpose of this review is to explore on Hyperloop technology as is used in railway transportation. For the many years' railways have been playing a significant role in mass passenger and freight transport. In the modern daily travel environment (commuter), railways face new challenges from different perspectives. For example, urban railways always focus on how to minimize the vibration and noise from trams, subways and light rail vehicles on the environment. Intercity transport must focus on how to achieve higher speeds as well as eliminating noise and vibration so as to minimize travel time and even achieve the potential of diverting passengers from air traffic and decreasing exhaust pollution in the atmosphere. Lastly, urban transport and intercity transport must all develop strategies to achieve better economic values regardless of what type of transport is used. Facing future demands and challenges, hyper loop trains provide a new option. It provides contactless operation on wheel/rail systems.

Keywords: Hyper loop • Railway transport • Safety

Introduction

This is the proposed mode of transportation for both passengers and freight, which used to describe an open-source tube train and style released by a joint team from SpaceX and Tesla. Hyperloop technology is transport technology that use sealed tube or system of tubes with low air pressure through which a body (train) can travel substantially free of air resistance or friction. The Hyperloop could effectively convey passenger or freights at airline or hypersonic speeds while being energy efficient compared with existing high speed rail systems. This, if implemented, may reduce travel times compared to other modes of transport such as airplane, and railways which are said to be faster modes of transport.

Literature Review

Elon Musk first richest person in the world publicly announced the Hyperloop in 2012. Elon Musk initial concept included reduced-pressure tubes during which pressurized capsules ride on air bearings driven by linear induction motors and axial compressors (Figure 1) [1].

Basic principle of hyperloop

Hyperloop is predicated on a principle of maglev. The principle of maglev is that a vehicle are often suspended and propelled on a guidance track made with magnets. The vehicle on top of the track could also be propelled with the assistance of a linear induction motor.

Construction tube

The tube is made of steel and it acts as rail when compare to the railway. There are two tubes which are welded together side by side configuration to permit the capsules travel in both directions. The tube will be supported by poles. There is a solar arrays are provided on a top of the tubes for the aim of power to the system (Figure 2).

Capsule

The capsule bear no resemblance to the vehicle bodies in train can carry up to 28 passengers at a time and it send at a very high speed and it is levitated by a high pressure air cushion (Figure 3). The configuration and design of capsule, start with the aerodynamic shape in order to minimize friction. There are two version of capsule are being considered which are a passenger only version and a passenger plus vehicle version [2].

Compressor

The compressor is attached at the front side of the capsule. It supplies the air to the air bearings which supports the load of the capsule. The compressor

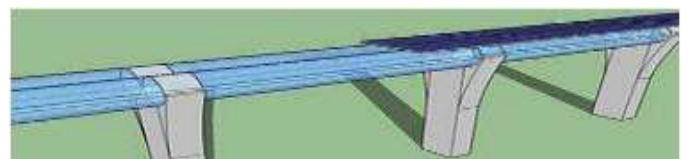


Figure 1. Hyperloop tube.

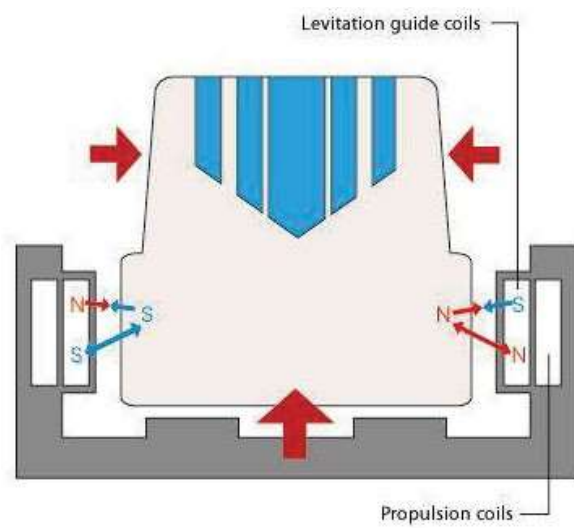




Figure 3. Hyperloop capsule.

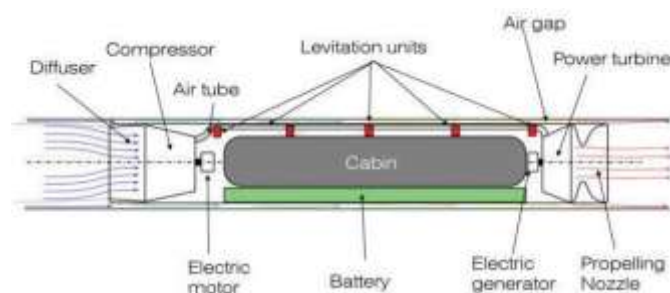


Figure 4. Description of working principle of hyperloop.

permits the capsule to traverse the tube without choking the air flow that travels between tube walls and capsule.

Working principle of hyper loop

Working of hyperloop system is predicated on maglev principle. As we know that the passenger capsule (pod) travel through low pressure tube which is pylon-supported tube. In hyperloop system a compressor fan is attached on front side of capsule which allows the air to enter, then transfers high air front side to the rear side of capsule (pod) and it propel the pod. It causes the air cushion around the Capsule (pod), so that the pod is swing in air within the tube [3].

Based on magnetic levitation principle the Capsule (pod) will be propelled due to the linear induction motor. By the linear induction motor the capsule send from one place to a different place to a subsonic velocity that's slower than the speed of sound [4].

The capsule will be self-powered. There is solar panel fitted on top of the tube for alternate power supply. By this solar array there's enough energy is stored in battery packs to work in the dark and in cloudy weather for a few periods. The energy is stored in the form of compressed air. The air between the capsule acts as a cushions to stop two capsules from colliding within the tube. Hence air in the compressor is directed to a bypass nozzle at the rear end of the capsule. If capsule occupies in addition, space of the tube then, the air will not flow around the capsule and ultimately the whole 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 cannot flow round the capsule and send it to bypass nozzle (Figure 4).

Merits of hyperloop

Merits and demerits of hyperloop transportation system over the other system Merits of hyperloop.

- It saves the travelling time: Since the capsule travels in frictionless and in closed tube thus no air resistance hence the time taken for the whole journey would be decreased, also due to the fact that no air resistance and contact friction energy consumption will have been saved.
- There is no problem of traffic: capsule travels in a closed tube in which no any other pods or body travels ie no traffic jam.
- It is powered by the solar panel: hyperloop transportation technology also uses solar power as alternative addition power thus it is environmental friendly and the system seems to be sustainable.
- It can travel in any kind of weather: weather changes do not have any impact on hyperloop transportation since the system travels in a closed tube.
- Cost of hyperloop is low: operation cost of hyperloop transportation is quite low compared to train transportation especial maglev since the hyperloop transportation uses the solar power as alternate power.

Demerits

- **Less movable space for passenger:** Hyperloop capsule which is resembled to car body in train can carries fewer people compared to car body of train.
- **High speed might cause dizziness in some passenger:** Since there is no friction or any other resistance so the hyperloop can attain maximum practical speed which can't being attain by any other object in the world, so that can result to the dizziness to some passenger
- **Punctured tunnel could cause shockwaves:** Due to the nature of its infrastructure and speed when the fault happens it is the disaster

Conclusion

Hyperloop transportation is relatively good over the traditional modes of transportation that are rail, road, water and air. And can provide a very high speed also it provides better comfort and cost is also low by reducing the pressure of the air in the tube which reduces simple air drag and enables the capsule to maneuver faster than through a tube at air pressure.

Recommendations

For the future development and modification the manufacturers should improve the passenger capacity that is increasing the number of passenger also should provide detailed station designs with loading and unloading of passenger alongside with safety features improvement.

References

1. Moon, Francis C. Superconducting levitation: Applications to bearings and magnetic transportation. John Wiley & Sons, (2008).
2. Doppelbauer J. "Hyperloop - An innovation for global traffic?" ZEVrail 142 (2018): 218-224.
3. Taylor, Catherine L, David J. Hyde, and Lawrence C. Barr. Hyperloop commercial feasibility analysis. *John A. Volpe National Transportation System Center* (2016).
4. Iwnicki, S. "Future trends in railway engineering." *Proc Inst Mech Eng CJ Mech Eng Sci* 223 (2009): 2743-2750.