

Hyperloop Transportation System: A New Mode of Transportation

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Abstract: *The concept of high-speed travel in tubes has been around for decades and it was first reintroduce by Elon musk and a team of engineers from Space Exploration Technologies Corporation in August 2013, it is a combination of a Concorde, Rail gun and an Air hockey table. This idea seeks to change the traditional transportation by being both fast and inexpensive for people and goods where conventional modes of transportation tend to be either relatively slow, expensive or a combination of both. Hyperloop is a proposed mode of passenger and freight transportation that propels a pod (train) through a low-pressure tube at 750mph which is more efficient and environmental friendly, the pod would accelerate to a cruising speed gradually using a linear electric motor with solar power and glide above their track using passive magnetic levitation. Passengers may enter and exit Hyperloop at stations located either at the ends of the tube, or branches along the tube length. Hyperloop minimizes the carbon footprint globally and also inexpensive and extremely fast intercity travel would be widely accessible. If both people and goods can move more quickly and comparatively cheaply, an economic growth will be noticed as well.*

Keywords: capsules, green energy, green transportation, pod, passive levitation, Safety, inexpensive

1. Hope for Hyperloop

As we know present modes of conventional transportation is relatively slow, expensive and also became hazardous due to the carbon emissions and the fluctuating price of the fuel. The last major development in the high-Speed rail was maglev by "Alfred Zehden" in 1902. Rail travel is relatively an energy efficient and environmental friendly option, but is too slow and expensive, these days. Whereas flights are faster but very expensive and you will be treated like Toys for safety, Hyperloop was designed keeping these issues in mind, which aims to make cost-Effective, high speed transportation with a clean and self-powering system.

2. 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.

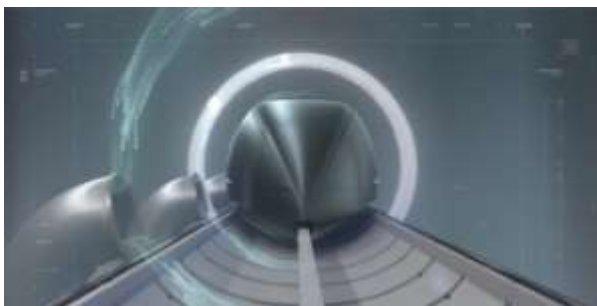


Figure 1: Concept of Hyperloop

3. Components

Tube:

The tube is made of steel and it is double layered to ensure safety. Two tubes are welded together side by side

configuration to allow the travel in both directions and are supported by pillars. Solar arrays are provided on the top of the tubes to make this, a self powering system.



Figure 2: Construction of tube

POD:

The pods are similar to train bogie and first generation pod of hyperloop is Xp-1 (fig 3) is made with sandwich system, where you have outer and inner skin that makes you sure that your always safe. Each pod can carry 28 passengers per travel. Permanent magnets are arranged at bottom of pod for levitation and augmented windows are arranged in Xp-1 pod for refreshment of passengers.

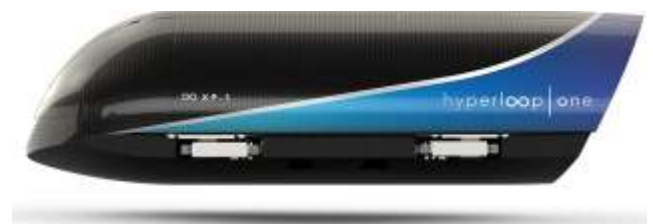


Figure 3: XP-1(First generation pod)

PYLON:

The tube will be supported by pylons which constrain the

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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.



Figure 4: Hyperloop pylon

Working principle

The pod would accelerate to cruising speed gradually using a linear electric motor and glide above their track after reaching certain speed using passive magnetic levitation in a low pressured tube

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

Hyperloop levitation

Traditional maglev or bullet trains uses 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 move due 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.



Figure 5: Hyperloop levitation

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.

Comparison

Mode	Speed	Accessibility	Cost	Capacity
Road	Moderate	High	Moderate	Low
Rail	Slow	Moderate	Low	Moderate
Air	Fast	Low	Very High	Very Low
Water	Very Slow	Moderate	Very Low	Very High
Hyperloop	Very fast	High	Very Low	Moderate

Installation cost of High speed rail and Hyperloop

High speed rail required more energy to power electromagnets for levitation and more lands are to be bought for construction of high speed rail whereas a Hyperloop technology uses passive levitation which do not require energy to levitate and also it's a self powering system and needs less land for its construction. So both the installation and maintenance costs will be very low.

Disadvantages

Tube pressurization
 Turning will be critical
 No answer for equipment malfunction, accidents, emergency evacuation

4. Conclusion

The Hyperloop would be the first truly revolutionary new transportation system in half a century, which could radically change the time and cost equation for travel and transport between nearby cities.

It is considered an open source transportation concept and will be available soon in many countries, which can transport people and goods at a speed of 760 miles per hour. It produces more energy than it consumes, takes lesser space for construction and also incurs very cheaper costs, when compared to super fast Rail.

Additional technological developments in Hyperloop and further optimization could likely reduce the price even further.

As the global population is increasing and the environmental values are declining, a better mass transport system like Hyperloop is definitely essential, in this world.

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