JOURNAL OF INFORMATION, KNOWLEDGE AND RESEARCH IN MECHANICAL ENGINEERING
ISSN 0975 – 668X| NOV 16 TO OCT 17 , VOLUME –04, ISSUE – 02

HYPERLOOP TECHNOLOGY THE PASSENGER TRANSPORT SYSTEM

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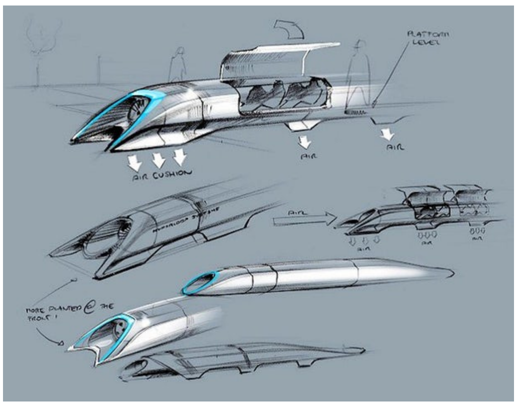
ABSTRACT:
Present orthodox approaches of shipping of folks reside of four unique types: rail, road, water, and air. These modes of transport tend to be either relatively slow (e.g., road and water), expensive (e.g., air), or a combination of relatively slow and expensive (i.e., rail). Hyperloop is a new mode of transport that seeks to change this paradigm by being both fast and inexpensive for people and goods. Hyperloop is also unique in that it is an open design concept, similar to Linux. 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. The capsules are accelerated via a magnetic linear accelerator affixed at various stations on the low pressure tube with rotors contained in each capsule. Passengers may enter and exit Hyperloop at stations located either at the ends of the tube, or branches along the tube length. Although Hyperloop is similar to other vacuum tube train (Vacuum Train) concepts,2 the soft vacuum represents a distinct difference. It allows the pod to run on air-bearings, thus removing the need for a magnetic levitation system used on other Vacuum Train designs. The air bearings require a source of pressurized air, which is provided by a compressor powered by on-board batteries. Since Hyperloop operates at transonic speeds and a low pressure environment, the design of the pod compression system can be likened to the compressor design for aircraft turbo machinery. Furthermore, the aerodynamic concerns arising from constricted flow through a tube are prevalent in the design of inlets and nozzles on aircraft engines and the entire system faces similar weight and volume constraints. For these reasons, the modeling approach applied here is inspired heavily by methods for aircraft sizing and turbine engine cycle analysis

***KEYWORDS*: Transportation, Hyperloop, Fast and Reliable, Suspension,**

1. INTRODUCTION



Fig, 1. Hyperloop transport concept

Two versions of the Hyperloop capsules are being considered: a passenger only version and a passenger plus vehicle version. Hyperloop Passenger Capsule Assuming an average departure time of 2 minutes between capsules, a minimum of 28 passengers per capsule are required to meet 840 passengers per hour. It is possible to further increase the Hyperloop capacity by reducing the time between departures. The current baseline requires up to 40 capsules in activity during rush hour, 6 of which are at the terminals for loading and unloading of the passengers in approximately 5 minutes.

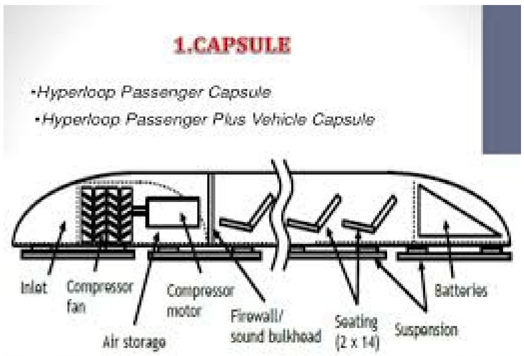


Fig 2. Hyperloop Passenger Plus Vehicle Capsule.

The passenger plus vehicle version of the Hyperloop will depart as often as the passenger only version, but will accommodate 3 vehicles in addition to the passengers. All subsystems discussed in the following sections are featured on both capsules. For travel at high speeds, the greatest power requirement is normally to overcome air resistance. Aerodynamic drag increases with the square of speed, and thus the power requirement increases with the cube of speed. For example, to travel twice as fast a vehicle must overcome four times the aerodynamic resistance, and input eight times the power. Just as aircraft climb to high altitudes to travel through less dense air, Hyperloop encloses the capsules in a reduce pressure tube.

This is an operating pressure of 100 Pascals, which reduces the drag force of the air by 1,000 times relative to sea level conditions and would be equivalent to flying above 150,000 feet altitude. A hard vacuum is avoided as vacuums are expensive and difficult to maintain compared with low pressure solutions. Despite the low pressure, aerodynamic challenges must still be addressed. These include managing the formation of shock waves when the speed of the capsule approaches the speed of sound, and the air resistance increases sharply. Close to the cities where more turns must be navigated, capsules travel at a lower speed. This reduces the accelerations felt by the passengers, and also reduces power requirements for the capsule. The capsules travel at 760 mph (1,220 kph, Mach 0.91 at 68 ºF or 20 ºC). The proposed capsule geometry houses several distinct systems to reside within the outer mold line.

2. CONSTRUCTION AND WORKING

2.1 Interior

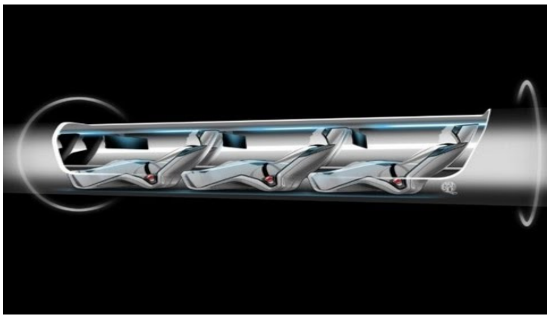
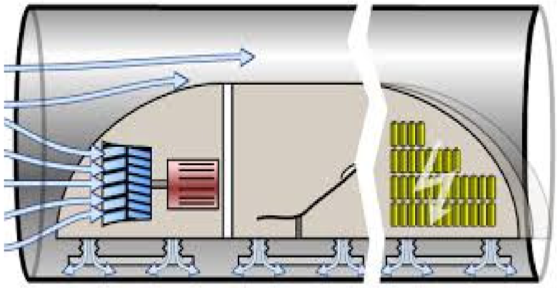


Fig. 3. Interior

The interior of the capsule is specifically designed with passenger safety and comfort in mind. The seats conform well to the body to maintain comfort during the high speed accelerations experienced during travel. Beautiful landscape will be displayed in the cabin and each passenger will have access their own personal entertainment system.

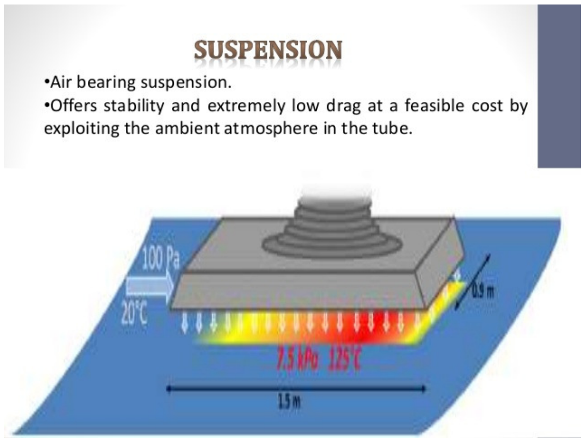
2.2 Compressor



Fig, 4. Compressor

One important feature of the capsule is the onboard compressor, which serves two purposes. This system allows the capsule to traverse the relatively narrow tube without choking flow that travels between the capsule and the tube walls (resulting in a build-up of air mass in front of the capsule and increasing the drag) by compressing air that is bypassed through the capsule. It also supplies air to air bearings that support the weight of the capsule throughout the journey.

2.3 Suspension



Fig, 5 Suspension system

Suspending the capsule within the tube presents a substantial technical challenge due to transonic cruising velocities. Conventional wheel and axle systems become impractical at high speed due frictional losses and dynamic instability. A viable technical solution is magnetic levitation; however the cost associated with material and construction is prohibitive. An alternative to these conventional options is an air bearing suspension. Air bearings offer stability and extremely low drag at a feasible cost by exploiting the ambient atmosphere in the tube.. When the gap height between a ski and the tube wall is reduced, the flow field in the gap exhibits a highly non-linear reaction resulting in large restoring pressures. The increased pressure pushes the ski away from the wall, allowing it to return to its nominal ride height. While a stiff air bearing suspension is superb for reliability and safety, it could create considerable discomfort for passengers onboard. To account for this, each ski is integrated into an independent mechanical suspension, ensuring a smooth ride for passengers. The capsule may also include traditional deployable wheels similar to aircraft landing gear for ease of movement at speeds under 100 mph (160 kph) and as a component of the overall safety system.

2.4 Onboard Power

The passenger capsule power system includes an estimated 5,500 lb (2,500 kg) of batteries to power the onboard compressor and capsule systems in addition to the compressor motor and coolant. The battery, motor, and electronic components cost is estimated to be near $150,000 per capsule in addition to the cost of the suspension system. The passenger plus vehicle capsule power system includes an estimated 12,100 lb (5,500 kg) of batteries to power the onboard compressor and capsule systems in addition to the compressor motor and coolant.
Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

3. ADVANTAGES

- Safer
- Faster
- Lower cost
- More convenient
- Immune to weather
- Sustainably self powering
- Resistant to earthquakes
- Not disruptive to those along the route.

4. DISADVANTAGES

Punctured tunnel could cause shock waves High speed might cause dizziness in some passengers.

5. APPLICATIONS

Hyperloop is a proposed mode of passenger and freight transportation that would propel a pod-like vehicle through a near-vacuum tube at more than airline speed.

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