Review Paper on Hyperloop: A New Mode of Transportation

Chetan Ramesh Ingale[1] Prof. Mrs J. V. Chopade[2]
[1]Student [2]Assistant Professor
[1,2]Department of Mechanical Engineering
[1,2]Pimpri Chinchwad College of Engineering and Research, Ravet Pune

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 aluminum 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. 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. In this paper Analyze the performance of New transportation system i.e. Hyperloop.

Key words: Hyperloop, Mode of Transportation

I. INTRODUCTION

Hyperloop is a conceptual transportation system designed to lower costs and travel times relative to California's current high-speed rail project.[1]

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. 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 Aeromovel is successfully operated in Porto Alegre (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 centers 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.

The vehicle is driven by a pneumatic propulsion system which converts electrical power into air flow and transmits thrust directly to the vehicle without gears or intervening electric circuits.(figure1) Stationary electrical blowers, located close to the passenger stations produce the necessary pressurized air, which is generated according to the desired vehicle acceleration rate and speed. The elevated guideway can accommodate gradients up to 12%, and tight horizontal curves with radii as low as 25 meters. AEROMOVEL with its exclusive right-of-way and comparatively short headways is designed to carry up to 10,000 passengers per hour per direction. The light weight of AEROMOVEL vehicles ensures that energy is not wasted moving heavy deadweight (empty vehicles); the extreme simplicity and high reliability of AEROMOVEL results in reduced maintenance requirements. Air propulsion eliminates the problems of heavy rail traction; wear on wheels and tracks is reduced to a minimum. The electric motors on the air blowers are sturdy, completely independent units. Because the purpose of these motors is to pump air, not drive the vehicle, maintenance requirements are minimal. Operation is fully automatic. No drivers are required on-board. High reliability automation systems are used for protection, control and supervision of the vehicle operation.

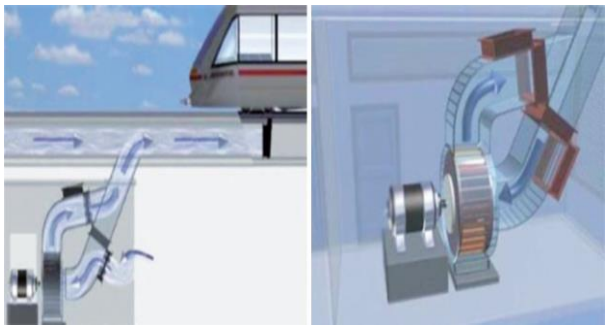

Fig. 1: Propulsion system of Aeromovel

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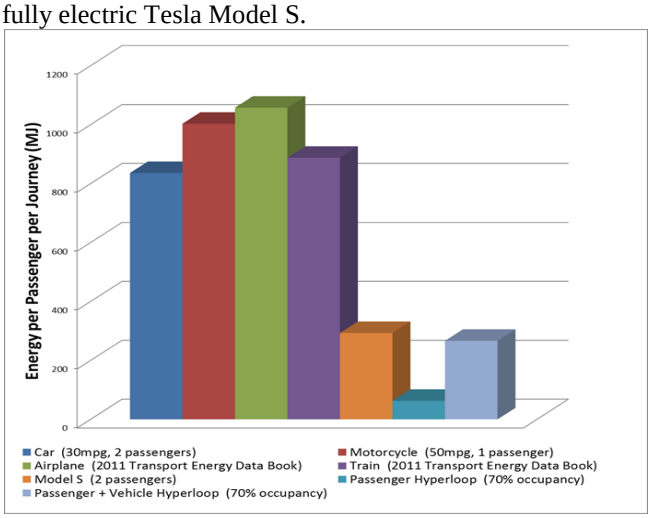

Fig. 2: Energy cost per passenger for a journey between Los Angeles andSan Francisco for various modes of transport.

II. HYPERLOOP TECHNOLOGY

Hyperloop is a new way to move people and things at airline speeds for the price of a bus ticket. It's on-demand, energy-efficient and safe. In Hyperloop uses technology that the company Tesla Motors practices in electric cars Tesla S. "Linear induction motors have long existed. They were invented by Nikola Tesla", — said E. Musk. To power the system will use solar panels.The Hyperloop consists of several distinct components, including:

A. Capsules

Sealed capsules carrying 28 passengers each that travel along the interior of the tube depart on average every 2 minutes from Los Angeles or San Francisco (up to every 30 seconds during peak usage hours).

The capsules are supported via air bearings that operate using a compressed air reservoir and aerodynamic lift capsule materials are polymers. The friction theory of polymers was developed byRussian scientist Bartenev G.M. [2]. Polymers can exist in four physical states - the crystalline and three amorphousstates (glassy, rubbery, and viscous flow). Polymers that exist in the glassy or crystalline state are sometimes calledrigid polymers. Each state has its own complex of mechanical properties and its own area of technical application.

B. Tubes

The tube is made of steel. Two tubes will be welded together in a side-by-side configuration to allow the capsules to travel both directions. Pylons are placed every 100 ft (30 m) to support the tube. Solar arrays will cover the top of the tubes in order to provide power to the system.

C. Propulsion

Linear accelerators are constructed along the length of the tube at various locations to accelerate the capsules. Rotors are located on the capsules to transfer momentum to the capsules via the linear accelerators.

D. Route:

There will be a station at Los Angeles and San Francisco. Several stations along the way will be possible with splits in the tube. The majority of the route will follow I-5 and the tube will be constructed in the median.

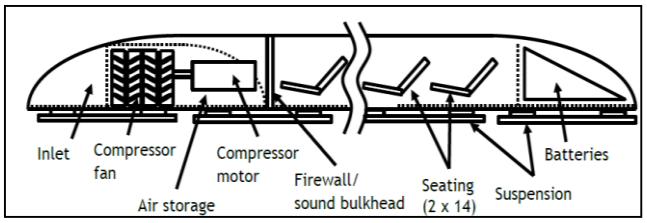

Fig. 3: Hyperloop passenger capsule subsystem notional locations

III. STATIONS FOR HYPERLOOP

Due to the short travel time and frequent departures, it is envisaged that there will be a continual flow of passengers, in contrast to the pulsed situation at airports which leads to lines and delays. Safety and security are paramount, and so security checks will still be made in a similar fashion as TSA does for the airport. The process could be greatly streamlined to reduce wait time and maintain a more continuous passenger flow.

Travel time is very short, the main usage is more for commuting than for vacations. There would be a luggage limit of 2 bags per person, for no more than 110 lb (50 kg) in total. Luggage would be stowed in a separate compartment at the rear of the capsule. This luggage compartment can be removed from the capsule, so that the process of stowing and retrieving luggage can be undertaken separately from embarking or disembarking the capsule's passenger cabin.

Note that loading and unloading would occur in parallel with up to three capsules at a given station at any time. The expected cost for each station is around $125 million for a total of $ 250 million USD initially.

Fast turnaround (2 mins) for the pod, only 5 airlocks needed for 30-second spacing • Virtually no vacuum pumping time or energy • Short walking distance for passengers, reduced station size • Passengers can take several minutes for changeover • Seating modules depart once passengers strapped in(FIG NO 4)[3].

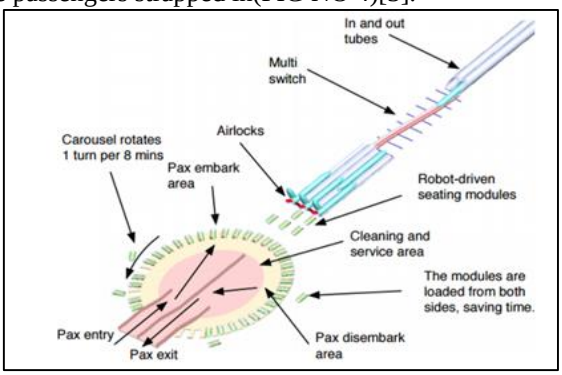

Fig. 4: Hyperloop station

IV. RAILWAY TRACKS FOR HYPERLOOP

One group of engineers plans to create the latest system a monorails which founded on the principles of the Lofstrom project (Figure 5). In this case, the movement of trains will be carried out by electromagnetic effects "sole" of structure with ways [4]. The similar method will allow an electric train to reach the speeds proportional to speed of movement of military fighter aircrafts, and to send to space 4 million people a year. The first Startram can already appear in 20 years [5]. The Startram orbital launch system would transport passengers and cargo into space in a magnetic levitation (maglev) train. Like a train, the Startram track can follow the surface of the Earth for most of this length. Side forces associated with the curvature of the surface can be accommodated by the design, but not the drag and sonic shock waves of a craft traveling at hypersonic velocity at sea level — the spacecraft and launching track would be torn to shreds [6]. The cargo Startram version, according to the estimates of J. Powell, will cost 20 billion dollars, reports Daily Mail.

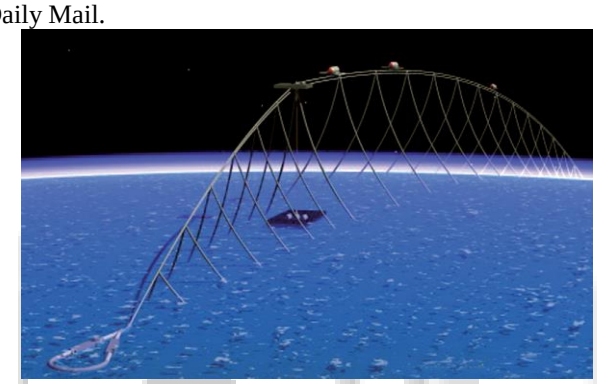

Fig. 5: Railway tracks based on Lofstrom

To start up structures on the special vacuum tunnels deprived of terrestrial gravitation .The similar method will allow to reach improbable speeds, however will demand still big power expenses.

Originally trains of the Elon Musk's project is planned to use only as freight transportation. The first tests of Elon Musk's Hyperloop are planned for 2017. Now scientists solve a problem of atmospheric overloads at movement and a problem of energy consumption.[6] In case of successful implementation of the project Elon Musk's Hyperloop will become "the fifth mode of transport" and the fastest in the world.

V. COST

"Hyperloop Alpha" suggests fares of $20 for the San Francisco the Los Angeles route which would apparently be used to cover operating expenses. However, this research has not found any sources providing estimates of operating costs for the system. A presentation made by an HT executive cited $10 to $15 for a route linking Abu Dhabi to Dubai. However, that presentation seemed to indicate that that fare amount was a price point which the market could bear, rather than an estimate of the service's operating cost. In a pricing structure where fares are only used to cover operating costs, some entity would be required to fund the upfront capital construction and vehicle costs without repayment. An assumption of public funding can only be speculative, especially in the current constrained fiscal environment for government expenditures.

VI. SAFETY AND RELIABILITY

- All capsules would have direct radio contact with station operators in case of emergencies, allowing passengers to report any incident, to request help and to receive assistance. In addition, all capsules would be fitted with first aid equipment.
- Hyperloop capsules will be designed to the highest safety standards and manufactured with extensive quality checks to ensure their integrity. In the event of a minor leak, the onboard environmental control system would maintain capsule pressure using the reserve air carried onboard for the short period of time it will take to reach the destination. In the case of a more significant depressurization, oxygen masks would be deployed as in airplanes. Once the capsule reached the destination safely it would be removed from service. Safety of the onboard air supply in Hyperloop would be very similar to aircraft, and can take advantage of decades of development in similar systems.
- Hyperloop would feature the same high level of security used at airports. However, the regular departure of Hyperloop capsules would result in a steadier and faster flow of passengers through security screening compared to airports. Tubes located on pylons would limit access to the critical elements of the system. Multiple redundant power sources and vacuum pumps would limit the impact of any single element.
- Transport systems are all built with earthquakes in mind. Hyperloop would be no different with the entire tube length built with the necessary flexibility to withstand the earthquake motions while maintaining the Hyperloop tube alignment. It is also likely that in the event of a severe earthquake, Hyperloop capsules would be remotely commanded to actuate their mechanical emergency braking systems.

VII. RELIABILITY

The Hyperloop system comprising all infrastructure, mechanical, electrical, and software components will be designed so that it is reliable, durable, and fault tolerant over its service life (100 years), while maintaining safety levels that match or exceed the safety standard of commercial air transportation.

VIII. 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.

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