CONCEPTUAL MODEL FOR PASSENGER POD: HYPERLOOP*

BY

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ABSTRACT

In this paper we will discuss about new mode of transportation. Hyperloop is new mode of transportation that reduces the travel time and costs less. Hyperloop consists of a low pressure tube with capsules that are transported at both low and high speeds throughout the length of the tube. It is alternative for high speed rail projects. It consists of the design and size of Hyperloop capsule, its working and types of hyperloop pods. We will get to know about the prototype of hyperloop made by us which work similar to hyperloop.

KEYWORDS

Hyperloop, Hyperloop Passenger Capsule (pod), Hyperloop Tube, Compressor.

I.INTRODUCTION

Hyperloop is a new fastest ground mode of transportation. Elon Musk had published “Hyperloop Alpha”- a white paper in which he had outlined the components of new mode of transportation that was more faster, cleaner and energy efficient and that is HYPERLOOP. Elon Musk and team of engineers from Space X and Tesla in August 2013, they proposed this concept. Hyperloop is new commercial transportation system which can be used to passenger travel and transport goods as well. Hyperloop is fastest and cost effective method of transportation. It works on the principle of magnetic levitation. Magnetic levitation is a method where a vehicle is suspended and propelled on path of magnets. Hyperloop travels within a vacuum tube, so that air resistance can be reduced and achieve high speed.

Hyperloop’s concept is to travel medium range distance in short period of time. Many commercial companies are working on Hyperloop transportation. In 2015 Space X sponsored a pod competition, so that they could get the best ideas to design a pod. Hardt Globalt Mobility this company won the Space X pod competition. There are many other companies that are

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working on hyperloop, few are Virgin Hyperloop One, Hyperloop transportation Technologies, Transpod, Hardt Globalt Mobility and many more.

Virgin Hyperloop conducted the first human trail in Las Vegas at speed of 172 km/hr. (107mph) with Josh Giegel and Sara Luchian. Hyperloop pod will travel in packed tube and it is clean and self-powering system as it will use solar energy. Pod even consists a compressor fan in the front so that the air present in tube will not cause resistance to the pod. Hyperloop will approximately cover 560km in 35 minutes. The construction of hyperloop will cost to approximately $7 billion.

Many routes have been proposed for the hyperloop. In United States in 2013 from Greater Los Angeles Area to San Francisco Bay Area. In India on 22nd Feb 2018, from Mumbai to Pune to reduce travel time from approx. 3 hours to 20 minutes. And many other routes are proposed in different countries.

Full scale testing was done in May 2017, Hyperloop ran its first full system test on its Devloop system. Devloop is the short form of Development loop. A 500m test track in Nevada desert was built, its approx. 40 miles outside of Las Vegas. On July 29, 2017 Phase 2 of testing was completed. The Devloop reached zero to 192mph and again back to zero within 500m. On December 2017, Phase 3 test was completed and hyperloop set the high speed record of nearly 240mph. As tube as not long enough to each 700 mph in only 500 m tube.

II.METHODOLGY

II. 1. CAPSULE (POD)

The original Hyperloop pods are made up of carbon fiber. Pod is magnetically levitated as similar to the puck in the air hockey. It even has battery storage where it can save the solar energy, which can be used during night or cloudy climatic conditions. Capsule can carry up to 28 passengers. There are two types of pods passenger pod and passenger plus vehicle pod. The seats in the pod will consist a mini TV and a timer on side, which will show the next destination and time required to reach the next destination. Capsule we made is of plastic. It is of 5.90 inches (0.15m) and diameter is 1.18 inches (0.03m). The middle part of the pod is cylindrical and front part is cone shaped. Its design is as per the air flow analysis and to increase the speed of pod in tube.

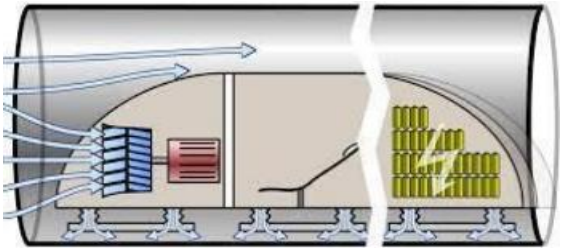

Fig.1. Air flow inside tube when pod travels.

II. 2. TUBE

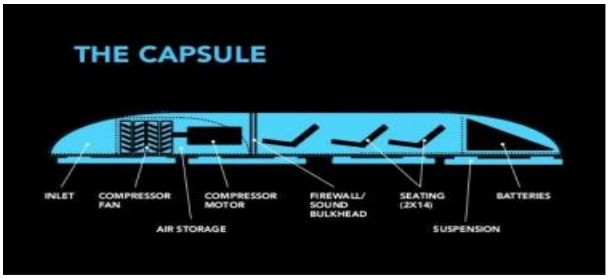

Fig.2. Capsule

The glass tube is resting on the metallic wires, which helps to reduce earthquake problem. Glass tube is packed from one end and the other end is used to attach blower. The packed glass tube will create Hyperloop tubes is made up of glass. Vacuum will be created inside the tube so that pod can travel with less air resistance.

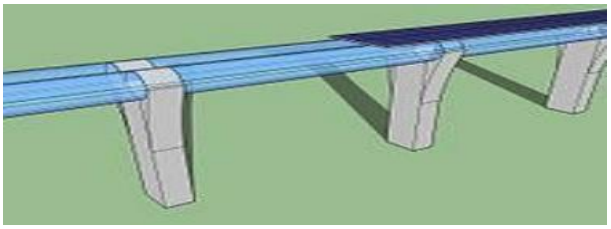

Fig.3. Hyperloop tube with solar panels on top

II.3. AIR COMPRESSOR

The air compressor acts as air friction reducing agent. As air flowing through the tube will produce friction on the pod and will reduce the speed. Air compressor sucks the air present in the front of the tube and let it out from the side of pod and behind the pod. The air moving out from the side acts as cushion to the pod so that it can run easily and avoid colliding to tube walls. The air moving out from the back of pod, produce some amount of thrust and helps to increase the speed of the pod.

III.WORKING

The actual Hyperloop works on magnetic propulsion principle. Here, we have made a prototype that run using the air flow by the blower in the tube. It is similar to the working as original hyperloop.

vacuum and help the pod to travel easily. The pod moves by air pressure produced by blower and even some thrust will be gained from compressor fan. The air flowing out through compressor will help to reduce friction and increase more speed of the pod.

Pod levitation is designed to reduce friction during high speed travel. The structures for two different phases : travel on land and travel under water. For travelling on the land tube will be

made with support of pylons at certain height. For travelling underwater, tube will be made at certain depth.

The one of the most important feature of hyperloop is net zero energy consumption. As there will be on pollution caused. Solar panels will absorb the energy and store it in battery. So that during cloudy weather or night time it can run on the batteries.

The capsule (pod) has a compressor fan. The use of the compressor fan is provide high speed. The air flows out through the back which provide some thrust to the pod and even flows out through side, which creates a air cushion for pod. Even air is required to produce airflow that is necessary for the weight of the vehicle. Compressor fan will help to reduce the resistance caused due to air which will reduce the speed of the pod.

Fig.4. Compressor Fan

IV.HEAT EXCHANGE AND TUBE THERMAL

Whenever the pod travels through the tube, it keeps on adding energy to the air in the form of heat. This regular cycle will heat the heat to the excess temperature. So water will be stored in on-board tanks to cool the air and the steam produced will be stored in other tank and will be unloaded when it reaches to the destination. If the tube temperature is not excessive then the pod occupants could be kept in comfort with simple air conditioning cabin. Cabin heat will be rejected from refrigerant to the tube environment.

V.POD AND TUBE SIZING

There are two types of pods, small passenger and other passenger + cargo pod.

	Passenger
r tube , cm	2
A tube , cm^2	695.42
A pod , cm^2	105.8
r pod, cm	1.5

Table 1. Dimensions of Passenger pod and tube designed

R tube = radius of tube A tube = area of tube A pod = area of pod

The pod is designed on the basis of the drag, geometry, mass, cycle and levitation subsystems.

Drag :- To determine how much the drag coefficient varies with Mach number Computational Fluid Dynamics (CFD) was performed. Then, it was found that viscous and pressure forces acting on the external pod surface and internal nozzle drag effect was included in Drag force.

Cycle :- To obtain the final geometry and mass of the pod, the thermodynamics analysis of compressor system is necessary to estimate on board power requirement and overall heat rise of pod. The compression cycle is comprised of an inlet, compressor, duct, nozzle and shaft that is connected to the electric motor drivetrain.

Drivetrain :- The drivetrain module has an electric motor, inverter and battery system by computing the mass and size of the motor and battery system required to sustain the torque and power demands.

Geometry and mass :- The final mass and geometry of the pod is required to analyze the design of the tube structure. The geometry model assumes that the pod to have cylindrical main body with conical frustums at inlet and exits. The mass module assumes that to determine the mass of the pod for levitation, mass of each components and mass of passenger is added.

VI.FLOW ANALYSIS

During the flow analysis two important aerodynamic design. First one is the ability to generate certain amount of lift to the pod. Second is minimization of the drag to reduce propulsion. The tube is coupled to the speed of the air as it passes around the pod. The diameter of the tube should be roughly twice the size of the pod to achieve more speed.

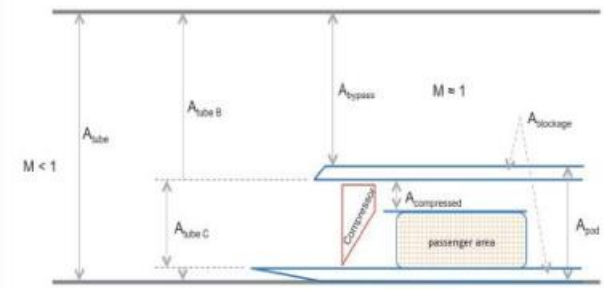

Fig.5. Longitudinal view of a hollow passenger pod that lets mass flow through it.

CONCLUSION

Hyperloop is the fastest means of transportation, which will save more time and travel more distance. Its dynamic structure and compressor reduces the drag and leads to high speed travelling. The pod travel speed and cross sectional area of tube are linked to each other. Net energy usage is found to be relatively insensitive to pod length. It even has few drawbacks like making of it is very costly. The people travelling through hyperloop many feel dizziness. Hyperloop will help to save the energy consumption and will even lead to less pollution.

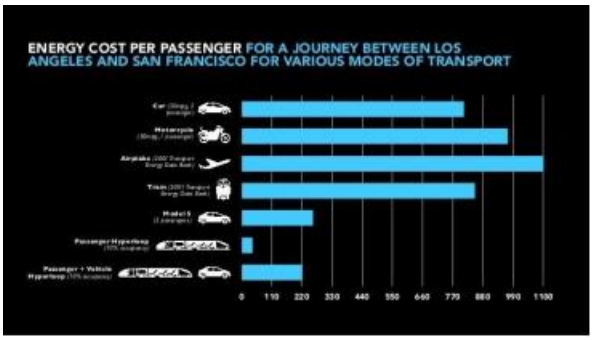

Fig.6. Energy cost consumption

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