Hyperloop

by Eashan Saikia - Wednesday, April 06, 2016

http://gonitsora.com/hyperloop/

Elon Musk has once again thrown forth an idea that has baffled the engineering community for the past few years. The CEO of Tesla Motors and SpaceX proposes to revolutionise high speed land travel with his concept of the Hyperloop which aims at transporting people at near supersonic speeds. Though his concept was suggested earlier in the 1960's as "The Evacuated Tube Transport", Elon Musk has successfully modelled a real life solution with the right estimation of physical parameters to be incorporated into the Hyperloop.

To achieve this feat, a carrier pod is placed inside a long and nearly vacuum tube connecting two cities. Since complete vacuum cannot be achieved, near vacuum is maintained at around 100 Pa within the tube which is 1000 times rarer than the atmosphere at sea level. This vacuum is created so as to substantially reduce the air drag on the hyperloop pod which will allow it to achieve high transonic speeds of over 1000 km per hour.

Even though, the tube is evacuated to a considerable amount, the pod will still be exposed to air drag and a more serious concern is that the pod will replicate the motion of a medical syringe in action whereby it will compress the air ahead of itself and which will restrict it from moving ahead. This phenomenon was first described by Krantowitz with respect to the evacuated tube technology years ago and in order to eliminate this problem, a limit known as Krantowitz limit is the deciding factor. Krantowitz limit in layman's term relates the maximum diameter of the pod to the minimum diameter of the surrounding tube so as to avoid the Syringe Compression phenomenon.

The Hyperloop decides to tackle this problem by positioning a compressor at the nose of the pod which will intake the air in front of it as it moves forward. And this compressor will serve a twin purpose by compressing the incoming air and releasing it at high velocity through the air bearings that will be placed at the bottom of the pod. The target is to release the compressed air at such high velocities that it will successfully create enough thrust to completely lift the pod so as to levitate itfrom the surface of the tube.

The compressor will be powered by high capacity batteries also supplied by Tesla and these batteries will store enough power for the initial acceleration by eddy current technology. These eddy current coupling panels will be placed on the tube bottom at a regular interval of 70 meters and will be solar powered by panels above the tube and as per the estimation, this form of travel will be significantly cheaper than trains using magnetic levitation technology.

Elon Musk, in his path of actually building the first model has brilliantly opened up to all universities across the United States and the world and Commercial Hyperloop Start-Ups to present their ideas during the SpaceX Hyperloop Challenge 2016 to be held at Texas A&M University, College Station, US. It is with great honour that I, being a Masters student at the State University of New York, Stony Brook will formally compete in this event along with my team. Our university, in collaboration with University of Virginia have prepared the blueprints of our version of the Hyperloop Pod which we will present at the

event. Subsequently, on its approval and considering generous corporate funding, we plan to construct our pod through the upcoming Spring Semester 2016 and formally compete in the live event to be held in California in the Summer of 2016. I am in charge as the Materials Specialist as this correlates with my field of interest which is Solid Mechanics and my responsibility is to suggest and incorporate appropriate materials for the frame and the body structure so as to ensure a very light weight yet a very strong structure.

To serve this purpose, we plan to use Carbon Epoxy Composites keeping in mind the pressure difference, lack of humidity and the estimated exterior temperature of 108 deg Fahrenheit. With my experience at the Sikorsky Aircraft Company, I was equipped to carry out extensive research on the aerospace grade composites commercially available. Also a frame structure constructed of Aluminium Alloy is planned to be incorporated so as to ensure light weight and a Faraday Cage like structure for electrical neutrality. Our team is organised into several subsystems namely: Ergonomics and Design, Fluid Mechanics with CFD, Thermal Design, Material Science and lastly the Electrical Automations aspect. I am leading the Material Science Division and exhaustive work has been carried out in the past few months with Finite Element Analysis softwares like Hypermesh, Abaqus and Ansys.

Our professors have played a very crucial role in executing this independent project which couldn't have been achieved without their motivation and technical knowhow.
