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Introduction to Magnetic Levitation: A Review

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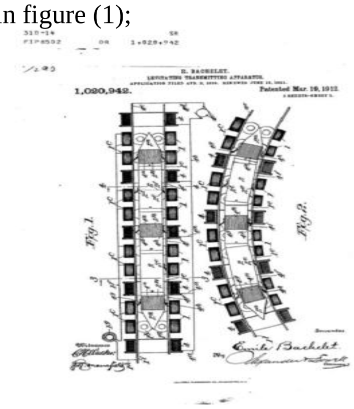
Abstract: Maglev has became the fastest growing technology in the field of railways infrastructure. The technical specifications of such technology are dominating on the available technical infrastructure of the existing railways. Maglev trains which are based on the principle of maglev have been compared with high speed transportations such as air transport. The main aim of this system is to deliver an efficient solution for the contemporary transportation problem that prevails in the world.

Keywords: Magnetic Levitation, Maglev, EI (Energy Intensity).

INTRODUCTION

Magnetic levitation provides fast, cost-efficient and environmentally friendly transportation and it can be more efficient and affordable. A transport system should have certain qualities i.e. it should be fast, efficient and affordable. These conflicting aims must be solved by developing an understanding of the underlying technology. Maglev systems have demonstrated successfully the maglev is set to be expensive and not enough better than competent technology to justify measure funding. Magnetically levitated vehicles provide fast, safe and efficient transportation over wide range of speed .under this paper we are analysing magnetic levitation. we will also look in to its feasibility with respect to India also. it has been reported that India is considering maglev technology during his Japan visit and interaction here with Chinese, prime minister Narendra Modi will be exploring complete financing option at close to zero interest rate. The idea of using magnet to levitate and propel was proposed by a Frenchman by the name of Emile Bachelet. As shown in figure (1);



His designs were well received and he successfully acquired much financial backings for his patents. However the technologies needed to make such an idea were non-existent at the time. Electromagnetism is one of four fundamental forces of nature. These forces affect all reaches of our known universe and include gravity, the strong interaction and weak force, and electromagnetism. Believe it or not, electromagnetism is a much stronger force than gravity. The development of conventional trains began in the early of 1800s. the conventional trains were not much faster; they run at speed of 110mph so it reached at the end phase of their development. After reaching the end phase of development of conventional trains, France, Germany, Japan have developed “high speed” or “bullet” trains which are capable of running at speeds of 150-180mph. but these trains are more expensive and maintenance is also time consuming so it also reached to the end phase of their development. It is the mechanical friction between wheels and metal track that limit this technology. This leads us to the development of Maglev trains that has no friction. In these trains, there is no physical contact between the rails and trains by which there is no friction to obtain higher speed and low maintenance.

Design consideration and comparison

There are three main methods of transportation used by society today. These include automobiles, airplanes and trains. Technology in these fields has advanced greatly in the last 40 years making the world a much smaller place. With the modern methods of transportation of today, one can be almost anywhere in the world within a day. Design of vehicle, Fuel efficiency, speed and price vary between each.

Comparison 1:

Vehicle Design: maglev is similar to other transport technology, but the implementation varies considerably according to the application.

Choice of vehicle, weight, shape and length dominate transport system design. There are 3 key issues that affect the EI of a transport system and are primarily determined by vehicle design.

1: For high speed travel the dominant energy usage is to overcome aerodynamic drag. For constant speed travel EI is proportional to drag force per passenger with 3.6 N/Pasc= 3.6J/Ps-m=1 wh/pas-km. Airplanes do much better than it is possible for ground transportation because of lesser pressure at greater (12,000 m) height.

2: For low-speed travel the dominant energy loss is due to the need to supply kinetic energy to change vehicle’s speed and this is lost when brakes are applied.

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3: Suspension and propulsion losses are always significant. Not only is there a direct loss such as wheel hysteresis and bearing friction but at high speed aerodynamic loss become more than direct losses.
With these facts in mind, consider the design aspect of the weight, shape and length.

Weight: All transport technology has been moving in the direction of reducing vehicle weight, and using regenerative braking. there are two E&A maglev designs, a low speed designated M3, for urban application and high speed version, designated M3+, for competition with HSR.

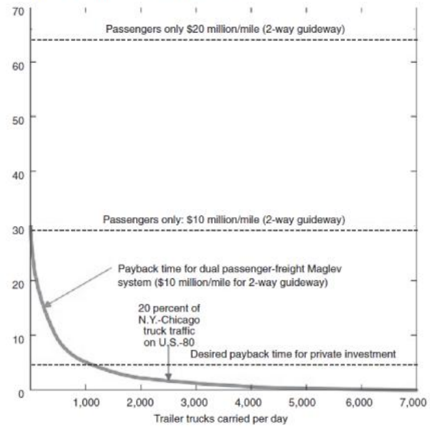
Shape: shape is important because it affect aerodynamic loss and noise, both external and internal. Even low speed vehicle should have modest streamlining and high speed vehicle need more extreme shapes. Japanese Fastech 360 train designed for 360km/h, Trans rapid TR09 designed for 350-500 km/h. the nose section is very important for high speed, particularly for vehicles entering existing tunnels. For HSR the main aerodynamic drag is on the body, wheels and pantograph. Well designed maglev vehicle have less drag and are quieter than modern high speed trains, even when going substantially faster.

Length: Vehicle length is a critical parameter. The frontal area is constrained by the assumed need to provide height for standing head room and width for at least four abreast sitting with reasonable comfort. With maglev the frontal can be less than for conventional trains because the suspension has less frontal area and there is no pantograph. The minimum length is determined by passenger carrying ability.

- **Comparison 2: Fuel Efficiency**
- Unlike the previous forms of transportation, Maglev trains run on electricity rather than fossil fuels. Electricity is a renewable source of energy and can be created in several different ways including nuclear, hydro and solar plants. Fossil fuels are non-renewable sources of energy. They must be burnt, releasing carbon emission in the atmosphere in order to produce energy
- Travelling at a speed of 300 mph and 150 mph. Maglev trains use 0.4 mega joules and 0.1 mega joules per passenger mile respectively. An automobile travelling at a speed of 60 mph with 20-mpg fuel efficiency uses 4 mega joules per passenger per mile. Using these numbers, Maglev trains moving at half this speed attains efficiency 40 times greater than that of an automobile.

- **Comparison 3: speed and cost**
- When commuting in a car one's average arrival time can be hard to calculate due to traffic and driving conditions. Everyone has been struck in traffic. Unannounced construction, gaper delays, sometimes nothing at all can create massive delays on the roadway.
- Car also requires much maintenance. Automobiles must meet state standards in order to be legal for the roads and all cars must be insured. This constant maintenance and legal coverage becomes very costly for any common citizen.
- Planes as well experience delays. Prime weather and air traffic condition are essential in insuring passenger a safe flight. However, when these criteria are not made, delays occur.
- In life, just as in driving, there is no way to predict what will happen in future. What we can do is to put the odds in our favour is to minimize risk. That's where maglev train come into play. Maglev trains have a dedicated infrastructure solely for the train itself. No other vehicles are compatible with their magnetic guide ways and so no other vehicles travel on it. This means no traffic and no collisions. Weather conditions have little to no effect on maglev trains except under severe conditions. So a train can travel even when the weather is subpar. In an automobile or conventional locomotive wet conditions decreases friction between the vehicle and ground. This increases stopping time and the probability that a vehicle may slip. The magnetic forces at hand are unaffected by such condition. Since no contact is made between the maglev train and the railway. Less wear is put on each. This means less maintenance. Less maintenance creates fewer delays while allowing lower ticket prices. Comparison shown by graph:

FIGURE 3
Economic Advantages of Maglev Carrying Both Passengers and Trucks



The figure shows the time it takes to pay back the cost of the Maglev guideway carrying passengers only, and a dual system that carries both passengers and freight. The conditions used in the calculation are 3 million passengers per year, at 10 cents per passenger mile, net revenue, and 25 tons per trailer truck at 20 cents per ton-mile revenue.

Projects around the globe:

- China built the first Maglev in 2005. As the fourth largest country in land area and first in population and area of increasing commerce and business one can understand the need for an expansive

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transportation system in such country. The United States ranks in third in population and land size, yet government cannot provide such a system economically. The Chinese Maglev cost billions to merely develop a system, and even more to actually build it. The American government is in recession that can barely sustain itself, let alone reinvent its transport system. While a Maglev system is more than applicable in this country the means for creating it simply do not exist at this time. However, several companies are hard at work perfecting the technology so that when the economic backing is available the system will be prepared. One such company is American Maglev Technology (AMT). Its funding comes from shareholders and private investors, who fund project such as those in its main test site in Project Springs, Unfortunately, there are other companies that are also trying to development a Maglev system for this country but cannot because of a lack of monetary input. One such company is Maglev Inc, located in McKeesport, Pennsylvania. Unlike AMT, Maglev Inc was funded through tax money. As beneficial as a revamped transportation system is, this country cannot give money it does not have.

CONCLUSION

- This section contains personal views on steps that should be taken to achieve E&A maglev and the remaining section provides evidence to support these views.
- **A: Speed and categories and competition.**
- It is important to match speed to application and recognized competing modes of transportation. Lets we focus too much on speed, higher acceleration and braking rates are often a more effective way of reducing travel time.
- **B: The Status of Maglev Competing Technology**
- Low speed maglev was implemented in a 600m shuttle in Birmingham, U.K that operated reliably from 1984 to 1995. The early Tran rapid TR TR04 design evolved into HSST, and then Linimo with an 8.9km line operating in Aichi Japan since 2005.South Korea is installing low speed maglev from Seoul to the airport using a variation of the Linimo system. These electromagnetic suspension (EMS) designs were intended as upgrades for light rail and APM in the low speed region, and have proven to be efficient and reliable, but not cost effective. Super speed maglev was studied extensively in Germany; Japan the United States, Canada, and elsewhere, with major test tracks constructed in Germany and Japan. These developments evolved into the operational TR EMS maglev system in Shanghai. China, in 2005, and the Yamanashi Test Line (YTL), Electro Dynamic Suspension (EDS).
- Energy Intensity as a Measure of Transport Efficiency: The efficiency of people mover transportation is best measured as Energy Intensity (EI), the energy required to move one passenger one kilometre. Even when comparing similar vehicles using similar fuels, efficiency comparisons can be misleading because of variations in testing procedure, climate condition, load factor.
- For three decades competing transportation technologies have seen dramatic changes that make them more efficient and cost effective. Operational maglev designs are both fast and efficient, but have not seen this same level of development. There is now a unique opportunity to invest in the next generation can use existing designs as a base and create reduction in cost and EI by using supporting technology not available when operational designs were developed.

Consideration:

Time is main concern. Locomotives have been energy loss due friction between the wheels and the tracks .and the other metal components of the train. One of the biggest issues is that they are restricted not only by physical components but governmental as well. There are limits on the speed one can drive at despite at high speeds most car can achieve. In addition ,roads twist and turn whereas train tracks follow a smoother, more linear route .The price of travel must be reasonable; it is no good to travel if puts an individual in any sort of debt. The steady rise of oil prices is no secret.. The need of travel from place to place increases as the ease of travel decreases. Trains, often more practical than cars, used to be thought inexpensive yet even can now be as costly as planes .Oil prices fluctuate considerable, but because Maglev do not require it as fuel their considerably less expensive costs are more or less constant. Yet factor is comfort. Most trains have suspension consisting links between the body and truck, which deals with managing train’s weight. These links allow the train to translate horizontally as it is in motive .This constant motion causes the “bumpiness” that make train uncomfortable after long time periods. Comfort may not be as large concern when only going a short distance, but for a journey that takes several hours it is a large factor. Car tips can be quicker, yet there are no beds in a Honda opposed to a Pullman. Maglev trains movement is created by the same element that creates its suspension. The train are suspended in air itself and glide through it, thus more or less eliminating such comforts. Another discomfort this new rail system removes environmental concern. As oils are heated and decompose they release green house gases, most notably an excess of carbon dioxide. This excess floats into the atmosphere and destroys the protective ozone layer. The same gases we eradicate from our bodies when exhale pervade the air from our traditional transportation methods. Electricity does not produce these same impurities. In additional, because one Maglev train does not work of several planes and even more cars, one maglev train it greatly reduces air pollution in an area.

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