MAGLEV TRAINS

Trains that fly on air

PRESENTED BY

P.DIVYA
V.KALPANA
III EEE
III EEE
ROLL NO:08MD1A0247
ROLL NO:08MD1A0263
EMAIL:divya0247@gmail.com EMAIL:
vkalpana0263@gmail.com

RAJAMAHENDRI INSTITUTE OF ENGINEERING AND TECHNOLOGY
RAJAHMUNDR
Y

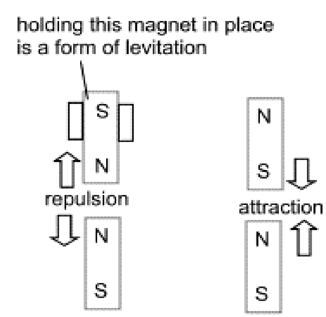
RAJAMAH
ENDRI
Institute of Engineering & technology
RAJAHMUN
DRY.

ABSTRACT

MAGNETIC LEVITATION –It uses magnetic fields to levitate a metallic object .By manipulating magnetic fields and controlling their forces an object can be levitated. Because of the growing need for quicker and more efficient methods for moving people and goods, researchers have turned to a new technique, one using electromagnetic rails and trains. This rail system is referred to as magnetic levitation, or maglev. Maglev is a generic term for any transportation system in which vehicles are suspended and guided by magnetic forces. Instead of engines, maglev vehicles use electromagnetism to levitate (raise) and propel the vehicle. Alternating current creates a magnetic field that pushes and pulls the vehicle which weighs almost about 1500 tonnes and keeps it above the support structure, called a guide way.

INTRODUCTION:

The word levitation is derived from a Latin word *"LEVIS"*, which means light. Magnetic levitation is the use of magnetic fields to levitate a metallic object. By manipulating magnetic fields and controlling their forces an object can be levitated. When the *like* poles of two permanent magnets come near each other, they produce a mutually repulsing force that grows stronger as the distance between the poles diminishes. When the *unlike* poles of two permanent magnets are brought close to each other, they produce a mutually attractive force that grows stronger as the distance between them diminish .A levitation system is designed around the attractive force, between unlike poles as it would require a perfect balance between the attractive magnetic force and the suspended weight .In the absence of a perfect lift and weight force profile, the conveyance would either be pulled up toward the magnets or would fall. This simple illustration of magnetic levitation shows that the force of gravity can be counterbalanced by magnetic force.



A simple form of magnetic levitation
ClearlyExplained.Com

TYPES OF LEVITATION

There are two ways of levitations,

1. Active 2. Passive.

In an *active levitation* system, electromagnets are coupled to amplifiers that receive signals from controllers. These controllers process signals from sensors that change the magnetic force to meet the needs of the magnetic system.

Passive magnetic levitation systems are impractical without a stabilizing ingredient. *Diamagnetic levitation* can be used to add stability to passive levitation systems. The combination of passive and diamagnetic levitation is a functional approach to many magnetic levitation applications.

Major applications of magnetic levitation:

1. Transportation: Maglev trains.
2. Moving of metallic objects in steel industry: Magnetic floaters.
3. Military applications: Rail-gun.

Magnetic levitation is used in transportation particularly in monorails, and in levitating displays. Magnetic bearings have been used in pumps, compressors, steam turbines, gas turbines, motors, and centrifuges, but these complex applications require electromagnets, sensors, and control systems.

MAGLEV:

Powerful electro magnets are used to develop high-speed trains called maglev trains. These will float over a guide way using the basic principles of magnets to replace the old steel wheel and track trains.

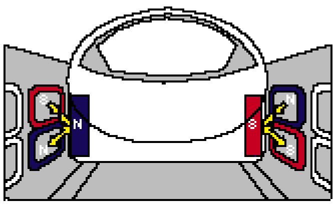
Magnetic levitation (maglev) is a relatively new transportation technology in which no contacting vehicles travel safely at speeds of 250 to 300 miles-per-hour or higher while suspended, guided, and propelled above a guide way by magnetic fields. The guide way is the physical structure along which maglev vehicles are levitated. Various guide way configurations, e.g., T-shaped, U-shaped, Y-shaped, and box-beam, made of steel, concrete, or aluminum, have been proposed.

A ultra high-speed transport system with a non-adhesive drive that is independent of wheel-and-rail frictional forces has been a long-standing dream of railway engineers. Maglev, a combination of superconducting magnets and linear motor technology, realizes super high-speed running, safety, reliability, low environmental impact and minimum maintenance.

Principle of Maglev

Maglev is a system in which the vehicle runs levitated from the guideway (corresponding to the rail tracks of conventional railways) by using electromagnetic forces between superconducting magnets on board the vehicle and coils on the ground. The following is a general explanation of the principle of Maglev.

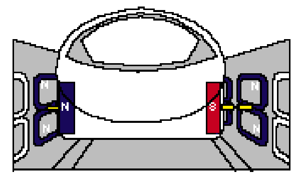
Principle of magnetic levitation



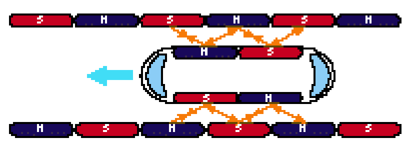
The "8" figured levitation coils are installed on the sidewalls of the guideway. When the on-board superconducting magnets pass at a high speed about several centimeters below the center of these coils, an electric current is induced within the coils, which then act as electromagnets temporarily. As a result, there are forces which push the superconducting magnet upwards and ones which pull them upwards simultaneously, thereby levitating the Maglev vehicle.

Principle of lateral guidance

The levitation coils facing each other are connected under the guideway, constituting a loop. When a running Maglev vehicle, that is a superconducting magnet, displaces laterally, an electric current is induced in the loop, resulting in a repulsive force acting on the levitation coils of the side near the car and attractive force acting on the levitation coils of the side farther apart from the car. Thus, a running car is always located at the center of the guideway.



Principle of propulsion



A repulsive force and an attractive force induced between the magnets are used to propel the vehicle (superconducting magnet). The propulsion coils located on the sidewalls on both sides of the guideway are energized by a three-phase alternating current from a substation, creating a shifting magnetic field on the guideway. The on-board superconducting magnets are attracted and pushed by the shifting field, propelling the Maglev vehicle

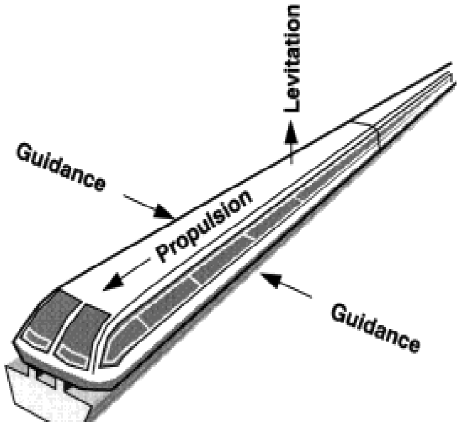
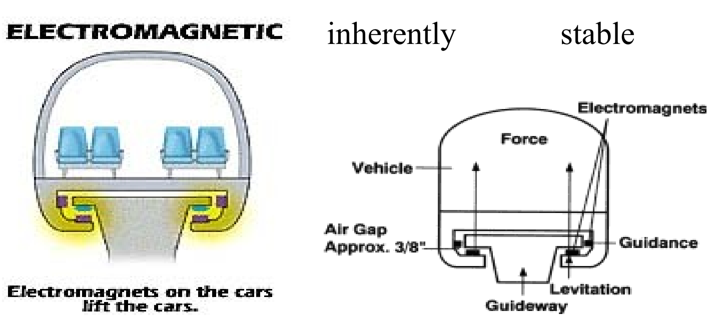


Figure depicts the three primary functions basic to maglev technology: (1) levitation or suspension; (2) propulsion; and (3) guidance. In most current designs, magnetic forces are used to perform all three functions, although a nonmagnetic source of propulsion could be used. No consensus exists on an optimum design to perform each of the primary functions.

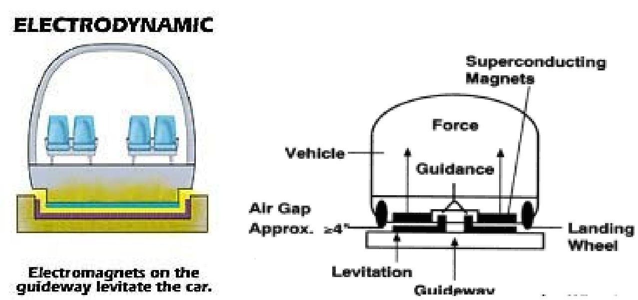
The Two Principal Systems Are EMS- attractive and EDS-repulsive

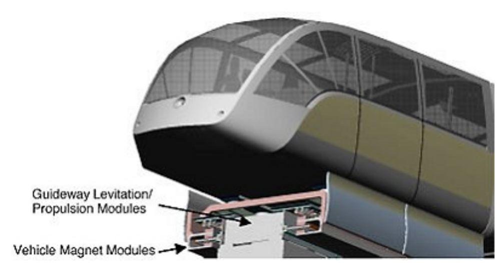
Electromagnetic suspension (EMS) is an attractive force levitation system whereby electromagnets on the vehicle interact with and are attracted to ferromagnetic rails on the guideway. EMS was made practical by advances in electronic control systems that maintain the air gap between vehicle and guideway, thus preventing contact.

Variations in payload weight, dynamic loads, and guideway irregularities are compensated for by changing the magnetic field in response to vehicle/guideway air gap measurements. Electrodynamic suspension (EDS) employs magnets on the moving vehicle to induce currents in the guideway. Resulting repulsive force produces inherently stable vehicle support and guidance because the magnetic repulsion increases as the vehicle/guideway gap decreases. However, the vehicle must be equipped with wheels or other forms of support for "takeoff" and "landing" because the EDS will not levitate at speeds below approximately 25 mph. EDS has progressed with advances in cryogenics and superconducting magnet technology.



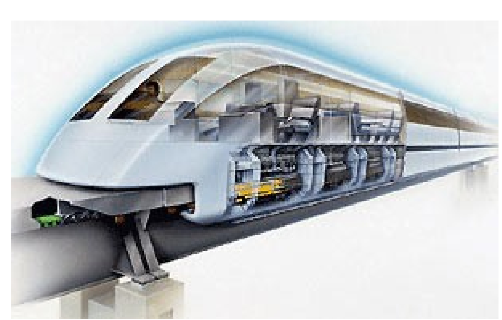
ELECROMAGNETIC SUSPENSION SYSTEM





ELECRODYNAMIC SUSPENSION SYSTEM

Propulsion Systems



"Long-stator"

propulsion using an electrically powered linear motor winding in the guideway appears to be the favored option for high-speed maglev systems. It is also the most expensive because of higher guideway construction costs.

"Short-stator" propulsion uses a linear induction motor (LIM) winding onboard and a passive guideway. While short-stator propulsion reduces guideway costs, the LIM is heavy and reduces vehicle payload capacity, resulting in higher operating costs and lower revenue potential compared to the long-stator propulsion. A third alternative is a nonmagnetic energy source (gas turbine or turboprop) but this, too, results in a heavy vehicle and reduced operating efficiency.

Guidance Systems

Guidance or steering refers to the sideward forces that are required to make the vehicle follow the guideway. The necessary forces are supplied in an exactly analogous fashion to the suspension forces, either attractive or repulsive. The same magnets on board the vehicle, which supply lift, can be used concurrently for guidance or separate guidance magnets can be used.

You can easily create a small electromagnet yourself by connecting the ends of a copper wire to the positive and negative ends of an AA, C or D-cell battery. This creates a small magnetic field. If you disconnect either end of the wire from the battery, the magnetic field is taken away.

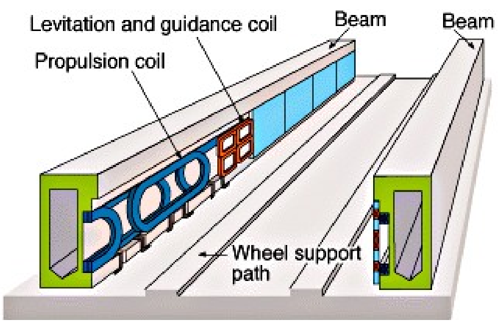
The magnetic field created in this wire-and-battery experiment is the simple idea behind a maglev train rail system. There are three components to this system:

- **A large electrical power source**
- **Metal coils lining a guideway or track**
- **Large guidance magnets attached to the underside of the train**

The big difference between a maglev train and a conventional train is that maglev trains do not have an engine -- at least not the kind of engine used to pull typical train cars along steel tracks. The engine for maglev trains is rather inconspicuous. Instead of using fossil fuels, the magnetic field created by the electrified coils in the guideway walls and the track combines to propel the train.

The magnetized coil running along the track, called a **guideway**, repels the large magnets on the train's undercarriage, allowing the train to **levitate** between 0.39 and 3.93 inches (1 to 10 cm) above the guideway. Once the train is levitated, power is supplied to the coils within the guideway walls to create a unique system of magnetic fields that pull and push the train along the guideway. The electric current supplied to the coils in the guideway walls is constantly alternating to change the polarity of the magnetized coils. This change in polarity causes the magnetic field in front of the train to pull the vehicle forward, while the magnetic field behind the train adds more forward thrust.

An image of the guideway for the Yamanashi maglev test line in Japan.



HOW THE GUIDEWAY WORKS

Maglev trains float on a cushion of air, eliminating friction. This lack of friction and the trains' aerodynamic designs allow these trains to reach unprecedented ground transportation speeds of more than **310 mph** (500 kph), or twice as fast as Amtrak's fastest commuter train.

How fast can they go?

On test runs maglev trains have been able to exceed 300mph. In Germany the top speed of a maglev train was 312mph and Japan's maglev trains reached 323mph in 1979 shattering the record books. With advances on maglev trains, people say it will be able to go 600mph to 1000mph in the future. If maglev trains succeed they will revolutionize the way we get around and dramatically reduce travel time**.**

ADVANTAGES OF MAGLEV OVER CONVENTIONAL TRAINS:

- Conventional trains use an engine where as maglev vehicles instead of engines use electro magnetism to levitate (raise) and propel the vehicle.
- Instead of using fossil fuels, the magnetic field created by the electrified coils in the guideway walls and the tracks combine to propel the train.
- Using a magnet's repelling force to float above magnets in the guideway, the trains aren't hampered by friction where as, Conventional trains are noisy due to the friction between their wheels and the steel rails, but maglev trains are much quieter. These maglev trains are incomparable faster than normal conventional trains.
- Moreover as these maglev trains work using electromagnetic induction using electricity these are pollution free.

IN COMPARISON WITH TGV:

- Today, the fastest train in regular passenger service is France's TGV. It actually topped out during a speed run at 319 mph. Japan has a demonstration maglev train that went 31 mph faster than that, but not without problems.
- While the TGV can reach such speeds, it does so by using tremendous amounts of power, and the noise is incredible. The TGV normally travels closer to 150 mph.
- Maglev trains don't have such problems. Using a magnet's repelling force to float above magnets in the guideway, the trains aren't hampered by friction.

Are Maglev trains safe?

Maglev trains have proven to be exceptionally safe, quiet, and fast. Because there's no friction with the ground, maglev trains are much quieter than trucks and automobiles. The only sound caused by the trains is the whoosh as the train goes by from the air friction. Farmers in Germany who have trains running over their fields, when asked about how the feel about the trains running through their farm replied "We don't even know it's there". Cows don't even lift their heads when trains come through at 250mph. Maglev trains are also almost accident free. They are above any obstacles on the ground and are enclosed in or around the track. Also the propulsion system caused by the magnetic fields disallows trains to come to close to other trains on the track.

WHY MAGLEV ?????

- Permits speed of vehicles of 250 to 300MPH and even higher.
- High reliability and less susceptible to congestion and weather conditions than air or highway travel.
- Maglev is petroleum independent with respect to air and auto because of maglev being electrically powered.
- Maglev is less polluting as fossil fuels are not used.
- Maglev has higher capacity than air travel.
- High safety and more convenient mode of transport.
- Research has shown that the maglev is about 20 times safer than airplanes, 250 times safer than conventional railroads, and 700 times safer than automobile travel.

Current Projects

Germany and Japan have been the pioneering countries in Maglev research. Currently operational systems include Tran rapid (Germany) and High Speed Surface Transport (Japan). There are several other projects under scrutiny such as the Swiss Metro, Seraphim and Induct rack. All have to do with personal rapid transit.

Other Applications

NASA plans to use magnetic levitation for launching of space vehicles into low earth orbit. Boeing is pursuing research in Maglev to provide a Hypersonic Ground Test Facility for the Air Force. The mining industry will also benefit from Maglev. There are probably many more undiscovered applications!

The future of magnetic levitation

- Magnetic levitation is a phenomenon that is likely to have considerable potential in the future. Particularly through the use of superconductive levitation.
- A new idea for magnetic levitation is in the use of storage of energy. Very basically it uses a rotating ring (flywheel) that stores (kinetic) moving energy which can be 'extracted'

CONCLUSION

The Maglev Train: Research on this 'dream train' has been going on for the last 30 odd years in various parts of the world. The chief advantages of this type of train are: 1. Non-contact and non-wearing propulsion, independent of friction, no mechanical components like wheel, axle. Maintenance costs decrease. Low noise emission and vibrations at all speeds (again due to non-contact nature). Low specific energy consumption. Faster turn around times, which mean fewer vehicles. All in all, low operating costs. Speeds of up to 500kmph.Low pollutant emissions. Hence environmentally friendly.

The Maglev offers a cheap, efficient alternative to the current rail system. A country like India could benefit very much if this were implemented here. Further possible applications need to be explored

REFERENCES

1. U.S. Department of Transportation (Federal Transit Administration). Low Speed Maglev Technology
Development Program – Final Report, FTA-CA-26-7025-02.1, March 2002.

2. R. F. Post, D. D. Ryutov, "The Inductrack: A Simpler Approach to Magnetic Levitation," I.E.E.E, Transactions on Applied Superconductivity, 10, 901 (2000)

3. David.W. Doll, Robert D. Blevins, and Dilip Bhadra, "Ride Dynamics of an Urban Maglev," Maglev 2002