Maglev Train

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Introduction to MagLev Train

• MagLev Train – Magnetically Levitated Train (Train that floats on air)

• Floats on opposing or attracting magnetic fields above its guideway on a cushion of air.

• Idea was first introduced by American Rocket Scientist, Sir Robert Goddard, in 1904.
• First train was developed in 1960 by Sir Eric Laithewaite, Professor in Imperial College, Great Britain.

  Weight – 1 tonne
  Capacity – 4 passengers
  Track Length – 1 mile (1.6 km)

• First commercial train developed in 1984 in England which ran from Birmingham Airport to Birmingham Railway Station.

  Track Length – 6 km
  Speed – 42 km/hr
Operating Principle

1. Principle of Magnetic Levitation
   - Electromagnetic suspension
   - Electrodynamical suspension
   - Inductrack

2. Principle of Propulsion

3. Principle of Lateral Guidance
Principle of Maglev Trains
Electromagnetic Suspension

- Developed by Germans, works on Attraction.
- Also known as Transrapid.
- Electromagnets used create a magnetic attraction between the train and the guide way.
- Electromagnets are located on underside of train and wrapped around T–shaped guide rail.
- Current through track starts electromagnet causing attractive forces and levitate the train.
• Levitation monitored by computers and maintained about 10mm.

• Guidance coils and sensors keep train centered.
Electrodynamic Suspension

• Developed by Japanese, works on Repulsion.

• SCMs are used to create a magnetic repulsion between the train and the guide way.

• Creates greater magnetic field.

• Can carry much heavier load without affecting levitation.
• Train floats on air as it is not hooked around track.
• SCMs are cooled by Nitrogen and Helium.

A - Super cooled superconducting magnets
B - Levitatioin Coils
C - Propulsion coils
D - Guide way
E - Maglev train
Inductrack

• Permanent magnets are used to create a magnetic repulsion between the train and the guide way.

• Magnetic bars are arranged in Halbach Array such that magnetic fields of bar are at 90° to bars on either side, causing high field below track.

• Guide way has two rows of tightly packed levitation coils.

• Use Linear Synchronous Motor
• Operates during power failure due to use of permanent magnets.

• Has high lifting efficiency.
Magnetic Field Distribution
Levitation Techniques

- **ELECTRODYNAMIC**
  - Magnetic Repulsion Using Electromagnets

- **ELECTROMAGNETIC**
  - Magnetic Attraction Using Electromagnets

- **INDUCTRACK**
  - Magnetic Repulsion Using Permanent Magnets
Principle of Propulsion

• A repulsive force and an attractive force induced between the magnets are used to propel the vehicle.

• Components used for Propulsion are -
  1. Propulsion coils on sides of guide ways.
  2. Guidance magnets for alignment.
  3. Three phase a.c current from a substation.
• The on-board superconducting magnets are attracted and pushed by the shifting field, propelling the Maglev vehicle.
Principle of Lateral Guidance

• Controls train’s ability to stay on track.

• Consist of electromagnets situated under carriage of train (in form of loop) in conjunction with computer control system, sensors and control devices to monitor levitation.
When a running Maglev vehicle displaces laterally, an electric current is induced in the loop, resulting in a repulsive force on the levitation coils of the side near the car and an 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 guide way.
Advantages of Maglev

SAFETY

• Collision between vehicles is impossible since derailment cannot be done.

• Vibrations produced are just below Human threshold.

PERFORMANCE

• Has high speed i.e about 300 – 500 km/hr.

• Has controlled movements with use of computer.

• Passengers are free to move while train operates.
COST and ECONOMY

• Has very low specific energy consumption.
• Operating and maintenance cost are less.

MAGNETIC FIELD

• The magnetic field created is low, therefore there are no adverse effects.
ENVIRONMENT

- Minimum amount of land is needed for tracks.
- Creates no Air Pollution.
- Creates no Noise Pollution.

[Image: Noise Emission chart showing Pass-by Level in dB(A) at a Distance of 25 m (82 ft).]
Advantages of Maglev Trains Over Conventional Trains

- **Inter-city transportation**: Much higher speeds than are possible with steel-wheeled trains, lower noise, greater passenger comfort, increased safety against mechanical failures, reduced maintenance.
- **Relative to aircraft**: Higher energy efficiency, safer, less weather-dependent, and would permit in-city departure and arrival.
- **Urban transit systems**: Lower noise, much lower maintenance, greater rider comfort, can climb steeper grades, potentially higher energy efficiency than buses or rubber-tired urban trains.
Disadvantages of Maglev

• Costly to build.

• Costly to run substations for production of electricity.

• Takes a while for the train to stop from full speed.
Other MagLev Applications

• U.S. military is looking into using MagLev

• Possible uses could include:
  • Rocket launching
  • Aircraft carrier launching pad
  • Roller Coaster
The Future of Maglev Technology

- **Maglev in USA** - California has projected a construction of a $6 billion Maglev project since 2003. The track shall be 92 miles long and operate in the Los Angeles area. Operation is projected to begin in 2010. The train will carry 118,000 riders per day.

- **Maglev Rockets** - NASA is looking into maglev technology for rockets. A reusable launcher on a maglev ramp will give the rockets a head start before taking off. This type of launch will reduce launching costs considerably.
References


• www.wikipedia.org/wiki/Acela_Express.


• www.gettransportation.com

• www.wired.com/news

• www.bwmaglev.com

• www.maglevpa.com
THANK YOU!!
QUERIES ?