

MAGLEV TRAIN: The Transport Of Future

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PRESENTATION

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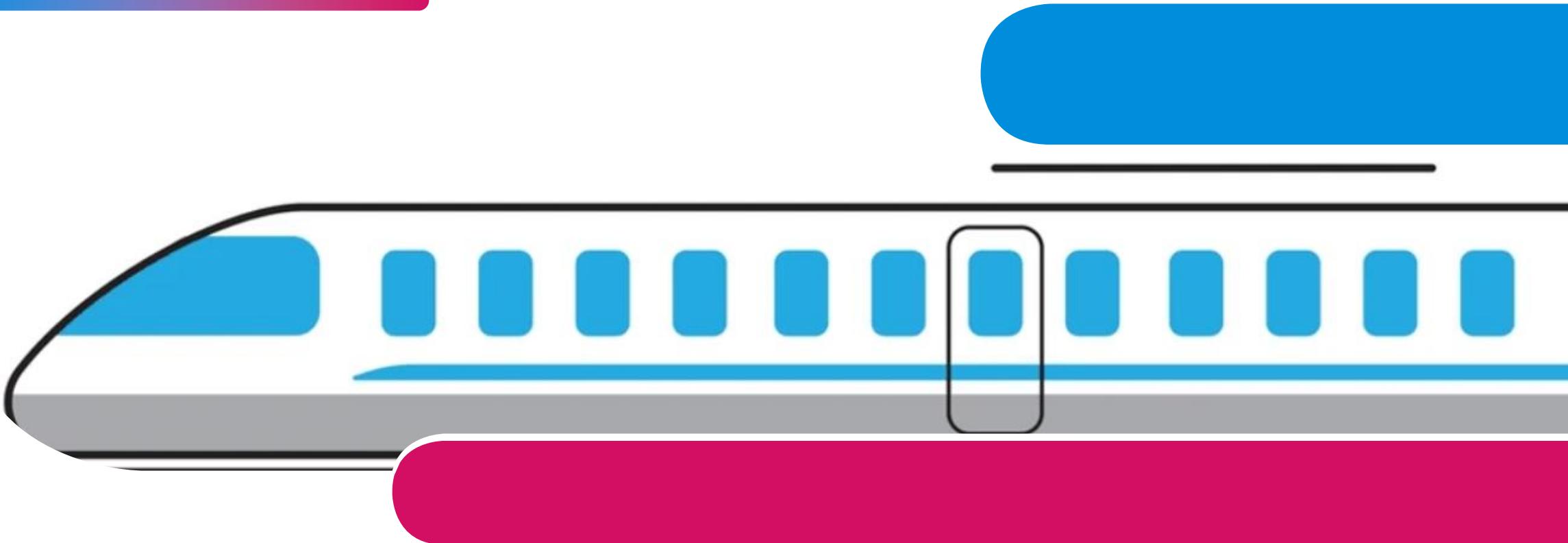




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Let's Begin the Journey





Introduction

- Imagine, a train running on magnetic and electrical forces only, no wheels, no engine and the steel track replaced by a guideway. I know this sounds like something straight out of science fiction but in present time it's a reality.
- Presenting to you, the Maglev (Magnetic Levitation) Trains the trains which are able to travel with a speed of about 600km/hr.
- The next leap in the field of Human Transportation, just like airplanes revolutionize 20th century's transportation.

HISTORY OF MAGLEV TRAINS

Maglev is the system of transportation that uses magnetic levitation to suspend, guide and propel the vehicles using magnets.

- First described by Robert Goddard, American Rocket Scientist, 1909.
- Later in 1937 & 1941 a series of German patents for maglev trains propelled by linear motors awarded to Hermann Kemper.
- In the 1960s in Britain Eric Laithwaite developed a functional maglev train.

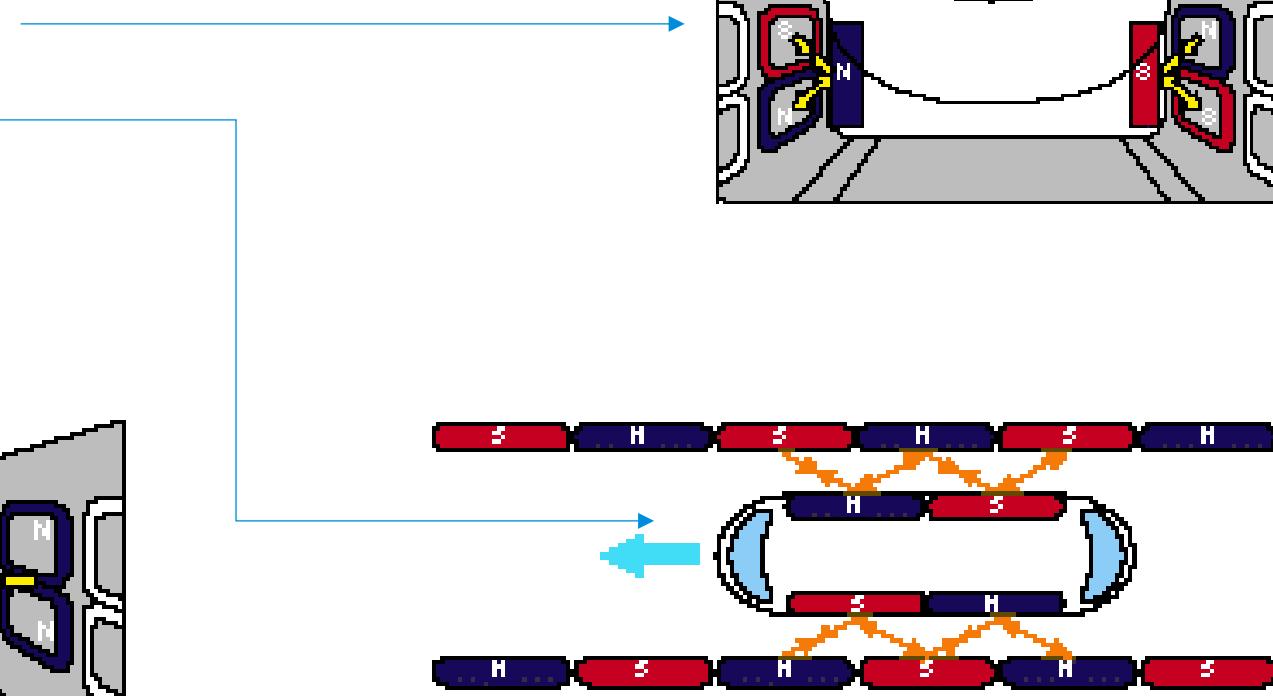
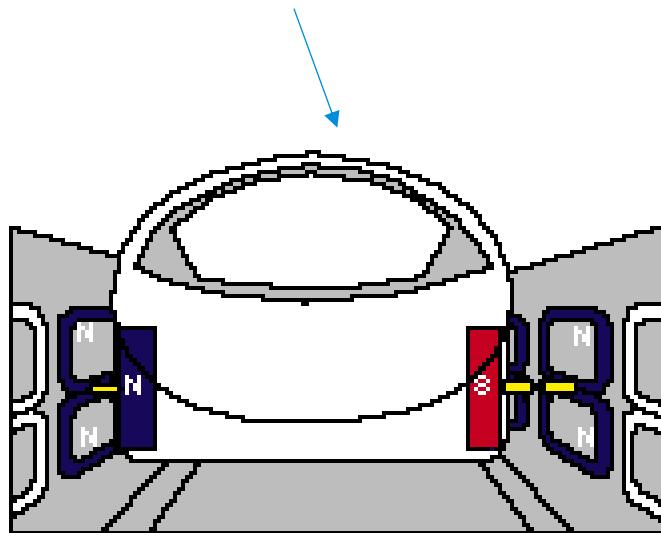
**Japanese Maglev Evolution
1972 - 2020**
maglev.net



WORKING PRINCIPLE

Working principle OF Maglev Train includes:

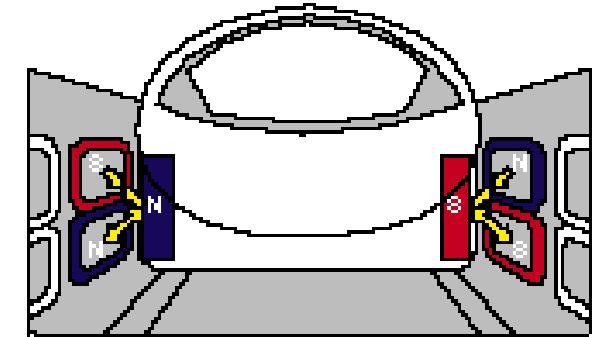
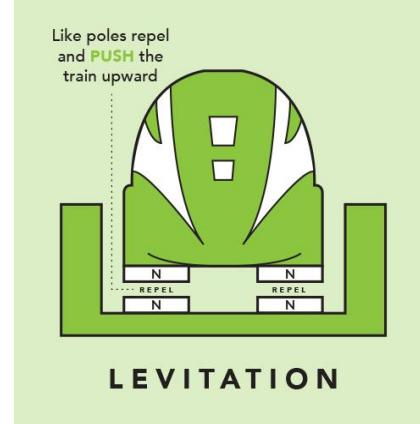
1. Suspension(Levitation)
2. Propulsion
3. Lateral Guidance



Suspension(Levitation)

There are 2 forms of suspension technology:

- 1-Electromagnetic suspension
- 2-Electrodynamic suspension



1-Electromagnetic suspension:

- In current EMS systems, the train levitates above a steel rail while electromagnets attached to the train, are oriented toward the rail from below.
- The electromagnets use feedback control to maintain a train at a constant distance from a track.

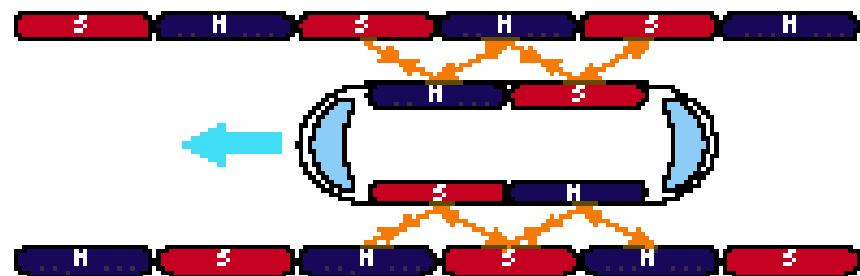
2-Electrodynamic suspension:

- In Electrodynamic suspension (EDS), both the rail and the train exert a magnetic field, and the train is levitated by the repulsive force between these magnetic fields. The magnetic field in the train is produced by either electromagnets or by an array of permanent magnets .
- At slow speeds, the force is not large enough to support the weight of the train. For this reason the train must have wheels or some other form of landing gear to support the train until it reaches a speed that can sustain levitation.

Propulsion

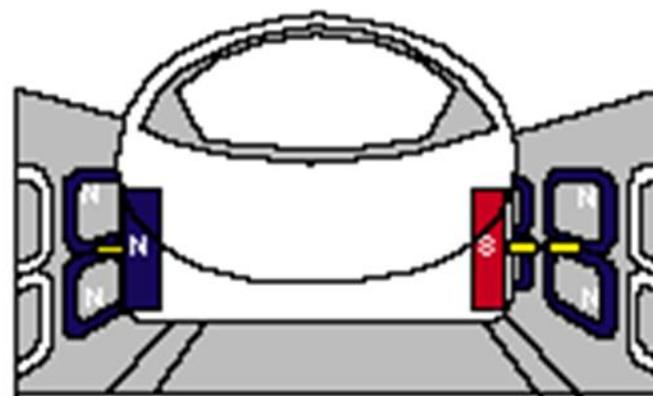
Electromagnetic Propulsion:

1. In real life the opposite poles of magnets attract each other and like ends repel, this is the simple principle behind electromagnetic propulsion.
2. However, electromagnets attract metal objects while charged with electricity, the pull is temporary and dependent on the charge.
3. For a train to operate three major components must be present in the system: a powerful electrical power source, large guidance magnets attached to the underside of the train, a track lined with metal coils.



Lateral Guidance(Guideway)

1. The magnetized coil running along the track, is called the guideway. This will repel the large magnets on the underside of the carriage, causing the train to hover above the track.
2. The key advantage of the Maglev train is that it floats on a cushion of air, with virtually no friction. This allows the train to reach such high speeds!



TYPES OF MAGLEV TRAINS

Low-speed EMS:

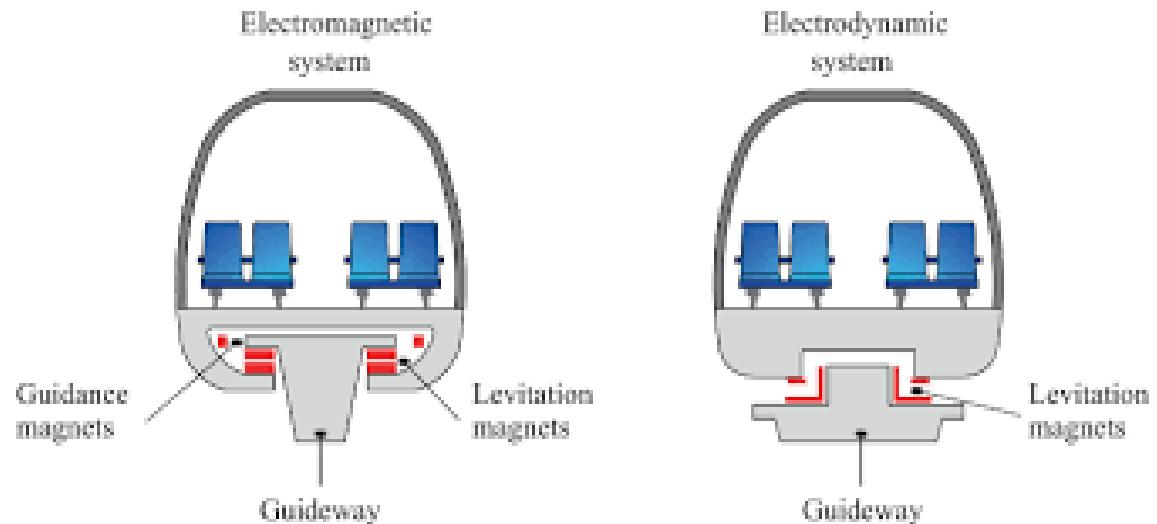
- Used in urban transport.
- Example: Transrapid (Germany).

High-speed EDS:

- Long-distance and fast travel.
- Example: SCMaglev (Japan).

Hyperloop Concept:

- A vacuum-sealed tube system that combines maglev with minimal air resistance for ultra-high speeds.



ADVANTAGES & DISADVANTAGES OF MAGLEV TRAINS



ADVANTAGES

High Speeds:

- Achieve speeds of over 600 km/h, reducing travel time.

Low Maintenance:

- Lack of physical contact with the tracks results in minimal wear and tear.

Energy Efficient:

- High-speed transport with lower friction losses compared to traditional trains.

Environmentally Friendly:

- Electric-powered, leading to reduced carbon emissions.

Smooth Ride:

- No mechanical friction; hence, reduced noise and vibration.

DISADVANTAGES

High Initial Cost:

- Infrastructure and technology are expensive to build.

Limited Networks:

- Few operational lines due to the cost and infrastructure requirements.

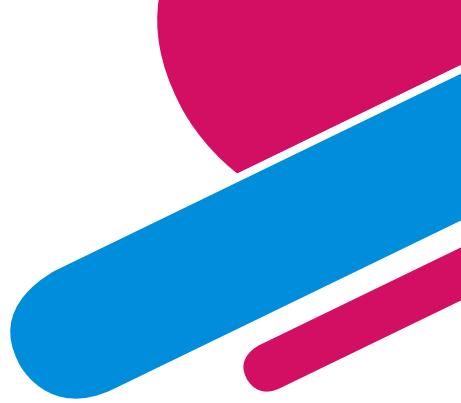
Compatibility:

- Maglev technology is not compatible with existing rail networks.

Energy Use:

- Though efficient at high speeds, the system requires significant power for acceleration and levitation.

CASE STUDY



Case Study: Shanghai Maglev Train

- Operating Since: 2004
- Route: Shanghai Pudong International Airport to the Longyang Road Station.
- Speed: 430 km/h (267 mph)
- Technology: Transrapid system (Germany).
- Advantages: Fast, efficient, reliable.
- Challenges: High operational costs and limited routes.

BREAKING NEWS



CHINA'S latest ULTRA HIGH SPEED MAGLEV TRAIN reaches 1000 km/hr in
it's initial testing phase.

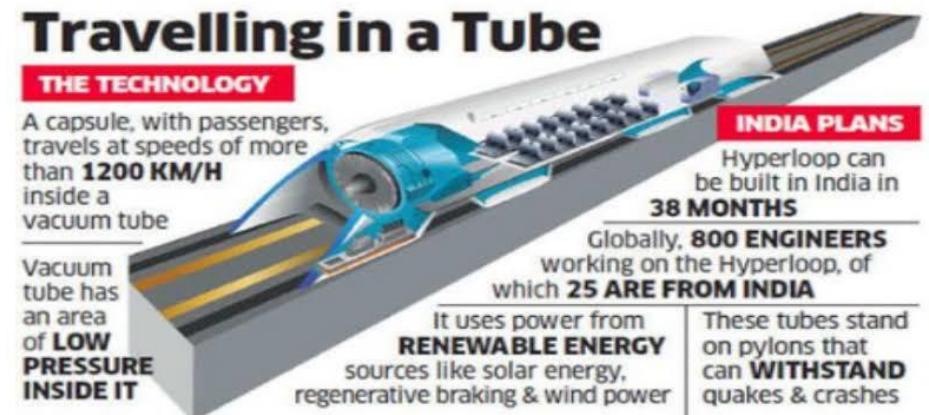
FUTURE SCOPE

- **Hyperloop:**

- Invented by **Elon Musk**, uses vacuum tubes and maglev.
- Capable of speeds up to 1,200 km/h.
- Currently in the testing phase; expected to revolutionize travel.

- **Next-Gen Maglev Trains:**

- Focus on **sustainability**, reducing costs, and making maglev accessible for urban transport.
- **Superconducting Technologies** for more efficient levitation.



Role of Different Engineering Disciplines



Mechanical Engineering

Design and Development:

- Developing efficient chassis, suspensions, and propulsion systems.
- Materials engineering for lightweight, durable train components.

Magnet and Coil Design:

- Mechanical engineers contribute to the design of superconducting magnets and linear motors.

Aerodynamics:

- High-speed maglev trains require sophisticated aerodynamic designs to reduce drag.

Vibration and Noise Control:

- Engineers design systems that minimize noise and ensure passenger comfort.

Maintenance and Reliability:

- Development of predictive maintenance technologies using mechanical and electrical systems to monitor performance.

Collaboration with other Engineering Branches

- Electrical Engineers:** Work on propulsion systems and control.

- Civil Engineers:** Design infrastructure, tracks, and stations.

- Computer Engineers:** Develop control algorithms and autonomous systems for maglev operation.

Conclusion

Summary:

- Maglev technology has the potential to revolutionize high-speed transportation.
- Its advantages include speed, efficiency, and reduced environmental impact.
- Mechanical engineers play a vital role in the design, testing, and maintenance of these systems.

Future Vision:

- Further research and development in superconductors, energy efficiency, and cost reduction can make maglev more widespread.
- Hyperloop could represent the next leap in transportation innovation.



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THANK YOU!

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