Introduction to Transportation Systems

PART III:

TRAVELER TRANSPORTATION

Chapter 30:

Intercity Traveler Transportation: Rail

Outline: Rail Traveler Transportation

- Rail Modal Advantages
- Rail Modal Disadvantages
- International Systems
- Technology for High-Speed Rail
- Maglev
- Incremental High-Speed Rail

Rail Station vs. Airport Location

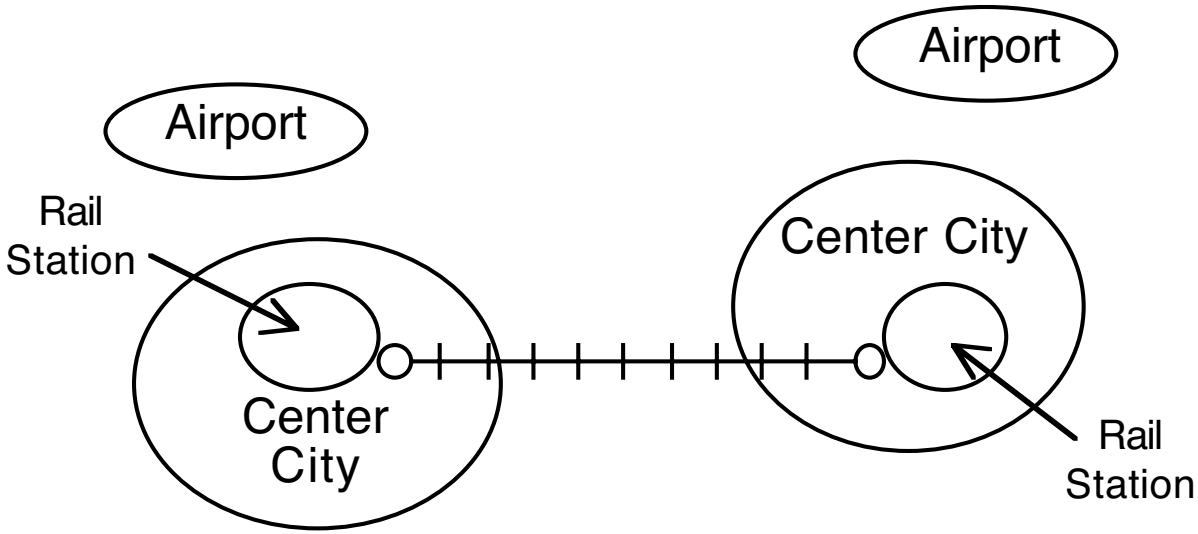


Figure 30.1

Rail Characteristics

- Surface Mode on Rail Guideway
  - Energy
  - Control
  - Speed
  - Noise

CLASS DISCUSSION

International Systems

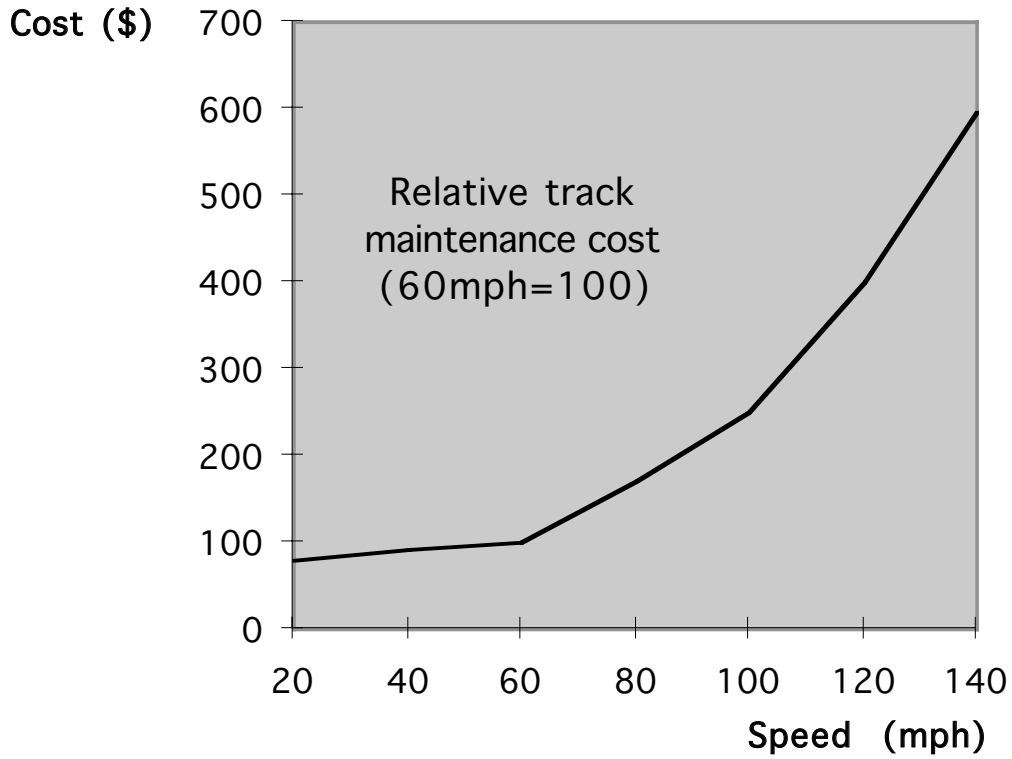
- The TGV in France routinely provides service approaching 200 miles an hour.
- Shinkansen operations provide service in the range of 170 miles an hour throughout Japan and have operated since 1964.
- High-speed rail technologies in Germany (the ICE Train), Sweden (Tilt Trains) and Italy are also deployed.
- These countries have all made a strong commitment to high-speed rail as a viable alternative for domestic air or highway for intercity travel.

Technology for High-Speed Rail

- The technologies for high-speed rail used in Japan, France and Germany all require a dedicated right-of-way (no other passenger or freight rail service).
- Track structures are typically continuous welded rail and concrete ties.
- Due to design speeds, there are horizontal and vertical curve constraints that are much more stringent than for conventional trains.
- For power, electrification is standard.
- Rolling stock for high-speed rail uses low-weight equipment, since energy costs are proportional to the weight of the car and to the cube of speed.
- Noise becomes more of an issue with high-speed trains. For example, the noise of the pantograph on the top of the cars picking up electric power from power lines is quite substantial at high speeds.

The Cost of "Speed"

Maintenance Cost vs. Speed

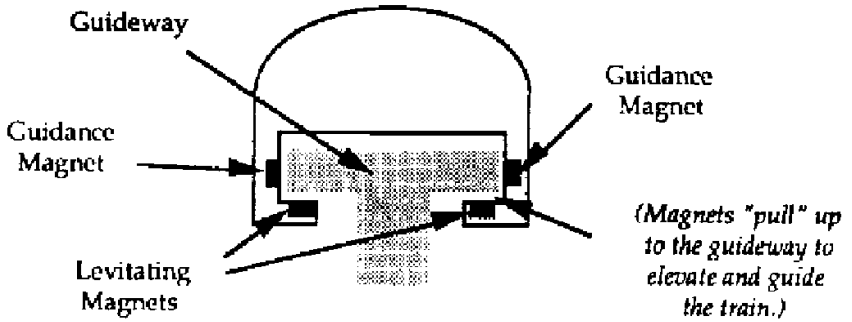


Source: *In Pursuit of Speed: New Options for Intercity Passenger Transport*, Special Report 233, Transportation Research Board, National Research Council, Washington D.C., 1991.

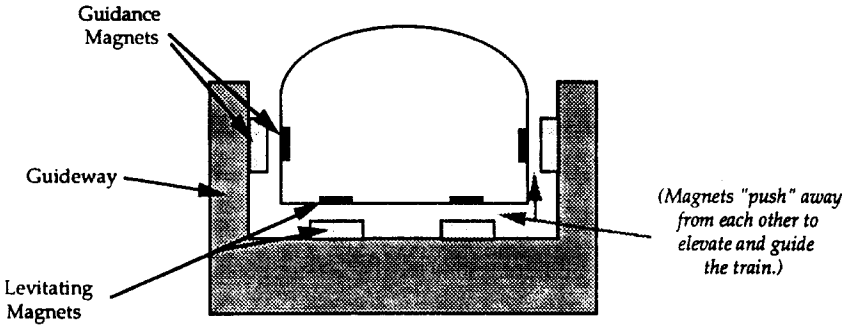
Figure 30.5

Mag-Lev

EMS "Attractive" Mag-Lev System



EDS "Repulsive" Mag-Lev System



Source: Phelan, Randal Scott, "Construction and Maintenance Concerns for High Speed Maglev Transportation Systems", Thesis for Master of Science in Civil Engineering, MIT, June 1990.

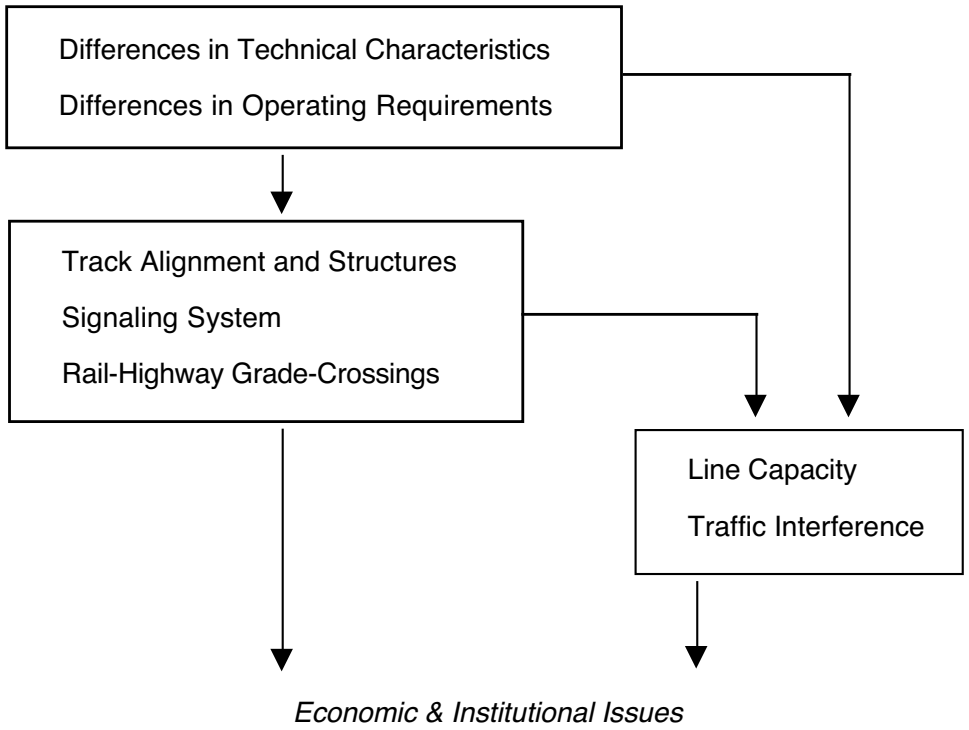
Figure 30.7

Incremental High-Speed Rail

- Another direction, rather than moving up to mag-lev, is what is called *incremental high-speed rail*.
- Incremental high-speed rail is characterized by a right-of-way *shared* between passenger and freight operations.
- Incremental high-speed rail would operate at speeds in the range of 125 to 150 miles per hour.
- The costs associated with incremental systems are substantially less, since existing rights-of-way are upgraded rather than building new rights-of-way at substantial costs.

Operations Issues for Incremental High-Speed Rail

Sharing R.O.W. between Passenger and Freight Trains



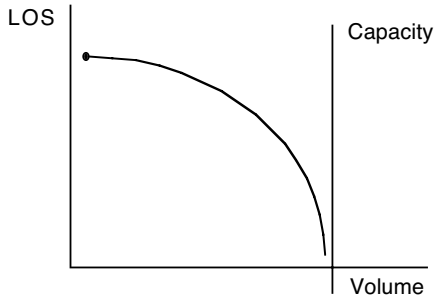
Source: Roth, Daniel, "Incremental High Speed Rail in the U.S.: Economic and Institutional Issues", Thesis for Master of Science in Transportation, Department of Civil and Environmental Engineering, MIT, July 1994.

Figure 30.8

Perspectives of Freight Railroads on Passenger Service

- Capacity

LOS Degrades as Volume Approaches Capacity



- Liability
  - The risk profile changes when a railroad has passenger operations, because of the increased probability of injuries and deaths.
- Cost-Sharing and Cost-Allocation
  - Right-of-way is being shared by freight and passenger; how do you decide who pays what for the use of that right-of-way?

Figure 30.9

HSR, Incremental HSR and Mag-Lev

H S R

dedicated service
very high speed
150-200 m.p.h.
(Europe and
Japan)

Less Technology

More Technology

Incremental HSR
Shared ROW (with freight)
Speed: 125-150 m.p.h.
Capacity Issues
Safety Issue (grade-crossing)

MAG LEV
Dedicated ROW
Speed: 300 m.p.h.
"High Tech"
Very expensive (comparatively)
As yet unproven technology (commercially)

Figure 30.10