



Transportation Engineering II: Highway Design & Railways

Lecture 1 INTRODUCTION

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Transportation Engineering



■ Main domains:

- Highway
- Railway
- Waterway
- Air
- Pipeline
- Space

■ Tasks of a Transport Engineer:

- Planning
- Functional design
- Operation and
- Management of facilities

■ Objective of Transportation Engineering:

Ensuring Safe, rapid, comfortable, convenient, economical, and environmentally compatible movement of people and goods

Importance



- Importance of transportation engineering within the civil engineering profession
 - Can be judged by the number of divisions in ASCE (American Society of Civil Engineers) that are directly related to transportation
 - Six divisions (Aerospace; Air Transportation; Highway; Pipeline; Waterway, Port, Coastal and Ocean; and Urban Transportation)
 - Represents one-third of the total 18 technical divisions within the ASCE (2000)

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Introduction to CE 353



- 4 credits
- Course outline
 - Highway materials
 - Railways
 - Construction
 - Maintenance
- Traditionally regarded as the most dreaded course of CE undergraduate curriculum !
 - Deathtrap: Railways !
 - Memorization
 - English skills

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Introduction to Railways



- Outline of lectures on railway
 - General requirements
 - Alignment
 - Permanent way
 - Station and yards
 - Signaling
 - Points and crossings
 - Maintenance
- Key to success
 - Do not pile up work

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Course Management



- Website
 - <http://teacher.buet.ac.bd/cfc/ce353.htm>
- Email list
 - BUET_CE07@yahoogroups.com
- Correspondence
 - Email: cfc95@yahoo.com
 - Office hours: Wed 1-2pm
- Quiz
 - Random viva on the material covered on previous class
 - Commit 30 mins each week
 - 1 class test/assignment

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Resources



▪ Suggested Readings

- Principles of Railway Engineering: Rangawala (2000)
- Railway Engineering: Agarwal and Chandra, Oxford University Press (1997)

▪ Video Lectures

- Prof Rajat Rastogi, IIT Roorkee
<http://www.cosmolearning.com/video-lectures/introduction-to-railway-engineering-8753/>

▪ Bangladesh Railway Information Book

- <http://www.railway.gov.bd>
-> Important Information

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History of Railroads: Timeline



▪ First Railway?

- 600 BC: Rutway Diolkos in ancient Greek and Roman times

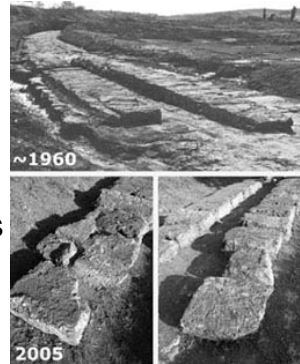
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Rutway



▪ Trackway Diolkos across the Isthmus of Corinth

- Granite road with grooved “tracks” in which large wooden flatbed cars carrying ships and their cargo were pulled by slaves or animals
- Length: 6 and 8.5 km
- Width: 1.5 m (current: 1.435 m)
- Regular and frequent service till 900 AD



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Rutway



Details: <http://www.suite101.com/content/the-diolkos-an-ancient-railway-a24554>
YouTube: DIOLKOS 1500 Years

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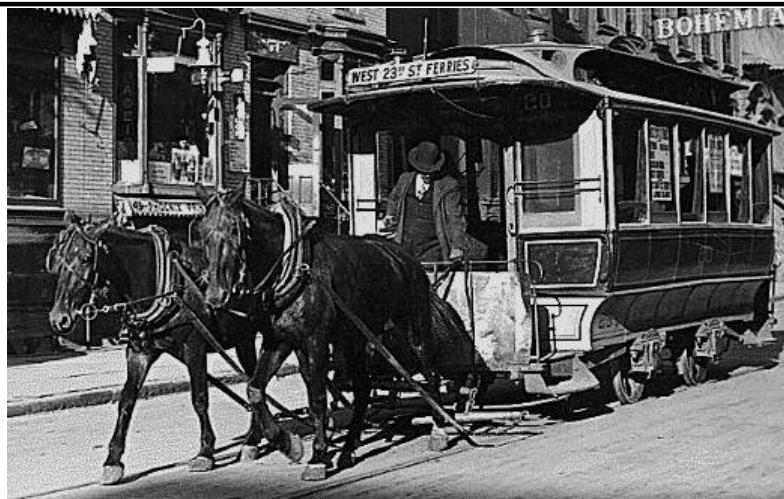
History of Railroads: Timeline



- Manual/ horse drawn railways
 - 1550: Hand propelled tubs known as "hunds" in Germany
 - 1603/4: first recorded above ground early railway/ wagonway
 - 1798: Lake Lock Railroad, the world's first public railway (carried only coal)
 - 1803: The first public passenger railway, the Surrey Iron Railway opens in south London

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History of Railroads: Timeline



St. Catharine's Street Railway, Canada

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History of Railroads: Timeline

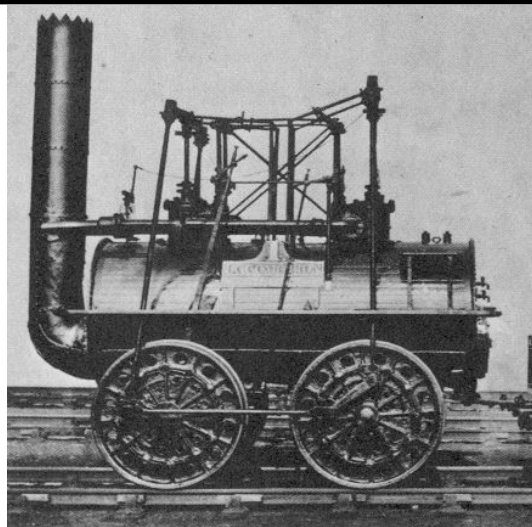


▪ Steam Engines

- 1804: First steam locomotive railway - Penydarren - built by Trevithick, used to haul iron in Wales
- 1814: George Stephenson constructs his first locomotive, Blücher
- 1829: George and Robert Stephenson's locomotive, The Rocket, sets a speed record of 47 km/h (29 mph), Liverpool
- 1857: First steel rails used in Britain
- **1863**: First underground railway, the 4 mile (6.2 km) Metropolitan Railway opened in London. It was powered by adapted steam engines

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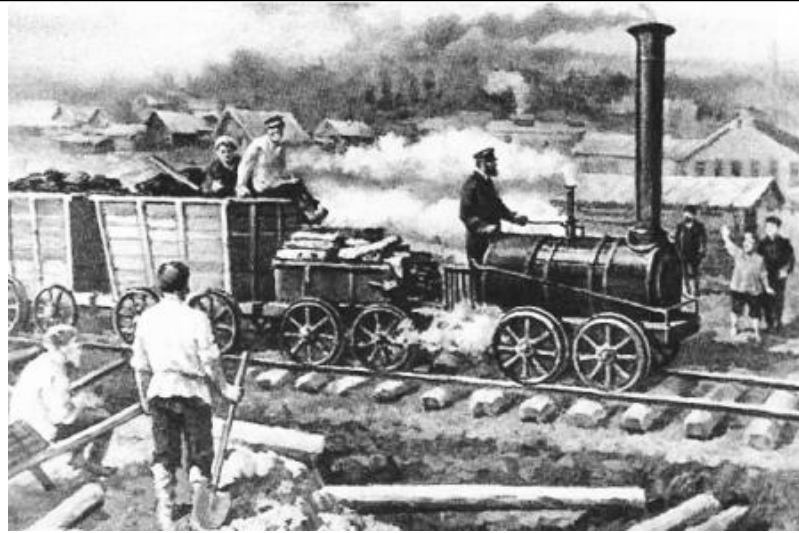
History of Railroads



1833-34 : Stevenson's Steam Engine

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History of Railroads



1833-34 : Built by Cherepanov and his son, total distance of about 3.2 Km (two miles)

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History of Railroads: Timeline



- Rails in Indian Subcontinent
 - 1851: First train in British India, built by British invention and administration
 - 1853: Passenger train makes in début in Bombay, India
 - ~1901: trains in our territories

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History of Railroads: Timeline



- Electricity propelled
 - **1879** First electric railway demonstrated at the Berlin Trades Fair
 - **1890** First electric London Underground railway (subway) opened in London—all other subway systems soon followed suit
- Diesel locomotives
 - 1913 First diesel powered railcar enters service in Sweden
- Diesel Electric locomotive
 - 1924 First diesel-electric locomotive built in Soviet Union (USSR)
 - Dominant type of locomotive in the world today

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The Quest for Speed



- 1957 Japan sets narrow gauge world speed record of 145 km/h (90 mph) with Odakyū 3000 series SE Romancecar
- 1964 Bullet Train service introduced in Japan, between Tokyo and Osaka. Trains average speeds of 160 km/h (100 mph) due to congested shared urban tracks, with top speeds of 210 km/h
- 2003 Heavily modified trainset of France's TGV had beaten its original world record when it travelled 320 km/h

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The Quest for Speed



TGV at Paris Station

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The Quest for Speed



- The Shanghai Maglev Train or Shanghai Transrapid being the first commercial high-speed maglev line in the world —the top operational commercial speed of this train is 431 km/h (268 mph), making it the world's fastest train in regular commercial services since its opening in 2004

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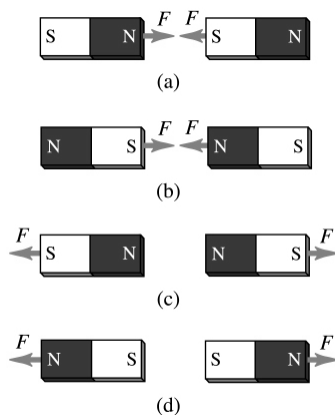
The Quest for Speed



“Is it a Bird? A Plane?”

Nope, only Shanghai's **Maglev**, the world's fastest train !”

Magnetic Levitation (Maglev) Principle



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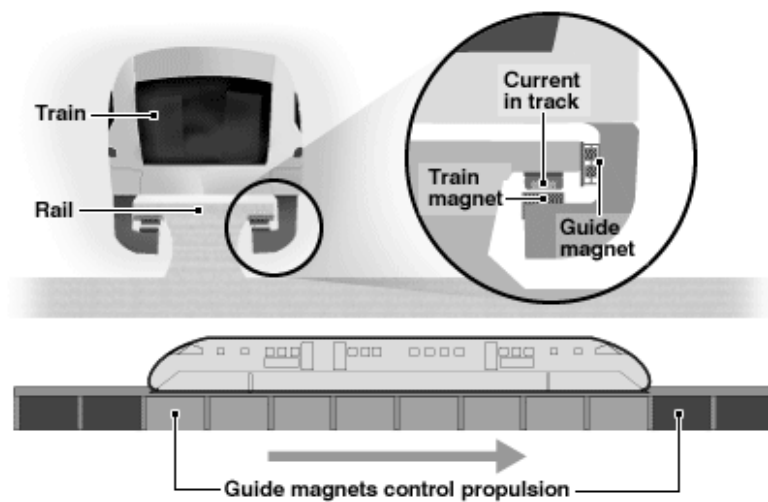
Maglev Principle



- Opposite poles on magnets keep train above track
- Train is propelled by electro-magnetic system in the sides of the "guideway" instead of onboard engine
- Trains "float" over a guideway without any contact between train and rail resulting "zero" frictional loss

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Maglev Principle



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Classification of Railway System



- Intercity
 - Long distance
 - Generally not very frequent
 - Every 20/30 mins to once a day
- Urban
 - Short haul
 - Frequent
 - Frequency as high as every 3 mins
- Sub-urban
 - Suburb to main city
 - Mostly caters to commuting traffic

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Forms of Urban Rails



- At grade
- Elevated
- Underground (Subway)

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Forms of Urban Rails



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Comparison with Roadway



- Load handling capacity
 - Railway can handle heavier loads at higher speeds
- Construction, maintenance and operating cost
 - Railway has higher construction and maintenance cost but lower operations cost
- Speed
 - High speed rails are much faster than roadway
- Degree of freedom
 - Railway movements are restricted to be in one direction

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Comparison with Roadway



- Length of haul (Distance)
 - Railways are much more convenient for long haul (>500km trips)
- Topography
 - Railway less suitable in hilly terrains with curves
- Energy consumption
 - Energy required in railway per ton is less than roadway
 - Is very environment friendly if 'clean' electricity is used

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Advantages



- High capacity
- Lower operating cost
- High speed
- Fixed route and easier operation

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Why Railway Engineering?

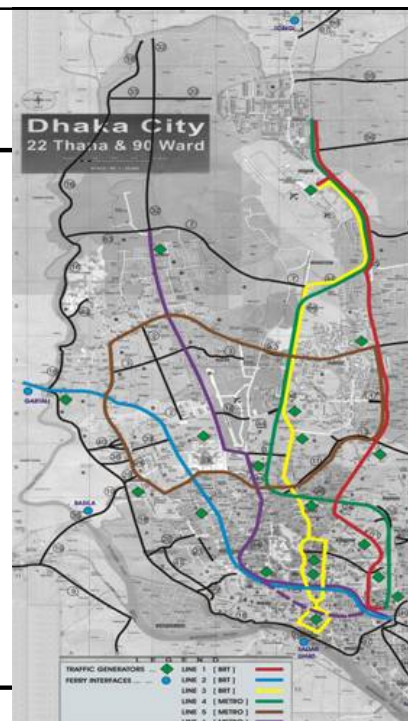


- Civil Engineers responsible for:
 - Planning the railway tracks
 - Designing the alignment
 - Right of Way designing
 - Operations
 - Maintenance

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Why Railway Engineering?

STP Proposal for Mass Rapid Transit



Why Railway Engineering?



The Daily Star

Wednesday, February 16, 2011

Metro rail in 4 years possible

Study finds a ride from Uttara to Jatrabari will take only 45 minutes, Tk 50
Staff Correspondent

A commute by metro from Uttara to Jatrabari will take about 45 minutes and cost Tk 50, according to studies conducted as part of the government plans for improved public transport in the capital.

The planned electric railway will carry some 60,000 people an hour at peak times. Commuters will have to pay Tk 2.50 for each kilometre.

Prof Jamilur Reza Chowdhury, consultant for the government's metro rail project, briefed journalists about the study findings after a meeting with Finance Minister AMA Muhith yesterday afternoon.

Held at the secretariat, the meeting discussed the status of various projects on the city's traffic systems.

"Metro rail project can be implemented within next four years, and once in place, it will ease traffic jam in the city," said Jamilur Reza adding that one train every three minutes can be run under the system.

The finance minister said the project would be implemented through public-private partnership and would require an estimated \$1.7 billion.

