Lecture 1

Introduction to Railway Engineering

- Railway Mode of Transport
- Early Beginnings
- Development of Railways in Iraq
- Advantages of Railways

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Definition of Railway

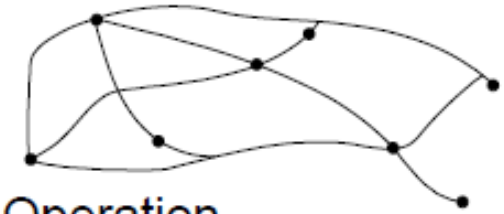
Rail transport is a means of transferring of passengers and goods on wheeled vehicles running on rails, also known as tracks. It is also commonly referred to as train transport. In contrast to road transport, where vehicles run on a prepared flat surface, rail vehicles (rolling stock) are directionally guided by the tracks on which they run.

Railways: Introduction

- In this mode of transport, all vehicles use rail tracks to move from one point to another.
- Vehicles consist of a long train of coaches attached to a locomotive.
- The coaches and the locomotive have steel wheels which run on steel rail tracks.
- The locomotive either uses diesel or use electricity as fuel (locomotives which run on coal are hardly used these days).
- Since the rail tracks provide a dedicated right-of-way for the train services, these are good for high-speed transit facilities.
- Trains stop at pre-specified locations called stations.

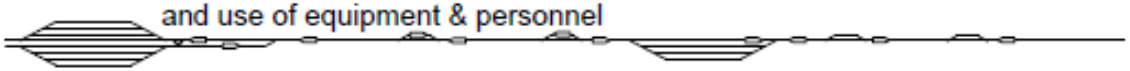
Elements of Railway Engineering

Railroad Network
System operation affects efficiency and service reliability



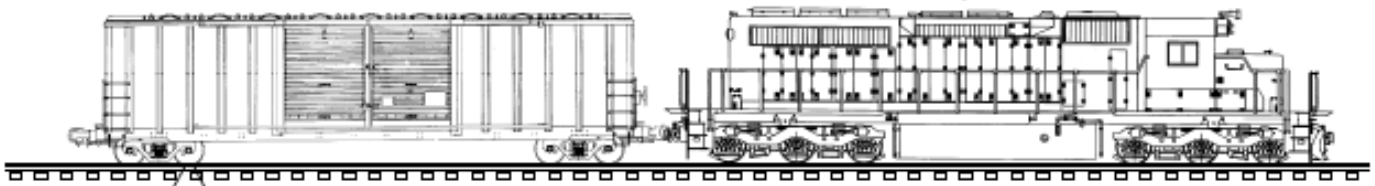
Traffic Control System
Safe, efficient operation of many trains on same tracks

Line & Terminal Operation
Timely and efficient train operation and use of equipment & personnel



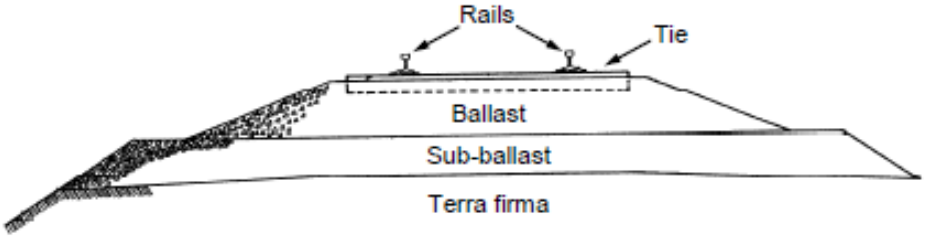
Rail Cars
Design and size affect operating efficiency

Locomotive
Efficient conversion of energy into tractive force to pull train



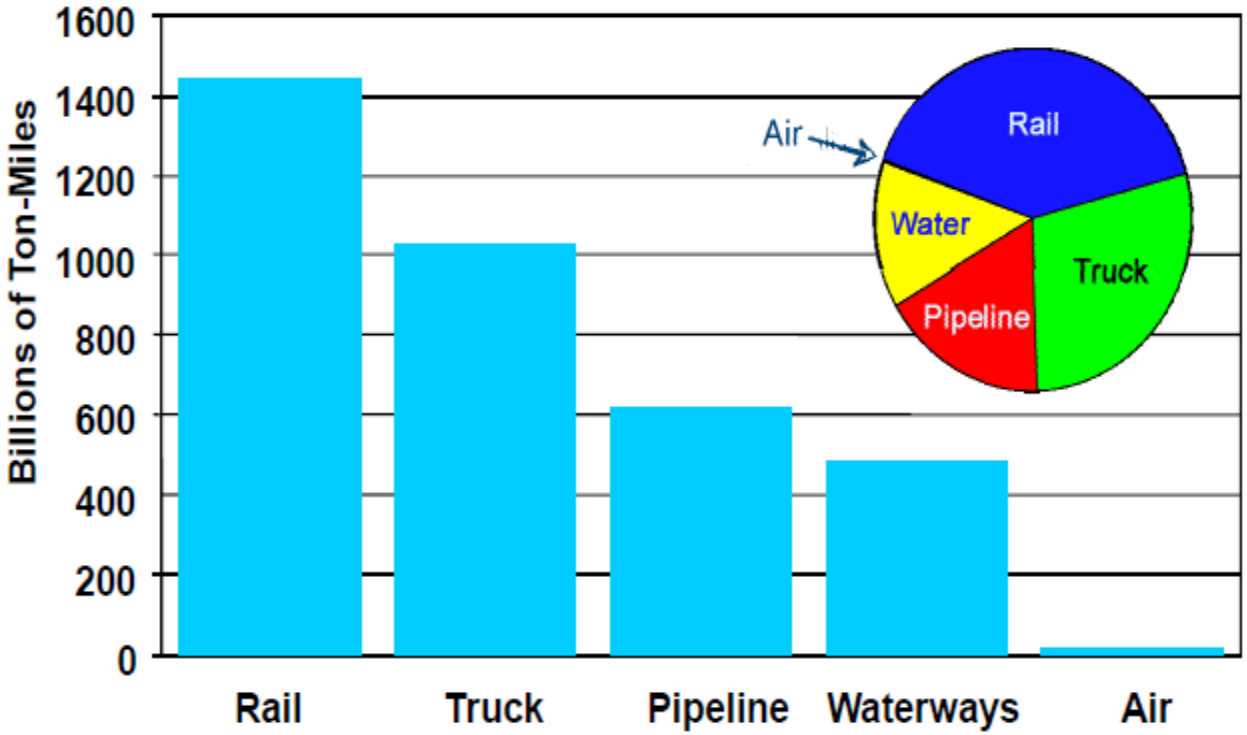
Brake System
Safe stopping distance affects train spacing and line capacity

Track System
Structure & condition affects speed and maintenance requirements



Wheel/Rail Interface
Complex dynamics affect stability & speed

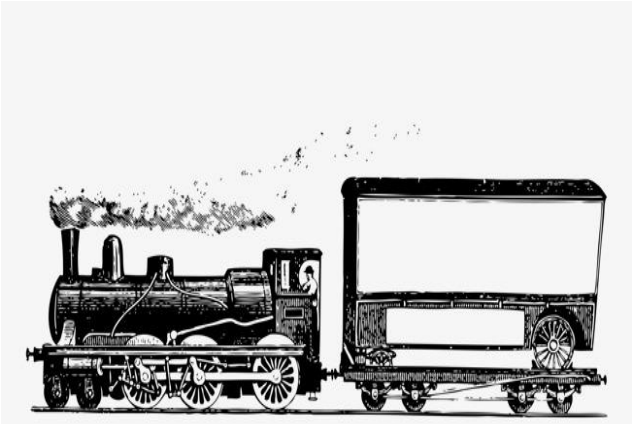
North American freight transportation volume by mode



History of Rail Transport

- It all began over 2000 years ago in ancient civilizations of Egypt, Babylon, and Greece.
- Transport of people and goods in those times was done with carts that were pulled by animals (horses or bulls), and their engineers quickly noticed that animals will spend much less energy if the cart was traveling on a predetermined path, without the possibility for steering or traveling over uneven terrain.
- To enable this new way of transport, they build roads with pre-built constraints for wheels.

- In the 19th Century, steam engines began to be trialed in England, however, they were found to be more expensive to run than horses. However, steam engines gradually improved, and the wagonways transformed into railways.



Early Beginnings

- By the time steam locomotives came on the scene, in the early nineteenth century, wrought iron rails and later steel rails were developed which were strong enough to support these heavy axle loads without assistance from longitudinal timbers.
- In essence, the track itself, together with its supports, had and still has the basic function of safely transmitting the loads and forces imposed by passing trains to the ground beneath.
- Various other civil engineering skills were also involved in the construction of early railways. These included the building of bridges, tunnels, and gravity walls as well as extensive earthworks and drainage.

Development of Railways in Iraq

- Railway construction began in Iraq in 1902, part of the Berlin – Baghdad project, seen as a standard gauge through route.
- After the British invasion of 1914, Basra – Baghdad was built with surplus meter gauge equipment from India.
- The first section of railway in what was then the Ottoman Empire province of Mesopotamia was a 123 kilometers (76 ml) length of the Baghdad Railway between that city & Samarra opened in 1914.
- Work had started northwards from Baghdad with the aim of meeting the section being constructed across Turkey & Syria to Tel-Kotchek and an extension northwards from Samarra to Baiji was opened in December 1918.

Development of Railways in Iraq

- From 1916 onwards an invading British Military force brought narrow gauge equipment, firstly (762 mm) gauge and later 1,000 mm meter gauge from India to Southern Mesopotamia to construct various sections of line to support its offensive against the Turks.
- In April 1920 the British military authorities transferred all railways to a British civilian administration, Mesopotamian Railways.
- The meter gauge line from Basra to Nasiriyah was the most important section constructed during the war in terms of its significance as part of later efforts to construct a national railway network.
- Soon after the end of World War I this was extended northwards from Ur Junction outside Nasiriyah up the Euphrates valley with the complete Basra to Baghdad route being opened on 16 January 1920.

Development of Railways in Iraq

- The other section of meter gauge line built during World War I that had ongoing significance was that from Baghdad East north eastwards to the Persian border.
- After the war the eastern end of this line was diverted to Khanaqin and the wartime-built line northwest from Jalula Junction was extended from Kingerban to Kirkuk in 1925.
- In 1932 Iraq became independent from Britain.
- In March 1936 Britain sold Mesopotamian Railways to Iraq, which renamed the company **Iraqi State Railways.**
- Work resumed on the extension of the Baghdad Railway between Tel Kotchek on the Syrian frontier and Baiji.
- The through route was opened and completed on 15 July 1940.
- In 1947 the Iraq Petroleum Company opened a branch at Kirkuk, which it is operated with its own Hudswell Clarke 2-8-4T's from 1951.
- ISR opened a new metre gauge line from Kirkuk to Arbil in 1949.

Development of Railways in Iraq

- A joint road & rail bridge was opened across the River Tigris in Baghdad in 1950, finally connecting the east and west bank metre gauge systems.
- In 1958 when Iraq's Hashemite monarchy was overthrown and a republic declared, ISR was renamed **Iraqi Republic Railways**.
- In 1961 IRR began to replace its standard gauge steam locomotive fleet with diesels from ČKD and ALCo.
- In 1972 several classes of steam locomotive were still in service on the standard gauge system, but these were replaced by further classes of diesel from Alstom, Montreal Locomotive Works and MACOSA.
- IRR did not begin to replace its metre gauge steam locomotives until after 1983.
- In 1964 IRR extended its standard gauge network with a line from Baghdad to Basrah which opened for freight in 1964 and for passengers in 1968.

Development of Railways in Iraq

- It has since been extended from Shouaiba Junction to the port of Umm Qasr.
- Iraq possessed two separate railroads at independence, one standard gauge and one meter gauge.
- The standard gauge line ran north from Baghdad through Mosul to the Syrian border and to an eventual connection with the Turkish railroad system, and the meter gauge line ran south from Baghdad to Basra.
- Because the two systems were incompatible, until the 1960s cargo had to be transloaded at Baghdad to be transported between the two halves of the country.
- In the 1960s, development plans converted metric railroads to standard railroads.
- The Soviet Union helped extend the standard gauge system to Basra, and by 1977 fully 1,129 kilometers of Iraq's 1,589 kilometers of railroad were standard gauge.
- By 1985 the total length of railroad lines had been extended to 2,029 kilometers, of which 1,496 kilometers were standard gauge.
- In 1985 the railroads were being traveled by 440 standard-gauge locomotives that moved 1.25 billion tons of freight per kilometer.

Development of Railways in Iraq

The first railway in Iraq opened in 1914 between Baghdad and Samarra, a distance of 120km. This was the first section in present day Iraq of the much-delayed Baghdad Railway, intended to connect that city with Istanbul, and authorised by the Ottoman government at the turn of the century.

By the beginning of the 21st century, Iraqi Railways were much run down. Some 1700 km of the standard gauge network remained in use, including the original Baghdad Railway connecting with the rail network of Syria, and through Syria to Turkey.

Development of Railways in Iraq

From 2003 war devastated even this remaining network and recovery took a number of years. By 2012, commuter lines in Baghdad and long-distance routes from Baghdad to Basra, Fallujah and Mosul had been restored to operation. The rail network is seen as economically important for the country,

In 2014 following invasion of the city by terrorist forces, the rail line to Mosul was severed again. The city was liberated in 2017 but it may be some time before reconstruction of the badly damaged city and restoration of the rail link can be achieved.

Advantages of Railways

(A) Economical Advantages:

- Due to railways industrial development in far off places is possible, increasing the land values and standard of living of the poor people.
- Due to easy movement of the products in all parts of the country, the price stabilization could be possible, giving relief to the common man.
- During famines the essential goods, food and clothing can be speedily sent to the effected areas.
- Congestion of cities has been relieved due to increase in mobility of the people, who can come from long distances daily to the places of work.
- Finished products of industries can be easily and cheaply distributed.
- Raw materials can be easily, economically and speedily brought to the industrial areas.
- Completion of big national projects such as dams, canals was possible due to railways only, as labour and materials could be brought from long distances speedily.

Advantages of Railways

(B) Political Advantages

- Only due to effective country wide network of railways, the central government administration has become easy and effective.
- Railway has created the national mentality among the people of different religions, areas, tastes, customs and traditions.
- During War the railway can easily and speedily move military from one place to another.
- Railway can also help in mass migration of people during emergency if required.

(C) Social Advantages

- During travel, as people of different castes and religions sit together, the feeling of caste is removed.
- The inhabitants of far-off places do not feel themselves isolated from the other parts of the country.
- People can easily reach their religions places even at very long distance easily.
- Railway is the most safe, comfortable and cheap type of transport than all other types of conveyances.
- Only the railway has made it possible for the people to visit all the parts of the country and make their social outlook broadened. People have started feeling pride of the greatness of their country.