RAILWAY FREIGHT SYSTEMS

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Freight Systems

- Freight railways carry only goods as opposed to passengers.
- Railway freight can include bulk materials, rail cum road container, special materials or freight in special wagons, general merchandise, autos, even at times animals.
- Normally a train is formed with one or multiple locomotives with a number of wagons and moves as a unit from origin to destination.
Freight Systems

- Freight systems are normally profitable:
  - Goods normally transported in bulk over larger distances – economical
  - Energy costs lower than road
  - Safety systems of lower standard as no passengers
  - Smaller goods now aggregated and transported in containers – reduced packing and door to door
Preference for railways over road

- Railways are preferred for bulk movement over larger distances for reasons:
  - High energy efficiency since wheel and rail have steel to steel contact
  - Much lower environment degradation
  - Safer
  - Lower external costs
  - Reduced land use
  - Improved flexibility due to containerisation
Freight Railway Features

- Quantum of transport measured in Tonne-Kilometres or Ton-Miles
- Can be government owned or private or leased by government to private company
- Can be general purpose, mining or other railways (sugar cane, military, etc)
- Heavy haul, Long Haul, Hub & Spoke are different systems of operation
Train consist

- Normally train consists of locomotives in front, wagons and brake van at end
- Modern systems now use end of train telemetry to eliminate brake vans
- Heavy haul and long haul necessitate use of distributed power i.e. Locos at different points within the train length radio controlled from front loco by the driver.
Yards, Terminals

- Freight trains are formed in classification yards where wagons are sorted destination-wise.
- Terminals are at destinations and origins at factories, warehouses, ports, etc.
- Larger factories/plants have sidings for receiving/despatching trains.
- Commercial transactions done at terminals/warehouses.
- Wagons loaded/unloaded at terminals/warehouses.
Railway Yard – Auto Carrier Wagons
Wagons

- General and special wagons (cars) used to carry goods
- General wagons are normally open or covered box shaped

Covered wagon
Open wagon

- Open wagon
Tank wagon

- Tank for liquids and gas wagon
Piggy Back or Roll On Roll Off (RoRo)
Special wagons

- There are special wagons like flat wagons, well wagons, bottom discharge wagons, refrigerated vans, brake vans, auto carriers, sliding roof wagons, container flats for carrying containers, currency vans, side opening, side discharge wagons.
- Departmental wagons are those required for railway’s own use for moving maintenance material, delivering material to maintenance depots from warehouses, moving smaller cranes
- And many more on different railway systems
Braking systems

- Brake systems earlier was vacuum type which became unsuitable for faster and longer trains
- Air brakes became the standard system
- Electro-pneumatic systems use electrical controls for operating air brakes faster
- Locomotives are at times fitted with resistive / regenerative braking
- Disc brake are also used for some wagons
- Hand brakes are used normally as parking brakes for locomotives and wagons
Freight Systems...

- Railway network connect origins to destinations (O-D linkages)
- Origins are goods producing centres e.g. manufacturing factories, steel plants, coal mines, iron ore mines etc
- Destinations are the consumer/marketing points for these goods
- In turn Factories, steel plants and similar have their own O-D links whereby their raw materials are transported form mines, etc
- There are computer simulation systems of networks to show effect of any change on the network
Freight systems...

- Large freight railways normally network based
- Mixed railway – have large freight and passenger traffic using common network
- Hub and spoke model used by some railways with a large system served by smaller railways
- Mining railways tend to connect mines with market or port or to consumer factories
- Closed group railways – normally internal – steel plants, sugar cane, power plants etc
Freight systems...

- In a mixed system:
  - Stations can be approx 10 kilometres apart as required for crossing both goods & passenger trains to board / deboard
  - Stations deal with passengers also – more staff and passenger facilities including platforms
  - Safety systems elaborate in view of passengers
  - Stations bigger with more lines and area
  - Higher operating & maintenance costs
  - Higher investments on above accounts
Freight systems

- In a normal pure freight system:
  - Stations are smaller & can be 25+ kilometres apart as required only for crossing with less staff and no passenger amenities – less cost
  - Since no passengers, safety systems are simpler and cheaper
  - No passenger dealing hence less staff needed
  - Lower operating and maintenance costs
Heavy Haul

- Heavy haul implies train loads over 8000 tonnes and axle load 25 tonnes or more – International Heavy Haul Association based in USA – normal axle load 16-20 tonnes
- Normally used by mining and large railways for heavy ore movement – longer loops, stations further apart, basic signalling
- Other commodities suited to Heavy Haul – paper, steel, coal and steel products
- The record for heaviest haul train by BHP Billiton, Australia – 99734 tonnes (6 locos and 682 wagons)
Heavy Haul train
Heavy Haul

- Containers moved on train – intermodal transport
- US and Canada developed system of double stack container movement – container lengths also increased from 40 ft to 53ft – also needs Heavy Haul
- HH infrastructure needs high technology special maintenance due to higher stresses on track and wagon - more capital cost for track / rolling stock
- Long trains with multiple locos & drivers only in front loco
- Unit cost of transportation lower as Signalling, station, staff, fuel costs lower and throughput much higher
Double stack container train
Long Haul

- Longer trains at normal axle loads
- Longer loop lengths required to accommodate longer trains
- Infrastructure costs lower – track same, signalling, staff, fuel, stations costs lower
- No increase of technology level needed
- Ideal for gauge conversion situations
- Provides increased throughput without additional investment
Hub and Spoke system
Hub and Spoke

- Major railway system runs long distance trains
- At hubs one or more companies run spoke lines
- Traffic is aggregated by spoke railways at each hub to form a unit train for each destination
- Hub railway moves the train from one hub to another destination hub
- Spoke railways distribute to final destination through spokes
- There are separate companies which specialise in hub and spoke operations
Dedicated Freight Corridor

- In mixed railways with large freight and passenger volumes, dedicated freight corridors built to separate passenger from freight substantially
- Build separate freight network connecting high density routes to serve goods transportation
- Can be operated on heavy haul or long haul as required by system
- Improves both passenger and freight productivity and reduces costs
Heavy haul wagons

- Loading per wagon is much higher
- Wagon payload (wt. of goods carried) to tare (wt. of empty wagon) ratio becomes vital
- Wagons made lighter with advanced steel to reduce tare weight
- Payload to tare ratio normally 2-3 in normal railway systems
- In heavy haul payload to tare ration as high as 6-7
Freight Corridor Features

- Movement envelope can be increased for wagons to carry higher payload
- Signalling systems simple, inexpensive – some railways dispensed with ground signalling – Satellite to driver signals
- Allows private investment in rolling stock – wagons / terminals can be funded by companies
- Improves passenger network capacity also.
Freight System Selection

- Networks with lower freight and passenger traffic require normal mixed system.
- Large passenger carrying systems can segregate freight through freight lines rather than corridors.
- Large pure freight systems can use either Heavy Haul or Long Haul systems or a mix depending on major commodities carried.
- System selection must provide optimum cost of transportation.
Appreciate the patience of participants. Thank you!

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