Transportation Engineering II: Highway Design & Railways

Lecture 2

COMPONENT, ALIGNMENT

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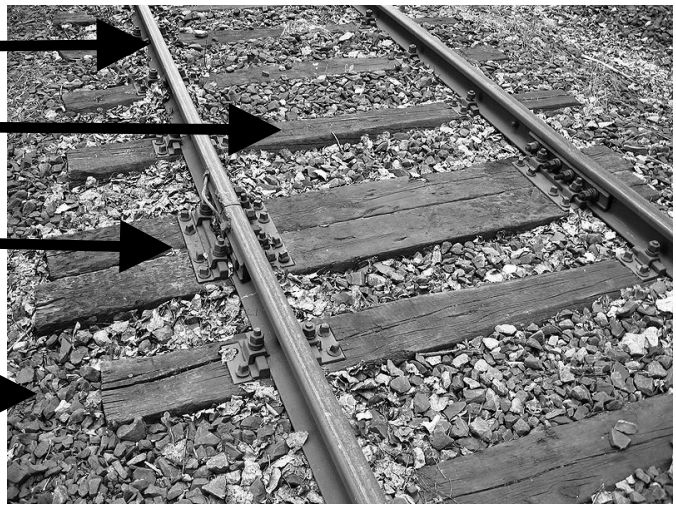
Permanent Way

- Permanent way = The railway track
- Typical components
  - Rails
  - Sleepers (or ties)
  - Fasteners
  - Ballast (or slab track)
  - Subgrade

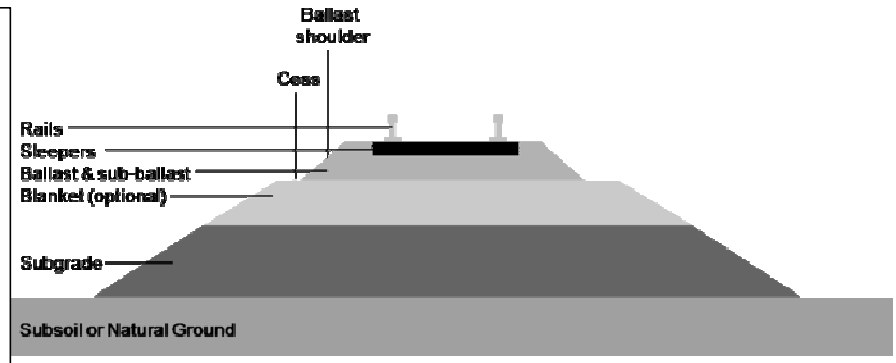
Permanent Way

A typical twin track

Components



Components



- What are the advantages of using rails in the railway?

Functions of Components

Rails: Provide a continuous and level surface for train movement, provide lateral guidance to the train wheels, bear the wheel load

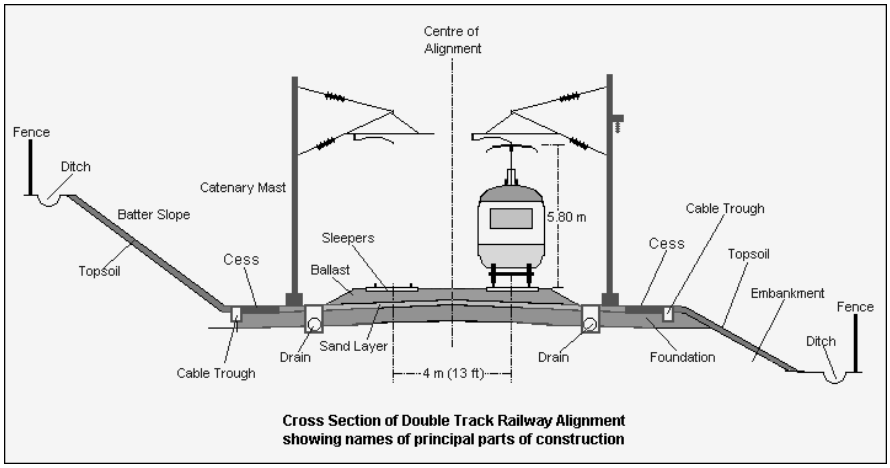
Sleepers (ties): Hold rails in correct alignment and spacing, provide firm and even support to rails and transfer load to a wider area of the ballast

Fasteners: Fix rails to sleepers

Ballast : Transfer and distribute loads to the subgrade, help drainage

Subgrade: Transfers and distributes loads to soil (stabilized) layer

Principal Components of an Electric Railway



Cross Section of Double Track Railway Alignment showing names of principal parts of construction

Source: http://www.railway-technical.com/track.shtml

Variations: Stabilized Ballast

High speed rail, Japan: Mats have been added to stabilize the ballast

Variations: Ballastless Track

High Speed Rail, China: Ballastless tracks

Alignment of Railway

- Alignment = direction and position given to the railway track on the ground in horizontal and vertical planes
  - Horizontal: straight and horizontal curvature
  - Vertical: level track, gradient, vertical curve
- Importance:
  - Alignment ensures safety and speed
    - Changing alignment later can be very costly

Requirements of Ideal Alignment

- Basic purpose of construction should be served
  - Strategic considerations
    - Developing backward areas, connecting new trade centers, shortening existing rail distances
  - Political considerations
- Should be integrated with development
  - Land-use plan and other development activities

Requirements of Ideal Alignment

- Should be as economic as possible
  - Shortest route
  - Construction and maintenance
    - C: Balanced cut and fill, minimum rock cutting, drainage along watershed line
    - M: Avoid steep gradients and sharp curves (-> minimize wear and tear of rails and rolling stock
  - Operational:
    - Provide easy gradient, avoid sharp curves, adopt direct route

Requirements of Ideal Alignment

- Ensure safety and comfort
  - Transition curve, safe gradients (typical gradient 1 in 80)
    - The *steepest railway gradient* is the Leas Cliff Railway, found in Folkestone England, where two gravity powered trains travel up and down a slope of gradient 1:1.64. What makes this even more WOW-worthy is the fact the railway is 123 years old, and the trains are powered by water!
- Aesthetic considerations
  - Journey should be visually pleasing
    - Avoid borrow pits, garbage disposal grounds etc.

Leas Cliff Railway

Selection of Alignment

- Selection of gauge
- Acknowledging control points
  - Cities and towns
  - Bridges and river crossings
  - Passes and saddles in hilly terrain
  - Tunnels
- Topography
  - Mountain: zigzag, switch back, spiral
- Geometric standards
- Geological formation