Bánfi Miklós
banfimiklos@kku.bme.hu

Transport technology

Basics of rail transportation

MŰEGYETEM 1782
Faculty of Transportation Engineering and Vehicle Engineering
Department of Transportation Technology and Economics

Railway

- Transportation mode where the vehicles run on rails
- Rails limit the degree of freedom to one: horizontal movement parallel with rails
- Driver can control only the acceleration of the train (parallel with rails)

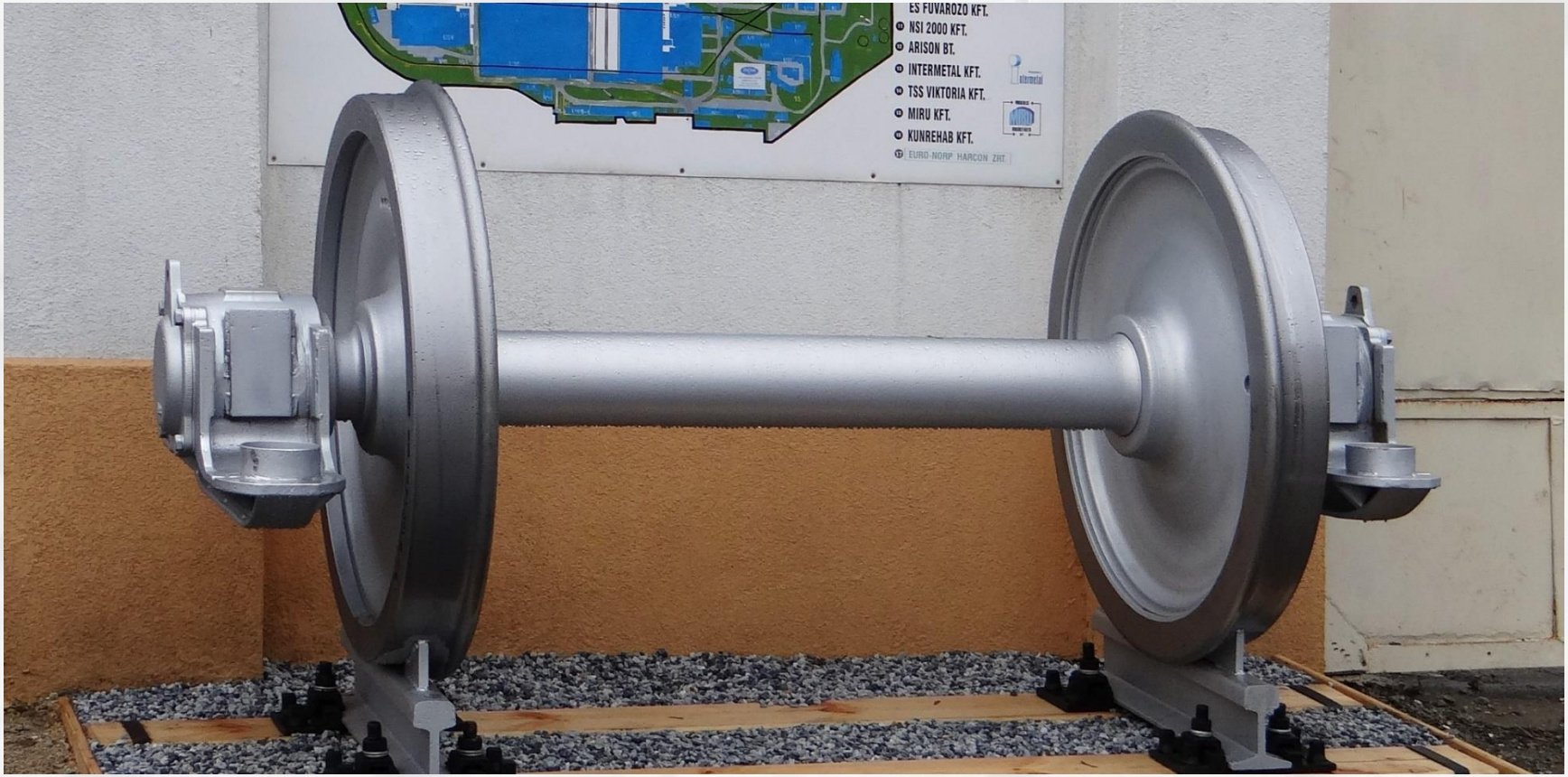
Railway

- Main types:
  - Traditional railway (metal wheel – metal rail contact)
    - National railway
    - Tram
  - Magnetic levitation technology
  - Other

Wheelset

- Truncated cone + flange
- Flange: for leading
- Cone: moving in curves (the simplest differential assembly)

How trains turn



ELEMENTS

Elements

- Rolling stock
  - Vehicle pulled or pushed on rail, installed with adequate safety equipment, built for passenger or freight (or special) transportation (passenger car/coach/carriage – goods/freight wagon)

Elements

- Locomotive:
  - Self-propelled vehicle, built for moving other rolling stock

Elements

- Multiple unit
  - One/more sectional self-propelled train carriages, capable of coupling with other units

Elements

- **Trainset**: a group of rolling stock that is permanently or semi-permanently coupled together to form a unified set of equipment
- **Train**: An engine or more than one engine coupled, with or without cars, displaying markers, train staff

Elements

Railways can be separated into:

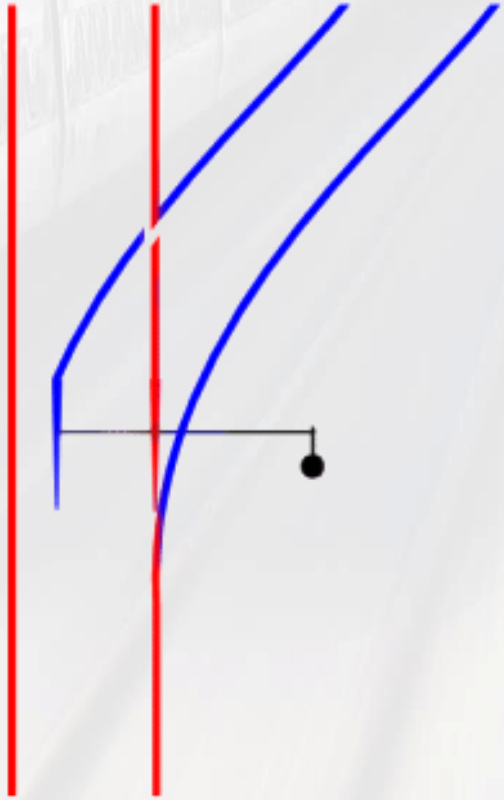
- Open lines
- Stations

Stations are the most important part of the railway in terms of traffic control.

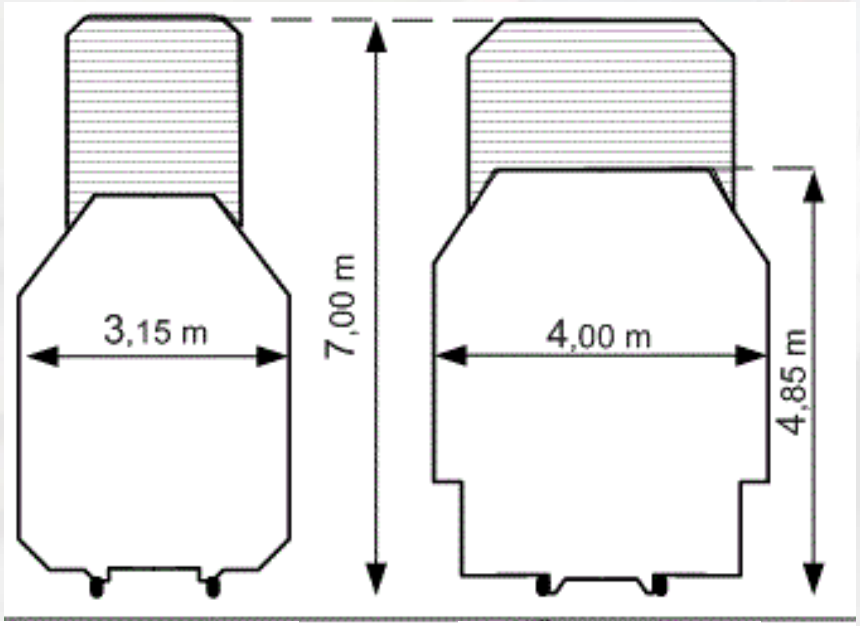
Stations are separated from open lines with signals.

Railroad switch

- A mechanical installation enabling trains to be guided from one track to another



Elements



Loading gauge (clearance)

Structure gauge

Structure gauge:

- The minimum height and width of the cross-section perpendicular to the track axis which allows the safe overpass of the trains

TRACK GAUGES

Track gauge

Track gauge: the distance between the inner faces of the rail heads
(perpendicular to the track axis)

The size of the European standard gauge:

1435 mm (56,5”)

Track gauge

- Broad gauge:
  - 1524/1520 mm (60”) – former USSR, Finland (17% of the world’s rail tracks)
  - 1600 mm (63”) – Brazil (ca. 4000 km), Ireland, Australia
  - 1668 mm – Portugal, Spain

Track gauge

- Narrow gauge:
  - 1067 mm (42”)– Japan, majority of Africa (9%)
  - 1000 mm – Brazil (ca. 23500 km), Argentina, Asia, Switzerland (mountain railways, trams, rack railways) (7%)
  - Narrower gauges – tourist trains (most common: 760 mm/30”)

TRAIN DRIVING SYSTEMS

Train driving systems

- Steam engine
- Electric engine
- Diesel engine

Transmissions:

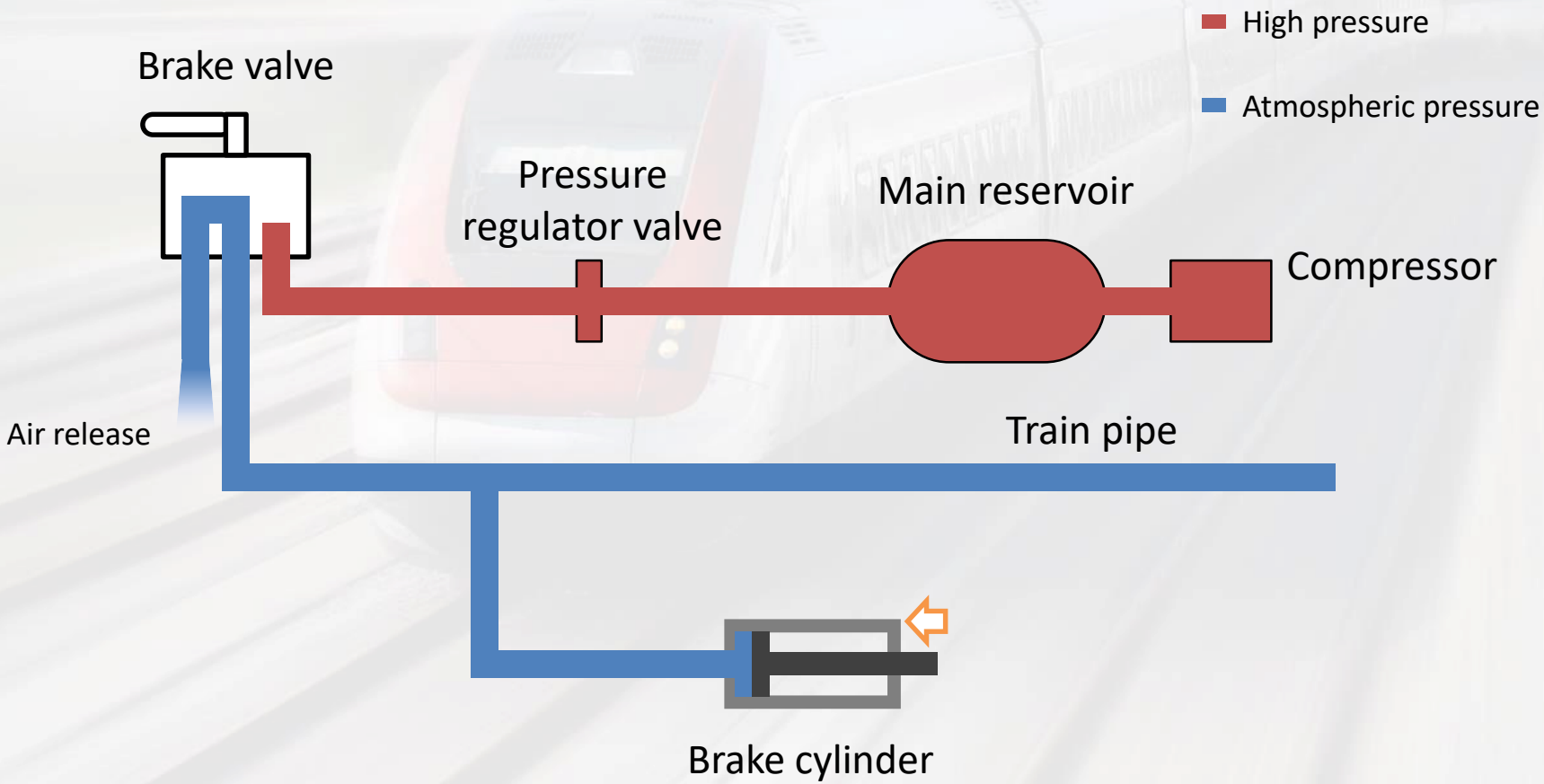
- Electrical
- Mechanical
- Hidraulic

TRAIN BRAKING SYSTEMS

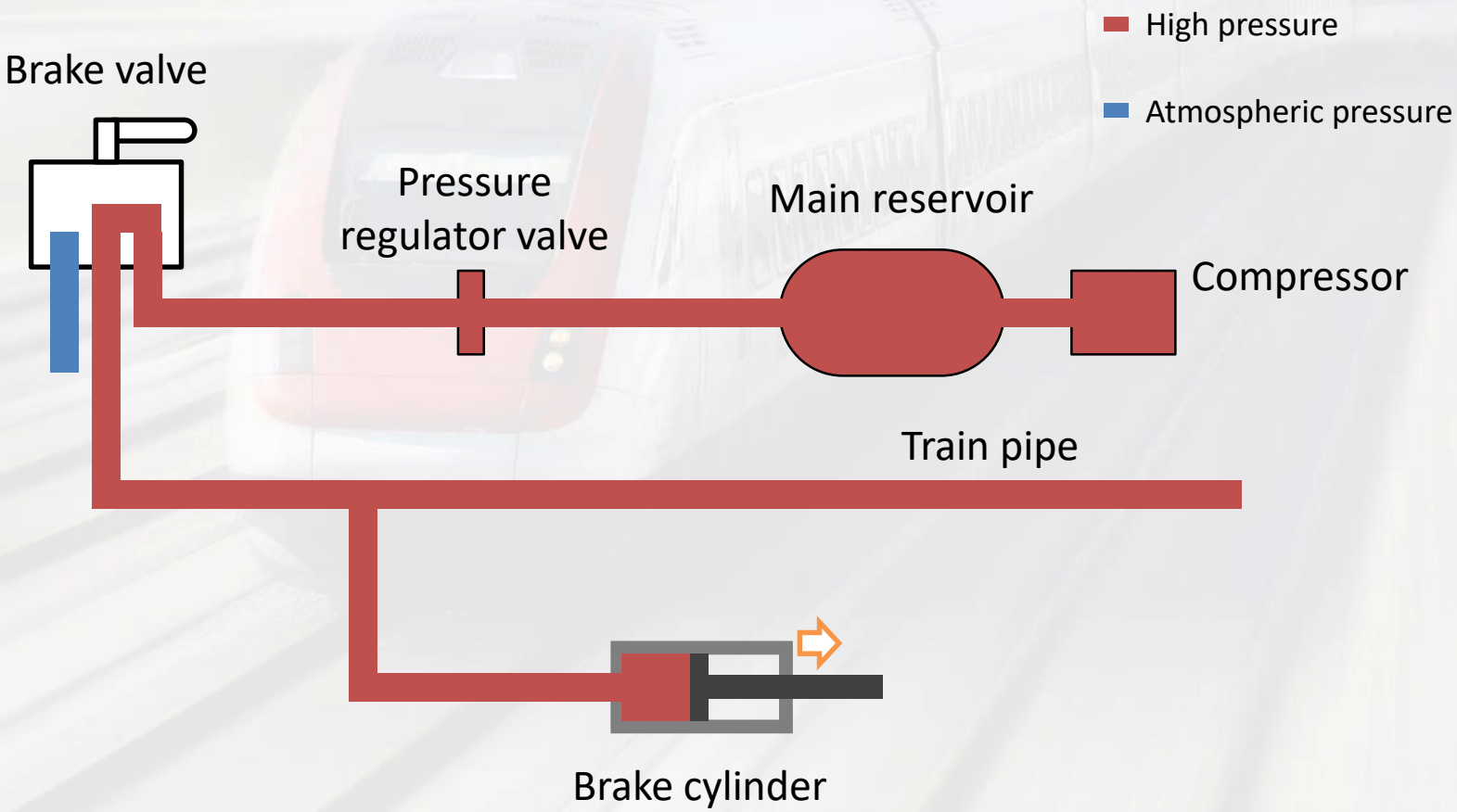
Train braking systems

- Mechanical brakes
  - According to the place of the friction:
    - Clasp brake
    - Disc brake
  - According to the origin of the friction force:
    - Air brake
    - Springforce storage
    - Mechanical parking brake
- Electrical brake
- Track brake

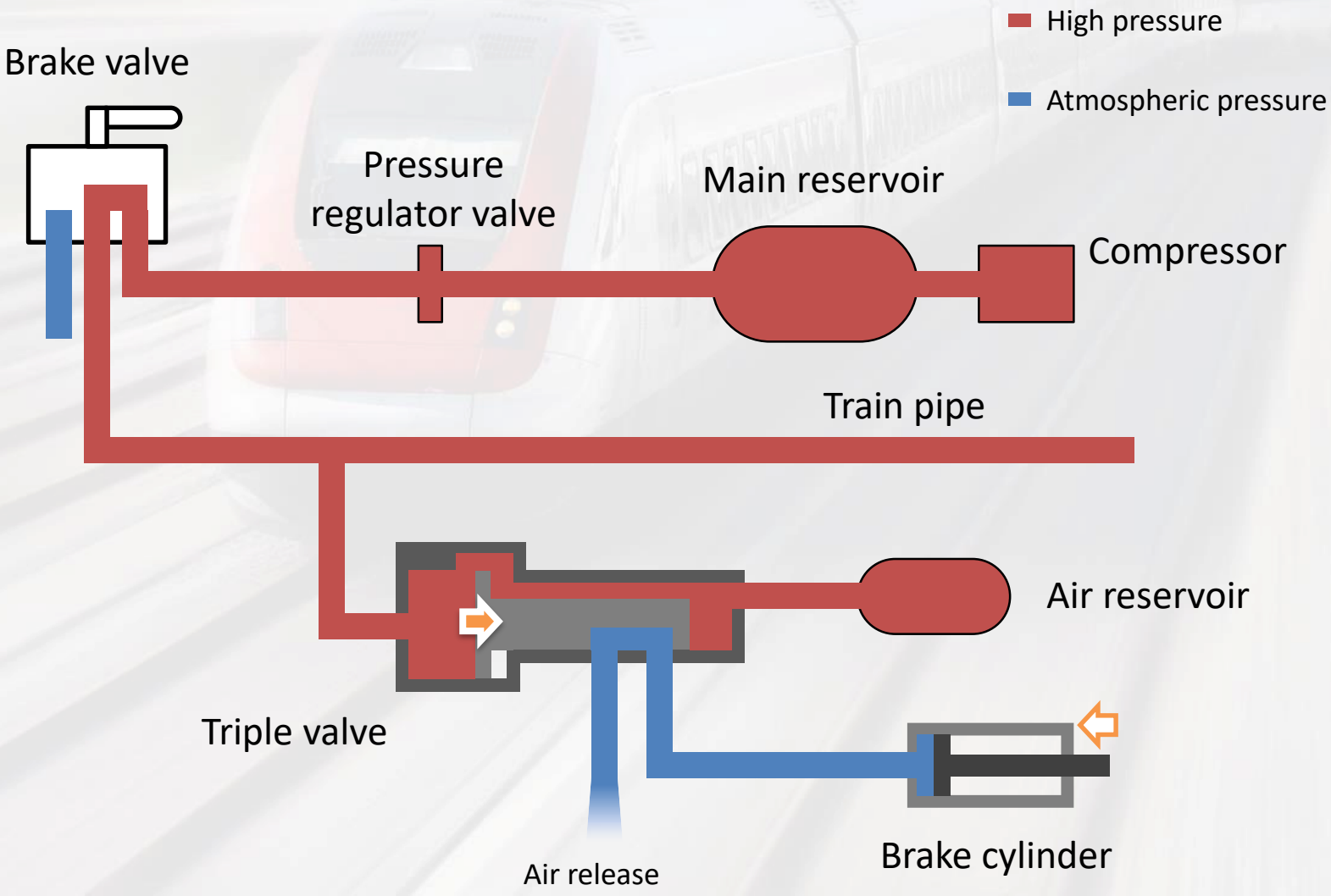
Non-automatic air-brake Release



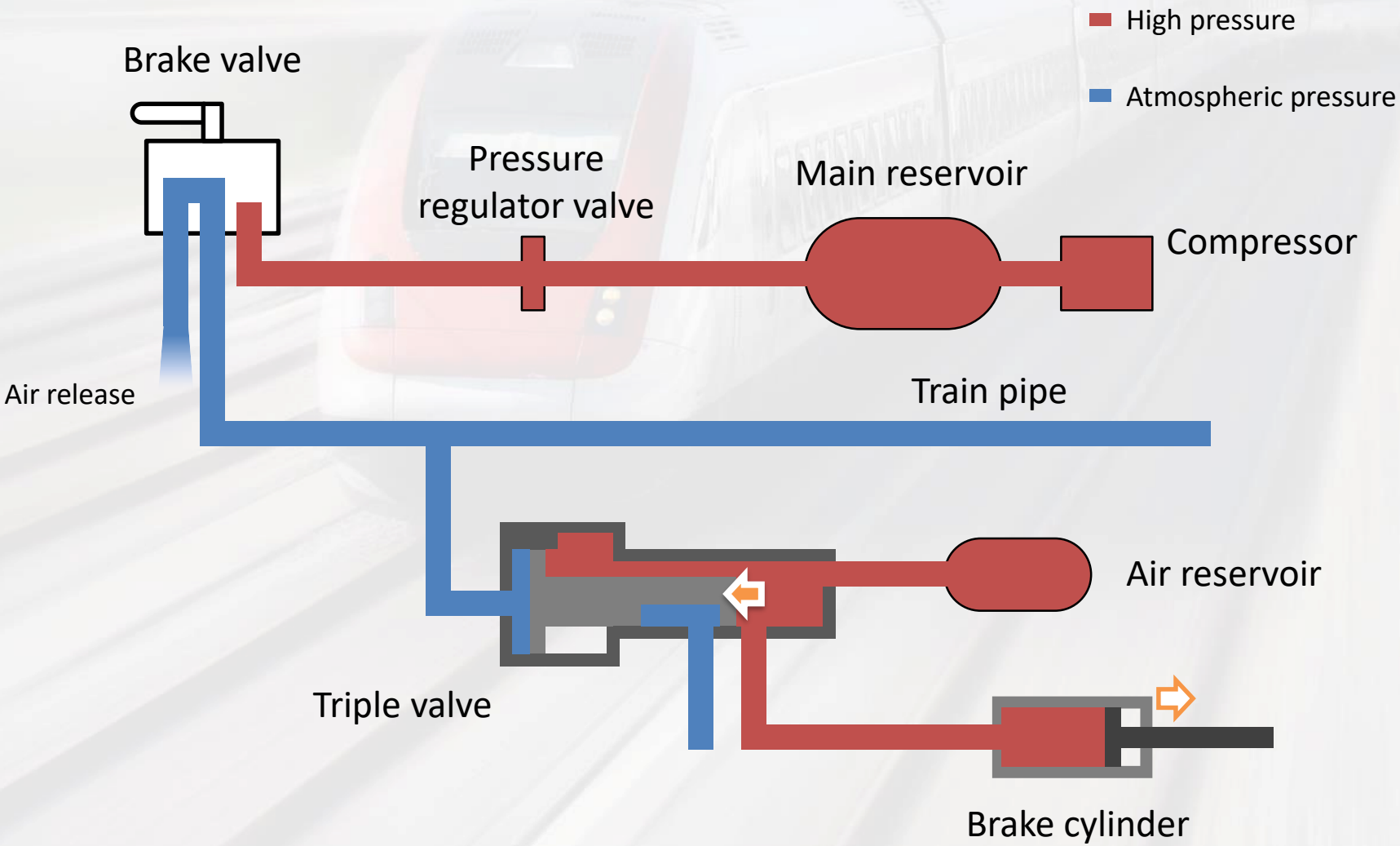
Non-automatic air-brake Braking



Westinghouse air-brake Release/Charging

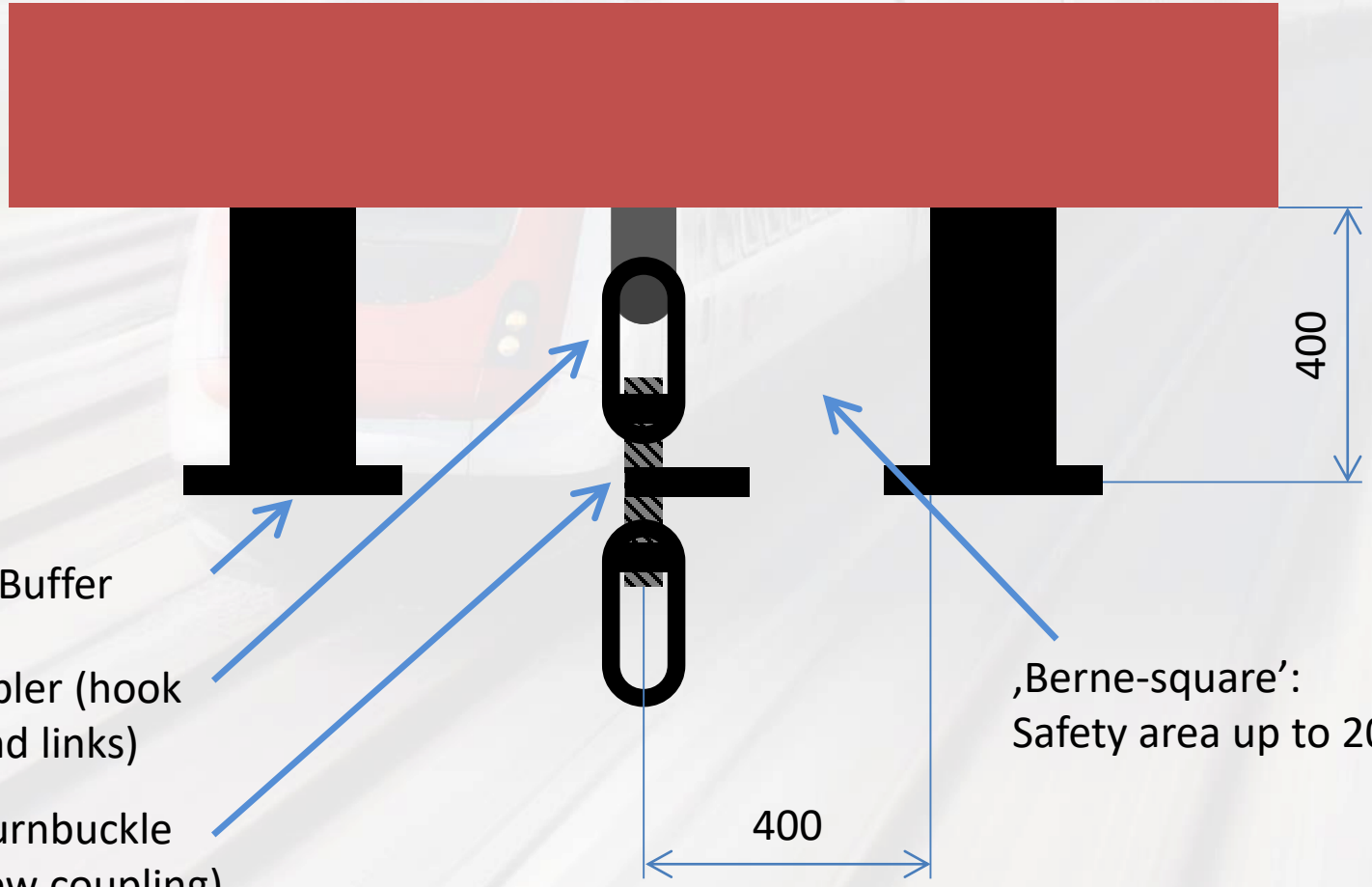


Westinghouse air-brake Braking



COUPLING OF RAIL VEHICLES

Buffer-and-chain coupler

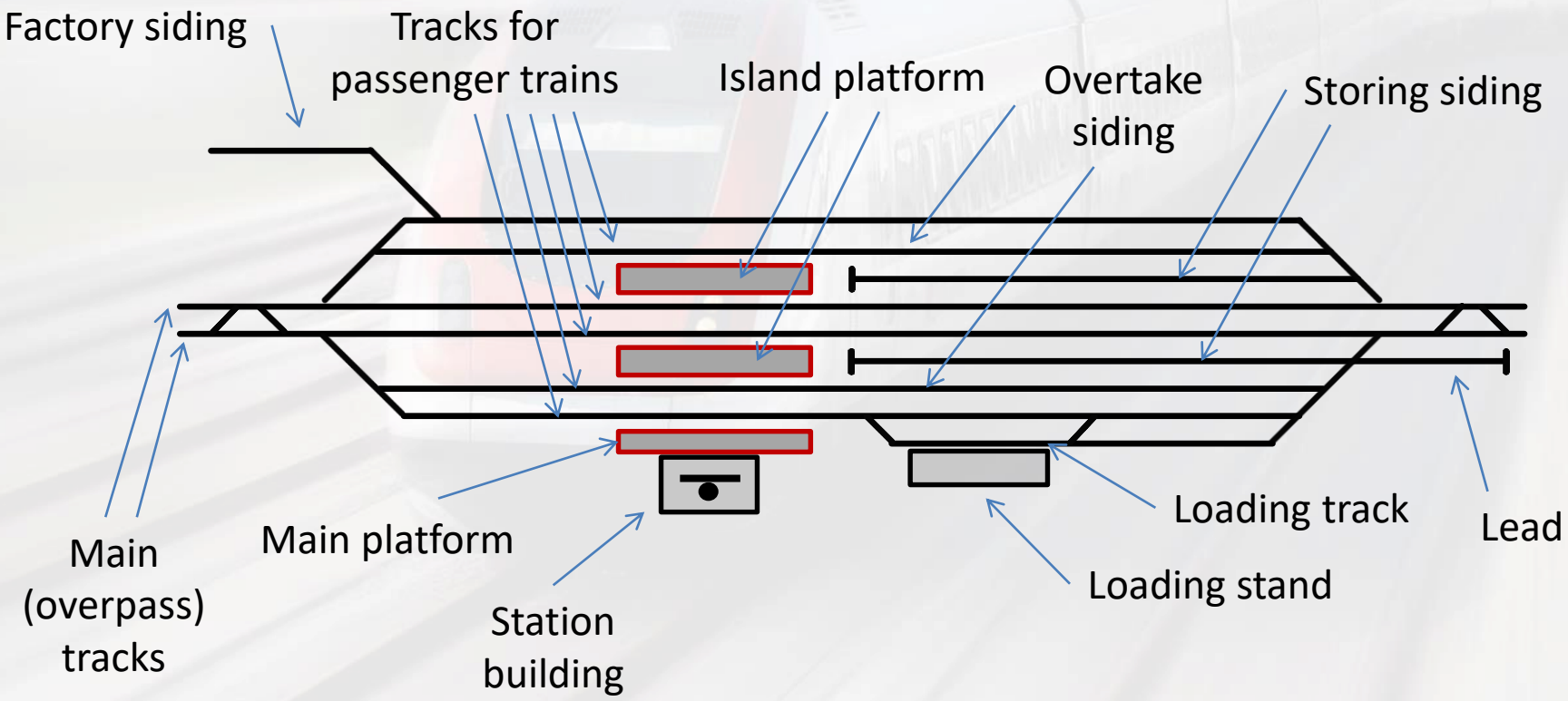


STATIONS

Stations

- Separated from open lines with signals
- The most important part of the railway in terms of traffic control
- Main functions:
  - Supporting the transport as scheduled in the timetable (traffic control)
  - Passenger transport
  - Freight transport
  - Rolling stock examination

Station tracks



STATION TYPES

Open line services

- Stops (Halts)
- Loading stands
- Intersections (delta-sidings)
- Factory siding intersections
- Passing loops

Stop

Loading stand

Passing loop

Station types
Functions

- (Normal) station
- Passenger station
- Goods station
- Classification yard

Station

Passenger station

Goods station

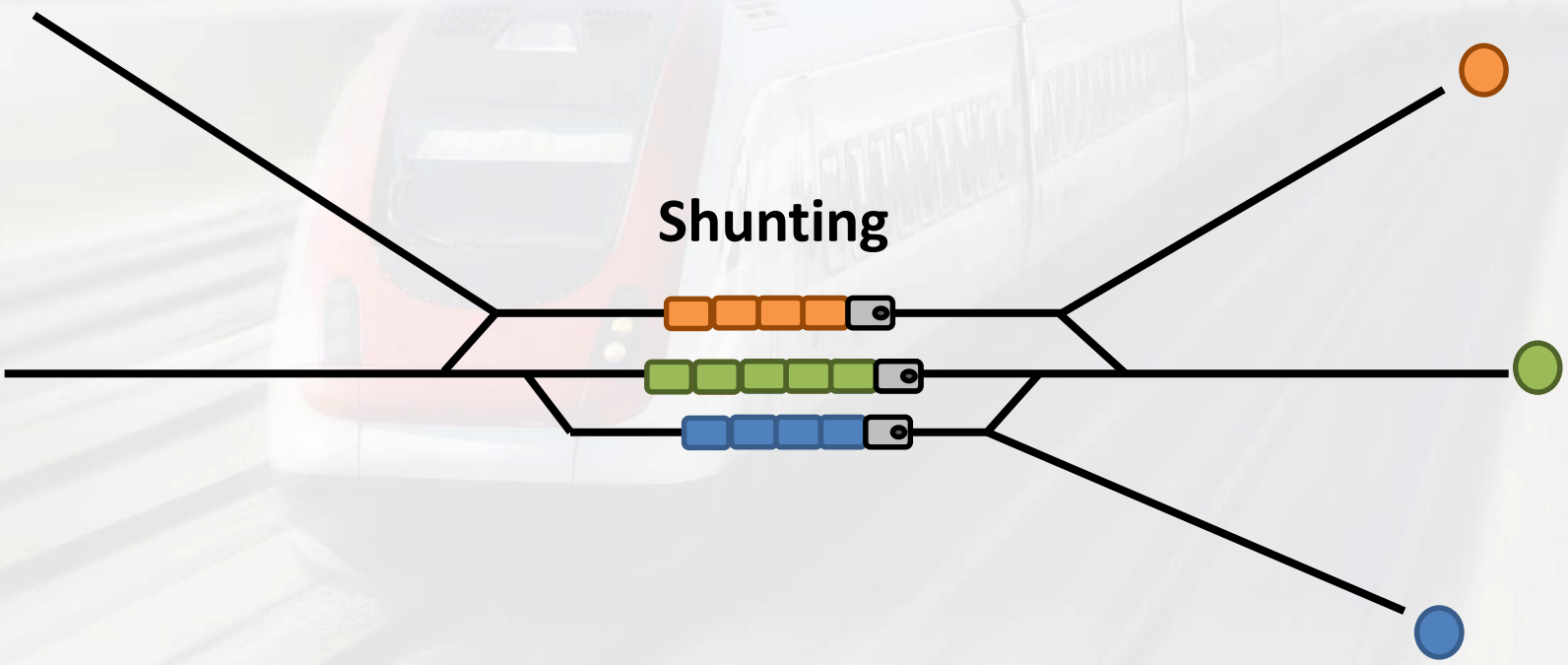
Classification yards

FREIGHT TRANSPORTATION AND SHUNTING

Freight transportation

- The basic unit of freight transportation is the **freight wagon**
- The basic unit of traffic control is the **train**
- **Wagon flow:** wagons with the same conveyance route
- Wagons with the same destination and/or conveyance route are forming a train

Shunting



Shunting: separating freight wagons of a train on to one of several tracks to form new trains

Classification yards

Freight train station with special equipments for shunting

- Flat yards
  - Shunting (with coupled locomotive)
  - Kicking
- Gravity yards
- Hump yards

During the shunting the brakes of the wagons are switched off!

Shunting with coupled locomotive

- Safe method, because the wagons are coupled to the locomotive
- Stopping of the wagons is solved by the locomotive
- Labour-intensive, slow method

Kicking

- After accelerating the loco brakes and uncoupled wagons run free to the appropriate siding
- Rail skates for the braking
- Lower safety level because of the free-running of the wagons
- Higher productivity (faster)

Gravity yards

- The wagons are pulled up to a small hump with a gradient ca. 4-6 $^{o}/_{oo}$, then uncoupled and let down
- The wagons run free and braked with rail skates at the required spot
- Safety level is the same as the shunting with tossing
- Productivity is also the same (but energy consumption is less)

Hump yards

- Before the classification tracks is a hill (hump) where a locomotive pushes the wagons over
- At the highest point the buffers compress and the wagons can be uncoupled
- On the classification tracks the wagons run free and braked with special rail brakes
- Safety level is higher than at the last two methods
- Productivity is the highest of the methods

Longitudinal profile

Longitudinal profile

Longitudinal profile

Dowty-retarders

Dowty-retarders

Thank you for your attention!