MUCK TRANSPORT SYSTEM

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MUCK TRANSPORT

The transport of the muck in tunnel project depends by:

• Size of the tunnel
• Length of the tunnel
• Logistic
• Geometrical parameter at the portal
  • Portal in trench
  • Portal in shaft
  • Portal in cavern
  • Portal at the surface
• Type of material excavated
• grade of the tunnels
• Alignment
TRANSPORT BY RAILS

LOCOMOTORS

• From a continuous system (belt conveyor in the TBM back up system) to a noncontinuous system, the wagons.
• Dimensioning the system, n. of wagons and size of the buckets, it needs to consider, production of muck for one stroke, time to exchange a loaded train and an empty convoy at the shaft and in TBM, time of unloading the train in the shaft/square.
• Slope
• The total weight of a stroke, and the wagons for the right choice of the traction system. (check the path in both the directions)
• The volume (advancement volume x 1.5)
• Friction coefficient, and environmental conditions.
• Take care in the track laying, because the derailment can decrease the production.
TRANSPORT BY RAILS

LOCOMOTORS
TRANSPORT BY RAILS

TRAIN COMPOSITION

The convoy composition has to consider not only the bucket wagons, but also the flat wagon for the transport of the segments, the wagon for the transport of material, grease, oil, for transport of personnel. It is better to have for all the convoys the same composition, in order to make easier all the operation of loading and unloading in the tunnel.
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Kurs w zakresie drążenia tuneli oraz maszyny drążącej

TRANSPORT BY RAILS

SAFETY IN TRAIN DRIVING

• DOUBLE CABIN
• TRAFFIC MANAGEMENT
• VIDEO CONTROL
TRANSPORT BY RAILS

TYPE OF WAGONS

- MOVABLE BUCKETS
- FIXED BUCKET – ROTARY DUMPING
- SIDE TILTING BUCKET

Type of wagons:
Movable bucket
TRANSPORT BY RAILS

TYPE OF WAGONS

• MOVABLE BUCKETS
• FIXED BUCKET – ROTARY DUMPING
• SIDE TILTING BUCKET
## RAILS

### Standard gauges:

- **600 mm**
- **750 mm**
- **900 mm**
TYPE OF SWITCHES

- Right switch
- Left switch
- Two tracks symmetrical switch
- Three tracks symmetrical switch
- Double switch
- Simple crossover
- Double cross over
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TYPE OF SWITCHES
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CALIFORNIAN SWITCH RAILS
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TYPE OF SLEEPERS

Wooden sleepers
Concrete curbs
Steel sleepers
Precast concrete sleepers
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TRANSPORT BY RAILS

ADVANTAGES AND LIMITS OF THE SYSTEMS

• SIMPLE AND CHEAP
• MAX PRATICABLE GRADE 3%
• NOT CONTINUOUS TRANSPORT SYSTEM
• DIESEL ENGINE IN TUNNELS IN CREASE VENTILATION
• DERAILEMENTS CAN REDUCE THE PRODUCTION
WHEELED VEHICLES

- STANDARD TRUCKS
- TURNING PLATFORM
- REVERSIBLE TRUCKS
WHEELED VEHICLES

• MULTICARS
• REVERSIBLE DRIVE TRUCKS
WHEELED VEHICLES

ADVANTAGES AND LIMITS OF THE SYSTEMS

• SIMPLE AND CHEAP
• APPLICABLE ON STEEP GRADE
• NOT CONTINUOUS TRANSPORT SYSTEM
• DIESEL ENGINE IN TUNNELS IN CREASE VENTILATION
• TRAFFIC CONGESTION CAN SLOW THE PRODUCTION
• LOT OF MANPOWER
• APPLICABLE ONLY IN LARGE TUNNEL
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TRANSPORT BY PUMPING
The slurry shield is a machine that is able to support the excavation front by the pressurised, bentonite slurry pumped into the excavation chamber. The slurry is substantially composed of a bentonite suspension in water, if necessary with some additives. The excavation chamber, called “plenum”, is a space between the excavation front and a steel bulkhead, where the excavated material is collected and mixed with the slurry. A pumping system performs the functions of feeding the fresh slurry to, and removing the muck from the plenum, through a pipeline.
TRANSPORT BY PUMPING

The flow of the system is function of density, speed of advancement, production expected.
It needs to consider that the excavated material mixed with fresh bentonite is 1/10 of the whole flow. The dimensioning of the pipes and the pumps has to consider this parameter, considering also no to undersized the system because could be a decreasing on production and advancement speed. The speed of the mixed muck has to be more than 3÷3,5 m/s to avoid the sedimentation.

When the system is sized, diameter of pipes, kind of pumps, hydraulic head, it is impossible modify the power of pumping system, that could be a limit.
TRANSPORT BY PUMPING

- It has to consider the maximum size of the materials
- steel grid between bulkhead and the pumping system to avoid the entering of boulders
- hydraulic crusher to destroy boulders
- Use of a big centrifugal pump in the back up, and use of booster pump to overcome the pressure drop along the line and help the discharge of the pumping line
- Usually the booster pumps for the discharging phase are more than the pumps for the feeding phase because the difference level from the bentonite tank in the surface and the TBM.
TRANSPORT BY PUMPING

TYPICAL CENTRIFUGAL PUMP FOR SLURRY PUMPING SYSTEM
TRANSPORT BY PUMPING
TRANSPORT BY PUMPING
CHECKING THE FLOW

It is important to check the flow by the difference from feeding and discharging, or also using densimeter. With modern nuclear density meters can be associated with flow measurement measuring the density of the mud flowing from moment to moment in the two suction and discharge pipes. From the difference you have the amount of dry material so you can understand if you have overexcavation or not and consequent problem at the front.
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TRANSPORT BY PUMPING
TRANSPORT BY PUMPING

ADVANTAGES AND LIMITS OF THE SYSTEMS

• CONTINUOUS TRANSPORT SYSTEM
• APPLICABLE ON STEEP GRADE
• FEW MANPOWER
• REDUCTION OF TRAFFIC REQUIRES LESS VENTILATION
• APPLICABLE ALSO IN SHARP CURVES
• HIGH INVESTMENT COST COMPARED TO OTHER SYSTEM
• HIGH ENERGY CONSUMPTION
• SEPARATION PLANT REQUIRED
• ENVIRONMENTAL PROBLEM
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EPB - THE SCREW CONVEYOR
The concept of the screw conveyor is to dissipate the pressure between the bottom of excavation chamber (where you screw "faces" to receive the material) which equals the design pressure and it is maximum value, and the discharge point on the first tape, at atmospheric pressure.
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EPB-SHIELD.
SCREW CONVEYOR. PRESSURE DISTRIBUTION.

- pressure screw conveyor inlet
- decreasing pressure per helix
- pressure screw conveyor outlet

Downloaded from https://www.astaldi.com/
The lower part of the bulkhead in the front shield of an EPBS must be equipped with a safety gate, which can be closed when the screw conveyor is retracted for maintenance. This allows the complete insulation of the plenum, avoiding water/material inflow during maintenance.
EXTENDIBLE BELT CONVEYOR

Sized themselves on producing top, and expressed in ton/h.
The width of the belt is dimensioned on the amount of the material excavated expected and on the speed of the advancement.
The dimension of the width is expressed in mm, for example 800 belt conveyor.
Load factor is another parameter to consider for dimensioning of the belt.

How does work this system?

As the TBM advances and digs a system ties the load point of the main conveyor to the discharge point of TBM tape, but especially the tape must somehow "follow" the path of TBM or "stretch".
To allow that the belt conveyor can follow the TBM, it is useful a belt storage.
EXTENDIBLE BELT CONVEYOR
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EXTENDIBLE BELT CONVEYOR
 STORAGE BELT CONVEYOR

The storage belt, is usually installed between the portal of the tunnel and dumping area. It is a series of postponements, to collect a certain stretch of rubber belt in a short length (usually about one third, which means for storing a 250 m long tape must be a warehouse 70 to 75 m).

As the machine advances, a device pulls the return pulley belt connected to the backup the machine itself, in the while time the storage the storage belt leaves a corresponding amount of tape.

Between pulley return drum and the rest of the tape is restored the system of rollers support and the corresponding metal elements that support the system along the tunnel.

The storage could be horizontal or vertical, it depends by the area, from the logistic problems.
EXTENDIBLE BELT CONVEYOR

- TYPE OF SUPPORT
- KNEE BRACING
- BOOSTER STATION
EXTENDIBLE BELT CONVEYOR

ADVANTAGES AND LIMITS OF THE SYSTEMS

• CONTINUOUS TRANSPORT SYSTEM
• APPLICABLE ON STEEP GRADE (20%)
• FEW MANPOWER
• REDUCTION OF TRAFFIC REQUIRES LESS VENTILATION
• NOT APPLICABLE IN SHARP CURVES
• HIGH INVESTMENT COST COMPARED TO OTHER SYSTEM
• ONE/TWO SHIFT STOPPAGE TO EXTEND BELT EVERY 200 m - 300 m
SPECIAL TRANSPORT SYSTEM

VERTICAL CONVEYOR BELT
SPECIAL SYSTEM OF TRANSPORT

SKIP SYSTEM
WAGON LIFTING SYSTEM
THANK YOU FOR YOUR ATTENTION!!