Rowa
Customer Day

Niagara Falls -
Sir Adam Beck

The worldwide largest open TBM with 14.4m diameter creates great challenges for the back

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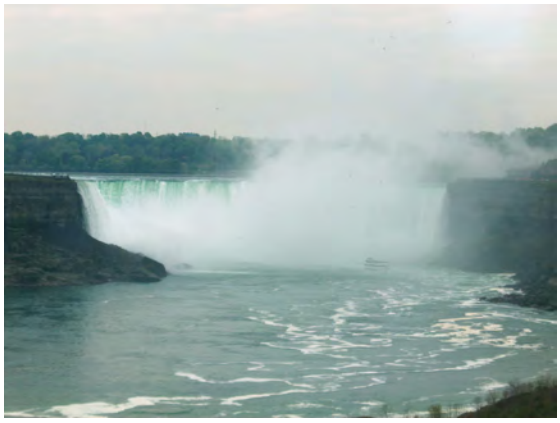

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2 About the project

The Sir Adam Beck hydroelectric power plant, which was built in 1958 and is the largest of its kind in Ontario, is currently being enlarged.

The enlargement covers the construction of a 10.4 km tunnel with a drill diameter of 14.4 m and ascending gradients of -7.8% / + 0.1 % / + 7,3% under the city of Niagara Falls in order to supply more water to the existing power plant and to reduce the erosion of the Niagara Falls (0.6 m / year).

From 2009 the power plant will increase its energy production by 1,600 gigawatt hours to 13,400.

Strabag AG of Austria, the principle contractor responsible for this enlargement project, contracted Rowa Tunnelling Logistics AG to develop, produce and deliver the back-up system for what is presently the world's largest Gripper TBM with a drilling diameter of 14.4 metres.

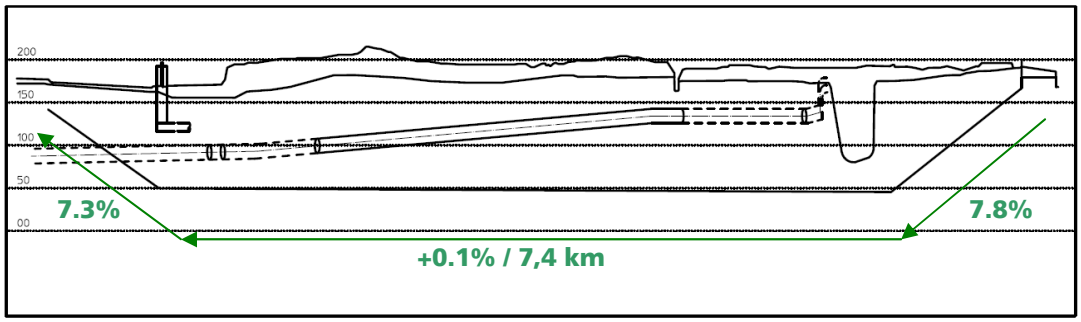
The search for solutions for better conditions of work, safety work places and increased efficiency let develop us again and again products, which cause a sensation on the market

In this respect, Amsteg was already a quantum leap. Now it applied to continue this and to master successfully further challenges like larger productivity and higher creation of value.

3 Particularities

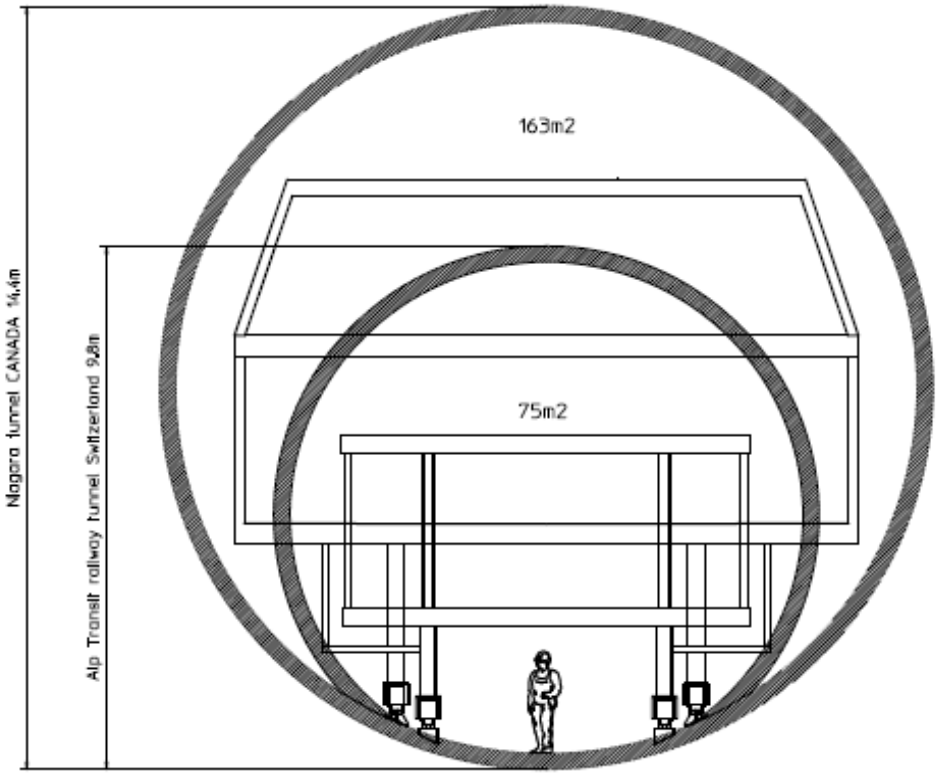
Longitudinal Profile

One special feature of this job is the varying gradients. Initially the TBM bores into the subsoil at a descending gradient of 7.8%, then continues almost horizontally for approximately 7.4 km, surfacing again at an ascending gradient of 7.3%. This calls for numerous special design features. In particular, all machines have to be specially adapted for descending and ascending advance.



Picture: Routing

Dimensioning



A back-up system, which had so far a diameter of 10 meters, increases at one time to 14.4 meters. This is one and a half time so large. Here, we are in much different dimensions with respective challenges.

4 Challenges

- **Logistics**
  Sophisticated logistics for supply and removal
- **Diameter**
  Command of big diameters of 14.4 m by:
  - direct supply ways
  - good connections between individual working levels
  - Command of the longitudinal displacement of 1.1 m in descending gradient from the roof head to the floor, as well as surmount of big hights.
- **Ascending- and descending gradient**
  Lining of tunnel, ascending and descending;
  This has enormous effects for all mobile parts, since the devices must be laid out both for rising and falling heading.
- **Rock protection**
  Rock protection directly behind the boring head with safe and mechanized working platforms.
- **Adaptability**
  for different geologies, which requires a high flexibility during the installation of the different supporting equipments.
- **Job safety and Health protection**

Picture: Overall view of back-up system

5 The Concept

Back-up System

The back-up system (total length 105 m) is constructed on four tiers and consists of four back-up train components.

Picture: Overall view back-up system

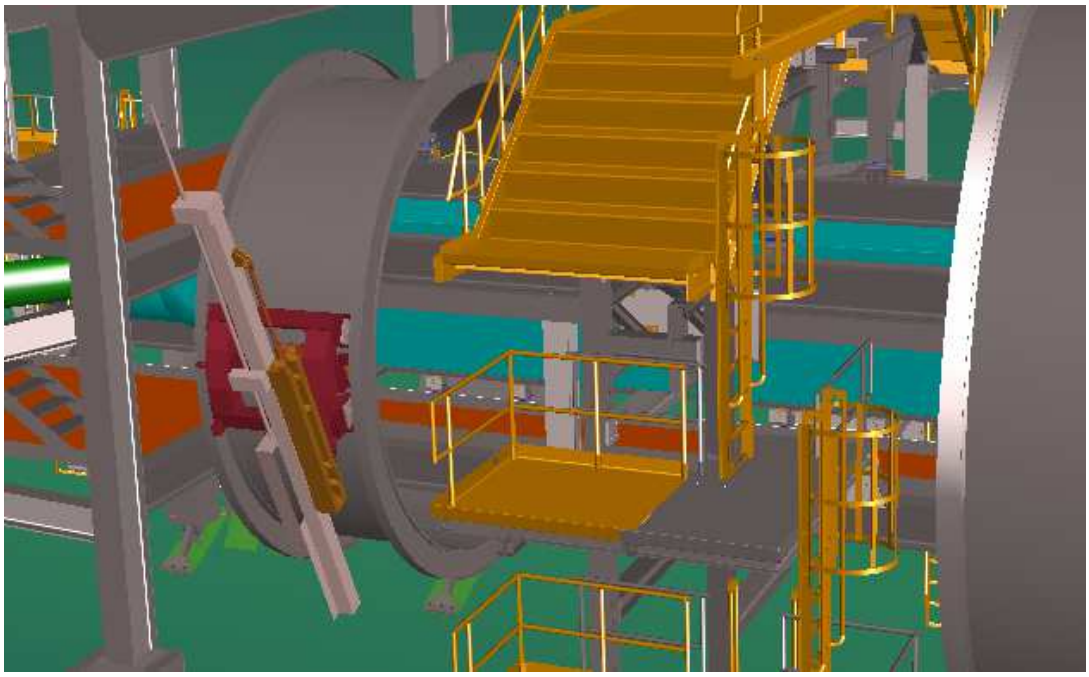
Stepper

The first element, the consolidation waggon, is installed with a stepper because it is located immediately behind the boring head and as yet no suitable line is in place there for this procedure.

Picture: Stepper

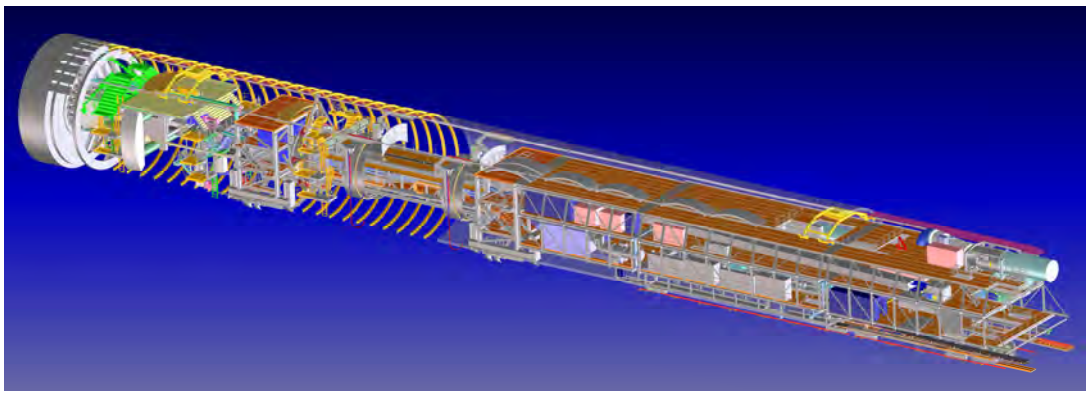
Rock-bolting Device

Two rock-bolting devices are fitted on the consolidation car (NL1). These can bore and displace rock bolts to a length of 6 m. The car is also equipped with two longitudinally moveable shotcrete robots with a spraying range of 360°, and an 8-metre longitudinal track as well as two longitudinal drivable working platforms for the unhindered entrance into the tunnel.



Picture: Rock-bolting Device

The other wagons are pulled on crawler tracks. In addition to this is the infrastructure for operation of the advance system, dedusting and ventilation systems, shotcrete installation, cooling and waste water systems, as well as the installation site for the tunnel conveyor extension. The excavation material is removed using a hauling lift from the machine belt via the back-up train belt and the tunnel belt straight to the disposal site.



Layout 3D: Overall view back-up system

Shotcrete Robot

A new development is the use of a shotcrete robot in the TBM sector directly behind the flight conveyer. The shotcrete robot ensures rock protection in horizontal stratified rock and has a spraying range of 200°.

Picture: Shotcrete robot L1 immediately behind flight conveyer

Overhead travelling crane

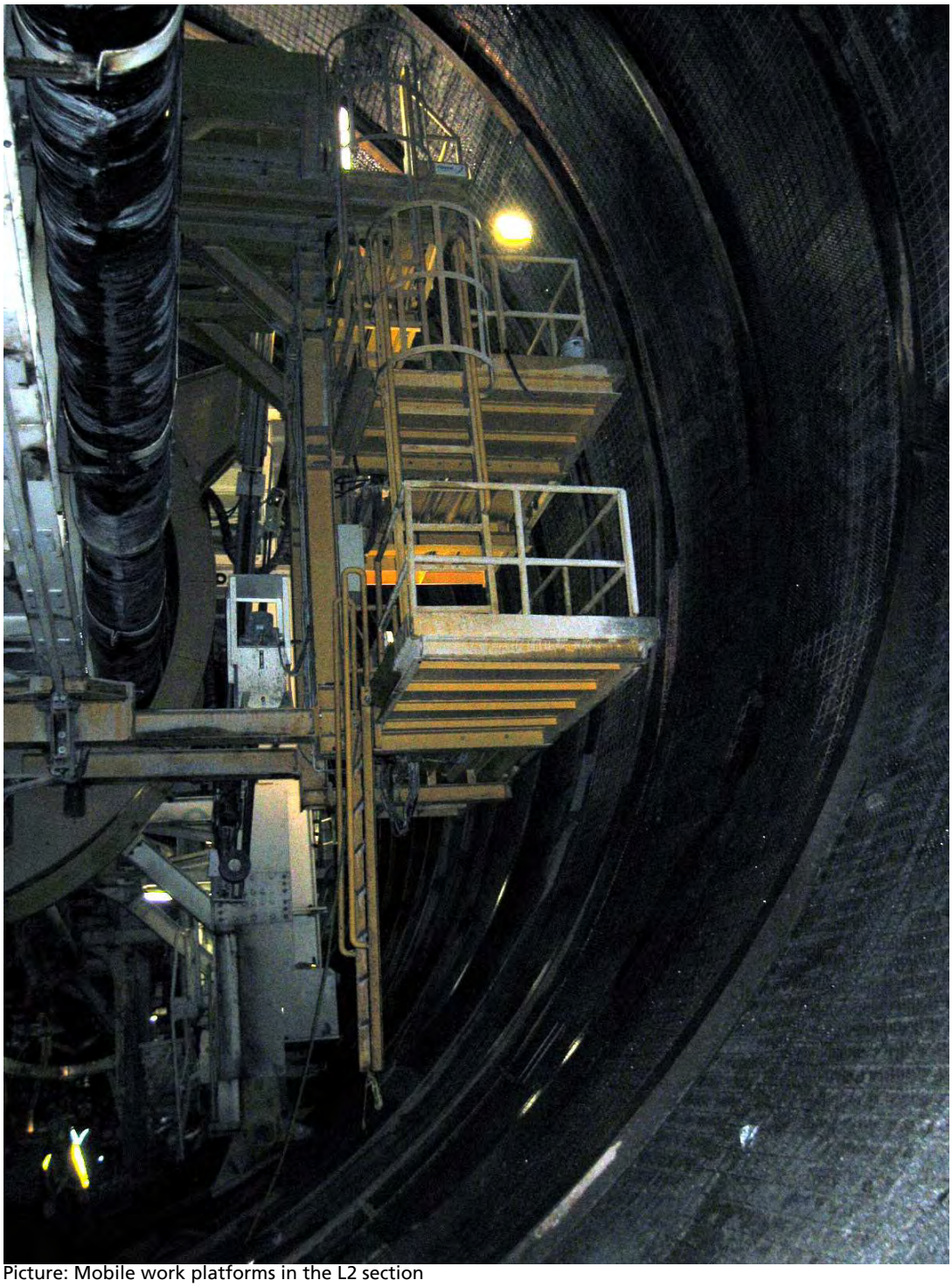
A two-track overhead travelling crane is suspended from the roof of the tunnel. This crane must, because of the lining of the tunnel, take over loads and transport them safely not only in ascending gradient, but also in descending gradient,. To guarantee an optimal supply logistics, the overhead traveling crane – which is separated from the back-up installation – can transport materials from the transport vehicles to the installation place directly behind the boring head.

Picture: Overhead traveling crane

An integrated swivelling telescopic arm is installed in the overhead travelling crane, to supply any point, from the roof heads to the floor. This type of high decreed mechanisation delivery, produce a remarkable increase in efficiency.

Mobile work platforms in the L2 section

Necessitated by the large boring diameter, the new work platforms ensure safe and comfortable working conditions when displacing the rock bolts, meshes and ring beams and while conducting other work.



Picture: Mobile work platforms in the L2 section

6 First Experiences

In the meantime, scarcely 1000 m heading are made and we have already first experiences in this tunnel behind us.

Picture: Rear of back-up train

We state that Rowa over long distances and time distances could integrate itself well into the new culture area.

Ladies and Gentlemen, we are proud to be part of the Ontario project and master this challenge. The exchange of know-how and experience overseas is very valuable for us and we means, it is a win-win situation for both sides.

We are pleased that we can carry out our part for the current supply of a whole region and that we can make a contribution to the conservation of the world-famous Niagra Falls. As time permits, sometimes in the future we will emerge from the tunnel and will be able to admire the Niagra Falls from above.

Many thanks.