

## CURRENT STATUS OF THE SEMMERING BASE TUNNEL

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### ABSTRACT

The tunnel construction work for the Semmering Base Tunnel (SBT) is now in its final phase. Approximately 98 % of the required tunneling has been completed and installation of the tunnel equipment has already begun.

The *Gloggnitz* and *Göstritz Ost* drifts are the final tunneling challenges, with around 450 m of highly geologically challenging tunnel excavation remaining in both tracks.

Tunnel lining work in the constructed sections of the Semmering Base Tunnel is progressing rapidly and has even been partially completed (western section of construction lot *SBT2.1*).

The renovation and rebuilding of *Mürzzuschlag* station is now entering in its final phase. To date, new tracks and platforms have been constructed, including platform roofs. A reception building, station forecourt and a large Park & Ride facility on the north side of the station have also been built.

The tender for the track equipment, *SBT4.1 GU Tunnelausrüstung*, was prepared in parallel with the ongoing construction work and is currently in the award phase since its publication in June 2023. The first stage of the tender for the slab track (*SBT5.1*) has also already been published Europe-wide. This will ensure the technical equipment starts in mid-2025 and the slab track is installed by mid-2027.

*Keywords: Semmering Base Tunnel, railway tunnel, Trans European Network, Baltic Adriatic rail corridor*

### 1. INTRODUCTION

The Semmering Base Tunnel (SBT) is a crucial component of the new southern line (Vienna – Graz – Klagenfurt), measuring approximately 27 km in length. Located between the stations of *Gloggnitz* (in the east) and *Mürzzuschlag* (in the west), it overcomes a continuous gradient of about 8.4 ‰ and a height difference of about 230 m. It consists of two single-track tubes connected by cross-cuts at least every 500 m and is equipped with an emergency station approximately in the middle of the tunnel (Figure 1).

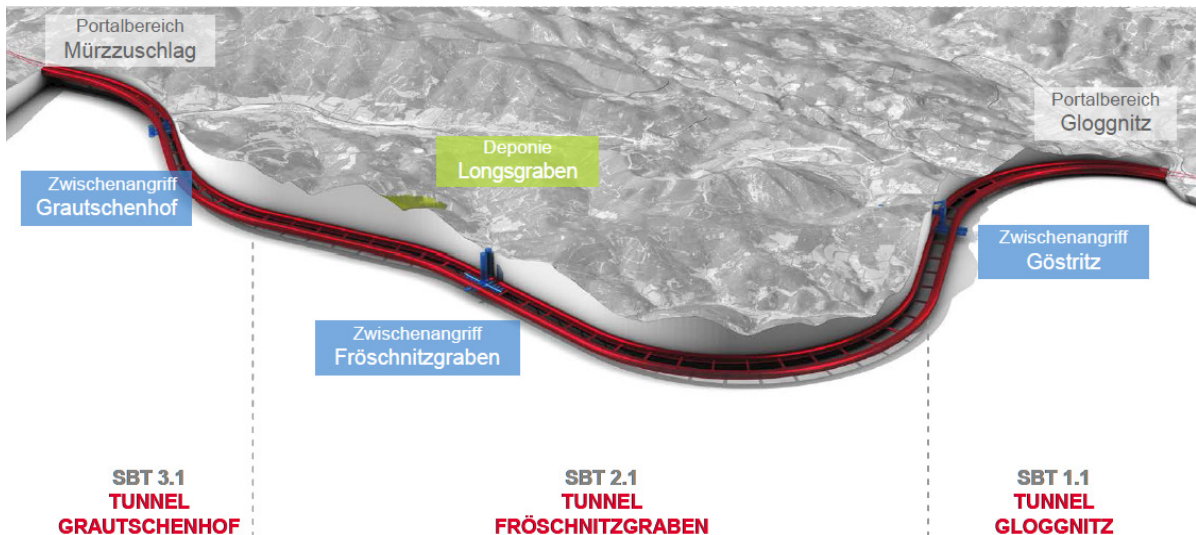


Figure 1: Overview of the Semmering Base Tunnel

In the standard profile, the two tunnel tubes have a clear cross-section of 41.65 m<sup>2</sup> (cyclic excavation) and 42.71 m<sup>2</sup> (continuous excavation). The spacing between the two tubes for the track is determined by the geological conditions and route requirements, ranging from 40 m to 80 m.

The tunnel will be constructed in the following phases:

- PGG – *Gloggnitz* portal construction site
- SBT1 – *Gloggnitz Tunnel*
- SBT2 – *Fröschnitzgraben Tunnel*
- SBT3 – *Grautschenhof Tunnel*
- PMZ – Renovation of *Mürzzuschlag* station

The first section, the *Gloggnitz Tunnel*, is approximately 7 km long and starts at the *Gloggnitz* portal. It includes the *Göstritz* intermediate access, which has a 1 km long access tunnel with two 250 m deep shafts and is being built using the conventional NATM tunneling method.

The second tunnel construction lot, *Tunnel Fröschnitzgraben*, is approximately 13 km long. In this construction lot, two 400 m deep shafts were built first, which will serve as tunnel ventilation shafts later. Furthermore, an emergency station approximately 900 m in length was constructed at the base of the shaft. From this point, two TBM excavations of approximately 9 km (in the direction of *Gloggnitz*) and two cyclic excavations of approximately 4 km (in the direction of *Mürzzuschlag*) were carried out. The primary challenge in this construction lot is logistics, as the entire construction site must be served by the two 400 m deep shafts.

The construction lot for the third tunnel, known as *Grautschenhof Tunnel*, is situated in the west and has an intermediate access near the S6 Semmering motorway. Four tunnel excavations, with a total length of approximately 7 km, start from here and are supplied via two shafts, each 200 m deep.

The *Semmering Base Tunnel* will be integrated into the existing structure in the west at *Mürzzuschlag* station. The station will be built using the cut-and-cover method, while rail operations continue. The station will include platforms, station roofs, passenger tunnels, elevator facilities, a heritage-listed reception building, a Park & Ride facility, and a bus station.

## 2. PROJECT STATUS

Around 98 % of the tunneling work for the Semmering Base Tunnel has been completed successfully to date. Ten of the initial 14 drifts have been finished, with only the *Gloggnitz* and *Göstritz Ost* drifts (both construction lot *SBT1.1*) still under construction.

### 2.1. Status of the Excavation Work

All excavation works for construction lot *SBT2.1* were successfully completed, i.e., *Fröschnitzgraben West* in February 2021 (track 1) and July 2021 (track 2), and *Fröschnitzgraben East* (TVM excavation) in December 2021 (track 1) and January 2022 (track 2). The *Göstritz West* drift (construction lot *SBT1.1*) was also finished shortly afterwards in June 2022 (track 2) and October 2022 (track 1) with the breakthrough from *SBT1.1* to *SBT2.1*.

In March 2023, the drifts of construction lot *SBT3.1*, *Grautschenhof East* (tracks 1 and 2) were completed with the breakthrough from *SBT3.1* to *SBT2.1*, and the drifts *Grautschenhof West* in June 2023 (track 1) and September 2023 (track 2). Completion of *SBT3.1* to the cut-and-cover method *PMZ2* ended with the breakthrough of the tunnel (Figure 2).



Figure 2: Breakthrough celebration SBT3.1 – PMZ2

This means that only the *Gloggnitz* and *Göstritz East* drifts remain to be bored, with a total length of around 450 m. Due to the so-called Grasberg-Nordrand fault (Lower Austria), which has to be overcome, these drifts are extremely challenging and complex in terms of tunnel construction (Figure 3).

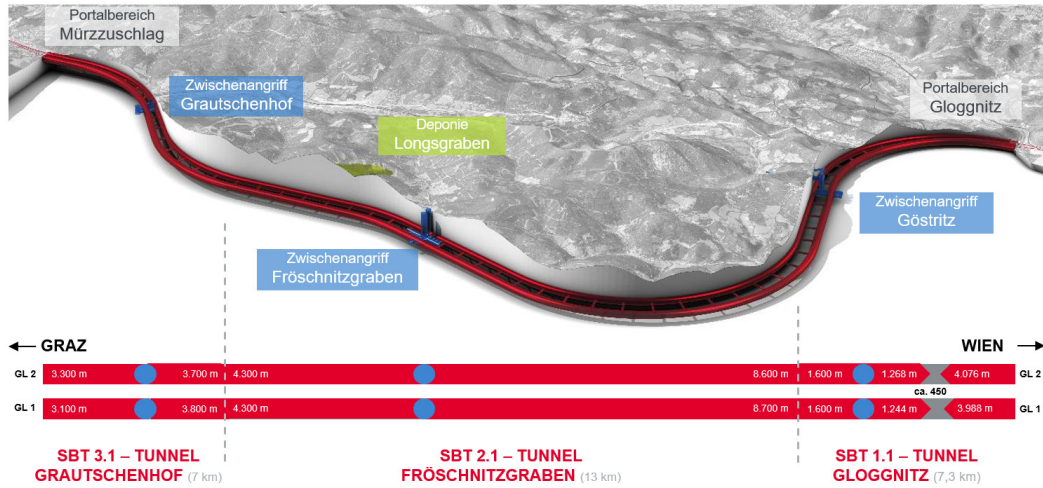


Figure 3: Status of the excavation work, March 2024

## 2.2. Status of the Tunnel Lining

The tunnel lining (invert filling concrete and invert vault, abutments, sealing and vault) has already started in all three tunnel construction lots and is progressing well everywhere (Figure 4).

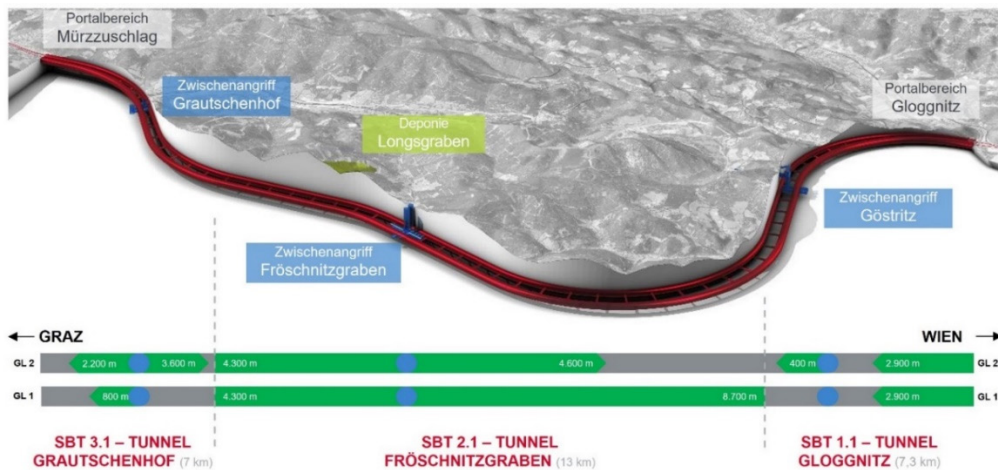


Figure 4: Status of the tunnel lining work, March 2024

## 2.3. Disposal Site Longsgraben

The *Longsgraben* disposal site was closed in spring 2022 with the completion of the TVM excavation work and the landfilling of approximately 4.25 million m<sup>3</sup> of excavated material. This was followed by various dismantling measures, so that the closure of the disposal site was requested from the authorities in December 2022, and the disposal site was able to switch to the post-closure phase. The first planting phase was carried out from April to June 2023.

## 2.4. Renovation of Mürzzuschlag Station

Between 2021 and 2023, platforms 4/5 including the platform roof and associated track systems were rebuilt. The passenger tunnel under the tracks, including the elevators, was also constructed and put into operation together with the new platforms 4/5 in July 2021 (Figure 5).





Figure 5: Station Mürzzuschlag, platform 4/5

The new construction of platform 1 (main platform) with the associated platform roof and reception building started with demolition in 2021. The commissioning of Platform 1 and the associated track systems took place in November 2022.

This was followed by the renewal of the track systems associated with platforms 2/3. The completion and subsequent commissioning of platform 2/3 is scheduled for April 2024.

To accompany the SBT, an ASC (*Anlagen Service Center*) track hall and a Park & Ride facility were built on the north side of the station. The ASC track hall was handed over in October 2021 and the Park & Ride facility for 428 cars (including eight handicapped parking spaces), 110 bicycles and 28 motorcycles was opened in June.

On the south side of the station, the forecourt of the *Mürzzuschlag* reception building was redesigned with a reorganization of the bus stops including shelters as well as a Bike & Ride facility and 4 handicapped parking spaces.

The ceremonial opening of the reception building and the station forecourt (Figure 6) took place on May 26, 2023. The Bike & Ride facility was opened in November 2022 and the handicapped parking spaces on the forecourt in early May 2023.



Figure 6: Mürzzuschlag station forecourt, reception building and bus stops

## 2.5. Gloggnitz Station

As part of lot *PGG4*, the ASC will be built on the site of *Gloggnitz* station. This includes the construction of an ASC operations building (office and administration building) with integrated workshops and areas for a rescue unit, as well as an attached two-track storage hall

for rail vehicles (track hall) and a shelter for the rescue train parked outside (rescue train shelter).

The new office building, including the workshops, was ready for use at the end of July/beginning of August 2023. Work is currently underway on the track systems to connect the track hall and the rescue train shelter. The completion of the track hall, the enclosure for the rescue train, the track systems and the outdoor areas and thus the commissioning of the entire ASC site in *Gloggnitz* is planned for April 2024.

## **2.6. Track Equipment**

In the current project phase of construction lots *SBT4* and *SBT5*, planning and the preparation of tender documents as well as the awarding of contracts for services of construction lot *SBT4.1* are taking place.

### **2.6.1. Construction lot SBT4.1: General Contractor for Tunnel Equipment**

The tender for the tunnel equipment for the SBT was completed in mid-2023 and published on June 27, 2023. The detailed tender review is currently underway and the contract award is planned for July 2024.

The track equipment work for the Semmering Base Tunnel is extensive and includes the following key services:

- Construction, operation and dismantling of the temporary construction facilities required for the equipment (construction power supply, construction lighting, construction communication, construction ventilation, ...)
- Complete cabling of the tunnel tube, all cross-passages and the emergency station
- Installation of a water mist system in the emergency station (water pipe and high-pressure water mist system)
- Installation of the systems for operational and emergency ventilation
- Equipping the cross passages and the emergency station with all necessary technical equipment components
- Technical equipment for the 3 operations buildings
- Installation of conductor rails and switchgear for traction current
- Installation of radio equipment including transmitting cables (GSM-R, GSM-P, TETRA, ...)
- Installation of the track vacancy detection system, the marker boards and the balises for ETCS-L2
- Production of the illuminated handrails and the entire lighting in the tunnel tubes, in the cross-passages, in the emergency station and in the ventilation shaft and portal areas
- Installation of all signs
- Connection of socket distributors and emergency call pillars
- Installation of cooling and drying equipment for the technical rooms
- Installation of systems to stabilize the hardness of the drainage water
- And much more

### **2.6.2. Construction Lot SBT5.1: Slab Track**

The *SBT5.1* service will be awarded by means of a negotiated procedure with prior publication: Stage I was published on October 11, 2023 – with a deadline for submission of requests to participate at the end of April 2024. The tender planning and tender preparation for Stage II is currently underway with the aim of publication on June 14, 2024.

The *SBT5.1* will be realized as follows:

- Production and delivery of the track base plates and installation of the slab track,
- Gravel superstructure incl. multiple points installation
- Adaptation of the already constructed bridges over the *Schwarza* river for the slab track
- Closure of the *Mürzzuschlag* trough (construction site access)
- Construction of a retention basin in the *Mürzzuschlag* portal area
- Construction of concrete end walls in 3 cross-connections of the two tunnel tubes
- Rail grinding
- Final tunnel cleaning
- Among other things

### 3. OUTLOOK

#### 3.1. Tunnel Construction

For construction lot *SBT1.1*, the focus in the near future will obviously be on completing the excavation work in the *Gloggnitz* and *Göstritz East* tunnel sections with the final breakthrough. This breakthrough, and thus the completion of all excavation work for the SBT, is expected to take place in the first quarter of 2025. Once the tunnel lining work, which has already begun, has been completed (around the second quarter of 2026), the tubes from the *SBT2.1* section boundary to the *Göstritz* shaft base will be handed over to the railway equipment.

In 2024, concreting of the vault in the continuous (east) excavation of the *SBT2.1* section will be completed, followed by concreting of the walkway in the two tubes by the end of 2025. This means that the inner lining of the tubes will be completed by early 2026. At the same time, the inner lining (shotcrete) in the emergency station will be constructed and the inner lining of the *Fröschnitz 1* shaft will be installed, so that the underground areas can be handed over to the railway equipment construction lots at the end of April 2026.

Four concreting wagons are currently working on section *SBT3.1*. In 2024, work will begin on the collector pipe, drainage concrete, concrete slab, walkways and crossovers from the *PMZ2* site boundary to *SBT2.1*. In 2025, work will commence to upgrade/deconstruct the caverns at the base of the shafts and backfill the two approximately 100 m depth shafts. In the first quarter of 2026, deconstruction work will commence at the *Grautschenhof* site.

In addition to the completion and commissioning of platform 2/3 planned for April 2024, the completion of the tunnel portal is also on the agenda for construction lot *PMZ2*. This includes the production of the portal blocks and the completion of the filter concrete filling – all in accordance with the requirements of the World Heritage Site.

#### 3.2. Equipping

The equipping work, which will be carried out with the two main construction lots *SBT4.1* and *SBT5.1*, as well as some other smaller lots (e.g., *SBT4.5* cross passage walls and doors), is based on a sophisticated logistics concept.

It is planned to start equipping the *Mürzzuschlag* portal in mid-2025 and then successively move to *Gloggnitz*. The switch to *Gloggnitz* will only take place once the slab track has been installed, around May 2027, also from *Mürzzuschlag*. All work for the technical equipment of the tunnel, such as cabling, equipping the cross-passages, etc., will then be carried out in the

opposite direction, while at the same time the slab track is being installed continuously from *Mürzzuschlag* (Figure 7).

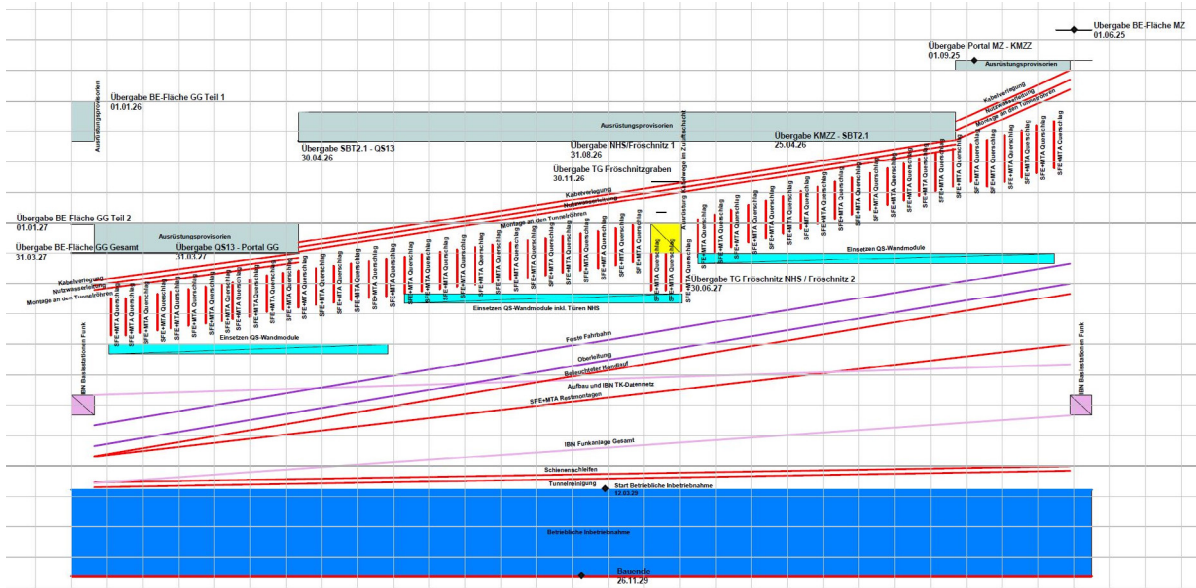


Figure 7: Tunnel equipment process SBT

The advantage of this concept is that all the cabling can be efficiently installed in the completed cable ducts and technical rooms before the slab track is laid, using standard road vehicles. The same applies to the equipment of the technical rooms. The high flexibility of road-bound traffic in the tunnel is only step by step limited once the slab track has been installed.

The equipment work must be fully completed by the start of operational commissioning (construction lot *SBT7*) on March 12, 2029, so that the necessary measurement and acceptance runs can take place as planned and the Semmering Base Tunnel can be commissioned on time.

#### 4. SUMMARY

Construction of the Semmering Base Tunnel is progressing well, with around 98 % of the required excavation work now completed. This means that ten of the original 14 simultaneous drifts have already been successfully completed. The *Gloggnitz* and *Göstritz East* tunnels represent the final challenges of the tunneling project. In total, approximately 450 m of tunnel remain to be excavated.

In the tunnel sections that have been completed from a structural point of view, the inner lining of the Semmering Base Tunnel has begun with the construction of the invert filling concrete and invert vault, abutments, sealing and vault. This work is progressing very rapidly, with the inner lining of the two tunnel tubes in the western section of construction lot *SBT2.1* (cyclic tunneling) already completed.

The renovation and new construction of the *Mürzzuschlag* railway station at the west portal of the Semmering Base Tunnel is nearing completion. In addition to the tracks and platforms, the station building has been built in accordance with the requirements of the monument protection regulations, as well as the station forecourt with a new arrangement of the bus stops, now including turning facilities, and a large Park & Ride facility on the opposite side of the station.



In parallel with the construction work, the tenders for the track equipment – *SBT4.1* general contractor tunnel equipment and *SBT5.1* slab track – have been prepared. They are already in the awarding phase (*SBT4.1*) and in the middle of the tendering phase (*SBT5.1*). This will ensure the planned start of the technical equipment in mid-2025.

Under these conditions, the commissioning of the Semmering Base Tunnel in 2030 is realistic.