Site report

Tunnel concreting train for building the slab track in the city tunnel of Malmö / Sweden

Putzmeister

The concreting train with electrically operated concrete pump, which is fed via a conveyor belt

A slab track is being laid in the tunnel section with two individual six km tunnels. The sleepers are embedded in concrete and can absorb the vibration caused by high-speed trains in a better way due to having an extremely flexible insert.

Maximum precision is required when the tracks are installed. The sleeper shoes that have been freshly embedded in the concrete must not be subjected to vibration. Even the slightest variations in the alignment of the tracks can result in the railway no longer complying with the original designs for high-speed travel.

The order for constructing the slab track in the Malmö city tunnel was placed with Rhomberg Bahntechnik GmbH.
The objective was to find a solution for installing the concrete track bed over a distance of two times six kilometres without a major amount of vibration. The plan was to do the concreting at a speed of 15 – 20 m/h.

Railway engineering specialist Rhomberg (based in Bregenz in the Austrian Vorarlberg area) made contact with the representative of Austrian company Putzmeister, Hans Eibinger GmbH. Together with the Concrete Project Division department at the main Putzmeister plant in Aichtal, all of the parties involved collaborated to produce a solution for supplying a tunnel concreting train based on the patented installation solutions of Rhomberg Bahntechnik.

Comprehensive planning

During the planning of the tunnel concreting train it had to be taken into consideration that the freshly embedded sleeper shoes could only bear a certain amount of load. Beginning with the setting speed of the concrete and the travel speed of the concreting train, it was calculated that a distance of between 250 and 400 m had to be maintained between the concrete paving machine and the pump unit. The entire pipeline would therefore have to be

A locomotive with the rail wagon shuttles between the concrete handover point and the concreting train

made mobile. The pump unit consists of an electrically powered concrete pump and two mixing drums, whereby the first one would be used to supply the system with fresh concrete, and the second one would provide the concrete for ensuring that a continuous concreting cycle could be maintained.

Concreting train

The concreting train consists of various railway wagons on which all of the necessary components for carrying out a continuous and smooth procedure are mounted (including the necessary cleaning and maintenance work). All systems are protected by an emergency power unit.

Pump and delivery line

The Putzmeister stationary concrete pump is on the third wagon, plus a small conveyor belt for feeding the concrete pump. In order to prevent the pump from drifting during the pumping procedure, the frame of the rail car is filled with concrete and the support legs of the pump are directly screwed to it. The pump can be operated using a cable-connected remote control during the pumping process. The concrete is transported from the pump to the concrete paver up to 400 m away via a steel delivery line that is installed on special wagons. The maximum permitted concrete pressure of the delivery line is 130 bar. The delivery line has a diameter of 125 mm and a wall thickness of 7.1 mm. Since the slab track in the Malmö city tunnel also has a long curve with a radius of 760 m, the line has been adapted accordingly in order to be able to run on the patented alignment system made by Rhomberg Bahntechnik. Non-critical load transmission was a challenge during dimensioning.

Paving machine

The patented paving machine is located at the end of the delivery line and consists of an upstream working and transport platform and a hopper. The concrete is transported to the track bed via three special chutes. The concrete is pre-smoothed using skimming boxes and then compressed using vibrators.

The main power supply is provided by a diesel unit with output of approx. 400 kW that is equipped with a soot particle filter for operating in the tunnel.

The concrete pump is screwed to the superstructure of the railcar

The patented concrete paving machine when embedding the sleeper shoes

City tunnel Malmö

The city tunnel is a section of railway that is under construction in Malmö/Sweden with an overall length of approx. 2 x 6 km.

The tunnel is intended to connect the rail traffic from Söderslätt with the Öresund rail traffic, turn the Malmö C main station into a transit station, relieve the strain on the "Kontinentalbanan" and increase the catchment area of the Öresund rail traffic.

The tunnel is being opened on 04.12.2010.

The patented paving machine on its own railcar.

Cleaning

Particular attention was also paid to having an environmentally friendly disposal and cleaning concept that meets the strict regulations in Sweden. In order to clean the delivery line with water, a media separating device must first be installed. This ensures that residual concrete and washing water do not mix. The residual concrete in the line can therefore still be laid in the track bed. The media separation system consists of the combination of sponge ball – soaked cement bags – sponge ball – wash-out pig – sponge ball.

Between the concrete delivery and the cleaning process, a hydraulic manual gate valve has been installed to block the delivery line.

Team success

It was possible to successfully deal with this complex project by means of close collaboration between participating project partners Rhomberg, Eibinger and Putzmeister. Not least the competent service engineers from Eibinger and their involvement, along with the efficient service contributed to the success of this new solution for supplying concrete.

Pre-deployment test run

An initial test run of the tunnel concreting train for constructing the slab track in the Malmö city tunnel took place on 06.08.2009 at the Rhomberg Bahntechnik test site.
During the test run, 10 m^3 of concrete was laid in the prepared track bed using the concreting train. A stroke time of 4.2 seconds was determined during the pumping process, which represents a delivery rate of approx. 38 m3/h. The hydraulic pressure reached a maximum of approx. 215 bar when this took place. Starting with a conveying distance of about 250 m, this results in a calculated friction coefficient of 2.6. No more than 25 – 30 m^3/h is required in the actual pumping process in Malmö, meaning that the required delivery capacity is therefore provided.

In order to simulate the situation on site as realistically as possible, part of the slab track in Malmö was modelled in Dornbirn/Austria. The sleeper shoes of the rails were embedded in concrete (see fig. below).
The mixer drum was fed with fresh concrete with a truck-mixer pump during the test.

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