

# Swiss Section

## Technical visit to the Pilatus Railway

Report by Chris Glättli



For this technical visit, the Swiss Section made their way to the heart of Switzerland to see the Pilatus Railway, refurbished in mid-2023 to include ATP Grade of Automation 2 (GOA2) for cog rail, accompanied by this year's IRSE president Steve Boshier. More than forty members took the presidency to new heights (2,132m above sea level) to enjoy breathtaking alpine views.

Before climbing Mount Pilatus with the cog rail, a lake cruise from Luzern to Alpnachstad was part of the programme to enjoy the best scenery of Switzerland.

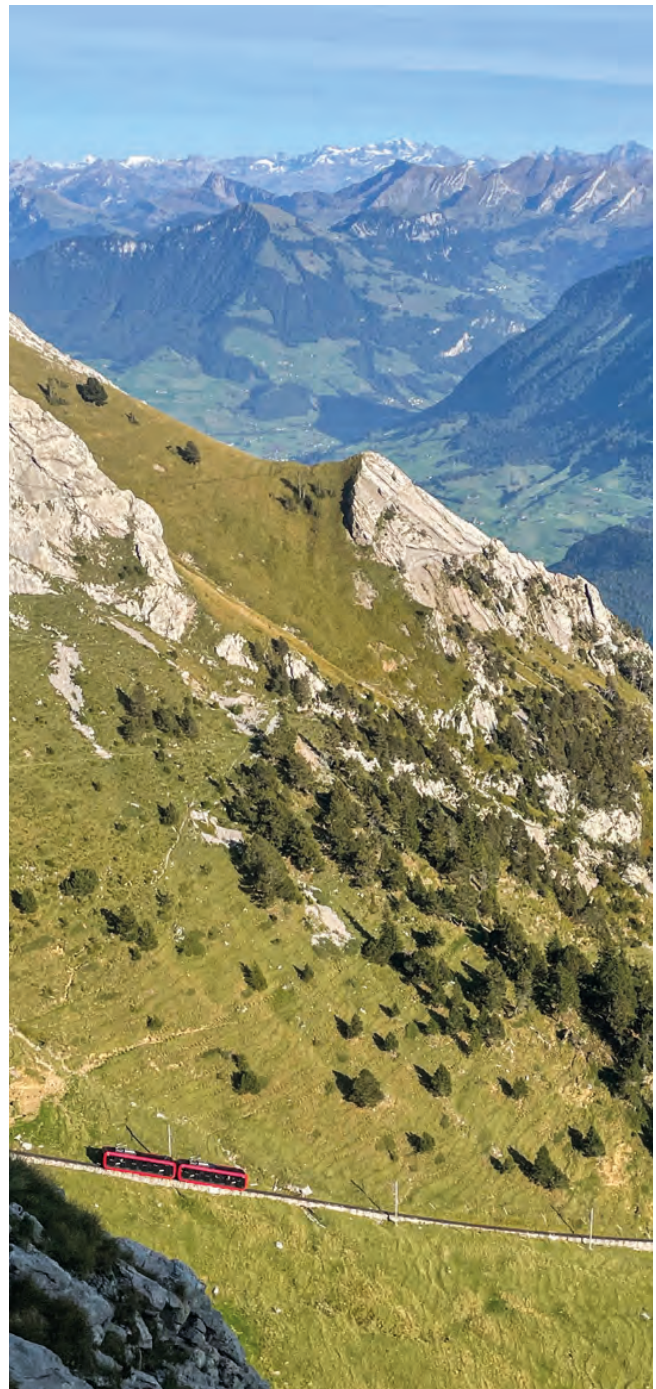
The Pilatus Railway was commissioned in 1889 with a gradient of up to 48 per cent and a travel time of about 30 minutes. When engineer Eduard Locher proposed building a railway on Mount Pilatus in the 19th century, many thought he had gone mad. But in 1889 the 4,618m long railway opened from Alpnachstad to Pilatus Kulm and it is the steepest cogwheel railway in the world.

It requires cleverly engineered technology to move a train on such a steep gradient. The ingenious design with two horizontally rotating cogwheels makes this possible, and the masterpiece design was exhibited at the World Fair 1889 in Paris. In 1931 the management of what was then known as Pilatus-Bahn-Gesellschaft found affordable electrification of the railway line. On 15 May 1937 railway operations started with the new electric rail cars.

In 2015 it was time to think about renewal and an 'idea factory' was set up among all employees to collect ideas. The new railway would have eight sets of two car motor coaches, one freight car to supply the hotel and restaurant on the top, a train service every 30 minutes to match the main line stopping pattern, a second platform to enable better passenger exchange, a lift for passengers using wheelchairs at the upper station, and a new dispatcher control system for train operation and to control points and signals.

Over the years some of the rivets of the cog rail system had been damaged by falling rock. These had been replaced using various types of nuts and bolts, but no records were kept. It was impossible to certify the track in such a situation, so around 10,000 nuts and bolts had to be replaced with one single type.

For the design of the new train sets the employees were also involved. The Board of Pilatus railway wanted to have its say and the public insisted the trains had to be red. Multiple designs were created by an artist respecting the wish to have big windows to enjoy the scenic panorama as well as some wooden features in the carriage to create a cosy atmosphere.





Above, two-car motor coach travelling over a set of rotary points on arrival at Alpnachstad station.

Only the third evolution of the custom flooring had passed the fire prevention requirements, by using harder wood and adjusting the ratio of board width to groove spacing.

The inside cabin was created using virtual reality, to ensure that there was no blocking of scenic views. A mock-up cabin was then constructed consisting of two compartments to understand how the angled multi-tier design would feel when in use, and again employees were invited to trial the seating. The first rail car was then delivered mid-2021.

Multiple infrastructure works were executed, including a second platform built for the bottom station. New pits were dug for the new rotary points and new rotary points were installed. Due to heavy snow, the top station could only be worked on during the summertime.

At first the new cars were used in conjunction with the old cars using the old regime with driving 'on sight' until late 2022. Then the last old car was retired after 85 years of service.

The dispatcher assistance system was developed using the existing Visualisation and Operating System for Railways (VBBa), which was based on a SIL 2 remote-control system. The system provides compliance with signalling principles to carry out such functions as setting routes and locking points, with train detection using axle counter sections. The signalling

system also provides safety at level crossings with every level crossing along the length of the line secured, so that trains can run in compliance with operational rules without the need for any signals.

The Position based Signalling (PbS) was a new development consisting of train control and signalling technology that does not require signals but provides ATP and cab signalling. The PbS ensures that the train cannot pass any section showing a 'stop aspect' and that the specified maximum speeds, including temporary speed restrictions, are not exceeded.

The system incorporates innovative collision warning detection. The collision warning detection has three different warning modes, warning on approach, automatic train stopping and override to couple single cars to a two-car train. PbS uses WLAN in stations and a 2kbps radio link outside the stations. The position of the rail cars is determined via RFID tags and odometric calculation. Of course, this is very precise on a cogwheel railway because wheel slip is minimal.

The central driver's cab control panel gives the drivers all the information they need to operate and monitor the vehicle from the point of view of the PbS. Points can be switched or routes set depending on the selected operating mode and both can be done directly from the train.



Swiss Section members and guests with IRSE president 2023-2024 Steve Boshier bringing the presidency to new heights on Pilatus Kulm.

PbS also supports ATO (Automatic Train Operation). The rolling stock on the Pilatus Railway is operated with GOA 2, whenever the train driver accelerates the train over a speed of 4km/h. This enables automatic acceleration and braking and takes the strain off the train drivers so that they can better concentrate on unexpected events on the line and intervene more quickly in an emergency. When passengers using wheelchairs join the train, precise positioning is needed to meet the exact level of entry and exit platforms to not create an unwanted step. The train driver can choose a functionality of fine calibration which enables a stopping accuracy of 1cm.

The operator's VBBA displays the actual state of the system including train routes, position of the points as well as free and occupied tracks. In the long sections it also shows the train positions via the radio link. The automatic route setter uses train describers to control the traffic.

Overall, a delightful visit with interesting technology and breathtaking views. Our thanks go to Ueli Wallimann of Pilatus Railway and Peter Tschan from the system provider Actemium for giving the tour and holding the detailed presentation. It was also a pleasure to have the 2023-2024 IRSE president Steve Boshier visiting the Swiss Section.



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Waiting at the middle station to let the other train set cross. The train is over the sliding point plate.