

# Swiss Section



## Aerial ropeways: safety from the ground up

George Raymond

Safety management was the focus of 26 IRSE Swiss Section members and guests on 9 March 2018 as we examined a cousin of the railway: the aerial ropeway. Ropeways are the core business of Bartholet Maschinenbau AG, which we visited in the eastern Swiss town of Flums. IRSE's Marco Lüthi organised the event; our lead host was Placi Wenzin, Bartholet's chief technology officer.

Anton Bartholet founded the company in 1962. The Flums site is known as BMF or in English as Bartholet Ropeways and employs about 400, including some 40 apprentices and 30 engineers. The company can also call on another 45 engineers. It designs ropeway systems and fabricates most system components itself, most noticeably the small and large wheel assemblies that hold the cables on which passengers' lives depend.

### Great variety

Helicopters help install ropeway towers, and drones help make the videos on [www.bmf-ag.ch](http://www.bmf-ag.ch) that show ropeways in all their variety. Vehicles range from simple T-bars for skiers to chair lifts to enclosed gondolas. In some designs,

multi-person chairs are fixed to the cable, and a conveyor brings skiers up to speed so a chair can swing around and scoop them up. In other designs, chairs or small gondolas momentarily detach from the moving cable so people can board or alight.

In most aerial ropeways, the cable that carries the vehicles also moves them. On some large aerial tramways, however, such as the one completed in 2016 in the French city of Brest, the gondola rolls along fixed cables while smaller cables pull. Brest's gondolas pass above and below instead of beside each other to save ground space.

Some ropeways climb mountains, while others move horizontally, especially in cities but sometimes in scenic areas. Cables pull vehicles, and usually support them as well, but sometimes the vehicles roll on fixed guideways. Most systems transport passengers, but some carry freight or underlie white-water rides in amusement parks.

### System integrator

In producing ropeway systems, BMF generally serves as system integrator. Mr Wenzin said that only two other

companies worldwide possess his company's breadth of competency in aerial ropeways. This has let them build a growing number of installations throughout the world.

BMF also sometimes builds control systems, lift chairs or gondolas for other companies. An example is Gangloff, which among other work installs rides on cruise ships. Some 400 chairs and gondolas a year are built in Flums, most of them to plans from Porsche Design Studio.

Customers also profit from the sun with solar panels installed on ropeway towers, even if the aesthetics are sometimes controversial.

### Standards

Mr Wenzin said that Switzerland has heavily influenced the EU standards for ropeways, which have become world standards. Standards were once more country-specific. China copied some standards and created some of their own. Unlike Europe, the US still does not require a safety bar on chair-lift seats.

Standards prevent customers from over-specifying ropeways – and from writing specifications that qualify only

A gondola ropeway in the Lenzenheide ski region in eastern Switzerland in March 2016. The gondolas detach from the moving cable momentarily while people board and alight. *Photo BMF.*







Top left: Daniel Candinas explains the fabrication of large cable wheels in Flums in halves that then go to the destination country, where his company supervises the safety-critical task of welding of the two halves together.

Top right: Fabrication of the cable wheels on which passengers' lives depend.

Above left: Wheels for a ropeway tower, including the cable catchers that keep the haul rope from falling to the ground in the rare event it slips off the wheels. The wheels' rubber liners need changing every 5 or 6 years.

Above right: One of up to 400 ski-lift chairs built every year in Flums, mostly to plans from Porsche Design Studio.

Photos George Raymond.

one competitor. Customers are better off when experienced specialist firms write the call for tenders. Standards specify interfaces that allow mixing parts and assemblies from different makers.

**Quality for safety**

Mr Wenzin said quality and thus safety assurance are a permanent focus of Berthelot Ropeways. Ten people, including technical documentation writers, lead quality assurance.

A proof of safety underlies design, production, installation, operation and maintenance. Handbooks prescribe how to buy, process, check and test

components. Tests are typically non-destructive. Mr Wenzin stressed the need to keep in mind a component's designed purpose. Quality checks are particularly critical for potential single points of failure, such as cables and wheels. The company checks conformity with all standards – and has a process ready to deal with non-conformity.

A safe ropeway requires standards, experience, calculation and the four-eye principle. All work is subject to internal and external audits, along with audits of suppliers. But Mr Wenzin warned that overly complex safety checks can hamper oversight.

Standards and documentation must be translated into the customer's language, for example Chinese. No documents are stored on paper.

The manufacturing and quality assurance process is particularly demanding for large cable wheels. Wheels are typically fabricated, welded and painted in Flums in halves that then go to the destination country, where engineers from Flums either weld the two halves together themselves or supervise this safety-critical work.

## Certification

Because hazards can arise in design, manufacturing and operations, all these phases are subject to certification. An ISO 9001:2000 certificate and qualification in welding according to DIN 18800-7 are in place. Mr Wenzin said that Switzerland lacks engineering firms like the Notified Bodies in Austria who are authorised to check his company's work. The Swiss Federal Office of Transport performs checks, but it is not a Notified Body under EU law.

## Maintenance and return of experience

A well-maintained 50-year-old ropeway is safer than a poorly maintained 2-year-old ropeway, Mr Wenzin said. Traditionally, a ropeway's buyer takes over operation and maintenance after

training. Ski areas like to maintain their lifts themselves because employees have less to do in summer. But ropeways in cities have less down time and thus seek to outsource maintenance. Increasingly, Mr Wenzin's company tries to gain maintenance contracts so it can benefit from a return of experience.

## Emergency responses and redundancy

A critical part of a ropeway's documentation specifies how to react in case of problems. Such documentation must also be certified. Much redundancy is built into a ropeway, including diesel generators for backup power and sensors that warn if a cable is about to fall off a tower's wheels.

A cable could become stuck. In this case, the ropeway system typically foresees

several ways for passengers to escape, including rescue by a second vehicle and means of descending safely to the ground. The last resort is rescue by helicopter. Safety is never absolute. For example, unlike nuclear power plants, ropeways are not built to withstand aeroplanes. For Mr Wenzin, requiring "safety" 'in every case' is saying a lot".

In case of fire, the objective is to return vehicles to a station as fast as possible. In this respect, a ropeway is more like a plane than a train in that safety requires the system to continue operating. An exception on the railway is a long tunnel like Switzerland's new Gotthard Base Tunnel, in which passengers' survival during a fire requires that trains also continue to run. Safety in long railway tunnels was the central theme of IRSE's Convention 2018 in Switzerland on 28 May to 1 June.

# Midland & North Western Section

## Technical visit to Buxton Health and Safety Laboratory

### Paul Darlington

The afternoon of Tuesday 24 April 2018, saw 16 members and guests of the Section visiting the UK Health and Safety Laboratory (HSL) in Buxton. The centre provides industry research, consultancy and training, to tackle often complex health and safety related issues, as well as undertaking incident investigation to identify common health and safety problems. HSL is part of the Health and Safety Executive (HSE), the safety regulator for the UK.

The old track bed of the Cromford and High Peak Railway runs through the site although this part of the route has been shut for over 100 years and access is now only possible by road. The site extends to over 500 acres and the facilities include a railway constructed to investigate explosions on trains, as well as collision impact assessments using smaller gauge tracks and drop tests.

Four hundred people are based in Buxton and the wide range of specialists include: medical doctors, psychologists, explosives engineers, toxicologists, ergonomists, fire engineers, occupational hygienists, process safety engineers, microbiologists, mathematicians, material scientists, and personal protective equipment experts.

The specialist teams provide health and safety solutions to industry and governments around the world, and combine significant scientific, medical and technical expertise to help all industries manage risk and protect people from illness and injury.

Investigations over the years have included a number of railway incidents in the UK including, Potters Bar, Ladbrooke Grove and Grayrigg, along with incidents in high hazard installations such as oil storage facilities. The HSE said that over the last 30 years their investigations have increasingly included incidents at amusement parks, fun rides, and bouncing castles, as the active leisure industry has grown.

One of the UK's largest dedicated human factors teams operate from the site and the technical visit included a human factors laboratory. The investigation facilities are extensive with many specialist tools and analytical systems available. The discussion with an investigator included the work he had done in the rail industry, including failures of trackside warning systems and signal passed at danger investigations.

The objective of human factors is to design systems, jobs and organisations

that match human capabilities. The aim is to optimise the interactions between people, equipment and working environment, and addressing human factors elements can improve organisational performance, efficiency, productivity and safety.

Next, we moved to a mechanical investigation laboratory and were shown high speed videos of explosive and rail vehicle collision testing. There is a wide range of assets from various industries, including leisure, on site. As in some cases the assets may involve legal cases that may go on for many years, items have to be kept securely at Buxton, before being returned to the owner.

Its not just about investigation after an incident. The risk management expertise that has been gained through the research, investigation and regulatory work at Buxton enables a great understanding of the immediate and root causes of failure. This is available to all businesses and industries to help manage major accident hazard risks. See [irse.info/wrimc](http://irse.info/wrimc) for an overview of the site

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