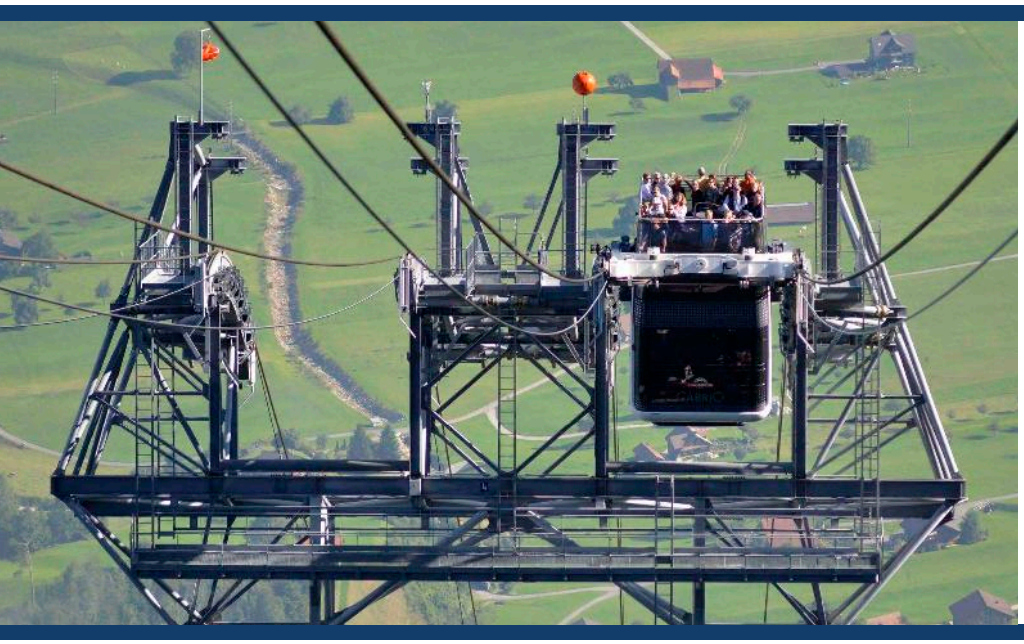
CabriO® -
A world first - made in Switzerland

60-FUF Kälti - Stanserhorn

The CabriO® aerial ropeway

One idea and a lot of open questions – but above all, there was no comparable reference project to be seen anywhere. Garaventa engineers and developers entered unknown territory as they began planning the world's first open-top ropeway, the CabriO®. The result was a combination of the Funifor and classic reversible aerial ropeways, which began carrying passengers up the Stanserhorn Mountain in the canton of Nidwalden, Switzerland, at the end of June 2012.

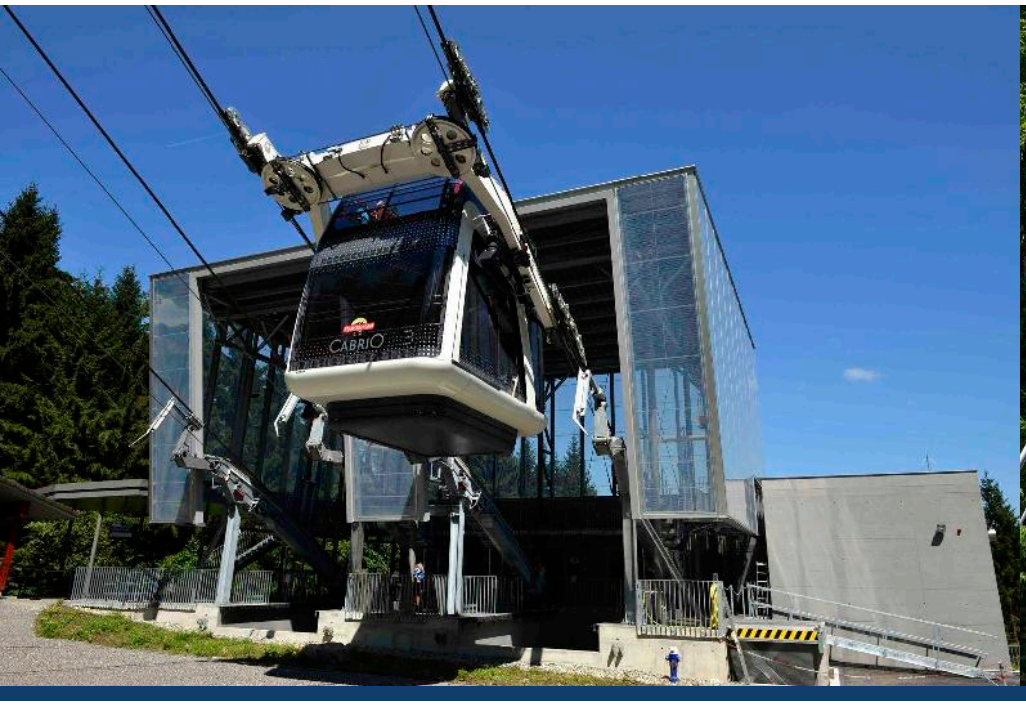
As is the case with so many other ropeways, the open-top CabriO® on the Stanserhorn is yet another Garaventa innovation. Since it began operating on June 28th, 2012, thousands of passengers have stood on the top deck of the gondola to enjoy the breeze of the mountain air – and marvel. As they have all discovered: there is scarcely a thing on this ropeway installation that can be compared with any other ropeway. At the same time, many of the sophisticated technical refinements and details remain hidden from the passengers.



the carriages had to be mounted on the sides of the open-top gondolas; a solution that demanded a different rope guidance system. The track ropes are not on top of the carriers as is usually the case with reversible aerial ropeways – no, these are positioned on the sides of the carriers. And that in turn meant the towers needed to be completely redesigned. The reason: passengers are to be able to enjoy an unobstructed view of the surroundings from the top deck – even as they traverse the towers.

The term 'convertible', otherwise known as 'open-top', now needs to be redefined – an inexorable fact since the opening of the new ropeway on the Stanserhorn. And that is because it is no longer just convertible automobiles that cruise the highways with an open top – so do the novel, stylish ropeway carriers traveling between the bottom station Kälti and the top station on the Stanserhorn. This really is the first carrier to date with an open-top deck for passengers to stand on while traveling up and down the mountain. However, that is not the only difference between the CabriO® ropeway and a conventional, reversible ropeway. To ensure the passengers really are able to enjoy the breathtaking panoramic view,

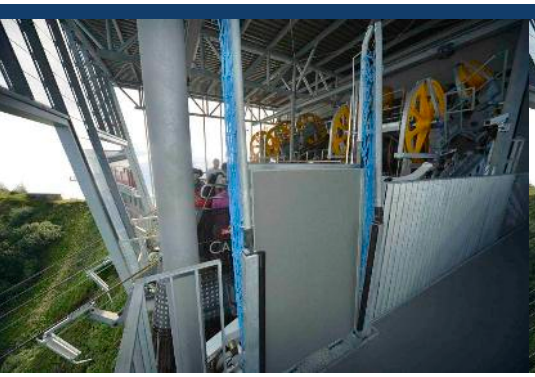
The carriers

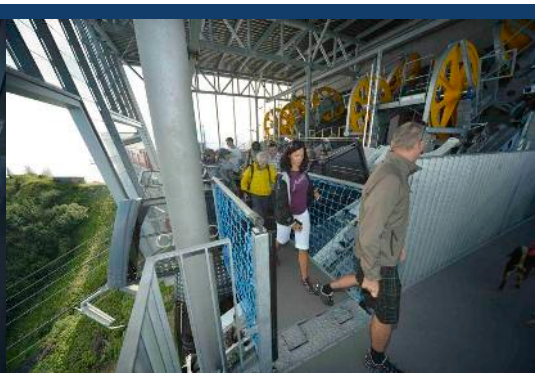


As with so much of this ropeway installation, the open-top carriers of the world's first CabriO® ropeway have been developed from scratch. The double-decker gondolas are designed with an enclosed lower deck and an open top deck. Both futuristic looking gondolas were made by Gangloff, based in Bern, Switzerland; each offers space for 60 passengers, of which 30 are able to travel on the top deck. The installation is able to transport 465 passengers an hour in one direction. The maximum travel speed is 8 meters/second, which corresponds to a travel time of precisely 6 minutes and 24 seconds for the stretch of line measuring 2320 meters. The moving load of a single carrier, that is the gondola, carriage and maximum passenger occupancy load, amounts to 16 340 kilograms.

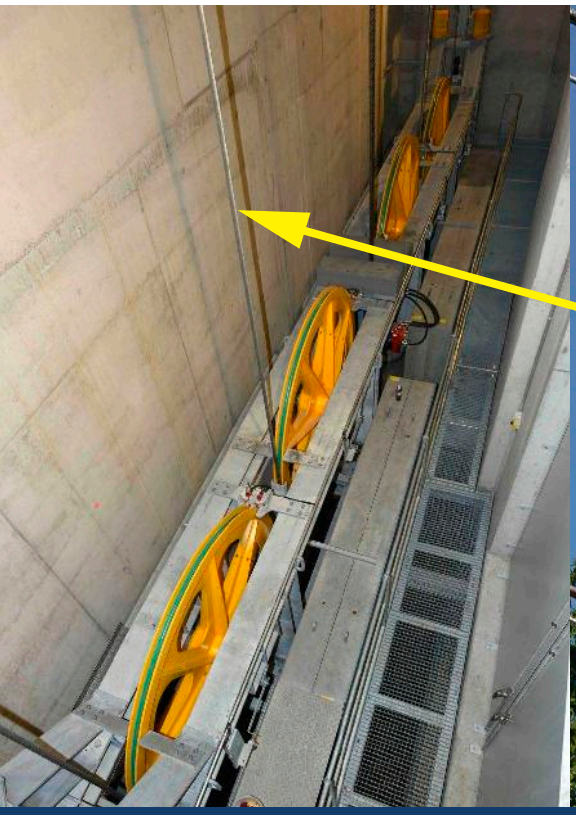
The control point is located on the lower deck, from where the passenger attendant is able to monitor all of the functions of the carrier. Passengers gain access the top deck via a spiral staircase.

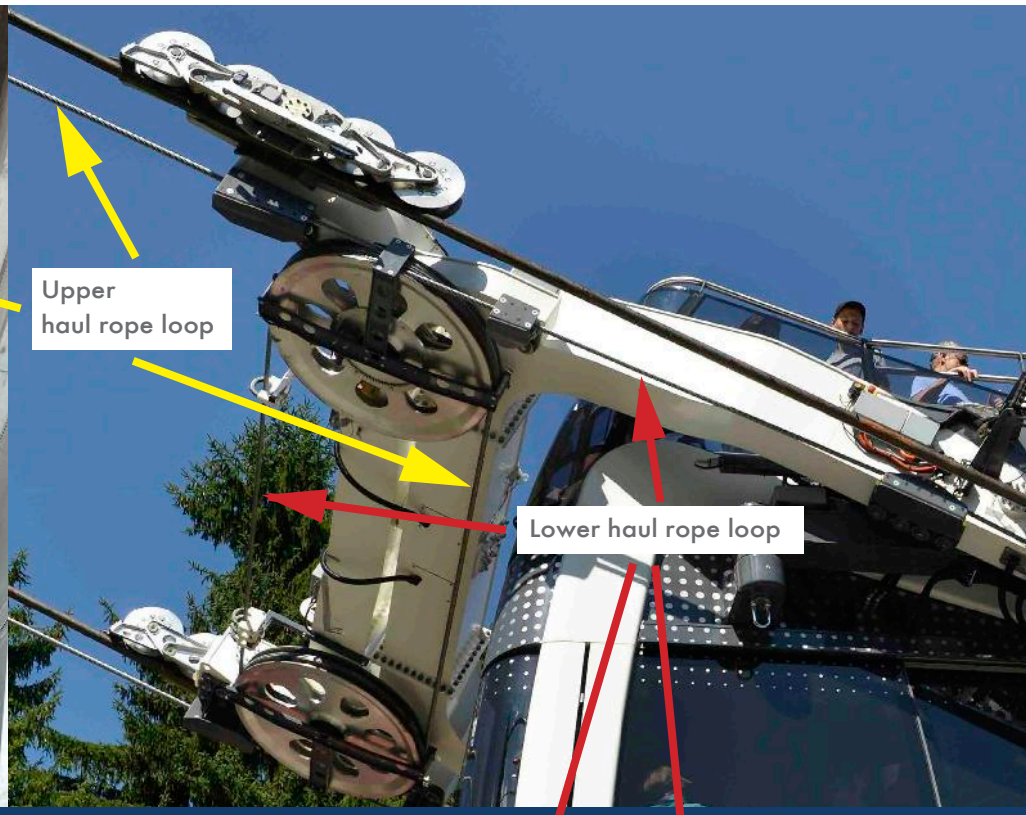
Partially hidden from the passengers' view is the ride-height control system of the gondolas. The heart of this system consists of two hydraulic cylinders mounted on the left and right sides of both carriers to continually compensate for longitudinal oscillating motions of the carriers; this is the first time this system has been used on an aerial ropeway anywhere in the world. The ride-height controls continually measure influencing variables, while actively determining the required position of the servo cylinders. This sophisticated system ensures it is possible to maintain passenger comfort at all times, including when traversing the towers and accelerating and decelerating. Two rechargeable batteries housed in the floor of the gondolas ensure the hydraulic cylinders are supplied with sufficient power during the journey. These are recharged each time the carriers enter the bottom and top stations.



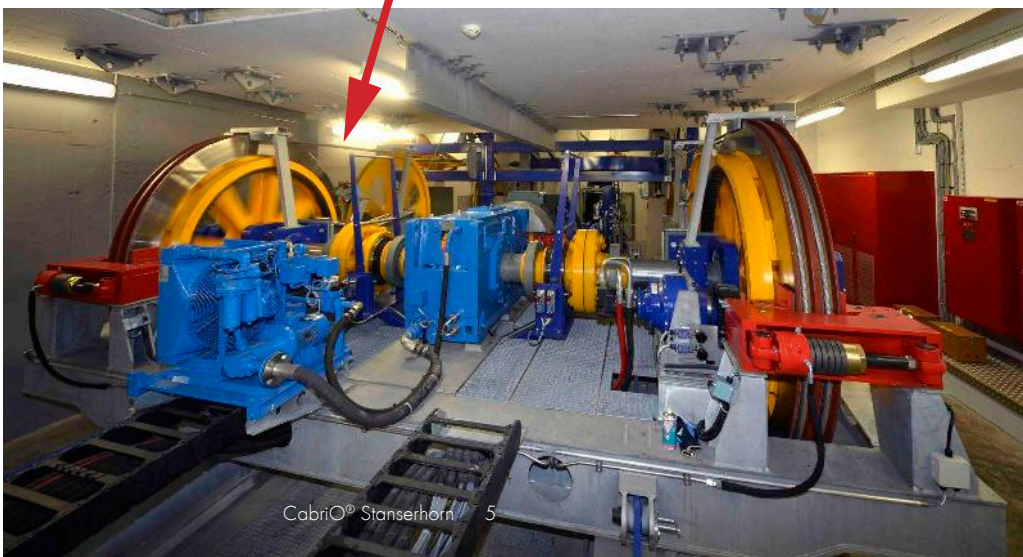


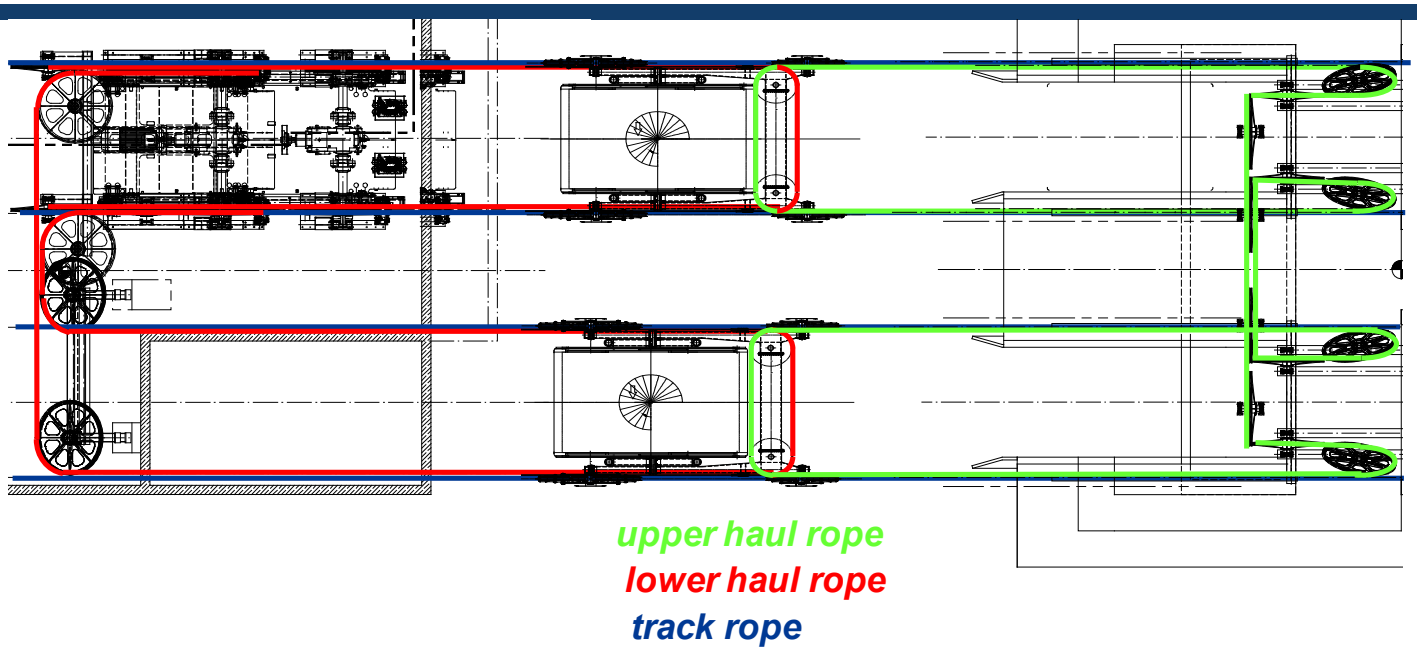
Rope guidance



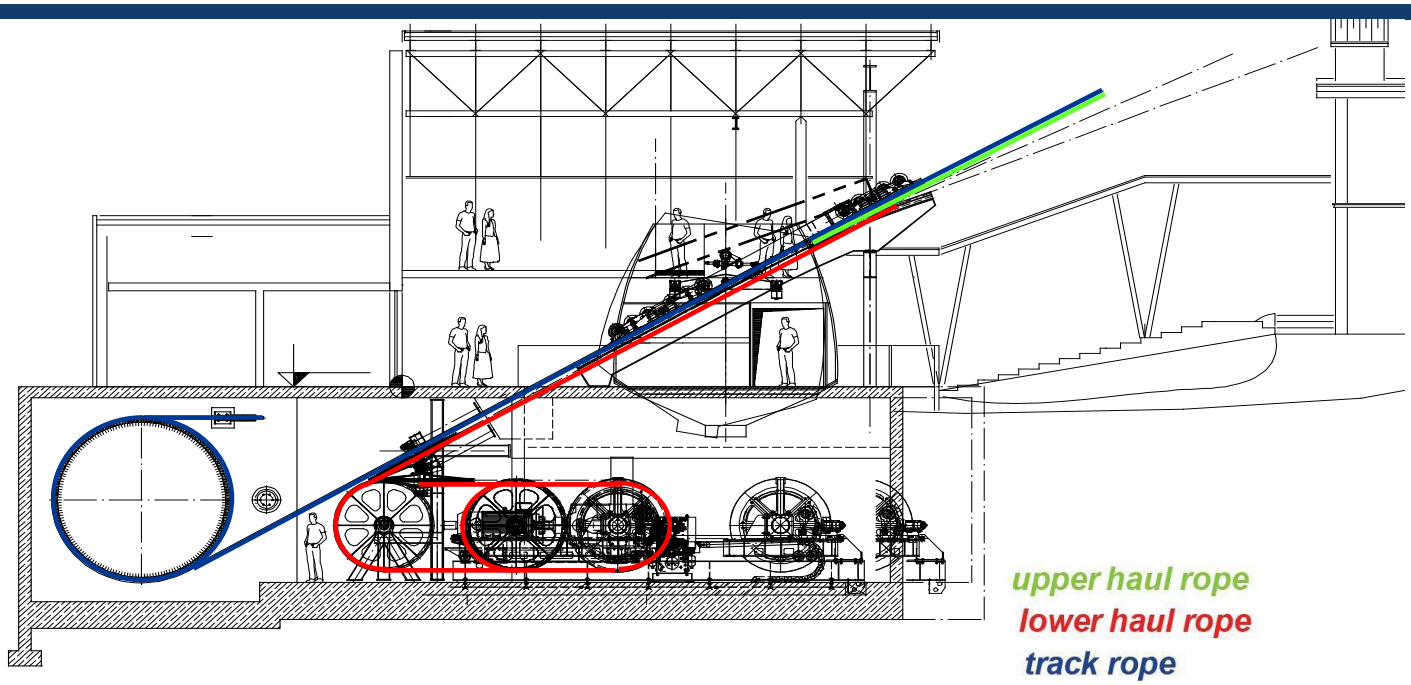


Both carriers travel by means of carriages consisting of 24 rollers running on laterally guided, fully enclosed track ropes. The track ropes have a diameter of 66 millimeters, and a gauge width of 5 meters. The four track ropes weigh in with a total weight of 266 tons. The carriers are extremely wind stable thanks to the installed configuration of the track ropes as well as the design of the carrier dictating a gauge width of 5 meters per line. There are as good as no lateral oscillating movements. The carriages are moved by means of an upper and lower haul rope loop. With a rope diameter of 30 mm, the upper haul rope loop is tensioned in the top station by means of a tensioning weight and deflected back to both carriages via horizontal bullwheels. The lower rope loop – the diameter of this rope measures 26 mm – is routed through the adjustable drive unit in the bottom station. As with the upper haul rope, the lower rope loop is deflected back to the carriages via horizontal bullwheels. This method of rope guidance corresponds to the Funifor type of ropeway developed by the Doppelmayr/Garaventa Group.

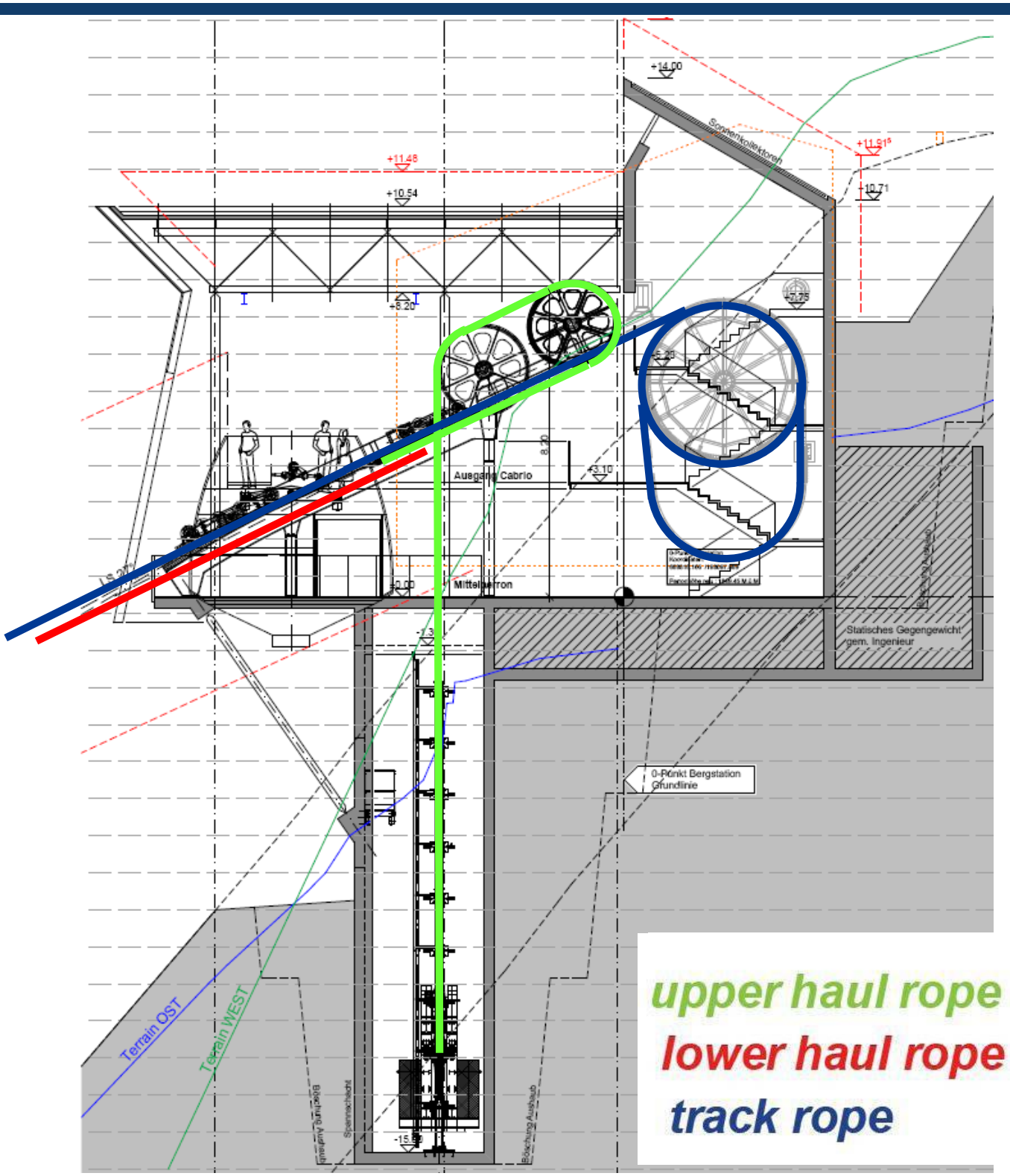




Rope guidance system FUNIFOR



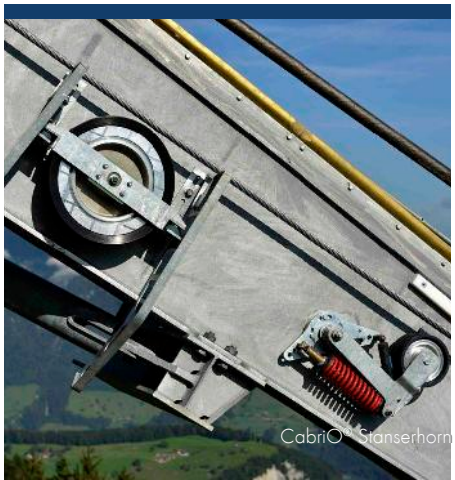
Rope guidance bottom station

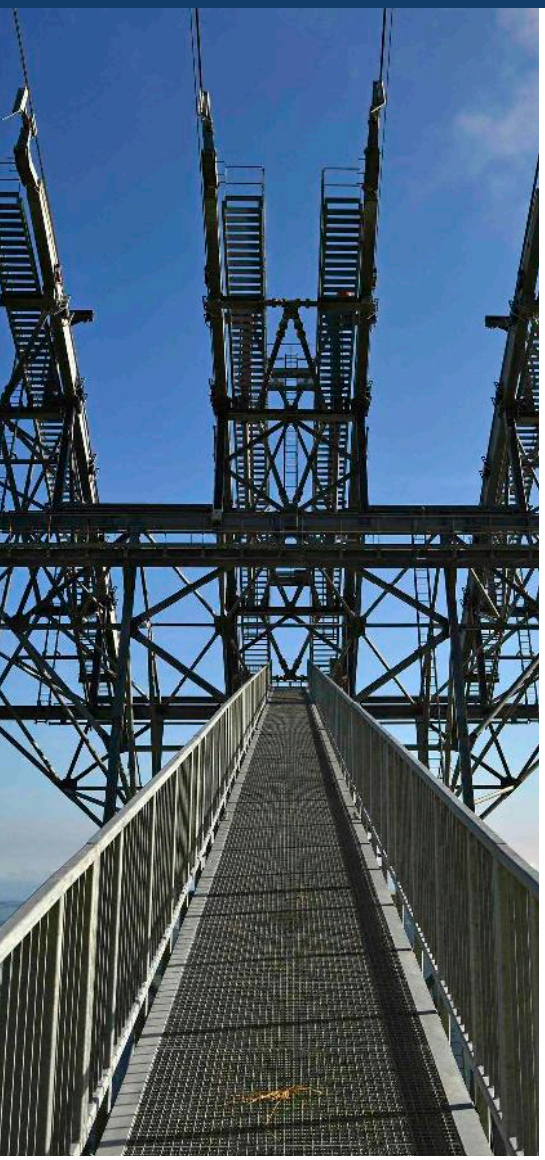


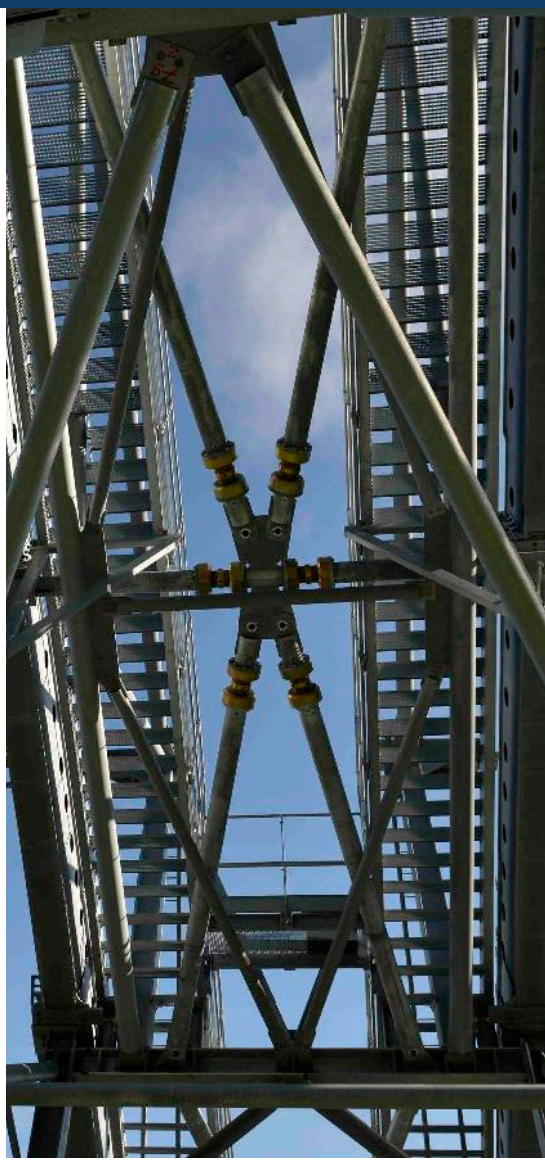
Rope guidance top station

The towers

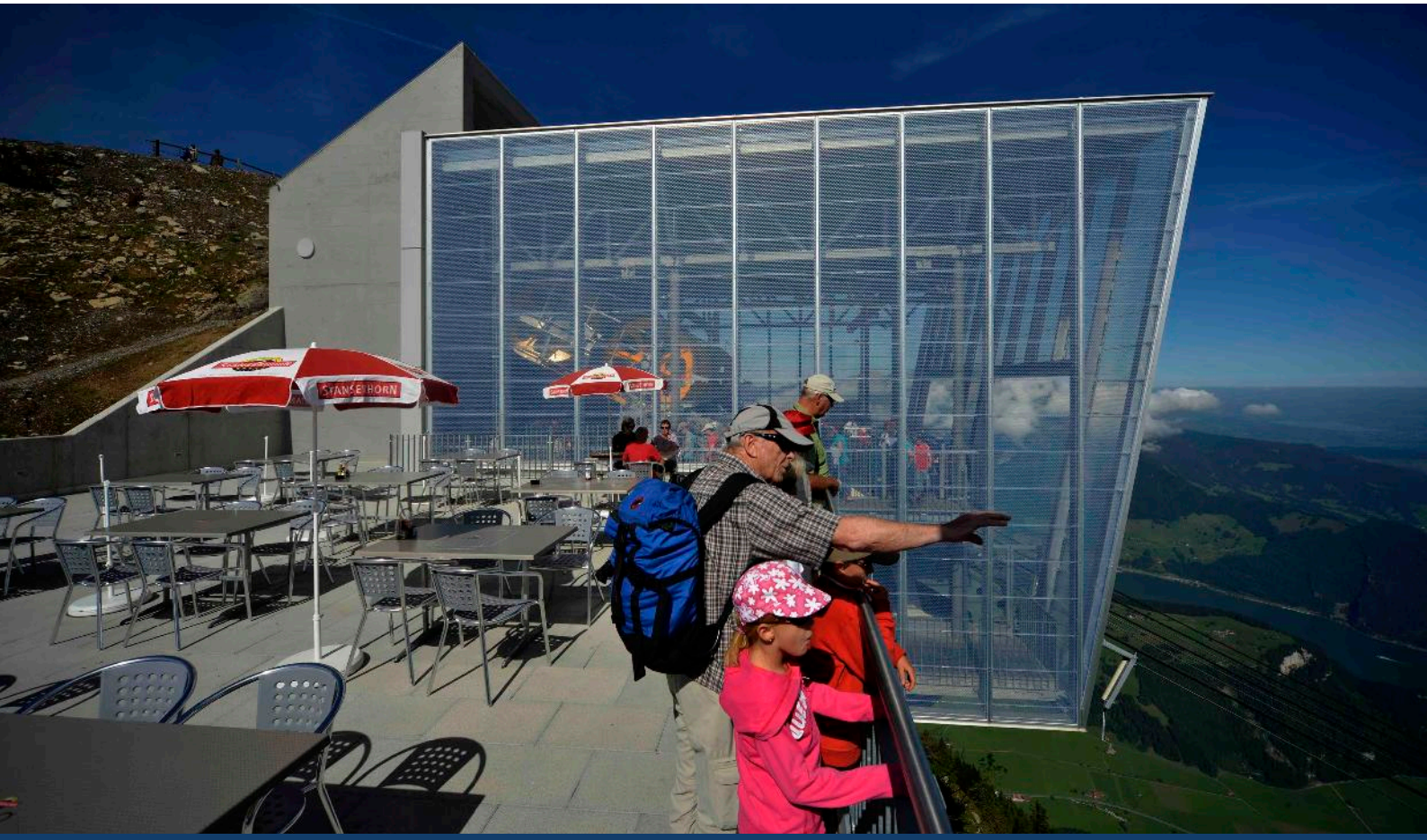
In contrast to the towers of a conventional reversible aerial ropeway, these four towers also had to be redesigned from scratch. This was a necessary to fulfill client specifications that passengers must still be able to enjoy the panoramic even view as they traverse the towers. Close to 535 tons of steel were needed to build the four towers. The rope saddles were fitted with special rope guidance elements, which prevent lateral deropement of the track ropes.



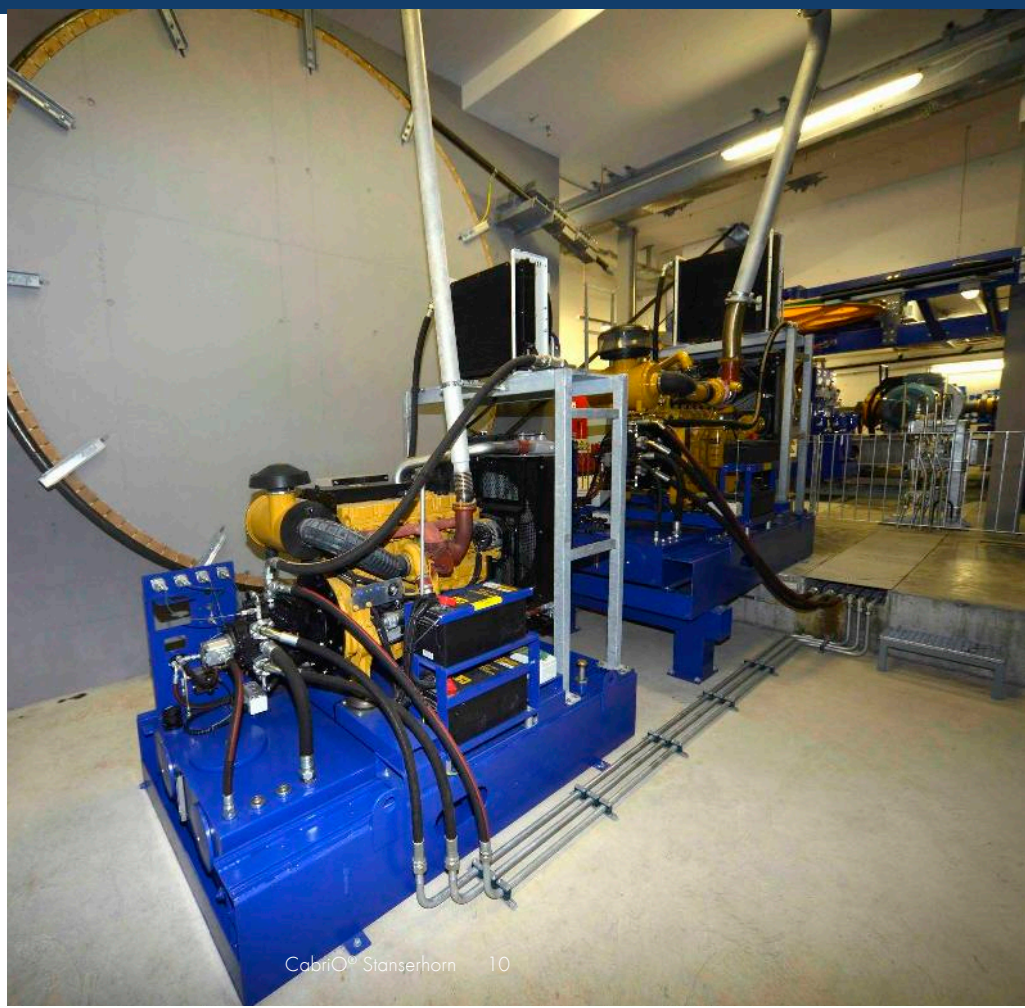




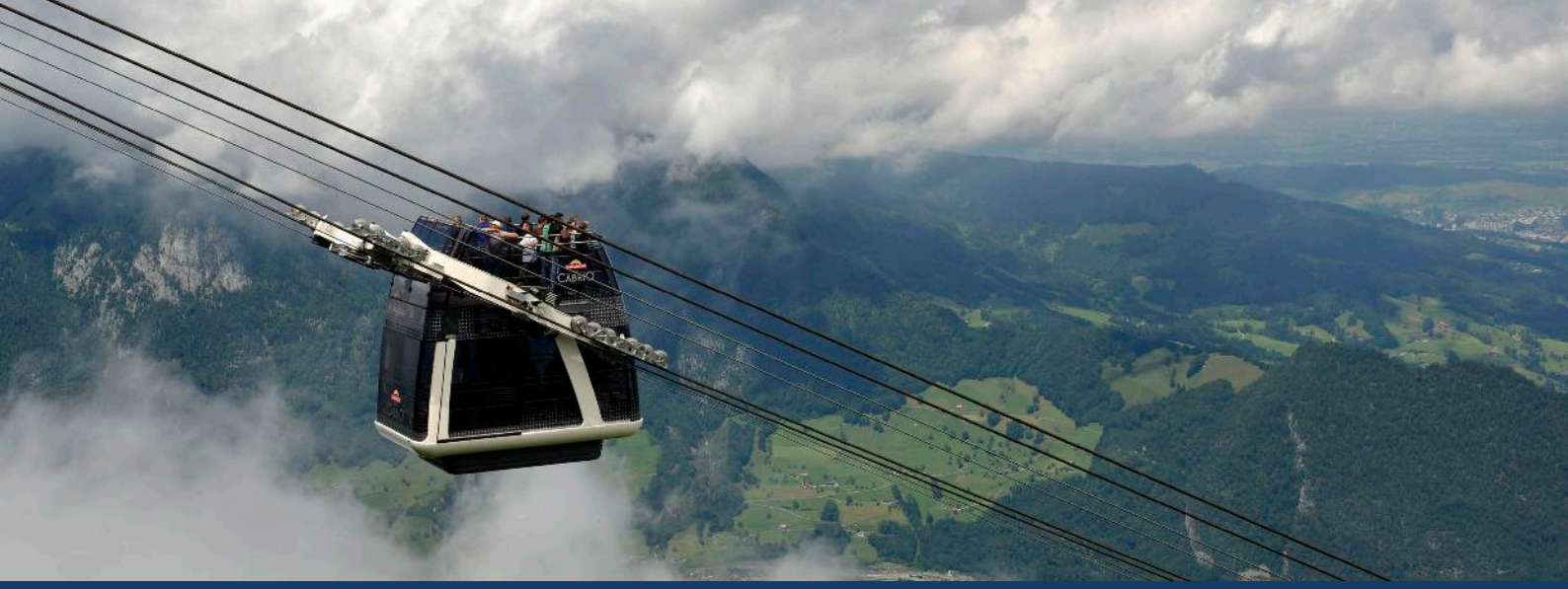
Recovery system



The recently integrated recovery concept means it is no longer necessary to deploy a rescue car, as was usually the case in the past. If a technical fault or defect makes it necessary to initiate a ropeway recovery operation, it is now possible, for example, to disengage the conventional drive unit and gearbox to allow the two diesel engines to move the carriers into the appropriate station.



The advantage of this system is that passengers no longer have to transfer to a rescue car, abseil down to impassable terrain or even be flown to safety by an emergency rescue helicopter. Recovery is quicker and, above all, involves fewer risks. Additional safety features have been added to the drive and counter bullwheels; these have been designed to ensure the bullwheels continue to rotate long enough to complete at least one more journey in the event damage occurs to the bearings.



Main technical specifications

Payload per carrier	60 passengers with 30 on the upper deck
Drive unit	Bottom station
Max travel speed incl. traversing towers	8.0 m/s
Travel time at max. travel speed	6 minutes 24 seconds
Passenger capacity in one direction	465 passengers per hour
Inclined length	2319.13 m
Difference in altitude	1138.50 m
Gauge width of track ropes and carrier	5000 mm

Ropes and rope connections

Haul rope ø	26 mm
Counter rope ø	30 mm
Weight 2 haul ropes	30 t
Track rope ø	66 mm
Weight 4 track ropes	266 t
Weight track rope per meter	25 kg
Total weight of 4 track and 2 haul ropes	296 t
Supplier	Fatzer AG

Drive unit

1 electric motor	
– Nominal output (max. output operational)	919 kW
– Peak output (max. output dynamic)	994 kW
2 diesel engines for recovery drive unit	

Electronics and ropeway control system

Supplier	Frey AG

Ride-height hydraulics and control

Supplier	Hagenbuch hydraulics

Mechanical equipment of the line structures

Number of towers	4
Weight of towers	534 t

Carriers

Total weight of full carrier (moving load)	16 340 kg
Double-decker gondola	max. 60 passengers of which 30 on top deck
Supplier	Gangloff

Reversible aerial ropeway and Funifor

A reversible aerial ropeway is the name given to an aerial ropeway that sees gondolas travel back and forth between the top and bottom stations suspended from a single or several track ropes. Reversible aerial ropeways are often thought of as classic aerial ropeways. However, a Funifor is a special variant of an aerial ropeway with the gauge width wider than the width of the gondola. In addition, the carrier is suspended between both track ropes by means of a short suspension hanger. The haul rope consists of one or two endless loops, which are guided through the carriage and deflected back via horizontal bullwheels. The first Funifor installation was built in 2000 on the Stilfserjoch Mountain.

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