

## **Case Study** Mountain station Zugspitze in Eibsee, Germany

### Products:

1′400 m<sup>2</sup> 150 m<sup>2</sup>

SUPERHOLORIB SHR 51 SVZ, 1.00 mm SUPERHOLORIB SHR 51 RAL 9006, 1.00 mm

Owner:

Bayerische Zugspitzbahn Bergbahn AG, Garmisch-Partenkirchen, Germany

Entreprise de construction: Pichler projects GmbH, Bozen, Italien

Enigneer:

Doppelmayr/Garaventa Gruppe Doppelmayer Seilbahnen GmbH, Wolfurt, Austria

Realisation: 2015 - 2017

Photography: Pichler projects GmbH, © Alex Filz



# WIRY SUMMITEER

Bigger, higher, more luxurious - that seems to be the motto for the building of the new Zugspitze cable car. The last construction phase of this big project has just begun. From December 2017, this transport system will bring 580 visitors per hour to Germany's highest mountain. And not only the building, the building site itself also has some impressive figures: Situated at about 3,000 metres altitude, the future station at the summit is at present the highest building site in Germany. And this presents geological, meteorological and logistical challenges to everybody working on it. The large observation areas are being implemented with high-quality composite steel profiles from the Swiss company Montana Building Systems Ltd.



New from old: Before the end of this year, the new Zugspitze Cable Car will begin operation. It will replace the Eibsee Cable Car that has been serving Germany's highest mountain peak from 1963 until early this year. The new cable car will start operating in time for the coming skiing season. This project involves three years of planning and two and a half years of construction, and is not only currently the highest building site in Germany but also has the goal of building the cableway with the world's longest free span.

### Records, records, records

The construction plan on the Zugspitze consists of three fields: the lower station, the support pylons, and the summit station. These three areas present different requirements and features. For instance, the intention to have only one support pylon for the new cableway (there used to be two) means huge compressive forces, that will act primarily on the summit station. The reason for that is that the new cableway will travel 3,207 metres from the support to the mountain and 1,945 metres in height - more than any other cable car system in the world. This plan requires the building of a steel support with a height of 127 metres. This is higher than, not only most church spires in Germany, but also the highest support pylon yet built anywhere in the world. And that's only the start of the superlatives of this impressive huge project - just as it is for the challenges.

Considerations right from the start were of the greatest priority - for example, how best to take and distribute the compressive forces at the summit station. The answer is, in this case: by using a pressure bar in the old station building.

This has the role of linking the suspension cable towers of the summit station with the structure for the rear tension on the south side. This diverts the compressive forces exerted by the new structure from the north side to the south side. In addition to this massive preliminary conceptual work the practical construction of the summit station contains special challenges. This demands everything of the engineers, geologists and craftsmen on the site - both regarding the altitude and climatic conditions and in the logistics. Since there is no road on which to transport the materials to the building site at nearly 3,000 metres altitude, a cableway for materials had to be built in the first stages of the construction work. This now bridges the height difference of 1,700 metres between the place where the parts are delivered and the summit station



### A real impressive view

Up here the task is to implement a big project that can reliably cope both with the climate in the high Alps and the loading in daily operation. After completion of the necessary removal of rock and the boring of holes for anchoring the steel construction at the bottom of the mountain, the construction crane was erected in June 2015 at 2,950 metres altitude. With elaborate securing against the mountain wind gusts, it is now a further whole 13 metres above the highest German mountain peak. This was enough to meet the necessary preconditions for building the steel substructure on the mountain.

The new station is arranged in three levels. Right at the bottom, as if in the steel framework, is the arrival and departure level. In future the passengers can get into and out of the cabins of the cable car here. Fully glazed, there is a breathtaking view over the north side of the Zugspitze, that continues with the middle storey of the station lying above it. The outer skin, also of glass, provides the all-round panorama view that culminates on the summit terrace above it. The levels are connected by impressive stairwells on the north and south side, made entirely of glass and steel. The stairwell to the south is also provided with outside seating steps. These are arranged somewhat like an amphitheatre and are a replacement for the earlier sun terrace.

### Special circumstances require special components

For the implementation of the planned loft-like floors, intended to give thrilling views, flooring with a particularly great load-bearing capacity was required. Therefore, composite steel profiles from Montana Building Systems Ltd. were applied to the steel structure anchored in the rock. Made of high-quality galvanised steel sheet, these SUPERHOLORIB® profiles act as the basis for the required composite floor decks. The carrying-structure properties of steel and concrete are optimally combined in the composite system: In the classical reinforced or prestressed concrete, the steel cores are cast into the concrete layer and their function there is simply to reinforce the concrete.

In the steel composite, on the other hand, the steel profiles and reinforced concrete parts are combined, as the name suggests, using an undercut profile shape. This combines the strengths of these building materials. The steel takes on the tensile forces, while the concrete is responsible at the same time for withstanding the compressive forces. This way, the system can implement particularly wide flooring spans. And this, even with a smaller number of support pylons or large-area glazing elements in the exterior wall, as in the case of the new cable-car station on the Zugspitze. A further advantage of the composite steel profiles is their flexibility. Compared with classical reinforced concrete they are less brittle, so they are better at withstanding wind and freak weather at the top of the mountain. The SUPERHOLORIB<sup>®</sup> system is particularly strong and makes possible large span widths and, at the same time, relatively small slab thicknesses. Just such a solution was sought for this very complex construction project. In total the three floors of the station on the Zugspitze finally had composite floor decks with an area of 1,500 square metres.

#### Production and servicing - hand in hand

A further 'must' for this building was that the SUPERHOLORIB<sup>®</sup> composite floor deck is an industrially ready-made building component. Thanks to good planning and in-depth cooperation with the Montana service team it was possible to match the profile components in the factory accurately to the conditions on the site. The perfectly timed delivery was of the same importance as the accurately pre-made profiles in the Zugspitze construction project. Any delay - or wrongly dimensioned profile elements - would have thrown the demanding programme of timings right off course. Altering or re-adjusting the profiles on-site would not have been an option because of the location, and sending the items back into the valley would have been catastrophic for the timings.

Therefore the production and service departments of Montana had to work together very closely, and they fulfilled their task brilliantly. The result: the three levels of the new summit station on the Zugspitze are standing on solid footings and are patiently waiting for the first visitors.

#### Summit Christmas 2017

After completion of the summit and valley stations on the Zugspitze, the core piece of the project, the cable car, will be installed in the next weeks and months. Transporting and assembling the four cables, each weighing 145 tons, and the commissioning of the cable car technology are still pending. Right on time for Christmas 2017, the cable car, almost four and a half kilometres long, will start rolling over the highest steel pylon in the world and carry the first passengers up to the Zugspitze. 120 guests per gondola can glide over the panoramic view of the mountain and one or the other will perhaps welcome the year 2018 in front of this impressive scenery.



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