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5. Skating Rink Roof, Arosa / GR

Client: Kurverein Arosa
Architects: A. + A. Rocco, Arosa
Engineers: P. Messerli, St. Blaise
H. Schad, Arosa
Contractors:
Piles: Brunner & Co., Zürich
Concrete and masonry work: Brunold AG, Arosa
Steel construction: Geilinger AG, Winterthur
Pre-stressing: Spannstahl AG, Hinwil
Roofing: L. Waidacher, Arosa
Construction year: 1978

General

In order to offer its guests the additional comfort of ice skating, regardless of the changing weather conditions, and to satisfy the requirements of the Ice Hockey Clubs, the Kurverein Arosa decided to roof its existing rink.

Choice of Construction

Interested parties were given the possibility of submitting projects together with price offers. Particularly valid were aesthetical and technically perfect projects, whereby to a certain extent, the very restricting existing conditions had to be taken into consideration (existing buildings, installations, surroundings, ground conditions).

The lengthwise spanned cable-supported steel construction of Messerli/Geilinger was selected.

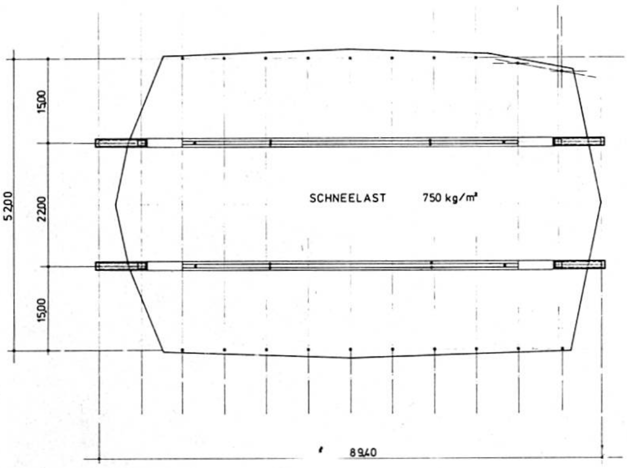

Fig. 1 Situation

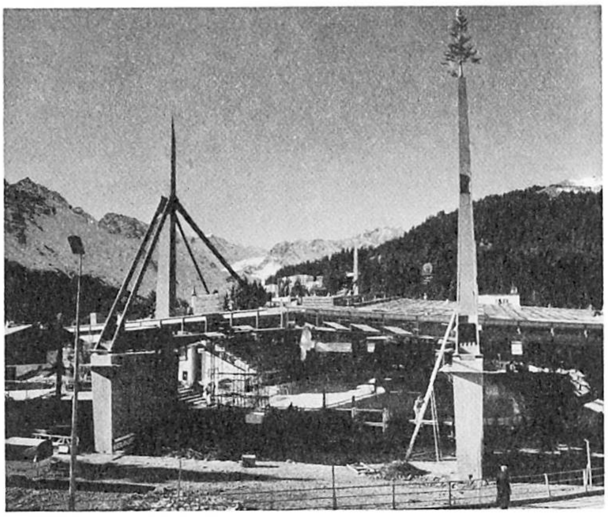

Fig. 4

Criterion for the Project

- good blending in the beautiful, natural surroundings
- minimum disturbance to the views for the surrounding buildings and to their sunshine conditions
- solid ground starts at a depth of 6 m
- high weight of snow (7,5 kN/m2)
- extreme climatical influence (– 30 °C)
- extremely difficult approach road; lorry without trailer, or narrow gauge railway
- maximum weight on ice surface 60 kN/m2

Foundation

The large tension and pressure forces are introduced into the solid ground at a depth of 6 m by means of a big concrete wall and piles. The spreading of the force over the pile groups made an unusually complicated concrete construction necessary.

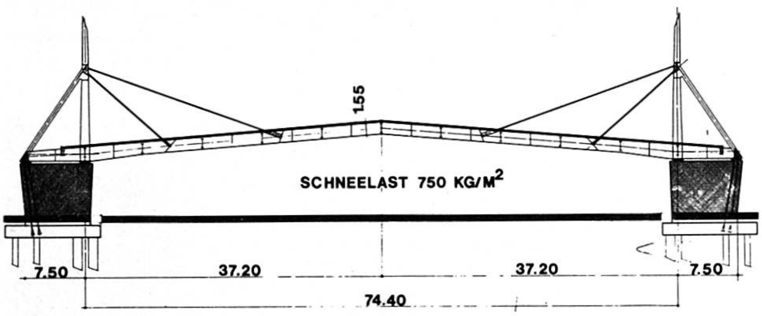

Fig. 2 Section

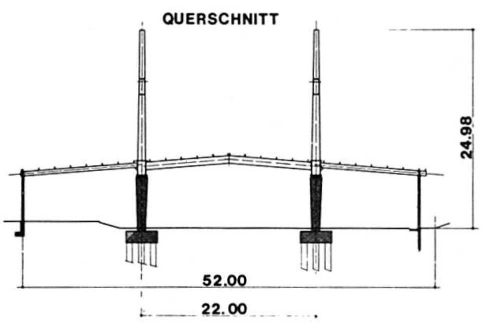

Fig. 3 Cross section

Fig. 5

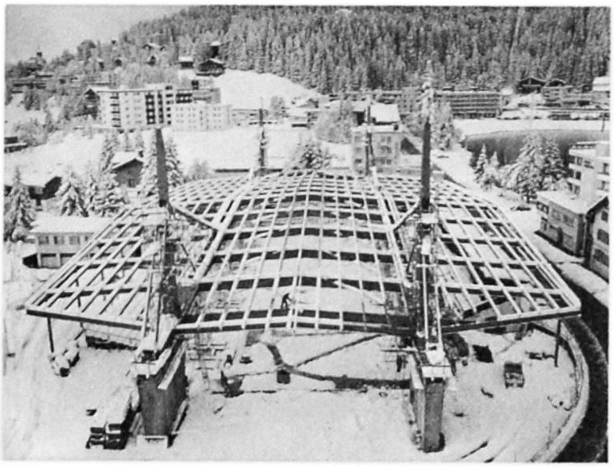

Fig. 6

Steel Construction

The primary construction consists of two steel-cable supported girders, lengthwise spanned (fig. 2). The three-span transverse girders are supported by the main girders and wall columns. To avoid additional forces due to the vertical displacement of the main girders (up to 30 cm), a hinge was placed in each of the two end spans.
The steel-cable supported girders are 1,55 to 2,00 m high and have a total length of 90 m, whereby the free span between the supports amounts to 74,4 m.
The girder ends are restrained for vertical loads by means of the concrete walls (fig. 4). This has been achieved by means of twenty pre-stressing rods with a total force of 16'000 kN which prevents lifting of the box girder ends.
This anchorage is placed at a slight angle and in foamfilled tubes. This allows an elastic movement in the longitudinal direction of ±40 mm without introduction of additional forces into the anchorage and the foundation.
The Dywidag system has been chosen for the inner supporting rods. Every girder is supported at four points with these Dywidag rods, which are fixed to the pilons.

A careful analysis was necessary to find the best positioning of the suspension points, in order to obtain an economic design of the main girders. An additional condition was that due to the pre-stressing, a vertical deflection of – 100 mm had to be achieved.
The pre-stressing rods are imbedded in a plastic pipe injected with cement mortar, the elements thus being permanently protected and maintenance free.
For technical reasons, the pilon forces were anchored by flats towards the outer side of the concrete wall.
The pilon head is of a very complicated construction, due to the fact that maximum vertical force of 25'000 kN has to be introduced.
Two supports are placed under the pilons allowing movement in both horizontal directions and the two remaining supports allow horizontal movement in one direction only.
The welded transverse girders (fig. 5) are 7,5 m apart and 1,1 m high. The force transmission at the crossing points through the main girders is achieved through high strength bolts.
The continuous purlins are bolted onto the transverse girders and carry the 100 mm thick sandwich plates of the roof.
The entire construction is stiffened by bracing (fig. 6).

Important Technical Data

- roof surface 4'300 m2
- max. building length 90 m, max. width 55 m
- roof drop on all four sides 8 %
- max. height of roof over the ice surface 12 m
- actual free height over the rink 7,5 to 10 m
- girder length 90 m, free span 74,4 m, girder height 1,55 to 2,00 m
- max. snow load 7,5 kN/m2
- steel quality mostly used RSt. 52-3
- steel weight 5'500 kN (1,28 kN per m2 of covered surface)
- suspension of the main girders: Dywidag System; 12 bundles of 8 rods each, rods Ø 36 mm St. 85-105
- supports Mageba

(Koblet)

Fig. 7