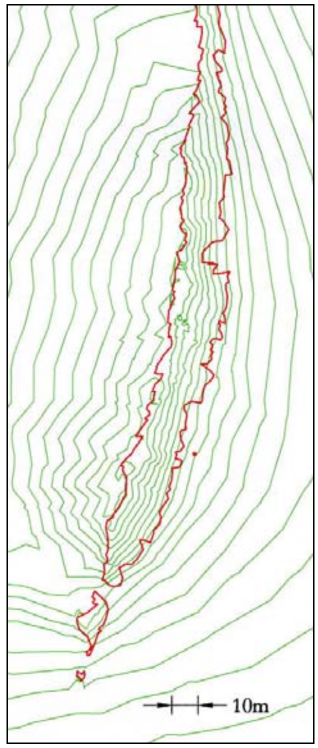


Fig 2.17: Topographic model: snow-free area (Snow boundary = red)
Contour interval of 1 m.

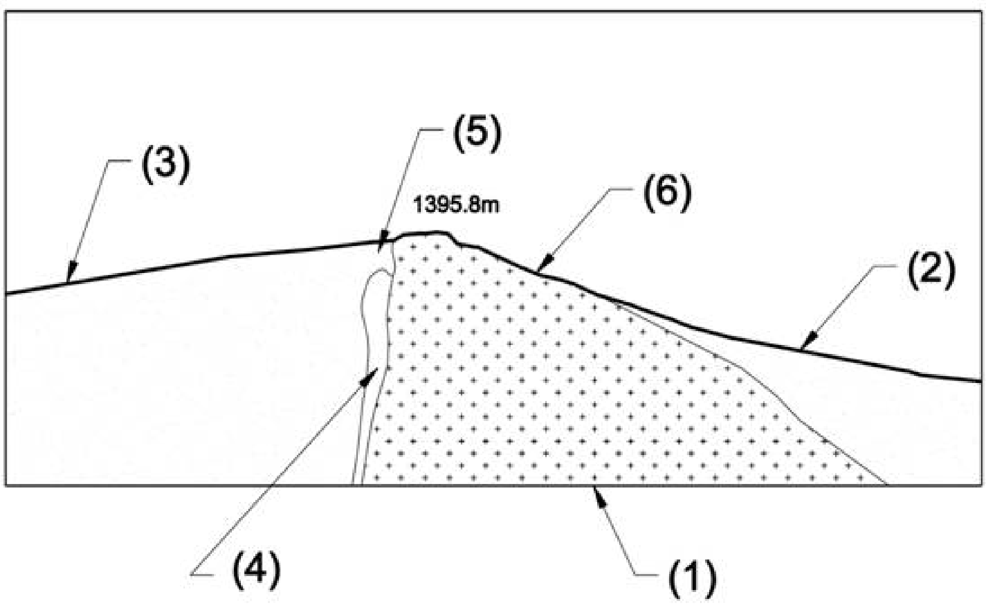


Fig 2.18: Utsteinen ridge characteristics:
(1) Utsteinen ridge – granite bedrock; (2) Compacted snow (west-side); (3) Compacted snow (east-side); (4) 'randkluft' (gap); (5) Snow-bridge; (6) Exposed rock surface

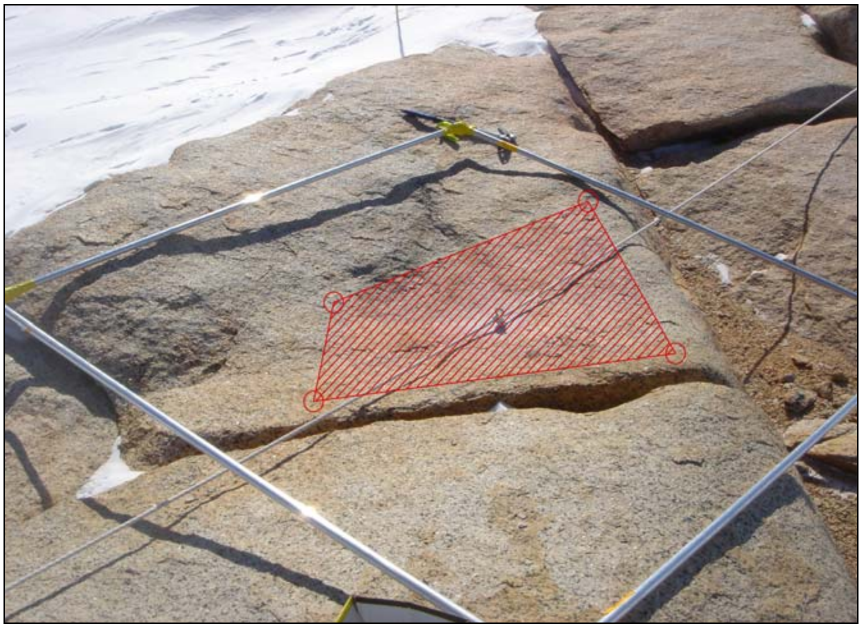
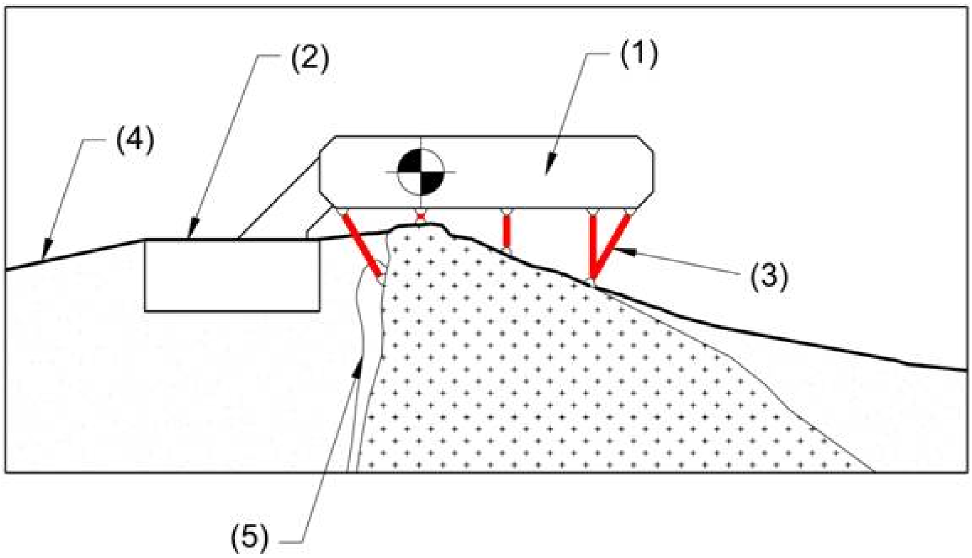


Fig 2.19: Anchoring points survey: 3D surface measurements
(red area corresponds to flat rock surface)

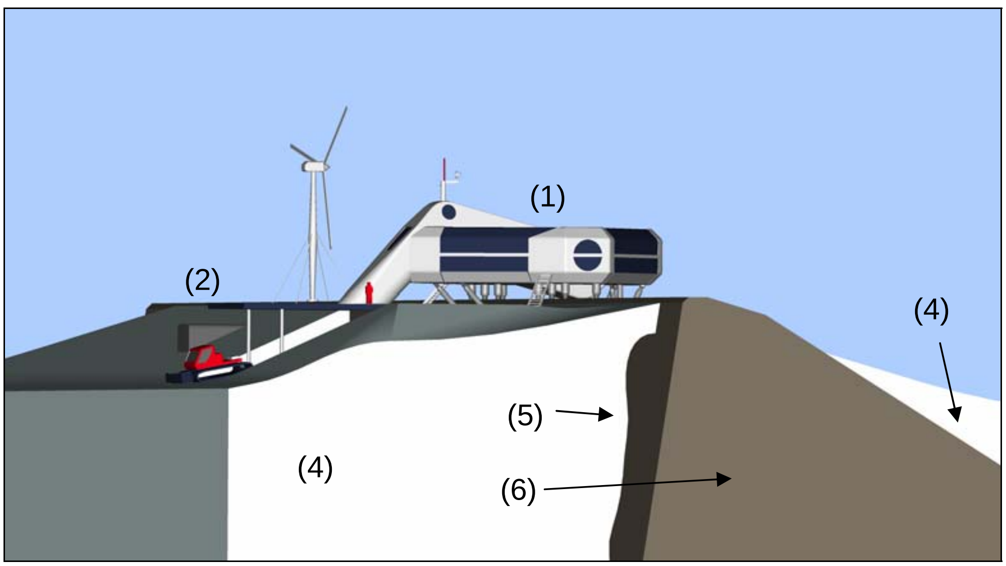
2.4.4. Building support concept

The integration of an above-ground building on the ridge implies that there is a considerable difference in support post height. In the proposed design the building centre of gravity is located near the ridge summit in the area where the support posts are the lowest (a 1m high air gap was defined by wind-tunnel testing). These support posts form a rigid N-S axis under the building and act as a stability point around which the rest of the building is laid out. The building extends to the west where it is supported by articulated posts to the bedrock's relative vertical surface on the west side of the ridge. To the east side the building has a number of articulated support posts that become gradually longer. Both east and west side supports are interconnected with a rigid beam structure.

This construction provides a number of benefits: Although the building has been shaped to reduce wind-induced lifting forces it is impossible to completely avoid this effect due the variability of the wind. Furthermore the thermal dilatation transfers (in W and E directions) originating from the high temperature difference is limited in length and thus in effect. This approach will make it possible to optimize the overall building-support concept resulting in less airflow disturbance underneath the building (porosity), a crucial parameter to enhance the building's aerodynamic performance for snow accumulation as well as to reduce wind-induced noise and vibrations.



view from the South



view from the South-West

<u>Fig 2.20</u>: building support concept:
(1) Above-the-ground building; (2) Under-surface building; (3) Articulated posts for support; (4) Compacted snow (terrain adaptation; (5) 'randkluft' (gap); (6) Ridge.

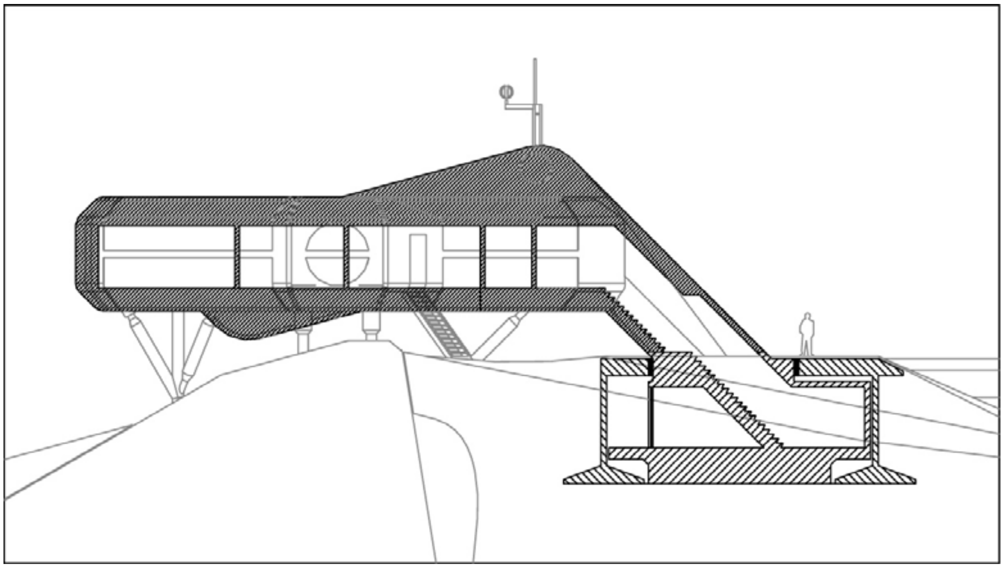


Fig 2.21: Building concept: main building and connection to garage/storage building.
Floor level of insulated units is at entrance height of containers

2.4.5. Aerodynamic studies carried out at the von Karman Institute

Wind conditions have a major impact on the structural aspects of the building but also heavily influence operations, comfort and energy efficiency. Aerodynamic testing is used to:

- limit the expected snow accumulation in the lee of the building;
- prevent snow accumulation upwind of the building;
- control wind-induced forces on the building;
- set mechanical engineering specifications;
- enhance the comfort inside (and outside) the building by reducing noise and vibrations;
- validate the numeric wind model to assess wind power potential;
- assign positions for stand-alone facilities.

Overview test planning:

- Wind Tunnel Test Session 1 (WTT-1): Snowdrift testing validation.
- Wind Tunnel Test Session 2 (WTT-2): Building Free Model and numeric wind model.
- Wind Tunnel Test Session 3 (WTT-3): Development of building configuration.
- Wind Tunnel Test Session 4 (WTT-4): Instrumented tests.

The WTT-1 and WTT-2 tests are validation tests on the aerodynamic test method to assure the realistic simulation of snow drift, snow accumulation and snow erosion in the wind tunnel. A good correlation between the building free model used in the wind tunnel, the computer model and the field measurements was found and from this the testing parameters were identified. In WTT-3 the concept proposals were tested mainly with respect to snow accumulation properties. From this result a final building design was selected. In WTT-4 the forces on the structure are measured in detail,

The selected design generates manageable snow accumulation and erosion features for the prevalent wind direction. It also prevents snow build-up on the windward side of the building. Such a snow build up would continuously change the incoming airflow characteristics creating unpredictable behaviour in terms of long term snow accumulation.

The worst case testing (blocked air gap) proved the robustness of the design: it will take a long time before the resulting accumulation compromises the functionality of the base allowing the station staff enough time to intervene. The geometry of the garage roof creates an almost horizontal snow-free surface at the lee side of the station, that will result in the snow accumulation zone to recede away from the base.

The vortex path generated by the building has positive and negative side-effects depending on the relative position of the garage building and its entrance. The erosion regions are exploited enabling a low maintenance entrance.

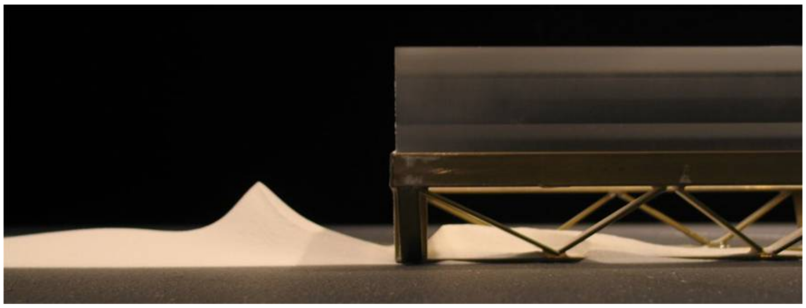


Fig 2.22: WTT-1 - Snowdrift model validation

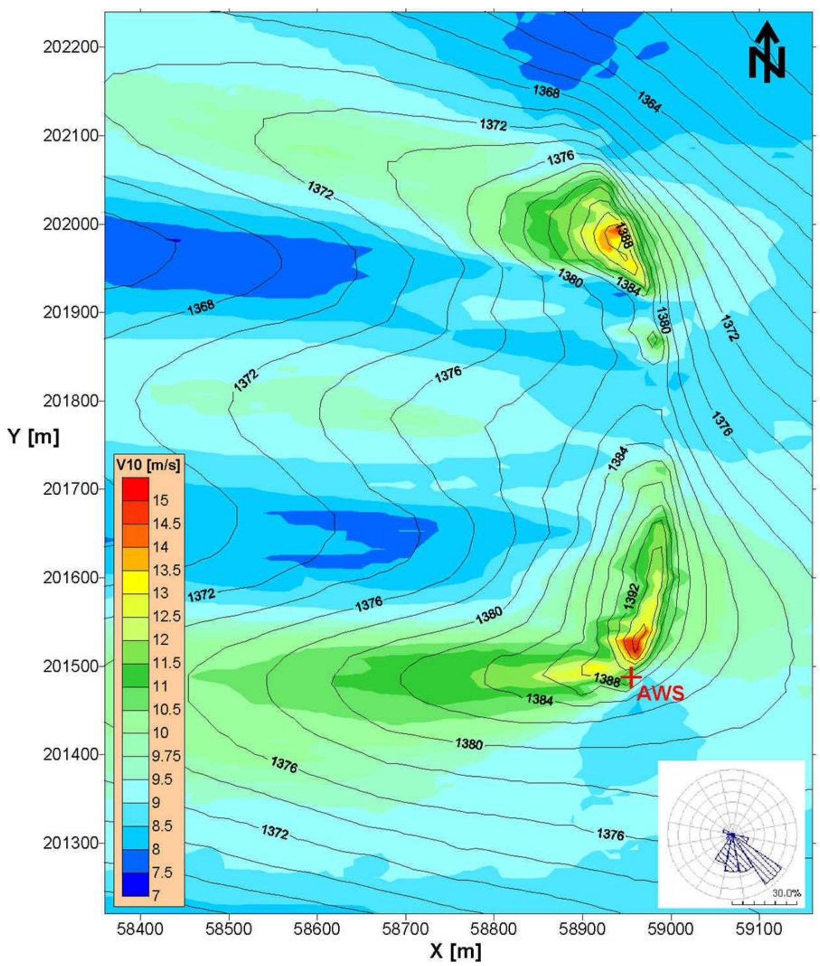


Fig 2.23: Terrain model (contour lines in m a.s.l.) and simulated wind field (m/s)