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Test report on the static test on the flat roof mounting structure SmartSolarBox of the company Smartvolt AG.

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1 Aim of the investigation

The aim of the tests is to determine the load limits regarding snow and wind loads (only anchoring of the modules to the structure) of the SmartSolarBox Version 5.0. The permissible design loads for the substructure are derived from the determined data.

The verification of the anchoring of the mounting structure on the ground was not subject of this test as the SmartSolarBox is a non-anchored self-ballasted system. The dimensioning of the necessary ballasting is usually done by means of aerodynamic tests or calculations. It was also not the subject of these tests to determine whether the supporting feet have a sufficiently large surface area to prevent damage to the insulation of a roof.
The design value for a specific PV-module must be determined separately or can be found in the respective product documentation.

2 Test sample specification

Mounting structure: SmartSolarBox mounting structure Version 5.0 – series status (release of 09/12/2022) with two PV-modules; the sheet metal parts of the structure are made of Magnelis-coated steel ZM310.

Module: Kopp 405Wp, 1.722 x 1.134m, frame height 30mm (1.95 m^2)

Illustration 1 Test setup for snow load testing of the SmartSolarBox Version 5.0

3 Test equipment and test procedure

- Eurotech static test stand using 6 pneumatic cylinders with 4 suction cups with Ø125mm per module.
- Testing pressure and suction loads with an increase mostly in 200Pa steps up to 5000Pa pressure and 2400Pa suction. In between partially unloading to determine the residual deformation. Load duration per level >2 minutes each.
- Pressure/suction direction perpendicular to the ground
- In order to be able to determine failure forces with suction tests, the concrete block as well as the outer support feet were clamped or tied to the test rig for this tests.
- In order to test the substructure to its load limits, the PV module was reinforced with a 27mm 3-layer wooden plate during the snow load tests.

4 Evaluation of the test results (summary)

4.1 Wind suction test

During the suction test at 400Pa, the PV modules lift off the substrate. Therefore, from this test load onwards, the central concrete element was fixed to the test stand using screw clamps. The outer feet were screwed to the underlying beam using 5x70mm wood screws.
During the further suction test, the upper module clamps failed only at the third test cycle with 2400 Pa. This has no significance in practice, since the entire assembly structure would have lifted off long since under this load.

4.2 Snow load test

The SmartSolarBox version 5.0 substructure withstood a simulated snow load of 5000 Pa on 1.95m2 test module area without failure. The module carrier beams showed an insignificant residual deformation only.

There is discretion in determining an appropriate safety factor for a structure constructed of differently loaded concrete and steel. Higher safety factors are generally assumed for concrete than for steel (typically 1.1). However, no change or failure was observed in the concrete at all. Reech deems a maximal design value of 4000Pa as reasonable for the SmartSolarBox substructure, provided that the substrate can absorb the forces occurring at the supporting points of the structure without causing damage and without significant deformation. This value corresponds to a safety factor of 1.25.

In order for the entire SmartSolarBox incl. PV modules to be approved for this design value, the intended PV module must also be tested at 6000 Pa, or at least by means of an equivalent mounting method. According to IEC61215, a safety factor of 1.5 applies to the modules.