BDA KEUR

Date
2011.03.31

BDA TEST
Determination of the resistance to thermal shock load

Category
BDA Test

Subject
Thermal shock

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Purpose

The determination of the resistance of a complete roof or façade assembly to rapidly changing climatic circumstances (thermal shock).

Introduction

Before a new product or system for roofs or façades is introduced on the market, the manufacturer needs to have a reasonable certainty regarding the good quality. The potential consumer requires certainty that the product or system will be satisfactory.
In general the common test methods have been written for products that already exist, and do not leave sufficient room for innovation. Often it is still possible to determine the properties of a new product, but the connection with practice can only be made when the product is investigated in the applied condition.
Furthermore mostly the existing test methods are small scaled and a full scale construction like in practice may perform quite differently. For that reason it is particularly useful to test a construction full scale, in order to be able to predict the behaviour of the construction parts realistically.

Regulations (Standards and directives)

It is possible that in initial condition a newly designed system fulfills the requirements regarding watertightness and/or resistance to wind loads. According to most national Building Regulations however, the system shall be resistant to all kinds of affecting loads during the reference period. Regarding the resistance to rain and wind there are clearly described tests. For testing on the resistance to climatic changes (temperature in combination with moisture), that will cause weathering of the exposed system, for most products no harmonized test standard has yet been prescribed. Testing upon the resistance to thermal shock load has established to be a reliable indication for the durability of the system, whether or not in combination with a subsequent testing on the resistance to watertightness and/or resistance to wind loads. This thermal shock test can be performed with the BDA SCUD Tester.

BDA SCUD Tester

The equipment in which the thermal shock test is realized, is the BDA SCUD Tester. SCUD stands for System test for Constructions Under Degradation.
The maximum dimensions of the system that can be tested in the BDA SCUD Tester are 7,50 m x 3,00 m. Because of these large dimensions, in required it is also possible to incorporate the testing of details. The slope on which the test can be performed, can be adjusted infinitely from 0° up to 45°.
In the BDA SCUD Tester the system can be heated up to 95 °C, can be cooled down with water of approximately 15 °C and can be frozen down to -40 °C (depending on the insulating capacity of the system to be tested). With these test parameters all kinds of combinations of loads are possible, all depending on the end use of the system.

The BDA SCUD is extremely suitable for full scale testing of sandwich panels in its end use construction in combination with its fastening system. For some types of sandwich panels this way of thermal shock testing is even prescribed in the 2011 revision of EN 14509:2006 - Self-supporting double skin metal faced insulating panels - Factory made products - Specifications.

Fig. 1 - BDA SCUD Tester

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Scope

In the BDA SCUD Tester all kinds of roof and façade assemblies can be investigated, like:
- sandwich panels;
- constructions with integrated PV-panels (photo-voltaic or solar panels);
- light façade constructions;
- parking roofs;
- corrugated metal roof sheets;
- cladding systems;
- et cetera.

Sandwich panels

In order to be able determine the sensitivity of the sandwich panels for a possible occurrence of blisters and/or wrinkles BDA has developed a thermal shock test. This test describes a horizontal mounting of the test specimens whereupon a thermal load is applied to the surface of the test specimen. In the aforementioned European product standard EN 14509:2006 a related way of testing is described. In the latest revision of 2011 however, also the BDA method of (practically) horizontal testing has been incorporated.
By performing the test on a system that has been mounted like is done in practice and according to the method as described below more information will be gained, not only on the whether or not occurrence of blisters, but also on the temperature at which these blisters appear. Extensive experiences with the BDA thermal shock test have shown a realistic relation with the performance in actual practice.

The thermal shock test has been drawn up as follows:
- ten cycles of 30 minutes of heating up to 40 °C, followed by fifteen minutes of cooling down with water of circa 15 °C;
- ten cycles of 30 minutes of heating up to 50 °C, followed by fifteen minutes of cooling down with water of circa 15 °C;
- ten cycles of 30 minutes of heating up to 60 °C, followed by fifteen minutes of cooling down with water of circa 15 °C;
- ten cycles of 30 minutes of heating up to 70 °C, followed by fifteen minutes of cooling down with water of circa 15 °C;
- five cycles of 30 minutes of heating up to 80 °C, followed by fifteen minutes of cooling down with water of circa 15 °C;
- one period of 2 hours of heating up to 85 °C.

When blisters occur, the moment on which this happens as well as the intensity of this occurrence defines the sensitivity to that.

Fig. 2 – Thermal shock test during heating

Fig. 3 – Thermal shock test during cooling down

PV-panels

In order to be able to determine how roofing waterproofing systems behave at considerable temperature differences, a test specimen is built including the details. Especially for building integrated photo-voltaic systems the details around the panels are extremely critical. The system is loaded cyclic by heating up to 75 °C, followed by cooling with water down to circa 15 °C. Besides the system is chilled down to -30 °C periodically. In between at the existing details the system is assessed on the occurrence of shrinkage, extension, detachment et cetera. In many cases by mutual agreement the temperatures up to which is heated or down to which is chilled can be determined and these also depend on the system to be examined.
After this test the system can be investigated on watertightness.