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Spett.le
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59100 PRATO (PO) - ITA

Test report N. 2021/0988 issued in Milan 09/04/2021

Client: LOGLI MASSIMO S.P.A.- PRATO (PO) – ITALIA

Specimen entry: 22/03/2021

TEST REPORT

Tests on cantilevered canopy La Pensilina “LUMIA” for equivalent snow and wind uplift loads

In the following pages are reported:

- Specimen description and test procedure;
- Test results.

The results are related only to the tested specimens.

The test report consists of 12 pages.

The test report can be only completely reproduced in full and shall be subjected to stamp duty for use according to Italian law D.P.R. 642/72.

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1. INTRODUCTION

This test report presents the results of static tests on cantilevered structural glazing.

Tests were performed at LPMSC (Materials, Structures and Constructions Laboratory) of Politecnico di Milano on the 23/03/2021 at the presence of the following persons:

Mr Daniele Spinelli (Politecnico di Milano)

Prof. Eng. Ph.D. Sara Cattaneo (Politecnico di Milano)

Eng. Ph.D. Lorenzo Piscitelli (Logli Massimo S.p.A.)

2. SPECIMEN IDENTIFICATION

La Pensilina "LUMIA" is a system by Logli Massimo Saint-Gobain, made with an EN AW 6063 T6 aluminum rail, clamps in Grivory GV-5H (polyamide) and gaskets in TPE. The system is intended for fixing of cantilevered canopies using laminated glass (LG) panels.

One LG specimen measuring 1000x1200mm was used to perform tests on the system. This specimen was made of two glass plies of 10 mm (both tempered), joined through 1.52 mm Sentryglas® interlayer (Fig.2.1). The length of 1000mm was inserted in the system *La Pensilina "LUMIA"*, also having a length of 1000mm, in such a way that the length of 1200 mm of the LG was put in a cantilevered position with respect of the base structure (Fig.2.2).

The glass specimen was provided by the company Quidam s.r.l. commissioned by the client.

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The code of each specimen is given by the type of test: WIND or SNOW depending on the load direction.

Six tests were performed for evaluating the performance with respect to equivalent WIND loads, in two different configurations:

- WIND tests 1 to 3 were performed in configuration 1, using 5 clamps (5 clamps/m),
- WIND tests 4 to 6 were performed in configuration 2, using 10 clamps (10 clamps/m),

One cyclical test was performed for evaluating the performance with respect to equivalent SNOW loads:

- SNOW test consisting of 3 consecutive load ramps in configuration 1, using 5 clamps (5 clamps/m),

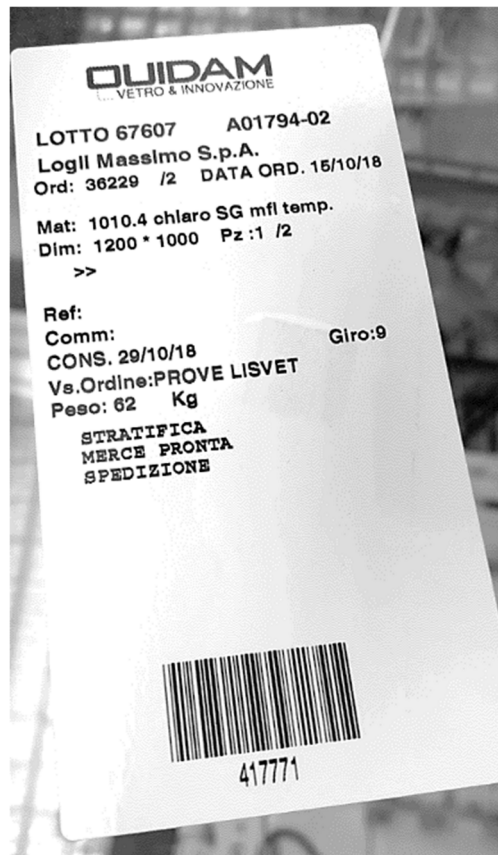


Figure 2.1 Glass label

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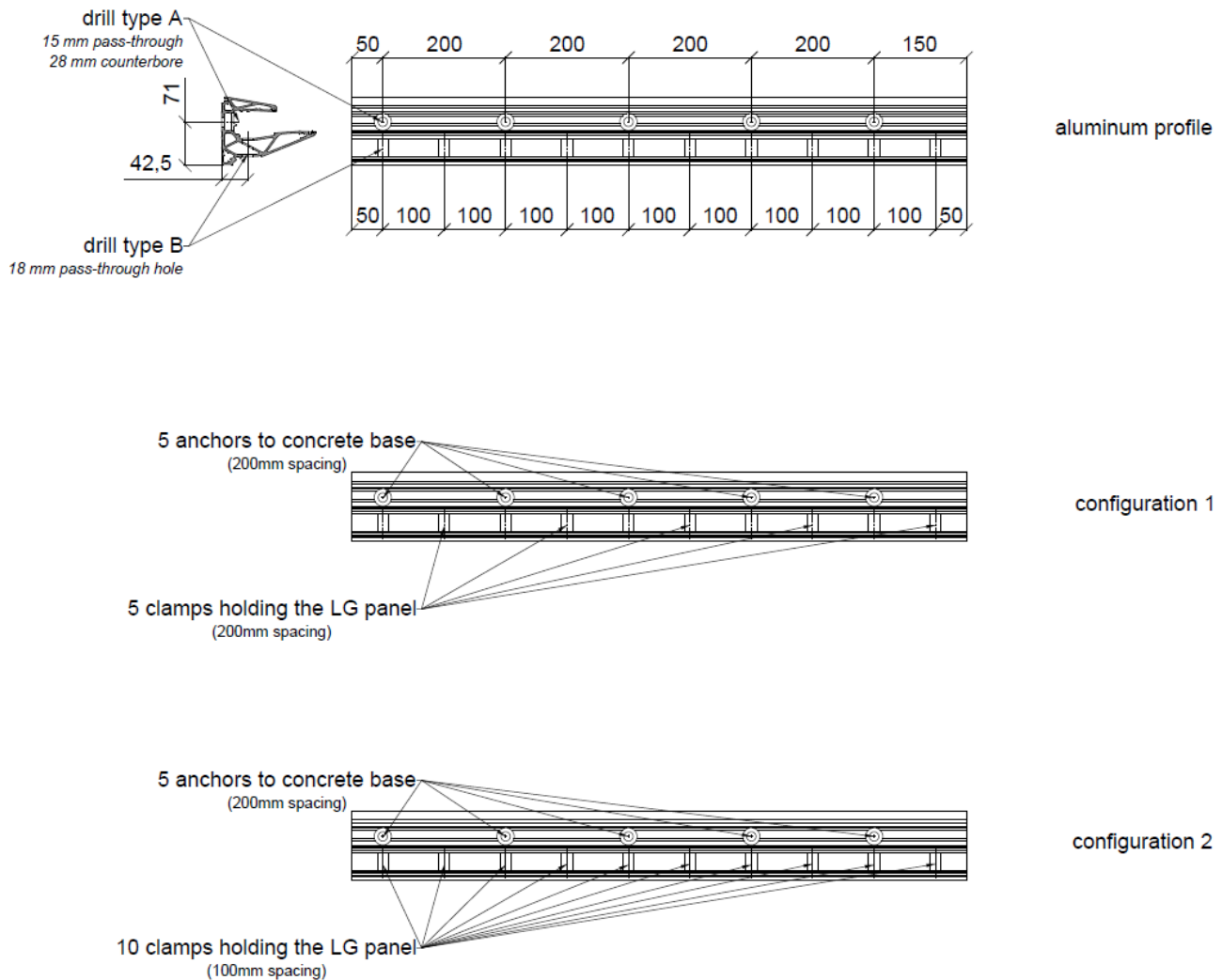


Figure 2.2 – aluminium rail and testing configuration details

3. TEST PROCEDURE

Tests were performed on specimens installed according to the following procedure:

1. Marking of the position of for the holes on the concrete slab (this was done using the rail as template and checking for the correct position with a level),
2. Drilling of the slab at an embedment depth of 120 mm in the anchoring points,

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3. cleaning of the dust within the holes,
4. installation of the rail La Pensilina “LUMIA” profile with 5 anchors (Fischer FBS10x100/15 US/A4 ETA-11/0095) with 200mm spacing,
5. tightening of the anchors up to a measured torque of 40 Nm,
6. assembly of the clamps and installation inside the profile with the spacing of 200 mm in configuration 1 (tests WIND 1-2-3 and in test SNOW), with the spacing of 100mm in configuration 2 (tests WIND 4-5-6),
7. inserting of the gaskets,
8. inserting of the glass aluminum profile (due to the vertical insertion of the glass, a thin plastic spacer about 3 cm long was used on both side of the aluminium rail, to avoid direct contact of the glass with the metal, this red spacer is visible both in Fig. 4.2c and Fig. 4.2d)
9. tightening of the clamps wedge with a torque moment of 3 Nm,

The installation was done according to instructions and with the supervision of the company Logli Massimo. Once the glass was placed, test were performed.

The system was installed on a concrete element C20/25, casted according to TR048 – EOTA -2016. The average concrete compressive strength (cubic) was equal to 30 MPa.

During all tests the temperature and the relative humidity were monitored with Extech Instrument RH520 Temperature and Humidity Recorder.

The test was performed with a loading system made of four pneumatic jacks attached to the strong floor and that apply the load via four ties attached to the upper edge of the balustrade with spacing 30 cm. The sketch of the testing system is shown in Fig. 3.1. Depending on the test the load was applied in two opposite directions (WIND or SNOW) according to Fig.3.2 and Fig.3.3.

The applied load of each jack was monitored via load cell (AEPTC4 S.N. 430971-400896–715249- 440041, class 1). By rotating the specimen 180°, it was possible to apply the load in two opposite directions when testing for equivalent WIND or equivalent SNOW loads, according to schemes described in Fig. 3.2 and Fig. 3.3.

The load was progressively increased to failure of the system or maximum capability of the testing setup (whichever came first):

- in testing for WIND loads, end test was always defined by ultimate resistance of the system: one load ramp was performed for each installation of the specimen, both for configuration 1 or configuration 2 (cf. Fig. 2.2). Six tests were performed in total.
- in testing for SNOW loads, end test was defined by the maximum capability of the setup:

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three consecutive cycles of loading/unloading were carried out up to the maximum capacity of the setup; during the last loading cycle, the load was held constant at the value of 9.0 kN (9.0 kN/m) for 15 minutes.

For all tests, the load simultaneously measured by the 4 load cells was acquired by control system PLC Siemens S7 running a dedicated software, designed to maintain a uniform load in the four points in all phases of the tests (loading, constant load, unloading).

The displacements were measured with three wire transducers WAYCON SX50-750-1R-KA02, placed at the same height of the load application, at midspan (S.N. 17555215) and with spacing of 30 cm (S.N. 18561245 (left), 17555213 (right)) (Fig.3.1).

All data (4 load cells and 3 displacement transducers) were acquired by Spider 8 HBM data acquisition system with specimen frequency of 2 Hz.

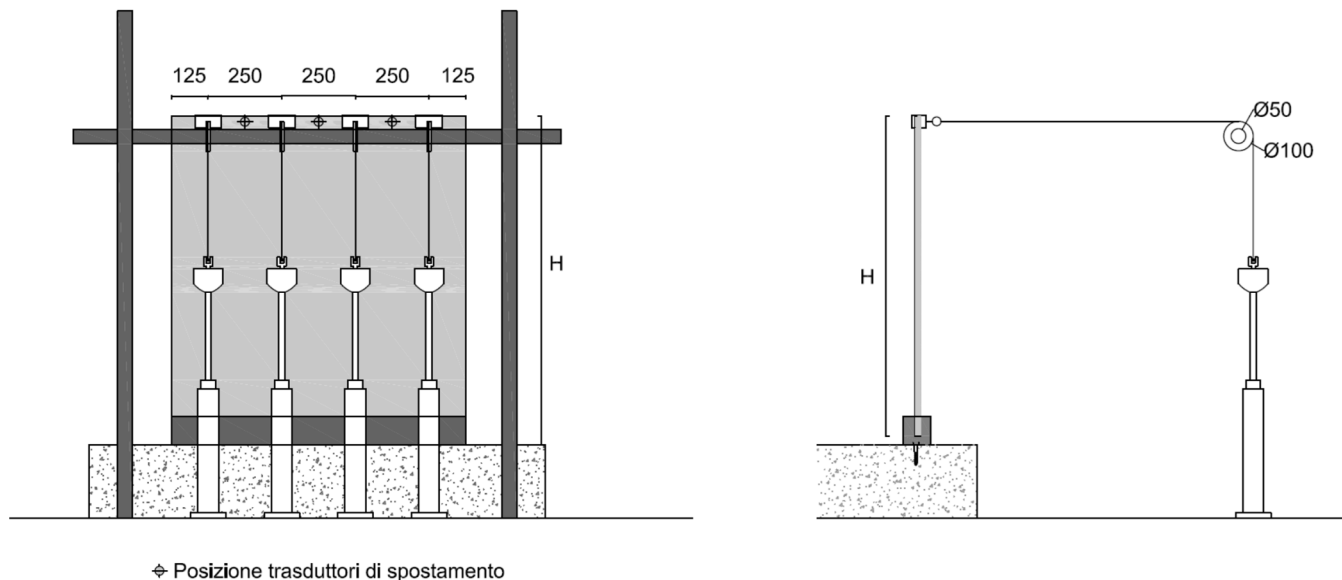


Figure 3.1 – Sketch of the testing setup – Front and lateral view (measure in mm)

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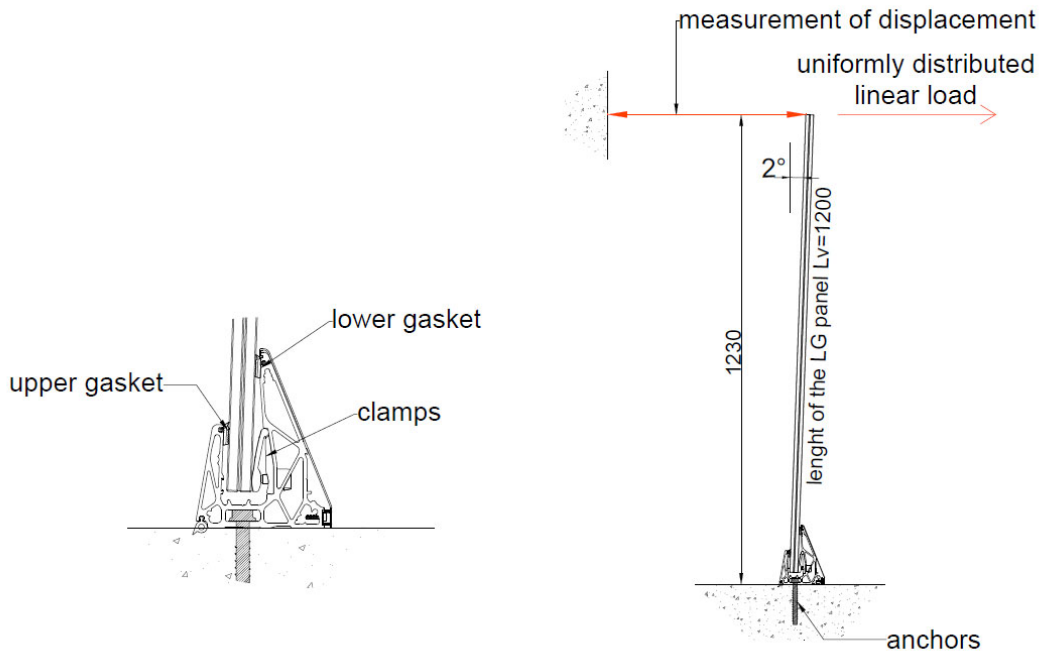


Figure 3.2 – equivalent SNOW tests

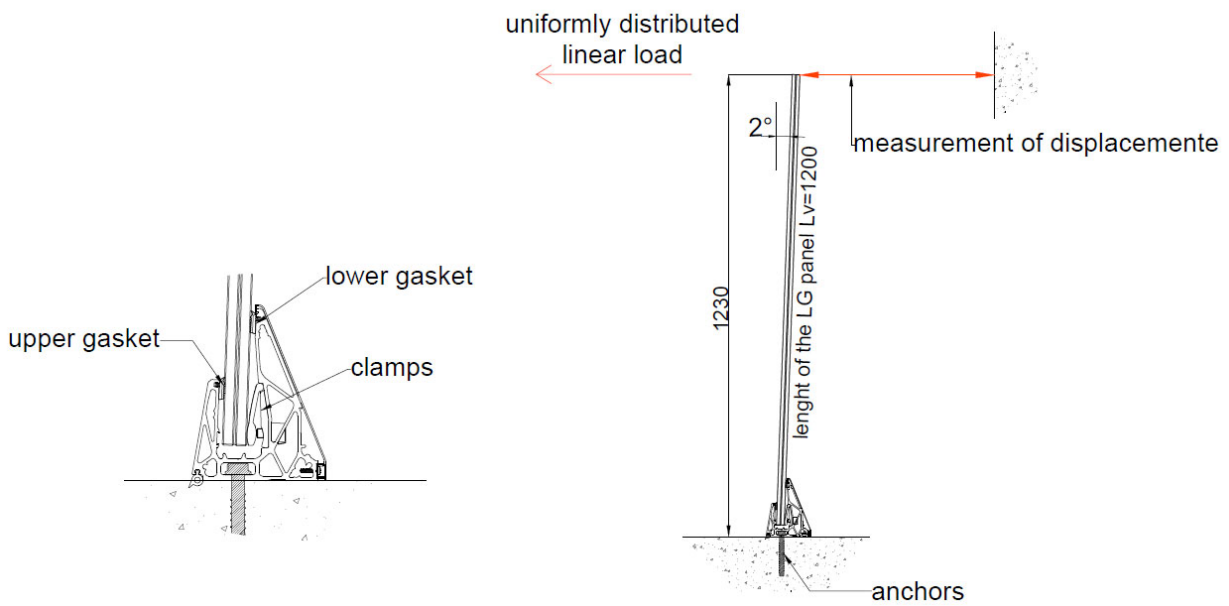


Figure 3.3 – equivalent WIND tests

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4. TEST RESULTS

The average temperature and the relative humidity of the laboratory during the tests were equal to 20°C and 49% respectively.

4.1 Equivalent WIND load tests

All of the six tests resulted in a localized punching failure within the body of the polyamide clamps (Fig. 4.2b).

Table 4.1 reports the maximum load associated to the failure of the clamps and the average displacement for each test under the “Wind configuration”.

Figure 4.1 shows the load - average displacements curves.

Figure 4.2 shows the test configuration and the failure of the clamps.

Table 4.1 – Maximum load and average displacement at failure

test reference	configuration	number of clamps	maximum load [kN/m]	displacement measured at max load [mm]
PENL-WIND-EQ-1	1	5 (5/m)	2.03	80.06
PENL-WIND-EQ-2			2.15	86.25
PENL-WIND-EQ-3			1.65	60.73
PENL-WIND-EQ-4	2	10 (10/m)	4.26	153.35
PENL-WIND-EQ-5			4.41	148.28
PENL-WIND-EQ-6			4.03	132.93

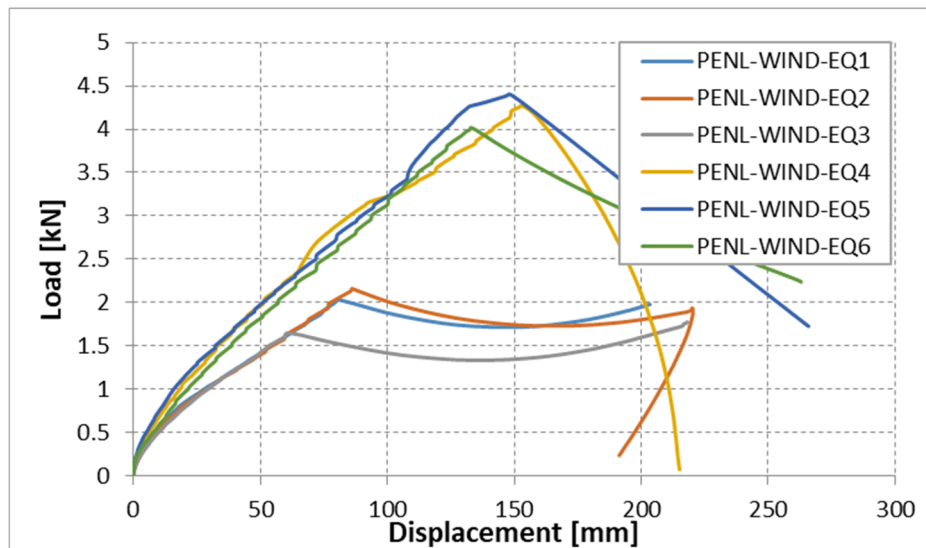


Figure 4.1 –WIND tests - Load- Displacement curves

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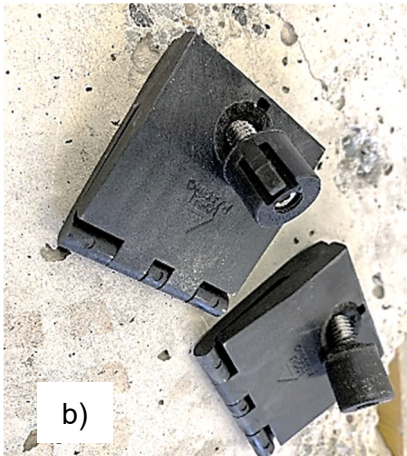
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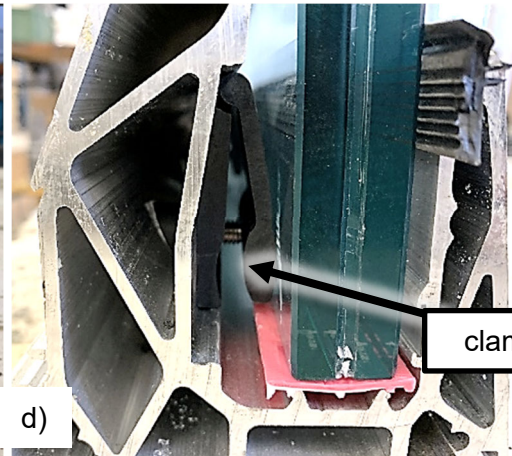
a)



b)



c)



clamps

Figure 4.2 – Specimen WIND: load application and detail of failure

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4.2 Snow test

Table 4.2 reports the maximum load, the average displacement at the peak load and the residual displacement after each load cycle.

Figure 4.3 shows the load - average displacement curve.

Figure 4.4 shows the specimen subjected to load.

The specimen did not fail (Fig.4.5).

Table 4.2 – Maximum load, displacement and residual load

test reference	Load cycle	Maximum load applied (kN/m)	Maximum displacement measured (mm)	Residual displacement ¹ (mm)
PENL-SNOW-EQ-1	1st	9.31	104.5	7.4
	2nd	9.22	104.4	7.5
	3rd ²	9.00	105.9	10.3

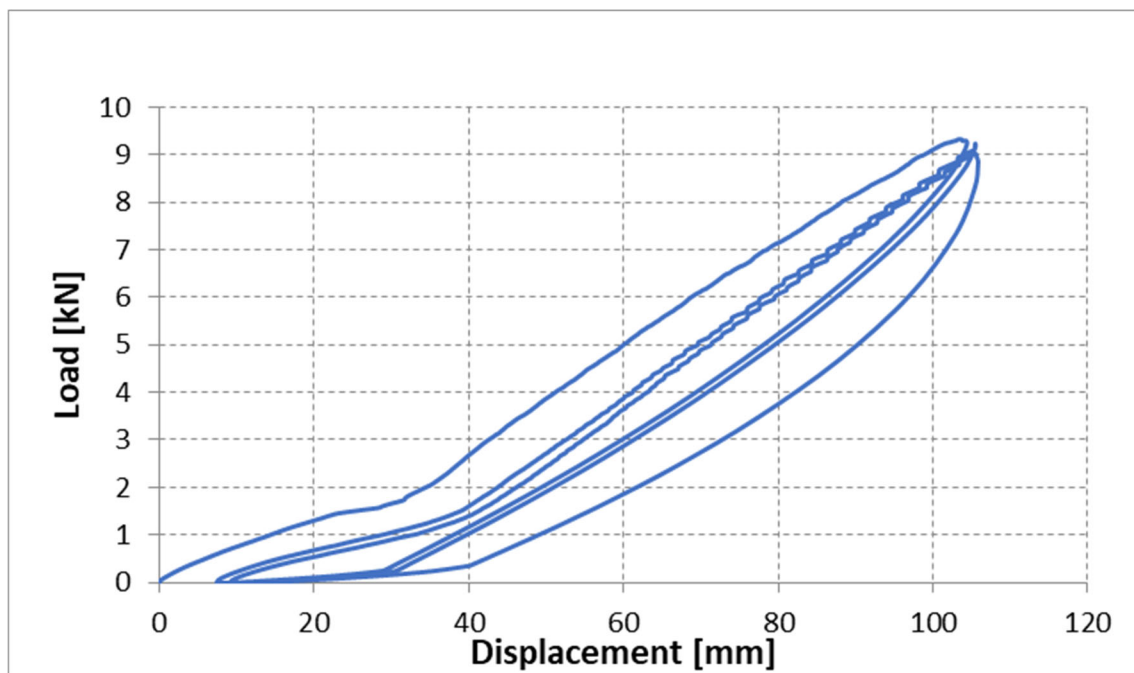


Figure 4.3 – SNOW test- Load- Displacement curve

¹ Residual displacement is total, not cumulative after each ramp

² Maximum load is held for 15 minutes during the 3rd load cycle

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Figure 4.4 – Specimen snow: load application

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Figure 4.5 – Specimen snow: load removed

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