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Test Report

Testing of OnLevel Glass Balustrades

Laboratories Oslo, Mechanical Testing

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2018-08-22

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Abstract:

SINTEF Building and Infrastructure (SINTEF Byggforsk) was requested by OnLevel GmbH to carry out mechanical tests of a selection of frameless glass balustrades. The testing was performed in SINTEF's laboratories in Oslo from February 26th to March 1st, 2018.

The glass balustrade systems subjected to testing consists of a laminated glass panel (thickness 17.52, 21.52, 25.52 or 31.52 mm), a glass profile (aluminium channel) and a type specific "Flex-Fit" mounting kit (including rubber gaskets, plastic wedges and adjustment clips). Properties of fasteners supplied by OnLevel for attaching profiles to the test base were not considered in the testing.

Glass profiles tested (with various glass panels);

TL-6020 Top Mount	&	TL-6021 Side Mount	(1.5 kN)
TL-3010 Top Mount	&	TL-3011 Side Mount	(1.0 kN)
TL-6030 Top Mount	&	TL-6031 Side Mount	(3.0 kN)

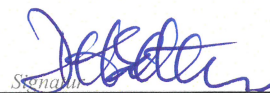
The testing was performed according to guidelines and requirements SINTEF Byggforsk has developed in collaboration with Glass og Fasadeforeningen, in accordance with NS 3510:2015.

1000 mm wide sections of the glass balustrades were subjected to static line load test and pendulum test, with loads and pendulum drop heights according to relevant categories of use in NS 3510.

See report for test results.

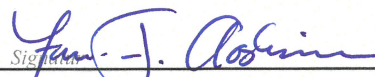
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Dag Henning Sæther


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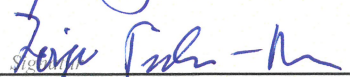
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Classification:

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REVISIONS

Rev. no.:	Date:	Description:	Revised by:
01	2018-08-08	Product descriptions changed to "1.0 kN" and text about handrails added in section 2. Glass thickness corrected in Table 1. Line load height in section 5.1.2 corrected to 1200 mm above the concrete base. Incorrect note about exceeded glass height removed from Table 3 and Table A1-1. Replaced drawings in Appendix 2 with updated drawings received from OnLevel and updated references in section 5.	JFA

1 INTRODUCTION

SINTEF Building and Infrastructure (in Norwegian; SINTEF Byggforsk) was in November 2017 requested by OnLevel GmbH in Germany to carry out mechanical tests on frameless glass balustrades according to NS 3510:2015. The tests were carried out in SINTEF Byggforsk's laboratories in Oslo from February 26th to March 1st, 2018 by Jan-Fredrik Aasheim and Dag Henning Sæther. Djóni Ziska and Frank Verhey from OnLevel were present during the tests and mounted all profiles and glass panels to the test jig.

OnLevel wanted to obtain test documentation for the products to be used in an application for SINTEF Technical Approval (SINTEF TG).

2 TEST SAMPLES

All test samples and fasteners were supplied and installed by OnLevel. The test materials were received on February 19th, 2018 and given internal tracking number P-92.

Laminated glass panels were supplied, with thickness 17.52, 21.52, 25.52 and 31.52 mm.

All panels were made of 2 layers toughened glass laminated with 1,52 mm foil.

The size of all glass panels was 1000 x 1300 mm.

The glass profiles (aluminium channels) tested were as follows, named according to OnLevel:

TL-6020 1.5 kN Top Mount	TL-6021 1.5 kN Side Mount
TL-3010 1.0 kN Top Mount	TL-3011 1.0 kN Side Mount
TL-6030 3.0 kN Top Mount	TL-6031 3.0 kN Side Mount

The tested glass profiles are shown in Figure 1, Figure 8, Figure 9 and Figure 10. Drawings and descriptions of the profiles are given in Appendix 2.

OnLevel has a set of "paired" profiles for top and side mounting. The part of the profile supporting the glass is the same, but the position of the fasteners is different. Three "sets" of profiles with glass panels were tested: 6020/6021, 6030/6031 and 3010/3011, see also Figure 1.

Glass profiles were supplied in 2500 mm lengths and cut to 1000 mm by SINTEF Byggforsk. Cutting positions were chosen to give a representative number of fastening holes.

Product specific mounting kits, named "Flex-Fit" were also supplied, consisting of rubber gaskets, adjustment clips and plastic wedges. See example in Figure 2 and specifications in Appendix 2.

None of the balustrade systems were delivered with optional glass handrails for testing, as only single glass panels were tested separately and not considered relevant for strength- and stiffness testing. NS 3510 recommends use of continuous handrail on top of the glass or binders between glass panels. For category C5 (3.0 kN/m), use of continuous handrail is required.

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Model 6020 anodized



Model 3010 anodized



Model 6030 anodized



Model 6021 Anodized



Model 3011 anodized



Model 6031 anodized

Figure 1. Glass profiles (aluminium channels) tested.

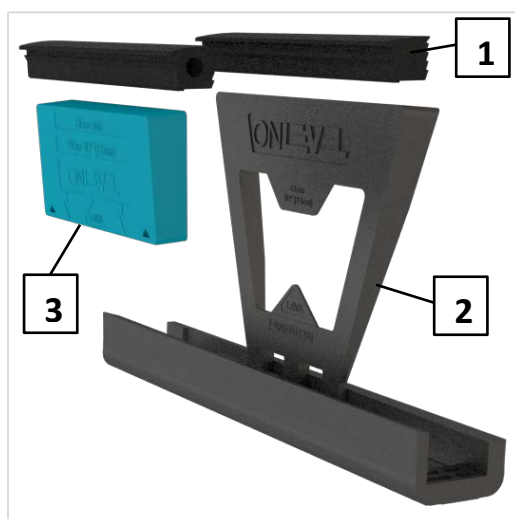


Figure 2. "Flex-Fit" mounting kit.

- 1 – Rubber gaskets.
- 2 – Adjustment clip (plastic).
- 3 – Plastic wedge.

3 TEST SETUP AND METHODS

3.1 Line Load Test

The glass panel was loaded with a horizontal line load at a specific height above the floor level or above the top of the glass profile, as illustrated in Figure 3. The load shall be equally distributed, and accordingly, the load beam is divided in sections and hinged to adapt to the glass surface (as in this case the glass panel is only supported by one evenly distributed glass profile underneath, the top the glass will have the same deflection in any point along the line load and a rigid beam could have been used).

The load beam was covered with a soft 20 mm wide rubber foam. The load was applied with an electric actuator and measured with a 10 kN electronic load cell (SINTEF equipment number MO-5018). Deflections were measured with Novotech 100 mm linear position transducers. Deflection was measured at the centre of the line load. After a discussion about load distribution, two more transducers were used to measure deflection on each end of the line load. The measurements verified that deflections were equal along the line load. The transducer was supported by a frame which was connected directly to the concrete base for the glass balustrade, to eliminate deflections in the test rig. See test setup in Figure 4.

When loading along the top edge of a glass panel, the centre of the line load was approx. 10 mm below the panel top edge, due to the 20 mm wide rubber foam. When panels were loaded further below the top edge, the height of load was defined as the upper edge of the rubber foam.

Load and deflection was continuously recorded and displayed with an HBM MGCplus datalogging system during all tests.

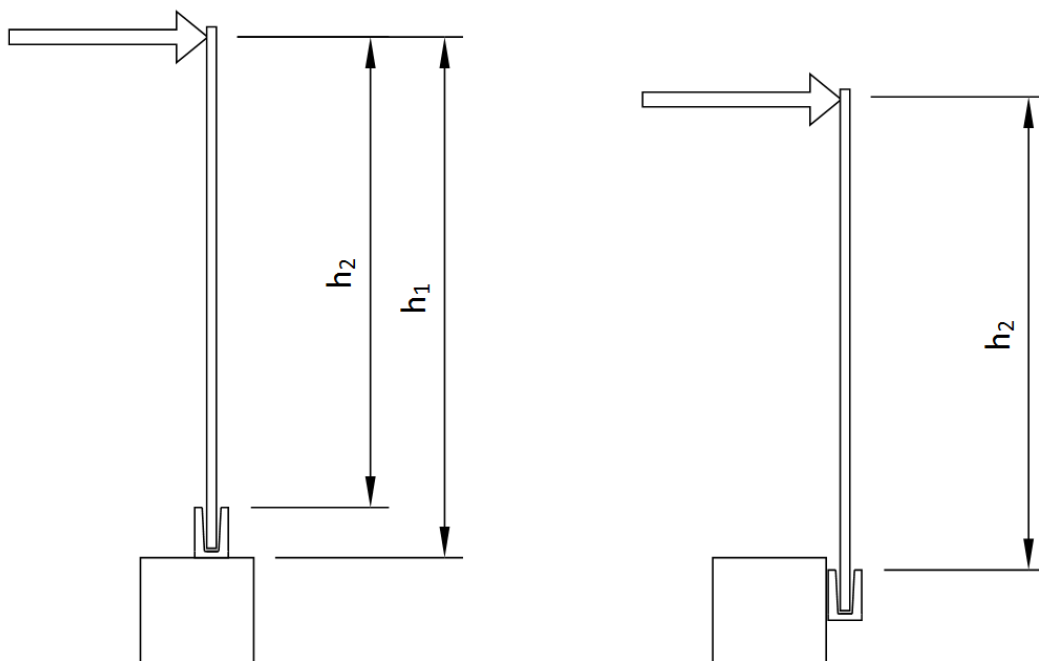


Figure 3. Line load test setup for top mounted and side mounted glass profiles.

h_1 – Line load height above concrete base.

h_2 – Line load height above top of profile.

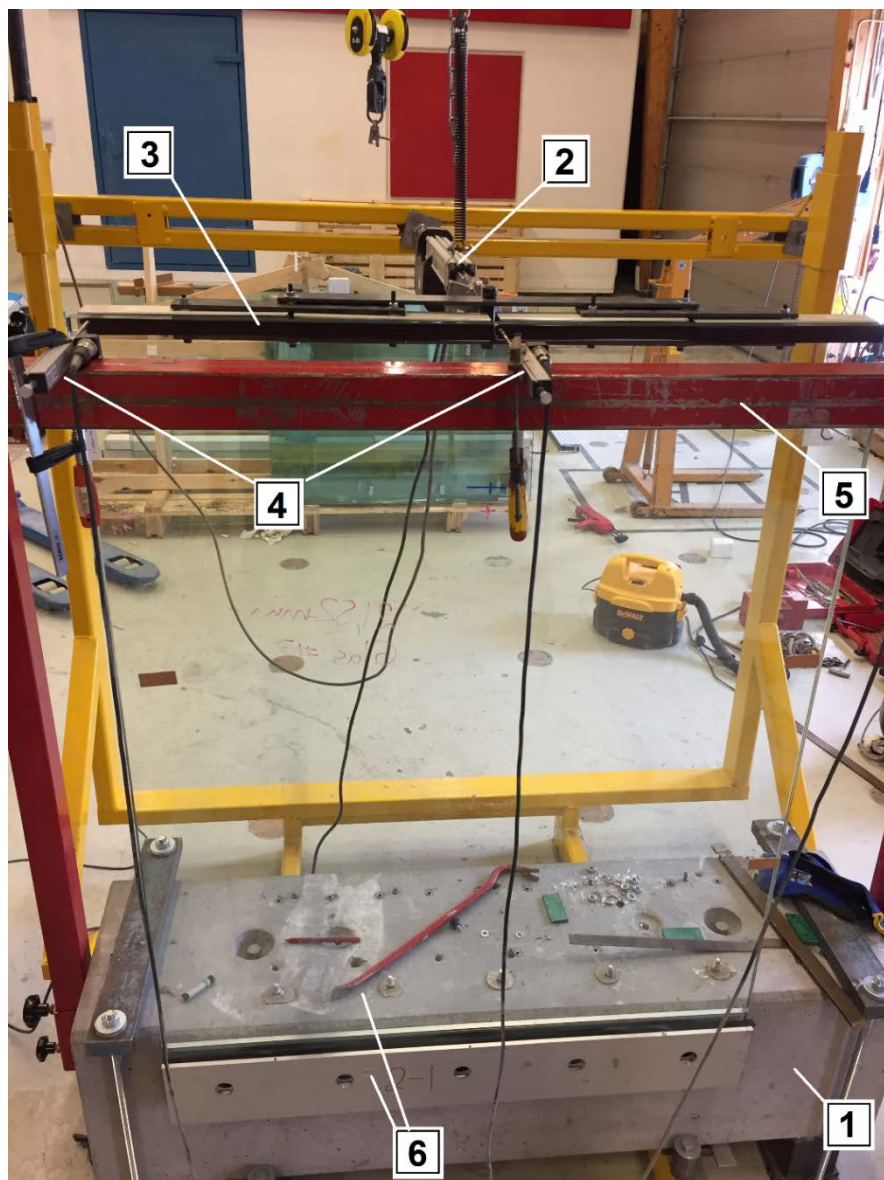


Figure 4. Applied test setup for line load test.

- 1 – Concrete base 400 x 400 x 1500 mm.*
- 2 – Electric actuator.*
- 3 – Hinged and flexible load beam with rubber foam.*
- 4 – Position transducers (one is hidden on figure).*
- 5 – Support frame for position transducers, attached to concrete base.*
- 6 – Glass profile with glass panel.*

3.2 Pendulum Test

Pendulum test was carried out according to NS-EN 12600.

The glass profile with the panel was mounted on the concrete base, and the base attached to the strong floor. The pendulum was adjusted to hit the centre of the glass panel. The pendulum, a 50 kg weight with two rubber tyres (MO-6035) was suspended by a wire, lifted to a specific drop height, and then released. Deflections were not measured. See test setup in Figure 5 and Figure 6.

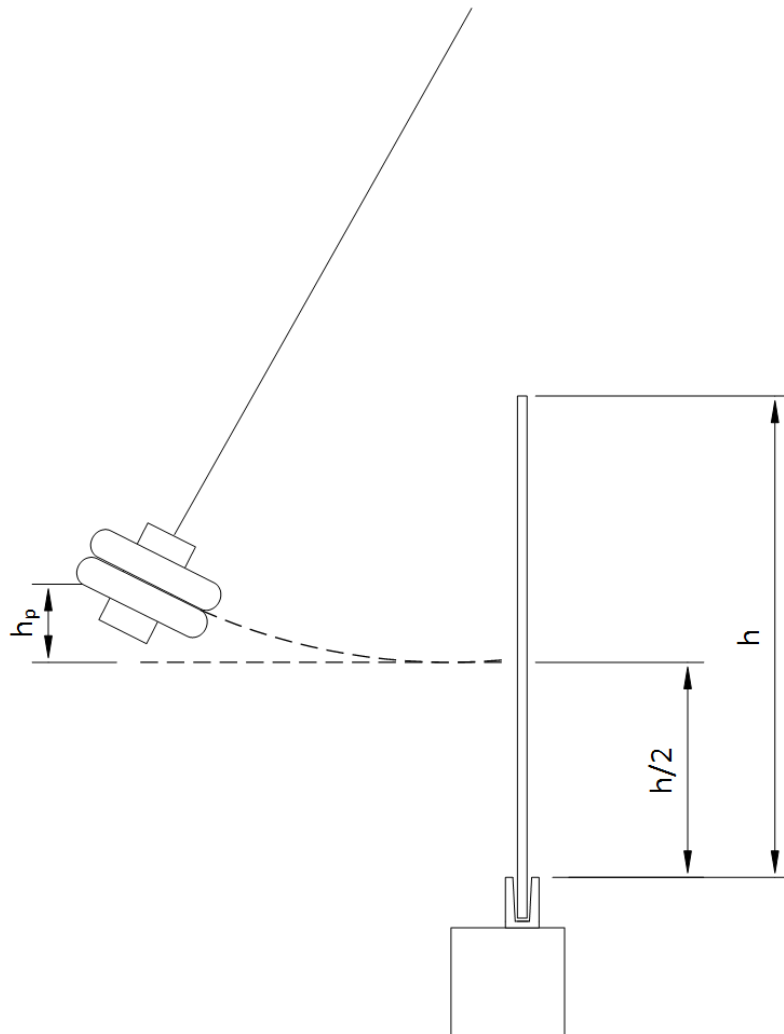


Figure 5. Pendulum test setup.

h – Glass height above profile.

h_p – Pendulum drop height.

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Figure 6. Applied test setup for pendulum test.

- 1 – Concrete base 400 x 400 x 1500 mm, attached to strong floor*
- 2 – Pendulum (50 kg)*

3.3 Fasteners for the glass profiles

OnLevel wanted to carry out the tests with a concrete block as base. The profiles were attached with the same fasteners as recommended in the supplier's user instructions.
(The fastening products will not be part of a SINTEF Technical Approval.)

Table 1. Fasteners used for glass profiles.

Profile tested	Glass thickness [mm]	Fasteners
TL-6020 Top Mount 1.5 kN	17.52 / 21.52	Fischer chemical anchor FIS A M 10x150 (art.no 90281)
TL-6021 Side Mount 1.5 kN	17.52 / 21.52	Fischer expansion anchor FH II 12/10 S (art.no 44884) l = 90 mm
TL-3010 Top Mount 1.0 kN	17.52 / 21.52	Fischer expansion anchor FAZ II 12/20 (art.no 95420) l = 120 mm
TL-3011 Side Mount 1.0 kN	17.52 / 21.52	Fischer chemical anchor RG M 10x190 (art.no 50281)
TL-6030 Top Mount 3.0 kN	25.52 / 31.52	Fischer expansion anchor FH II 12/15 SK (art.no 44917) l = 90 mm
TL-6031 Side Mount 3.0 kN	25.52 / 31.52	Fischer expansion anchor FH II 12/15 SK (art.no 44917) l = 90 mm

For all relevant tests as listed in Appendix 1, three evenly distributed wedges were used per glass profile / glass panel setup.

In addition, two tests with line load (test number 6 and 7) were performed with four wedges to see if this affected the stiffness of the system. Some potential gained stiffness was observed, but as this setup deviates from OnLevel's standard setup, content of the mounting kits and user instructions, OnLevel instructed to continue testing with three wedges only.

4 TEST PROGRAM AND REQUIREMENTS

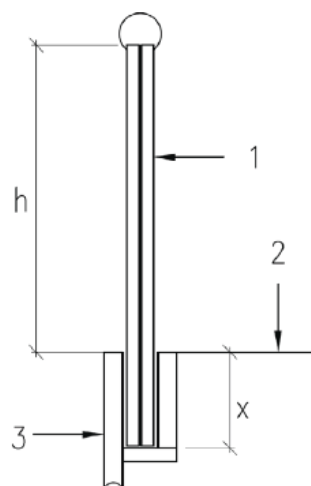
The testing is performed according to guidelines and requirements SINTEF Byggforsk has developed in collaboration with Glass og Fasadeforeningen, in accordance with NS 3510:2015.

SINTEF Byggforsk has a set of requirements for technical approval of glass railings. For these frameless glass balustrades, the most important requirements for the testing are:

- 4 parallel tests shall be carried out on each product.
- Glass panels shall be subjected to a horizontal line load along the top edge (or at a maximum distance of 1200 mm from the floor level¹).
- Nominal line loads corresponding to categories of use are²:
 - o 1.0 kN/m for categories A, B and C1.
 - o 1.5 kN/m for categories C2, C3, C4 and D.
 - o 3.0 kN/m for category C5.
- Maximum permitted deflection when subjected to nominal line load is 50 mm. This requirement applies for each test sample in a test series.
- The panels (all 4 specimens) shall withstand a line load of 1.5 x nominal load without failure.
- Panels shall withstand a pendulum test from 450 mm drop height for categories A, B, C1-C4 & D (1.0 kN/m and 1.5 kN/m panels), and 1200 mm drop height for category C5 (3.0 kN/m panels)².

¹ In NS 3510, measurement of glass height is illustrated with only one applicable example of side mounted glass balustrades, see Figure 7. In this report, interpreted and applied datum points for measurement of glass and line load height are illustrated in Figure 3 and Figure 5.

² Categories of use as given in NS 3510, based on NS-EN 1991-1-1:2002+NA:2008 are shown in Table 2.


Tegnforklaring:

- 1 glassrute iht. tabell A.7, A.8.a og A.8.b
- 2 gulv
- 3 kontinuerlig innfesting i dekkeforkant
- h høyde (vertikal utkraging) over gulv til overkant glassrute eller overkant håndløper
- x innfestingshøyde skal være større eller lik 120 mm eller større enn $h/10$

Figure 7. The figure is reproduced from NS 3510:2015 Figur A.7. Example of side mounted glass balustrade in relation to the floor.

Translated legend:

1 – Glass panel according to table A.7, A.8.a and A.8.b.

2 – Floor.

3 – Continuous fastening to front surface.

h – Height above floor level to the upper edge of the glass or hand rail.

x – Fastening height shall be greater or equal to 120 mm or greater than $h/10$

Table 2. Categories of use with examples of usage according to NS-EN 1991-1-1:2002+NA:2008.

Category	Specific use	Example
A	Areas for domestic and residential activities	Rooms in residential buildings and houses; bedrooms and wards in hospitals; bedrooms in hotels and hostels kitchens and toilets
B	Office areas	
C	Areas where people may congregate (With the exception of areas defined under category A, B and D)	C1: Areas with tables, etc. E.g. areas in schools, cafés, restaurants, dining halls, reading rooms, receptions. C2: Areas with fixed seats, e.g. areas in churches, theatres or cinemas, conference rooms, lecture halls, assembly halls, waiting rooms, railway waiting rooms. C3: Areas without obstacles for moving people, e.g. areas in museums, exhibition rooms, etc. and access areas in public and administration buildings, hotels, hospitals, railway station forecourts. C4: Areas with possible physical activities, e.g. dance halls, gymnastic rooms, stages. C5: Areas susceptible to large crowds, e.g. in buildings for public events like concert halls, sport halls including stands, terraces and access areas in railway platforms.
D	Shopping areas	D1: Areas in general retail shops D2: Areas in department stores

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5 TEST RESULTS

For all the profiles tested, deflection under nominal load was the critical property. All panels could withstand 1,5 x nominal load, and all panels passed the corresponding pendulum test. To reduce the number of tests, the weakest profile in a "set" was subjected to 4 parallel tests, while for the strongest, just one test was carried out.

For all sets of profiles, the top mounted version was the weakest, and 4 parallel tests were performed. One line load test and one pendulum test were performed on the side mounted version.

For all line load tests, the glass profile / glass panel assembly was first subjected to a low pre-load, then released and wedges were tightened up before applying the test load.

Several tests were performed with various line load heights to simulate different glass heights. All relevant tests are listed in Appendix 1. In cases where the results are close to the acceptable deflection limit, the glass height may be adjusted afterwards through calculations to fully comply with the requirements.

In cases where the glass heights are outside allowed dimensions according to NS 3510, a note is made in the results summary. However, the glass panel size may still be used if it can be proven through calculations that its properties are equal or better than the examples given in NS 3510.

5.1 Glass Profile 6020 / 6021 – 1.5 kN

According to drawings in Appendix 2 (Figure A2-1 to A2-8) the glass panel's fastening height inside the profile of 98 mm is below minimum allowed fastening height of 120 mm in NS 3510, see Figure 7.

5.1.1 Test with 17.52 mm glass panels

According to NS 3510, 17.52 mm glass panel may be used in category A, B and C1 (1.0 kN/m) with a maximum exposed glass height of 1000 mm (above profile).

The top mounted profile 6020 with 17.52 mm glass passed both static linear load test and pendulum test, with line load height 1000 mm above profile. Only one glass profile/panel was tested. See test number 1 in Table A1-1.

The side mounted profile 6021 with 17.52 mm glass was not tested, as this was considered likely to perform better than the corresponding top mounted profile 6020.

5.1.2 Test with 21.52 mm glass panels

According to NS 3510, 21.52 mm glass panel may be used in category A, B and C1 (1.0 kN/m) with a maximum exposed glass height of 1200 mm (above profile).

The top mounted profile 6020 with 21.52 mm glass passed both static linear load test and pendulum test, with line load height 1200 mm above the concrete base (1060 mm above profile). Only one glass profile/panel was tested. See test number 5 in Table A1-1.

According to NS 3510, 21.52 mm glass panel may be used in category C2, C3, C4 and D (1.5 kN/m) with a maximum exposed glass height of 1000 mm (above profile).

The top mounted profile 6020 was initially tested with different panel heights, and both 4 and 3 wedges. A line load height of 1100 mm above concrete was chosen (960 mm above profile). The top mounted profile 6020 with 21.52 mm glass passed both static linear load test and pendulum test, except for one of four parallel line load tests which gave deflection at nominal load just above the acceptance limit of 50 mm. See test number 8 to 11 in Table A1-1.

In addition, as an informative test, the top mounted profile 6020 with 21.52 mm glass was tested once for category C2, C3, C4 and D (1.5 kN/m) with line load height 1200 mm above the concrete base (1060 mm above profile) and passed. However, the glass panel height exceeds maximum allowed exposed glass height of 1000 mm according to NS 3510. See test number 31 in Table A1-1.

The side mounted profile 6021 was tested for category C2, C3, C4 and D (1.5 kN/m) with line load height 1000 mm above profile and passed the test. Pendulum test was not performed. See test number 12 in Table A1-1.

The side mounted profile 6021 was also tested for category A, B and C1 (1.0 kN/m) with line load height 1200 mm above profile and passed both static and pendulum test. See test number 14 in Table A1-1.

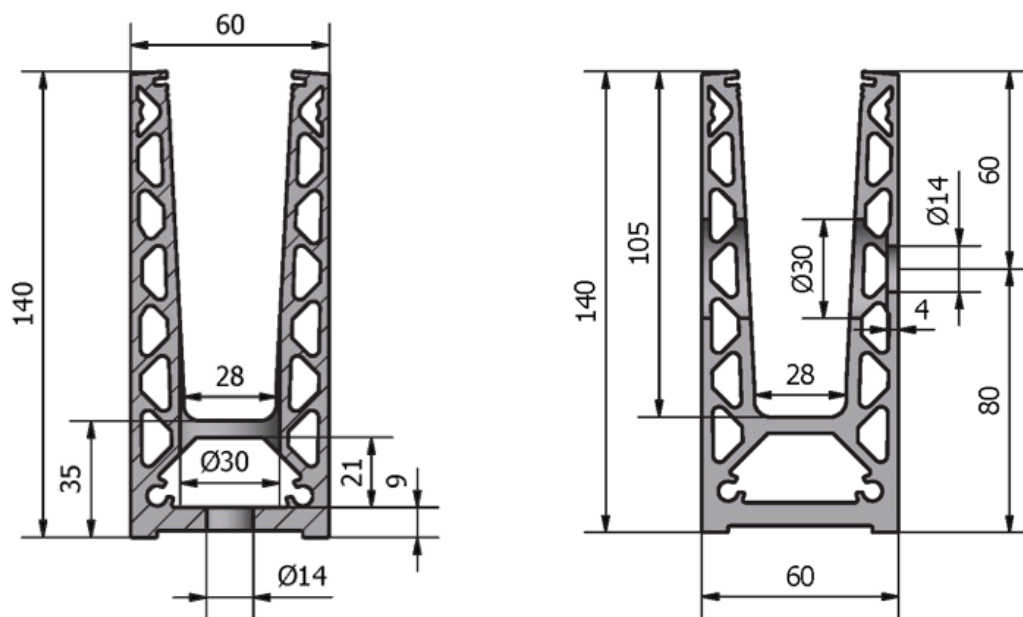


Figure 8. Glass profiles 6020 (left) and 6021 (right).

5.2 Glass Profile 3010 / 3011 – 1.0 kN

According to drawings in Appendix 2 (Figure A2-9 to A2-16) the glass panel's fastening height inside the profile of 98 mm is below minimum allowed fastening height of 120 mm in NS 3510, see Figure 7.

5.2.1 Test with 17.52 mm glass panels

According to NS 3510, 17.52 mm glass panel may be used in category A, B and C1 (1.0 kN/m) with a maximum exposed glass height of 1000 mm (above profile).

The top mounted profile 3010 with 17.52 mm glass passed both static linear load test and pendulum test, with line load height 1000 mm above profile. Only one glass profile/panel was tested. See test number 15 in Table A1-1.

The side mounted profile 3011 with 17.52 mm glass was tested for category A, B and C1 (1.0 kN/m) with line load height 1000 mm above profile. The line load test gave deflection at nominal load just above the acceptance limit of 50 mm. See test number 25 in Table A1-1.

5.2.2 Test with 21.52 mm glass panels

According to NS 3510, 21.52 mm glass panel may be used in category A, B and C1 (1.0 kN/m) with a maximum exposed glass height of 1200 mm (above profile).

The top mounted profile 3010 with 21.52 mm glass passed both static linear load test and pendulum test, with line load height 1200 mm above profile. See test number 16, 18, 19 and 20 in Table A1-1.

The side mounted profile 3011 with 21.52 mm glass was tested for category A, B and C1 (1.0 kN/m) with line load height 1200 mm above profile and passed both static linear load test and pendulum test. See test number 23 in Table A1-1.

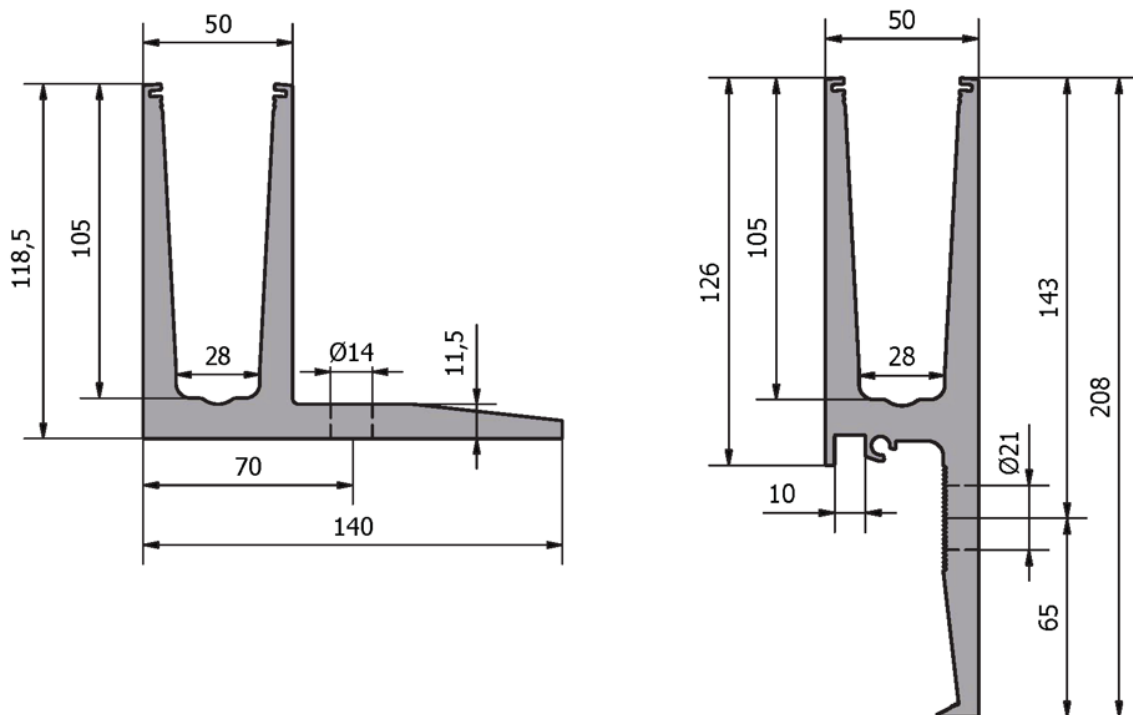


Figure 9. Glass profiles 3010 (left) and 3011 (right).

5.3 Glass Profile 6030 / 6031 – 3.0 kN

According to drawings in Appendix 2 (Figure A2-17 to A2-24) the glass panel's fastening height inside the profile of 96 mm is below minimum allowed fastening height of 120 mm in NS 3510, see Figure 7.

5.3.1 Test with 25.52 mm glass panels

According to NS 3510, 25.52 mm glass panel may be used in category C2, C3, C4 and D (1.5 kN/m) with a maximum exposed glass height of 1200 mm (above profile).

The top mounted profile 6030 with 25.52 mm glass passed both static linear load test and pendulum test, with line load height 1075 mm above profile (1200 mm above concrete). Only one glass profile/panel was tested. See test number 22 in Table A1-1.

The side mounted profile 6031 with 25.52 mm glass was not tested, as this was considered likely to perform better than the corresponding top mounted profile 6030.

5.3.2 Test with 31.52 mm glass panels

According to NS 3510, 31.52 mm glass panel may be used in category C5 (3.0 kN/m) with a maximum exposed glass height of 1200 mm (above profile).

The top mounted profile 6030 with 31.52 mm glass passed both static linear load test and pendulum test, with line load height 1075 mm above profile (1200 mm above concrete). See test number 26, 27, 28 and 29 in Table A1-1. In one of the four tests, the wedges were tightened up and test repeated after an unsuccessful first attempt with diverging results.

The side mounted profile 6031 with 31.52 mm glass was tested for category C5 (3.0 kN/m) with line load height 1200 mm above profile and passed both static linear load test and pendulum test. Only one glass profile/panel was tested. See test number 30 in Table A1-1.

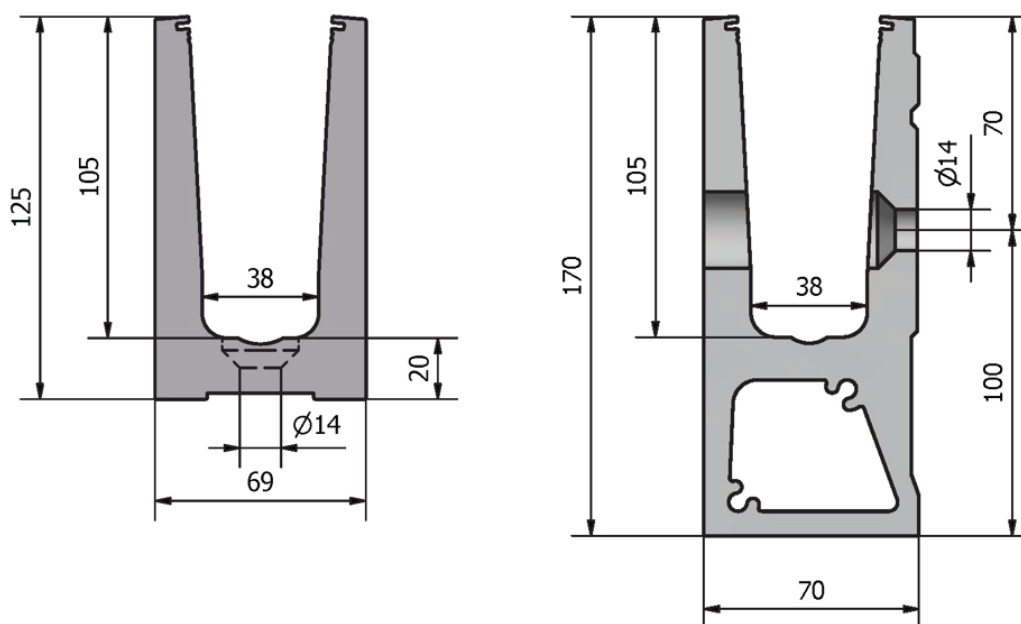


Figure 10. Glass profiles 6030 (left) and 6031 (right).

6 CONCLUSION

Table 3 below summarizes all tested products with various combinations of glass profile, glass thickness and glass height, in conjunction with applicable acceptance criteria and categories of use according to NS 3510:2015.

In addition, Table 4 summarizes side mounted product combinations which are not tested but considered likely to meet all requirements based on the corresponding test of top mounted profile which is considered as a tougher test.

Table 3. Summary of tested profiles in combination with various glass panel thickness and height.

Glass profile	Glass thickness [mm]	Glass height (above profile) [mm]		
		Class A, B and C1 (1.0 kN/m)	Class C2, C3, C4 and D (1.5 kN/m)	Class C5 (3.0 kN/m)
TL-6020 Top Mount 1.5 kN	17.52	1000	-	-
TL-6020 Top Mount 1.5 kN	21.52	1060	960 ¹	-
TL-6021 Side Mount 1.5 kN	21.52	1200	1000	-
TL-3010 Top Mount 1.0 kN	17.52	1000	-	-
TL-3010 Top Mount 1.0 kN	21.52	1200	-	-
TL-3011 Side Mount 1.0 kN	17.52	1000 ¹	-	-
TL-3011 Side Mount 1.0 kN	21.52	1200	-	-
TL-6030 Top Mount 3.0 kN	25.52	-	1075	-
TL-6030 Top Mount 3.0 kN	31.52	-	-	1075
TL-6031 Side Mount 3.0 kN	31.52	-	-	1200

¹ Glass height should be slightly reduced through calculations to fully meet the stiffness requirement.

Table 4. Summary of glass profiles and panels not tested but considered likely to pass testing.

Glass profile	Glass thickness [mm]	Glass height (above profile) [mm]		
		Class A, B and C1 (1.0 kN/m)	Class C2, C3, C4 and D (1.5 kN/m)	Class C5 (3.0 kN/m)
TL-6021 Side Mount 1.5 kN	17.52	1000	-	-
TL-6031 Side Mount 3.0 kN	25.52	-	1075	-

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APPENDIX 1 – SUMMARY OF TEST RESULTS

Table A1-1. Summary of all relevant test results.

Summary of test results for OnLevel glass balustrades tested by SINTEF Byggforsk Oslo, February 26nd to March 1st 2018

Test no	Glass profile model	Glass thickness (mm)	Line load height above profile (mm)	Line load height above concrete (mm)	Deflection at 1,0 kN (mm)	Deflection at 1,5 kN (mm)	Deflection at 3,0 kN (mm)	Stiffness test result	Strength test load (kN)	Strength test result	Pendulum fall height (mm)	Pendulum test result	Category of use, according to NS 3510	Notes
1	TL-6020 Top Mount 1.5 kN	17.52	1000	1140	49	-	-	Passed	1.5	Passed	450	Passed	A, B & C1 (1.0 kN/m)	2
5	TL-6020 Top Mount 1.5 kN	21.52	1060	1200	42	-	-	Passed	1.5	Passed	-	-	A, B & C1 (1.0 kN/m)	2
8	TL-6020 Top Mount 1.5 kN	21.52	960	1100	-	45	-	Passed	2.25	Passed	450	Passed	C2, C3, C4 & D (1.5 kN/m)	2
9	TL-6020 Top Mount 1.5 kN	21.52	960	1100	-	51	-	Not passed	2.25	Passed	450	Passed	C2, C3, C4 & D (1.5 kN/m)	2, 3
10	TL-6020 Top Mount 1.5 kN	21.52	960	1100	-	50	-	Passed	2.25	Passed	450	Passed	C2, C3, C4 & D (1.5 kN/m)	2
11	TL-6020 Top Mount 1.5 kN	21.52	960	1100	-	50	-	Passed	2.25	Passed	450	Passed	C2, C3, C4 & D (1.5 kN/m)	2
31	TL-6020 Top Mount 1.5 kN	21.52	1060	1200	-	41	-	Passed	2.25	Passed	-	-	C2, C3, C4 & D (1.5 kN/m)	1, 2
12	TL-6021 Side Mount 1.5 kN	21.52	1000	-	-	36	-	Passed	2.25	Passed	-	-	C2, C3, C4 & D (1.5 kN/m)	2
14	TL-6021 Side Mount 1.5 kN	21.52	1200	-	33	-	-	Passed	1.5	Passed	450	Passed	A, B & C1 (1.0 kN/m)	2
15	TL-3010 Top Mount 1.0 kN	17.52	1000	1118.5	49	-	-	Passed	1.5	Passed	450	Passed	A, B & C1 (1.0 kN/m)	2
16	TL-3010 Top Mount 1.0 kN	21.52	1200	1318.5	50	-	-	Passed	1.5	Passed	450	Passed	A, B & C1 (1.0 kN/m)	2
18	TL-3010 Top Mount 1.0 kN	21.52	1200	1318.5	47	-	-	Passed	1.5	Passed	-	-	A, B & C1 (1.0 kN/m)	2
19	TL-3010 Top Mount 1.0 kN	21.52	1200	1318.5	45	-	-	Passed	1.5	Passed	450	Passed	A, B & C1 (1.0 kN/m)	2
20	TL-3010 Top Mount 1.0 kN	21.52	1200	1318.5	44	-	-	Passed	1.5	Passed	450	Passed	A, B & C1 (1.0 kN/m)	2
23	TL-3011 Side Mount 1.0 kN	21.52	1200	-	49	-	-	Passed	1.5	Passed	450	Passed	A, B & C1 (1.0 kN/m)	2
25	TL-3011 Side Mount 1.0 kN	17.52	1000	-	51	-	-	Not passed	1.5	Passed	-	-	A, B & C1 (1.0 kN/m)	2, 3
22	TL-6030 Top Mount 3.0 kN	25.52	1075	1200	-	38	-	Passed	2.25	Passed	450	Passed	C2, C3, C4 & D (1.5 kN/m)	2
26	TL-6030 Top Mount 3.0 kN	31.52	1075	1200	-	-	44	Passed	4.5	Passed	1200	Passed	C5 (3.0 kN/m)	2
27	TL-6030 Top Mount 3.0 kN	31.52	1075	1200	-	-	47	Passed	4.5	Passed	1200	Passed	C5 (3.0 kN/m)	2, 4
28	TL-6030 Top Mount 3.0 kN	31.52	1075	1200	-	-	31	Passed	4.5	Passed	1200	Passed	C5 (3.0 kN/m)	2
29	TL-6030 Top Mount 3.0 kN	31.52	1075	1200	-	-	34	Passed	4.5	Passed	1200	Passed	C5 (3.0 kN/m)	2
30	TL-6031 Side Mount 3.0 kN	31.52	1200	-	-	-	40	Passed	4.5	Passed	1200	Passed	C5 (3.0 kN/m)	2

- 1 Exceeds maximum allowed exposed glass height (1000 mm) according to NS 3510.
- 2 Fastening height of the glass panel inside profile is below minimum allowed height according to NS 3510.
- 3 Deflection at nominal line load exceeds maximum allowed deflection of 50 mm.
- 4 Wedges were tightened up after first attempt and test load repeated.

The test results relate only to the tested samples.

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APPENDIX 2 – PRODUCT DRAWINGS

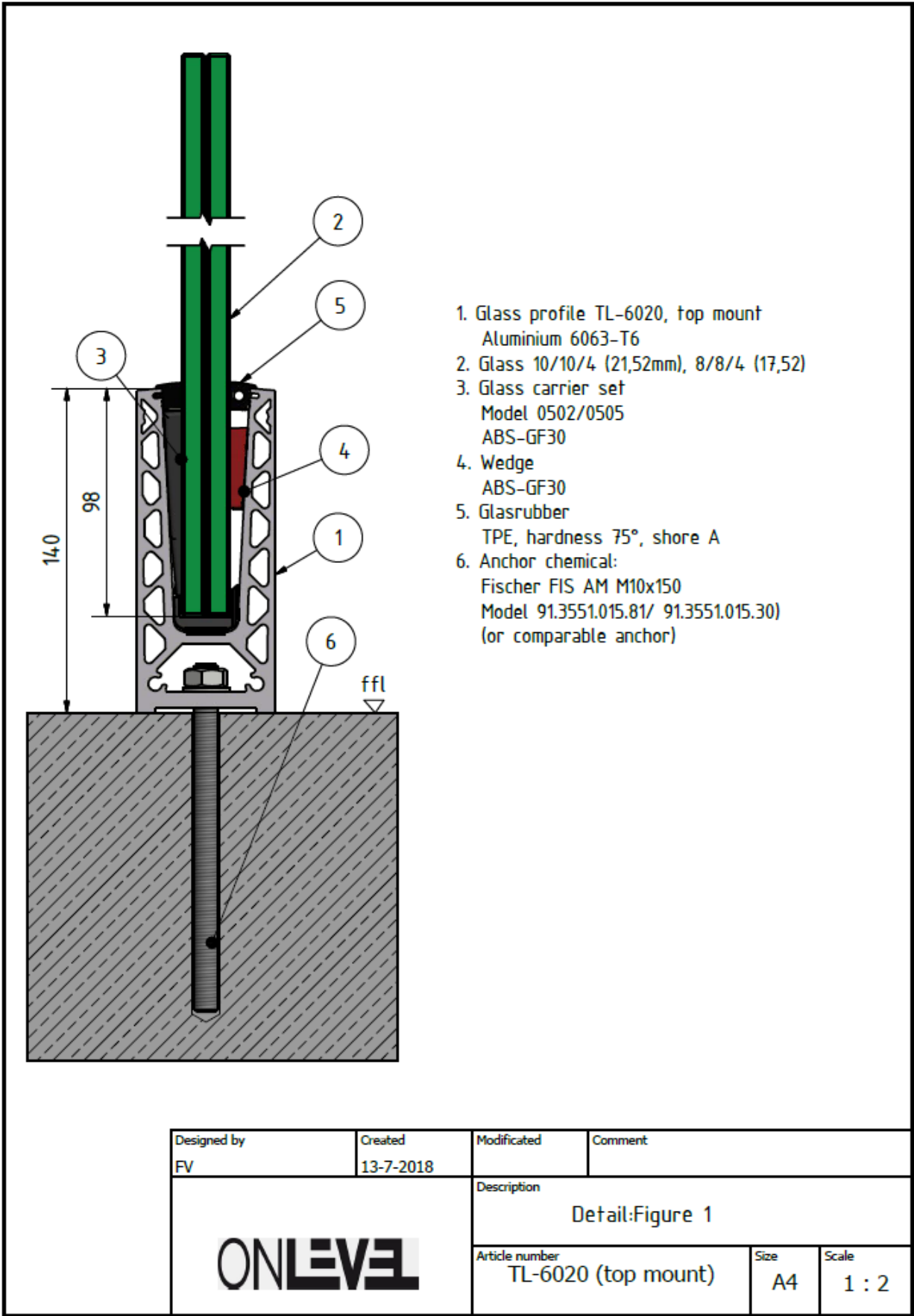


Figure A2- 1. Product drawing from OnLevel for profile 6020 Top Mount – 1.5 kN/m, sheet 1 of 4.

The test results relate only to the tested samples.
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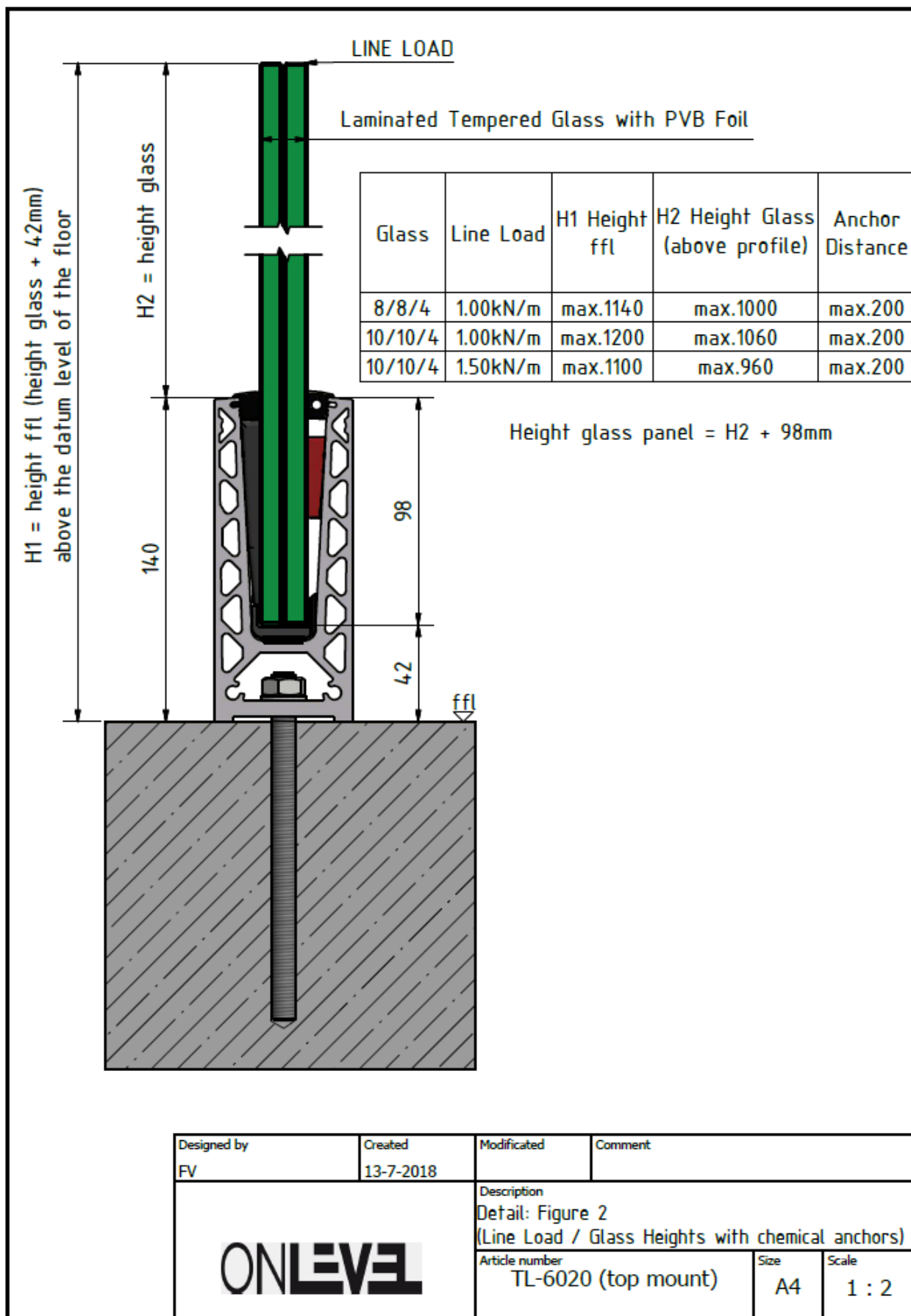


Figure A2- 2. Product drawing from OnLevel for profile 6020 Top Mount – 1.5 kN/m, sheet 2 of 4.

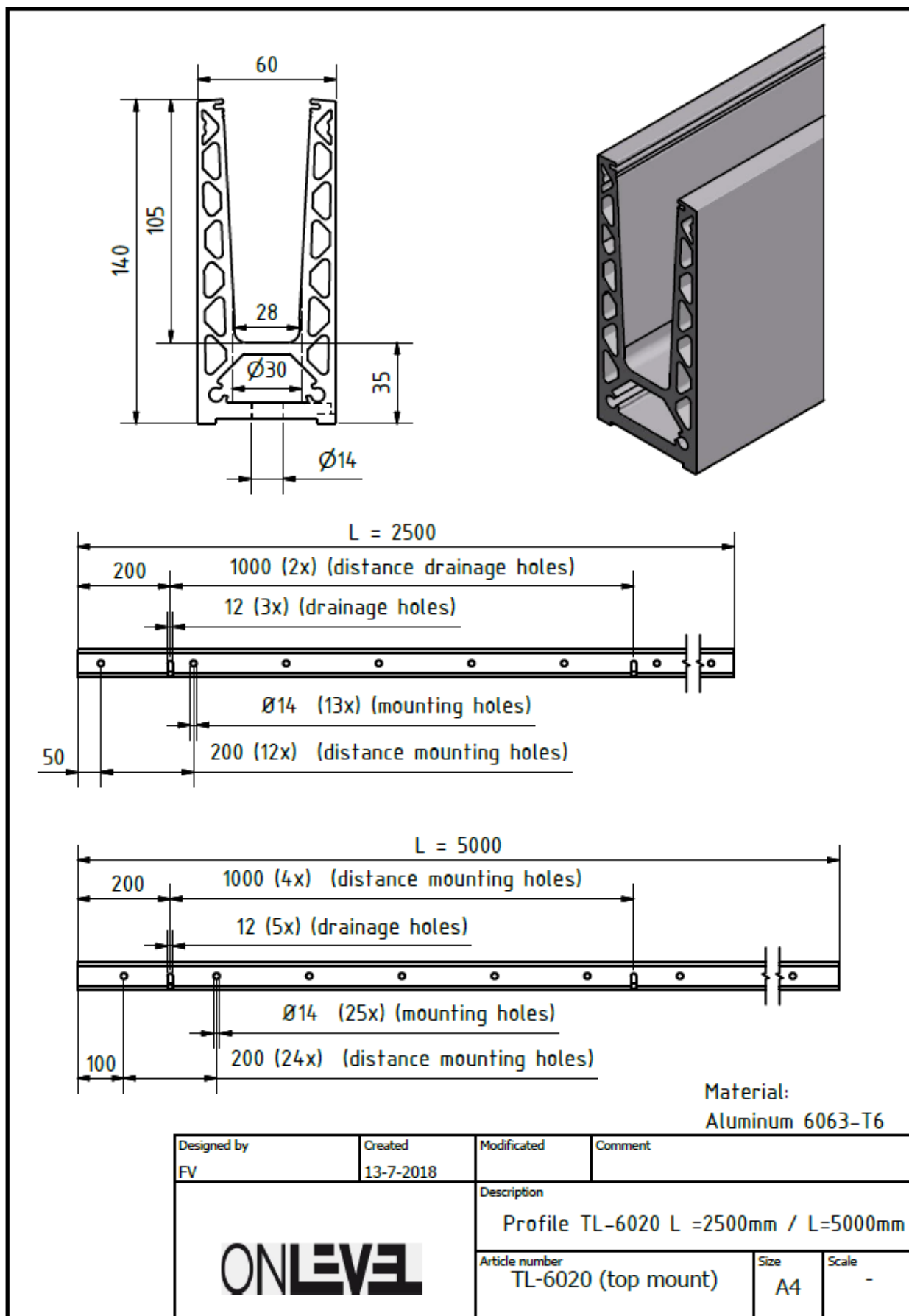
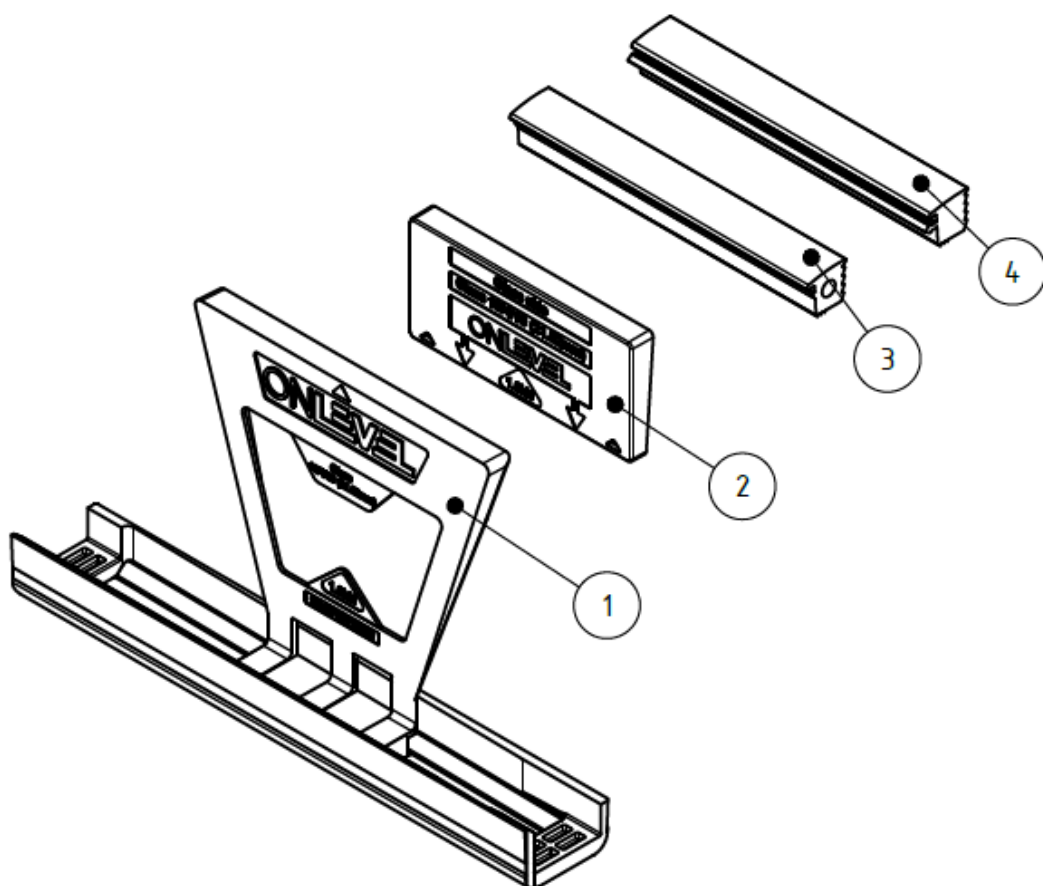
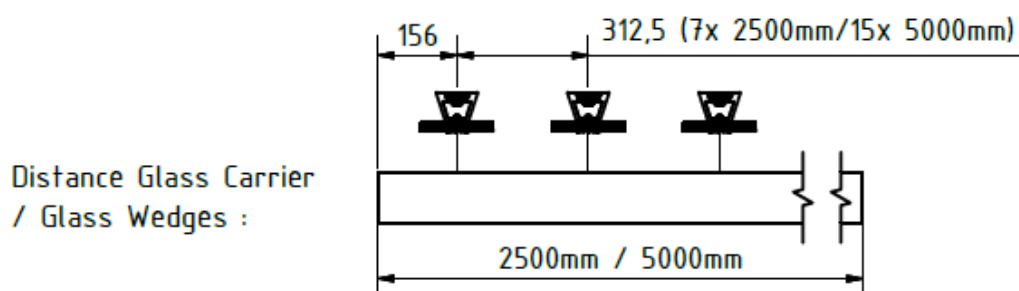


Figure A2- 3. Product drawing from OnLevel for profile 6020 Top Mount – 1.5 kN/m, sheet 3 of 4.



ITEM	PCS (L=2500mm)	PCS (L=5000mm)	Description
1	8	16	Flex-Fit 1.0KN
2	8	16	Glass Wedge 1.0KN
3	1 (L=2500mm)	1 (L=5000mm)	Rubber User Side
4	1 (L=2500mm)	1 (L=5000mm)	Rubber Falling Side



Designed by FV	Created 13-7-2018	Modified	Comment
		Description Flex-Fits sets (quantity and distance)	
		Article number TL-6020 (top mount)	Size A4 Scale -

Figure A2- 4. Product drawing from OnLevel for profile 6020 Top Mount – 1.5 kN/m, sheet 4 of 4.

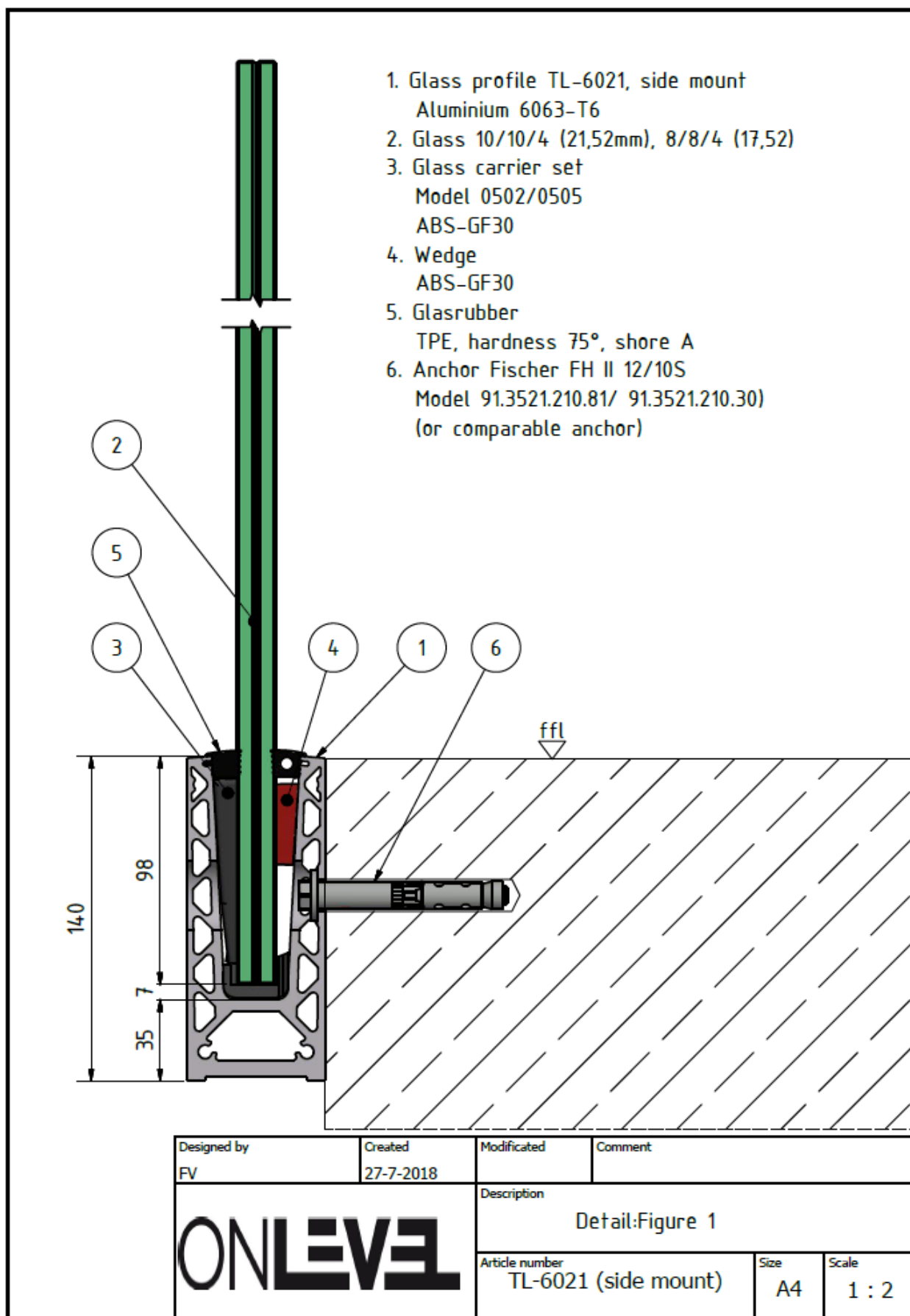


Figure A2- 5. Product drawing from OnLevel for profile 6021 Side Mount – 1.5 kN/m, sheet 1 of 4.

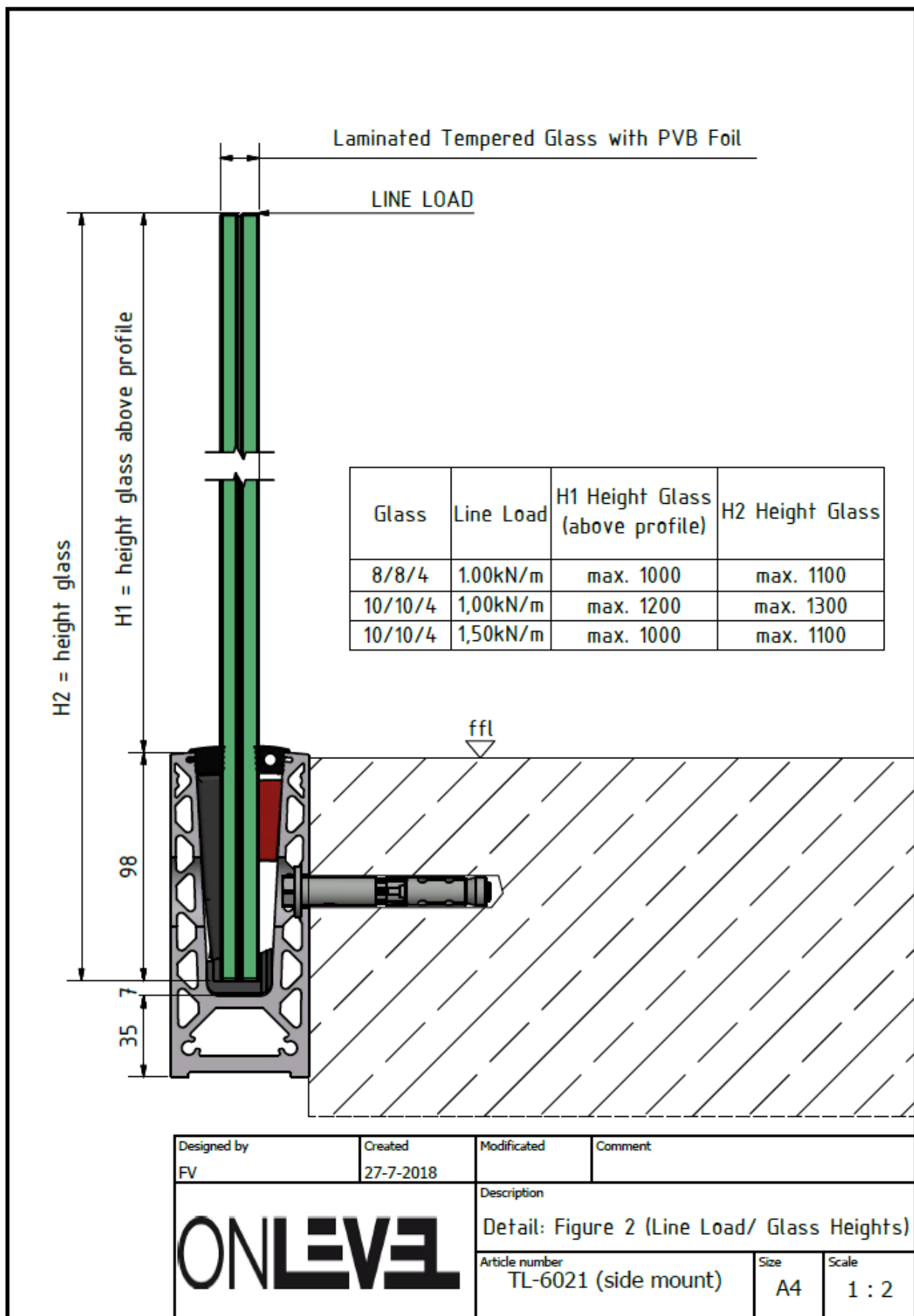


Figure A2- 6. Product drawing from OnLevel for profile 6021 Side Mount – 1.5 kN/m, sheet 2 of 4.

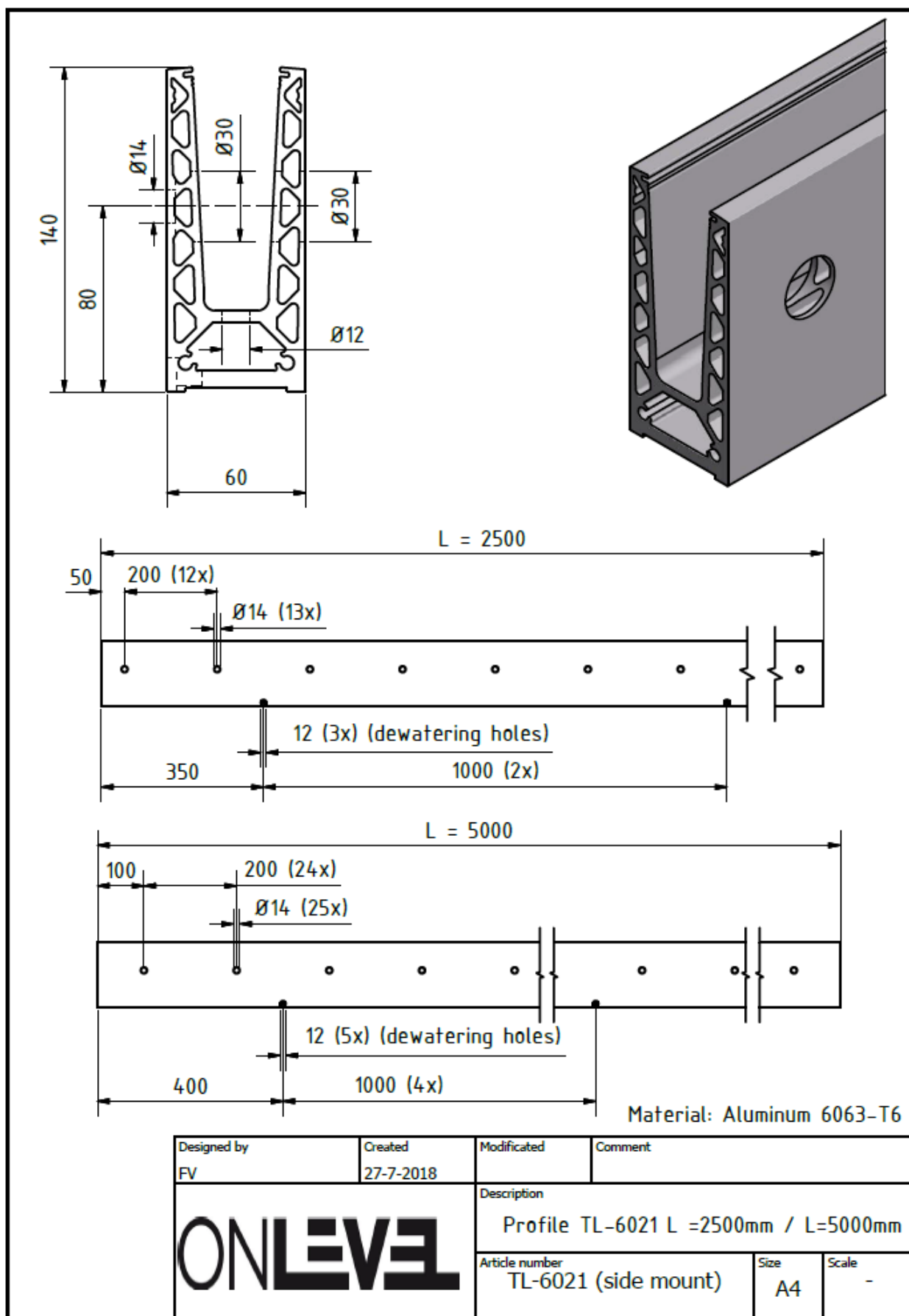
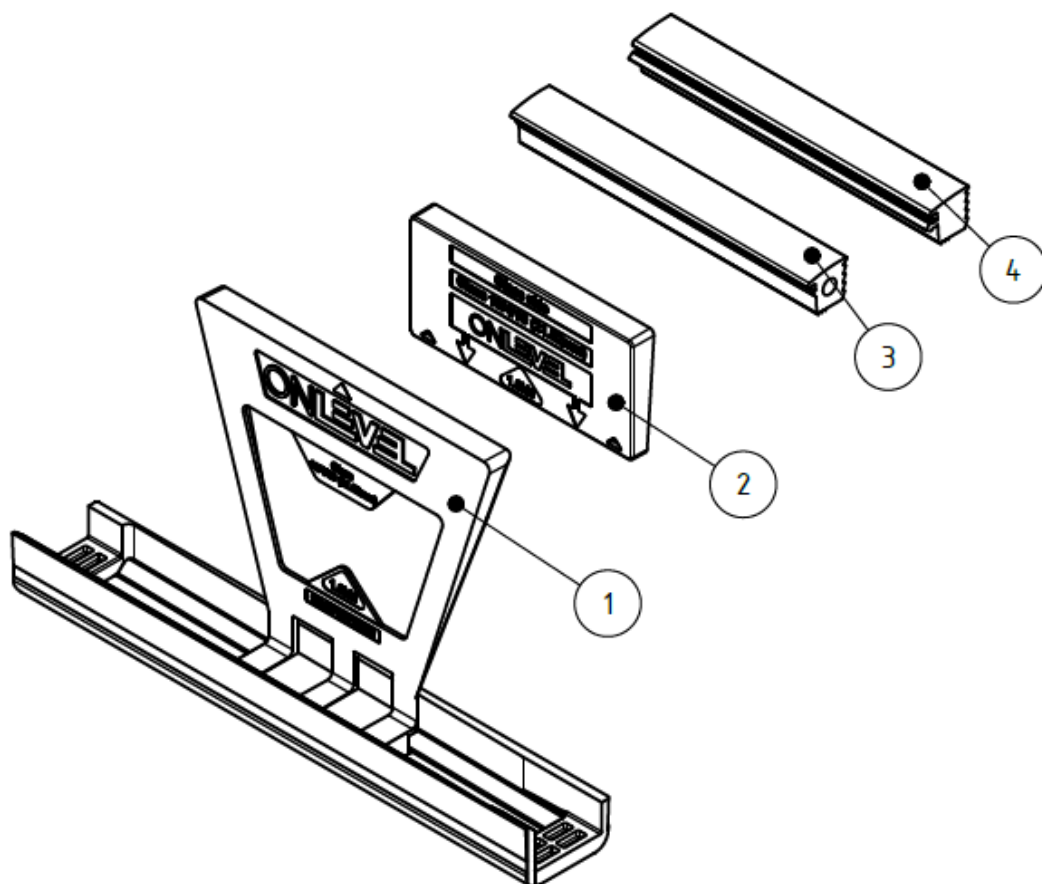
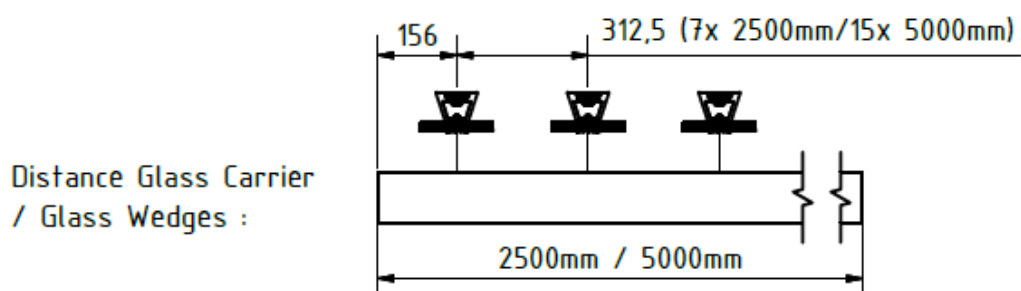


Figure A2- 7. Product drawing from OnLevel for profile 6021 Side Mount – 1.5 kN/m, sheet 3 of 4.



ITEM	PCS (L=2500mm)	PCS (L=5000mm)	Description
1	8	16	Flex-Fit 1.0KN
2	8	16	Glass Wedge 1.0KN
3	1 (L=2500mm)	1 (L=5000mm)	Rubber User Side
4	1 (L=2500mm)	1 (L=5000mm)	Rubber Falling Side



Designed by FV	Created 27-7-2018	Modified	Comment
		Description Flex-Fits sets (quantity and distance)	
		Article number TL-6021 (side mount)	Size A4 Scale -

Figure A2- 8. Product drawing from OnLevel for profile 6021 Side Mount – 1.5 kN/m, sheet 4 of 4.

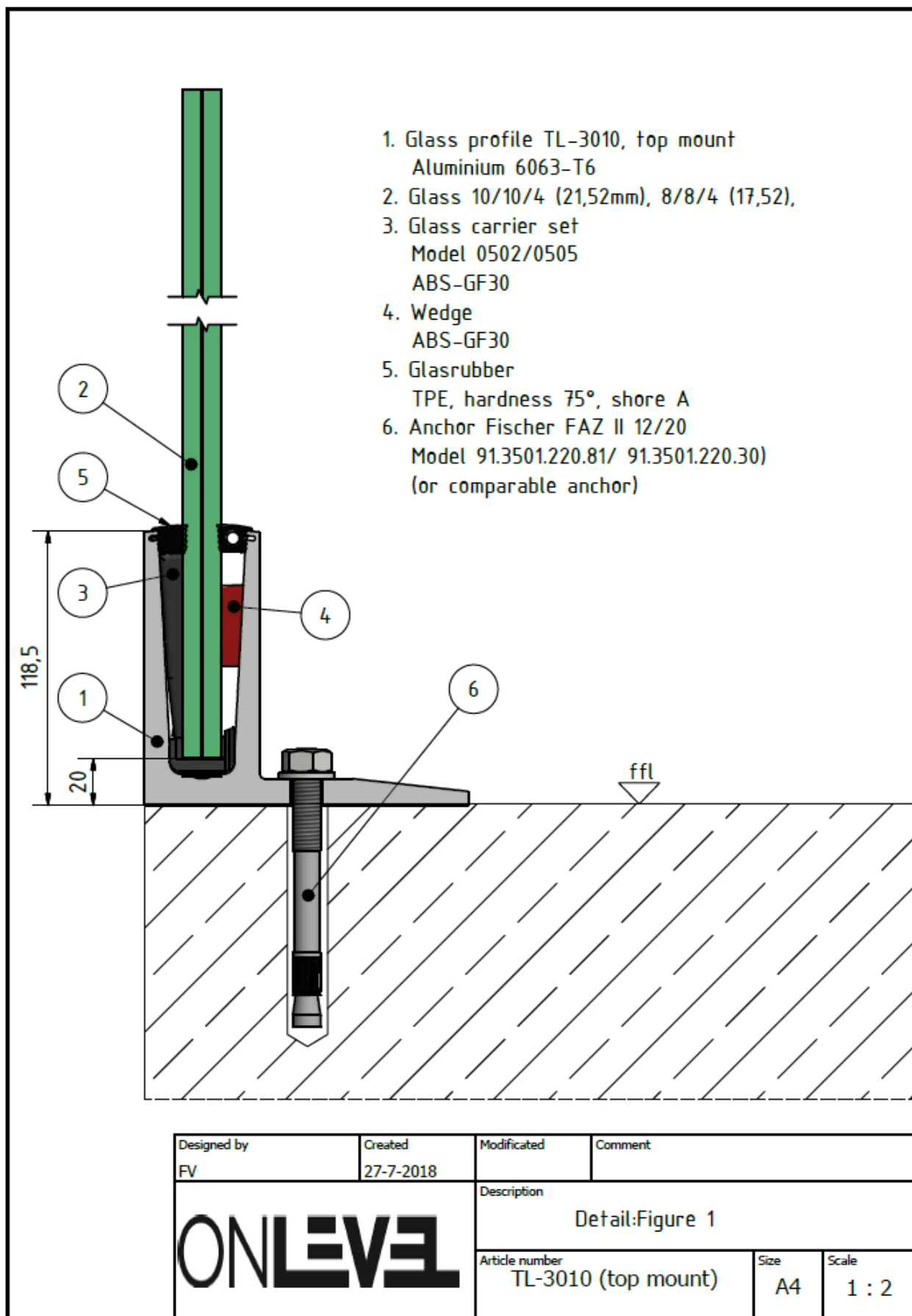


Figure A2- 9. Product drawing from OnLevel for profile 3010 Top Mount – 1.0 kN/m, sheet 1 of 4.

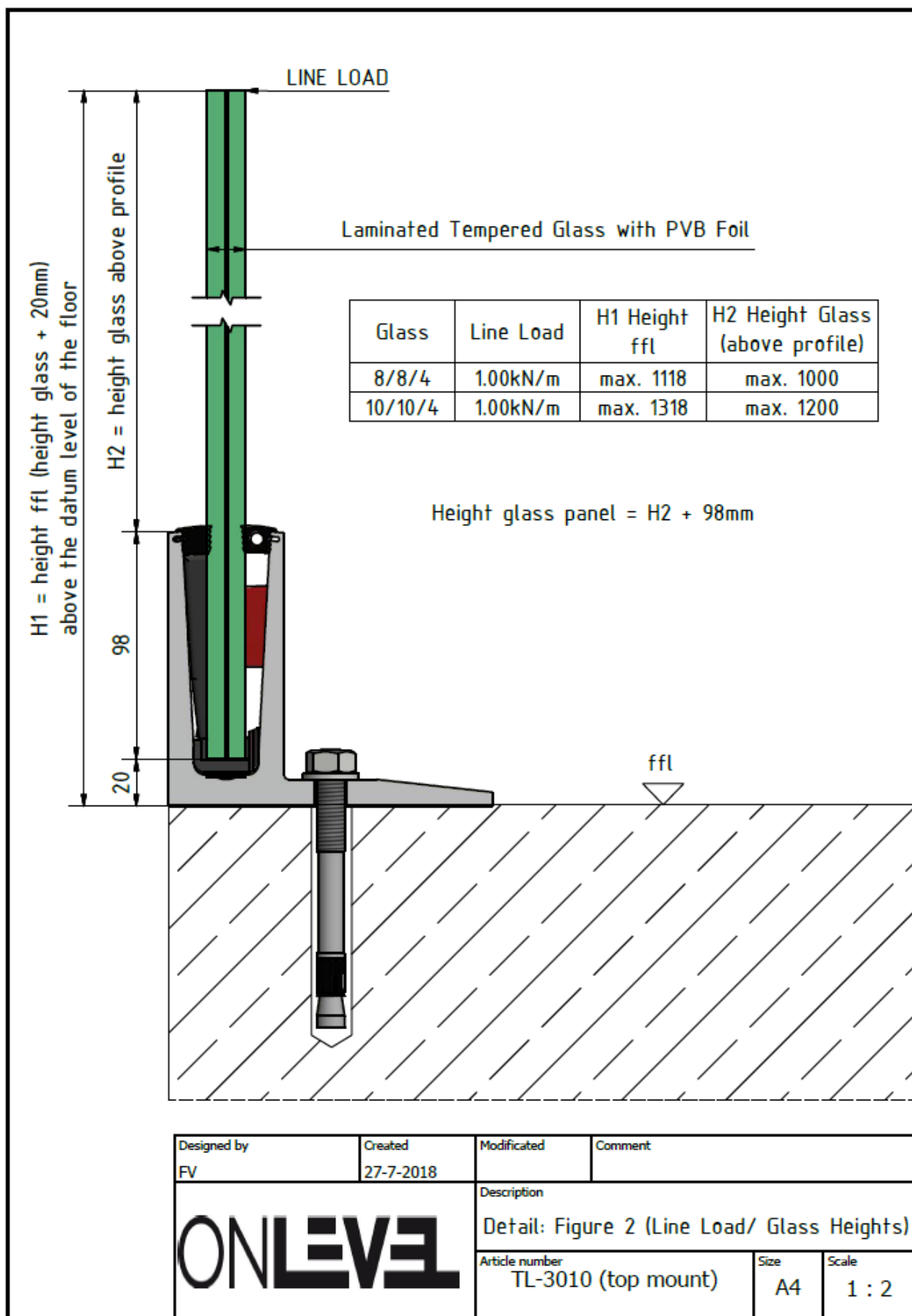


Figure A2- 10. Product drawing from OnLevel for profile 3010 Top Mount – 1.0 kN/m, sheet 2 of 4.

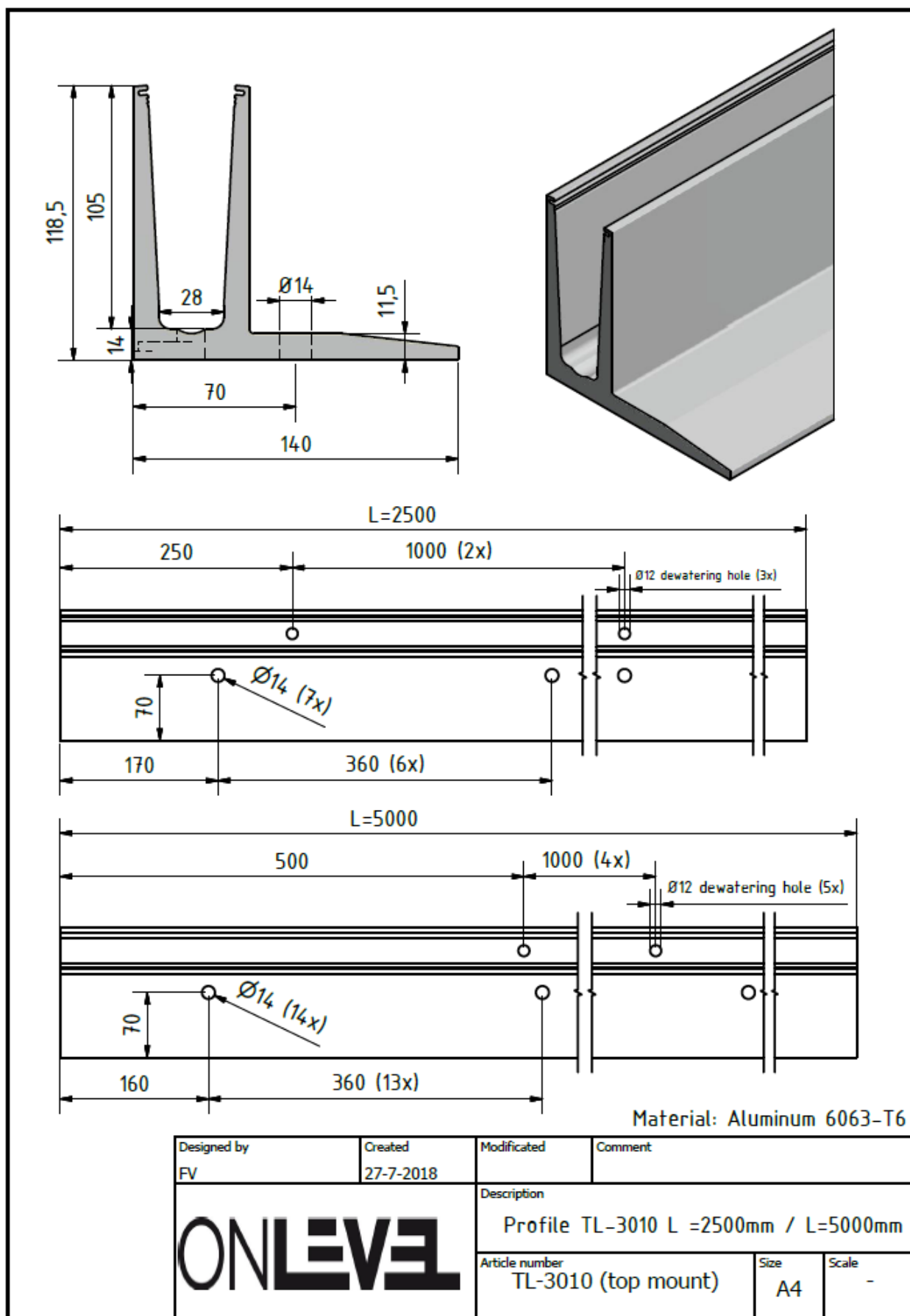
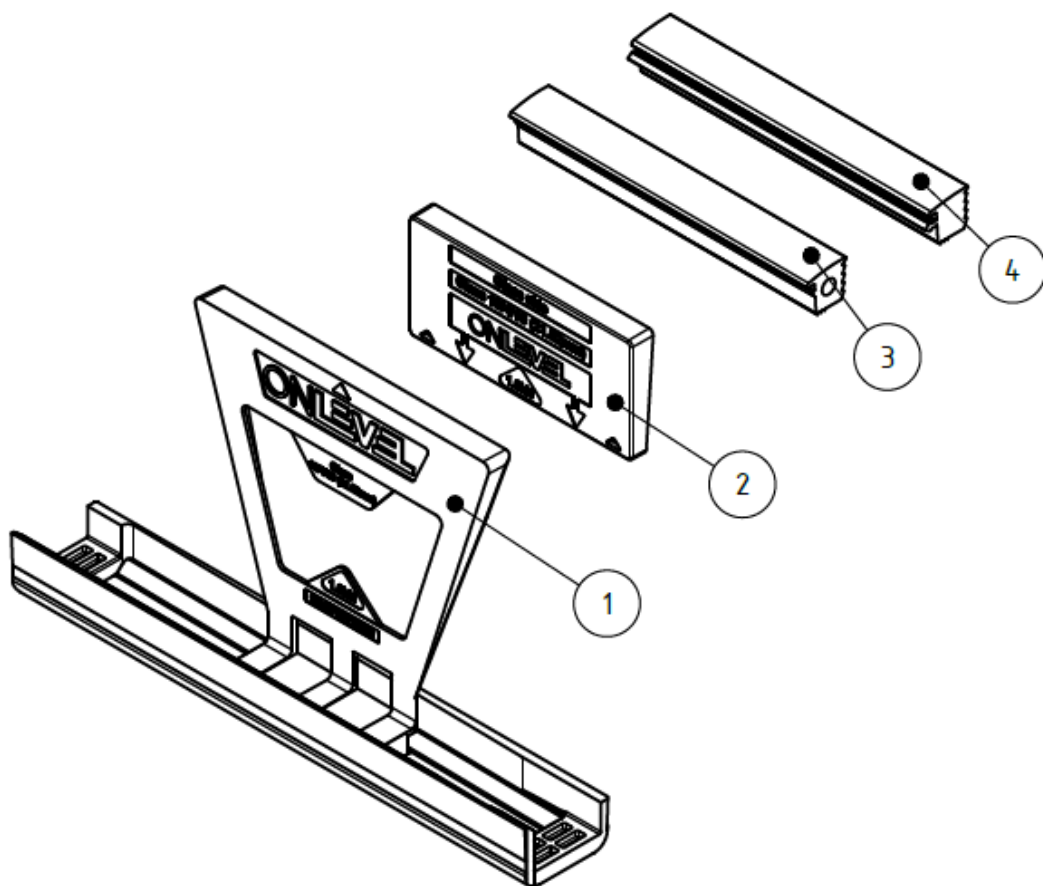
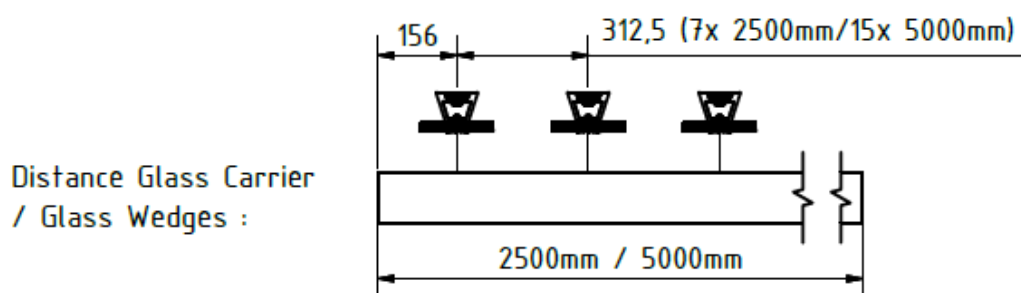


Figure A2- 11. Product drawing from OnLevel for profile 3010 Top Mount – 1.0 kN/m, sheet 3 of 4.



ITEM	PCS (L=2500mm)	PCS (L=5000mm)	Description
1	8	16	Flex-Fit 1.0KN
2	8	16	Glass Wedge 1.0KN
3	1 (L=2500mm)	1 (L=5000mm)	Rubber User Side
4	1 (L=2500mm)	1 (L=5000mm)	Rubber Falling Side



Designed by FV	Created 27-7-2018	Modified	Comment
		Description Flex-Fits sets (quantity and distance)	
		Article number TL-3010 (top mount)	Size A4 Scale -

Figure A2- 12. Product drawing from OnLevel for profile 3010 Top Mount – 1.0 kN/m, sheet 4 of 4.

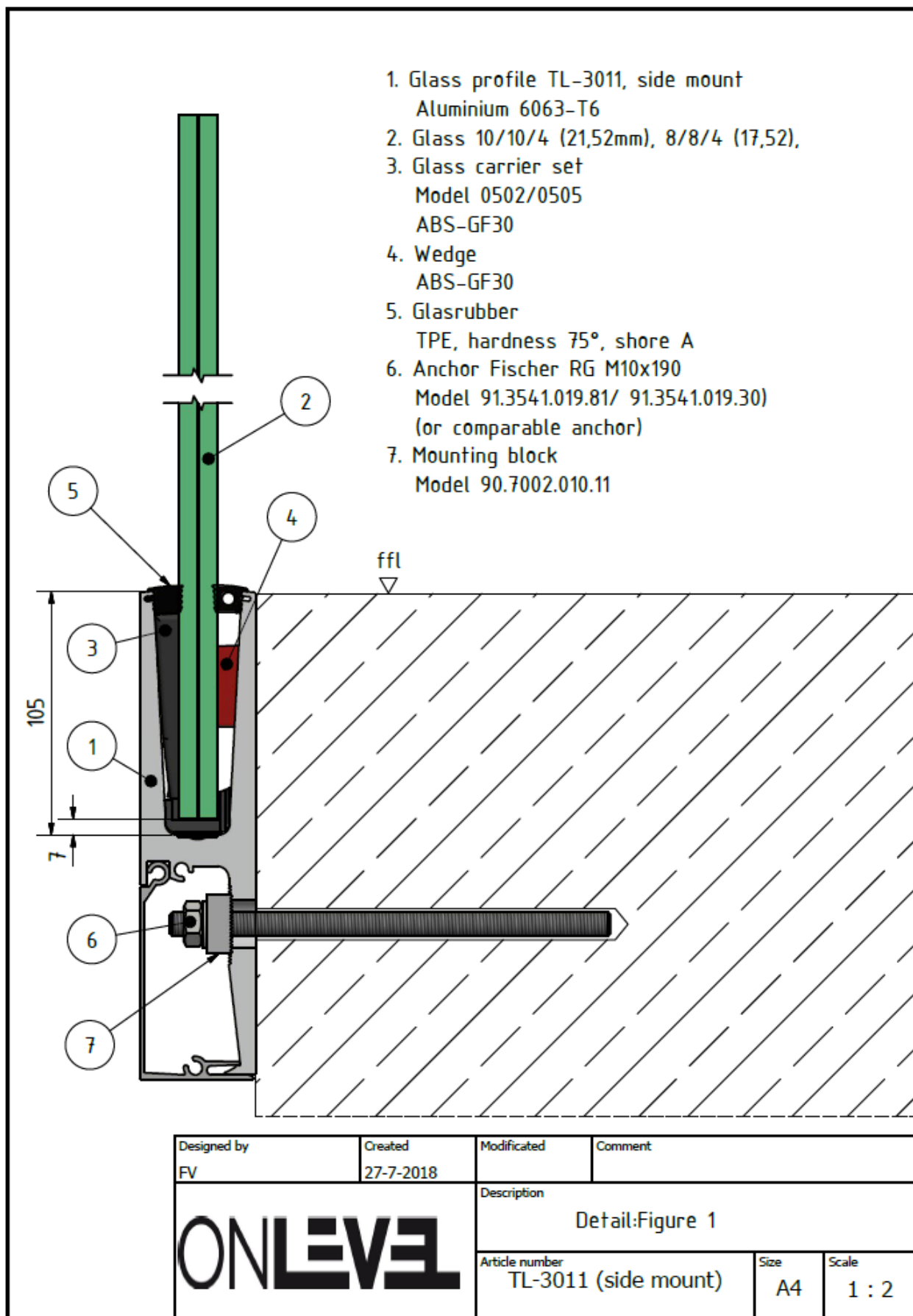


Figure A2- 13. Product drawing from OnLevel for profile 3011 Side Mount – 1.0 kN/m, sheet 1 of 4.

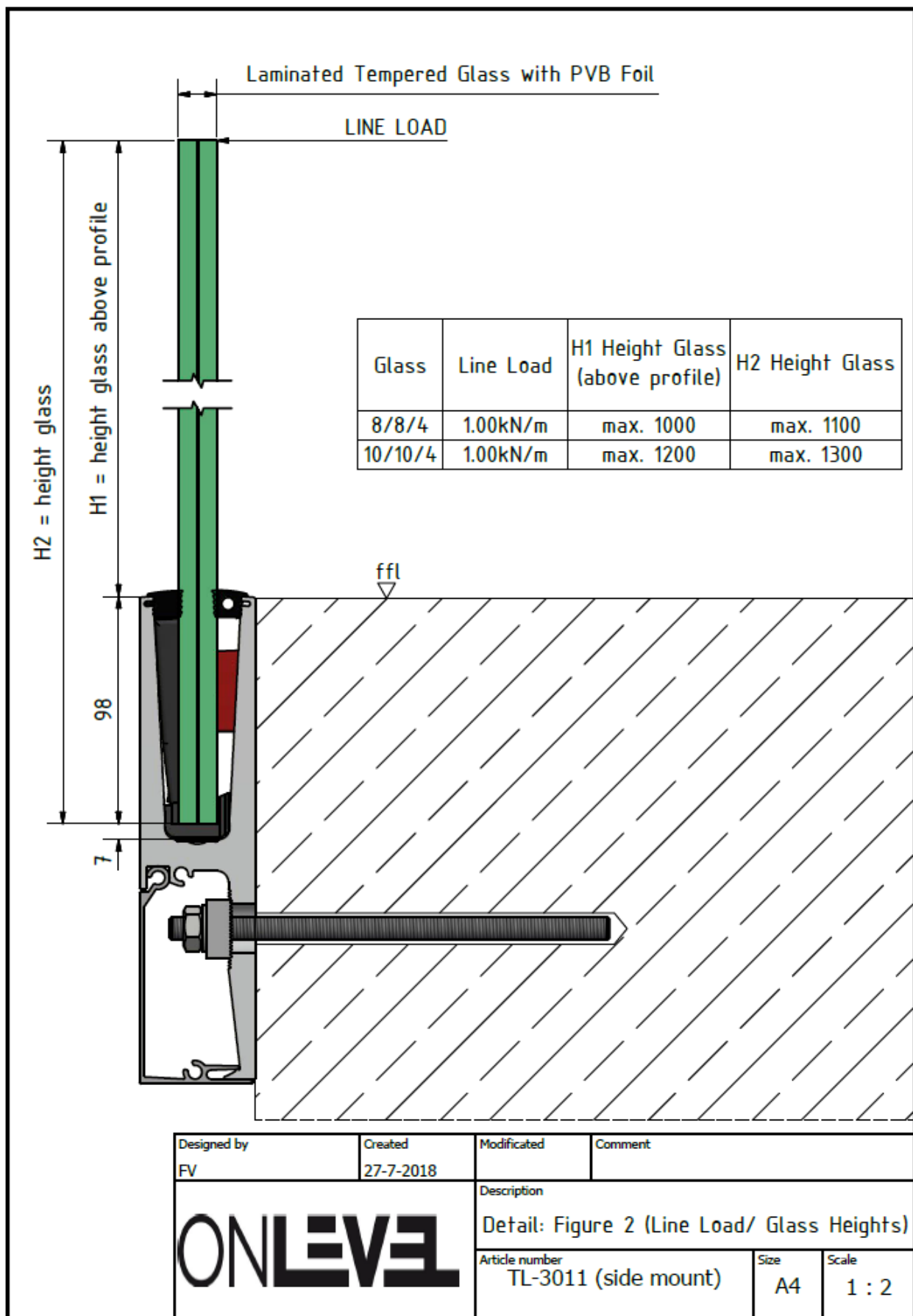


Figure A2- 14. Product drawing from OnLevel for profile 3011 Side Mount – 1.0 kN/m, sheet 2 of 4.

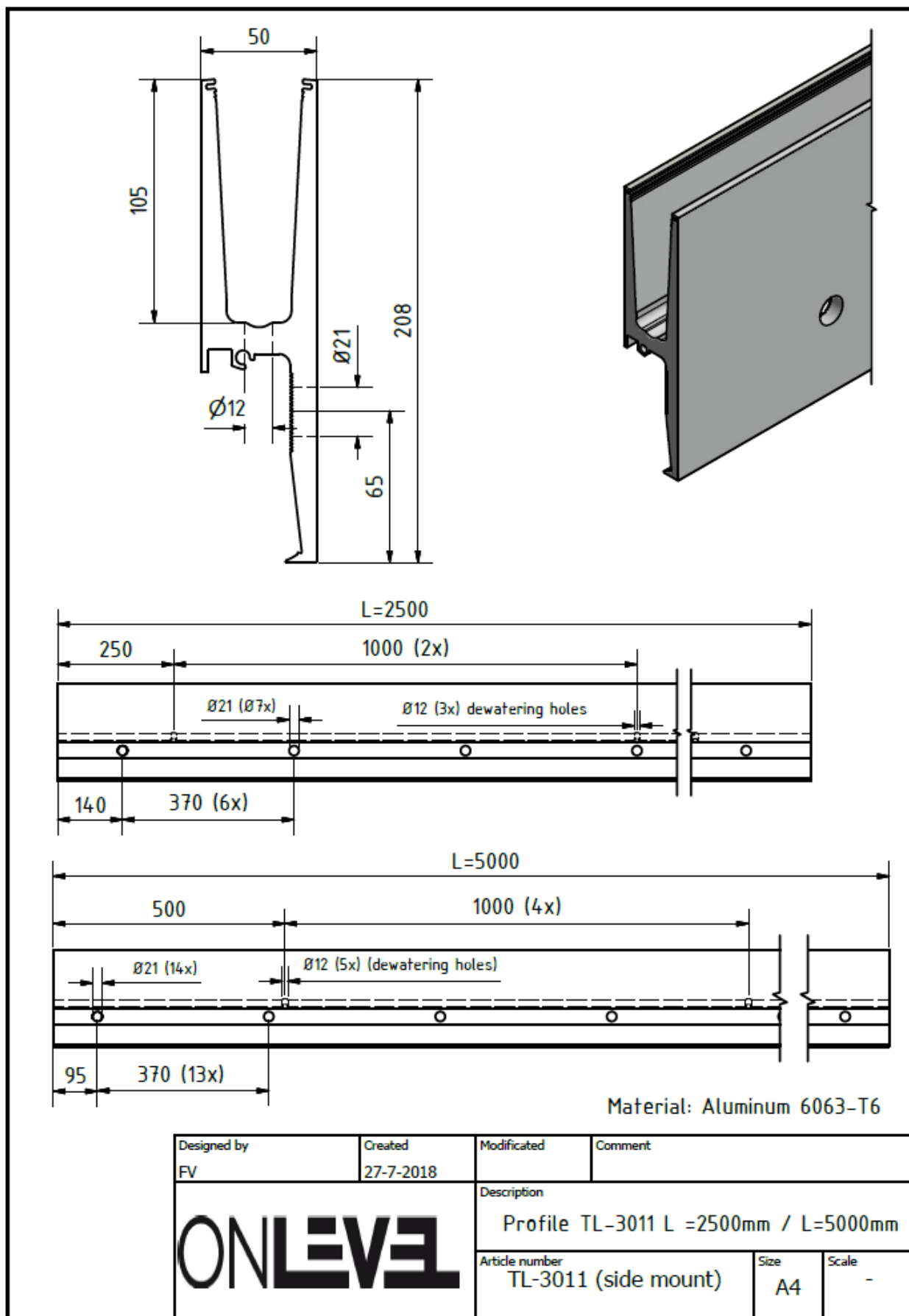
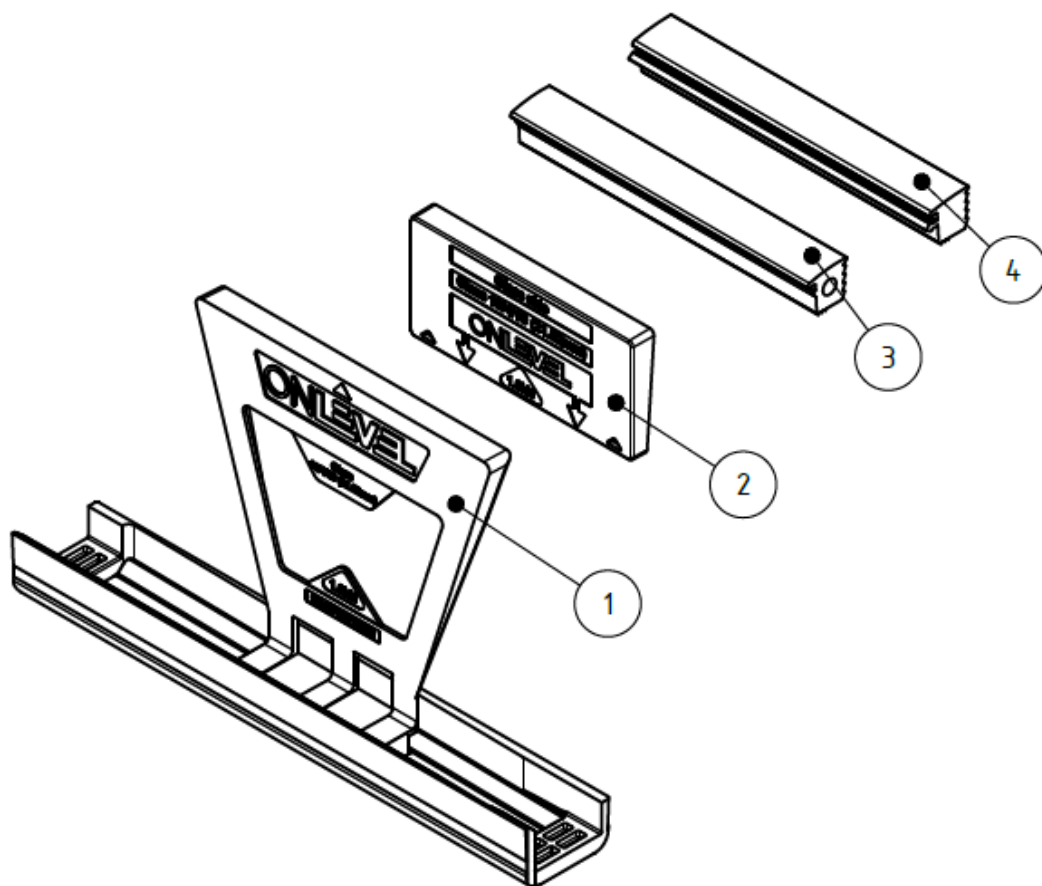
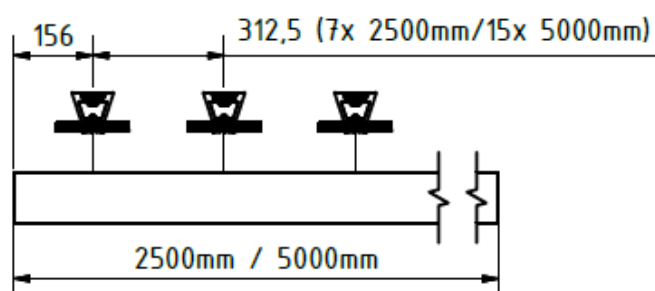


Figure A2- 15. Product drawing from OnLevel for profile 3011 Side Mount – 1.0 kN/m, sheet 3 of 4.



ITEM	PCS (L=2500mm)	PCS (L=5000mm)	Description
1	8	16	Flex-Fit 1.0KN
2	8	16	Glass Wedge 1.0KN
3	1 (L=2500mm)	1 (L=5000mm)	Rubber User Side
4	1 (L=2500mm)	1 (L=5000mm)	Rubber Falling Side

Distance Glass Carrier
/ Glass Wedges :



Designed by FV	Created 27-7-2018	Modified	Comment
		Description Flex-Fits sets (quantity and distance)	
		Article number TL-3011 (side mount)	Size A4 Scale -

Figure A2- 16. Product drawing from OnLevel for profile 3011 Side Mount – 1.0 kN/m, sheet 4 of 4.

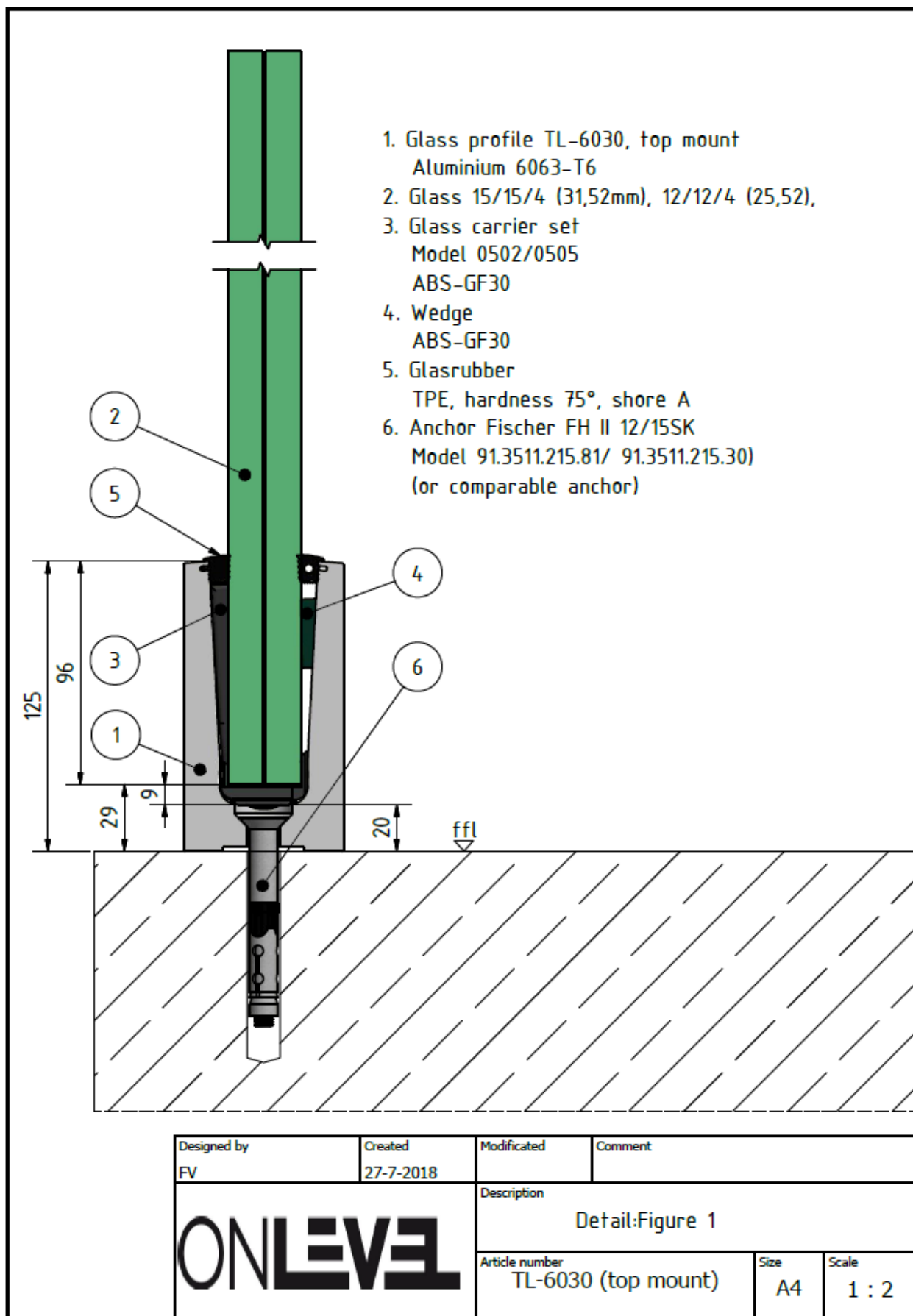


Figure A2- 17. Product drawing from OnLevel for profile 6030 Top Mount – 3.0 kN/m, sheet 1 of 4.

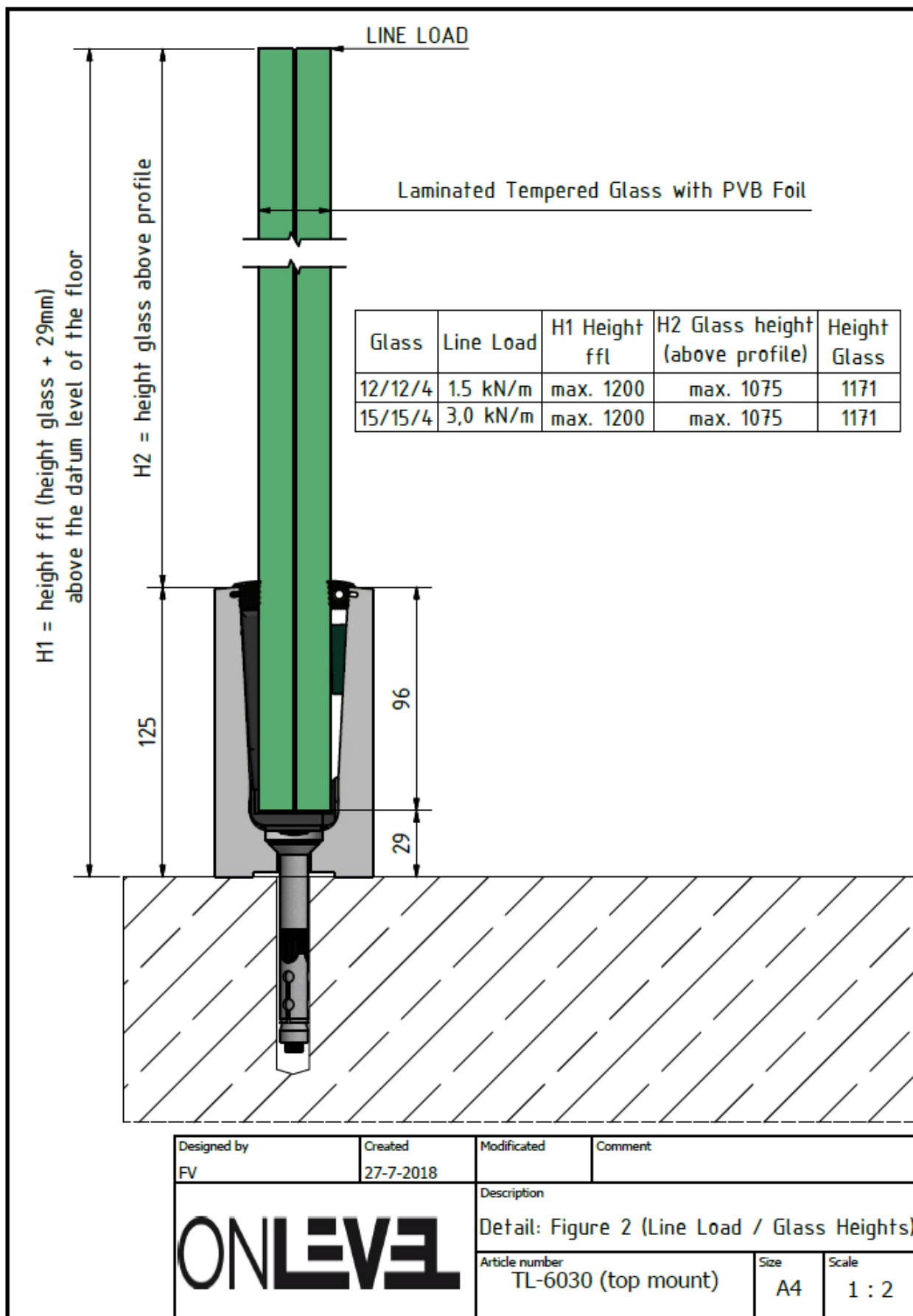
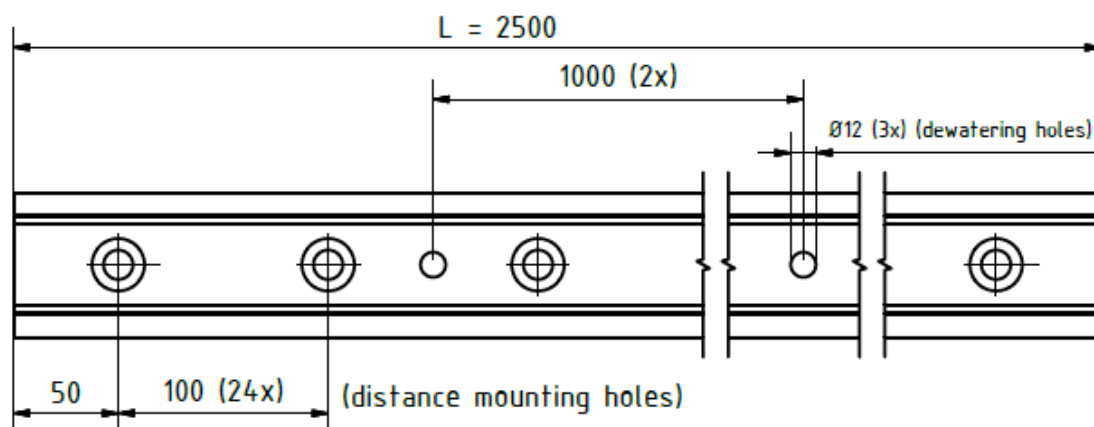
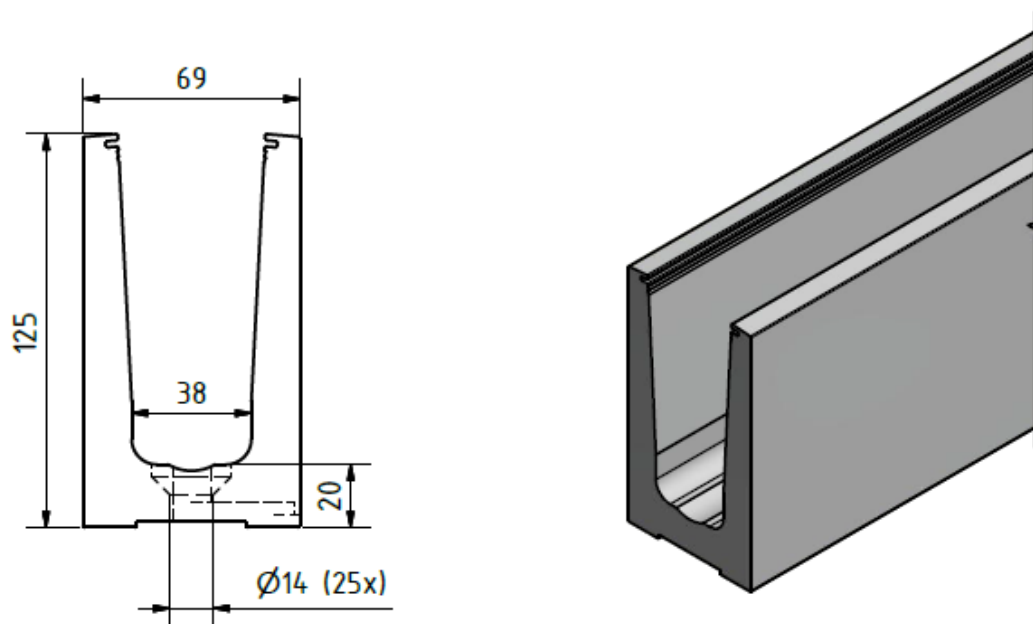


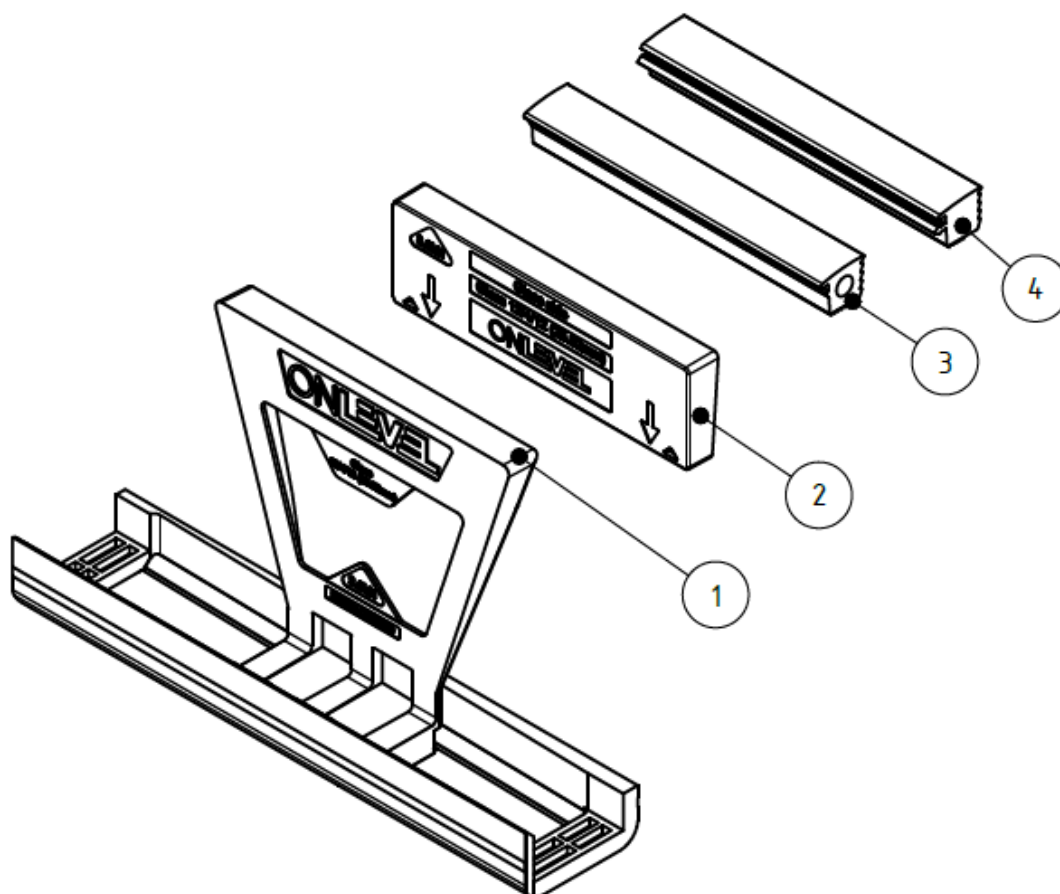
Figure A2- 18. Product drawing from OnLevel for profile 6030 Top Mount – 3.0 kN/m, sheet 2 of 4.



Material: Aluminum 6063-T6

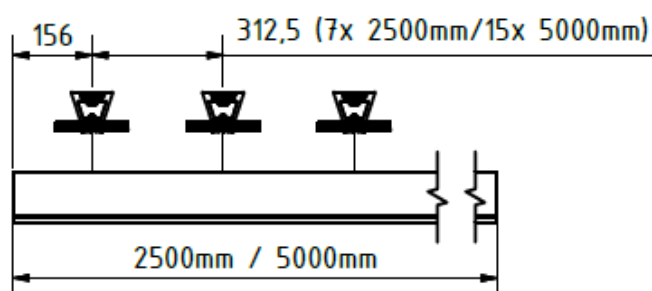
Designed by FV	Created 27-7-2018	Modified	Comment
		Description Profile TL-6030 L = 2500mm	
		Article number TL-6030 (top mount)	Size A4
			Scale -

Figure A2- 19. Product drawing from OnLevel for profile 6030 Top Mount – 3.0 kN/m, sheet 3 of 4.



ITEM	PCS (L=2500mm)	PCS (L = 5000mm)	Description
1	8	16	Flex-Fit 3.0kN
2	8	16	Glass Wedge 3.0kN
3	1 (L=2500mm)	1 (L=5000mm)	Rubber User Side
4	1 (L=2500mm)	1 (L=5000mm)	Rubber Falling Side

Distance Glass Carrier
/ Glass Wedges :



Designed by FV	Created 27-7-2018	Modified	Comment
		Description Flex-Fits sets (quantity and distance)	
		Article number TL-6030 (top mount)	Size A4 Scale -

Figure A2- 20. Product drawing from OnLevel for profile 6030 Top Mount – 3.0 kN/m, sheet 4 of 4.

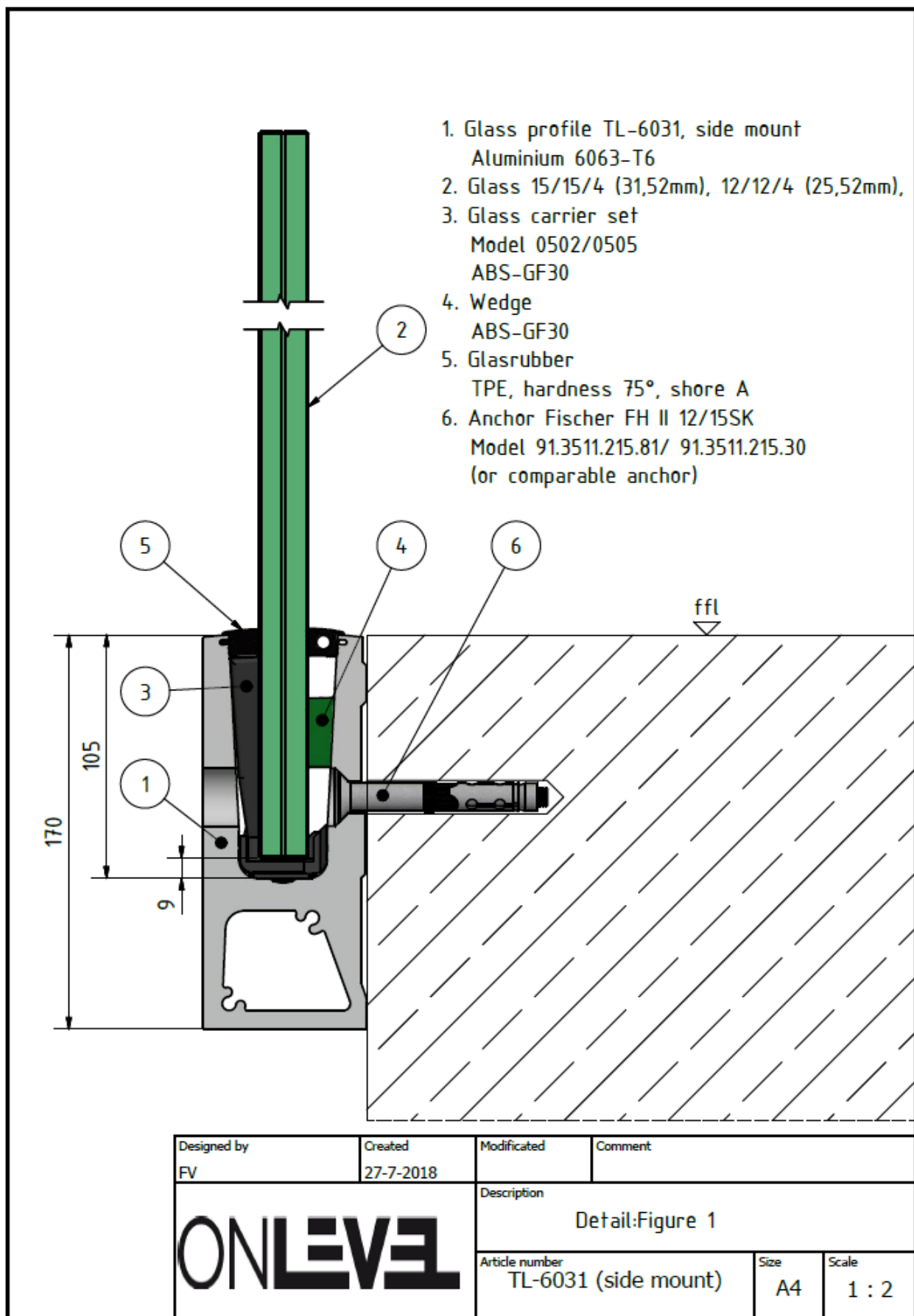


Figure A2- 21. Product drawing from OnLevel for profile 6031 Side Mount – 3.0 kN/m, sheet 1 of 4.

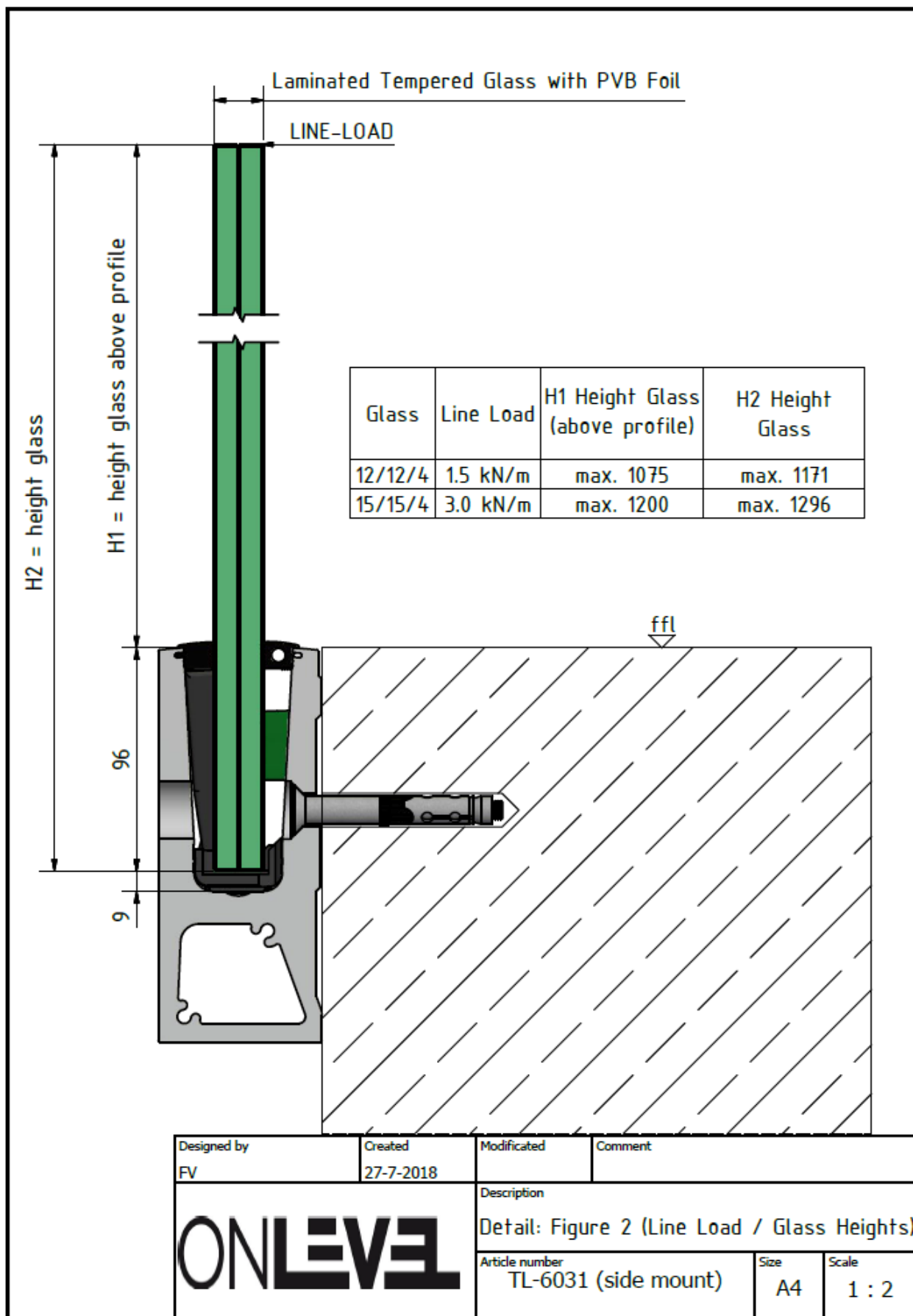


Figure A2- 22. Product drawing from OnLevel for profile 6031 Side Mount – 3.0 kN/m, sheet 2 of 4.

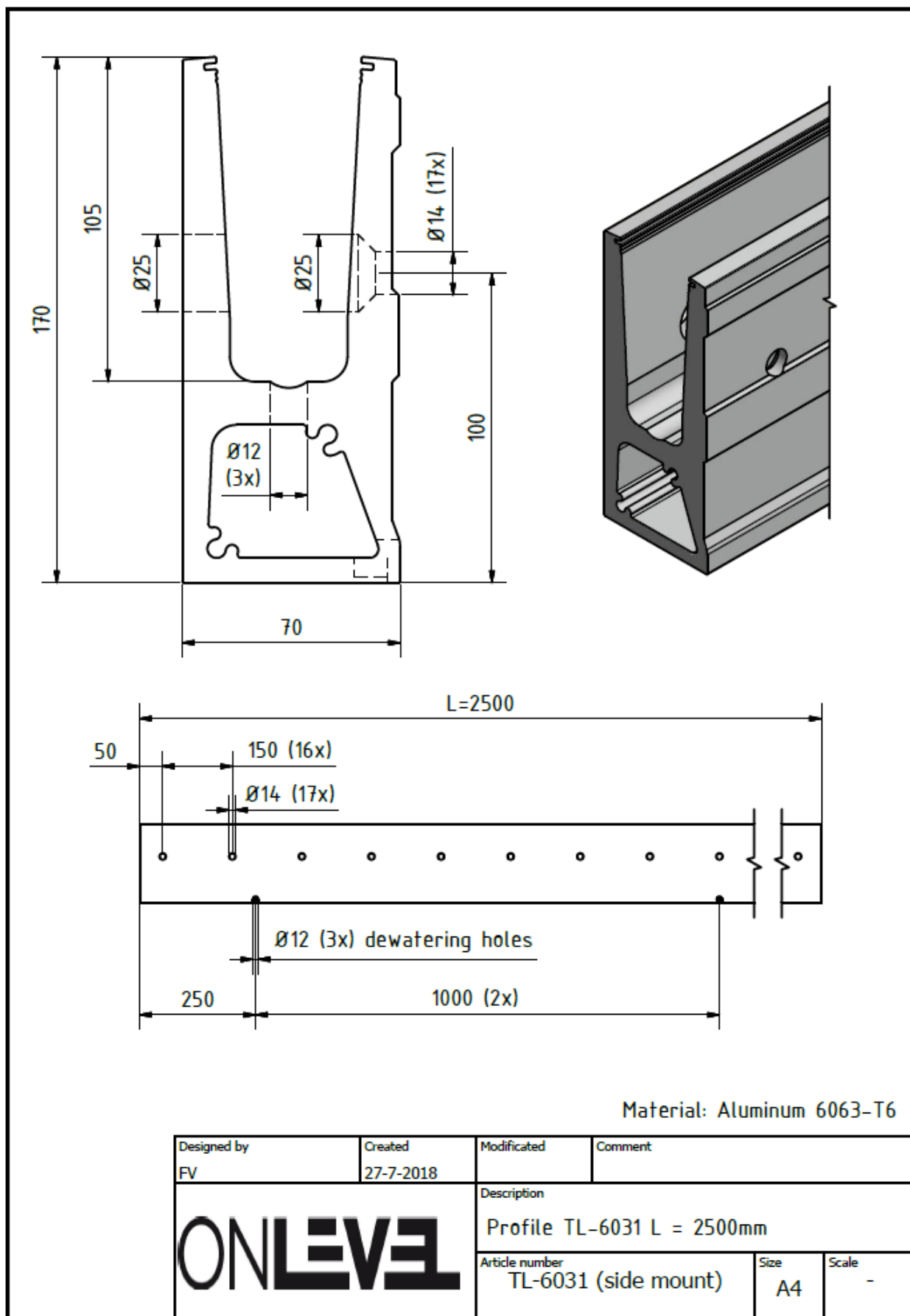
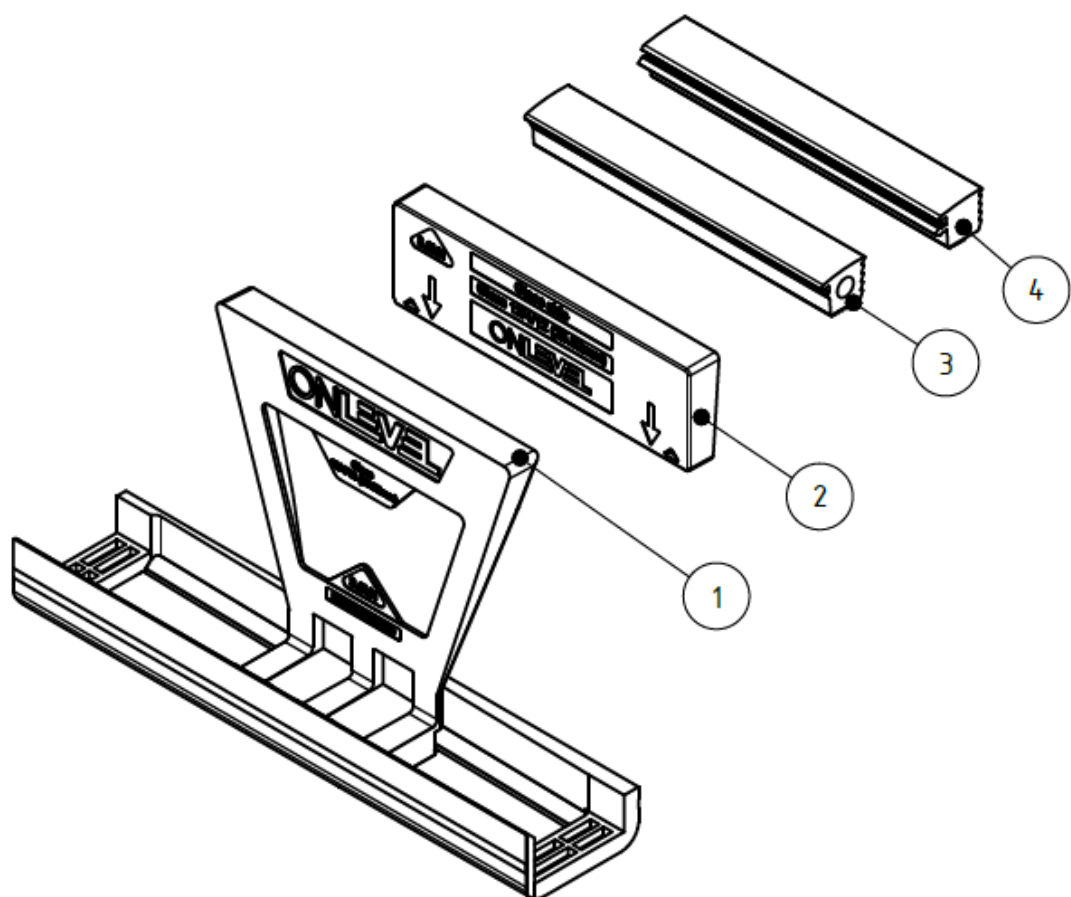
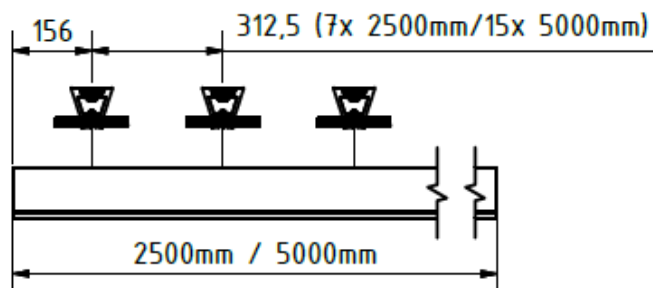


Figure A2- 23. Product drawing from OnLevel for profile 6031 Side Mount – 3.0 kN/m, sheet 3 of 4.



ITEM	PCS (L=2500mm)	PCS (L = 5000mm)	Description
1	8	16	Flex-Fit 3.0kN
2	8	16	Glass Wedge 3.0kN
3	1 (L=2500mm)	1 (L=5000mm)	Rubber User Side
4	1 (L=2500mm)	1 (L=5000mm)	Rubber Falling Side

Distance Glass Carrier
/ Glass Wedges :



Designed by FV	Created 27-7-2018	Modified	Comment
		Description Flex-Fits sets (quantity and distance)	
		Article number TL-6031 (side mount)	Size A4 Scale -

Figure A2- 24. Product drawing from OnLevel for profile 6031 Side Mount – 3.0 kN/m, sheet 4 of 4.