Materialprüfanstalt Hannover
Bauwesen und Produktionstechnik

Test report no. 251467

English version

1st copy of 14 May 2025

Principal:	Samrat Plywood Limited (Factory) Village Bir Plasi Tehsil Nalagarh District solan HIMACHAL PRADESH INDIA - 174101 INDIA
Date of commission:	26 March 2025 / Mr Peter Paulsen
Subject of commission:	Testing of balcony elements according to ETB-Richtlinie „Bauteile, die gegen Absturz sichern“ Flat laminate: „Samrat“ / “Trendoo”, HPL, 6 mm Fasteners: „Balkonschrauben-Set M5 x 45 mm, K 16 mm“ Height of handrail: 900 mm Flat laminate: „Samrat“ / “Trendoo”, HPL, 8 mm Fasteners: „Balkonschrauben-Set M5 x 45 mm, K 16 mm“ Height of handrail: 1100 mm

The test report contains 13 pages.

The testing material is used up.

Remark: This test report is the English version of original German version of 14 May 2025.

Materialprüfanstalt für das Bauwesen und Produktionstechnik
Nienburger Straße 3 · 30167 Hannover, GERMANY
Contact Dr.-Ing. K. Fischer
Direct dial +49 511 762-3745
E-mail k.fischer@mpa-hannover.de
Internet www.mpa-hannover.de

1. General

The principal assigned MPA HANNOVER with testing of soft impact, hard impact and testing of fixing elements according to ETB-Richtlinie „Bauteile, die gegen Absturz sichern", edition July 1985. The scope is shown in section 3. This test report states the results of these tests.

2. Delivery of samples

The following samples were delivered to MPA HANNOVER by an employee of the company Holzimport-Nord GmbH:

5 pieces	HPL-flat laminate, l x b x d ca. 1000 mm x 700 mm x 6 mm, colour: white
5 pieces	HPL-flat laminate, l x b x d ca. 1000 mm x 900 mm x 8 mm, colour: white
1 packet	"Balkonschrauben-Set M5 x 45 mm, K 16 mm mit Hutmutter, Dichtscheibe, Unterlegscheibe und Federring, Firma MBE"

According to the principal the HPL-flat laminates were manufactured by the company Samrat Plywood Limited in India and are sold under the product names „Samrat" and „Trendoo".

3. Scope

Testing of soft impact, hard impact and testing of fixing elements according to ETB-Richtlinie „Bauteile, die gegen Absturz sichern", edition July 1985, was to be performed. The substructure consisted of square steel profiles, two vertical members 40 mm x 30 mm x 3 mm and two crossbars 35 mm x 25 mm x 2 mm from a local steel trade, which were assembled according to Appendix A2 and A3. The height of handrail was fixed to 900 mm for the flat laminate of 6 mm thickness and 1100 mm for the flat laminate of 8 mm thickness. The elements were fixed to both crossbars of the substructure by approved fasteners according to Appendix A1. The whole in the flat laminate was drilled at a diameter of 8.0 mm for the sliding point and 5.0 mm for the fixed point. The whole in the substructure was drilled at a diameter of 5.1 mm. Additional bending strength of the flat lamintes was determined according to DIN EN ISO 178:2019-08, method A, as well as material properties under tensile stress of the substructure according to DIN EN ISO 6892-1:2017-02, method B.

4. Test results

4.1 Testing of balcony systems

4.1.1 Basis of testing

- ETB-Richtlinie „Bauteile, die gegen Absturz sichern", edition July 1985
- DIN 4103-1:1984-07 Nichttragende innere Trennwände – Teil 1: Anforderungen und Nachweise

According to ETB-Richtlinie „Bauteile, die gegen Absturz sichern", edition July 1985, 3.2.1 there are the following requirements on balcony systems:

Maintaining safety:

- No tearing out of the holder
- No falling of fragments that could endanger people
- No puncturing of the entire thickness due to the applied loads

4.1.2 Soft impact

One balcony system was tested with a height of handrail of 900 mm for the flat laminate of 6 mm thickness and a second with a height of handrail of 1100 mm for the flat laminate of 8 mm thickness above the top of the balcony floor.

The balustrade element was tested lying in horizontal position. Restraining the vertical members on steel beams, which were fixed to the testing machine, approximated the fixing of the vertical members at the balcony floor. The test rigs of both test series are shown in Appendix A2.

Pushing a compression plate on the middle of the flat laminate performed the proof of soft impact. The compression plate consisted of a steel plate (Ø 200 mm) and a rubber plate of 6 mm thickness and Shore-A ≈ 80 according to DIN 53505, arranged between steel plate and flat laminate. The deflection between the steel plate and the support (deflection at impact area) was measured and recorded during the test. The Energy (resistance energy) Eu is determined using the load-deflection diagram

$$E_u = \int_{\delta=0}^{\delta_u} F \cdot d\delta$$

with F: load, δ: deflection and δ_u: deflection at failure

The value $E_{Versuch}$ is decisive for the proof and can be calculated with the values of the 3 required tests.

$$E_{Versuch} = \bar{E}_u \,/\, \gamma$$

Herein approximately

$$\gamma = \sqrt{1+(s_E / \bar{E}_u)^2} \cdot \exp\,(K \cdot s_E / \bar{E}_u)$$

With $\bar{E}_u$ mean value,

s_E standard deviation of the tests results according to DIN 53804-1 and

K = 0,9.

In ETB-Richtlinie it is required:

$E_{Versuch}$ = 1,25 · 1,0 · E_{Basis} = 1,25 · 1,0 · 100 = 125 N · m.

The test results are shown in table 1 and table 2.

Materialprüfanstalt Hannover MPA HANNOVER Bauwesen und Produktionstechnik

Table 1: Results of testing soft impact –
Flat laminate: „Samrat“ / “Trendoo”, 6 mm
Fasteners: „Balkonschrauben-Set M5 x 45 mm, K 16 mm“
Test rig: s. Appendix 2.1
(test date: 28.04.2025)

Height of handrail 900 mm				
Test no.	F_{max} N	δ mm	E_u N · m	Failure —
1	5500	56	154	Test was stopped; vertical substructure slightly bent
2	6000	56	167	
3	6000	60	179	
mean E_u			166	—
Standard deviation s_E			12.69	—
γ			1.0741	—
$E_{Versuch}$			155	—
Erforderlich $E_{Versuch}$			125	—
Requirements according to ETB-Richtlinie „Bauteile, die gegen Absturz sichern“, edition July 1985, 3.2.1			erfüllt	—

Tafel 2: Results of testing soft impact –
Flat laminate: „Samrat“ / “Trendoo”, 8 mm
Fasteners: „Balkonschrauben-Set M5 x 45 mm, K 16 mm“
Test rig: s. Appendix 2.2
(test date: 28.04.2025)

Height of handrail 1100 mm				
Test no	F_{max} N	δ mm	E_u N · m	Failure —
1	5000	69	172	Test was stopped; vertical substructure slightly bent
2	5000	70	175	
3	5000	62	155	
Mean E_u			167	—
Standard deviation s_E			10.75	—
γ			1.0618	—
$E_{Versuch}$			157	—
required $E_{Versuch}$			125	—
Requirements according to ETB-Richtlinie „Bauteile, die gegen Absturz sichern“, edition July 1985, 3.2.1			met	—

4.1.3 Hard imapct

The hard impact was performed according to section 3.2.3 of the mentioned guideline by the impact of a steel ball (Ø 63.5 mm, 1 kg) being dropped from a height of 1.0 m on the positioned balcony system. One element of each panel thickness was loaded with 15 impact tests. The impact areas were arranged in the middle, at free edges and near the fasteners of the flat laminate. The test results are shown in table 3.

Table 3: Results of testing soft impact –
Flat laminate: „Samrat“ / “Trendoo”
Fasteners: „Balkonschrauben-Set M5 x 45 mm, K 16 mm“
(test date: 28.04.2025)

Thickness of flat laminate; Height of handrail	Observations after 15 impact tests regarding the requirements of ETB-Richtlinie „Bauteile, die gegen Absturz sichern“	Requirements according to ETB-Richtlinie „Bauteile, die gegen Absturz sichern“, edition July 1985, 3.2.1
d = 6 mm; 900 mm	No visible damages found	met
d = 8 mm; 1100 mm	No visible damages found	met

4.1.4 Testing of fixing elements

Another balcony element was tested according to ETB-Richtlinie „Bauteile, die gegen Absturz sichern“, chapter 3.2.2.2.3. Therefor the compression plate consisted of a steel plate (Ø 200 mm) and a rubber plate of 6 mm thickness and Shore-A ≈ 80 according to DIN 53505, was arranged at places being supposed to be most unfavourable for the screw fixings (s. Appendix A3). A maximal load of at least 2.8 kN is required in ETB-Richtlinie „Bauteile, die gegen Absturz sichern“. The test results are shown in table 4.

Table 4: Results of testing of fixing elements –
Flat laminate: „Samrat“ / “Trendoo”
Fasteners: „Balkonschrauben-Set M5 x 45 mm, K 16 mm“
(test date: 28.04.2025)

Thickness of flat laminate; Height of handrail; Test rig	Test	Observations regarding the requirements of ETB-Richtlinie „Bauteile, die gegen Absturz sichern“	Requirements according to ETB-Richtlinie „Bauteile, die gegen Absturz sichern“, edition July 1985, 3.2.1
6 mm; 900 mm; s. Appendix 3.1	1: centre bottom	• Load reached • No visible damages found	met
	2: corner top	• Load reached • No visible damages found	
8 mm; 1100 mm, s. Appendix 3.2	1: centre bottom	• Load reached • No visible damages found	met
	2: corner top	• Load reached • No visible damages found	

4.2 Bending tests of flat laminates

Samples in the direction of production and across the direction of production were cut out of the delivered flat laminates after testing the construction elements. Bending tests according to DIN EN ISO 178:2019-08 were performed with the visible side in bending zone. The results are shown in table 5 and table 6.

Testing lengthwise means tension in machine direction of production machine during testing. Testing crosswise means the other way around.

Table 5: Bending test results – flat laminate: „Samrat“ / “Trendoo”, 6 mm

Lengthwise				test date: 29.04.2025
Sample no	Support span	Thickness	Bending strength	Bending modulus
—	mm	mm	MPa	MPa
1	96	6.0	104.3	13200
2	96	6.0	105.1	13100
3	96	6.4	102.7	13000
4	96	6.4	105.0	12800
5	96	6.3	107.3	13100
6	96	6.3	109.3	13400
7	96	6.4	101.5	13400
8	96	6.4	101.5	13500
9	96	6.3	111.4	13400
10	96	6.3	108.8	13400
Statistical evaluation				
Mean	—	6.3	105.7	13200
Crosswise				test date: 29.04.2025
Sample no	Support span	Thickness	Bending strength	Bending modulus
—	mm	mm	MPa	MPa
1	96	6.0	80.4	10300
2	96	6.0	79.7	9720
3	96	6.2	86.6	9570
4	96	6.8	70.4	7330
5	96	6.3	79.8	9640
6	96	6.3	74.0	9570
7	96	6.3	86.4	9830
8	96	6.3	82.6	9930
9	96	6.3	76.6	9520
10	96	6.3	80.2	9670
Statistical evaluation				
Mean	—	6.3	79.7	9510

Table 6: Bending test results – flat laminate: „Samrat“ / “Trendoo”, 8 mm

Lengthwise				test date: 29.04.2025
Sample no	Support span	Thickness	Bending strength	Bending modulus
—	mm	mm	MPa	MPa
1	128	7.8	101.3	12800
2	128	7.8	103.7	12800
3	128	7.1	115.7	17600
4	128	7.7	103.0	12900
5	128	7.8	105.3	13500
6	128	7.8	104.8	13400
7	128	7.8	100.9	13400
8	128	7.8	109.8	13800
9	128	7.8	111.2	13300
10	128	7.8	99.1	12900
Statistical evaluation				
Mean	—	7.7	105.5	13600
Crosswise				test date: 29.04.2025
Sample no	Support span	Thickness	Bending strength	Bending modulus
—	mm	mm	MPa	MPa
1	128	7.8	73.5	9380
2	128	7.8	77.0	9250
3	128	7.8	76.6	9120
4	128	7.8	74.7	9050
5	128	7.8	73.1	9490
6	128	7.8	76.1	9520
7	128	7.9	72.1	9400
8	128	7.9	68.4	9580
9	128	7.8	76.2	9460
10	128	7.8	72.3	9340
Statistical evaluation				
Mean	—	7.8	74.0	9360

Materialprüfanstalt Hannover MPA HANNOVER Bauwesen und Produktionstechnik

4.3 Material properties of the substructure

Material properties of the substructure were determined in a tensile test in accordance with DIN EN ISO 6892-1:2020-06, method B, on samples 20 mm wide and 80 mm long. The results are shown in table 7.

Table 7: Material properties of the substructure
(test date: 23.01.2023)

Sample no	Steel profile	Thickness	Technical elastic limit $R_{p0,2}$	Tensile strength R_m	Elongation at break A_{80}
—	mm	mm	MPa	MPa	%
1	Vertical bar 40 x 30 x 3	2.777	472	515	15.8
2		2.772	467	513	14.4
3	Cross bar 35 x 25 x 2	1.896	357	407	21.1
4		1.896	364	411	21.6

Hannover, 14 May 2025
Head of Testing Institute

(ORR Dr.-Ing. H. Höveling)

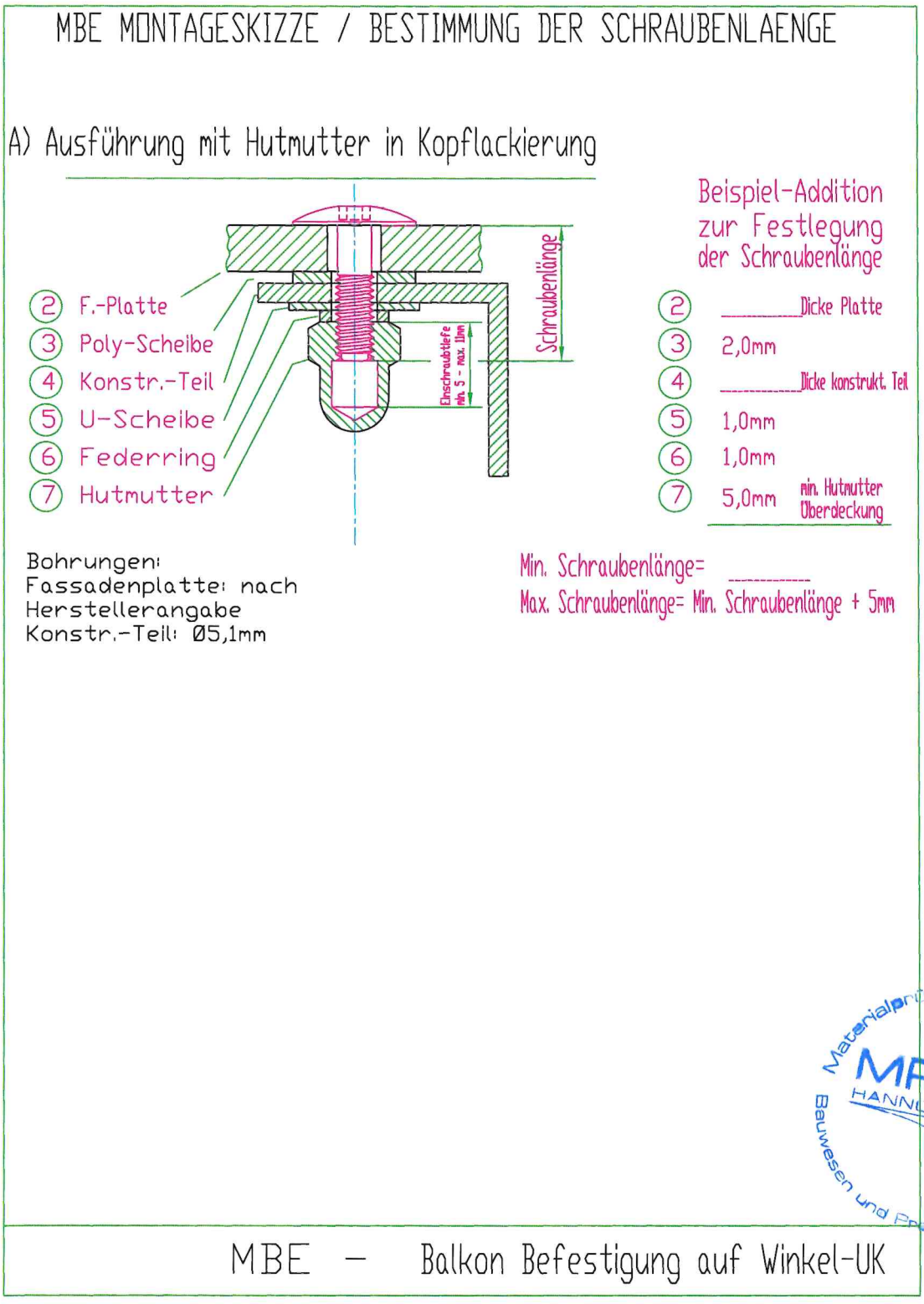
Contact

(Dr.-Ing. K. Fischer)

Materialprüfanstalt Hannover MPA HANNOVER Bauwesen und Produktionstechnik

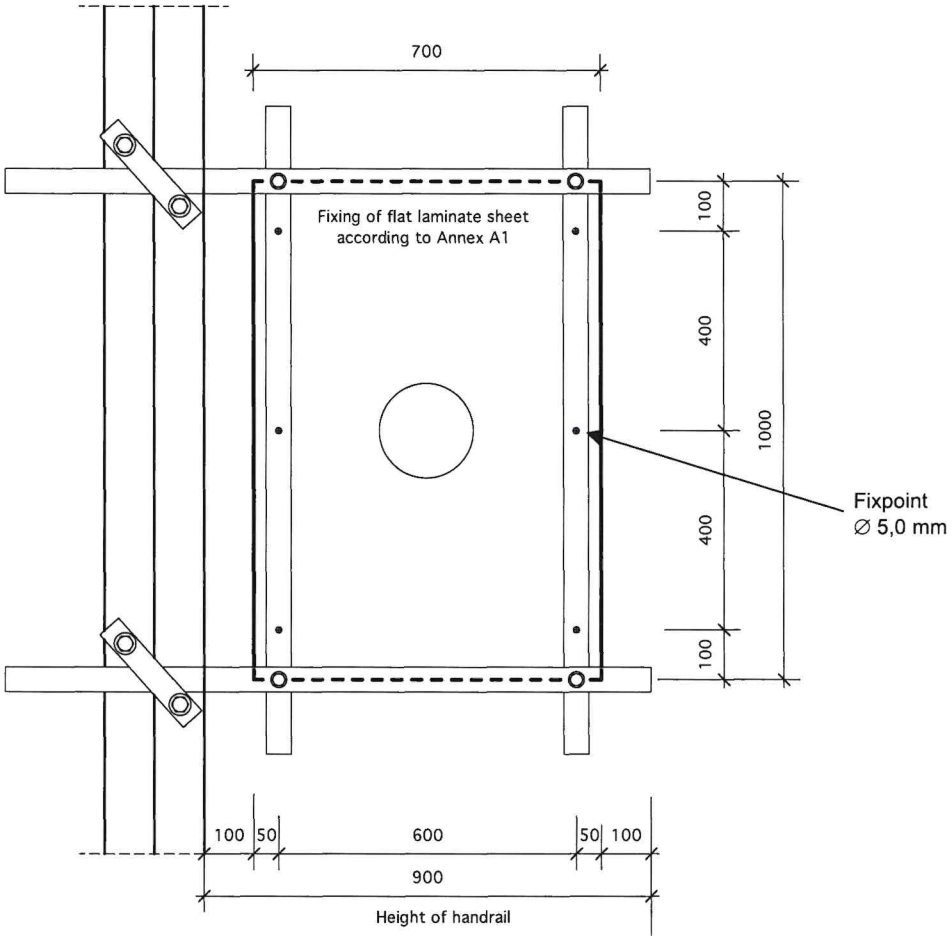
APPENDIX

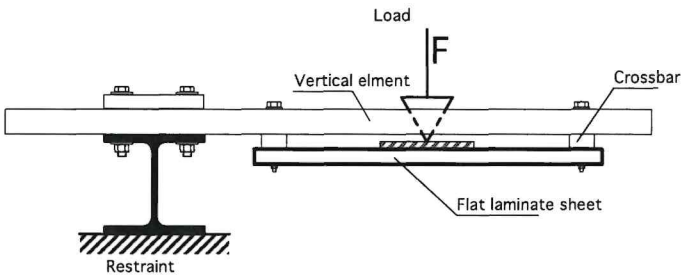
Appendix A1: Assembly sketch for "Balkonschrauben-Set M5 x 45 mm, K 16 mm"
The structural part consisted of the steel rectangular crossbar 35 mm x 25 mm x 2 mm.



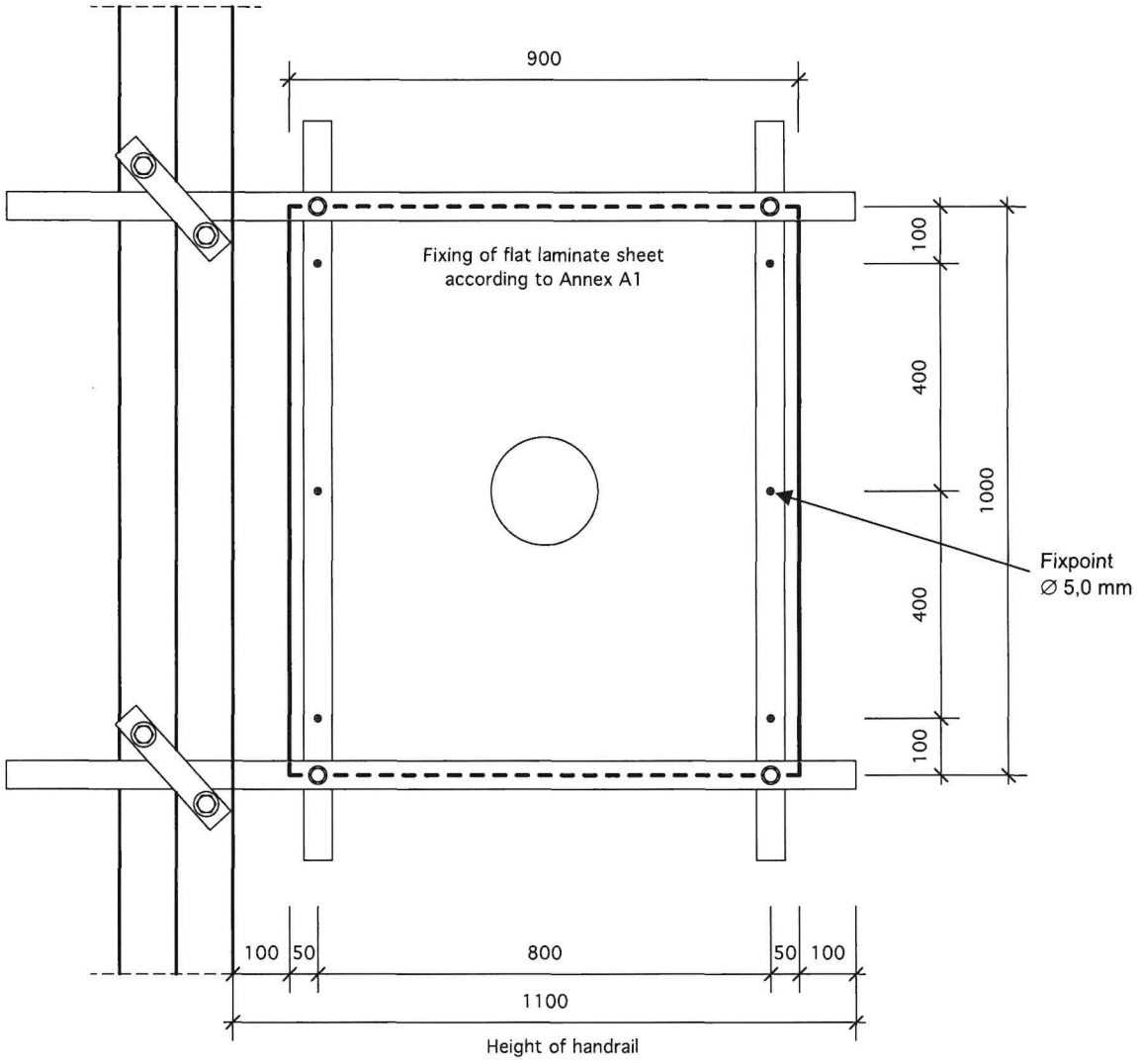
Appendix A2: Sketches of test rig for soft impact tests

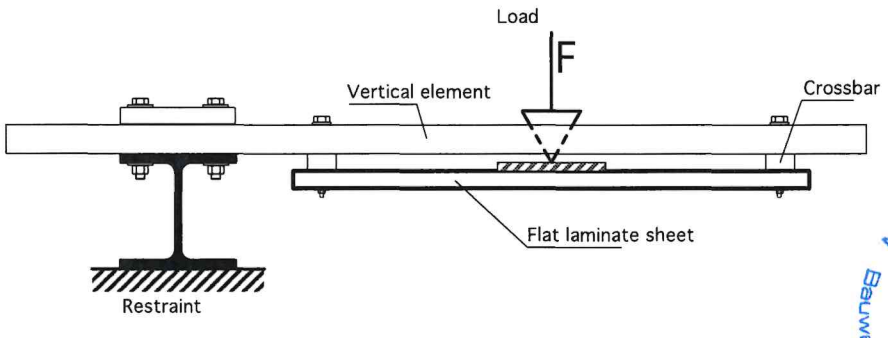
Appendix A2.1: Test rig of testing soft impact –
Flat laminate: „Samrat“ / “Trendoo”, d = 6 mm
Fasteners: „Balkonschrauben-Set M5 x 45 mm, Kopf 16 mm“





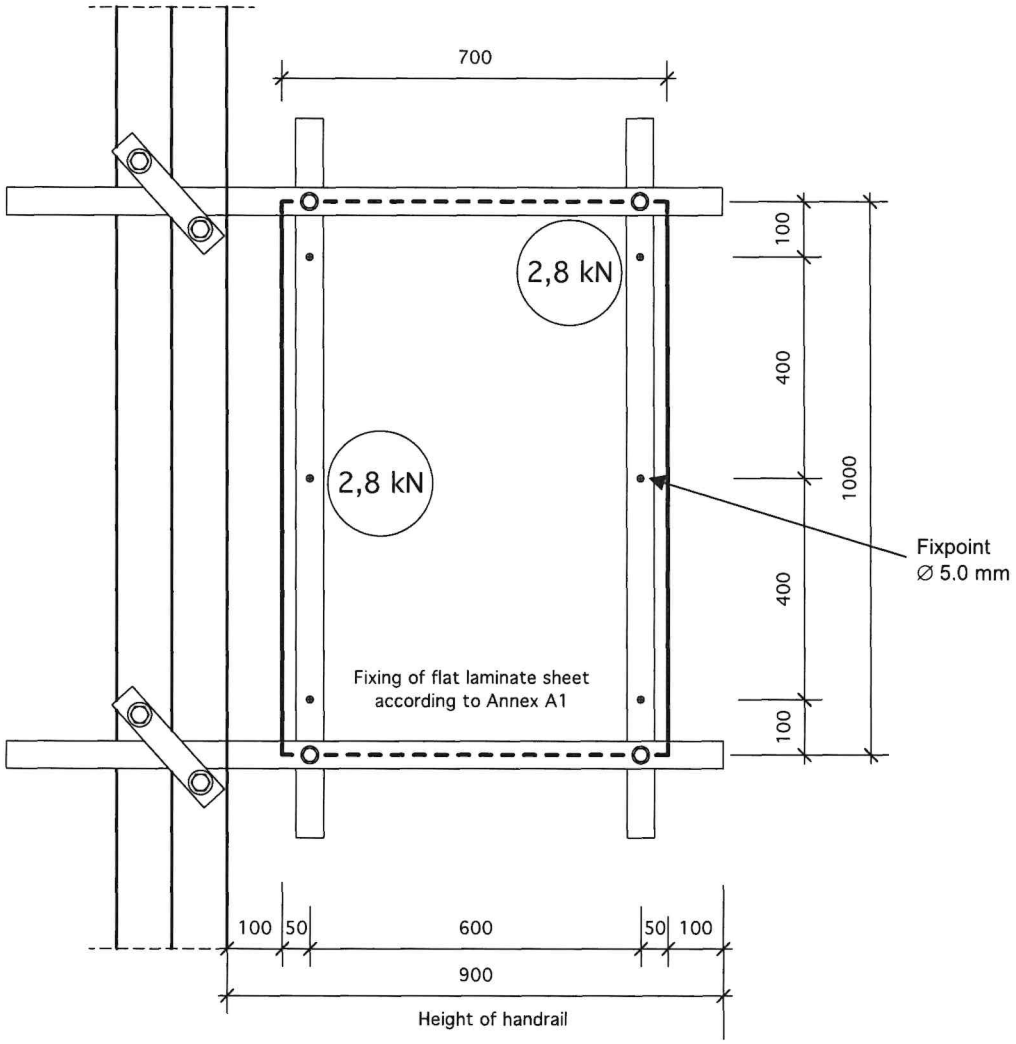
Appendix A2.2: Test rig of testing soft impact –
Flat laminate: „Samrat“ / “Trendoo”, d = 8 mm
Fasteners: „Balkonschrauben-Set M5 x 45 mm, Kopf 16 mm“

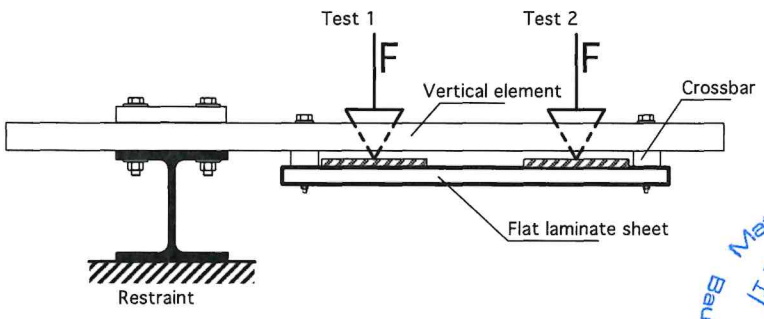




Appendix A3: Sketches of test rig for testing fixing elements

Appendix A3.1: Test rig of testing fixing elements –
Flat laminate: „Samrat“ / “Trendoo”, d = 6 mm
Fasteners: „Balkonschrauben-Set M5 x 45 mm, Kopf 16 mm“





Appendix A3.2: Test rig of testing fixing elements –
Flat laminate: „Samrat“ / “Trendoo”, d = 8 mm
Fasteners: „Balkonschrauben-Set M5 x 45 mm, Kopf 16 mm“