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krafton® bridge deck plank 236.40

Mechanical properties

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1. Summary

In this report the mechanical properties of the pultruded glass fibre reinforced krafton® 236.40 bridge deck plank are reported. These tests have been performed on a calibrated testing machine, located on Markweg Zuid 34, 4794 SN, Heijningen, The Netherlands, under supervision of SKZ – Testing Gmbh. Solico received these results on 24-02-2021

A few properties are based on additional test, performed by krafton. Solico received these results on 15-04-2021

The characteristic properties are summarized in Table 1.

		Units	krafton® 236.40
Dimensions	(b x h)	mm	236 x 40
Surface	(A)	mm^2	2986
Shear surface	(A_s)	mm^2	1052
Moment of inertia	(I)	mm^4	625197
Moment of Resistance	(W)	mm^3	26593
Weight	(G)	kg/m^2	22.8
Modulus of elasticity	(E_{av})	N/mm^2	32130
Flexural stress	($\sigma_{b,char}$)	N/mm^2	439
Shear stress	(τ_{char})	N/mm^2	51.2
Profile properties			
Flexural stiffness	(EI)	Nmm^2/mm	86.70×10^6
Flexural strength	(M_b)	Nmm/mm	50031
Shear strength	(D)	N/mm	228
Permissible shear force resulting from point load on 100x100	($D_{char,100}$)	N	103000
Permissible shear force resulting from point load on 200 x 200	($D_{char,200}$)	N	103000[1]

Table 1

[1] This value has not been tested, but will at least be equal to the test result on 100x100.

2. Product description

Pultruded, glass fibre reinforced polyester bridge deck plank.

Figure 1 shows the cross-section of the plank. The global dimensions are 236 x 40 x 5 mm. The thickness of the vertical ribs is 5 mm.

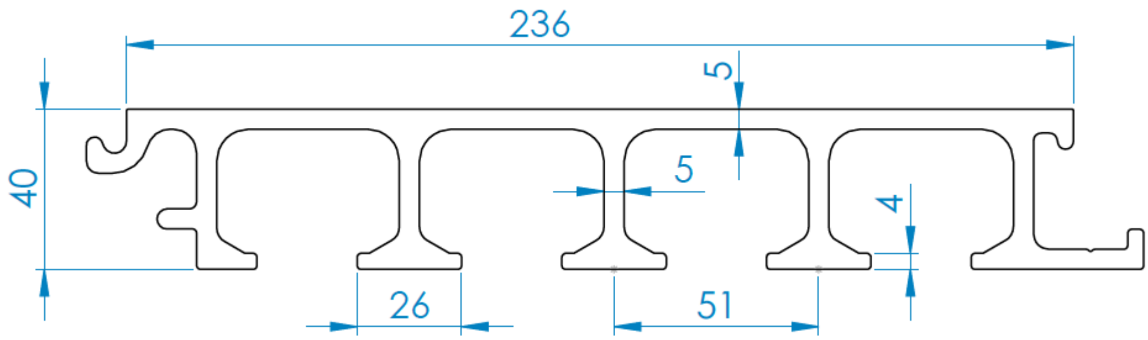

Figure 1

2.1. Geometric Properties

Width	b	:	236	mm
Height	h	:	40	mm
Number of ribs	n	:	5	st.
Distance between the ribs	d	:	51	mm
Surface area	A	:	2,986	mm^2
Shear area	As	:	1,052	mm^2
Moment of inertia	I	:	625,197	mm^4
Moment of resistance	W	:	26,593	mm^3
Weight plank	G	:	22.8	kg/m^2

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3. Tests

3.1. Test description

The following tests have been performed under supervision by SKZ:

- E-modulus using a 3-point bending test
- Flexural strength using a 3-point bending test

krafton has performed two additional tests, namely:

- Determination of shear strength using a 3 points bending test. The point load is applied with a stamp right next to the support.
- Determination of the permissible shear force due to a point load on 100mm x 100mm, corresponding to the wheel print of an unintended vehicle acc. To EN1991-2-NB-Traffic loads on bridges.

3.2. Test results

According to EN1990:2002 appendix D, the characteristic strength value is calculated from the average strength value minus k_n times the standard deviation. The values for k_n are used according to table D1 in EN1990:2002. The characteristic stiffness value is equal to the average measured stiffness value.

3.2.1. Flexural modulus

The flexural modulus is determined by determining the slope of the force-displacement curve. The slope is determined by taking two points on the graph and drawing a line between them. The points are chosen in the linear part of the curve. The E-modulus is calculated with the following formula:

$$\Delta y = \frac{\Delta F \times \ell^3}{48 \times E_b I} \quad \rightarrow \quad E_b = \frac{\Delta F \times \ell^3}{48 \times I \times \Delta y}$$

Wherein:

Δy	=	Displacement [mm]
ΔF	=	Force [N]
L	=	Span [mm]
E_b	=	Flexural modulus [N/mm^2]
I	=	Moment of inertia [mm^4]

Sample nr.	L [mm]	ΔF [N]	Δy [mm]	E_b [N/mm^2]
1	1,200	39,590	71.72	31,786
2	1,200	40,740	72.61	32,308
3	1,200	41,950	75.02	32,199
4	1,200	42,390	76.22	32,024
5	1,200	41,510	74.15	32,235
6	1,200	41,750	74.6	32,226
Average value [$E_{b,ave}$]				32,130
Standard deviation [s]				193

Table 1

3.2.2. Flexural strength

The test values ($F_{failure}$) are used to determine the flexural strength (σ_b) using the following formula:

$$\sigma_b = \frac{F_{max} \times \ell}{4 \times W}$$

Wherein: ℓ = Span

W = Moment of resistance 26,593 **mm³**

Sample nr.	ℓ [mm]	F_{breuk} [N]	σ_b [N/mm²]
1	1,200	39,590	447
2	1,200	40,740	460
3	1,200	41,950	473
4	1,200	42,390	478
5	1,200	41,510	468
6	1,200	41,750	471
		Average value [$\sigma_{b,ave}$]	466
		Standard deviation [s]	12
		Characteristic value [$\sigma_{b,char}$]	439

Table 2

The characteristic value is determined from the average value minus 2.18 x the standard deviation.

3.2.3. Shear strength

The test values ($F_{failure}$) are used to determine the shear strength (τ) by the following formula:

$$\tau = \frac{F_{failure}}{2 \times A_s}$$

The test has been performed on a test bench with a measuring range of 250 kN. The specimen has a length of 350 mm, and has been tested with a span of L = 200mm.

Sample nr.	$F_{failure}$ [N]	τ [N/mm²]
1	115,981	55.1
2	117,820	56.0
3	110,923	52.7
4	118,195	56.2
5	110,834	52.7
6	116,579	55.4
	Average value [τ_{ave}]	54.5
	Standard deviation [s]	1.5
	Characteristic value [τ_{char}]	51.2

Table 3

The characteristic value is determined from the average value minus 2.18 x the standard deviation.

3.2.4. Shear strength for a concentrated load at 100 x 100 mm

The test results (F_{max}) are used to determine the shear strength (D_{100}) by means of the following formula:

$$D_{100} = \frac{F_{max} \times (\ell - \ell_0)}{\ell}$$

This only applies to a load on 100 x 100 mm. The value ℓ_0 is equal to half the length of the point load surface, plus the distance between the support and the edge of the point load.

Sample nr.	ℓ [mm]	ℓ_0 [mm]	$F_{failure}$ [N]	D_{100} [N]
1	1,000	55	115,981	109,602
2	1,000	55	117,820	111,340
3	1,000	55	110,923	104,822
4	1,000	55	118,195	111,695
5	1,000	55	116,579	104,738
6	1,000	55	115,056	110,168
			Average value [$D_{ave,100}$]	109,303
			Standard deviation [s]	2,876
			Characteristic value [$D_{char,100}$]	103,033

Table 4

The characteristic value is determined from the average value minus 2.18 x the standard deviation.