

krafton® bridge deck plank 256.40

Mechanical Properties



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1. Summary

In this report the mechanical properties of the pultruded glass fibre reinforced krafton® 256.40 bridge deck plank are reported. The mechanical properties of the bridge deck plank have been determined by means of tests. The tests were executed by TÜV Rheinland (former TNO Quality services) and reported in report 11609R-E09.0246 dated 01.09.2011.

The characteristic properties are summarized in Table 1.

In version 2, the characteristic shear force ($D_{char,200}$) due to a point load on 200x200 mm has been recalculated, based on the tests performed by krafton® on 21-12-2018.

	Units	krafton 256.40
Dimensions (b x h)	mm	256 x 40
Surface (A)	mm ²	3.123
Shear surface (A _s)	mm ²	1.126
Moment of inertia (I)	mm ⁴	716,946
Moment of Resistance (W)	mm ³	31,473
Weight (G)	kg/m ²	22.0
Modulus of elasticity (E _{av})	N/mm ²	29,402
Flexural stress ($\sigma_{b,char}$)	N/mm ²	391
Shear stress (τ_{char})	N/mm ²	43.5
Profile properties		
Flexural stiffness (EI)	Nmm ² /mm	79.5x10 ⁶
Flexural strength (M _b)	Nmm/mm	46.4x10 ³
Shear strength (D)	N/mm	184.8
Permissible shear force ($D_{char,100}$) resulting from point load on 100x100	N	39,117
Permissible shear force ($D_{char,200}$) resulting from point load on 200 x 200	N	89,268

Table 1

2. Product description

Pultruded, glass fibre reinforced polyester bridge deck plank.

Figure 1 shows the cross-section of the plank. The global dimensions are 256 x 40 x 5 mm.

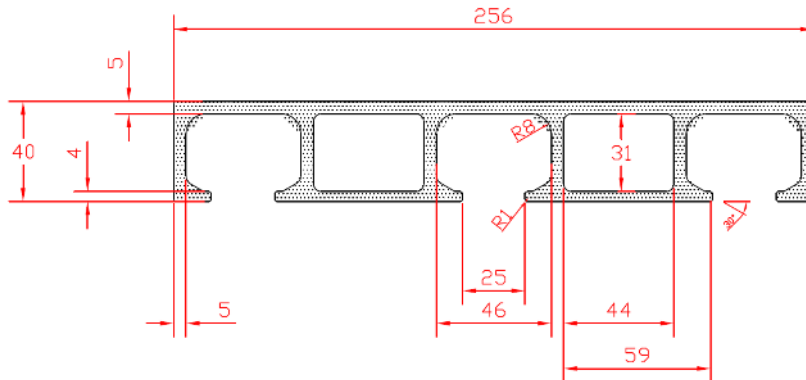


Figure 1

2.1. Geometric properties

Width	b	:	256	mm
Height	h	:	40	mm
Number of ribs	n	:	6	pcs
Distance between the ribs	d	:	50	mm
Surface	A	:	3,123	mm ²
Shear area	A _s	:	1,126	mm ²
Moment of inertia	I	:	716,946	mm ⁴
Moment of resistance	W	:	31,473	mm ³
Weight of plank	G	:	22.0	kg/m ²

3. Tests

3.1. Test description

- Flexural strength and stiffness according to EN ISO 14125
- Shear strength analogous to EN ISO 14130
- Permissible shear force due to a point load
 - o Point load on 100x100 mm cf. NEN 6706. The point load is applied to a board with a 'large' span, right next to the support..
- Permissible shear force due to an unintended vehicle
 - o Point load on 200x200 mm cf. EN 1991-2. The concentrated load is applied to a board with a 'large' span, right next to the bearing.

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/mm²]
- I = Moment of inertia [mm⁴]

TEST								CALCULATION	
No.	Span	y1	F1	y2	F2	D _y	D _F	I	E
-	[mm]	[mm]	[N]	[mm]	[N]	[mm]	[N]	[mm ⁴]	[MPa]
256x40_1	1,500	30	8,105	70	19,543	40	11,438	716,946	28,044
256x40_2	1,500	30	8,079	70	19,549	40	11,470	716,946	28,122
256x40_3	1,500	30	8,576	67	20,071	37	11,495	716,946	30,469
256x40_3_1_1	1,300	30	13,105	54.5	24,518	24.5	11,413	716,946	29,740
256x40_3_1_2	1,300	30	13,002	54.5	24,446	24.5	11,444	716,946	29,820
256x40_3_1_3	1,300	30	13,090	54.5	24,520	24.5	11,430	716,946	29,784
256x40_3_1_4	1,300	30	13,015	54.5	24,373	24.5	11,358	716,946	29,596
256x40_3_1_5	1,300	30	13,032	54.5	24,408	24.5	11,376	716,946	29,643
Average value [E _{b,av}]									29,402

Table 2

Nr.	Span
-	[mm]
256x40_1	1500
256x40_2	1500
256x40_3	1500
256x40_3_1_1	1300
256x40_3_1_2	1300
256x40_3_1_3	1300
256x40_3_1_4	1300
256x40_3_1_5	1300

Met opmerkingen [TvZ1]:

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 [m]
 W = Moment of resistance [mm³]

Sample no.	ℓ [mm]	W [mm ³]	F_{max} [N]	σ_b [N/mm ²]
256x40_1	1,500	31,474	34,466	411
256x40_2	1,500	31,474	38,193	455
256x40_3	1,500	31,474	36,782	438
256x40_3_1_1	1,300	31,474	41,725	431
256x40_3_1_2	1,300	31,474	38,630	399
256x40_3_1_3	1,300	31,474	42,428	438
256x40_3_1_4	1,300	31,474	41,386	427
256x40_3_1_5	1,300	31,474	40,102	414
Average value [$\sigma_{b,av}$]				427
Standard deviation [s]				18
Characteristic value [$\sigma_{b,char}$]				391

Table 3

Test nr.
256x40_1
256x40_2
256x40_3
256x40_3_1_1
256x40_3_1_2
256x40_3_1_3
256x40_3_1_4
256x40_3_1_5

Met opmerkingen [TvZ21]:

The characteristic value is determined from the average value minus 2.0 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:

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

Test no.	ℓ [mm]	A_s [mm ²]	F_{max} [N]	τ [N/mm ²]
256x40_3_1_1	200	1,126	105,077	47
256x40_3_1_2	200	1,126	105,994	47
256x40_3_1_3	200	1,126	116,701	52
256x40_3_1_4	200	1,126	118,760	53
256x40_3_1_5	200	1,126	112,468	50
Average value [τ_{av}]				50
Standard deviation [s]				2.8
Characteristic value [τ_{char}]				43.5

Table 4

The characteristic value is determined from the average value minus 2.33 x the standard deviation.

Test nr.
256x40_3_2_1
256x40_3_2_2
256x40_3_2_3
256x40_3_2_4
256x40_3_2_5

Met opmerkingen (TvZ3):

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.

Test no.	ℓ [mm]	ℓ_0 [mm]	F_{max} [N]	D [N/mm ²]
3_3_1	1,000	55	46,926	44,345
3_3_2	1,000	55	46,627	44,063
3_3_3	1,000	55	44,465	42,019
3_3_4	1,000	55	43,037	40,670
3_3_5	1,000	55	47,267	44,667
Average value [$D_{av,100}$]				43,153
Standard deviation [s]				1,732
Characteristic value [$D_{char,100}$]				39,117

Table 5

The characteristic value is determined from the average value minus 2.33 x the standard deviation.

Test nr.	
3_3_1	
3_3_2	
3_3_3	
3_3_4	
3_3_5	

Met opmerkingen [TvZ4]:

3.2.5. Shear strength for a concentrated load at 200 x 200 mm

The test results (F_{max}) are used to determine the shear strength (D_{200}) by means of the following formula:

$$D_{200} = \frac{F_{max} \times (\ell - \ell_0)}{\ell}$$

This only applies to a load on 200 x 200 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.

Test no.	ℓ [mm]	ℓ_0 [mm]	$F_{failure}$ [N]	D [N/mm ²]
200x200_1	1,000	105	101,350	90,708
200x200_2	1,000	105	104,690	93,698
200x200_3	1,000	105	102,160	91,433
200x200_4	1,000	105	104,420	93,456
200x200_5	1,000	105	103,490	92,624
200x200_6	1,000	105	101,040	90,431
Average value [$D_{av,200}$]				92,058
Standard deviation [s]				1,280
Characteristic value [$D_{char,200}$]				89,268

Table 6

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

Test nr.	
200x200_1	
200x200_2	
200x200_3	
200x200_4	
200x200_5	
200x200_6	

Met opmerkingen [TvZ5]: