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## Evaluation Report to European Technical Assessment

**ETA 23/0523 – version 01  
of 20/11/2024**

**Trade name of the construction product:**

Composite GFRP bar reinforcement TopBAR

**Product family to which the construction product belongs:**

Product area code: 26  
PRODUCTS RELATED TO CONCRETE, MORTAR AND GROUT

**Manufacturer:**

Composite Group s. r. o.  
Panenská 5  
811 03 Bratislava – mestská časť Staré Mesto  
Slovak Republic  
<https://composite-group.com/>

**Manufacturing plant:**

Composite Group s. r. o.  
Priemyselná 8  
924 01 Galanta  
Slovak Republic

**This Evaluation Report contains:**

17 pages

**This Evaluation Report replaces:**

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## **1. Introduction**

This report describes the methods used to assess the composite GFRP bar reinforcement Composite TopBAR for its intended use.

This report describes the methods used to assess the fitness for the intended use of the composite GFRP bar reinforcement Composite TopBAR in accordance with the Essential Requirements, as specified in EAD 260023-00-0301 (Edition 01/2019,) Carbon, glass, basalt and aramid FRP (Fibre Reinforced Polymer) bars as reinforcement of structural elements, if not determined differently in the following.

## **2. Description of the product and Intended use**

### **2.1 Description of the product**

Composite GFRP bar reinforcement Composite TopBAR for concrete is a glass fiber reinforced polymer bar made of strands of glass fibers that are impregnated with a thermoset polymer resin. The bars are profiled on the outside with reinforcing rib (winding) to improve cohesion with concrete. As a standard Composite TopBAR reinforcement is produced in diameters of 6 mm, 8 mm, 12 mm, 16 mm.

### **2.2 Intended use**

Composite GFRP bar reinforcement Composite TopBAR is used to reinforce load and non-load bearing elements of monolithic and precast concrete structures. It is used primarily in those parts of buildings that are exposed to an increased risk of corrosion, in structures with requirements for protection against electromagnetic influences, and in structures where cutting of the reinforced structure is considered.

Composite TopBAR is intended to be used as reinforcement of construction works and elements made of reinforced concrete (beams, columns, panels, slabs and other structural elements). Bars are used in parts of concrete structures in which is full bond between reinforcement bar and concrete at whole length of a bar.

Concerning product packaging, transport and storage it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport and storage, as he considers necessary in order to reach the declared performances.

## **3. Evaluation of Available Data**

### **3.1 Cross-sectional properties**

Cross-sectional properties have been determined by the tests according to EAD 260023-00-0301, clause 2.2.1. Test results are documented in [8] and presented in Table 1 to Table 4.



**Table 1 – Effective diameter  $d_{eff}$  and effective cross-sectional area  $A_{eff}$  of rebars with diameter of 6 mm**

Diameter (mm)	Test piece no.	Effective cross-sectional area $A_{\text{eff}}$ (mm <sup>2</sup> )		Effective diameter $d_{\text{eff}}$ (mm)	
		Single value	Average	Single value	Average
6	1	29,9	30,2	6,2	6,2
	2	29,7		6,2	
	3	30,0		6,2	
	4	31,5		6,3	
	5	29,7		6,2	
	6	29,8	30,0	6,2	6,2
	7	30,7		6,3	
	8	29,8		6,2	
	9	29,7		6,2	
	10	29,9		6,2	
	11	29,6	29,7	6,1	6,2
	12	29,8		6,2	
	13	29,7		6,2	
	14	29,7		6,2	
	15	29,6		6,1	
Maximum value		30,2		6,2	
Minimum value		29,7		6,2	
Average value		29,9		6,2	

**Table 2 – Effective diameter  $d_{eff}$  and effective cross-sectional area  $A_{eff}$  of rebars with diameter of 8 mm**

Diameter (mm)	Test piece no.	Effective cross-sectional area $A_{\text{eff}}$ (mm <sup>2</sup> )		Effective diameter $d_{\text{eff}}$ (mm)	
		Single value	Average	Single value	Average
8	1	52,3	52,5	8,2	8,2
	2	52,5		8,2	
	3	52,5		8,2	
	4	52,6		8,2	
	5	52,5		8,2	
	6	53,0	53,4	8,2	8,3
	7	53,1		8,2	
	8	53,1		8,2	
	9	54,0		8,3	
	10	53,9		8,3	
	11	52,3	52,6	8,2	8,2
	12	52,5		8,2	
	13	52,5		8,2	
	14	52,6		8,2	
	15	53,2		8,2	
Maximum value		53,4		8,3	
Minimum value		52,5		8,2	
Average value		52,8		8,2	

**Table 3 – Effective diameter  $d_{eff}$  and effective cross-sectional area  $A_{eff}$  of rebars with diameter of 12 mm**

Diameter (mm)	Test piece no.	Effective cross-sectional area $A_{eff}$ (mm <sup>2</sup> )		Effective diameter $d_{eff}$ (mm)	
		Single value	Average	Single value	Average
12	1	118,7	115,3	12,3	12,1
	2	115,4		12,1	
	3	113,8		12,0	
	4	114,1		12,1	
	5	114,3		12,1	
	6	114,6	114,7	12,1	12,1
	7	115,4		12,1	
	8	113,6		12,0	
	9	115,0		12,1	
	10	114,9		12,1	
	11	117,9	116,1	12,1	12,2
	12	118,3		12,1	
	13	113,7		12,0	
	14	115,2		12,1	
	15	115,4		12,1	
Maximum value		116,1		12,2	
Minimum value		114,7		12,1	
Average value		115,6		12,1	

**Table 4 – Effective diameter  $d_{eff}$  and effective cross-sectional area  $A_{eff}$  of rebars with diameter of 16 mm**

Diameter (mm)	Test piece no.	Effective cross-sectional area $A_{eff}$ (mm <sup>2</sup> )		Effective diameter $d_{eff}$ (mm)	
		Single value	Average	Single value	Average
16	1	209,4	209,1	16,3	16,3
	2	208,0		16,3	
	3	210,0		16,4	
	4	208,9		16,3	
	5	209,3		16,3	
	6	207,8	208,9	16,3	16,3
	7	209,7		16,3	
	8	208,5		16,3	
	9	209,1		16,3	
	10	209,3		16,3	
	11	208,6	208,4	16,3	16,3
	12	208,3		16,3	
	13	207,9		16,3	
	14	208,1		16,3	
	15	208,9		16,3	
Maximum value		209,1		16,3	
Minimum value		208,4		16,3	
Average value		208,8		16,3	



### 3.2 Tensile strength

Tensile strength has been determined by tests according to EAD 260023-00-0301, clause 2.2.2. Test results are documented in [9] and presented in Table 5.

**Table 5 – Tensile strength**

Test piece no./ Diameter (mm)	Tensile strength $f_R$ (MPa)			
	Ø6	Ø8	Ø12	Ø16
1	1184	1200	1115	952
2	1356	1154	1100	906
3	1305	1113	1067	866
4	1353	1180	1105	938
5	1320	1174	1125	939
6	1260	1123	1136	935
7	1177	1095	1187	953
8	1252	1211	1073	967
9	1186	1198	1141	930
10	1153	1111	1097	1010
11	1221	1184	1115	943
12	1181	1142	1128	1000
13	1189	1154	1143	904
14	1193	1209	1080	960
15	1297	1139	1147	931
16	1226	1216	1079	934
17	1248	1148	1121	965
18	1224	1218	1153	923
19	1197	1155	1100	973
20	1171	1152	1135	942
21	1229	1170	1120	892
22	1133	1194	1054	899
23	1148	1189	1138	945
24	1148	1138	1052	962
25	1121	1157	1130	939
Average value $f_{R0}$	1218,9	1165,0	1113,6	940,3
Standard deviation	66,307	34,741	33,005	32,032
Coefficient of variation	5,4%	3,0%	3,0%	3,4%
Minimum value	1121	1095	1052	866
Maximum value	1356	1218	1187	1010
Characteristic value $f_{R0k}$	1103,2	1104,3	1056,0	884,4
Type of failure	rupture of vicinity in anchor area			

### 3.3 Tensile modulus of elasticity

Tensile modulus of elasticity has been determined by tests according to EAD 260023-00-0301, clause 2.2.2. Test results are documented in [9] and presented in Table 6.

Table 6 – Tensile modulus of elasticity

Test piece no./ Diameter (mm)	Tensile modulus of elasticity $E$ (GPa)			
	Ø6	Ø8	Ø12	Ø16
1	52,2	53,2	52,8	52,4
2	51,3	52,5	51,0	52,4
3	51,9	52,6	51,3	51,1
4	51,8	51,8	51,6	50,7
5	52,3	51,1	51,8	52,0
6	51,0	51,9	52,3	52,2
7	52,4	51,2	51,9	53,2
8	50,6	52,4	51,3	52,3
9	51,4	51,8	50,9	52,1
10	51,8	53,1	51,5	52,9
11	51,0	53,3	51,4	51,7
12	51,5	52,1	51,9	51,3
13	51,7	52,0	51,8	55,3
14	51,0	51,8	51,5	55,3
15	50,0	52,2	51,3	52,8
16	51,7	52,3	51,5	53,7
17	50,8	53,7	52,2	51,5
18	52,0	53,7	52,3	51,8
19	51,9	52,2	52,9	52,1
20	51,3	52,6	51,6	52,4
21	51,3	52,9	51,9	53,6
22	52,0	51,6	53,7	51,0
23	51,7	53,6	52,5	52,3
24	50,0	53,4	52,4	53,0
25	51,0	52,1	52,4	52,0
Average value $E_t$	51,4	52,4	51,9	52,4
Standard deviation	0,633	0,760	0,642	1,143
Coefficient of variation	1,2%	1,4%	1,2%	2,2%
Minimum value	50,011	51,05	50,872	50,695
Maximum value	52,398	53,704	53,65	55,344



### 3.4 Tensile failure strain

Tensile failure strain has been determined by test according to EAD 260023-00-0301, clause 2.2.2. Test results are documented in [9] and presented in Table 7.

Table 7 – Tensile failure strain

Test piece no./ Diameter (mm)	Tensile failure strain $\epsilon_{ft}$ (mm/mm)			
	Ø6	Ø8	Ø12	Ø16
1	0,022	0,023	0,021	0,020
2	0,023	0,022	0,022	0,020
3	0,022	0,023	0,020	0,020
4	0,021	0,023	0,020	0,020
5	0,021	0,023	0,021	0,020
6	0,022	0,022	0,020	0,020
7	0,023	0,022	0,021	0,020
8	0,021	0,023	0,020	0,021
9	0,021	0,022	0,021	0,020
10	0,022	0,021	0,021	0,023
11	0,023	0,023	0,021	0,021
12	0,020	0,023	0,023	0,023
13	0,021	0,021	0,023	0,021
14	0,022	0,022	0,021	0,020
15	0,024	0,022	0,021	0,023
16	0,022	0,022	0,022	0,020
17	0,022	0,021	0,021	0,021
18	0,023	0,022	0,022	0,020
19	0,023	0,021	0,023	0,020
20	0,022	0,022	0,021	0,021
21	0,022	0,022	0,021	0,022
22	0,022	0,023	0,020	0,020
23	0,022	0,023	0,020	0,021
24	0,022	0,023	0,020	0,020
25	0,022	0,023	0,021	0,021
Average value $\epsilon_{ft0}$	0,022	0,022	0,021	0,021
Standard deviation	0,0009	0,0007	0,0010	0,0010
Coefficient of variation	3,9%	3,3%	4,5%	4,9%
Minimum value	0,020	0,021	0,020	0,020
Maximum value	0,024	0,023	0,023	0,023
Characteristic value $\epsilon_{ft0k}$	0,020	0,021	0,019	0,019

### 3.5 Compressive strength

Compressive strength has been determined by tests according to EAD 260023-00-0301, clause 2.2.3. Test results are documented in [10] and presented in Table 8.

**Table 8 – Compressive strength**

Test piece no./ Diameter (mm)	Compressive strength $f_c$ (MPa)			
	Ø6	Ø8	Ø12	Ø16
1	306	456	492	383
2	336	501	535	375
3	316	494	458	435
4	353	540	493	400
5	351	516	460	442
6	320	553	508	430
7	314	500	477	414
8	370	524	482	384
9	300	560	495	381
10	310	548	461	385
11	311	468	427	409
12	311	477	481	381
13	313	534	450	391
14	287	529	475	396
15	307	497	485	431
Average value	320,3	513,1	478,6	402,5
Standard deviation	22,395	31,724	25,823	22,756
Coefficient of variation	7,0%	6,2%	5,4%	5,7%
Minimum value	287	456	427	375
Maximum value	370	560	535	442
Characteristic value	279,1	454,8	431,1	360,6
Type of failure	delamination			

### 3.6 Compressive modulus

Compressive modulus has been determined by tests according to EAD 260023-00-0301, clause 2.2.3. Test results are documented in [10] and presented in Table 9.



Table 9 – Compressive modulus

Test piece no./ Diameter (mm)	Compressive modulus $f_c$ (GPa)			
	Ø6	Ø8	Ø12	Ø16
1	48,01	50,19	42,51	44,62
2	44,76	51,43	43,46	45,97
3	42,91	51,26	48,03	50,50
4	42,78	47,23	43,12	49,93
5	47,81	43,80	45,63	46,28
6	46,56	43,03	45,16	53,64
7	42,49	43,72	44,77	46,80
8	43,08	51,67	44,68	51,11
9	44,88	46,94	41,52	50,70
10	42,90	44,01	46,92	50,29
11	48,09	51,81	41,94	47,15
12	42,54	48,39	41,79	48,95
13	46,83	47,44	43,80	53,81
14	46,65	48,64	43,02	47,12
15	49,85	46,97	44,09	46,28
Average value	45,3	47,8	44,0	48,9
Standard deviation	2,487	3,101	1,878	2,822
Coefficient of variation	5,5%	6,5%	4,3%	5,8%
Minimum value	42,49	43,03	41,52	44,62
Maximum value	49,85	51,81	48,03	53,81
Characteristic value	40,8	42,1	40,6	43,7

### 3.7 Bond strength in concrete by pull-out testing

Bond strength in concrete has been determined by tests according to EAD 260023-00-0301, clause 2.2.4. Only centric test was performed, with reinforcement bars not submerged in alkaline solution. Test results are documented in [11] and presented in Table 10.

Table 10 – Bond strength in concrete by pull-out testing

Bond strength in concrete by pull-out testing $\tau_b$ (MPa)	C20/25;20°C			C50/60;20°C
	Ø6	Ø12	Ø16	Ø16
1	24,6	12,7	10,1	19,9
2	27,8	13,3	10,7	18,1
3	27,5	12,0	10,4	19,9
4	20,9	13,3	10,1	18,7
5	25,7	13,6	9,8	20,0
Average value	25,3	13,0	10,2	19,3
Standard deviation	2,788	0,638	0,342	0,867
Coefficient of variation	11,0%	4,9%	3,3%	4,5%
Minimum value	20,9	12	9,8	18,1
Maximum value	27,8	13,6	10,7	20
<b>Characteristic value</b>	<b>18,8</b>	<b>11,5</b>	<b>9,4</b>	<b>17,3</b>
Type of failure	pull-out			
Average substrate compressive strength in MPa	29,2	29,0	28,9	60,8

### 3.8 Transverse shear strength

Transverse shear strength has been determined by test according to EAD 260023-00-0301, clause 2.2.5. Test results are documented in [12] and presented in Table 11.



Table 11 – Transverse shear strength

Transverse shear strength $\tau_s$ (MPa)	Ø6	Ø8	Ø12	Ø16
1	216,4	177,2	169,2	151,1
2	206,2	164,6	174,7	146,0
3	211,9	185,8	184,5	158,4
4	218,7	176,6	176,4	159,1
5	242,5	189,8	159,2	149,5
6	228,3	172,8	163,4	159,6
7	215,9	173,6	167,1	146,3
8	199,5	189,4	166,9	157,5
9	229,8	182,6	181,4	157,3
10	215,6	186,7	172,9	163,9
11	252,5	217,8	170,0	144,7
12	241,3	198,3	169,0	158,1
13	198,5	172,6	170,3	153,7
14	235,0	186,6	175,2	160,2
15	213,9	204,6	183,2	151,6
16	222,4	193,1	181,1	155,3
17	223,9	197,3	176,8	165,3
18	220,2	180,7	184,9	155,7
19	247,0	177,6	178,8	169,5
20	209,5	185,5	166,4	159,0
21	250,0	202,9	178,7	165,8
22	240,6	181,0	174,1	162,0
23	224,8	203,0	188,3	157,9
24	205,2	187,6	185,1	160,2
25	224,4	180,9	173,4	159,4
Average value	223,8	186,7	174,8	157,1
Standard deviation	15,445	12,196	7,517	6,269
Coefficient of variation	6,9%	6,5%	4,3%	4,0%
Minimum value	198,5	164,6	159,2	144,7
Maximum value	252,5	217,8	188,3	169,5
Characteristic value	196,8	165,5	161,7	146,1
Type of failure	shear at both surfaces			

### 3.9 Interlaminar shear strength

Interlaminar shear strength has been determined by tests according to EAD 260023-00-0301, clause 2.2.6. Test results are documented in [13] and presented in Table 12. Span to diameter ratio was 3:1.

**Table 12 – Interlaminar shear strength**

Interlaminar shear strength (MPa)	Ø6	Ø8	Ø12	Ø16
1	43,51	44,44	47,32	46,78
2	47,71	46,97	44,19	46,30
3	46,16	49,37	47,38	48,95
4	47,26	45,33	47,55	49,21
5	47,71	42,55	46,51	48,41
6	48,15	45,08	50,04	44,83
7	43,07	46,59	49,52	48,44
8	45,06	47,10	47,49	46,78
9	43,95	49,12	48,07	48,83
10	43,51	45,46	48,36	47,01
11	44,84	44,82	45,58	48,41
12	45,28	47,35	44,65	49,34
13	45,72	44,07	49,12	48,44
14	44,61	46,47	49,17	46,85
15	46,16	44,70	47,32	47,84
16	45,06	44,95	49,23	47,68
17	47,71	46,21	46,74	47,90
18	44,61	46,84	47,20	45,82
19	46,16	46,59	46,22	46,08
20	47,04	45,96	49,81	47,23
21	43,95	43,06	50,74	49,24
22	47,93	48,23	48,25	47,87
23	46,16	43,81	48,36	45,98
24	45,94	45,46	51,67	45,34
25	47,71	49,12	45,81	48,09
Average value	45,8	46,0	47,9	47,5
Standard deviation	1,565	1,814	1,831	1,284
Coefficient of variation	3,4%	3,9%	3,8%	2,7%
Minimum value	43,07	42,55	44,19	44,83
Maximum value	48,15	49,37	51,67	49,34
Characteristic value	43,1	42,8	44,7	45,3
Type of failure	Interlaminar (horizontal) shear			

### 3.10 Tensile fatigue

No performance assessed

### 3.11 Creep failure

No performance assessed

### 3.12 Coefficient of longitudinal thermal expansion

Coefficient of longitudinal thermal expansion has been determined by tests according to EAD 260023-00-0301, clause 2.2.9. Test results are documented in [14] and presented in Table 13.



**Table 13 – Coefficient of longitudinal thermal expansion**

Coefficient of longitudinal thermal expansion $\alpha_{sp,L}$ (°C <sup>-1</sup> )	Ø6	Ø12	Ø16
average value	5,4 E-06	5,3 E-06	4,8 E-06

**3.13 Coefficient of transverse thermal expansion**

Coefficient of transverse thermal expansion has been determined by tests according to EAD 260023-00-0301, clause 2.2.10. Test results are documented in [14] and presented in Table 14.

**Table 14 – Coefficient of transverse thermal expansion**

Coefficient of transverse thermal expansion $\alpha_{sp,T}$ (°C <sup>-1</sup> )	Ø6	Ø12	Ø16
average value	1,59 E-05	1,57 E-05	1,77 E-05

**3.14 Glass transition temperature**

Glass transition temperature has been determined by tests according to EAD 260023-00-0301, clause 2.2.11. Test results are documented in [14] and presented in Table 15.

**Table 15 – Glass transition temperature**

Glass transition temperature $T_g$ (°C)	Ø12			
Glass transition temperature, first cycle	$T_{g,I}^S$	89,6	$T_{g,I}^C$	93,9
Glass transition temperature, second cycle	$T_{g,II}^S$	106,3	$T_{g,II}^C$	109,7
Cure ratio $T_{g,I}^S - T_{g,I}^C$	4,3			

**3.15 Long-term relaxation**

Performance not assessed.

**3.16 Maximum service temperature**

Maximum service temperature has been determined experimentally by tests according to EAD 260023-00-0301, clause 2.2.13. Resulting value was evaluated as characteristic value from first/second derivation. Test results are documented in [15] and presented in Tables 16 to 18.

Table 16 – Maximum service temperature – diameter 6 mm

Diameter (mm)	No. of the test specimen	Effective cross- sectional area $A_{eff}$ (mm <sup>2</sup> )	Load $P$ (N)	Extreme of the 1 <sup>st</sup> derivative $T_c$ (°C)	Extreme of the 2 <sup>nd</sup> derivative $T_{1a}$ (°C)	Maximum service temperature $T_{max}$ (°C)
6	1	29,9	168	90,5	68,6	66,8
	2			90,7	73,2	72,2
	3			84,6	66,8	65,2
	4			86,9	71,8	70,2
	5			89,6	75,0	72,2
Average				88,46	71,09	69,31
Minimum				84,60	66,84	65,17
Standard deviation				2,65	3,34	3,21
Coefficient of variation				3,0%	4,7%	4,6%

Table 17 – Maximum service temperature – diameter 12 mm

Diameter (mm)	No. of the test specimen	Effective cross- sectional area $A_{eff}$ (mm <sup>2</sup> )	Load $P$ (N)	Extreme of the 1 <sup>st</sup> derivative $T_c$ (°C)	Extreme of the 2 <sup>nd</sup> derivative $T_{1a}$ (°C)	Maximum service temperature $T_{max}$ (°C)
12	1	115,6	802	103,7	71,7	68,4
	2			107,6	72,6	70,8
	3			107,3	72,2	70,2
	4			107,8	72,0	68,5
	5			102,1	70,9	67,8
Average				105,71	71,88	69,14
Minimum				102,13	70,92	67,83
Standard deviation				2,62	0,64	1,26
Coefficient of variation				2,5%	0,9%	1,8%

Table 18 – Maximum service temperature – diameter 16 mm

Diameter (mm)	No. of the test specimen	Effective cross- sectional area $A_{eff}$ (mm <sup>2</sup> )	Load $P$ (N)	Extreme of the 1 <sup>st</sup> derivative $T_c$ (°C)	Extreme of the 2 <sup>nd</sup> derivative $T_{1a}$ (°C)	Maximum service temperature $T_{max}$ (°C)
16	1	208,8	1410	105,8	72,1	68,6
	2			105,8	72,1	68,6
	3			106,0	72,0	69,1
	4			105,0	72,6	70,0
	5			107,0	71,9	69,5
Average				105,91	72,15	69,17
Minimum				104,98	71,94	68,58
Standard deviation				0,74	0,24	0,63
Coefficient of variation				0,7%	0,3%	0,9%



### 3.17 Bond strength in concrete at maximum service temperature

Bond strength in concrete at maximum service temperature has been determined by test according to EAD 260023-00-0301 (method ISO 10 406-1, Clause 7). Maximum service temperature value was determined at 80°C. Test results are documented in [11] and presented in Table 19.

**Table 19 – Bond strength in concrete at maximum service temperature**

Bond strength in concrete by pull-out testing $r$ (MPa)	C20/25;80°C		
	Ø6	Ø12	Ø16
1	16,4	11,1	7,7
2	17,5	11,9	8,9
3	17,8	10,9	8,9
4	16,3	12,3	8,8
5	18,1	10,9	8,0
average value	17,2	11,4	8,5
standard deviation	0,823	0,642	0,568
variation coefficient	4,8%	5,6%	6,7%
minimal value	16,3	10,9	7,7
maximal value	18,1	12,3	8,9
characteristic value	15,3	9,9	7,1
type of failure	pull-out		
average substrate compressive strength in MPa	29,2	29,0	28,9

### 3.18 Strength of FRP bent bars

No performance assessed

### 3.19 Reaction to fire

No performance assessed

### 3.20 Alkali resistance

Alkali resistance has been determined by tests according to EAD 260023-00-0301, clause 2.2.16. Solution consisted from demineralized water mixed with 8,0 g of KOH and 22,4 g of NaOH. Resulting pH was > 13. Only rate of percentage of mass loss and tensile retention rate was determined. Test results are documented in [16] and [17] and presented in Tables 20 and 21.

Table 20 – Alkali resistance – rate of percentage mass loss

Rate of percentage mass loss (%)	Ø6	Ø10	Ø12
1	2,24%	0,80%	0,38%
2	2,29%	0,80%	0,36%
3	2,26%	0,79%	0,36%
4	2,24%	0,80%	0,36%
5	2,24%	0,79%	0,36%
average	2,25%	0,80%	0,36%
standard deviation	0,000219	0,000055	0,000089
coefficient of variation	0,97%	0,69%	2,46%
result of visual inspection	chalking of surface (loss of colour)		

Table 21 – Alkali resistance – tensile retention rate

Tensile retention rate $R_{et,t}$ (%)	Ø6	Ø12	Ø16
1	88,0%	69,2%	69,7%
2	84,7%	52,5%	66,4%
3	89,6%	57,8%	75,2%
4	86,7%	64,6%	69,0%
5	89,2%	69,5%	67,1%
average	88%	63%	69%
standard deviation	0,0199	0,0741	0,0347
coefficient of variation	2,3%	11,8%	5,0%
minimum	84,7%	52,5%	66,4%
maximum	89,6%	69,5%	75,2%

The tensile retention capacity  $R_{et,t}$  (%)  
for specimens of 3000h at temperature of 60°C ±3°C:

No performance assessed

The interlaminar  $R_{et,l}$  (%) capacity retention  
after submersion in alkaline solution:

No performance assessed



#### 4. References

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- [5] EN 1992-1-1:2023 Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings, bridges and civil engineering structures
- [6] ISO 10406-1:2015 Fiber-reinforced polymer (FRP) reinforcement of concrete – Test method. Part 1: FRP bars and grids
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- [17] Test report no. 20-24-1081 (Alkali resistance). Issued by Building, Testing and Research Institute, Testing laboratory, Laboratory branch Bratislava, 27.08.2024
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