Non-metallic fiber-reinforced polymer plastic rebar for construction works.

Durable non-metallic rebar made of plastic and polymers is the new armed element of construction works implementation.

Non-metallic fiber-reinforced plastic rebar is produced as bar-one with spiral relief of any building length and is made of glass or basalt fiber, impregnated with chemical-resistant polymer. Fiber-reinforced plastic rebar made of glass fiber is called glass-plastic AGP and that is made of basalt is called basalt-plastic ABP.

Fiber-reinforced polymer plastic rebar had come through corrosion and physical-mechanical tests in NIIZB (Moscow). According to the results of long researches, the life length of constructions that are built with the usage of fiber-reinforced plastic rebar is not less than 100 years.

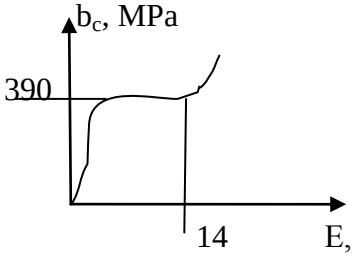
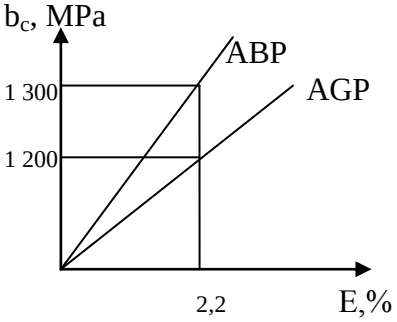
Such a long operating life is provided by high chemical resistance of fiber-reinforced plastic rebar to all the known hostile environments – gas environment of high concentration, chlorides, anti-frees reagents, sea water and so on.

Building features of metal and fiber-reinforced rebar.

There are comparison characteristics of metal and fiber-reinforced rebar in table 1.

Table 1.

Features	**Metallic rebar A3 (A400C) GS 5781-82**	**Non-metallic fiber-reinforced plactic rebar**
Tensile strength, MPa	b_c = 390; b_{rated}= 360	TS 5769-183-40886723-2004 **AGP:** b_c= 1 000; B_{rated}= 900; **ABP:** b_c= 1 100; b_{rated}= 1 000
		TS 5769-248-35354501-2007 **AGP:** b_c= 1 200; B_{rated}= 1 100; **ABP:** b_c= 1 300; b_{rated}= 1 200
Modulus of elasticity	E_r= 200 000	TS5769-183-40886723-2004 **AGP:** E_r = 41 000;

		ABP: E_r = 47 000
		TS 5769-248-35354501-2007 **AGP:** E_r = 55 000; **ABP:** E_r = 71 000
Rebar character behavior under the load (dependence «b & E»)	 Area of malleability under the load	 Line-elastic dependence until devastation
Elongation, E, %	14	2,2
Density, γ, г/см^3	7,8	1,9
Noncorrodibility	Has corrosion with rust emission	Doesn't have corrosion
Heat conduction	Heat conductive	Not heat conductive
Electroconductivity	Electroconductive	Not electroconductive
Thermal endurance		Is tested in hot asphalt-concrete medium (~ 200^{0}C)and within concrete production steaming (~ 100^{0}C). Durability loss is not ascertained.
Freeze-thaw durability		Is tested in climatic chamber up to the temperature of -55^{0}C within 100 cycles. Durability loss is not ascertained.

Replacement of metallic rebar for fiber-reinforced plastic rebar

Estimation and construction of concrete production are made according to Building Code 52 – 01 – 2003 "Concrete and concrete-reinforced constructions. Basic Provisions.", and according to "Estimation recommendations to glass-plastic rebar constructions E-16-78 (NIIZB, 1978)".

When building construction with the usage of fiber-rebar is projecting, it is necessary to follow the equality of loads that are forced to arming elements. The order of replacement is in table 2.

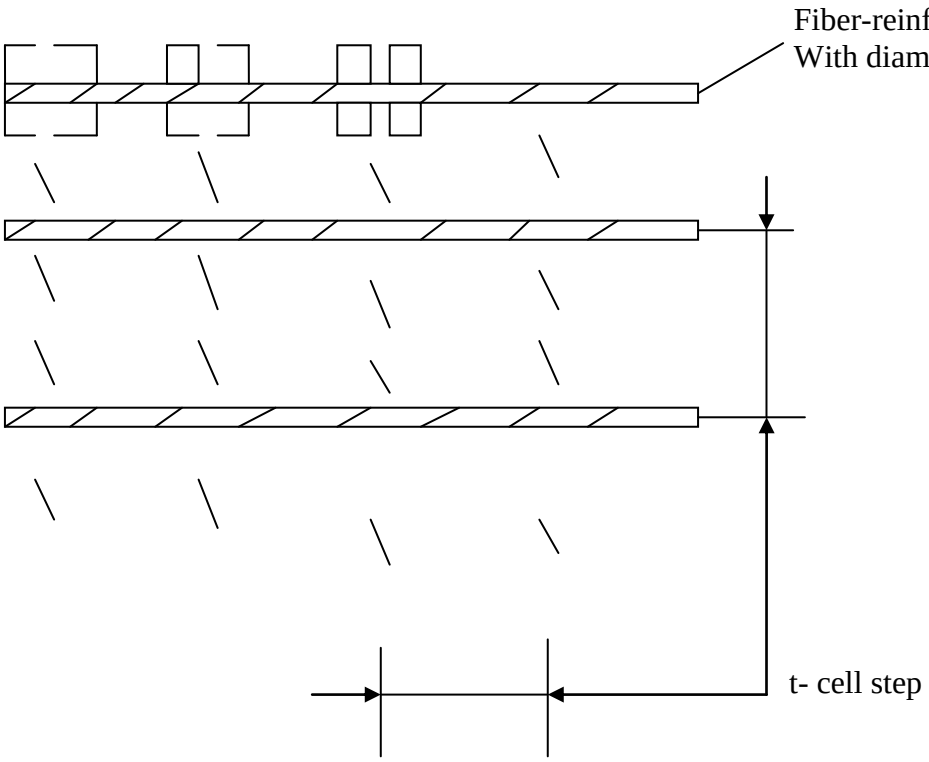
Table 2

Metallic rebar A3 (A400C) GS 5781-82	**Non-metallic fiber-reinforced polymer plastic rebar AGP TS 5769-248-35354501-2007**
6A3 F_{sect} = 28,3 mm^2 P_{rated} = 10 200 N	5AGP Fsect = 10,2 mm^2 Prated= 10 200N
8 A3 Fsect = 50,3 mm^2 Prated= 18 100N	6 AGP Fsect = 18,2 mm^2 Prated= 18 100N
10 A3 Fsect = 78,5 mm^2 Prated= 28 300 N	7AGP Fsect = 28,3mm^2 Prated= 28 300 N
12 A3 Fsect = 113,1 mm^2 Prated= 40 720 N	8 AGP Fsect = 40,7 mm^2 Prated= 40 720 N
14 A3 Fsect = 154 mm^2 Prated= 55 450 N	10 AGP Fsect = 55,5 mm^2 Prated= 55 450 N
16A3 Fsect = 201 mm^2 Prated= 72 360 N	11 AGP Fsect = 72,4 mm^2 Prated= 72 360 N
18 A3 Fsect = 254 mm^2 Prated= 91 450 N	12 AGP Fsect = 91,5 mm^2 Prated= 91 450 N
20 A3 Fsect = 314 mm^2 Prated= 113 040 N	13 AGP Fsect = 113 mm^2 Prated= 113 040 N
22 A3 Fsect = 380 mm^2 Prated= 136 800 N	14 AGP Fsect = 137 mm^2 Prated= 136 800 N

Fsect - cross-section of rebar, mm2
Frated – rebar tensile load within rated tensile strength, N
Non-metallic rebar is chipper than metallic one for 10-20%.

Fiber-reinforced polymer plastic rebars grids.

Grids of different load characteristics are made of bars of fiber-reinforced plastic rebar with diameter from 5 to 12 mm (picture 1).
Fastening of grid bars is produced by polymer chair and also with the help of annealed metal tie wire as tie of metallic rebar grids.



pictire 1.

The grids that are made of glass-plastic fiber-reinforced polymer rebar with diameter of 5-12 mm, rated for the load of 50 up to 500 kN/m (5-500 t/m) are in table 3.

Table 3

Grid tensile strength, kN/m	Grid cell size, mm					
	5 AGP	6 AGP	7 AGP	8 AGP	10 AGP	12 AGP
50	200*200					
100		200*200				
200			150*150	200*200	300*300	
300				150*150	200*200	300*300
400					150*150	200*200
500						150*150