



**SIMPROLIT
POLYSTYRENE
CONCRETE**

Simplolit

Simplolit polystyrene concrete – is a patented mixture made of expanded polystyrene granules, Portland cement, water and special admixtures, with best thermo-physical properties in the class of light-weight concretes:

- excellent ecological (sanitary-epidemiological) properties, which are a whole class higher than values required by the GOST R 51263-99 standard;
- buildings made of Simplolit elements offer to their residents exceptional durability and comfortable living conditions;
- Simplolit structures and elements do not pollute the environment, neither during production nor during the long-lasting exploitation period;
- Simplolit structures and elements can be defined as «dry» (no more than 4% humidity). When exposed to flood or other natural disasters, Simplolit elements dry very quickly, without any loss of strength or other thermo-physical properties;
- possible application in all climate regions of the world, from arctic to tropical zone;
- Simplolit has the most favorable coefficient of relation between strength and thermo-insulation ability, among other similar materials;
- Simplolit has the highest coefficient of relation between humidity resistance and thermo-insulation properties, among other similar materials;
- Simplolit also has the highest coefficient of relation between durability and thermo-insulation properties, among other similar materials;
- Simplolit polystyrene concrete is a unique non-flammable material in the whole class of polystyrene concretes; panels made of this material and styrofoam as the middle layer have passed all tests at the Russian Ministry of Defence Research Center «Opitnoe» - according to the testing results the following conclusion has been derived: "During 90 minutes of fire-resistance testing no integrity loss or thermo-insulation ability loss have occurred".



Simprolit polystyrene concrete and Simprolit elements are applied for residential, business, industrial, sports, rural and other special structures, such as:

- Monolith and prefabricated structures, thermo-insulating and soundproofing covering layers;
- Self-supporting walls in all types of buildings;
- Outer soundproofing and thermo-insulation cladding of facade structures and other structural elements;
- Inner self-supporting partition walls;
- Permanent thermo-insulation formwork for monolith structures;
- Thermo-insulating, soundproofing and leveling layers for slabs and roof structures.

Simprolit monolith and its products are certified for application all over the Russian Federation territory and may be applied for all types of structures, considering that they fulfill the requirements of the following norms:

- СНиП II-3-79* «Thermo-technics in Civil engineering»
- СНиП II-12-77 «Noise protection»
- СНиП II-26-76 «Roofs»
- СНиП 3.04.01-87 «Isolating and finishing layers»
- СНиП 23-01 «Civil engineering climatology»
- СНиП standards for specific types of buildings and special structures
- СанПин 2.1.2.729-99 «Polymeric and polymer-composite building materials, products and structures. Ecological (hygienical) safety requirements»
- suitable fire-safety norms (НПБ)
- recommendations of НИИСФ РААСН about Simprolit monolith and Simprolit elements' application in the coldest climate regions of the Russian Federation.

According to the conclusions and the certificate issued by the Fire-safety Testing Center (ИЦ ПБ) «Požpolitest», ANO, and the «Elektrosert» certification **"Simprolit falls into the category of non-flammable materials** (group NG).

Using special water-repellent admixture as a component material made it possible to apply Simprolit in any type of building - either with dry, normal or humid regime of exploitation.

Simprolit monolith and Simprolit elements are produced and brought to the market according to the license agreement signed with the «SIMPRO HOLDINGS LTD».



Application of Simprolit

The above mentioned characteristics of Simprolit enable this type of polystyrene concrete to be applied not only as a thermo-insulation material but also as a permanent thermal formwork for different structural elements.

Small weight of Simprolit polystyrene concrete, its good workability and presence of a cementitious «structural truss» (which serves not only as anticorrosion protection for steel rebars, but also takes part in the redistribution of structural influences within the structural element), makes it possible to apply Simprolit for design of various elements or parts of bearing structures, such as:

1. Roof thermo-insulation, both in monolith and in prefabricated variant.
2. Outer and inner sound- and thermo-insulation of walls, slabs and roof plates.
3. Building construction for various functions and various heights.
4. Adaptation and additional building.
5. Construction of houses and weekend cottages.
6. Production of elements varying their type and purpose:
 - blocks of different types and dimensions for inner and outer walls
 - facade thermo-insulation plates
 - partitions, waterproofing and floor plates
 - prefabricated and semi-prefabricated slabs and roof plates, etc.
7. Thermo-insulation of special buildings and structures:
 - covering plates for underground water reservoirs filled with drinking water or atmospheric water, for reversible water-supply systems, for shelters, breeding places, etc. In any case, Simprolit polystyrene concrete may be reinforced, consequently taking on some of the structural functions
 - collecting pools – accumulations as a part of complex heating plants, steam power plants, hydroelectric power stations and other power resources
 - pipe lines, fittings or other structures with complex form
8. Application in the state of emergency (earthquakes, floods, etc.) with the possibility to quickly start the production of elements at the site, which could drastically reduce the reparation work deadlines and consequently the building costs; also, the erected objects are not just a temporary solution, but permanent buildings suitable for settlement of endangered population.



I GENERAL PROPERTIES OF SIMPROLIT POLYSTYRENE CONCRETE

- * The requirements which Simprolit polystyrene concrete must fulfill are designed according to:
ГОСТ Р 5263-99,
ГОСТ 25192,
ГОСТ 25820 и
СТ СЭВ 1406,
And also in accordance to
Technical conditions ТУ 5741-003-52775561-2003
«Polystyrene concrete Simprolit and its products»
- * The strength of Simprolit polystyrene concrete is defined as the compressive strength at the designed age:
B0,5; B0,75;
B1; B1,5;
B2; B2,5.
- * The strength of Simprolit polystyrene concrete used for elements which are not subjected to requirements of СТ СЭВ 1406, is defined as the compressive strength:
M2; M2,5;
M3,5; M5.
- * The relation between concrete classes and grades of Simprolit polystyrene concrete according to the Russian standards, with normative variation coefficient equal to 18%, is given in the Table I-1.

The relation between concrete classes and grades of Simprolit polystyrene concrete (defined by compressive strength of concrete)

Table I-1.

Concrete class (by strength)	Average concrete strength R, (MPa)	Approximate grade of Simprolit polystyrene concrete (by strength)
B0,5	0,73	M7,5
B0,75	1,09	M10
B1,0	1,45	M15
B1,5	2,16	M20
B2,0	2,90	M25
B2,5	3,60	M35

- * Using average density of the dry material as indicator, the following classes of Simprolit polystyrene concrete could be defined:
 - D150,
 - D200, D250, D300, D350, D400, D450,
 - D500, D550, D600.
 - D900, D1000 – special soundproofing sand-based Simprolit polystyrene concrete

CLASSES AND GRADES OF SIMPROLIT POLYSTYRENE CONCRETE

* For Simprolit polystyrene concrete, which is applied for elements and structures subjected to cyclic freeze-thaw treatment during exploitation, the following frost resistance classes are defined: F25, F35, F50, F75, F100.

The choice of necessary frost resistance class of Simprolit polystyrene concrete is made according to design requirements, class of building, exploitation regime and calculated outside air temperatures for the given climate region.

* The classes and grades of Simprolit polystyrene concrete used for specific types of elements and structures are defined according to the standards or technical requirements for such elements or structures, taking into account the design normatives and values presented in the Table I-2.

Table I-2.

Concrete grade (by strength)	Simprolit polystyrene concrete class (by compressive strength)	Density class of Simprolit polystyrene concrete	Frost resistance class of Simprolit polystyrene concrete
M2	-	D150,	F25 – F35
M2,5	-	D200	F35 – F50
M3,5	-	D250	F35 – F75
M5	-	D200	F35 – F50
	B0,5	D250	F35 – F50
	B0,75	D300	F35 – F75
	B1,0	D350	F35 – F75
	B1,5	D400	F35 – F75
	B2,0	D500	F50 – F100
	B2,5	D550, D600	F50 – F100

NORMATIVE AND CALCULATED STRENGTHS OF SIMPROLIT POLYSTYRENE CONCRETE

* Normative and calculated strengths of Simprolit polystyrene concrete, which are necessary for calculation and design of structures, could be applied using values presented in the Tables I-3.

Table I-3.1.

Type of load	Normative strength of Simprolit polystyrene concrete and calculated strength of Simprolit polystyrene concrete (in MPa), for the second group of limit states – classified by concrete classes						
	M5	B0,5	B0,75	B1,0	B1,5	B2,0	B2,5
Axial compression (strength of prism) R_{bn} and $R_{b,ser}$	0,35	0,5	0,75	1,0	1,5	1,8	2,1
Axial tension R_{btn} and $R_{bt,ser}$	0,12	0,15	0,21	0,26	0,3	0,32	0,35
Tension at flexure R_{btfn} and $R_{btf,ser}$	0,23	0,27	0,38	0,47	0,55	0,58	0,64

Table I-3.2.

Type of load	Calculated strength of Simprolit polystyrene concrete (in MPa), for the first group of limit states – classified by concrete classes						
	M5	B0,5	B0,75	B1,0	B1,5	B2,0	B2,5
Axial compression (strength of prism) R_b	0,25	0,35	0,55	0,75	1,05	1,4	1,75
Axial tension R_{bt}	0,07	0,09	0,12	0,15	0,18	0,20	0,23
Tension at flexure R_{btfn} and $R_{btfn,ser}$	0,14	0,16	0,22	0,28	0,32	0,35	0,40

INITIAL ELASTICITY MODULUS OF SIMPROLIT POLYSTYRENE CONCRETE

Table I-3.3.

Simprolit polystyrene concrete class based on average density	Initial elasticity modulus of Simprolit polystyrene concrete at pressure and tension $E_0 \times 10^{-3}$ MPa						
	M5	B0,5	B0,75	B1,0	B1,5	B2,0	B2,5
D250	0,35	0,45	-	-	-	-	-
D300	0,40	0,50	0,60	-	-	-	-
D350	0,50	0,60	0,70	1,1	-	-	-
D400	-	0,70	0,80	1,2	1,3	-	-
D450	-	-	-	1,3	1,4	1,6	-
D500	-	-	-	-	1,45	1,7	1,9
D600	-	-	-	-	1,6	1,8	2,1

* Factual average density of Simprolit polystyrene concrete should not be larger then the value required by the ГOCT 27005 standard.

STRENGTH OF SIMPROLIT POLYSTYRENE CONCRETE SUBJECTED TO FLEXURAL TENSION

* The flexural-tensile strength, depending on the class (grade) of Simprolit polystyrene concrete, should not be smaller than the values presented in the Table I-4.

Table I-4.

Simprolit polystyrene concrete class or grade (defined by compressive strength)	Limit strength values of Simprolit polystyrene concrete subjected to flexural tension (MPa)
M2	0,08
M2,5	0,10
M3,5	0,15
B0,35	0,25
B0,5	0,35
B0,75	0,50
B1,0	0,60
B1,5	0,65
B2,0	0,70
B2,5	0,73

- Depending on its function and exploitation conditions, Simprolit polystyrene concrete in structural elements and structures can possess compact, porous or large-porous (cavernous) structure, according to ГOCT 25192 standard.
- Simprolit polystyrene concrete with compact or porous structure and with cement quantity larger than 200 kg/m³, guarantees steel reinforcement protection against corrosion in standard exploitation conditions.

THERMO-TECHNICAL PROPERTIES OF SIMPROLIT POLYSTYRENE CONCRETE

Thermo-technical properties of Simprolit polystyrene concrete, necessary for calculation of structural elements, could be taken from the Table I-5.

Table I-5.

Simprolit class based on average density	Heat inertia, KJ/(kg °C)	Heat conductivity coefficient λ in dry condition, W/(m °C)	Calculated mass relation of humidity inside the material, (in %), for exploitation conditions		Calculated coefficients for exploitation conditions		
			A	B	Heat conductivity, W/(m °C)		Steam permeability mg/(g·h·Pa) (A, B)
					A	B	
150	1,06	0,055	4	8	0,057	0,060	0,135
200	1,06	0,065	4	8	0,070	0,075	0,120
250	1,06	0,075	4	8	0,085	0,090	0,110
300	1,06	0,085	4	8	0,095	0,105	0,100
350	1,06	0,095	4	8	0,110	0,120	0,090
400	1,06	0,105	4	8	0,120	0,130	0,085
450	1,06	0,115	4	8	0,130	0,140	0,080
500	1,06	0,125	4	8	0,140	0,155	0,075
550	1,06	0,135	4	8	0,155	0,175	0,070
600	1,06	0,145	4	8	0,175	0,200	0,068

* Settlement of Simprolit polystyrene concrete, applied for monolith outer walls construction, should not exceed 1,0 mm/m.

* Heat conductivity coefficient of Simprolit polystyrene concrete in dry condition, at 25 °C temperature, should not exceed the limits presented in the Table I-6 for more then 10 % .

Table I-6.

Simprolit class based on average density	Heat conductivity coefficient in dry condition λ (W/m °C)
D150	0,055
D200	0,065
D250	0,075
D300	0,085
D350	0,095
D400	0,10
D450	0,115
D500	0,125
D550	0,135
D600	0,145

II SIMPROLIT POLYSTYRENE CONCRETE PRODUCTS

II-1. Blocks

Simplolit blocks are classified, depending on the application field, structural filling and density of the material, into following categories:

- Simplolit structural blocks, with cavities (Table II-1.1.)
- Simplolit partition blocks (Table II-1.2.)
- Simplolit massive blocks, without cavities.

TYPES OF SIMPROLIT BLOCKS

Table II-1.1.

Type	Mark	Dimensions (mm)			Class according to density
		Length	Height	Thickness	
with four cavities	SB25 SB30	500 600	190	250 300	D200
with two cavities	SBD25 SBD30	500 600		250 300	
with styrofoam or Simplolit joints	SBS20	600		250 300	
	SBS25	500			
	SBS30	600			
with styrofoam or Simplolit joints, with two cavities	SBDS20	600		250 300	
	SBDS25	500			
	SBDS30	600			
with four cavities	SB30v	600	225	300	D300
with two cavities	SBD30v				
with five cavities	SBS30v				
with three cavities	SBDS30v				

Table II-1.2.

Type	Mark	Dimensions (mm)			Class according to density		
		Length	Height	Thickness			
with two cavities	SPB50	500	190	120	D200		
with two cavities	SPB60	600					
with three cavities	SPB90	900					
with joints	SPBS50	500					
with joints	SPBS60	600					
with joints	SPBS90	900					
with two cavities	SPB60v	600	225	120	D300		
with three cavities	SPBS60v	600					
with five cavities	SPBS90-15	900				190	150
with round cavities	SPB8r	600				190	80
with square cavities	SPB8k						
with two cavities, soundproofing	SPB60zi	600	190	120	D1000		

Simplolit massive blocks, without cavities: SBK350-D350; SBK400-D400; SBK450-D450
Dimensions of these blocks are defined upon Customer's request.

II-2. Plates (panels)

Depending on the structural filling, application field, thickness and density of Simprolit polystyrene concrete, two types of Simprolit plates (panels) are produced:

- Single-layered (Table II-2.1.)
- Three-layered, with 10mm thick outer layers made of Simprolit polystyrene concrete and thermo-insulation middle layer made of class 15 Styrofoam (Table II-2.2. and Table II-2-3.).

Table II-2.1.

Application	Mark	Thickness (mm)	Class according to density
Simprolit plates for facade covering	SOP3	30	D350
	SOP5	50	
	SOP8	80	
	SOP10	100	
	SOP12	120	
	SOP15	150	
Simprolit partition plates	SPPO 8	80	D350
	SPPO 10	100	
	SPPO 12	120	
Simprolit floor plates	SNPD 400 SNPD 450	upon request	D400 D450

Table II-2.2.

Application	Mark	Thickness (mm)	Class according to density
Simprolit plates for facade covering, without rebates	SUP 3_R	30	D300
	SUP 5_R	50	
	SUP 8_R	80	
	SUP 10_R	100	
	SUP 12_R	120	
	SUP 15_R	150	
Simprolit plates, with rebates on all sides*	SUP 5	50	D300
	SUP 8	80	
	SUP 10	100	
	SUP 12	120	
	SUP 15	150	
Simprolit partition panels, with two rebates	SPP8	80	D400
	SPP10	100	
	SPP12	120	
Simprolit partition panels, with three rebates	SPS8	80	D400
	SPSO8	80	
	SPS10	100	D500
	SPSO10	100	
	SPS12	120	
	SPSO12	120	
Simprolit hydro-thermo-isolation plates, For walls and floors	SIP3	30	D400
	SIP4	40	
	SIP5	50	
	SIP6	60	

Table II-2.3.

PLATE TYPE	Rebate thickness	Rebate width	Styrofoam thickness	Total thickness of outer layers	Simplolit layer thickness	Total thickness of the plate
1	2	3	4	5	6	7
SUP 5	25	25	30	20	10	50
SUP 8	40	25	60	20	10	80
SUP 10	50	25	80	20	10	100
SUP 12	60	25	100	20	10	120
SUP 15	75	25	130	20	10	150

II-3. Nominal linear dimensions of the products

Nominal linear dimensions (in mm) of Simplolit products are given in the Table 1.7.

Table 1.7.

Block		Plate	
Parameter	Value	Parameter	Value
Length	500 - 1200	Length	300 – 2000
Width	120 - 500	Width	300 - 1000
Height	190 - 600	Height	30 - 150

* The production of Simplolit products with other dimensions is also possible, but only in agreement with Simplolit patent rights owner.

* Dimensions of such products and their deviation limits should be presented in the form of drawing or in the production order.

TYPES OF SIMPROLIT PANELS

II-4. Nominal linear dimension of products

Product title	Norm marks		
	SB25, SB30, SBD25, SBD30, SBS25, SBS30 SBDS25, SBDS30 SPB50, SPB60, SPB90 SPBS60, SPBS90, SPBS90_15	SB30v, SBD30v, SBS30v, SBDS30v SPB60v, SPBS60v, SPB8r, SPB8κ SBK350, SUP 5,8,10,12,15 SUP 3p,5p,8p,10p,12p,15p SPP0 8,10, 12 SOP 3,5,8,10,12,15 SPP 8,10,12	SPS 8,10,12 SPSO 8,10,12 SIP 3,4,5,6 SNP400 SBK400 SNP450 SBK450
Class according to density	D 200	D 300 D 350	D 400 D 450
Class according to compressive strength*, not less then	M5	B 0,75	B1,0
Flexural-tensile strength limit (in MPa), not less then	0,25	0,50	0,60
Heat conductivity coefficient, at 25 °C, (in W/m°C), not higher then**	0,075	0,085; 0,095 (adequate with the class according to density)	0,105; 0,115 (adequate with the class according to density)
Frost resistance class	F50	F50	F50

Remarks:

- * Concrete class B 0,75 – average compressive strength, MPa –1,09
- * Concrete class B 1,0 – average compressive strength, MPa –1,45
- ** Taking into account the deviations according to ГОСТ P 51263 standard.

* Average releasing compressive strength of concrete is determined at the age of 3 days and should amount to at least 60% of the average concrete strength at the age of 28 days, with normal hardening conditions.