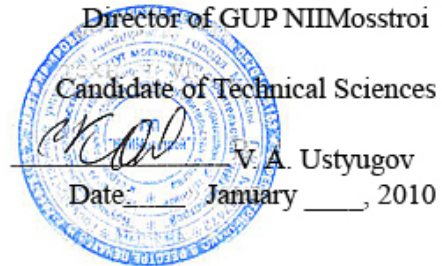


**State Unitary Enterprise of Moscow
Moscow Construction Scientific Research Institute
GUP NIIMosstroj**

Accreditation certificate No. ROSS RU.0001.21SL27

Registration certificate No. 176

APPROVED BY



TECHNICAL FINDINGS No. 35
regarding test results

on the subject: Conducting Tests of the Physicomechanical and Operating Parameters of GRAN-TEX Facade Material According to the Attached List, Refinement of Testing Methods, and Issuing Findings Regarding the Test Results.

contract No. 1042/44/00/09-12, dated November 11, 2009

Construction Materials Durability and Sealing Laboratory

Laboratory director, Candidate of Technical Sciences

N.D. Serebrennikova

Telephone (499) 739-30-34, fax (499) 739-31-23

Moscow 2010

Registration No.34/44/10

REGISTERED / GUP NIIMosstroj / Planning Dept. / -Signature Ivanova/

34/44/10
**ГИП «НИИМОСТРОЙ»
ЗАРЕГИСТРИРОВАНО**
ПЛАНОВО-ЭКОНОМИЧЕСКИЙ ОТДЕЛ
Иванова

Specimens of GRAN-TEX facade finishing material were tested in the Construction Materials Durability and Sealing Laboratory of GUP NIIMosstroj under contract No. 1042/44/00/09-12 with OAO TsNIIEPzhilishcha, dated November 11, 2009.

PURPOSE OF THE WORK

The purpose of the work was to determine physicotchnical parameters of the GRAN-TEX material and study its resistance to corrosive factors according to the agreed testing program. It was planned to determine the following properties:

- strength of the facade material;
- water absorption;
- water permeability;
- bond strength with concrete;
- water vapor permeability;
- frost resistance;
- resistance to chemical media (acid, alkali, salt solution);
- resistance to UV radiation (color fastness).

TEST SPECIMENS

The GRAN-TEX material is a geotextile on which granite chips are glued with an acrylic adhesive. The Client provided three types of specimens, which differed in the particle size of the granite chips and their color: yellow, blue, or natural. The specimens were tested in the form of strips and fragments. The fragment specimens were concrete substrates $100 \times 100 \times 30$ mm in size, to which GRAN-TEX had been glued with acrylic mastic.

TESTING METHODS

Strength parameters were determined according to State Standard GOST 2678-94, Roofing and Waterproofing Roll Materials. The tensile breaking load

for a strip of material 5 cm wide was taken as the strength parameter. The breaking strength of a strip of material was also determined as the amount of the breaking load relative to the cross-sectional area of the strip.

Water absorption by weight was determined on specimens of the material according to GOST 26589-94. Surface water absorption was determined on fragment specimens by a procedure that was developed in the laboratory. According to this procedure, water absorption is determined using a Karsten tube fastened to the surface of the facade material glued to concrete. Water absorption is evaluated as the amount of water that passed through a certain area of the surface.

Water permeability was determined according to GOST 2678-94 with pressure of 0.001 MPa for 72 hours on specimens of the facade material 100 × 100 mm in size. Water permeability of the concrete base has also been tested.

Separation strength of bond with concrete on submitted samples - fragments was determined according to GOST 26589-94 (method A), using detachable elements glued onto the surface of the facade material with epoxy adhesive (drawing 2). In addition, the strength of the adhesive mastic with concrete was determined on “cross” specimens according to the procedure in GOST 26589-94 (method B) (drawing 3).

Water vapor permeability was determined according to GOST 25898-83 on fragment specimens over the course of 1.5 months. The water vapor permeability of concrete without the facade material was determined in parallel.

Frost resistance of fragment specimens was determined according to GOST 10060.0-95 on fragment specimens over 50 cycles of freezing at minus 20°C and thawing in water at 20°C, with intermediate sampling after 35 cycles.

Resistance to UV radiation. Testing was done in an artificial weather chamber with a xenon lamp and a system for sprinkling water on the drum and specimens, which complies with the requirements of GOST 23750-79^x: UV radiation intensity in the wavelength range of 280–400 nm at least 70 W/m²,

black panel temperature $55\pm 5^{\circ}\text{C}$. Testing in the artificial weather chamber was done on specimens 220×100 mm in size, which were cut out from a roll of façade material. The impact of UV radiation was evaluated according to the change in color of the specimens, using a gray scale.

Resistance to the impact of corrosive chemical media was determined according to GOST 9.030-74. The corrosive media were 3% solutions of sulfuric acid, alkali, and salt. The tests were done on fragment specimens in contact with concrete, and strips of the facade material. Reliability was evaluated according to the strength of connectivity with the concrete, change in coloration of the façade material, and loss of granite chips.

TEST RESULTS

The result of determination of the initial physicochemical parameters of the GRAN-TEX material are given in Table 1.

The results of tests of the initial parameters (Table 1) show that GRAN-TEX finishing material not glued to a concrete base is water-permeable and has high water absorption.

However, testing of the water resistance factor in fragment specimens while façade material was glued onto concrete base showed high resistance to prolonged effects of water at a pressure level of 0.001 MPa, which complies with GOST 2678-94, while samples of clean concrete base without the façade material proved not water resistant in the same conditions.

We should point out the high bond strength of the adhesive mastic to the concrete in the tests of concrete plates glued together with mastic; the bond strength was greater than 1.0 MPa. The bond strength of the facade material to concrete is lower, since failure of the fragment specimen occurs at the boundary of the granite chips with the geotextile, or a mixed nature of the specimens' failure is observed.

Determining vapor permeability in specimens-fragments with façade material and concrete base proved to be at a normal level for concrete indicators.

The presence of a gluing layer somewhat lowers the water vapor permeability of fragment specimens with the facade material in comparison with the water vapor permeability of the concrete base, but not significantly.

Table 1. Physicotechnical properties of GRAN-TEX material

Parameter	Testing method	Actual value
Tensile breaking load of the material, kgf	GOST 2678-94	28
Breaking strength of the material, MPa	GOST 2678-94	1.22
Bond strength of adhesive mastic with concrete, MPa	GOST 26589-94 Method B	1.13
Bond strength of facade coating with concrete, MPa	GOST 26589-94 Method A	0.64
Water absorption in 24 h, %, by weight	GOST 26589-94	33.8
Water vapor permeability, mg/m·h·Pa - fragment specimen - concrete substrate	GOST 25898-83	0.017 0.025
Heat resistance of the material, °C, for 2 h	GOST 2678-94	At least 80
Flexibility on round rod with radius of 50 mm, degrees	GOST 2678-94	Greater than plus 10
Water permeability of the material under pressure of 0.001 MPa for 72 h	GOST 2678-94	Permeable after 1 min

The material is heat-resistant at temperatures up to 80°C; no shrinkage or creeping of the granite chips was noted. However, the material is not elastic, and at temperatures below 10°C it cracks when bent on a rod 100 mm in diameter.

Resistance to corrosive factors (chemical environment, freeze-thaw cycles, UV radiation) was evaluated according to the change in the specimens' external appearance and color, the change in bond strength with concrete, and loss of granite chips.

The results are given in Table 2.

Table 2. Physicotechnical parameters of GRAN-TEX material after the impact of corrosive factors

Parameter	Actual value	Nature of failure of specimens
Bond strength of facade material with concrete after 35 frost resistance cycles, MPa	0.53	Failure at boundary between granite chips and geotextile
Bond strength of facade material with concrete after 50 frost resistance cycles, MPa	0.52	The same
Bond strength of facade material with concrete, MPa, after 10 days of impact of:		
- 3 % solution of sodium hydroxide	0.30	The same
- 3 % solution of sulfuric acid	0.51	The same
- 3 % solution of sodium chloride	0.40	The same
Loss of granite chips, g, after 10 days in:		
- 3 % solution of sodium hydroxide	0.2	
- 3 % solution of sulfuric acid	0.4	
- 3 % solution of sodium chloride	0.2	

The test results given in Table 2 show that GRAN-TEX material glued to a concrete base is resistant to the cyclic impact of temperatures below and above freezing. After 50 freeze-thaw test cycles (frost resistance according to GOST 10060.0-95), the condition of fragment specimens was satisfactory: no peeling from the concrete or changes in external appearance were noted. The bond strength of GRAN-TEX material with concrete is somewhat reduced in comparison with its initial value, but this is because of a decrease in adhesion of the granite chips to the geotextile, as is indicated by the nature of the specimens' failure.

The impact of chemical media also did not cause peeling of the facade material from the concrete on fragment specimens. Practically no loss of granite chips from the surface of the specimens was noted in any of the tests.

Testing of the color consistency was performed on seven specimens of the facade material in an artificial weather chamber. The change in color was evaluated according to the gray scale threshold. The absence of a change in color is estimated at 5 thresholds. A decrease in the threshold indicates a change in color.

Results of testing (Table 3) show that 5 samples out of 7 which were tested are resistance to UV radiation from direct sunlight.

Results shown in Table 3 demonstrate that green and dark red colored specimens did not change in color under radiation; specimens in shades of mustard yellow, yellow and brown colors had very light discoloration, while blue and orange colored samples had the highest degree of change in color.

Table 3. Color consistency of GRAN-TEX façade material

Specimen color	Change in coloration after 100 hours of UV radiation in “XENOTEXT” chamber / gray scale threshold
Mustard yellow	4.5
Orange	4
Yellow	4/5
Blue	3
Brown	4/5
Green	5
Dark red	5

Thus, the results of testing have shown that the GRAN-TEX material presented by OAO TsNIIEPzhilishcha is resistant to the exploitation factors. It has a satisfactory bond with a concrete surface both in its original state and after the impact of freezing and thawing in water or under the impact of corrosive chemical media. Various color granite chips on specimens have been found satisfactory when subjected to the impact of UV radiation.

On the basis of the data obtained, the GRAN-TEX finishing material can be recommended for use in experimental construction for finishing of walls and ceilings of general-use spaces in residential and public buildings (lobbies, entryways, stairways, corridors, etc.). The material can be used for exterior finishing in producing factory-ready outside wall panels, provided that the color fastness issue is resolved and the concrete surface to be finished is carefully prepared, for which purpose it is necessary to develop instructions for use of the material.

Based on conducted testing, the longevity of GRAN-TEX materials should be minimum of 10 years subject to compliance with manufacturer’s instructions on use.

Director of the Construction Materials Durability
and Sealing Laboratory,
Candidate of Technical Sciences.

N.D. Serebrennikova

Regulatory compliance officer

E.L. Zheglova



ДЕПАРТАМЕНТ СІРРОИТЕЛЪСТВА
НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ
"НИИ 'ОССТРОЙ'"
1919г. Москва, улица Вихмичевая, дом 8