

Modern Russian high-tech construction materials and their application in domestic construction industry (on example of metal-ceramic panels «Hardwall»)

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Abstract. In modern construction field there is a constant need in new high-performance materials, that's why the manufacturing companies constantly release new high-tech materials on the market. An important factor is the cost of construction materials: if earlier construction firms mostly preferred foreign producers, taking into account the significant growth of the European and American currencies rate they increasingly use the domestic producers products today. In the choice of material construction companies have high requirement on the durability, reliability, ease of installation, products cost-effectiveness. Speaking about exposed panels they also have demands to a high resistance to aggressive climatic conditions. The features of such modern construction materials as metal-ceramic panels "Hardwall" by «Bautrade» are examined in this article; and especially we study their advantages over other analogues of this product on the market. The purpose of our study is to confirm the high technical characteristics of the metal-ceramic panels "Hardwall". During the testing according to GOST 18124-2012 methodic we got some results of tests in which we determine the ultimate bending strength at the universal electromechanical machine «Instorn 3382» made for measuring the tensile strength, bending, peeling. These results provide us with a loss strength percent of the metal-ceramic panels. In addition, we made the frost-resistance tests. After the tests, all samples showed a satisfactory value, specified in GOST 18124-2012. And also a comparison of the ultimate bending strength test results of the samples tested for frost-resistance and samples not tested for frost-resistance was made. Thus, the panels have all the necessary properties: they are resistant to aggressive environmental influences, to impact loads and chemical influences. Also, the panels can resist to high temperature differences. Nowadays metal-ceramic panels "Hardwall" are one of the most sought decoration materials, the safety and quality of which are confirmed by a number of laboratory tests.

Key words: construction materials, metal-ceramic panels, ultimate bending strength, frost-resistance, chemical influences, impact loads, facades of buildings.

1. Introduction

In the modern construction of buildings and structures, there is a constant need in new materials that improve the appearance of the building, as well as improve its durability. To date, the market is overfull of new offers. To choose the right material, construction companies have a large number of requirements that allow selecting durable, reliable, economical in operation and, most importantly,



safe facing slabs. But also simplicity of installation and high resistance to climatic conditions is important.

Not so long ago, decoration materials of a new generation - metal-ceramic panels "Hardwall" were developed. They have all the necessary properties: the panels are resistant to aggressive environmental influences; to shock loads and chemical influences. They can also withstand high temperature changes. They do not fear of the direct fire contact, the surface that has been subject to heating remains unchanged, there are no emissions of toxic gases. Panels "HARDWALL" have anti-vandal properties: any paint applied to the surface of panels can be removed with ordinary water.

2. Methods

After analyzing and studying the metal-ceramic panels, the authors decided to determine the flexural strength by the method of GOST 18124-2012. The tests were carried out on the Instorn 3382 testing machine. It is designed to determine the force of tensile, bending, peeling, compression using a special auxiliary program developed by the same company. With the help of this machine, new production technologies as well as materials of the new generation are tested.

For the test, eight panels were chosen. Three of them were tested for frost resistance in accordance with GOST 10060-2012 for three months, so that the results can be compared with the results of the samples without testing for frost resistance.

First of all, the tested material was kept under normal climatic conditions (air temperature in the laboratory $t = +20^{\circ}\text{C}$, relative humidity $\varphi = 65\%$, atmospheric pressure $p = 742\text{ mm Hg}$), this is done to stabilize the properties and to reduce of the material after the impact of previous climatic conditions, in time it took about two hours. After the samples are examined again for defects and each is assigned a serial number. After all preliminary procedures, tests begin. The samples are immersed in water for eight hours, after which they were removed and placed in a freezer MK-110, also for eight hours, so repeated one hundred and fifty cycles.

3. Results

The results of the tensile strength tests are given in Table 1 below.

Figure 1 shows a test circuit for samples in determining the flexural strength according to GOST 18124-2012.

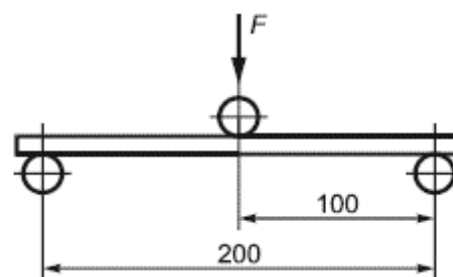


Figure 1. Scheme of testing samples

In the figures 2-9 the diagrams are given, they show the dependence of plate deflection on load for each sample.

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Figure 2. The diagram "Load-Deflection of plate" for sample No. 1

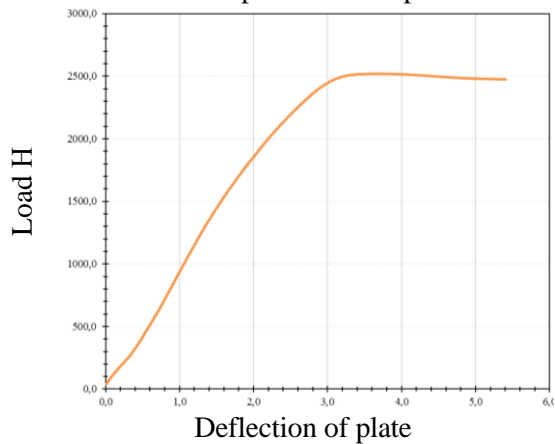


Figure 3. Diagram "Load-Deflection of plate" for sample No. 2

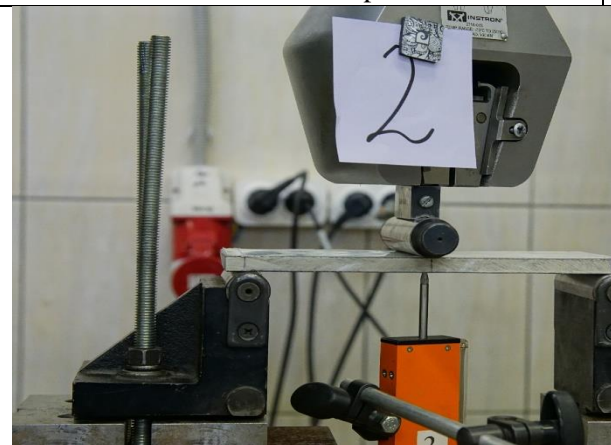
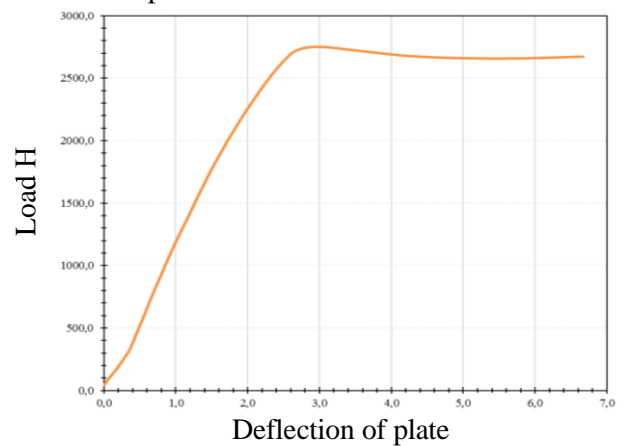


Figure 4. Diagram "Load-Deflection of plate" for sample No. 3

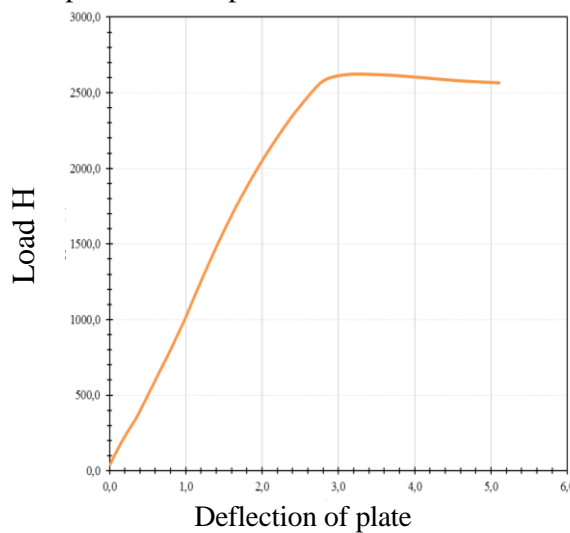


Figure 5. Diagram "Load-Deflection of plate" for sample No. 4

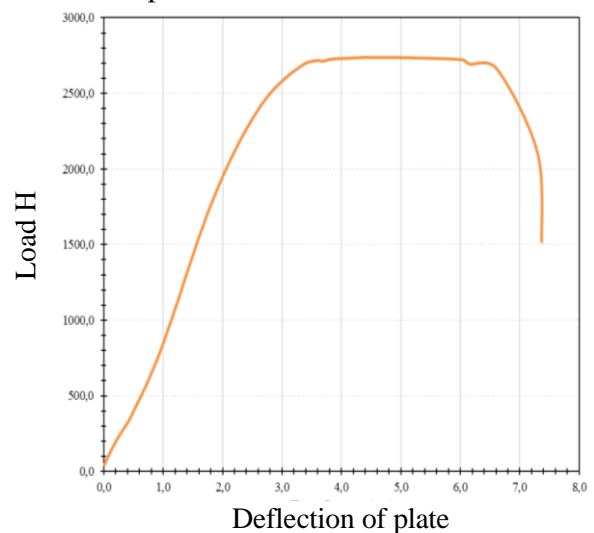
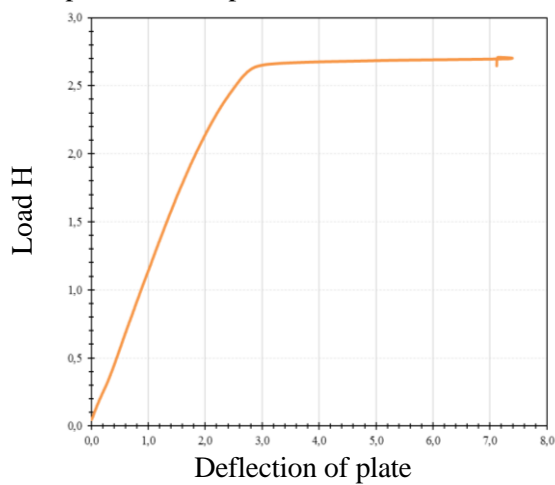
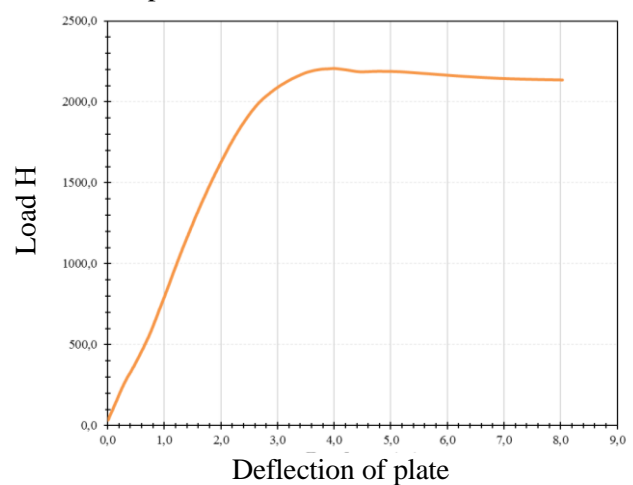
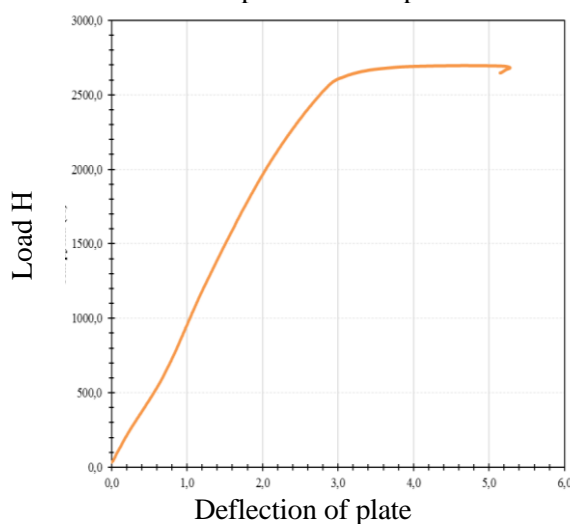
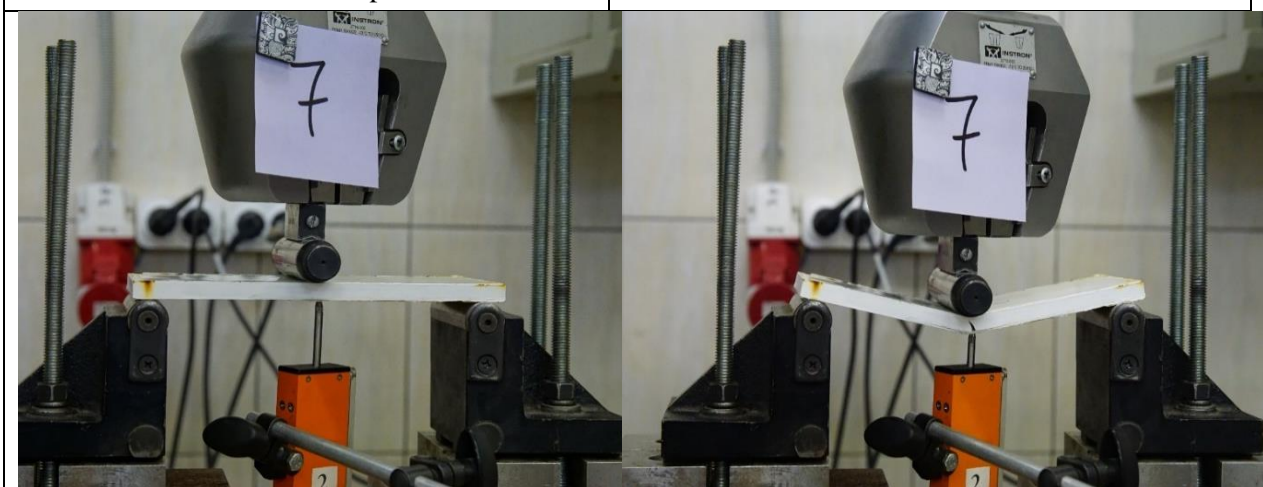
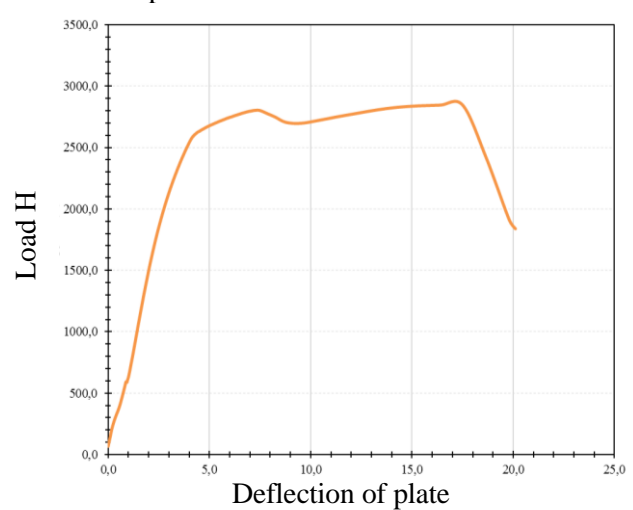


Figure 6. Diagram "Load-Deflection of plate" for sample No. 5**Figure 7.** Diagram "Load-Deflection of plate" for sample No. 6**Figure 8.** The diagram "Load-Deflection of plate" for sample No. 7**Figure 9.** Diagram "Load-Moving of traverse" for sample No. 8

Article I.

Table 1. Results of plates samples tests for the frost resistance definition

Sample number	Sample marking	b , mm	t , mm	l , mm	F , N	σ , MPa	Nature of destruction
1	6	96.7	10.3	200	2206.42	64.52	Fracture of the base plate on the crack
2	7	98.5	10.0	200	2696.93	82.14	Fracture of the base plate on the crack
3	8	98.1	10.1	200	2845.84	85.31	Fracture of the base plate on the crack
Average value:						77.33	
Mean square deviation:						11.20	
Coefficient of variation,%:						14.49	
F – destructive load, N; l – distance between axes of supports, mm; b – width of the sample measured near the fracture region, mm; t – thickness of the sample, measured along the fracture line, mm; σ – bending strength, MPa;							

After tests to determine frost resistance, it can be concluded that all three samples showed the result of the flexural strength of the satisfying value specified in GOST 18124-2012.

The results of the samples without a frost resistance test are given in Table 2.

Table 2. Test results of plates samples

Sample number	Sample marking	b , mm	t , mm	l , mm	F , N	σ , MPa	Nature of destruction
1	1	97.5	10.2	200	2519.31	74.51	Fracture of the base plate on the crack
2	2	97.4	10.0	200	2751.17	84.18	Fracture of the base plate on the crack
3	3	98.6	10.3	200	2623.15	75.23	Fracture of the base plate on the crack
4	4	97.1	9.9	200	2737.54	86.30	Separation of metal sheathing
5	5	97.3	10.3	200	2708.15	79.22	Fracture of the base plate on the crack
Average value:						79.89	
Mean square deviation:						5.26	
Coefficient of variation,%:						6.58	
F – destructive load, N; l – distance between axes of supports, mm; b – width of the sample measured near the fracture region, mm; t – thickness of the sample, measured along the fracture line, mm; σ – bending strength, MPa;							

The results showed a satisfying value, which is given in GOST 18124-2012.

After testing the samples subjected to the frost resistance tests in accordance with GOST 10060-2012, the average value of the tensile strength of 77.33 MPa and the samples without frost resistance testing showed an average strength value of 79.89 MPa.

In comparison, the data obtained established the loss of strength of the samples subjected to the frost resistance tests of 1.03%, which satisfies the requirements of GOST 10060-2012, also the metal-ceramic panel is really frost-resistant and can withstand a load of 788.5 kg / s².

4. Conclusion

The carried out researches allow to draw a conclusion that the metal-ceramic panels withstand a high load on bending without loss of strength after the tests for frost resistance.

In accordance to the results of the study, metal-ceramic panels can be used for facing external walls of buildings and structures for various purposes, provided that the characteristics of the panels correspond to the decisions of the developer.

The claimed lifetime of the metal-ceramic panels is confirmed by the conducted studies.

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