



## Analysis of Test Methods and Accreditation System of Testing Laboratories of Building Materials

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**Abstract:** This article is devoted to the analysis of test methods and the system of accreditation of testing laboratories of building materials, classification, basic properties, as well as the main indicators of quality and safety of building materials. The requirements of the accreditation system, personnel and regulatory documents associated with the organization of the activities of testing laboratories of building materials have been studied. The basics of test methods and measurements of building materials are highlighted. Based on the results of analysis and research, conclusions and recommendations are formulated.

**Keywords:** testing laboratory, building materials, basic properties of building materials, quality and safety indicators, accreditation, standardization, metrology, quality system, regulations, test methods, measurements.

### INTRODUCTION

Building materials are an integral part of the process of building construction, repair, reconstruction and modernization of various facilities. High demands are placed on their quality. The latter is confirmed by certificates and declarations. A manufacturer who wants to successfully sell products of this type, have high competitive performance, expand the sales market, is obliged to check building materials for certification and state registration. It is aimed at identifying environmental and fire safety, efficiency, compliance with the declared characteristics.

**The purpose of testing is** to ensure that a product is placed on the market and that it can be used and used safely. Accreditation of the testing laboratory allows these works to be carried out at the level of international standards, which ensures the recognition of the results obtained by all market participants.

Testing laboratories carry out control and testing of various types of products and materials for compliance with the requirements of regulatory documents (standards, technical regulations, etc.). Methods of research of building materials used in testing laboratories and the process of passing the accreditation of laboratories is the main element and stage for the effective provision of their activities at the present stage of development.

## USED MATERIALS AND METHODS

**Building materials** - materials used for the construction and erection of load-bearing and enclosing structures, to improve the operational, aesthetic and special properties of buildings and structures, as well as the reconstruction and repair of building structures, as well as their parts.



**Most building materials have common properties:**

- ✓ average density, - specific gravity, - specific volume, - bulk density,
- ✓ porosity, - humidity, - water absorption, - water permeability,
- ✓ thermal conductivity, - fire resistance, - frost resistance, - strength,
- ✓ hardness, - sound conductivity, - chemical resistance.

**2. Natural stone materials.** Natural stone materials and products are obtained from rocks during mechanical processing: crushing, splitting, grinding, polishing, etc.

**3. Ceramic materials and products.** Building ceramic materials and products are called artificial stones and clay products mixed with sand (or other impurities), which acquire strength when fired in special furnaces.

**4. Inorganic (mineral) and organic binders.** A binder is a substance that, under the influence of physico-chemical processes, is able to change from a liquid or pasty state to a stone-like state and, at the same time, bind individual stones, pieces and small particles of materials mixed with it.

**5. Concrete.** Concrete is called an artificial stone material obtained by hardening a rationally selected mixture of a binder, water and aggregates - fine sand and coarse gravel or crushed stone. Concrete is classified depending on the bulk density, type of binder, purpose and other features.

**6. Reinforced concrete structures.** Reinforced concrete is a rational combination of two materials that differ in their mechanical properties - iron (steel) and concrete, working together in structures as one monolithic whole.

**7. Mortars.** Mortars are called fine-grained concrete, consisting of one or more binders, water and fine aggregate. The difference between mortars and concretes is conditional.

**8. Artificial stone materials and products based on inorganic binders.** This group includes stone materials and products obtained from mixtures based on mineral binders.

**9. Wood materials.** Wood is one of the most ancient building materials. In recent years, wood has been replaced in construction by reinforced concrete, plastics, etc. Wood is widely used due to its high strength, low average density (400-700 kg / m<sup>3</sup>), low thermal conductivity, durability, ease of processing, and low cost.

**10. Metals.** Ferrous metals (steel and cast iron) have received the greatest use in construction, but in recent years, especially in industrial and civil construction, non-ferrous metals have been increasingly used: aluminum and its alloys with low mass (three times lighter than steel).

**11. Materials and products based on plastics.** Plastics in the field of construction are replacing traditional building materials, as they have valuable properties such as low average density and high strength, ease of processing.



When using heat-insulating materials for building envelopes, their weight is reduced, the consumption of materials is reduced, heat losses are reduced, and, consequently, fuel consumption for heating buildings. This reduces construction and operating costs.

### 13. Roofing and waterproofing materials

**14. Paints and varnishes** .Paints and varnishes should protect structural elements from exposure to harmful gases and vapors, as well as atmospheric influences, they protect the material from fire, decay, give the surface a pleasant appearance, and improve sanitary and hygienic conditions in the room.

### Quality indicators of construction products and products used in construction:

**An indicator of product quality** is a quantitative characteristic of one or more product properties included in its quality, considered in relation to certain conditions of its creation and operation or consumption.

A single indicator of product quality is an indicator of product quality that characterizes one of its properties.

A complex indicator of quality is an indicator of product quality that characterizes several of its properties.

The defining indicator of product quality is an indicator of product quality, according to which a decision is made, evaluating its quality.

Integral indicator of product quality - an indicator that is the ratio of the total beneficial effect from the operation or consumption of products to the total costs of its creation and operation or consumption of quality.

Nomenclature of quality indicators: Product quality is characterized by a combination of the following criteria:

- ✓ technical level;
- ✓ stability of quality indicators;
- ✓ economic efficiency;
- ✓ competitiveness in the foreign market.

### Methods for determining product quality indicators:

*Measuring* - carried out on the basis of technical measuring instruments;

*Registration* - is built on the basis of observation and counting the number of certain events, items or costs;

*Calculated* - based on the use of theoretical or empirical dependences of product quality indicators on its parameters;

*Expert* - implemented on the basis of a decision made by experts; *Sociological* - is used on the basis of collecting and analyzing the opinions of its actual or potential consumers;

*Organoleptic* - carried out on the basis of the analysis of the perceptions of the senses.

## RESULTS AND DISCUSSION

**Tests of materials** is the determination of the physicochemical, mechanical and technological properties of materials in order to assess their performance.

The concept of "testing materials" combines methods of research and control of the properties of materials.

Testing of materials is carried out at all stages of the production of the material (raw materials, semi-finished product, final product), as well as during the operation of products (structures) made from it.

In the process of testing, the impact on the material of external factors (mechanical loads, temperature, environment, etc.) is reproduced. In the control tests of materials, they are guided by standards or technical specifications that regulate test methods (operating modes, equipment, etc.).

With the help of sample testing, material characteristics are determined and compared with standard values.

Both destructive methods of testing materials are used, causing damage or complete destruction of the test object, and non-destructive, after which further use of the object is possible (non-destructive testing). The variety of methods for testing materials is due to the different properties of materials.

- **Test methods in building materials laboratories:** To determine that the products are safe and can be used for the construction of various structures, a quality certificate is issued. Therefore, building materials undergo various test methods.
- During the test, information about the quality characteristics of the object is obtained. The used methods of testing building materials allow:
  - determine how reliable the offering materials are;
  - carry out construction work at the highest quality level;
  - prevent emergencies and other serious problems on the construction site;
  - ensure the life of the erected building or structure to the maximum.

In specialized laboratories, building materials are tested in accordance with standards and SNiPs, which determine the requirements for different types of building materials groups. After testing, an official conclusion is issued, which provides an assessment of the quality of the samples provided.



The parameters to be checked depend on the type of product. For example, for reinforced concrete structures, the strength, the location of the reinforcement, the thickness of the protective layer are determined. For linoleum and ceramic tiles - geometric parameters, water absorption, thermal resistance, density, humidity, change in linear dimensions. For thermal insulation materials - water absorption, tensile strength under mechanical stress, density, compressibility and elasticity, linear temperature shrinkage.

**Methods used for testing building materials:** The following testing methods for building materials can be used in the laboratory:

- 1) **Destructive.** They include chemical and mechanical effects that are exerted on pre-prepared samples of materials.

- 2) **Non-destructive.** The integrity of the structure is not violated, the strength of the materials is determined. Such methods include ultrasonic flaw detection, elastic rebound method, X-ray method.3)

**Special for concrete and concrete products.** Depending on the method of conducting the study, destructive or non-destructive methods can be used. For example, the compressive strength can be determined using a vibratory hammer or a spring hammer.

- Testing of building materials is carried out in a specialized certification center, which has official permission to perform this type of work and laboratory facilities.

**Test methods:** The following methods are used during tests in laboratories:

- ✓ Destructive testing - the actual characteristics of materials are revealed;
- ✓ Ultrasonic testing - to detect hidden defects, strength control;
- ✓ Measuring method - visual inspection of materials and making the necessary measurements;
- ✓ Seismo-acoustic check - examination of piles, their depth, absence of defects in it, strength check;
- ✓ Mechanical verification - a wide range of activities required to assess the strength, hardness and other physical parameters of materials;
- ✓ Capillary method - control using penetrating substances, with their use it is possible to determine any defect on the surface;
- ✓ Thermal imaging methods - aimed at monitoring equipment, units, enclosing structures;
- ✓ The magnetic method diagnoses the position and properties of reinforcement in concrete;
- ✓ Vibration - assessment of the dynamic parameters of structures under the influence of loads.



**According to the types of impact, testing of materials is divided into:**

- **chemical**, designed to determine the chemical composition of materials, their solubility, ability to withstand chemical attack, such as oxidation (in particular, for metals and metal-based composite materials - various types of corrosion: general, pitting, intergranular), etc.;
- **physical**, used to determine the electrical conductivity of materials, their thermal conductivity, heat capacity, optical transparency, temperature resistance, moisture saturation (for composite and non-metallic materials), magnetic properties, linear expansion coefficient. And also to determine the macrostructure (visually assessed) and microstructure, including crystalline or amorphous structure and atomic structure.
- **mechanical** (they are often identified with the general concept of "testing materials"), used to test structural materials.

Mechanical tests of materials (tensile, compression, impact, bending, torsion, shear, hardness, fatigue) make it possible to determine the resistance of a material to deformation and destruction under the action of static or dynamic loads (long-term or short-term).

The results of mechanical tests also serve to obtain design values, make it possible to evaluate the bearing capacity, durability and safe damageability of structures.

Technological tests of materials make it possible to determine the temperature and speed conditions of material deformation, heat treatment parameters, shaping indicators, weldability, the possibility of soldering, gluing, processing with various tools, as well as the quality of the treated surface after various technological operations (cutting, turning, grinding, polishing, etc.) .

According to the purpose of testing materials, they are classified:

- **for qualification** tests used to substantiate the specified performance of the product (they involve a comprehensive statistical assessment of the technical characteristics of the material);
- **certification** - to establish the conformity of a batch of materials with the requirements presented in the technical specifications for the supply;
- **arbitration** - to determine the compliance of the material of the destroyed part with regulatory requirements and in case of a complaint.

**Test laboratory accreditation:** Accreditation is one of the tools to improve the quality and competitiveness of goods and services at the level of individual sectors of the economy, individual states and international level.

**Accreditation** is an official recognition by third (independent) parties of the competence of a legal or natural person in the performance of specific tasks.

Accreditation is the process by which a government-approved body provides formal recognition that an organization has the ability and resources to perform specific conformity assessment tasks.

Conformity assessment refers to the activity to determine the compliance of the object of conformity assessment with the requirements of regulatory documents in the field of technical regulation.

These requirements are set out in international standards developed by the International Organization for Standardization - ISO.

Organizations engaged in conformity assessment activities are conformity assessment bodies, including testing laboratories, certification bodies for products and services, management systems, and inspection bodies.

**First**, recognition by third parties means that these parties are themselves competent. **Secondly**, accreditation must be independent, i.e. these third parties cannot participate in or influence the relationship between the accredited person and their clients. **Third**, standards must be set in order to be accredited.

These standards include the types of activities for which accreditation is carried out, as well as the rules for accreditation.

The main goal pursued by accreditation is to ensure and increase the level of trust of all market participants: consumers, producers, society and stakeholders, as well as government services.



The main advantages that accreditation provides to conformity assessment bodies are:

- guarantees for customers and consumers in the provision of quality services in the area where the body is accredited;
- continuous improvement of activities and improvement of qualifications and competence of personnel through regular assessments by the accreditation body;

- expanding the scope of the market by recognizing the results of work by market participants, including those abroad;
- saving time to prove your competence.

To do this, when conducting accreditation, the following basic principles must be observed:

- ✓ openness - the absence of any discrimination in their activities;
- ✓ transparency - availability of information about the structure, management and decision-making;
- ✓ independence and impartiality – lack of pressure in the process of carrying out activities and making decisions on accreditation;
- ✓ Competence – a high level of personnel training and equipment with resources to perform assigned tasks;
- ✓ confidentiality - protection against illegal and unauthorized dissemination of information;
- ✓ unified approach - establishment of unified requirements for the accreditation process, accreditation criteria, methods of work;
- ✓ interaction with international accreditation organizations.

To determine the scope of accreditation of a testing laboratory, it is necessary:

- establish activities for testing and control;
- establish objects of control and testing;
- to determine the composition of regulatory documents for the objects of control;
- determine the composition of controlled parameters;
- determine the types of control and testing;
- to determine the composition of regulatory documents on methods of control and testing.

**Testing Laboratory Accreditation Criteria:** In order to be successfully accredited, a testing laboratory must fully meet the accreditation criteria for the chosen scope of accreditation. When accreditation of a testing laboratory is carried out, an authorized organization checks the full compliance of the declared scope of accreditation with the established criteria.

Criteria for the technical equipment and competence of the laboratory include:

- ✓ normative documents;
- ✓ laboratory premises and environment;
- ✓ auxiliary equipment and materials;
- ✓ test equipment, measuring instruments, standard samples.

**Criteria for accreditation of the testing laboratory in relation to the competence of personnel:**

The criteria of this group may apply both to the main personnel who directly carry out tests or measurements, and to auxiliary ones.

Criteria related to personnel competence include:

- ✓ Basic education of staff and work experience;
- ✓ professional development and staff development.

**Documents for accreditation of the testing laboratory:** Accreditation of the testing laboratory is carried out on the basis of the submitted documents. In general, the composition of documents for accreditation of a testing laboratory includes:

- ✓ заявление на аккредитацию;
- ✓ documents of the quality system;

- ✓ documents of technical equipment;
- ✓ documents on education and qualifications of personnel;
- ✓ documents on the type and condition of laboratory facilities.

Currently, the National Accreditation System of the Republic of Uzbekistan, the State Register, lists 14 calibration laboratories, 189 testing laboratories, 19 quality management system certification bodies, 72 product certification bodies, 18 inspection bodies.

Ensuring the quality and safety of building materials indicates the need to introduce international standards and their requirements in this area. Implementation of harmonization of the requirements of national standards with international standards and standards of industrially developed countries, training of highly qualified personnel.

It is necessary to study and implement a modern approach and methods for assessing the quality and safety of building materials, developing mechanisms for the implementation by all participants of a responsible approach to their activities.

### **Conclusions and recommendations**

In order for the Quality Standards to become the norm, to ensure the requirements of the standard, increase and create conditions for promoting the export of building materials, it is necessary to organize training for manufacturers and national experts, consultants, with the involvement of experienced specialists from abroad, who have vast experience in the field of production. It is expedient and necessary to organize the exchange of experience and coordination of actions of both local and foreign construction testing laboratories to assess the conformity of building materials.

Compliance with quality indicators and reliability of modern buildings and structures under construction depends not only on the activities of designers, architects, designers and other professions in the construction industry, but also depends on enterprises producing building materials.

In order to ensure the efficient operation of construction testing laboratories, it is necessary to provide constant assistance in improving the material and technical base. Presentation of preferential preferences for newly imported into the Republic of modern measuring instruments, when they pass through customs control.

Development of measures for the training of qualified specialists of construction testing laboratories, the organization of permanent advanced training courses based on modern achievements in science and technology in the construction industry. Establishing links and establishing information exchange between state and non-state testing laboratories and certification bodies;

Creation of a simplified system and conditions for accreditation of testing laboratories, taking into account regional and industry conditions. Improvement of normative-legal and normative-technical documents of standardization, conformity assessment and technical regulation of the Republic of Uzbekistan for the production and assessment of building materials, taking into account the experience of industrialized countries.

An analysis of the activities of testing construction laboratories shows that the main problems of laboratories are considered to be the insufficient level of laboratory infrastructure. The test methods used in testing construction laboratories are obsolete, the measuring and testing instruments are old and do not fully meet the requirements of current modern standards.

The activity of testing construction laboratories is a complex and multifaceted process, it involves: personnel, infrastructure, processes, technologies, services, measuring instruments, regulatory documentation. The complexity of the system lies in the fact that these elements must work in accordance with the requirements of the norms and rules established in the documentation and require the coordination of these actions.



The main purpose of the system of the system and conditions for accreditation of testing laboratories and the test methods used in testing construction laboratories is to ensure the timely presentation of the results of qualitative analysis and research, ensuring their accuracy and reliability.

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