Proposals for the development of the harmonized standards justifying the requirements of the technical regulations concerning the buildings and structures safety

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Abstract. The system of the technical regulation in construction assumes the existence and functioning of the three components: the rationing system, the supervision and control system, and the conformity assessment system (Figure 1) [1].

![Technical regulation system diagram](image)

1 - Two-level rationing
2 - Conformity assessment
3 - Control and supervision

Figure 1. Technical regulation system according to the Russian Federation law “On the Technical Regulation”

The effective interaction of these three components makes it possible to ensure the entire “life cycle” of the construction objects existence from the engineering surveys and design to the reconstruction and disposal [2,3,4].

Introduction

Taking into account the fact that the progressive systems of technical regulation involve the use of a parametric method of rationing allowing the use of traditional and alternative technological solutions along with the traditional ones, the problem of confirming the compliance of the proposed alternative solutions and controlling their safety level arises.

Regulatory documents, currently used in the form of the building codes and updated codes of rules do not fully allow opening the way to the alternative solutions use in the form of new progressive building materials, effective technologies for their use and other innovative developments (Figure 2).
The same problem arises when the advanced foreign offers concerning the materials, technologies, construction equipment and engineering equipment try to enter the construction market of the CIS countries.

The evaluating innovative developments mechanisms have been developed and adopted in the form of the Federal Law “The Law on Technical Regulation”. WTO member countries have been successfully applying and improving the principles and rules for the use of this law over the years (Figure 3).
Goals, objectives, methods of learning

According to the requirements of the technical safety regulation [5], its requirements are considered fulfilled if the harmonized standards are used to confirm the compliance with the requirements of the technical regulations [6] (Figure 4).

![Diagram of regulatory documents]

**Figure 4.** The relationship of the regulatory documents to justify the requirements of the Technical regulations on the safety of buildings and structures

The application of the updated rulebooks currently does not solve this issue, since the use of the harmonized standards involves three methods of conformity assessment: the calculation method, the modeling method and the test method with an assessment of the emergency condition risk level [7].

The current system of conformity assessment uses only one method - the method of calculation for the limited states, which is referred to as “semi-probabilistic” methods of calculation using a number of safety factors.

The method of modeling and testing is not provided by the above-mentioned current regulatory documents.

The limited possibilities of the updated rulebooks and building codes restrict the use of innovations in the construction environment, since they are based on the prescriptive method of regulation, when the developer is prescribed the entire design route before the final result is obtained (Figure 5).

At the same time, the parametric rationing method provided in the Technical Regulations on Safety assumes that the project developer has received initial data for the project and requirements for the final result of the project and the way to achieve these goals remains at the discretion of the contractor, including the use of alternative solutions innovation basis (Figure 6).
But in this case, the author must have not only calculation methods, but also simulation methods and test methods to confirm the security of the solution proposed.

**The proposed Solutions**

Taking into account the above-mentioned facts, it is planned to discuss the rules for the development and use of the harmonized standards to confirm the compliance with the requirements of the Technical Safety Regulations.

Calculated methods of harmonized standards should be based on probabilistic methods of calculation and the theory of the building structures reliability.
The left and right parts of the limit inequality in the limit state method operate on the probabilistic values of the “loading effect” and the bearing capacity of the building structures, having a certain probability distribution.

It should be taken into account, that the purpose of engineering analysis in the design of building structures is to determine the scalar values of the carrying capacity for performing design and reliable comparisons of various design solutions.

However, at present, it is generally recognized that the reliability of $P_{\text{suc}}$ structures (or its addition - the probability of failure $P_{\text{fail}} = 1 - P_{\text{suc}}$) is the indicator that allows a much more objective assessment of the design decision. Thus, the goal of building design is to achieve an acceptable probability of failure of a building structure when it becomes unsuitable for further operation.

With this approach, possible solutions $\gamma_i$ ($i = 1, 2, 3 \ldots N$) can be taken if $P_{\text{fail}}(\gamma_i) \leq P_{\text{fail}}$, where $P_{\text{fail}}$ - is a prescribed failure probability.

Thus, the main purpose of the harmonized standard is to solve two problems:

1) to provide the designers with the methods for calculating reliability, allowing $P_{\text{fail}}$ to be the calculated from the available data on the original calculation parameters;
2) to limit the value selection $P_{\text{fail}}$ for the calculated failure probability.

It is noteworthy that both the loadings and the partial safety factors were adjusted in the Euro-norms used by the countries of the Eurozone, also using the limit state method in the calculations.

In our opinion, one more step should be taken in the development of the harmonized standards: the transition to probabilistic calculation methods.

A lot of useful information can be obtained using the experience of the Euro-norm standards in the development of simulation and test methods for obtaining the additional capabilities in assessing the conformity of the alternative technical solutions.

Summary
The harmonized standards of building structures should be the evidence base of the Technical Safety Regulations with a full range of methods for assessing and confirming compliance when using alternative solutions, namely, the calculation methods, modeling methods and test methods with an assessment of the risk of the accident condition (failure).

The creation of standards for the development and the harmonized standards use of the compliance with the full range of technical regulations on the safety of buildings and structures deserves attention.

The following development standard should be defined:
- uniform requirements for the harmonized standard development;
- the harmonized standard composition.

The application standard should define the conditions for the harmonized standards use at the following stages:
- design;
- supervision and control over the construction of buildings;
- assessment of the project’s conformity, properties of construction materials and the object completed with the construction of the facility to the requirements of the Technical Regulations on the safety of buildings and structures.

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Acknowledgements
The work is realized in the framework of the Program of flagship university development on the base of the Belgorod State Technological University named after V.G. Shukhov, using equipment of High Technology Center at BSTU named after V.G. Shukhov.