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A. Tulebekova*, A. Zhankina
L.N. Gumilyov Eurasian National University, Nur-Sultan, Kazakhstan
Corresponding author: krasavka5@mail.ru

Technical regulation in the construction

Abstract. The system of technical regulation is considered as foundation for the creation of a high construction culture, increasing the competitiveness of the industry in Kazakhstan. Key actions to reform regulatory framework which was established by the government focused on achieving a sustainable balance of economic and social interests of construction participants and consumers. The process of adopting international standards to Kazakhstan soil and construction conditions is gradual. The first step was to adapt foreign technical documentation to the national technological environment. In this way, there were developed appropriate methodologies for assessing conformity to educate builders and designers to develop appropriate training programs, handbooks, and manuals, translation to the Kazakh language, checking the general format of the maintenance of the Eurocodes by comparative calculations, etc. It is important that this process does not contradict the Eurocode relating to any aspects of the requirements in Kazakhstan that are not covered by the Eurocode. The article presents discussions of stages for harmonization and adaptation of Eurocode to Kazakhstan norms.
Keywords: standard, technical regulation, construction, concept, harmonization.

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Introduction

Construction codes pursue several socially significant aims - ensuring the safety of life and health of people and other living organisms and the creation of decent conditions for their existence.

The purpose of building codes and regulations is to reduce the risks associated with the exploitation of buildings and structures to a level acceptable by society [1-3]. Any technical standards, regardless of what is the subject of their consideration - fire safety, electrical networks, sanitary equipment, ventilation, or energy resources - should reflect the current level of risks that society considers acceptable. At the same time, the purpose of the rules remains unchanged at an acceptable level of risk and aims to protect health, ensure safety and create decent living conditions for people. The difference between different levels of risk lies in the degree of health, degree of safety, and degree of comfort. In economically developed societies, this degree is much higher than in less developed ones. Accordingly, in developed countries, the level of risk expected by society is much lower than the level of risk considered acceptable by less developed societies.

Construction norms and rules impose minimum requirements on construction objects by setting minimum allowable restrictions. A participant of the construction activity should not ignore them. In case of non-observance of the established restrictions, there is a risk that the building or structure will cease to provide an acceptable level of safety for people in it [4].

Concerning building codes, the level of safety is interpreted as the degree of risk that society considers acceptable in terms of damage to human health and safety. In the meantime, extreme degree of risk lies between minor damage (for example, bodily injuries) and fatal, catastrophic damage for instance loss of human life. This level of risk is contextual and depends on many factors, including political, social, and cultural buttress and traditions of society, the level of its economic development, the level of building technologies used, the professional level of human resources, and the expectations of consumers of building products. Accordingly, the bottom bracket of minimum requirements in building codes is determined by a degree of risk to human life and safety that a society considers acceptable.

The concept of reforming the regulatory framework

The experience of Kazakhstan is also an important example, as the advantage of the countries largely depends on the reform of the system of technical regulation, which was carried out comprehensively, based on a well-thought-out national strategy.

The concept of reforming the regulatory framework of the construction sector represents the vision, opportunities, and stages of reform, including the industrial policy of the industry in the Republic of Kazakhstan [5].

The concept reflects the main opportunities and expected scenarios for reforming the regulatory framework of the construction sector, taking into account regional and global integration processes.

The system of technical regulation is considered as the foundation for the creation in Kazakhstan of a high construction culture, increasing the competitiveness of the industry.

Key actions to reform the regulatory framework should be focused on achieving a sustainable balance of economic and social interests of construction participants and consumers. Successful implementation of such a vision requires great efforts from the state in terms of abandoning the historically established monopoly on technical regulation of the construction market and a gradual transition to a system of technical self-regulation [5].

The degree of economic and creative freedom granted to the subjects of regulation must be simultaneously supported by an adequate social self-awareness of the regulated subjects and the observance of the norms of professional ethics.

This concept is based on the orientation towards the deep integration of the construction industry of Kazakhstan into the regional and global socio-economic system by harmonizing the principles of technical regulation with a variety of forms of implementation of these principles considering national peculiarities.

Special attention was paid to the close cooperation of public authorities and specialists of the private sector, the direct participation of all interested government bodies and enterprises, and organizations of the private sector who represent the professional interests and interests of consumers of products of construction activities.

The path to the future success of the system of technical regulation of construction will be laid through the tools for the implementation of the Concept.

The purpose of the Concept is to create a progressive system of technical regulation that will satisfy society's expectations of product construction activities regarding their safety as well as in creating favorable conditions for economic development and prosperity of populated places. The regulatory reform periods according to the concept are shown in Figure 1[5].

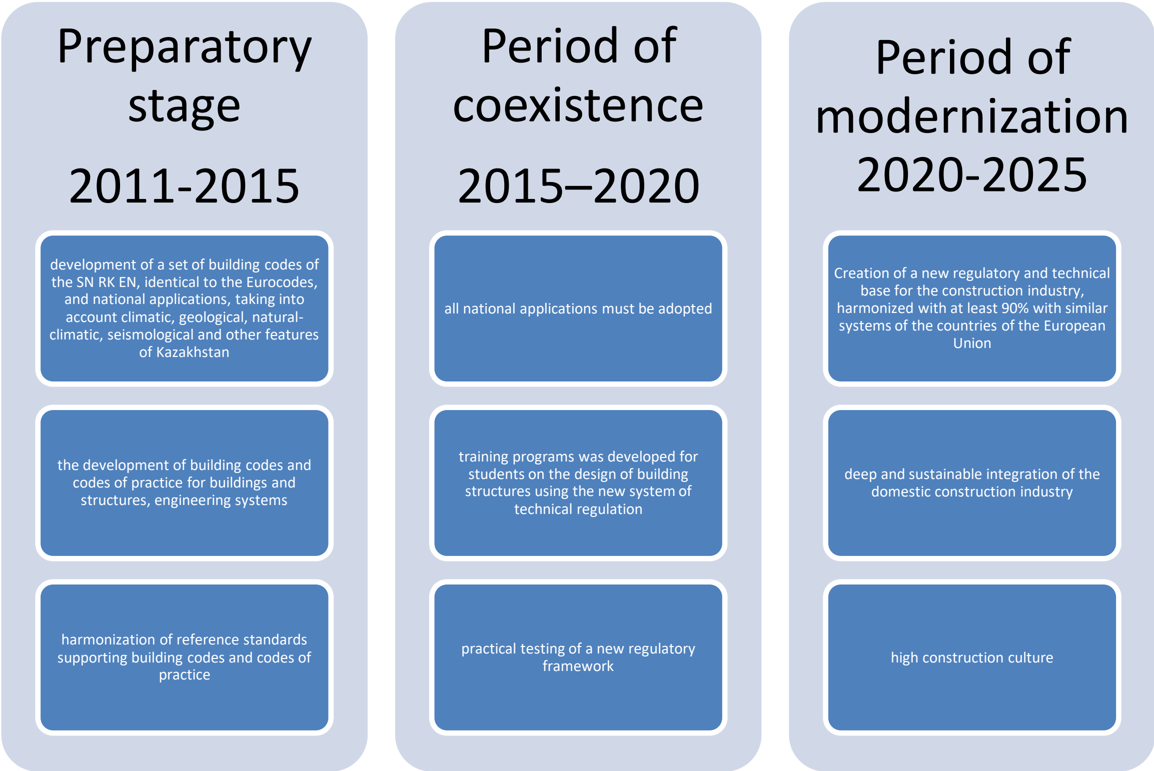

Figure 1. Regulatory reform periods

The practicability of the European construction norms adaptation

The adaptation of the Eurocodes into the construction and designing practice implies the creation of such conditions which will not allow existing of different standards related to identical products. Accordingly, the process of scientific, technical, and economic integration will not be possible without reducing various national standards to the united, agreed conditions. The logic of such requirement implies the creation of appropriate incorporate scientific and technical committees with the participation of all concerned countries' representatives. The results of such work are the Eurocodes integrating the best scientific and technical achievements available in various national standards.

At the moment when such integrated norms appear, a question naturally emerges about the inadmissibility of simultaneous acts of the two standards - integrated and national.

The adoption of the Eurocodes by a country gives it the advantage of an intensive exchange not only by goods but by technologies as well. But it is considerably not easy to take such a path. There is a bunch of conditions: application of closely related technologies, organizational methods, control, and, most important, the protected consumer rights. The same technical safety implies the same legal safety, which is of crucial importance and predetermines the important tasks for a country willing to possess an economy, integrated with developed countries [6].

The effectiveness of the European approach to the field of technical regulation is acknowledged by several existing agreements on mutual recognition of the results in compliance assessment with such countries as Japan, the USA, Canada, Australia, and others [7].

The key target of the Eurocodes adoption in Kazakhstan is the integration of the construction sector into the European system of technical regulation and the elimination of barriers to the activities of foreign investors in the country.

The analogs of native standards associated with the Eurocodes are given in Table 1.

Table 1

Comparison of the Eurocodes and native norms for designing engineering structures

Eurocode number	Eurocode title	GOST, SNiP, SP
EN 1990	Basis of structural design	GOST 27751- 87
EN 1991	Actions on structures	SNiP 2.01.07-85*
EN 1992	Design of concrete structures	SNiP 52-01-2003,
EN 1993	Design of steel structures	SNiP II-23-81*
EN 1994	Design of composite steel and concrete structures	SP 52-101-2003
EN 1995	Design of timber structures	SNiP II-25-80
EN 1996	Design of masonry structures	SNiP II-22-81*
EN 1997	Geotechnical design	SNiP 2.02.01-83*, SNiP 2.02.03-85
EN 1998	Design of structures for earthquake resistance	SNiP II-7-81*
EN 1999	Design of aluminum structures	SNiP 2.03.06-85

Transition to parametric model in all system components of technical regulation within the construction industry (normative base, supervision, and control, compliance assessment system), taking into account the advanced foreign experience and national features play an important role.

The process of adopting international standards to Kazakhstan soil and construction conditions is gradual. The first step was to adapt the foreign technical documentation to the national technological environment. In this way, the appropriate methodologies were developed for assessing conformity to educate builders and designers to develop appropriate training programs, handbooks, and manuals, translation to the Kazakh language, checking the general format of the maintenance of the Eurocodes by comparative calculations, etc. The process needed not to be contradicted the Eurocode relating to any aspects of the requirements in Kazakhstan that are not covered by the Eurocode. Stages for harmonization and adaptation of Eurocode to Kazakhstan norms are shown in Figure 2.

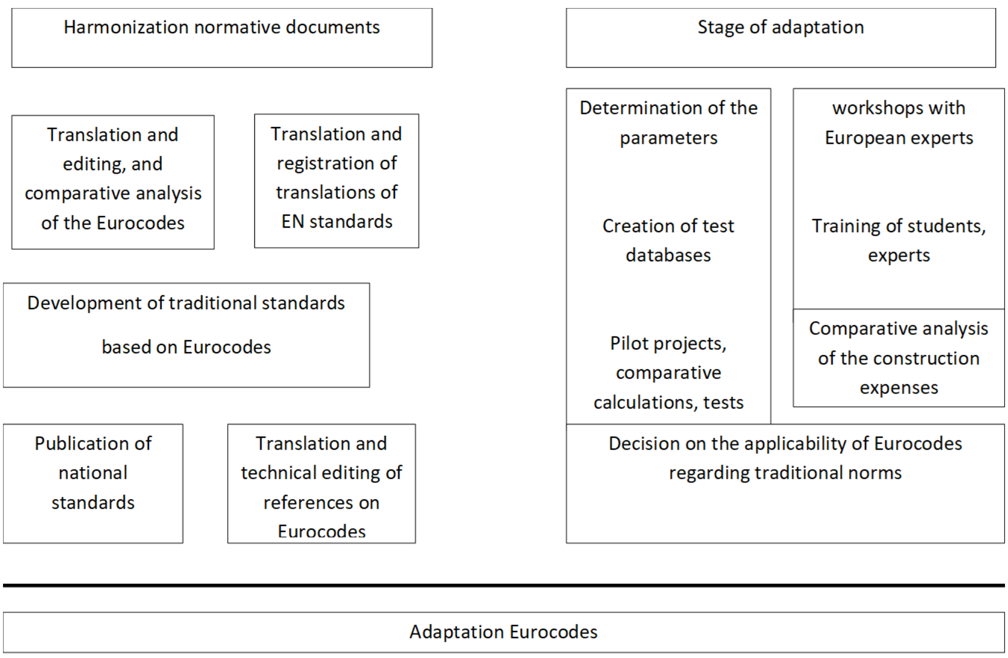

Figure 2. Program of harmonization national standards with Eurocode

Geotechnical specificity of standards

Eurocode 7 is a comprehensive code that is concerned with the entire geotechnical design process. This design process is illustrated by the flow diagram in Figure 3. Eurocode 7 distinguishes between simple geotechnical designs, such as those for light buildings on firm ground and involving negligible risk for people or property and for which the fundamental requirements are satisfied based on comparable experience and qualitative geotechnical investigations, and complex designs, such as large, sensitive structures on soft ground or deep excavations close to old buildings. For the latter case, additional calculations and more extensive ground investigations are required [8].

The factors to be taken into account when assessing the complexity of a geotechnical design are as follows: ground conditions; groundwater conditions; regional seismicity; influence of the environment; nature and size of the structure; conditions with regard to the surroundings.

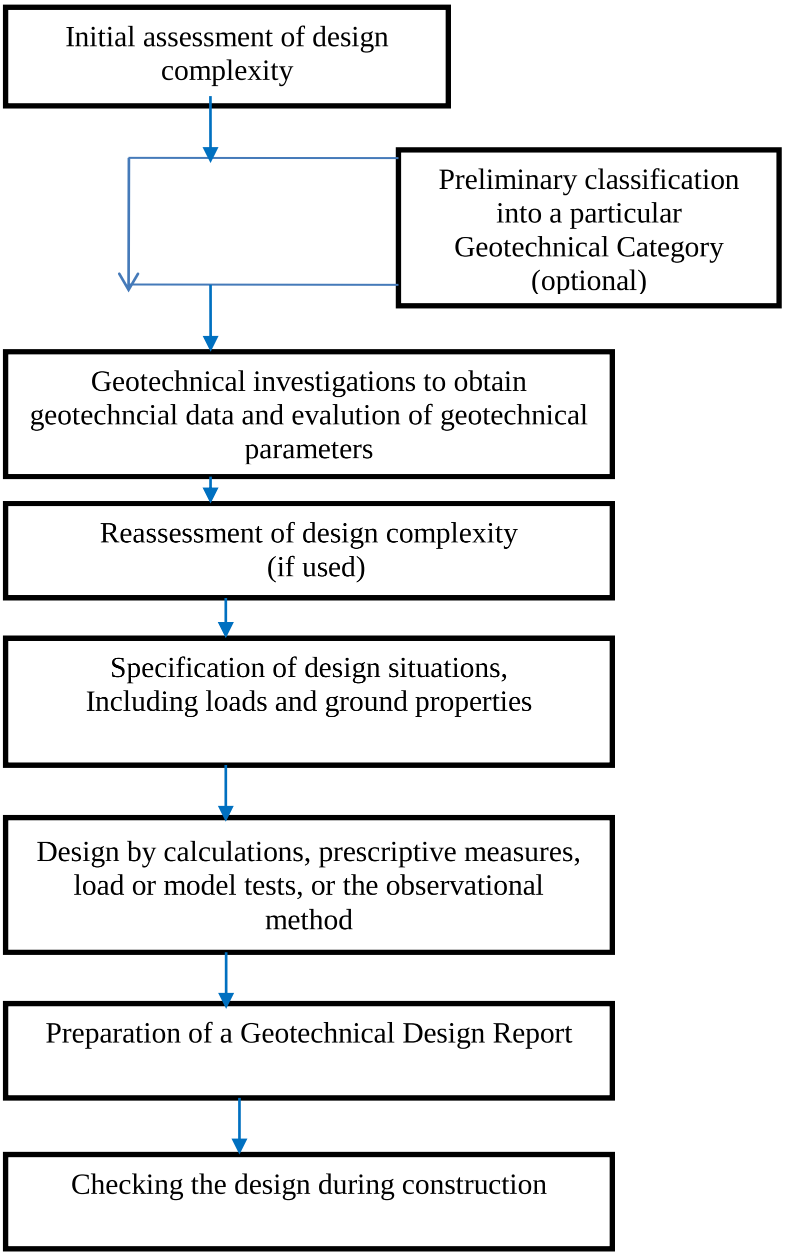

Figure 3. European and international standards for geotechnical design and construction and ground investigation and testing [8]

Testing methods for pile foundations in different stages of investigations include the follows Weight sounding test (WST); Cone penetration test (CPT); Dynamic probing tests (DP); Standard penetration test (SPT); Field vane test (FVT); Pressuremeter test (PMT); Static axially loaded compression; Pile integrity tests and determination of a pile length. The principal difference between Eurocode and the Kazakhstan Code is the absence of requirements for the geotechnical design in the latter. In Eurocode, the strategy of geotechnical design includes the interaction of two disciplines, namely geological and geotechnical engineering.

Presently, it is, however, difficult to design without qualitative geotechnical investigations. Geotechnical research includes the results of engineering and geological investigations that are used during the investigation of the soil and foundation. Recommendations from Eurocode are aimed at both researchers and designers. The special requirement was absent in the Kazakhstan code and engineering and geological investigations represent different parts of the design process; frequently there is no interaction between researchers and designers. Another difference between Eurocode and the Kazakhstan code is the design of soil basements, which is recommended to be carried out in three steps.

Results and discussion

During the first and second steps of the foundation design, it is allowed to use preliminary strengthen and deformation properties of the soil as taken from a table of SNiP RK. During the third step, it is required to perform both laboratory and field tests so to obtain approval of the design project. According to Eurocode, for all of the aforementioned steps, the strengthen and deformative properties of soil must be determined only from laboratory or field tests. Moreover, Eurocode uses the term "derive value", which means the value of a geotechnical parameter of soil obtained by results of laboratory or field testing of soil using either a correlation relationship or an inverse calculation. For example, the deformation modulus is obtained independently from laboratory tests, field tests by dilatometer, by correlation relationship with physical parameter, or by results of well-known settlement calculation.

About geotechnical parameter values: the values should be obtained from test results; other data shall be interpreted appropriately for the limit state considered; account shall be taken of the possible differences between the soil properties and geotechnical parameters obtained from test results (derived values) and those governing the behavior of the geotechnical structure; geotechnical parameter values governing the behavior of a geotechnical structure may differ from derived values due to several factors listed in Eurocode 7. The process to obtain characteristic parameter values is summarized in Figure 4.

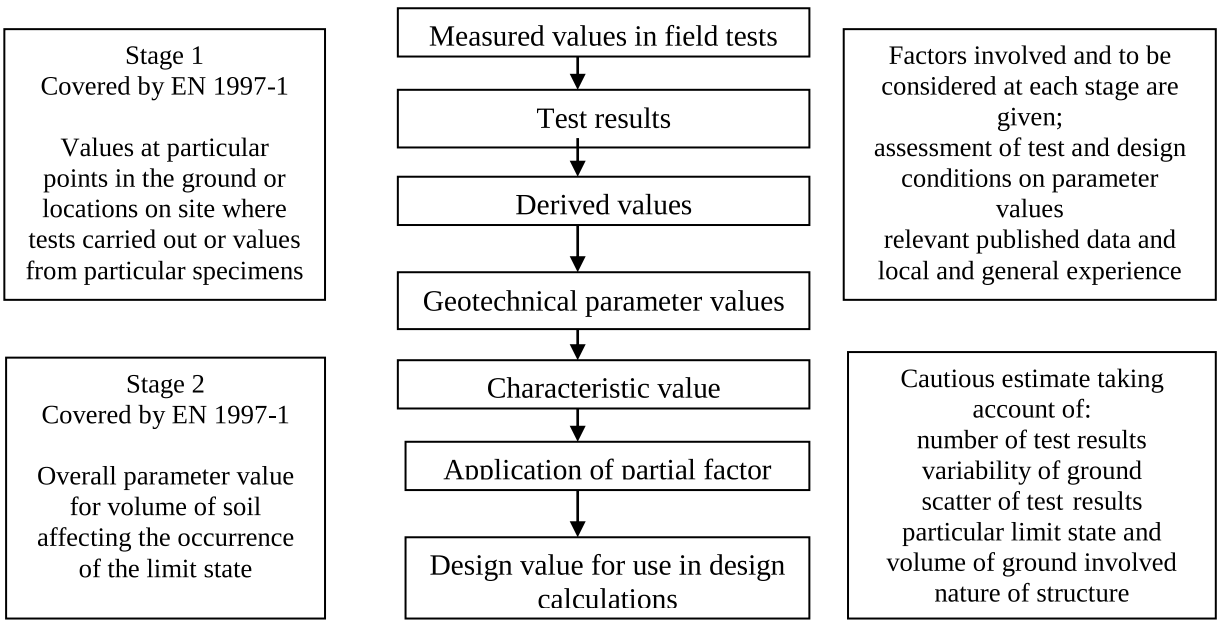

Figure 4. The process to obtain characteristic parameter values

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Also, the comparison showed that Eurocode 7 does not pay so much attention to pile testing for permafrost soils, and the value of the depth of freezing soil in Kazakhstan is higher [9-10]. Finally, comparisons have shown that the traditional Kazakhstan code does not include normative documents for pile integrity testing.

By Eurocode 7, when choosing the type of pile and method of installation, the pile's integrity must be verified through suitable testing. Pile integrity testing (Figure 5) provides a check of the homogeneity of piles and provides a method for detecting hidden defects in the piles (e.g., cracks and necking in driven piles).

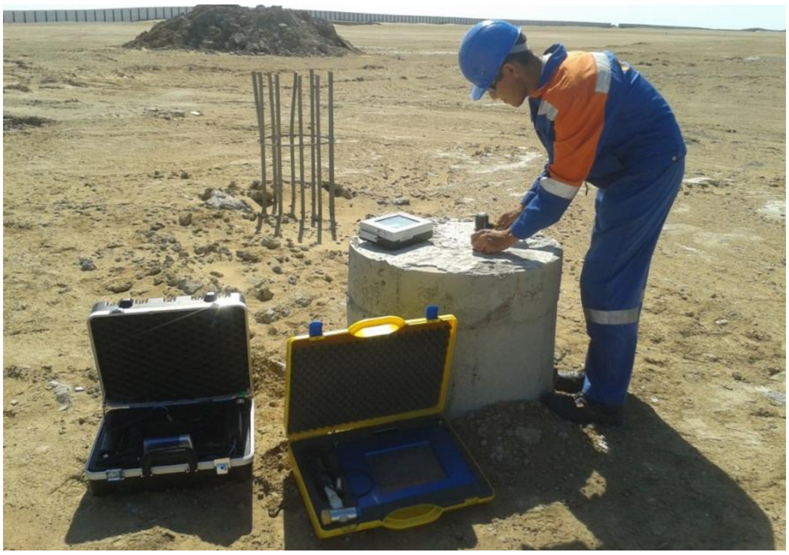

Figure 5. Performing pile integrity test

In pile integrity tests, the highest quality signals are achieved by observing the following:

– Blow zones of concrete foundation construction should be trimmed back to sound material, free of loose surfaces and debris.

– The surface should be free of water.

– Any structures or elements attached to the concrete foundation construction, long projecting reinforcement, or cages, may return signals generated by these elements which may make the signal impossible to interpret. Often, interference from these elements may be electronically filtered out: access to the side of the pile should permit delivery of several hammer blows and provide sufficient room for movement of the transducers on the side; "green" concrete should not be tested. The concrete foundation construction normally requires a curing time of 28 days to being ready for testing; several blows should be delivered to each test place to ensure repeatability and hence consistency of results [11].

The test procedure associated with a pile integrity test consists of the following steps:

– Clearing of the concrete pile from the soil, snow, ice to sound surface. Preparation of three zones (if possible) of flat, dry concrete on the pile; the size of such zones should be approximately 100×100 mm to attach the sensor (accelerometer) and to blow by a special hammer on the concrete surface.

– The following parameters are introduced in memory of the device: Site, symbol of concrete foundation, length, stress wave velocity in concrete.

– The sensor, registering reflected signals is fixed on a prepared zone on the pile through special paste for best registration of the signals. Three light blows are produced by a special hammer on the foundation site of the prepared place. The graph (reflectogram) of blow amplitude to the length of concrete foundation dependence is represented on the display of the device. If the operator determines graphs to be acceptable for interpretation, these results are written into the memory of the device for additional processing. If the blows were either very strong or very weak, the device does not register any signal and it is required to repeat the blow. The blows are produced until the operator can interpret the reiterative graphs (reflectograms).

All integrity test data are processed by special software after testing, and output is represented by a graph “signal amplitude” – “crack location”. According to the graphs the operators classify the depth of crack penetration. A technical report will be given to the client after all tests with detailed analysis.

The pile side is struck with a hand-held hammer that sends sound waves directly through the concrete foundation. Pile side movements affected by a series of hammer blows and subsequent rebounds are then received by a very sensitive acceleration meter positioned on the side of the foundation. The acceleration signal is converted into velocity and is represented on the screen as a function of time. All results are easily saved into the computer, to be used in the processing thereof.

The interpretation of reflectograms consists of the following actions:

– If the graph has clear fluctuations with a further reflection of the signal, it means the pile has experienced necking, cracking, incursions, geological influence, etc.

– If such fluctuations are not significant, it means that the pile is without defects.

– If the curve has sharp clear upward peaks followed by downward peaks, then the pile is likely acceptable. If, however, the graph has downwards and then upward peaks, then the pile likely has necking, the influence of geological conditions (e.g., soils filled by water), change of density of soil or concrete, etc.

– If the graph has sharp fluctuations, it means that the pile has serious cracking/necking in the place of the beginning of fluctuation.

Figure 6 shows some defective piles. One of the main advantages of pile integrity testing is that the ITS system enables the following to be realized for any pile, with a minimum inconvenience to a construction process at a given site: very quickly receive required information on piles; uncover different pile’s defects, determine a pile’s length up to 60m. Thereby the method supposes to fulfill the integrity tests of piles on the fly.

At a given site, it is required to test a minimum of 50% of driven piles and 60% of bored piles using the pile integrity test. This guarantees the reliability of a buildings’ foundation without any damage.

Figure 6. Examples of defective piles

These features were taken into account in the first and second phases of regulatory reform.

Conclusion

The analysis showed that Eurocode 7 – Geotechnical Engineering seems to be more reliable for adaptation for Kazakhstan construction conditions. Many countries have successfully accepted Eurocode 7. Eurocode 7 has already shown itself to be a very elaborate design code, with recommendations and requirements for the most geoengineering process. It also allows for the use of common international geoengineering terms and provides understanding among designers, testing specialists, and geotechnical engineers all over the world. Eurocode 7 includes recommendations and requirements for modern advanced technologies and embraces many aspects of modern geoengineering design. By comparison to Eurocode 7, the Kazakhstan code has a lot of features. Eurocode 7 is also presented by unified documentation for geoengineering. Investigation showed that the introduction of the Eurocodes was allowed to ensure the use of high technologies and innovations, as well as to eliminate technical obstacles under the implementation of investment projects in Kazakhstan. The reform’s basis was three components: normative base, supervision and control system, conformity assessment system.

During the modernization period, which according to the 2021-2025 yy. concept [5], attention should be paid to the digitization of regulatory documents of the construction industry, as the use of BIM technology allows the automated verification of information and electronic models of each construction project against the valid technical safety requirements of design and technological solutions, which will minimize the risk of various types of unforeseen events and also allow the automation of expert review. And work has begun on introducing automated verification of design and estimate documentation, similar to the experience of Singapore (E-Plan Check).

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А.С. Тулебекова, А. Жанкина

Л.Н. Гумилев атындағы Еуразия ұлттық университеті, Нұр-Сұлтан, Қазақстан

Құрылыстағы техникалық реттеу

Аңдатпа. Техникалық реттеу жүйесі Қазақстанда жоғары құрылыс мәдениетін құру, саланың бәсекеге қабілеттілігін арттыру үшін негіз ретінде қарастырылады. Үкімет құрған нормативтік-құқықтық базаны реформалау жөніндегі негізгі іс-қимылдар құрылысқа қатысушылар мен тұтынушылардың экономикалық және әлеуметтік мүдделерінің тұрақты теңгеріміне қол жеткізуге бағытталған болатын. Қазақстандық топырақ және құрылыс жағдайларына халықаралық стандарттарды қабылдау процесі біртіндеп жүріп жатыр. Бірінші қадам шетелдік техникалық құжаттаманы ұлттық технологиялық ортаға бейімдеу болды. Осылайша, құрылысшылар мен жобалаушыларды тиісті оқу бағдарламаларын, анықтамалықтар мен нұсқаулықтарды әзірлеуге, қазақ тіліне аударуға, салыстырмалы есептеулер арқылы Еурокодтарды жүргізудің жалпы форматын тексеруге оқыту үшін сәйкестікті бағалаудың тиісті әдістемелері әзірленді және т.б. бұл процестің Қазақстанда Еурокодпен қамтылмаған талаптардың қандай да бір аспектілеріне қатысты еурокодқа қайшы келмеуі маңызды. Бұл мақалада Еурокодты қазақстандық нормаларға үйлестіру және бейімдеу кезеңдерін талқылау ұсынылған.

Түйін сөздер: стандарт, техникалық реттеу, құрылыс, тұжырымдама, үйлестіру.

А.С. Тулебекова, А. Жанкина

Евразийский национальный университет им. Л. Н. Гумилева, Нур-Султан, Казахстан

Техническое регулирование в строительстве

Аннотация. Система технического регулирования рассматривается как основа для создания высокой строительной культуры в Казахстане, повышения конкурентоспособности отрасли. Основные действия по реформированию нормативно-правовой базы были направлены на достижение устойчивого баланса экономических и социальных интересов участников строительства и потребителей. Постепенно идет процесс принятия международных стандартов с учетом особенностей страны. Первым шагом стала адаптация зарубежной технической документации к национальной технологической среде. Таким образом, разработаны соответствующие методики оценки соответствия для обучения строителей и проектировщиков, разработаны соответствующие учебные программы, справочники и инструкции, производится проверка общего формата ведения Еврокодов путем сравнительных расчетов и т.д. В данной статье представлено обсуждение этапов гармонизации и адаптации Еврокодов к казахстанским нормам.

Ключевые слова: стандарт, техническое регулирование, строительство, концепция, гармонизация.

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Information about authors:

Тулебекова Ә. – «Ғимараттар және құрылыстарды жобалау» кафедрасының доценті, Ph.D., Л. Н. Гумилев атындағы Еуразия ұлттық университеті, Нұр-сұлтан қаласы, Қажымұқан көшесі, 13а, 6 корпус, krasavka5@mail.ru.

Жанкина А. – Құрылыс кафедрасының аспиранты, азаматтық құрылыс факультеті, Л. Н.Гумилев атындағы Еуразия ұлттық университеті, Нұр-сұлтан қаласы, Қажымұқан көшесі, 13а, 6 корпус, zhankina_aizhan@mail.ru.

Tulebekova A. – Ph.D., Associate Professor in Department of Civil Engineering, L.N. Gumilyov Eurasian National University, Nur-Sultan, Kazhymukan Street, 13a, block 6, krasavka5@mail.ru.

Zhankina A. – Ph.D. student in Construction, Department of Civil Engineering, L.N. Gumilyov Eurasian National University, Nur-Sultan, Kazhymukan Street, 13a, block 6, zhankina_aizhan@mail.ru.