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КОМПЕТЕНЦИИ XXI ВЕКА ИНЖЕНЕРОВ-СТРОИТЕЛЕЙ

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21 век предъявляет профессии инженера в области строительства новые требования. Профессионал в области строительства должен обладать общекультурными, общетехническими и узкопрофессиональными компетенциями, которые позволят ему успешно осуществлять профессиональную деятельность. Будущий инженер в области строительства стоит перед необходимостью определения как своих склонностей и особенностей личности, так и перечня необходимых в будущей профессии компетенций, знаний, навыков, умений, свойств личности. Будущему инженеру в области строительства необходимы знания в следующих областях: архитектура, дизайн, история, социология, математика, информатика, механика, сопротивление материалов, физика, компьютерная графика и т.д. Важными учебными дисциплинами являются: геология, химия, физика, механика, инженерная и компьютерная графика и т.д.

Ключевые слова: профессия инженера, строительство, компетенции 21 века, общекультурные компетенции, общетехнические компетенции, узкопрофессиональные компетенции, знания, навыки, умения

MY PROFESSION IN THE 21ST CENTURY. THE COMPETENCES OF THE ENGINEERS IN THE FIELD OF CONSTRUCTION

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In the 21 century the civil engineers have to meet new demands of society. The profession is connected with new challenges as far as cultural, technical and professional competences are concerned. The disciplines which are necessary for proper design of the functional environment: knowledge in the field of architecture and design to create comfortable spaces; history and sociology allow us to determine the basic needs of society in the construction and formation of functional areas; knowledge of mathematics, physics, mechanics and material science to do some calculations and to choose the materials for floor, walls, ceiling, floors, etc.; knowledge of geometry and graphics will allow you to arrange the project, which will be implemented by the formation of zones of the premises.

Keywords: civil engineering, construction, competences of the 21 century, general cultural competences, general technical competences, professional competences, knowledge, skills, abilities

Membership

We, like many students of the NNGASU (Nizhny Novgorod State University of Architecture and Civil Engineering), came here because we decided to become engineers in the construction industry. Each of us has one's own vision of the future career; understands the role played by structural engineers in the modern world; realize responsibilities of the builders.

However, not everyone got the full picture of what should an engineer consider in the design and construction of a building or structure and for what he/she is responsible. This attitude leads to professional incompetence, because of it people can get hurt physically.

To prevent that, we have prepared this report, which will try to make a full picture of the modern requirements of construction, the duties of engineers in the field of construction and most importantly how to be competent in their field.

Basic requirements of construction

To begin, let's determine what engineers do in the construction industry. It's pretty simple: the design and construction of buildings and structures.

What are the main criteria for the construction of buildings and structures. There are only three: the functionality, the strength, the beauty. These criteria formed in the first century before our era by the Roman architect Vitruvius (let's call these criteria the precepts of Vitruvius). Since then, the only change is the wording of these claims, but the essence remains the same.

The criterion of functionality forms the *operational requirements* for the construction, strength and safety – *technical requirements,* of beauty – the *aesthetic requirements*.

Let's examine each of the requirements in detail.

Functionality (operational requirements): *the building should fulfill its basic*

functions and be easy to use. This criterion provides the correct location of a building or structure and its objects, the formation of the necessary areas and good distribution of space.

For the construction of a building or structure a reason and a purpose are needed. In other words, every building is erected for its functional use.

Residential buildings are created for a comfortable stay in it. At home people sleep, relax, eat, and conduct various procedures to maintain the health of their organism. The building is a social space: at home people communicate, raise children, etc. The interior working area is created for the convenience of the implementation of the activity: in the offices of the convenient location of jobs as far as light sources, working areas of colleagues, and other facilities are concerned; in workshops and industrial buildings it is important to take into consideration the equipment one is working with. The interior of restaurants and cafes is created for meal. So, various rooms are created for various functions. Function is the main goal and reason for creating the interior, so the room should maximally meet its function.

For the creation of the most convenient, functional and usable space ergonomic standards are responsible. Simple example is the size of the objects and the distance between them. In the free spaces should be easy to move, to act, to implement the function of the room.

Observance of the norms of ergonomics, due to the function of the room, provides convenience in its use.

Strength (technical requirements): *the building should withstand the weight of its own structures, the additional weight; be resistant to wind, precipitation and many other influences, which it may be subjected to in the process of continuous operation.*

This is a very important part of the design, since miscalculation of the strength may cause the formation of dangerous areas in the building or its complete destruction; the consequences in such cases are irreparable or very expensive. Therefore, the project is carefully checked at all stages of production.

You also need to consider the safety in use and a certain degree of durability.

Safety in use, as well as convenience are ensured by ergonomics. It is dangerous to handle objects which can cause harm to human health. You can hit on a desk, wardrobe, bookshelf and other furniture, if they are inconveniently located; on the door when it is inconvenient to open, etc. You should create safe environment when you form design of the room. You should think about the convenient arrangement of objects and space areas.

Durability, in fact, determines the period of safe use of the product or, in our case, the design of the building as a whole. Everything in the world is not infinite, and you need to take into account the period of use anything in a such way, that the item wouldn't become a threat. Any construction of design, material, coating, furniture, technique must serve a certain time corresponding to its value. After the end-of-lifetime objects update or are disposed of.

Competent calculations, construction and operation of buildings and structures to prevent threats to health and human life are needed.

Beauty (aesthetic requirements): *the building should match the aesthetic needs of people to fit in with the surroundings.*

Researches in the field of sociology claim that the physical and psychological health of people is influenced primarily by their lifestyle and environment. That means that human health is significantly affected by where and in what conditions one lives. Bad arrangement of the around residential areas, unsuitable exterior of buildings and interior spaces, rubbish, dirt and other problems of architecture and ecology are detrimental to the wellbeing of citizens.

The formation of the right environment is the key to the health of a person. For this there are standards of architecture and ecology.

All these requirements must be met equally and do not contradict each other. To sacrifice one criterion in favor of another is not correct: the importance of each requirement is revealed in its domain and to compare them is not worth doing, just it is needed to know that all the requirements are important and should be taken into consideration while working on the project.

Based on the requirements of the construction, it is possible to establish the main obligations of engineers.

The duties of the engineers in the field of construction

The duties of the engineers in the construction industry are generated from claims submitted to the building structure. We have reviewed the basic requirements and cited several examples of what the engineer should consider in the design and construction. Let's take a closer look.

Operational requirements

The basic operating requirements are prescribed in «SP 255.1325800.2016 Buildings and structures. The rules of operation. General provisions», and one should not forget about ergonomic standards. For compliance with op-

erational requirements, meet architects, designers, project and construction Manager.

As we have said, the main operational requirement is to meet its functions. Therefore, the main duty of the authors of the project is the creation of the necessary functional, social, sanitary-hygienic zones and the proper distribution of these zones in the space of the room. Additionally, you must ensure the security and trouble-free operation of all building systems, to maintain the specified indoor climate and cleanliness during normal service life.

To ensure these requirements in the design: set a specific number of required spaces with their individual characteristics (size, communications, equipment), provide evacuation routes (given the size and location of passing zones, stairwells, etc.), mark the place of laying of communications.

In the building it is necessary to maintain cleanliness, availability of escape routes, proper work communication and the functioning of key areas. It is crucial for people using the premises.

This is what refers to the total operational requirements.

For each building, depending on its functional orientation there are special requirements. For work areas they are lighting, location of equipment; for residential areas it includes a kitchen with a minimum set; for public areas and special spaces they deal with certain furniture, etc. Special requirements also depend on the building construction, which depends on the climate, temperature and humidity conditions of the region.

Technical requirements

Technical requirements are regulated by the Federal law dated 30.12.2009 N 384–FZ (as amended on 02.07.2013) «Technical regulations on safety of buildings and constructions». The main technical requirements of strength are: resistance, reliability, flame resistance, durability, frost resistance, water resistance and other.

For compliance with technical requirements almost all engineers working on the same project are responsible: geologists, surveyors, architects and drafters, as well as bricklayers, concrete workers, engineers, craftsmen, carpenters, welders, facing workers. Everyone is responsible for the correct execution of their duties.

Geologists conduct studies of local conditions and make a report on the safety conditions of construction and operation of buildings on the site; provide recommendations on the preparation of plots for construction, the laying of the foundations. Research must be accurate, otherwise the building can partially or completely go under the ground, crack or crumble. The consequences of such disasters are irreparable.

Surveyors are preparing the site for the construction of buildings. They mark the territory and prepare it to construction: make the cut or fill, level the site. This stage is the beginning of laying the foundation – the main structural part of the building structure. Errors at this stage can cause the destruction of the foundation and, as a consequence of the building as a whole. Layout and site preparation must be accurate; otherwise there is a risk of the destruction.

The draft prepared by the architects and engineers of structures is the basis on which the building is erected, so any error in the project can be catastrophic. The authors of project have a great responsibility: their calculations must be 100% correct. Correctly should be done the choice of materials, because they determine the safety and durability of buildings and structures.

Incorrect counting of the load or wrong selection of materials for specific parts of the building can lead to its deformation or fracture. Consequence may be an emergency or partial destruction. Elimination of damage costs companies a considerable amount.

The observance of all technological processes in the construction of the building is a very important part of the production of the project. This stage embodies all the basic requirements. Not observing the rules of the building may be unacceptable in one or more of the criteria, which makes the whole process useless. And, again, incorrect operation may lead to damage: to harm the building and people. So workers should follow all the rules of construction of the particular element.

The aesthetic requirements

Architectural requirements are contained in the «Federal law of the Russian Federation: On architectural activity in the Russian Federation» and is mentioned in many SR (sets of rules). Let's look at the responsibilities of the architect of the project concerning architecture and design.

The architect needs to create beautiful, convenient, beneficial effects on the building. The building should be organically related to the environment. Appearance should match the design scheme, town planning conditions and assignment (associative array makes the building more attractive to people).

The aesthetic quality of the building or complex of buildings may be raised to the level of architectural and artistic images, i.e. the level of art, reflecting by means of architecture a certain idea of actively influencing human minds. To achieve the desired architectural and artistic qualities one should use composition, scale etc.

Architecture is as important for people as art. Maybe a lot of people do not notice, but the buildings around us, our surroundings affect our mental state, shape us as individuals. The architectural appearance of the building must be in tune with the modern era, to meet the aesthetic demands of people.

All stages of construction are controlled by agencies which monitor compliance with Federal Laws, Building regulations and Regional laws SP. These people are also responsible for compliance with all major requirements.

So, we understand the basic requirements of construction and on their basis to formulate the principal duties of the engineers in the field of construction. How do you become competent in the field of construction?

Becoming competent

To be competent means to be able to act successfully on the basis of knowledge, skills and experience in the field of their professional activities.

We identified the main areas of activity of engineers in the construction industry. Everyone will be in varying level of competence, based on their experience, their knowledge and skills. Experience comes to everyone in the process of direct activity – hard work.

So the main source of competence is training. To become competent you need to conscientiously study, to expand your knowledge in various disciplines, to broaden your horizons. Skills are developed during practical classes; they should also be given special attention to.

Depending on the responsibilities of an engineer he/she should be well trained in certain disciplines.

Working on operational requirements engineers need to know such subjects as: architecture, design, history, sociology, ecology, descriptive geometry, engineering and computer graphics, mathematics, building physics, structural mechanics, material science and others. These are the disciplines which are necessary for proper design of the functional environment: 1) Knowledge in the field of architecture and design to create comfortable spaces; history and sociology allow us to determine the basic needs of society in the construction and formation of functional areas. 2) Knowledge of mathematics, physics, mechanics and material science to do some calculations and to choose the materials for floor, walls, ceiling, floors, etc. 3) Knowledge of geometry and graphics will allow you to arrange the project, which will be implemented by the formation of zones of the premises.

Proper design and implementation of technical requirements will be enabled by the knowledge in the following disciplines:

- mathematics
- geology
- chemistry
- mechanics
- mechanics of materials
- strength of materials
- engineering and computer graphics
- technology in the construction of utilities, etc.

Knowledge of these disciplines helps to carry out studies for the construction, to make accurate project and build the necessary structures.

Professionals in architecture, sociology, history, philosophy, psychology, cultural studies, material science, and mechanics work on the architectural requirements. Knowledge of the above mentioned disciplines is needed to create beautiful, beneficial effects on human exterior of the building.

Conclusion

To be competent you need to clearly define your responsibilities and work hard, in accordance with your knowledge, skills and experience. So you have to study, constantly supplement and enrich your knowledge, broaden your horizons, develop your skills. Knowledge, skills and experience come with time. What is especially important is not to stand still, and keep moving forward.

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