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**THE SPECIAL FEATURES OF FUTURE CIVIL ENGINEERS' TRAINING FOR ENGINEERING ACTIVITY****ОСОБЛИВОСТІ ПІДГОТОВКИ МАЙБУТНІХ ІНЖЕНЕРІВ-БУДІВЕЛЬНИКІВ ДО ІНЖЕНЕРНОЇ ДІЯЛЬНОСТІ**

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**Abstract.** *The paper considers the peculiarity of engineering activity and its orientation to solving social and technical tasks. The authors analyze the required skills and traits for civil engineers set by Ukrainian and foreign employers and organizations in the context of European integration processes. These requirements include technical competence, practical ingenuity, communication skills, creativity, problem-solving skills, organizational skills, adaptability and flexibility, responsibility for engineering solutions, engineering ethics, readiness for lifelong learning, good powers of observation, etc. The requirements for civil engineers demonstrate the necessity to acquire professional competence and functional communicative competence, providing an opportunity for effective functioning in the professional environment. The special features of professional training of civil engineers at university are outlined in the study as well, covering professional-value orientation, humanistic component and professional English proficiency. The topicality of the issue has been proved and the rules of implementation of pedagogical approaches into the current educational system have been described. The study assesses the curriculum and the syllabus of "Professional English" for students majoring in civil engineering at the National Aviation University and subsequently evaluates its effect on students' achievement in their field.*

**Key words:** professional training, civil engineer, engineering activity, professional English.

**Introduction.**

The era of diverse social transformations in the cultural and economic life of Ukraine, rapid scientific and technological development of society and competitiveness requires the professionals capable of analyzing the changeable social and economic conditions of production development, making and implementing unconventional decisions in the conditions of market competition and avoiding stereotypes in the production and personal areas of interaction. Moreover, the dynamic nature of our modern life requires the engineers to have a flexible nature of thinking and harmonic combination of logic and creativity, as well as to be broad-minded people with developed intuitions. Such a combination can ensure the successful realization of their personal potential and creative abilities during professional activity.

According to the Concept of Professional and Technical Education in Ukraine and the National Doctrine of Education Development in Ukraine in the 21<sup>st</sup> Century, the urgent necessity is to train the qualified specialists at higher schools, especially the universities which train future engineers and tend to advanced, innovative development of engineering education trying to provide the appropriate conditions



for successful professional development, further self-assertion and career growth of future professionals.

According to the current legislation of Ukraine (Law of Ukraine “On Higher Education”, the National Strategy for the Development of Education in Ukraine for 2012-2021) the main attention of professional education must be focused on the development of future specialists’ vital competencies, which allow them to respond quickly to changes in the professional environment and society and master professional skills during their whole life, i.e. to be involved into lifelong self-education [7].

**The purpose of the paper** is to analyze the current state of organizing the professional training of civil engineers at technical universities in Ukraine (on the example of the National Aviation University) and define the specific features of the professional training. The consideration of the civil engineers’ professionalism, which starts developing during professional training at university, is impossible without considering the specifics of the engineer’s professional activity which is based on the concept of engineering activity in general and current requirements to the personality and skills of a civil engineer in particular.

#### **Main part.**

#### ***Engineering Activity and Requirements to Civil Engineers***

Professional training of future civil engineers is a social and pedagogical system, which aims at developing their values for professional and personal self-development and self-improvement. Therefore, the basic requirement of education at the stage of professional training at university is not only the development of future civil engineers’ hard skills, but also the development of such personality traits as self-sufficiency, sociability, social and professional responsibility, interpersonal skills, creative approach to the task, readiness for lifelong self-education and self-improvement.

On the basis of the analysis of the normative educational base (e.g., Law of Ukraine “On Higher Education”, The Standards of Ukraine, etc) [6], [11], it should be noted that the system of national higher education in Ukraine provides the four qualification levels of civil engineers’ training (a bachelor’s degree, a master’s degree, a PhD, and a doctoral degree). The specificity of engineering activity is that, on the one hand, it is substantive and practical as its basis is the knowledge of the properties of the object it deals with, and, on the other hand, it is social by nature due to the development of production relations in society and subjective reflection of these relations by an individual.

The peculiarities of engineering activity in comparison with other types of human practice are self-organization, invention and designing, creation of systems which convert materials, energy and information into a more useful form. Understanding special features of engineering activity makes it possible to determine its peculiarity through the analysis of the content and professional tasks solved by the engineer: the design and maintenance of engineering systems, research, the development and implementation of new technologies and the modernization of the old ones, exchange of scientific and technical experience, development of techniques and methods of work, and production management.



According to the requirements to the level of professional training of civil engineers, indicated in *the National Framework of Qualifications (Ukraine)*, the essential qualities for these professionals are self-organization, high intelligence, professional mobility, responsibility for the consequences of their activity, readiness for intercultural interaction, the desire for self-development and creative intuition [7]. In our opinion, a future civil engineer should be considered as an integrated personality at the factual, theoretical and reflective levels. The factual level deals with the knowledge and ability to navigate in the empirical basis of the profession of a civil engineer, the theoretical level – the knowledge of the principles of object functioning, and the reflective level – the understanding of the origin of these principles, knowledge of the methodology of cognition and designing.

The globalization of the economy and increasing competition in the engineering labour market require the development of common requirements to the quality of training of these specialists and ensuring their international mobility. The creation of the international registers of professional engineers contributes to this task. There are the following international organizations that register professional engineers and promote the international recognition of their qualifications: the Engineers Mobility Forum (EMF), the European Federation of National engineering organizations (FEANI), etc.

Let us consider the main requirements for civil engineers. N. Pidbutska summarises the specific requirements for engineers (so-called key skills) that are indicated by potential employers and stated in the certification programs:

- 1) technical competence, mathematical skills and strong fundamental training;
- 2) communication skills (ability to communicate effectively, written literacy, proficiency in English (or other foreign languages), public speaking);
- 3) leadership skills (ability to organize work, delegate tasks, influence employees, understand the responsibility for the result);
- 4) creativity needed for an unconventional approach to solving professional tasks;
- 5) team-working skills;
- 6) problem-solving skills (ability to solve complex professional tasks that involve making difficult decisions);
- 7) organizational skills (time-management, ability to plan, set up schedules and meet deadlines);
- 8) motivation and enthusiasm;
- 9) adaptability and flexibility, necessary for communication with different people, representatives of different companies from different regions and countries;
- 10) good powers of observation [8, p. 104].

These requirements are also mentioned in other studies and documents. For instance, according to “The engineer of 2020” report by the National Academy of Engineering the key skills of the future engineers are science and practical ingenuity, creativity, business and management skills, leadership, dynamism, agility, resilience, analytical skills, professionalism, and flexibility [9, p. 69].

These lists of requirements can be complemented with the following points:

- 1) use of universal knowledge (availability of broad and deep fundamental



- knowledge and the ability to use them as the basis for practical engineering activity);
- 2) application of local knowledge in practice;
  - 3) the analysis of engineering tasks (setting, researching and analyzing complex engineering tasks);
  - 4) evaluation of engineering activities (evaluation of the results of integrated engineering activities);
  - 5) responsibility for engineering solutions and engineering ethics;
  - 6) public safety of engineering activities (understanding of the social, cultural and environmental consequences of integrated engineering activities);
  - 7) lifelong learning (lifelong professional self-development, sufficient to keep up and develop competencies);
  - 8) legality and normativeness (compliance with laws and legal standards, protecting public health and ensuring the safety of integrated engineering activities) [4].

During the professional training for engineering activity, students develop their integrative and analytical skills, critical thinking, ability to innovate and contextually understand the engineering, industrial and international conditions of professional activity, and the ability to self-education. In the modern world, a new professional and social psychological model of an engineer-humanist is required, the one who has not only deep knowledge but also high moral and intellectual potential, a humanistic attitude to work, a broad outlook, a sense of high responsibility to society for their actions. The image of engineers acts as a set of their knowledge and qualities, reflecting the requirements to them as professionals, personalities and subjects of social relations [1, p. 18].

Let us consider and analyze the professional training for engineering activity of students mastering in “Industrial and Civil Engineering” at the National Aviation University (Kyiv, Ukraine) and define its special features. It comprises professional and value component, humanistic component, including proficiency in English (or another foreign language).

### ***Professional and Value Orientation of Civil Engineers’ Training***

During professional training of future civil engineers at university, the purposeful self-analysis and the correction of professionally important personality traits take place, responsibility for decision-making increases, the ability to predict the results and choose the best actions develops. The axiological development of future civil engineers is their professional and value development as specialists, personality and spiritually mature people, and the growth of their consciousness.

At technical university, civil engineers develop the ability to scientifically analyze social issues and processes and the skills to use the methods of these sciences in various types of professional activity. While studying at university, civil engineers develop abilities to re-evaluate their accumulated experience in the conditions of the development of science and practice, analyze their possibilities, and be able to acquire new knowledge by using modern information technologies. At the same time, students understand the essence and importance of their future profession, the main issues in the content of basic subjects that determine a specific field of future



professional activity, and its relationship with the integrated system of knowledge. The main features of professional and value orientations are the knowledge of moral rules and norms, the responsibility for the profession that has been chosen, and the ability to reflect.

The readiness for self-organization in the professional activity, the independent formulation of the moral duties and their fulfilment and the self-control and self-esteem takes an important place in the structure of professional and value orientations.

The axiological content of the educational process at technical university is carried out through different academic disciplines, each of which represents a system of scientific knowledge as a result of the integration of information with social, professional and personal values of a student. The analysis of educational and methodological complexes has shown that the content of natural sciences, social sciences and the humanities at technical university is also profession-oriented. It should be noted that it is based on the mutual integration of the humanities and technical sciences due to which the thinking of the future engineer is developed. This thinking is required for their creativity in solving technical and technological tasks, understanding that any technical product or device is created for a human.

A technical university creates opportunities for students to review, develop their previous ideas, acquire new knowledge and find personal values of their future professional activity. Thus, during professional training, professional and value orientations are transferred to future civil engineers, and they actively adhere to these orientations.

Value orientations determine the direction and level of activity and affect significantly the professional qualities of civil engineers during the process of developing their personality. Nowadays, engineering knowledge is increasingly important in the cultural system, but the danger of science and technology estrangement from humans becomes real. The content of engineering knowledge is based on the results of social and natural sciences, including in the “blended form” the humanities and scientific-natural knowledge, moral imperatives, practical experience, etc. Technical universities are unique educational institutions for training highly qualified engineering experts and at the same time are unique centers for the cultural, educational and intellectual development of students. On this basis, we can indicate that the first feature of the professional training of future civil engineers is to involve them in professional and value orientations, as an axiological basis of engineering activity.

According to the curriculum for the students majoring in “Industrial and Civil Engineering” the subjects belonging to the professional and practical ones include: Engineering Graphics, Theoretical Mechanics, Introduction of Civil Engineering, Structural Mechanics, Civil Engineering Materials, Engineering Geodesy (General Course), Architecture of Buildings and Structures, Building Technical Equipment, Production Base of Civil Engineering, Mechanics of Materials, Solid Body Mechanics, Mathematical Methods of Design and Optimization of the Systems and Processes, Metal Structures, Electrical Engineering in Construction, Airport Building and Structures, Building Technical Equipment, etc. The comprehensive study of the



abovementioned subjects and the special features of professional training allows providing more complete and thorough training for the future civil engineer, which results in effective developing professional competence.

### ***The Humanistic Component in Professional Training of Civil Engineers***

The increasing demand for the 21<sup>st</sup>-century skills of an engineer and the rising number of collaborations between engineering and the humanities require for the integration of the humanities into the professional training of future civil engineers.

The theoretical analysis of professional training of future civil engineers causes the study of such factor as the interaction of professional and general cultural training of the engineer. That is why we have investigated the correlations and interdependencies between the various goals of students' professional training (profession-oriented or practical subjects in the curriculum) and cultural and liberal training (the humanities and social and economic subjects in the curriculum).

Taking into account the traditions of national education and the tendency of development of education abroad, the basis for knowledge integration is the humanities, revealing the regularity of personality development and realization in the professional activity. The humanities (liberal arts) form the personal traits that are vital for a professional in the context of new market relations. In addition, international experience shows that the role of liberal education and the cultural intensity of knowledge as the basis of personality development have increased recently. While studying the humanities students master the future professional activity as a set of economic, social, socio-psychological laws and evaluate the usefulness of created artificial environments from the standpoint of the priority of human values, humanism, and the civilized approach. Thus, the second important specific feature of future civil engineers' training is the humanistic attitude to work.

### ***Professional English Proficiency as a Vital Need for Engineering Activity***

Taking into account the current requirements and public inquiries, the development of professional competence of a future civil engineer is impossible without the development of their communication potential. Therefore, one of the peculiarities of future civil engineers' training is the development of communicative competence. There are new demands to the English proficiency necessary for interpersonal communication, searching for and processing the information from foreign sources, as well as the knowledge of international business and professional etiquette.

Under the influence of globalization today the English language is one of the most widely used languages in the world and is considered to be the most accepted form of communication in the business world. It is the official language of the European Union and is studied as the second language in most of the countries all over the world [2, p. 8]. Therefore, proficiency in English has become the basic requirement in most professions and industries [5, p. 4].

The analysis of the curriculum for training the students majoring in "Industrial and Civil Engineering" at the National Aviation University has shown that the subject entitled "Professional English" is included to the cycle of professional and practical training by the Ministry of Education and Science of Ukraine. A detailed analysis of all approved syllabi and course training programs has shown that one of the most



meaningful and vital subjects for the development of future civil engineers' communicative competence is "Professional English".

Future civil engineers are called not only to be good professionals in engineering but also to be fluent in their native and foreign languages, especially in English which is one of the most common European languages nowadays particularly in the field of technology. Fluent English and its extensive use in the field of science, engineering and technology is the 'must' for a modern professional, in particular, and society, in general. Firstly, it breaks down communication barriers being used as the lingua franca. Secondly, the English language is one of the most vital tools for acquiring scientific and technological information and mastering skills [10, p. 225]. Thirdly, it is the language that is widely used all over the world for publishing reports, journals, papers based on scientific investigations carried out by the researchers in the field of technological innovation. And, finally, it is the language of information technologies; therefore, any professional using computer programs will have difficulties working with them without knowing English. These are some factors that motivate future civil engineers to study English and professional disciplines in order to develop the professional and communicative competences in future professional activity.

Bobikova's study has shown that under current conditions the integration of a foreign language with professional subjects for developing future civil engineers' professional competence is of great importance. It is these factors that develop the personal qualities required for civil engineers for self-education, familiarize the students with human values, enable a broader and deeper perception of the world, develop their modern world outlook [1, p. 123].

According to the curriculum at the National Aviation University, the students majoring in "Industrial and Civil Engineering" study a foreign language (English) three years: the undergraduate students study "Professional English" and master students study "Business English".

The analysis of the syllabus on "Professional English" for the first-year students has shown that it has mainly educational nature, not a professional one. Students become familiar with student's life in Ukraine and abroad, its peculiarities, opportunities provided by student's exchange programs, and some general facts from the building construction which influences the development of a self-educational component of foreign language training and expands the communicative and intellectual parameters of personal qualities necessary for acquiring professional competence. While studying "Professional English" a student acquires the skills of practical knowledge of a foreign language (English) in various types of speech activities in the scope of topics, due to the needs of daily communication; receives up-to-date information from foreign sources; develops the skills of skimming, scanning, and in-depth reading. By mastering this training course students develop the skills of putting their knowledge into practice when participating in simulated professional situations.

Students must know lexical and grammatical material, be able to adequately respond during communication, participate in conversation and be engaged in a dialogue, be able to think logically, participate in conversations and discussions on indicated topics, express and substantiate their point of view.



In our study, we have focused mainly on the analysis of the syllabus on “Professional English” for the second-year students. The second-year students are involved in studying this subject, and this allows integrating the efforts of both teachers and students to optimize the process of developing future civil engineers’ professional competence. This course is designed to meet the specific needs of a definite group of professionals. The materials of the course are created by taking specific jargon and terminology from the specific field (e.g., civil engineering) that is focused on the use of English in specific contexts [5, p. 4]. Therefore, the materials of this course are directed on the student’s major. Mastering the subject “Professional English” contributes to the professional training of future civil engineers, because it assists in developing such vital skills for professional growth of civil engineers as communication skills and organizational skills.

The purpose of learning this subject is to develop the necessary communication skills in the fields of professional and situational communication in oral and written forms, present technical profession-oriented topics, as well as to form the basis of working with professional literature. The topics that are studied during this course reflect the essence, tasks and functions of civil engineering and covers the following areas: building materials; elements of buildings and constructions (foundations, walls, roofs, etc); types of buildings and engineering structures; bridges, roads, tunnels; airports; stages of the construction process (feasibility study, surveying, designing a project, earthwork, laying the foundation, bricklaying, roofing, facing, floor covering, landscaping, commissioning, etc); computer technologies in civil engineering, etc. At the same time, the basic language models which were learnt during the first year of study are used and practised during this course as well. It facilitates the development of future civil engineers’ communication and organizational skills that are important for their striving for self-development. In terms of the so-called “English project” (the project functioning at the National Aviation University where the students, who are involved in it, study all professional and practical subjects in English), the analysis of the content of the activity of a civil engineer makes it possible to determine that the main trend for increasing the level of self-training of these students is to use an integrative approach, that is: the integration of foreign language with professional subjects to enhance the professional knowledge of future civil engineers; and the introduction and use of integrative technologies while studying professional subjects, application of professional interdisciplinary tasks, etc.

Future civil engineers’ training aims at a high level of proficiency in English approaching the native speakers’ level. Such proficiency will simplify their work, as well as it significantly assists in the self-training. For instance, the self-training process of future civil engineers in English creates a wide potential to facilitate mastering the existing knowledge and acquiring a new one. The aforementioned knowledge and skills are required to solve a set of production tasks in the civil engineering, which are performed by using such software as: AutoCAD, Autodesk 3ds Max, AVEVA, CATIA, etc in English. These programs are used for 3D modelling, animation, rendering, visualization, designing building plans, calculations of various characteristics of materials, etc.

The future civil engineer should not only know the grammatical structures of the





English language but also have the necessary communication skills to solve professional tasks and social problems. In addition to knowledge of grammar and relevant professional vocabulary and the ability to use them in communication properly, they should also be aware of the business culture of native speakers, business etiquette, peculiarities of business correspondence, construction documents, etc. Therefore, “Business English” is also required. So the third important special feature of the professional training of future civil engineers is that it requires English proficiency. We consider the integration of ESP with professional subjects as an efficient approach to deal with the challenges and needs of civil engineers.

### **Conclusions.**

The study has revealed the peculiarities of professional training of future civil engineers in the context of modern requirements and public requests. They include the involvement of future civil engineers in professional and value orientations as the axiological basis of engineering activity; humanistic component in the professional training; and proficiency in English (with the main focus on professional English). The results of the analysis of the curriculum for “Industrial and Civil Engineering”, approved syllabuses on “Professional English” and “Business English” have given an opportunity to determine the specificity of engineering activity, which deals with the professional orientation and development of personal traits of future civil engineers; and the compliance of the approved curriculum, syllabuses and the organization of the professional training of future civil engineers at the National Aviation University with the requirements to such professionals to be successful in the engineering activity. In our future study, we intend to develop and test the technologies to improve the professional training of future civil engineers at professional English classes at university in order to facilitate the formation of their key competencies.

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**Анотація.** У статті розглядаються особливості інженерної діяльності та її орієнтація на вирішення соціально-технічних завдань. Автори аналізують навички та риси, необхідні інженерам-будівельникам для ефективною професійною діяльністю у контексті європейських інтеграційних процесів та встановлені українськими й іноземними роботодавцями та спеціальними організаціями, відповідальними за реєстрацію інженерів. Вони включають технічну компетентність, практичну винахідливість, комунікативні навички, креативність, навички вирішення проблем, організаторські здібності, адаптивність та гнучкість, відповідальність за інженерні рішення, інженерну етику, готовність до навчання впродовж життя, розвинені здібності спостереження тощо. Вимоги до інженерів-будівельників демонструють необхідність набуття професійною компетентності та функціональної комунікативної компетентності, забезпечуючи можливість ефективного функціонування у професійному середовищі. У статті також висвітлюються особливості професійної підготовки інженерів-будівельників у технічному ЗВО, що охоплюють професійно-ціннісну спрямованість, гуманістичну складову та знання фахової англійської мови. Стаття аналізує навчальну програму з фахової англійської мови, а також навчальний план для студентів освітньо-професійної програми «Промислове та цивільне будівництво» Національного авіаційного університету для визначення їхньої відповідності сучасним вимогам до фахівців будівельної галузі.

**Ключові слова:** професійна підготовка, інженер-будівельник, інженерна діяльність, фахова іноземна мова.

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