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**THE PROBLEM OF SPECIALISTS' TRAINING
TO ASSESS THE STRENGTH OF STEEL STRUCTURES
UNDER SPECIAL OPERATING CONDITIONS**

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Training of specialists in the specialty 192 «Construction and Civil Engineering» is carried out under the standard of higher education in Ukraine for the first level of education [1], approved in March 2021. The standard defines the list of graduates' competencies, which include integrating (ability to solve complex, specialized problems of construction and civil engineering), 10 general, and 9 special competencies. Attention should be paid to the following competencies: GC 6 (ability to search, process and analyse information from different sources), GC 8 (ability to communicate with representatives of other professional groups of different levels (with experts from other fields of knowledge / economic activities)), SC 1 (ability to use conceptual scientific and practical knowledge in mathematics, chemistry, and physics to solve complex practical problems in the field of construction and civil engineering), SC 3 (ability to design building structures, buildings, structures and engineering networks (according to specialization), taking into account engineering and

resource-saving measures, legal, social, environmental, technical and economic indicators, scientific and ethical aspects, and modern requirements of regulatory documents in the field of architecture and construction, environmental protection and occupational safety).

In the project of the standard of higher education of Ukraine for the second level of education, the list of special competencies includes SC 8 (ability to integrate knowledge from other fields to solve complex problems in broad or multidisciplinary contexts), in another version uses the wording and understanding of other engineering disciplines. All the above suggests that the requirements for the training of specialists in the speciality 192 imply the formation of their ability to use knowledge from different fields of knowledge to solve complex problems in professional activities. It requires the implementation of the educational process based on an integrative approach [2]. Reforming modern higher education involves a gradual transition from the isolated teaching of disciplines to the creation of integrated courses, integrated modules of disciplines, and integrated tasks that will form future professionals a holistic view of the problem, systematic, holistic knowledge of objects and phenomena. Also, integration is used to establish relationships between individual disciplines, forming the unity of individual elements for their study in combination.

An integrated approach is needed to prepare professionals for the design and assessment of the strength of steel structures under special operating conditions.

Steel materials have almost unlimited applications in the industry. They are used to implement a variety of structural forms for any purpose, from small span structures to unique in their purpose and scale structures (for example, New safe confinement over destroyed unit 4 Chornobyl nuclear power plant (NPP)).

According to the design standards of steel structures [3, p. 1] when designing steel structures in special operating conditions (such as structures subject to seismic hazards, higher temperature impact, etc.), it is necessary to consider additional requirements that reflect the characteristics of these structures. One of the examples of structures that go into special operating conditions is steel supporting structures of NPP equipment and piping. According to the Requirements for seismic resistance design and the evaluation of seismic safety of Ukrainian NPPs [4], these steel structures are designed so that they can withstand simultaneous action:

- the higher temperature outside the environment (see more detail [5]);
- loads from equipment and piping with the internal environment (pressure, water, steam) in different technological conditions of operation NPP (see more detail [6]);
- seismic hazards (see more detail [7]).

These factors are the initial data for determining the loads on steel supporting structures of NPP equipment and piping. Thus, the assessment of the strength of these steel supporting structures is a complex issue, the solution of which today requires the involvement of experts from various scientific fields, such as specialists in seismic investigations, thermohydraulic and strength steel structures calculations. The application of an integrated approach will allow forming specialists' of strength calculations of steel supporting structures of NPP equipment and piping basic skills and abilities of processing, analysis and correct use of results of seismic investigations and thermohydraulics calculations.

In our opinion, interdisciplinary integration between «seismology, thermohydraulic processes in equipment and piping and strength of steel support structures of NPP equipment and piping under seismic loads» is necessary for effective training of specialists to assess the strength of steel structures under special

operating conditions. By «interdisciplinary integration», we mean the purposeful strengthening of interdisciplinary ties while maintaining the theoretical and practical integrity of academic disciplines. This integration is a process of harmonizing the content of academic disciplines to reflect their continuous and holistic process of assessing the strength of steel structures.

Concerning the strength of steel supporting structures of NPP equipment and pipelines under seismic loads, the training program should include the following basic modules:

- 1) relationship between ground accelerations, floor accelerogram and building response spectrum;
- 2) changes the internal environment in equipment and piping in different technological conditions of operation NPP;
- 3) parameters outside environment for steel supporting structures of NPP equipment and piping;
- 4) approach to preparing the list of load and load combinations for steel supporting structures of equipment and piping in different technological conditions of operation NPP.

In conclusion, it should be noted that mastering the described interdisciplinary relationship will allow specialists in strength calculations of steel supporting structures of NPP equipment and piping:

- to form basic skills and abilities of processing, analysis and correct use of results of seismic investigations and thermohydraulics calculations;
- improve their skills as engineers and scientists.

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