

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

**O. M. BEKETOV NATIONAL UNIVERSITY
of URBAN ECONOMY in KHARKIV**

METHODOLOGICAL RECOMMENDATIONS

for independent and practical work
on the subject

«ENGINEERING STRUCTURES»

*(for students of the second (master's) level of higher education all forms
of education specialty G19 – Building and Civil Engineering,
education program “Industrial and civil construction”)*

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**Kharkiv
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INTRODUCTION

Practical classes and independent work of the student are an important part of the process of mastering the educational material in the discipline “Engineering Structures”. During the study of the discipline, the student's ability to work with special technical literature, using previously acquired knowledge from general education disciplines, is revealed.

Subject to independent study are educational literature, regulatory documentation, Internet pages, methodological manuals, and materials from recent research on the selected topic published in journals and scientific publications.

After each lecture, before preparing for the next one, the student must study the recommended literature and regulatory documents in order to deepen, expand, and consolidate the lecture material.

1 LECTURE TOPICS

Content module 1 Design and calculation of reinforced concrete engineering structures

1. The concept of engineering structures, their main purpose, types, classification of tanks.
2. Round and rectangular tanks, features of calculation and design.
3. Bunkers, types and purpose, calculation, construction of vertical and sloping walls.
4. Silos. Purpose and type, the difference between silos and bunkers, determination of horizontal pressure on the walls.
5. Underground channels and tunnels. Main design characteristics of underground channels and tunnels. Unified designs of single-section and multi-section tunnels. Design schemes of tunnels and their loading, calculation and design
6. Bridges and overpasses. Main structural elements of bridges and overpasses. Dependence of bridge dimensions on water level and traffic. Sequence of calculation of bridge elements

Content module 2 Design and calculation of metal engineering structures

7. Basic data on radio and television towers. Calculation of radio and television towers for horizontal load according to the deformed scheme.
8. Structural solutions of elements of radio and television towers. Structural solutions of tower shafts, transitional extensions and foundations in radio and television towers and towers. Reinforcement of walls of radio and television tower shafts.
9. Subways. Subways, functional purpose and historical sketch.
10. Structural solutions of metro elements. The main elements of metros, their main parameters, dependence on the dimensions of stations.

11. Distillation tunnels. Characteristics of distillation tunnels, their design solution, numerical analysis and features of loads and calculations.

Content module 3 Features of designing tunnels, bridges and overpasses

12. Varieties and conditional classification of metal engineering structures. Roof structures of large-span buildings. Types of buildings by purpose and by structural scheme.

13. Beam, frame and arch structures. Advantages and disadvantages of beam, frame and arch structures. Features of calculation and layout of structural schemes.

14. Spatial roof structures. General characteristics of spatial structures. Structural structures. Calculation and design, Single-grid and multi-grid shells. Features of calculation. Design.

15. Suspended coverings. Suspended coverings. General characteristics. Advantages and disadvantages. Calculation and design, nodal connections.

16. Sheet structures.. Working conditions and basic provisions for calculating sheet structures. Types of tanks, their calculation, gas holders, general information, bunkers and silos. Types of loading of sheet structures, features of their calculation and design

2 Test questions for the academic discipline

"Engineering structures"

Content module 1 Design and calculation of reinforced concrete engineering structures

1. Types of engineering structures, their purpose and general analysis.
2. Round and rectangular tanks, features of calculation and design.
3. What is the difference between calculating round and rectangular tanks?
4. Bunkers, purpose and calculation features.
5. How are the loads on the walls of bunkers determined?
6. Construction of bunkers, connection of main elements.
7. Silos, types of silo buildings, calculation features.
8. How is the friction force of bulk material against the walls of silos taken into account in calculations?
9. Structural features and reinforcement of silo buildings.
10. Structural solutions for silo slabs.
11. Types of vertical and horizontal pipes, pipe connection units.
12. Features of calculating reinforced concrete pipes, technical parameters.
13. Pressure reinforced concrete pipes, their varieties.
14. Underground canals and tunnels, their technical characteristics.
15. Determination of tunnel design schemes and loads on them.
16. Calculation of tunnels at the operation and construction stages.
17. Reinforcement of tunnel walls.

Content module 2 Design and calculation of metal engineering structures

1. Radio and television towers, their types and purposes.
2. Calculation of radio and television towers for horizontal load according to the deformed scheme.
3. Structural design of shafts, transitional extensions and foundations in radio and television towers.
4. Reinforcement of the walls of radio and television tower shafts.
5. Metros, functional purpose and historical sketch.
6. The main elements of subways, their main parameters, dependence on the dimensions of stations.
7. Characteristics of distillation tunnels, their design solution, features of loads and calculations.
8. Main types of subway stations, overall parameters, calculation and design.
9. Bridges, their types, components, classification according to water level.
10. Loads on bridges, features of taking into account mobile loads.

Content module 3 Features of designing tunnels, bridges and overpasses

1. Purpose of metal engineering structures, features of their use.
2. The purpose and effectiveness of using large-span metal structures.
3. Comparative analysis of beam, frame and arch structures.
4. Features of calculating large-span structures, ensuring their stability under load.
5. Spatial metal structures, types and scope of application.
6. Single-grid spatial coverings, calculation and construction.
7. Structural metal coatings, calculation and design.
8. Radial and radially ribbed domes, features of the design solution.
9. Multi-storey building frames, features of layout solutions.
10. Establishing a connection in multi-story metal frames.

11. Spatial rigidity of multi-storey buildings, methods of ensuring it.
12. Use of different types of steels (high-strength) for multi-story buildings.
13. Typical designs for the application of spatial coatings.
14. The use of suspended and membrane types of coatings in large-span structures, varieties and scope of application.
15. Determination of forces in cables in a simplified way from external loads.
16. Structural features, arrangement of nodes for suspended coverings, connection of cables with stiffeners and the perimeter of the building.
17. Sheet metal structures, types and purposes.
18. Bunkers and silos made of sheet structures, features of arrangement and calculation.
19. Gas holders, purpose and manufacturing technology, calculation.
20. High-rise towers and towers, varieties and design solutions.
21. Features of calculating high-rise towers for vertical and horizontal loads.
22. Advantages and disadvantages of sheet structures.
23. Technological sequence of construction of high-rise towers.

3 Individual tasks

The main goal of studying the discipline “Engineering Structures” is that the student should familiarize himself with the most common engineering structures of energy-saving, transport, technological or special purpose. At the same time, engineering buildings made of reinforced concrete and metal are considered separately. Each student is given the right to independently choose the topic of the essay in order to more thoroughly study all aspects of this topic and further use the collected material in the diploma design.

The individual task is that during the academic semester the student chooses a topic for the essay and works on it before the beginning of the examination session, consulting with the teacher. The topic can be chosen both on reinforced concrete engineering structures and on metal ones.

During the preparation of abstracts (amount 10–14 pages) must include the following sections on the chosen topic:

1. Variety selected engineering buildings, its purpose and sphere of application. In this case, it is necessary to refer on researchers of various types of engineering buildings, described in literary sources.

2. Technological processes that determine the use of the selected engineering structure.

3. Methodology of static and structural calculation of engineering buildings, including determining loads, choosing a calculation scheme and using formulas to determine forces and selection of cross-sections. At the same time submit a link on literary sources.

4. Describe and illustrate the design of the selected engineering buildings or its element, indicate dimensions and characteristics of the materials used.

5. Feasibility studies and variant design of different types of selected engineering buildings.

6. They lead list of used literary sources (not less than three), on basis which the abstract is made.

The abstract is drawn up in accordance with the existing rules for compiling reports and explanatory notes. It is imperative to provide the required number of drawings and captions. It is allowed as drawings use photocopies from literary sources.

4 Essay topics

Content module 1 Design and calculation of reinforced concrete engineering structures

1. Purpose and scope of engineering buildings.
2. Round tanks, features of calculation and design.
3. Rectangular tanks, wall calculation and their design decision.
4. Varieties of bunkers, sphere their application, constructive solution bunker elements.
5. Calculation of walls and funnel bunkers, varieties schemes for the destruction of bunker walls.
6. Appointment of silos, their varieties, composition structural elements for silos.
7. Determination of wall load silos.
8. Constructive decision for walls round and rectangular silos.
9. Features of the constructive decision foundation slabs for silos, methods of their calculation.
10. Varieties reinforced concrete pipes, their calculation and designing.
11. Underground canals, types and purpose, construction decision.
12. Tunnels, design features: single-section solutions and multi-section tunnels.
13. Tunnel calculation methodology, features accounting wheel load, wall and bottom reinforcement.

14. Metro, types of 8ku9i0olp90o-plation and construction of round and rectangular distillation tunnels.

15. Varieties subway stations, their technological purpose, design features solutions.

Content module 2 Design and calculation of metal engineering structures

1. Radio and television reinforced concrete towers, purpose, structural decision.

2. Features of calculating radio and television towers for deformed diagram, foundations for the tower.

3. Lowering wells, types, calculation method for immersion, calculation of the walls of lowering wells.

4. Varieties of retaining walls, their calculation method and designing.

5. Bridges, their classification, design depending on hydrological conditions.

6. Varieties of bridges, calculation method for beam spans buildings, consideration of movable property wheel load.

7. Constructive decision and the purpose of the overpasses and technological routes pipelines.

8. Warehouses, galleries, varieties, purpose, features of calculation and design.

9. Cooling towers, purpose, calculation features and designing.

10. Chimneys, their types, calculation methods, design.

Content module 3 Features of designing tunnels, bridges and overpasses

1. Large-scalecoatingciviliansand industrial houses.

2. Design and calculation principles of the frame and arched large-span systems.

3. Structural coatings, types, calculation and design methods.
4. Cable-stayed systems, their varieties, calculation and design methodology.
5. High-rise metal frames civilian houses, features of element layout hardness, varieties frame systems.
6. Sheet metal structures, their varieties and design features.
7. Metal bunkers.
8. Metal silos.
9. Features of design and calculation of metal tanks.
10. Features of design and calculation of metal gas containers.
11. High-rise towers and masts. Principles of design and calculation.
12. Prestressed metal structures, methods of creating prestress.
13. Metal structures with using aluminum, titanium, vanadium elements and alloys thereof.

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