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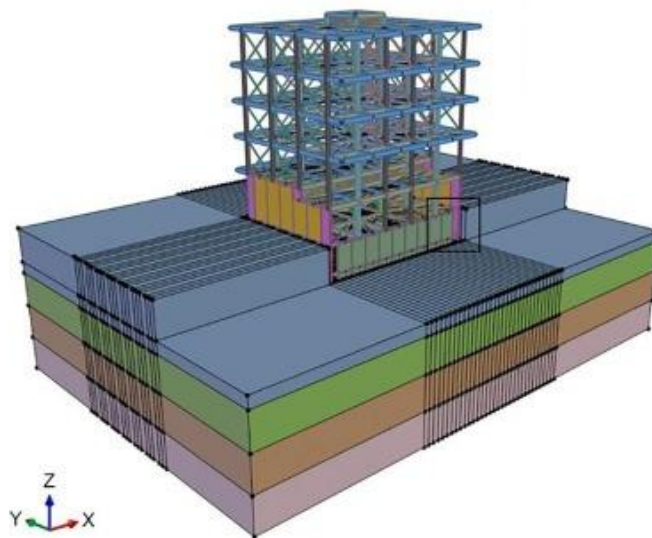
**O. M. BEKETOV NATIONAL UNIVERSITY OF URBAN
ECONOMY IN KHARKIV**

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MODELING OF A SOIL-STRUCTURE INTERACTION SYSTEM

DETAILED LECTURE PLAN

*(for applicants of the second (master's) level of higher
education of all forms of study in the specialty
G19 "Building and Civil Engineering")*



**Kharkiv
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This detailed lecture plan was compiled to help students of construction specialties at higher educational institutions in their preparation for classes and exams in the discipline of Modeling of a Soil-Structure Interaction System.

INTRODUCTION

This detailed lecture plan has been developed in accordance with the working program of the educational component “Modeling of a Soil-Structure Interaction System” and corresponds to the educational programs for the preparation of Masters in the specialty G19 - Construction and Civil Engineering.

The purpose of teaching this educational component is to train construction specialists who possess the skills to analyze a structure and its foundation as a single system, in accordance with current regulatory documents in construction. As a result of studying this discipline, students should know that the structure and its foundation must be considered in conjunction. They must be able to perform modeling of the "foundation-superstructure" system to account for their mutual influence on the stress-strain state of the building elements and the foundation, as well as to assess the mutual influence of buildings constructed in dense urban environments.

The educational component “Modeling of a Soil-Structure Interaction System” is a mandatory part of the educational programs for the preparation of Masters in the specialty G19 - Construction and Civil Engineering. It consists of three content modules: content module 1 "Creation of a Geotechnical Massif Model," content module 2 "Modeling of the calculation system “base-foundation-building”, and content module 3 "Geotechnical forecast of the impact of new construction on existing structures".

Content module 1 examines the history of the development of soil models. It analyzes and compares the models of Winkler, Pasternak, variable subgrade reaction coefficients, linearly deformable half-space, and a linearly deformable layer of finite width and finite distribution capacity. Methods for determining the coefficients of subgrade reaction are studied. Ways of creating models of the soil foundation are also explored.

Content module 2 analyzes the criteria for selecting a computational model of the foundation. It considers methods for creating a finite element mesh on a plane and the application of subgrade reaction coefficients. The formation of computational

schemes from volumetric elements is studied. The types of computational schemes for buildings are examined. The creation of the "foundation-superstructure" computational scheme, loading and analysis of the building's structural elements, analysis of forces in structures considering the differential settlement of column foundations, analysis of forces in structures considering the stiffness of the raft foundation, and analysis of the influence of foundation compliance on the stability analysis of the building are performed.

Content module 3 discusses methods for accounting for the mutual influence of foundations and buildings. It analyzes the choice of foundation installation methods, considering the impact on adjacent buildings and probable changes in engineering-geological and hydrogeological conditions. Engineering surveys in conditions of dense urban development, measures for the preservation of objects in the adjacent territory, destructive processes in the soils of the site, changes in the established groundwater level, and contamination of soils, surface, and groundwater are studied.

DETAILED LECTURE PLAN
FOR THE DISCIPLINE "MODELING OF A SOIL-STRUCTURE
INTERACTION SYSTEM"

CONTENT MODULE 1

Topic 1. Development of 2D Soil Base Models

1. History of the development of soil models.
2. The Winkler model.
3. The Pasternak model.
4. The model of variable subgrade reaction coefficients.
5. The model of a linearly deformable half-space.
6. Models of a linearly deformable layer of finite width and finite distribution capacity.

Topic 2. Development of 3D Soil Base Models

1. Finite elements for solving 3D problems in the theory of elasticity.
2. Creation of a 3D soil base model.

CONTENT MODULE 2

Topic 3. Selection of a Soil Base Model

1. Criteria for selecting a computational model of the foundation.
2. The "Zapyt" program, specifics of calculating subgrade reaction coefficients.
3. The "KROSS" program, specifics of its application in the "foundation-superstructure" system.
4. Generation of a finite element mesh in a plane.
5. Application of the modulus of subgrade reaction.
6. Creating analysis models from 3D elements.

Topic 4. Analysis of the Soil-Foundation-Structure System

1. Types of structural analysis models for buildings.
2. Creating a "soil-foundation-structure" analysis model.
3. Loading and analysis of structural elements.

4. Analysis of internal forces considering differential settlement of isolated foundations.
5. Analysis of internal forces considering raft foundation stiffness.
6. Analysis of the influence of foundation compliance on the building's stability analysis.

CONTENT MODULE 3

Topic 6. Assessment of the Mutual Influence of Buildings

1. Methods for accounting for the mutual influence of foundations and buildings.
2. Selection of foundation installation methods considering the impact on adjacent buildings and probable changes in engineering-geological and hydrogeological conditions.

Topic 7. Monitoring of Adjacent Development and Territory

1. Geotechnical investigations in dense urban environments.
2. measures for the preservation of adjacent structures, destructive processes in the site's soils.
3. Destructive processes in the site's soils, changes in the established groundwater level.
4. Contamination of soil, surface water, and groundwater.

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