Compulsory exam topics – 2024 Spring semester

Geotechnics I

1. Formation of soils
2. Phase (weight-volume) relationships
3. Grain size distribution test and hydrometer test
4. Atterberg limits
5. Compaction: purpose of compaction, technologies and quality control
6. Vertical stress in soil
7. Groundwater flow in soils
8. Determining the coefficient of permeability in laboratory and on the field
9. Quick condition (hydraulic failure)
10. Compression
11. Primary consolidation
12. Secondary consolidation
13. Mohr-Coulomb failure theory
14. Determining shear strength parameters in laboratory

Geotechnics II

1. Rankine earth pressure theory
2. Geotechnical design based on Eurocode: limit states, characteristic and design values, design approaches
3. Retaining structures: Gravity walls and types of gravity walls
4. Retaining structures: Embedded walls and types of embedded walls
5. Retaining structures: Reinforced soil walls and types of reinforced soil walls
6. Dewatering of earthworks, elements used for drainage
7. Quality control and its methods
8. Material classification, categories and general principles of material classification
9. Slope stability in general, calculation methods (for soils with no friction angle and no cohesion, Taylor's friction circle method)
10. In-situ tests in general and CPT
11. In-situ tests and dynamic probing, vane shear test, pressuremeter, SPT
12. Basic principles of earthquakes, wave types, intensity and magnitude
13. Liquefaction: phenomenon, susceptibility, cyclic-stress based empirical (simplified) calculation method
14. Methods of soil improvement
15. Geosynthetics: types and purposes

Geotechnics III

1. Discuss the factors influencing the bearing capacity of shallow foundations under drained and undrained conditions, including the impact of water table variations.
2. Explain the significance of stress distribution below foundation elements and how it impacts settlement predictions and bearing capacity.

3. Describe the main models of foundation failure, settlement, and bearing capacity, and their implications for soil deformation and shear plane development.
4. Compare various shallow foundation types (strip footings, isolated footings, slabs), highlighting their applications, limitations, and relevant design criteria.
5. Discuss empirical methods used in geotechnical engineering for determining bearing capacity and settlement, referencing commonly used in-situ tests.
6. Summarize Terzaghi's model for calculating shallow foundation bearing capacity under different conditions.
7. Compare methods for settlement calculation of shallow foundations, emphasizing lab versus in-situ tests.
8. Evaluate immediate, consolidation, and secondary settlements, explaining how each affects shallow foundation performance and design.
9. Analyze how cohesive versus non-cohesive soils impact shallow foundation settlement.
10. Discuss the concept of stress distribution under shallow foundations and its relevance to limiting depth calculations. Include the application of Jaky's theory.
11. Explain factors influencing immediate settlement of rigid and flexible foundations and their impact on settlement predictions.
12. Describe the Standard Penetration Test (SPT) and Cone Penetration Test (CPT) roles in settlement calculations, with pros and cons of each.
13. Discuss the principles and applications of the Menard pressuremeter test in shallow foundation design, including comparisons to the CPT.
14. Explain shape factors and their role in settlement calculations for shallow foundations, including determination methods.
15. Summarize the criteria and methods for verifying shallow foundation bearing capacity (ULS) and settlement/horizontal displacement (SLS).
16. Discuss deep foundation types (replacement piles, displacement piles) and their applications in geotechnical engineering.
17. Explain rigid-plastic theories for pile bearing capacity, including how soil type affects the bearing capacity of frictional versus cohesive soils.
18. Compare Menard pressuremeter and CPT methods for designing pile bearing capacity, highlighting each method's strengths and weaknesses.
19. Discuss the design criteria for retaining structures, including the key factors that influence their stability and performance. Provide examples of different types of retaining structures.
20. Explain the process of designing cantilever walls and the considerations for ensuring their stability. How do soil properties and loading conditions impact the design?