



Project No.  
4032CIV

Date  
2025

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EOTSS4032

Serial No  
4032/2025

Rev.  
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CIVIL

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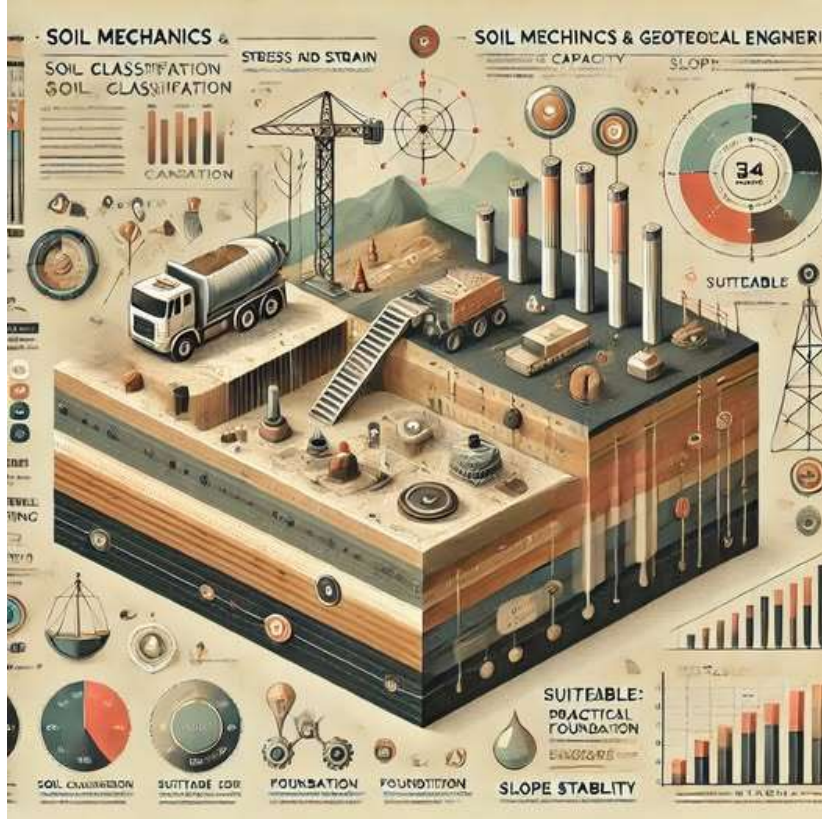
EOTSS/CIVIL/4032Soft-CIV/2025



المعهد الهندسي لخدمات التكنولوجيا والبرمجيات

Engineering office for Technology and Software Services

## Course Title: Soil Mechanics and Geotechnical Engineering



Code: 4032-CIV

**Duration: 7 Weeks**

**Format: Blended (Theoretical Sessions + Lab & Software Work + Project-Based Learning)**

**Language: Bilingual (English / Arabic)**

### 1. Introduction

Geotechnical engineering forms the foundation of all structural and infrastructural projects. Understanding soil behavior, classification, and foundation design is critical for safe and economical construction. This course provides in-depth knowledge of soil mechanics, geotechnical testing, and foundation engineering—essential for any civil engineer involved in structural design or site preparation.

### 2. Course Description

Main Branch: United building – E Shams –Front NBE  
, El Siouf \_Alexandria

Tel: 01102060500-01144470856



الفرع الرئيسي: عمارات المتحدة – عمارة عين شمس – امام البنك  
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This 7-week intensive course covers fundamental and advanced topics in soil mechanics and geotechnical design. It integrates theoretical understanding with real-world application through lab work, case studies, and geotechnical software usage. The course is highly practical and aligned with the latest international design standards and site safety practices.

#### ■ Course Outline – Detailed Structure

**Course Title:** Soil Mechanics and Geotechnical Engineering

**Code:** 4032-CIV

**Duration:** 7 Weeks

#### ◆ Week 1: Introduction to Soil Mechanics

##### • Objectives:

- Understand the role of soil mechanics in civil engineering.
- Identify soil as a construction material and its engineering relevance.

##### • Topics Covered:

- Origin and formation of soils.
- Phases of soil (solid, liquid, gas).
- Basic soil properties (void ratio, porosity, unit weight).
- Stress in soil (total, effective, pore water pressure).
- Soil-water relationship basics.

#### ◆ Week 2: Soil Classification and Properties

##### • Objectives:

- Classify soils using standard systems (USCS, AASHTO).
- Analyze physical properties of different soil types.

##### • Topics Covered:

- Particle size distribution (sieve and hydrometer analysis).
- Consistency limits (liquid limit, plastic limit, shrinkage limit).
- Soil structure and fabric.
- Soil compaction and its significance.
- Field identification and classification.

#### ◆ Week 3: Soil Testing (Lab & Field)

##### • Objectives:

- Conduct geotechnical tests to assess soil strength and permeability.
- Interpret lab and field data for design decisions.

##### • Topics Covered:

- Standard Proctor and Modified Proctor tests.
- Direct shear test, triaxial compression test, unconfined compression test.
- Permeability tests (falling head, constant head).
- Field tests: SPT, CPT, plate load test.

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- Report writing and interpretation of test results.

#### ◆ Week 4: Shallow Foundation Design

##### ● Objectives:

- Analyze and design spread footings and mat foundations.
- Evaluate bearing capacity and settlement.

##### ● Topics Covered:

- Types of shallow foundations.
- Terzaghi and Meyerhof bearing capacity equations.
- Immediate and consolidation settlement.
- Foundation design under eccentric loads.
- Structural and geotechnical design coordination.

#### ◆ Week 5: Deep Foundation Design

##### ● Objectives:

- Understand principles of pile and pier foundations.
- Design deep foundations under axial and lateral loads.

##### ● Topics Covered:

- Classification of piles: driven, bored, CFA, micropiles.
- Load transfer mechanisms (skin friction & end bearing).
- Negative skin friction and group effects.
- Pile load testing methods.
- Pile design examples (manual + software-assisted).

#### ◆ Week 6: Slope Stability and Earth Retaining Systems

##### ● Objectives:

- Assess slope stability for cut/fill slopes.
- Analyze retaining wall design principles.

##### ● Topics Covered:

- Types of slope failures and causes.
- Limit equilibrium methods (Fellenius, Bishop, Janbu).
- Soil nailing, geogrids, and reinforcement techniques.
- Earth pressure theories (Rankine, Coulomb).
- Retaining wall types: gravity, cantilever, anchored.

#### ◆ Week 7: Final Project – Foundation Design

##### ● Objectives:

- Apply course knowledge to a real-life project.
- Present complete geotechnical documentation.

##### ● Topics Covered:

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- Site profile interpretation and investigation planning.
- Design of suitable foundation system based on soil data.
- Use of geotechnical software for modeling.
- Technical report and design drawings.
- Group presentation or defense of the proposed design.

#### Optional Tools/Software Suggested

- **Plaxis 2D/3D**
- **GeoStudio / SLOPE/W**
- **SAFE / Foundation Design Tools**
- **Microsoft Excel for calculations**
- **AutoCAD / Civil 3D (for documentation)**

#### Course Objectives

- Build a solid foundation in soil mechanics and geotechnical engineering
- Teach how to conduct and analyze lab/field tests for soil behavior
- Train on design methods for shallow and deep foundations
- Apply geotechnical knowledge to slope stability and soil-structure interaction
- Integrate modern software tools into geotechnical problem-solving

#### Learning Outcomes

By the end of this course, participants will be able to:

- Classify soils using international systems (USCS, AASHTO)
- Determine essential soil properties and parameters via testing
- Design foundation systems based on soil conditions and loads
- Evaluate safety and stability of slopes and retaining walls
- Use analysis software to simulate real foundation conditions
- Complete a geotechnical design project for a real or hypothetical structure

#### 9. Weekly Breakdown

##### **Week Topic**

Week 1 Introduction to Soil Mechanics: Basic concepts, soil formation, and role in design

Week 2 Soil Classification & Properties: Grain size, Atterberg limits, compaction

Week 3 Laboratory & Field Testing: Standard Proctor, SPT, CPT, permeability, shear strength

Week 4 Design of Shallow Foundations: Bearing capacity, settlement, design procedures

Week 5 Design of Deep Foundations: Pile types, load transfer, negative skin friction

Week 6 Slope Stability & Retaining Structures: Failure mechanisms, reinforcement techniques

Week 7 Final Project: Complete design and documentation of foundation system for a structure

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