



**NATIONAL TECHNICAL UNIVERSITY OF ATHENS**  
**SCHOOL OF CIVIL ENGINEERING - DEPARTMENT OF**  
**GEOTECHNICAL ENGINEERING**  
**SOIL MECHANICS LABORATORY**

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**1. X-Ray tomography**

Three-dimensional X-ray scans will be examined to identify microstructural features such as cracks, pore networks, and fabric heterogeneities in soil and/or concrete samples.

**2. Unsaturated soil testing**

Unsaturated soils exist in abundance in areas with hot semi-arid climate but can also be found in the Mediterranean, near the surface and above the water table. Lowering of the ground water table is common, irrespective of climate conditions, simply due to excessive irrigation e.g. in Thessaly, Greece. For these soils upon wetting i.e. due to precipitation over continental areas, water infiltration and soil permeability, factors of major importance in the prediction of floods, are essentially unknown. When in the presence of expandable clay minerals, they exhibit extreme swelling potential upon wetting.

In this Diploma thesis state of the art equipment i.e. a triaxial apparatus specifically built for unsaturated soils will be used to perform tests and investigate these behaviours. An oedometer cell also adapted for the testing of unsaturated soils will be used to study the behaviour under normal compression.

**3. Soil retention curves** for unsaturated soils will be established in the lab using the 'Plate testing' device. These are simple tests that will be combined with more complicated tests like the abovementioned tests already existing in the lab, to be presented in the Diploma thesis.

**4. The use of fly ash in soil improvement**

The use of fly ash as a stabilizing agent can provide sufficient cementation to improve the local soil properties for site remediation. The cementitious behaviour of fly ash has many geotechnical applications in slope stability, shallow foundations and highway construction. It can enhance natural soil and/or subgrade stability by increasing its strength, control the swell properties of expansive soils, act as a drying agent to facilitate compaction and alter the infiltration capacity of the treated soil (ref). More recently, its application to the treatment of waste materials currently lying in coalfield dumps has been considered as part of the post-mining planning in Europe. A controlled mix of coal mining waste geomaterials with fly ash, also a by-product of burning pulverized coal, can return an improved state of properties in terms of strength and stiffness thus facilitating reclamation through reuse in a circular economy.

In this Diploma thesis a detailed literature review on the methods of soil stabilization with emphasis on sustainable processes, will be accompanied by a series of laboratory oedometer and triaxial tests on mixtures of fly ash with kaolin.

**5. Pull out tests**

A series of large scale pull out tests is already performed. Analysis and presentation of the results along with numerical simulation will complete a diploma thesis. Numerical simulation involves FE testing.

**6. Laminar box tests**

A large scale laminar box (see: [geotechlab.civil.ntua.gr](http://geotechlab.civil.ntua.gr)) will be set up and used for testing in the seismic table of the soil mechanics lab.