5. THE DETERMINATION OF COMPRESSION PROPERTIES OF SOILS

The load-induced deformation of soils can be determined by several laboratory methods, but the application of some side support is usually needed. The soil can be considered as an infinite halfspace by foundations. Thus the deformations in side directions are inhibited. In laboratories this condition can be best generated in triaxial cells, but the so-called oedometric tests with inhibited side deformations (Figure 1.22) are the most widely used methods because of their simplicity. In this case the side deformations are prevented and the soil is loaded in a closed ring. This is the stress condition of compression.

The soil sample is placed in a steel ring. Its diameter is $\mathrm{D} = 7.5 - 10.0\ \mathrm{cms}$, its height is $\mathrm{H} = 1.5 - 2.5\ \mathrm{cms}$, (a $\frac{H}{D} = 2$ rate is needed). Through the porous filter under and above the soil sample, the water (forced out of the sample because of the compression) can be drained.The deformation of the sample can be only vertical because of the rigid bin of the ring. The load is applied in the centre of the load distribution plate placed above the upper filter stone. The usual load steps are the following during these tests: $50 - 100 - 200 - 400 - 800\ kPa$, but offloading and re-loading can be applied also. During the test the vertical deformation of the sample (ΔH) is measured, the temporal evolution of the deformations and the specific deformations ε_z are determined:

$$\varepsilon_z = \frac{\Delta H}{H}$$

The load is applied gradually. Each load step needs more time to transform neutral stresses into effective stresses. A load step runs until the sample becomes consolidated. For tests of clays this usually takes 5-24 hours.

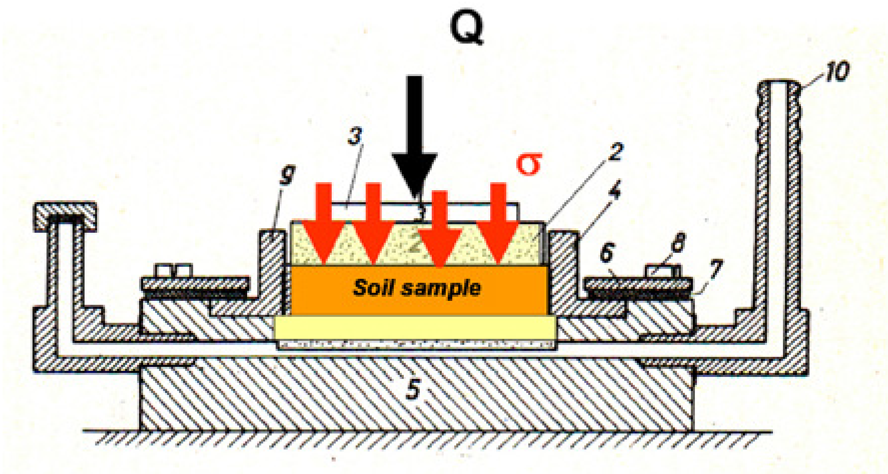

Figure 1.22: Cross section of the oedometer
Signs: 2 filter; 3 load distribution plate; 4 and 9 sample holder rings; 5 bottom plate; 6-7-8 sealing plate, clamp ring, screws; 10: pipe for water inlet and outlet

The processing of the results gives the compression curve (Figure 1.23). The compression curve can be described by a power function for the majority of soils. This processing is advantageous for computer calculations, since the hardening-up properties of the soils can be well characterized.

The compression modulus of soils can be defined as the stress by unit specific compression, thus it is a function of stress for compressive soils. The compression modulus of the soil is at $\sigma = 100\ \frac{kN}{m^2}$.

Other deformation phenomena can be examined by oedometer tests:

- Loess slump: the potential load of the soil is applied on the sample, than the sample is irrigated with water and the static and the sudden slump is measured and determined as specific compression.
- Swelling of clays, the determination of the swelling pressure: The increase of the void ratio (swelling) is measured when applying real normal load, or the pressure which stops the swelling entirely is determined.

The oedometer can be used also for the determination of the hydraulic conductivity of soils. In this case, water pressure is applied to the sample through the tube marked 10 in Figure 1.22 and the water quantity leaking through the sample is measured by constant water pressure, or the pressure drop is measured by variable pressure. This method is applicable primarily to low permeability soils. An advantage is the possibility of the determination of the change of the hydraulic condutcitivity as a function of the compactness of the soil (performing the test gradually at different load steps).

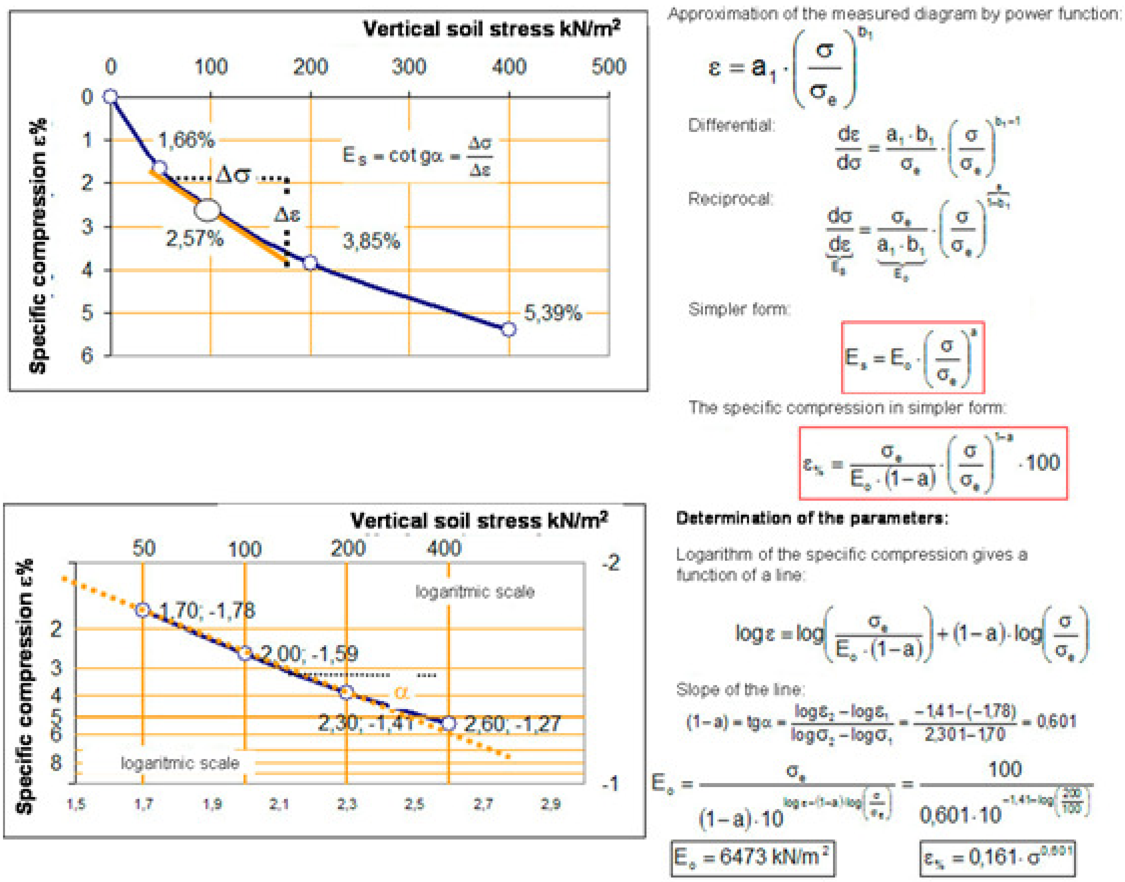

Figure 1.23: Processing of the results of the compression test (Mecsi, 2009)

A tananyag kifejlesztése a TÁMOP 4.1.2-08/1/A-2009-0033 pályázat keretében valósult meg.