SOIL MECHANICS I
LABORATORY CLASS 3: OEDOMETER TEST

INTRODUCTION

During the laboratory class the behaviour of fine-grained soil in one-dimensional compression is studied in the oedometer. The specimen is a cylinder, typically of diameter from 50 to 100 mm and height 20 to 30 mm. The radial strains are zero throughout the test. In the conventional test the specimen is water saturated and drained from both ends being sandwiched between two porous stones. The total axial (vertical) stress is applied through a lever arm. The change in specimen height is measured by a dial gauge.

TEST PROCEDURE

The reconstituted specimen of kaolin clay ($G_s = 2.65$) has been prepared from a paste above w_L and has been consolidated by the axial stress of σ_v =100 kPa. Before applying further load steps the specimen's weight and height shall be determined.

The specimen will be loaded and unloaded in several steps: A 100→200 kPa, B 200→400 kPa, C 400→800 kPa, D 800→1600 kPa, E 1600→800 kPa, F 800→400 kPa, G 400→200 kPa, H 200→100 kPa and I 100→0 kPa. At each loading stage the change of the height is recorded while consolidation takes place. The readings will be taken at suitable intervals, for example as suggested in the table below (convenient for manual plotting). The way of loading and the exact sequence of steps will be specified by your supervisors at the lab.

At the end of the test, after final unloading (removing all weghts), take the final dial gauge reading. After removing the dial gauge and the top platen measure the final height of the specimen by the calipers. Immediately after that remove the free water from the soil surface and weigh the specimen (with the ring), put the specimen in the oven to determine the water content, and void ratio.

DATA PROCESSING

From the phase diagram it follows that during the test $\Delta v/v = \Delta H/H$ where H id the height of specimen, v is specific volume (v=1+e) and Δ is an increment (for example $\Delta v = v_{final} - v_{initial}$). At compression the changes in the dimensions are negative, so take care to have the signs right. For each measurement of the height of the sample it is then possible to calculate the specific volume and void ratio (its change during the test). Your initial dimensions will be measured before you first loading A (from 100kPa to 200kPa), and then the changes in dimensions and the strains will be computed consecutively until the end of the test.

From the initial water content and specific gravity G_s calculate the void ratio before the test. Calculate also the void ratio at the end of the test from the final water content determined after the test. Using the above relationship check (compute) the e_f from e_0, and vice versa. Further, from the known dimensions of the specimen and dry and specific densities calculate also the initial and final void ratios. Comment on the differences in the obtained values of the initial void ratio, and choose the most appropriate (representative) way of determining it for your specimen.

For all your loading/unloading steps A to I plot the time-settlement curves (graphs ΔH: time t, ΔH: √t, ΔH: logt). From the loading steps determine coefficient of consolidation c_v (try to use both Casagrande's and Taylor's methods and decide which was appropriate for your test). From the final deformations of each step plot the compression curves $\varepsilon_V:\sigma'$, $e:\log\sigma'$, $\varepsilon_V:\log\sigma'$ and determine the oedometer modulus E_{oed}, m_v, compressibility index C_c and modified compressibility index $C_{c\varepsilon}$ for both loading and unloading. Determine the intervals at which the quantities may be considered parameters (constants).

REPORT

In your report:

1) Give the above quantities (E_{oed}, m_v, C_c, $C_{c\varepsilon}$) and graphs;
2) Give your comments on the correspondence/deviation of your experiment with/from the theory;
3) Summarise the test and comment on its ease, problems if any, accuracy, determination of void ratio, etc.

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DATA

Oedometer Ring

height: mm; diameter: mm; mass: g

Specimen Height

Initial: H_0= mm

Change of Height before stage A: ΔH_{0-A}= mm

Final Reading (after the final unloading to σ_v=0): ΔH_{F-f}= mm

Final Height (after removing the specimen from the ring): H_f= mm

Water content and void ratio before the test

Moist Specimen + Ring : g; Dried Specimen + Ring : g;

w_0=

$e_0=w_0\ \rho_s/\rho_w$ =

Water content and void ratio before the test

Moist Specimen + Ring : g; Dried Specimen + Ring : g;

w_f=

$e_f=w_f\ \rho_s/\rho_w$ =

Initial WC determined from the deformation during the test: $e_0=e_f-\Delta e$=

Porosity / Void Ratio prior to the test FROM THE SPECIMEN DIMENSIONS

Initial Specimen Volume:

Dried Mass:

Porosity / Void Ratio: e_0= n_0=

Loading step																												
Initial and final stress kPa																												
Date & time																												
Recommended time interval		real t	read.	settl.	real t	read.	settl.	real t	read.	settl.	real t	read.	settl.	real t	read.	settl.	real t	read.	settl.	real t	read.	settl.	real t	read.	settl.	real t	read.	settl.
t	√t [√min]	min	mm	mm	min	mm	mm	min	mm	mm	min	mm	mm	min	mm	mm	min	mm	mm	min	mm	mm	min	mm	mm	min	mm	mm
0	0																											
8s	0,37																											
15s	0,5																											
30s	0,71																											
45s	0,87																											
1 minute	1																											
2 minutes	1,41																											
3	1,73																											
4	2																											
6,25	2,5																											
9	3																											
12,25	3,5																											