

CONSOLIDATION TEST

SOIL MECHANICS

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CONSOLIDATION TEST

Consolidation is defined as the reduction of the volume of a soil due to the expulsion of water. This will be accompanied by the dissipation of pore water pressures.

A laboratory consolidation test is performed on an undisturbed sample of a cohesive soil to determine its compressibility characteristics. The soil sample is assumed to be representing a soil layer in the ground.

A conventional consolidation test is conducted over a number of load increments. The number of load increments should cover the stress range from the initial stress state of the soil to the final stress state the soil layer is expected to experience due to the proposed construction.

Increments in a conventional consolidation test are generally of 24 hr duration and the load is doubled in the successive increment.

In this practical class one load increment of a multi increment consolidation test is conducted and the data will be analysed to obtain the compressibility characteristics of the soil.

The compressibility characteristics of the soil are;

- (a). Parameters needed to estimate the amount of consolidation settlement
- (b). Parameters needed to estimate the rate of consolidation settlement in the field.

Using the data from a single load increment of the test, only the coefficient of volume compressibility m_v can be estimated. Data from all the load increments should be combined to draw the e vs $\log \sigma$ graph and to obtain the compression index C_c - the other parameter used to estimate the consolidation settlement.

The rate of consolidation settlement is estimated using the Coefficient of consolidation C_v . This parameter is determined for each load increment in the test. In this laboratory assignment, the coefficient of consolidation should be estimated using two methods - the root time method (Taylor's method) and the log (time) method - Casagrande's method.



Course work report - Important points to remember

1. Outline the objectives of the test
2. List the equipment used in the test
3. Draw a diagram of the apparatus
4. Describe the test procedure in your own words
5. Enter the observations in the sheets provided
6. Carry out the computations, draw the necessary graphs in the sheets provided and estimate
 - (a). The coefficient of volume compressibility for the load increment
 - (b). The coefficient of consolidation for the increment by both the root time method and the log (time) method.
7. Discuss the importance and relevance of the test, the parameters obtained, shortcoming and possible ways of improvement.

Laboratory Consolidation Test and Analysis

Data obtained from one increment in a conventional multi increment Consolidation Test

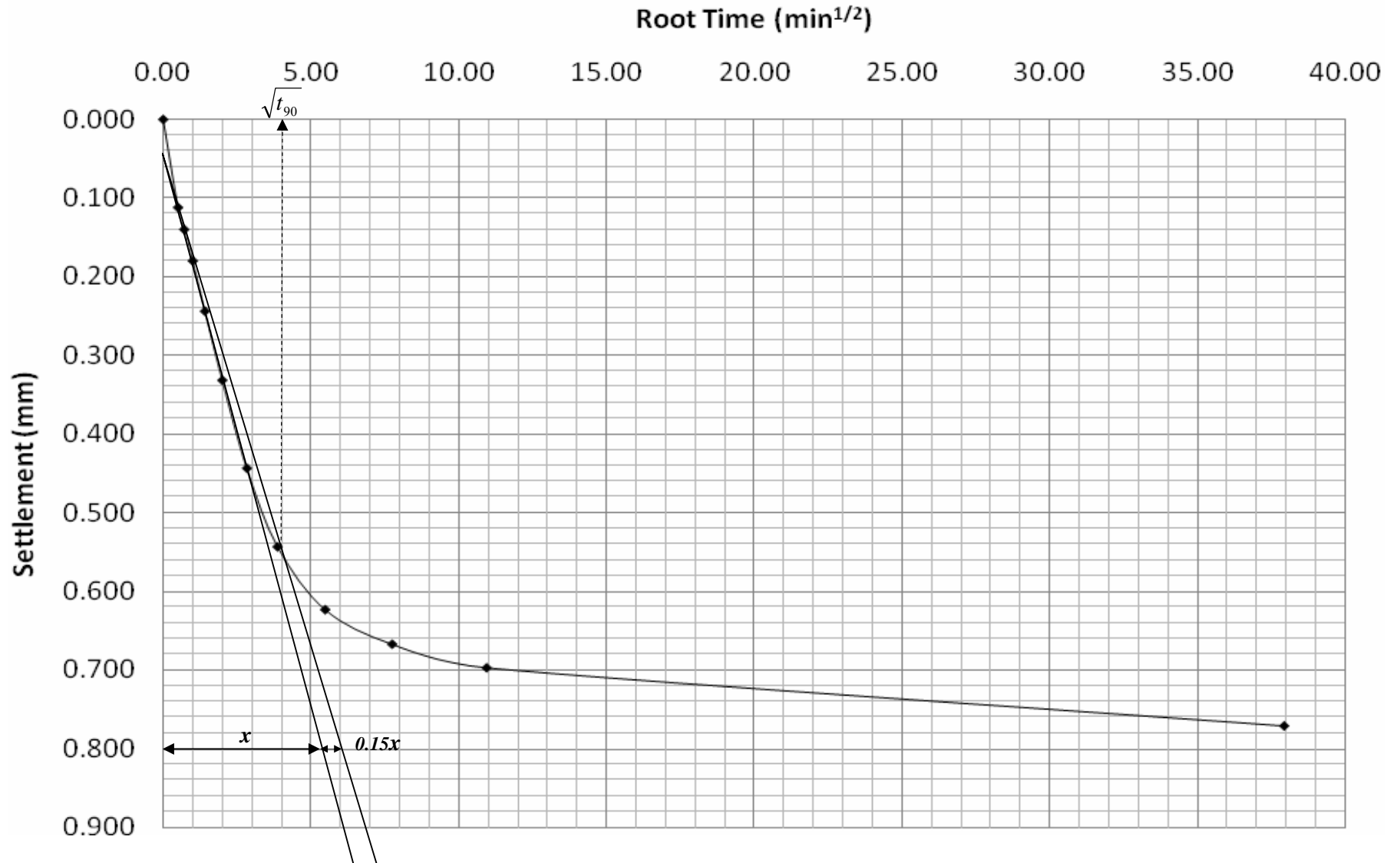
Sample Diameter (mm)	= 50.00
Initial Sample thickness (mm)	= 20.00*
Dial gauge reading at the start of the test (mm)	= 0.000
Dial gauge reading at the start of the current increment (mm)	= 3.744
Initial Moisture content of the sample %	= 43.43
Specific gravity of the particles	= 2.20

Current load increment is from 60 kN/m² to 120 kN/m²

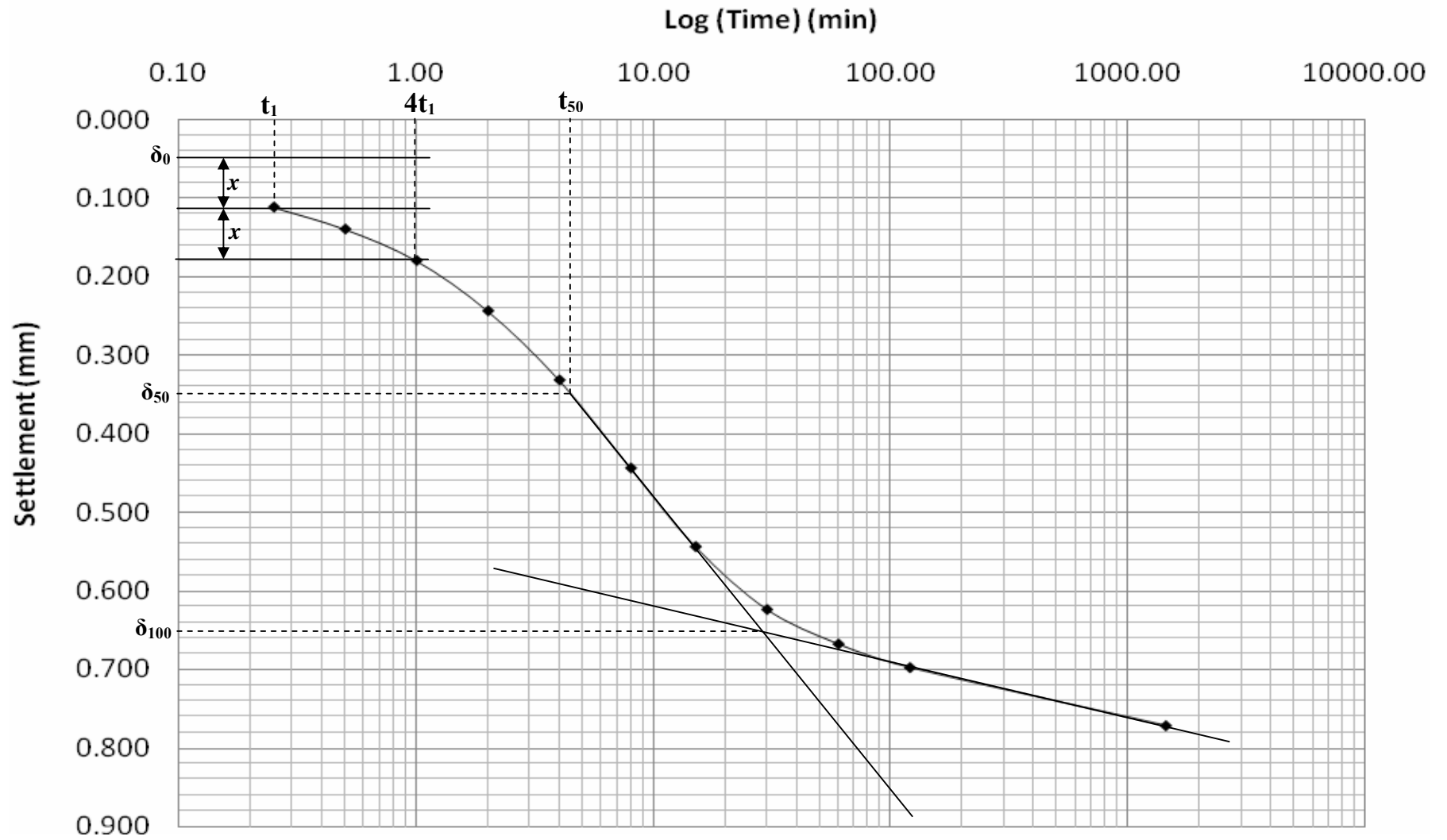
Date	Time	Time Elapsed (min)	Root Time (min ^{1/2})	Dial Reading		Dial Reading (mm)	Settlement (mm)
				Major	Minor		
26/06/2009	2:00 PM	0.00	0.00	3.6	72	3.744	0.000
		0.25	0.50	3.8	28	3.856	0.112
		0.50	0.71	3.8	42	3.884	0.140
		1.00	1.00	3.8	62	3.924	0.180
		2.00	1.41	3.8	94	3.988	0.244
		4.00	2.00	4.0	38	4.076	0.332
		8.00	2.83	4.0	94	4.188	0.444
		15.00	3.87	4.2	44	4.288	0.544
		30.00	5.48	4.2	84	4.368	0.624
		60.00	7.75	4.4	6	4.412	0.668
		120.00	10.95	4.4	21	4.442	0.698
		1440.00	37.95	4.4	58	4.516	0.772

* Sample thickness is 20 mm at the start when the load is 0 kN/m². At the beginning of the load increment 60 – 120 kN/m², sample has already settled 3.744 mm and the sample thickness is 16.256 mm.

Root Time Plot (Taylor's Method)



Log (Time) Plot - Casagrande's Method



Specimen Calculations

Coefficient of Volume Compressibility(m_v)

$$m_v = \frac{\Delta h}{\Delta \sigma \times H} = \frac{0.722}{60 \times 16.256} = 7.91 \times 10^{-4} \text{ m}^2/\text{kN}$$

Coefficient of Consolidation (C_v)

a) By the Square Root Time (Taylor's) Method

$$\sqrt{t_{90}} = 4.0 \text{ min}^{1/2}$$

$$\sqrt{t_{90}} = 16 \text{ min}$$

$$C_v = \frac{T_{90} \times d^2}{t_{90}} = 0.848 \times \left(\frac{16.256/2}{16} \right)^2 = 3.5 \text{ mm}^2/\text{min} = 1.84 \text{ m}^2/\text{year}$$

b) By the Log (Time) – Casagrande's Method

$$\delta_0 = 0.05 \text{ mm}$$

$$\delta_{100} = 0.65 \text{ mm}$$

$$\delta_{50} = \frac{0.05 + 0.65}{2} = 0.35 \text{ mm}$$

$$t_{50} = 4.68 \text{ mm}$$

$$C_v = \frac{T_{50} \times d^2}{t_{50}} = 0.197 \times \left(\frac{16.256/2}{4.68} \right)^2 = 2.78 \text{ mm}^2/\text{min} = 1.46 \text{ m}^2/\text{year}$$