Research Paper Engineering

Effect of H/D Ratio on Stress Strain Characteristics of Clayey Soil in Triaxial Test

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ABSTRACT

A comparative study of the clayey soil behaviour under stress and strain is presented based on the data obtained from a series of strain controlled unconsolidated undrained shear tests performed on CH soil collected from Bagodara region of Gujarat. The paper concentrates on the effect of H/D ratio of sample on the stress strain behavior of soil. The H/D ratios used for this study are 0.5, 1.0 and 1.5 test at different cell pressures of 50 kPa, 100 kPa and 150 kPa. The stress values changes with values of strain with change in H/D ratio of the sample.

Keywords : H/D ratio, Triaxial test, stress, strain

INTRODUCTION

It is more precise to model stress and strain state in the soil using a triaxial apparatus. Triaxial test is the most widely used test method for determining the strength and stress-strain properties of soil. K. H. Head suggests that due to friction near the platens a so-called dead zone is formed between Triaxial sample ends and the platens [4]. That dead zone causes a non-uniform distribution of stress and strain and non uniform distribution of pore pressure in case of an undrained test. The use of lubricated ends eliminates the dead zones and protects from a wrong increase in measured strength due to the end restraint. The length of sample should be decreased from the standard ratio of height and diameter 2:1 to 1:1.

C. K. Januskevicius and E. Vey for measuring stresses and strains in triaxial sample used embedded gauges. Samples were 12,7 cm in diameter and 27.94 cm in height. They were vertically loaded at constant rate of strain and confined by horizontal pressure. The results of the strain gauge show a non-uniformity of strain along the sample length. In the middle of the sample (at its axis) the strains were found to be higher than the average ones, whereas they were less than average at the distance of 3.81 cm from the sample ends (at its axis). The strains were lower at the distance of 3.81 cm from the sample bottom than at the same distance from the sample top (at its axis).

LABORATORY INVESTIGATION

Soil sample for carrying out experiments is collected from Bagodara region, Gujarat. The percentage of Gravel, Sand and Clay + Silt is 2%, 10% and 88 % respectively. The liquid limit and plastic limit of sample is 70% and 21% respectively. Thus soil can be classified as CH. The MDD and OMC of the soil is 1.57 kg/cm^3 and 22 % respectively. The Triaxial tests were performed on the soil sample remoulded at MDD and OMC. The strain rate of the test was kept constant at rate of 1.25 mm/min. A 25 mm dial gauge was used to measure the deformation of sample during testing with least count of 0.01 mm. A proving ring of 1000 N capacity was used for measuring the loading on the sample.

TESTING METHODOLOGY

Unconsolidated undrained Triaxial test were conducted on the soil sample with different H/D ratio 0.5, 1 and 1.5. The soil sample is then remolded at MDD and OMC using standard proctor test method. The soil sample is the prepared using sampler tubes of 38 mm diameter. The soil sample is then extracted from the sampler tubes using sample extruder. The samples extracted are then trimmed to required length to obtain the H/D ratio of 0.5, 1 and 1.5. These samples are then used for testing. The UU triaxial test is the carried out with different cell pressures of 50 kPa, 100 kPa and 150 kPa for different H/D ratio of the soil samples.

RESULTS AND ANALYSIS

Different trials of unconsolidated undrained triaxial test for different H/D ratios are carried out at different cell pressures (s_3) of 50, 100 and 150 kPa. The results of the stress strain values obtained are tabulated in Table 1

Table 1 : Observed Testing Data

H/D = 0.5						H/D = 1.0						H/D =1.5					
s_3 = 50 kPa		s_3 = 100 kPa		s_3 = 150 kPa		s_3 = 50 kPa		s_3 = 100 kPa		s_3 = 150 kPa		s_3 = 50 kPa		s_3 = 100 kPa		s_3 = 150 kPa	
Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain	Stress	Strain
0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
34	0.007	11	0.007	34	0.007	11	0.007	11	0.007	11	0.007	11	0.007	23	0.007	11	0.007
68	0.013	34	0.013	79	0.013	34	0.013	34	0.013	45	0.013	34	0.013	45	0.013	34	0.013
101	0.020	67	0.020	112	0.020	56	0.020	67	0.020	67	0.020	45	0.020	67	0.020	45	0.020
112	0.026	89	0.026	123	0.026	100	0.026	89	0.026	100	0.026	67	0.026	89	0.026	67	0.026

122	0.033	111	0.033	133	0.033	111	0.033	122	0.033	122	0.033	78	0.033	100	0.033	89	0.033
132	0.039	121	0.039	143	0.039	121	0.039	132	0.039	132	0.039	99	0.039	110	0.039	110	0.039
131	0.046	142	0.046	153	0.046	131	0.046	142	0.046	142	0.046	109	0.046	131	0.046	120	0.046
141	0.053	152	0.053	163	0.053	141	0.053	152	0.053	163	0.053	109	0.053	141	0.053	130	0.053
140	0.059	162	0.059	173	0.059	140	0.059	173	0.059	173	0.059	119	0.059	151	0.059	140	0.059
139	0.066	171	0.066	171	0.066	139	0.066	171	0.066	193	0.066	129	0.066	150	0.066	150	0.066
149	0.072	181	0.072	181	0.072	138	0.072	170	0.072	202	0.072	128	0.072	160	0.072	160	0.072
148	0.079	190	0.079	190	0.079	148	0.079	179	0.079	211	0.079	127	0.079	158	0.079	169	0.079
157	0.086	189	0.086	199	0.086	147	0.086	178	0.086	210	0.086	126	0.086	168	0.086	178	0.086
167	0.092	198	0.092	198	0.092	146	0.092	177	0.092	208	0.092	114	0.092	167	0.092	177	0.092
165	0.099	196	0.099	196	0.099	145	0.099	176	0.099	207	0.099			176	0.099	186	0.099
174	0.105	205	0.105	205	0.105	144	0.105	164	0.105	205	0.105			174	0.105	185	0.105
173	0.112	193	0.112	204	0.112	132	0.112			204	0.112			173	0.112	193	0.112
				202	0.118					192	0.118			162	0.118	202	0.118
				211	0.125											201	0.125
				209	0.132											199	0.132
				217	0.138											188	0.138
				206	0.145												

The stress strain characteristics for different cases are as under

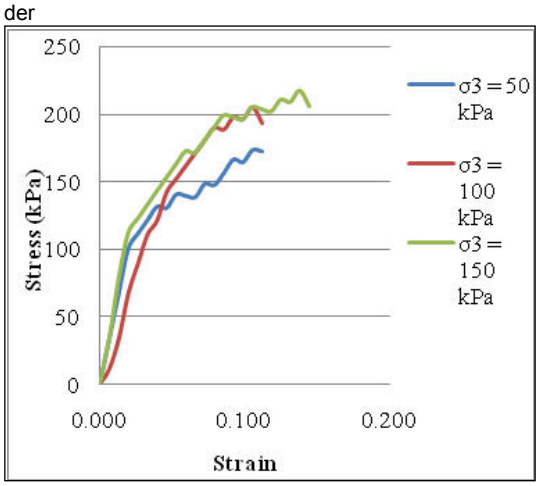

Fig 1 : Stress strain curve for H/D ratio 0.5 with different s3

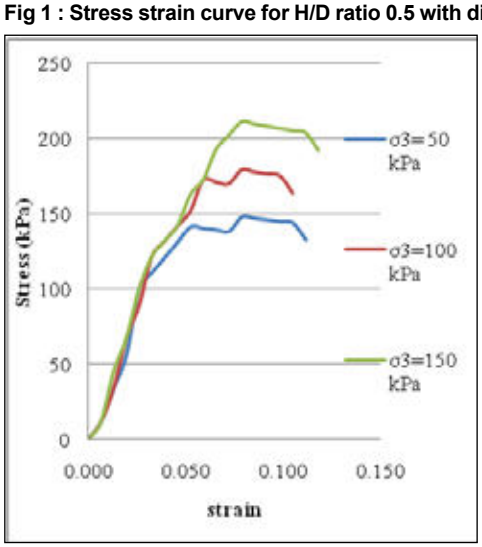

Fig 2 : Stress strain curve for H/D ratio 1.0 with different s3

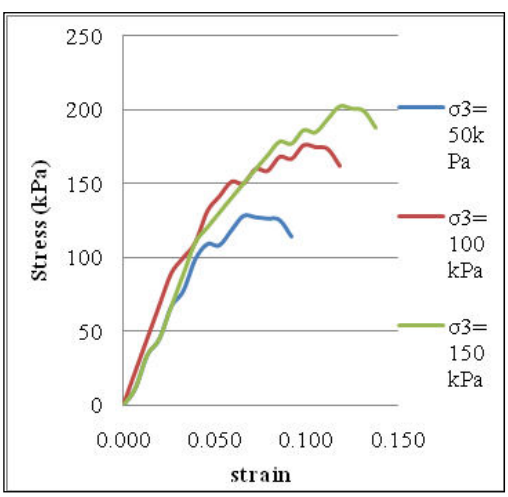

Fig 3 : Stress strain curve for H/D ratio 1.5 with different s3

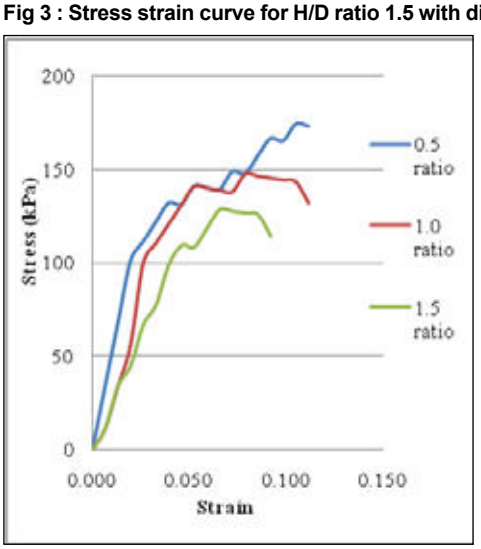

Fig 4 : Stress strain curve for s3 = 50 kPa with different H/D ratio

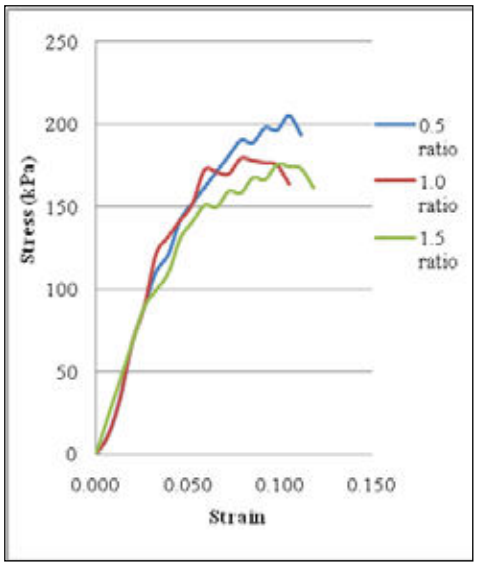

Fig 5 : Stress strain curve for s3 = 100 kPa with different H/D ratio

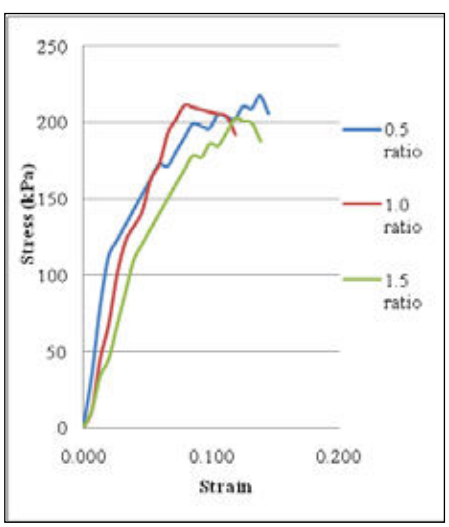

Fig 6 : Stress strain curve for s3 = 150 kPa with different H/D ratio

Conclusions

The following conclusions can be made based on the results obtained

1. The significant change in modulus of elasticity is not observed with constant H/D ratio and various cell pressures
2. The maximum stress value increases with increase in the cell pressures keeping the H/D ratio constant.
3. The modulus of elasticity decreases with increase in the H/D ratio keeping the cell pressure constant
4. Higher stress value is observed for Lower H/D ratio sample with higher value of cell pressures i.e 217 kPa for H/D ratio of 0.5 and cell pressure of 150 kPa.
5. Lower stress value is observed for higher H/D ratio and lower cell pressure i.e 129 kPa for sample with H/D ratio of 1.5 and cell pressure of 50 kPa.
6. The higher strain of sample is observed with increase in the value of the cell pressures with constant H/D ratio.

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