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CHARACTERISTICS OF SOME WET CLAY SOILS AFTER REMOULDING TREATMENTS

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ABSTRACT

In order to derive homogeneous remould soil sample, which is very important for obtaining reliable experimental results in terra-mechanics research, the characteristics of two clay soils at high moisture contents after remoulding treatment were investigated. It was found that with the remoulding process employed the coefficients of variation was less than 1.2% for the soil density and the soil could be treated as fully saturated soil.Therefore, the remould process was satisfactory. The strength of wet soil will decrease while it is remoulded and will restore after a period of time. Some suggestions were given follow the results of the drop cone test.

INTRODUCTION

Compare with original structure soils, remould soils are structureless and more unstable. Their characteristics highly rely upon the remoulding process, Head (1982). Despite of these disadvantages, remould clay soils are still widely used in soil-machine system research. The reasons are:

a. For the laboratory experiments, which is very important for the research of soil operation machine, the remould soils are almost the only choice, especially for the soil bin experiments;

b. It is possible to derive more homogeneous soil samples using remould soil than using original soil in site, and therefore, obtain more reliable experimental results.

In this paper, remoulding process for some clay soils with high moisture contents are investigated. The homogeneity and reliability of the remould soils are discussed. Some suggestions are proposed.

MATERIALS AND METHODS

1. Soils

Two clay soils with high moisture contents were used in the experiments. Table 1 provides details of the soils mechanical analysis determined by the pipette method, Atterberg Limits, specific gravity and particle density. The first soil was a heave clay, and the second soil was a light clay.

Pilot experiments showed that when the moisture content was higher than 55%, the first soil was very weak and stable soil specimens could not be formed. Hence, 50% moisture contents (d.b.) was chosen as the wettest soil for the experiments, with 30% as the driest, being at the plastic limit (PL), the third moisture content 40% was selected as midway between this range. For the second light clay, the approximate midway value between plastic limit and liquid limit, 32% moisture content was chosen.

2. Remoulding Processes

soils with the required moisture contents were remoulded to make specimens for the experiments by the following processes:

a) Breaking off the wet soil into small clods (size) and allowing them to dry in the open air.

b) Using a grinding machine to crush the air dry soil clods into fine soil aggregates.

c) Mixing a known mass of dry fine soil with a calculated amount of water. The moisture distributed evenly and the pores filled and the degree of saturation was increased by kneading the mixture soil. This was then left to equilibria for 10 days.

d) Using suitable mould to make soil specimens.

e) Remoulding the soil using a pug mill after experiments for future use.

When the soil moisture content is close to plastic limit, such as 30% for first soil, the soil will be to dry to form suitable specimens using mould. Hence, a technique using polyethylene glycol to reduce the moisture content to 30% as used by Waldron and Manbeian (1970) and Spoor and Godwin (1979) was used to prepare the soil samples.

TEST OF THE REMOULD SOIL SAMPLES AND RESULTS DISCUSSION

1 Soil Density, Degree of Saturation and Homogeneity Tests.

The homogeneity of soil samples after remoulding treatment which is mainly characterized by their density and saturation rate is very important for deriving accurate and reliable experimental results. If the homogeneity is poor, that means the remoulding treatment process employed is not effective and needs to be improved.

The first clay soil was used to do the tests. The results of homogeneity tests and the formulae used for calculations are shown in Table 2. Coefficients of variation was less than 1.2% for the soil density. The degree of saturation of the soil samples ranged between 0.6-0.7. Although the samples were not fully saturated soil, the triaxial test results (Fig.1) showed the samples could be treated as a purely cohesive soil with a cohesion (c) value of 41 kN/m^2 and negligible internal shearing resistance. These show that homogeneity of the soil samples were good and that the remoulding process was satisfactory.

2. Drop cone tests

It is well known that the strength of wet soil will decrease while being disturbed, and will be restored after a period of time. In order to find out the variation pattern of this particular soil, drop cone tests were conducted. The cone drops down and penetrate into the soil on pushing the button to release the shaft. The weaker the soil, the deeper the cone will penetrate. The experimental results are shown in Fig 2. It was shown that during the first 5 hours after the soil block was made, the strength of the soil varied considerably. After 5 hours the variation was smaller and after about 20 hours the initial strength has restored.

The results showed that in order to decrease the experimental error, it was better leave the soil block to age for at least 10 hours before using them in the experiments.

During the experiments, all the soil blocks were made in the afternoon, and the experiments were conducted during the next morning.

CONCLUSIONS

1. With the remoulding process discussed in this paper, the coefficients of

variation was less than 1.2% for the soil density and soil could be treated as fully saturated soil. The remould process was therefore satisfactory.

2. The strength of wet clay soils will decrease while it is being remoulded and will restore after a period time. The results of drop cone test suggested that it was better to leave soil samples to age at least 10 hours before using them in order to decrease the experimental error.

REFERENCES

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TABLES

Table 1. The mechanical properties of the soils

a) First soil

Particle analysis

Sand	Clay (< 2 m)	Silt (< 63 m)
3.9%	83.2%	12.9%

Atterberg limits

LPL	UPL	P.index
30.6%	97.3%	66.7%

b) <u>Second soil</u>

Particle analysis

Sand	Clay (< 2 m)	Silt (< 63 m)
39.6%	34.0%	26.4%

Atterberg limits

LPL	UPL	P.index
5%	48.3%	27.8%

Table 2. Soil density and homogeneoneity tests

No.	1	2	3	4	5	6
No. of samples	2	6	16	6	2	8
Moisture contents(%)	53	50	46	42	36	31
Dry density (t/m^3)	1.107	1.14	1.187	1.27	1.374	1.455
Standard error of dry density	0.0098	0.0068	0.0093	0.0013	0.0059	0.0017
Coefficient of variation, cv	0.88%	0.60%	0.79%	1.00%	0.43%	1.2%
Other parameters						
Bulk density (t/m^3)	1.69	1.71	1.73	1.8	1.87	1.91
porosity, n	0.83	0.82	0.82	0.8	0.79	0.77
Void rate, e	4.83	4.66	4.43	4.08	3.69	3.43
Degree of saturation,sr	71%	69%	67%	66%	63%	58%

FIGURES

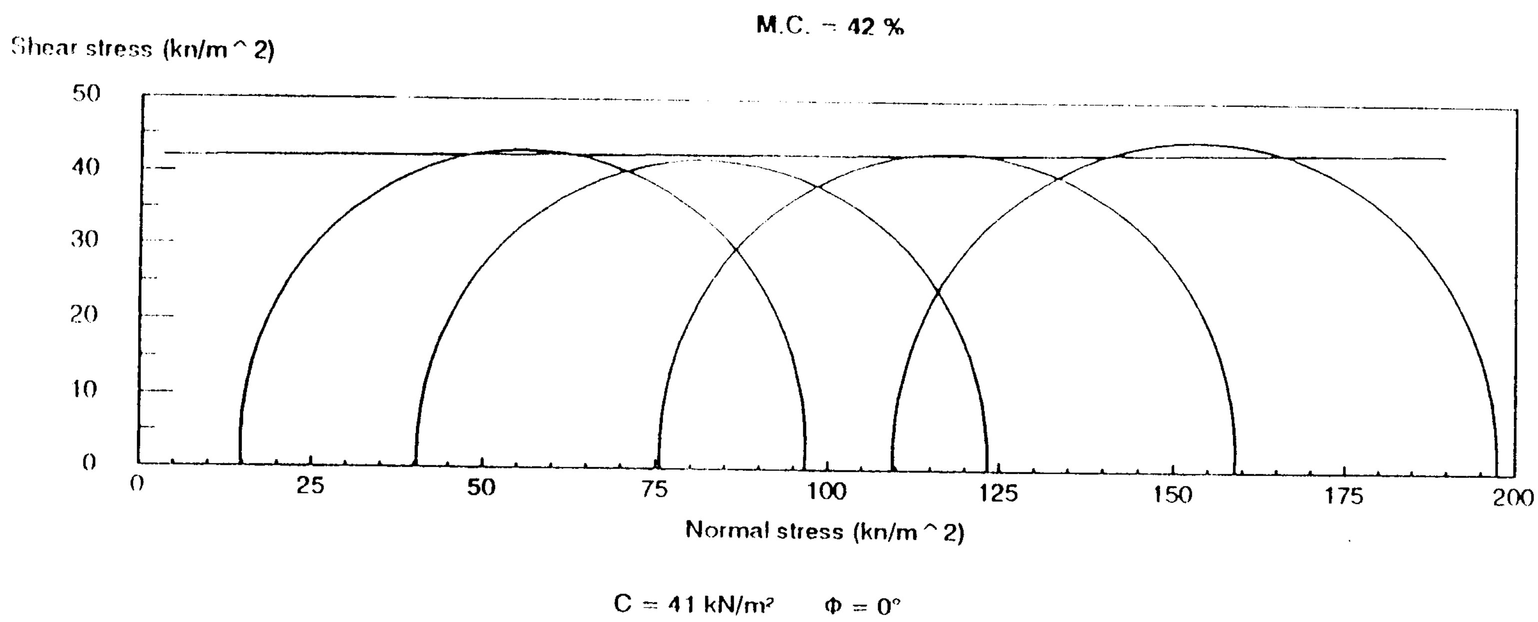

Fig 1. Soil parameters from triaxial shear test

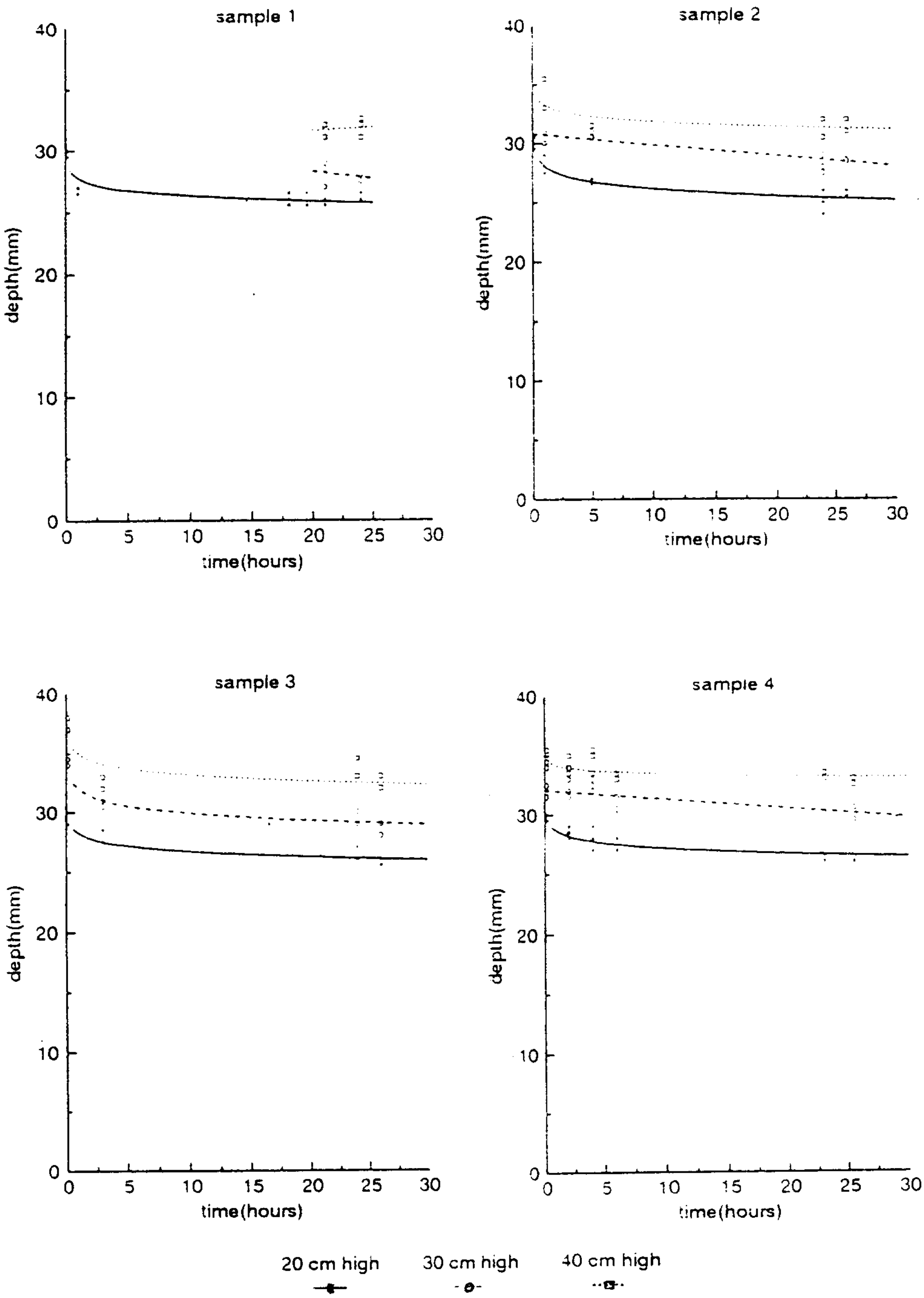

Fig 2· Drop cone tests