The Shear Strength Characteristics of Red Clay

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Abstract. The paper is aimed at the phenomenon of red clay subgrade disease,taking the subgrade filling from the Yuqing-Kaili Expressway as the research object,the soil mechanics as the theoretical foundation,the testing technology of geotechnical engineering as the method，resrearched the change regulation of the strength characteristics of red clay。The research findings not only has the important academic value for improving the evaluation system of red clay road，but also has some engineering practical significance to the highway construction in the red clay area，Besides this， it can provide technology reference for other industries.

Foreword

The red clay has high moisture content, high plasticity, high void ratio and other special engineering properties，and there is more rain in South China，during the drying and wetting cycle，the long-term strength and stability of red clay subgrade descend，caused the subgrade to have some disease,as subgrade settlement,pavement crack,transverse crack,shoulder collapse,slope sliding,collapse and landslide.So it is has great important meaning to research the strength characteristics of red clay.

Basic physical properties of Red clay

Field Sampling. The red clay used in this experiment is from Yuqing-Kaili Expressway。Thsee red clay's colors are brown red, brown red and brown yellow.The soil taking form subgrade is a little dry，and uniform，these soil's structure is compact；The soil taking form cutting slope is a little damp and loose,the amount of pieces of leaves and plant root tip in these soil is very little.Form the analysis of the particle compositicle,finding the soil sample is mianly clay.The natural water content is high, the viscosity property is strong,the void ratio is big,the liquid limit is a little higher and in the soft plastic state.

Basic physical properties of Red clay

Table1 Basic physical properties of red clay

JTG E40-2007	>0.075mm（%）	0.074～0.002mm（%）		<0.002mm (%)	
	17.25	71.41		11.34	
Optimum moisture content(%)	Plastic limit(%)	Liquid limit (%)	Plasticity Index	Proportion	Maximum dry unit weight(g/cm3)
37.2	38	59	21	2.720	1.46

Testing Program

Sample Preparation

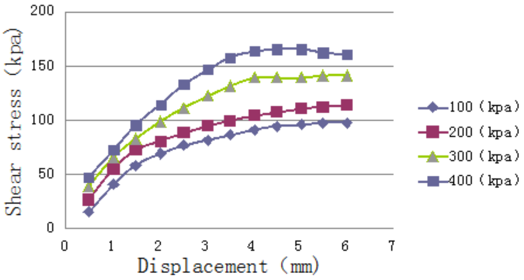
Table2 Sample preparation

Moisture content/%	Degree of Compaction/%			
30	75	85	90	96
34	75	85	90	96
37.2	75	85	90	96
40	75	85	90	96
44	75	85	90	96

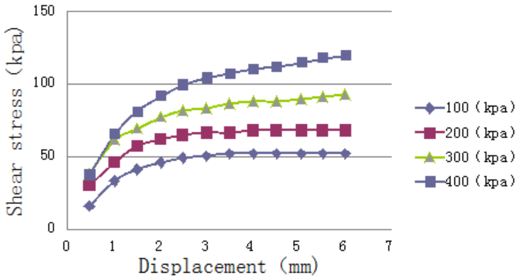
Test Method. When the soil sample prepared, do the unconsolidated-undrained triaxial shear test, set the vertical stress as 100kpa, 200kpa, 300kpa and 400kpa, and the shear rate is 0.8mm/min. When the shear displacement value reach 4mm, press the pause button and write down the damage value; When the process of shear without peak value, should shear until the displacement value reach 6mm. And taking the shear stress as the longitudinal coordinate, the shear displacement as the horizontal coordinate, then draw the shear stress-displacement curve, at last calculate cohesion value and angle of internal friction.

Experiment Result

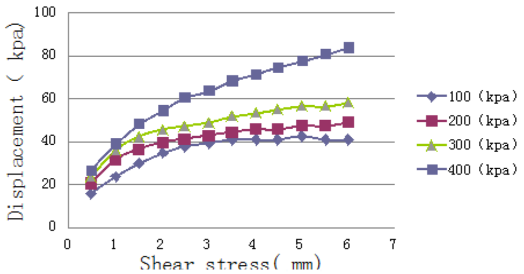
Shear stress-displacement curve



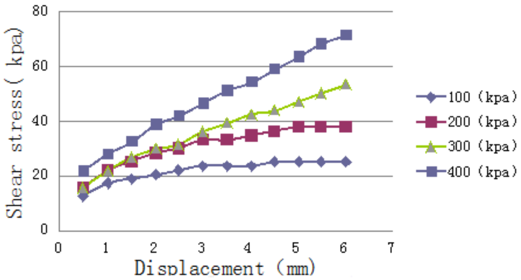
(a) k=75%, ω = 30%



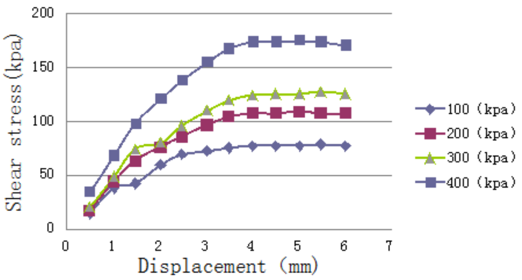
(b)k=75%, ω = 34%



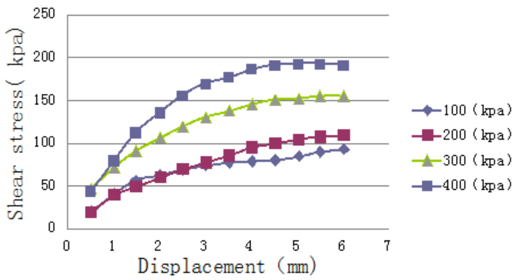
(c) k=75%, ω = 37.2%



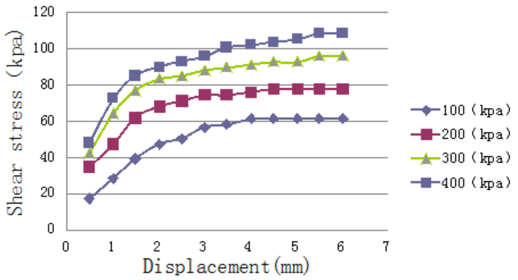
(d)k=75%, ω = 40%



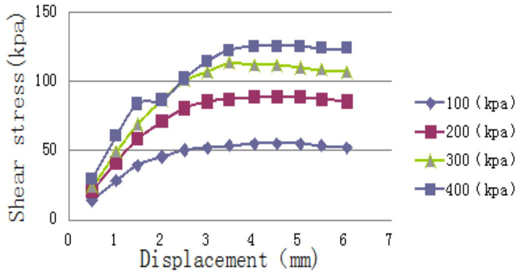
(e)k=75%, ω = 44%



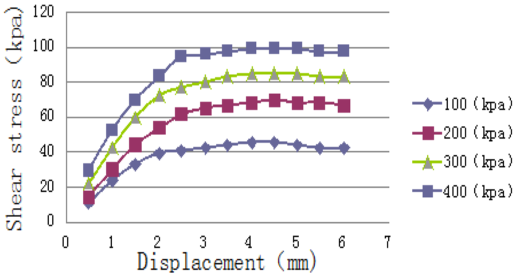
(f)k=85%, ω = 30%



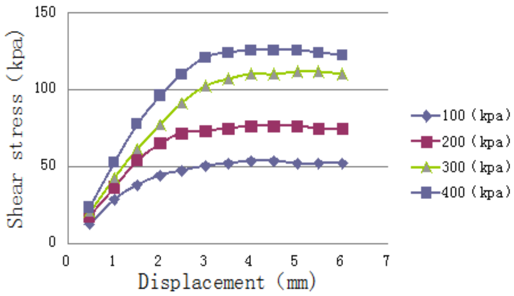
(g)k=85%， ω = 34%



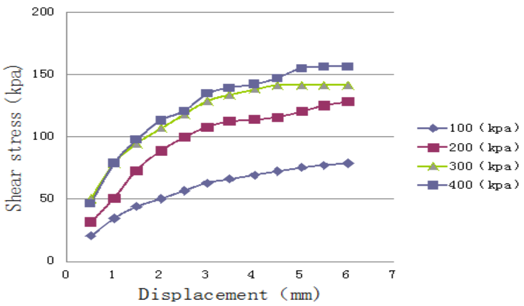
(h)k=85%， ω = 37.2%



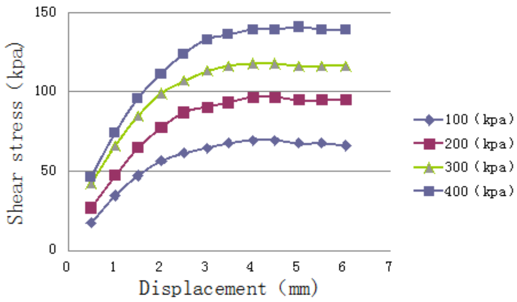
(i) k=85%， ω = 40%



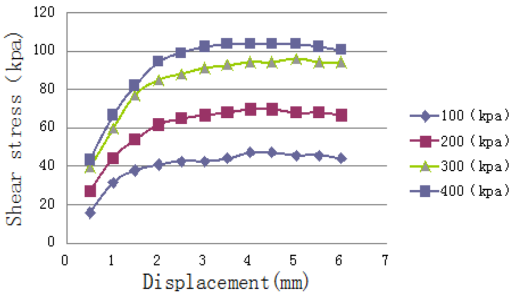
(j)k=85%， ω = 44%



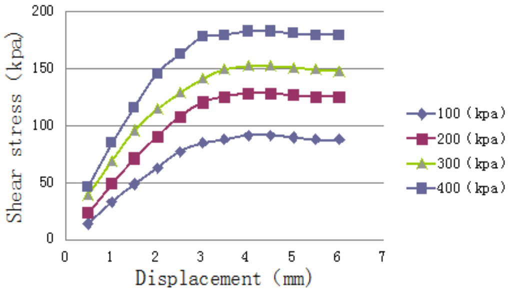
(k)k=90， ω = 30%



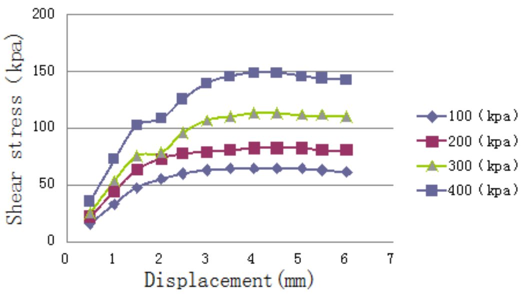
(l)k=90%， ω = 34%



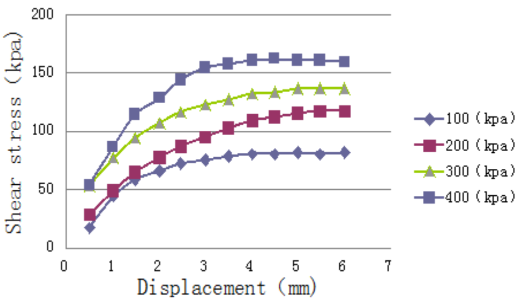
(m)k=90%， ω = 37.2%



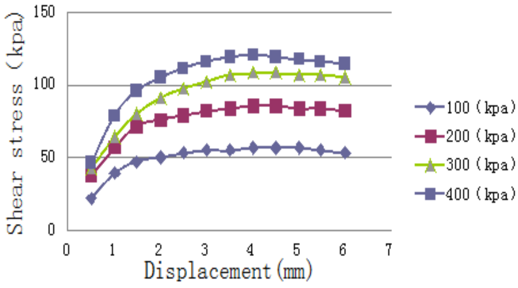
(n)k=90%， ω = 40%



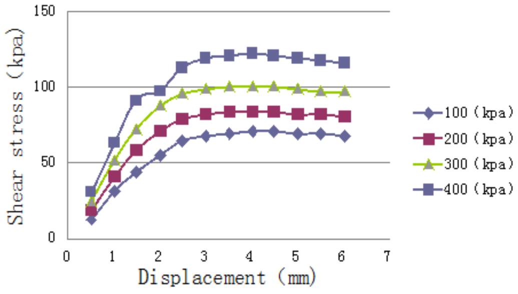
(o)k=90%， ω = 44%



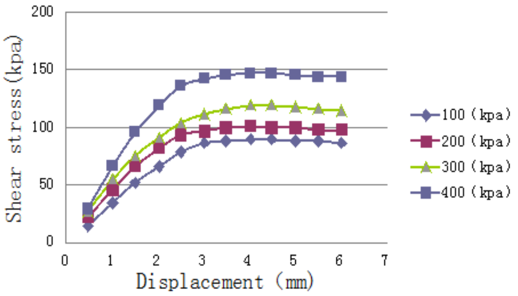
(p)k=96%， ω = 30%



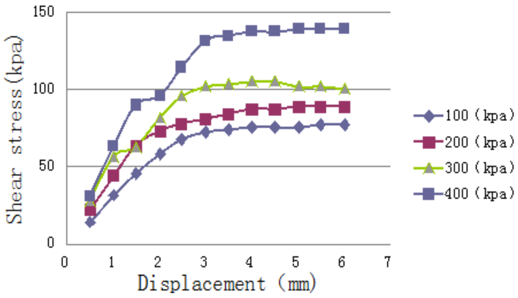
(k)k=96%, ω = 34%



(r)k=96%, ω = 37.2%



(s)k=96%, ω = 40%



(t)k=96%, ω = 44%

Fig.1 Shear stress-displacement curve

Form these curves, we can find Shear stress-displacement curve is begin steep, when the strain reached a certain value the curve is begin smooth,there is no peak value,it's appear as weakly hardening type.

Shear strength index-Moisture conten curve,shear strength index-Degree of compaction curve

(1) Shear Strength Index

Table3 Cohesion value c (kpa)

Moisture conten/%	Degree of Compaction/%			
	75	85	90	96
30	38.23	52.73	56.24	64.48
34	26.44	47.24	52.23	60.25
37.2	23.71	45.26	50.24	55.21
40	8.61	42.03	47.26	52.36
44	17.42	37.02	41.12	47.24

Table4 The angle of internal friction φ(°)

Moisture conten/%	Degree of Compaction/%			
	75	85	90	96
30	14.47	17.36	19.35	21.23
34	12.73	16.02	18.21	19.75
37.2	7.79	14.02	17.23	17.53
40	8.72	11.32	13.02	15.02
44	11.24	9.81	10.89	11.89

(2) The relationship between shear strength index with Moisture conten,the relationship between shear strength index with Degree of compactness

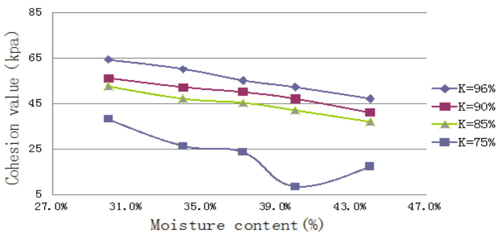


Fig.2 Cohesion value -Moisture content curve

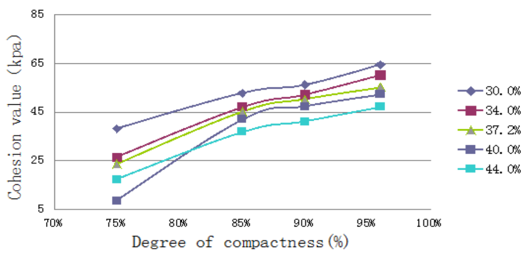


Fig.3 Cohesion value -Degree of compactness curve

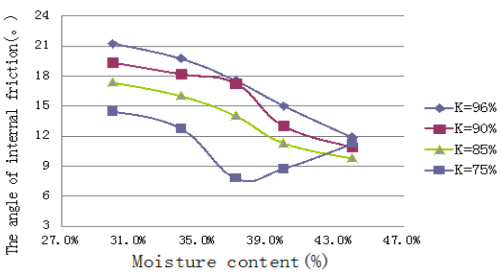


Fig.4 The angle of internal friction-Moisture content curve

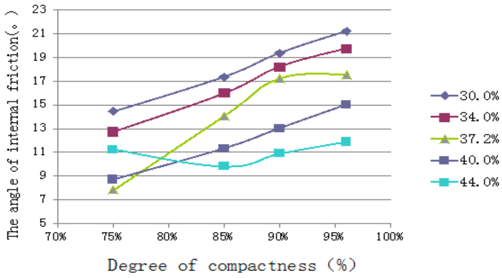


Fig.5 The angle of internal friction-Degree of compactness curve

Conclusion

（1）The cohesion value c decreases monotonically with the increase of moisture conten ω, and increases monotonically with the increase of the degree of compactness k.

（2）The angle of internal friction decreases monotonically with the increase of the moisture content ω, and increases monotonically with the increase of the degree of compactness k..

（3）The amplitude of cohesion value C varies with the change of moisture conten ω and degree of compactness K than that of angle of internal friction.

Acknowledgements

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