Foundation conditions at a proposed industrial estate at Legana, West Tamar

D.J. Sloane

Abstract

A proposed Industrial Estate at Legana is underlain by yellow, brown and grey mottled clays which vary in sand content. Clays with minor sand content range from 30-40% field moisture content and from 10-30% linear shrinkage. The angle of internal friction for the clays is between 22 and 25° and cohesion ranges from about 16 KPa to 19 KPa. The clays have a medium to high plasticity and a medium to very high dry strength. Clayey sands have a much higher angle of internal friction (37°) while cohesion values are similar to the clays with low sand content.

The surface drainage of the area is generally poor.

INTRODUCTION

At a request from the Department of Planning and Development, soil conditions were examined on a 20 ha proposed industrial estate at Legana [EQ042198]. Seven shallow holes were drilled and several disturbed auger samples and undisturbed drive-tube samples were taken. Laboratory determination of Atterberg Limits, linear shrinkage, moisture content and shear box tests were performed by R.N. Woolley of the Department of Mines. The location of the auger holes is indicated on the accompanying map (fig. 1).

TOPOGRAPHY

The area is undulating and is situated in Zone II of the Tamar Valley Landslip Zone Map, a zone classified as stable ground but on soft rocks. There are several small drainage channels and ditches but the area is generally poorly drained and some surface water lies in pools after heavy rain. The morphology of the area is structurally and geologically controlled with this flat area underlain by Tertiary sediments, at the base of the steeper dolerite fault controlled hillside to the west.

GEOLOGY

The area is underlain by Tertiary clays and clayey sand. As can be seen from the borehole logs (table 1) the clays vary widely in their sand content which is also reflected in their geomechanical properties. The Tertiary clay is generally yellow brown with dark yellow brown to reddish brown mottling. The reddish mottling is probably a soil profile feature. Concretionary iron pisolites and quartz particles up to 10 mm in diameter are often contained in the sandy clays. Muscovite mica particles can also be recognised in the fine clayey sands. The lateral variation in the clay and clayey sands throughout the area is typical of Tertiary deposits in general. Lenses of sandier sediment are common rather than horizontal bedding. Unless detailed sampling is conducted the extent and variation of the surface sediment cannot be accurately predicted. The samples taken can be considered indicative of the range of sediment underlying the area.

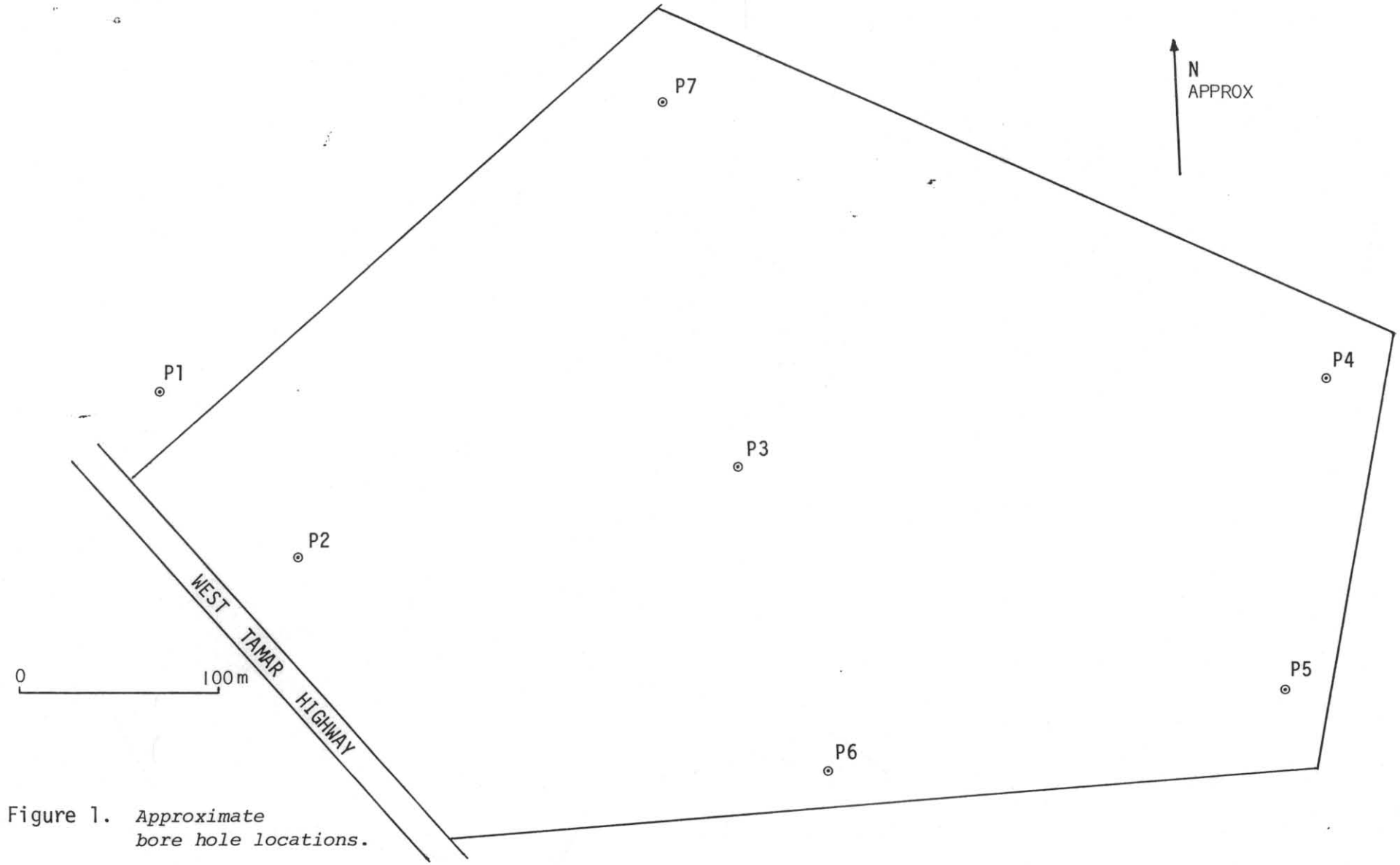


Figure 1. *Approximate bore hole locations.*

Table 1. LOGS OF PROLINE AUGER HOLES (Depths in metres)

HOLE P1

0 Grey-brown silty A_1 soil horizon.

1 Orange-brown sandy clay; quartz grains and ironstone pisolites up to 4 mm diameter.

2 Grey clay with reddish-brown mottles. Ironstone concretions to 10 mm diameter.

3

4 Grey to yellow brown mottled clay.

HOLE P2

0 Grey-brown silty A_1 soil horizon.

1 Yellow-brown sandy clay with some reddish brown mottles.

Sample P2

2 Yellow-brown clay.

HOLE P3

0 Grey-brown silty A_1 soil horizon.

1 Grey and reddish-brown mottled clay.

Sample P3

2

3 Yellow-brown sandy clay.

4

HOLE P4

0 Grey brown sandy A_1 soil horizon.

Sample P4 1 Light yellow-brown sandy clay.

2 Grey clay with yellow-brown mottles.

HOLE P5

0 Grey-brown silty A_1 soil horizon.

1 Yellow brown sandy clay - dark yellow brown mottles.

2 Light yellow brown very sandy clay containing mica flakes.

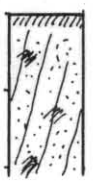
HOLE P6

0 Sandy organic rich A_1 soil horizon.

Sample P6 1 Grey brown clayey sand. Yellow brown sandy clay.

2 Grey sandy clay - reddish brown mottles.

HOLE P7



0 Sandy-silt A_1 soil horizon - Grey brown.

1 Yellow-brown sandy clay mottled dark yellow brown.

Sample P7 and P7 drive-tube sample 2

Table 2. Geomechanical properties of clay samples

Sample	Field moisture content (% of dry sample mass)	Liquid Limit	Plastic Limit	Plasticity Index	Linear Shrinkage (%)	Shear Box moisture content (%)	Angle of Internal shearing resistance (Ø°)	Cohesion c (KPa)
P2	35.2	118.6	36.3	82.3	28.0			
P3		98.7	24.2	74.5	20.0	28.9	24.5	16.35
P4		29.0	16.8	12.2	4.0	132.0	37.0	19.08
P6		56.2	17.6	38.6	12.0			
P7	39.3							
P7 (drive tube sample)	30.8					32.5	22.5	19.08

GEOMECHANICAL PROPERTIES

A summary of the clay properties tested in the laboratory is given in Table 2. Field moisture contents ranged from 30 to 40% expressed as a percentage of the dry sample weight. Linear shrinkage tests indicate a range from 4 to 28%, although the sample P 4 with a value of 4% had a much higher sand content than the other samples. A range from 10 to 30% is a fair estimation of linear shrinkage for the clayey sediments. Liquid limit and plasticity index results have been plotted in Figure 2. The results plot as a straight line which is above the 'A' line (Casagrande, 1932) indicating inorganic clays of medium to high plasticity. Their classification is CH on the Unified Soil Classification System (U.S. Bureau of Reclamation, 1963). The sediments are considered to have a medium to very high dry strength. Since the points on the graph lie on a straight line that is approximately parallel to the 'A' line it is likely that they represent different samples from the same stratum.

The angle of internal friction (Ø) as determined by shear box testing lies between 22 and 25°. Sample P 4 again gave a much higher value (37°) due to its high sand content. The cohesion values for samples tested varied from 16.35 to 19.08 KPa.

These results were taken from only a few samples and statistically could not be considered representative. However, the fairly close correspondence of the results and the sample selection is likely to give a good indication of the clay properties.

CONCLUSIONS

The clays can be classified as inorganic, of medium to high plasticity and of medium to very high dry strength. Linear shrinkage is about 10-30% indicating that clay shrinkage could be a problem if not adequately accounted for in the foundation design. Surface drainage of the area is poor and should be adequately provided for in the design.

REFERENCES

CASAGRANDE, A. 1932. Research on the Atterberg limits of soils *Public Roads* 13:121-136.

TERZAGHI, P; PECK, R.B. 1967 *Soil Mechanics in engineering practice* 2 ed. Wiley : New York

U.S. BUREAU of RECLAMATION 1963. *Earth manual* 1 ed., revd. USGPO : Washington, D.C.

[22 December 1978]

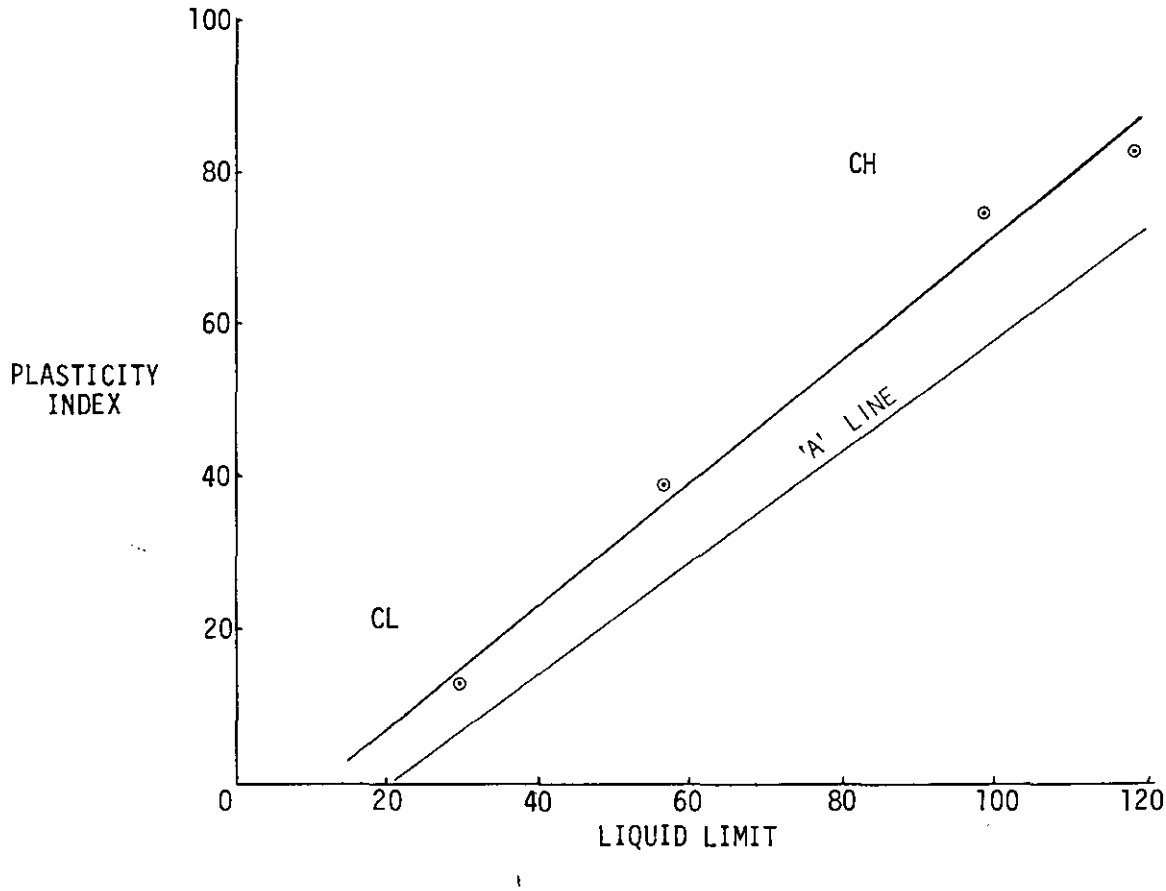


Figure 2. *Relation between liquid limit and plasticity index for Legana clays.*

5 cm