



HIGHWAYS DEPARTMENT

**GUIDANCE NOTES
ON
SOIL TEST FOR PAVEMENT DESIGN**

1 Site Investigation

- 1.1 Prior to commencement of any road construction project involving site formation work, site investigation is carried out to establish the geological profile along the road alignment. Very often, samples are taken by borehole drilling for tests including, particle size distribution, moisture content and triaxial tests etc. The results are useful for engineering design e.g. slope stability analysis.
- 1.2 For pavement design, soil properties at subgrade level are required. It is recommended that samples from the designed subgrade level should be taken for California Bearing Ratio (CBR) evaluations. This is considered appropriate for design purpose.
- 1.3 Other than for road construction projects, CBR tests and other associate tests are also required for the design of structural maintenance treatments for existing roads.
- 1.4 The number of CBR tests required will very much depend on the uniformity of the subgrade soil. Considerable engineering input is required.

2 Relevant tests for Subgrade Soil

2.1 General

- 2.1.1 Classification tests, include moisture content determination, liquid and plastic limits, specific gravity and particle size analysis. In the case of Hong Kong soils, liquid and plastic limits and specific gravity have limited application for soil classification, and more information can be obtained from the particle size distribution. Moisture content and specific gravity are also used in the calculation of other soil properties, such as degree of saturation. All tests must be conducted by laboratories accredited by the Hong Kong Laboratory Accreditation Scheme (HOKLAS).

2.2 Logging

- 2.2.1 Sampling can either be done by drilling or hand-dug pits. Logging of subgrade information should be done by a trained staff who can classify the soils in accordance with the recommendation made in the Guide to Rock & Soil Descriptions (Geoguide 3) issued by Geotechnical Engineering Office of Civil Engineering and Development Department.

2.3 Types of tests

- 2.3.1 It is recommended that laboratory tests should be carried out to determine the particle size distribution and in-situ moisture content for every sample taken.
- 2.3.2 From the logging information or the particle size distribution results, the Engineer can determine the number of fully soaked CBR tests required.
- 2.3.3 For investigation of failed pavement, in-situ CBRs may be required by the Engineer.
- 2.3.4 For fill materials, proctor tests are required to determine the optimum moisture content at which the material should be compacted on site. Although provision of subsoil drains could likely reduce the effect of water on subgrade, fully soaked CBR is considered to be appropriate for pavement design purposes.

3 Testing Frequency

- 3.1 It is difficult to give a rigid rule on testing frequency. Considerable input from Engineer is required. When found necessary, advice is available from R & D Division.

4 Sampling and Testing

- 4.1 At subgrade level, when the soil is likely to be affected by water added during drilling or excavating operation, the top 150 mm of the subgrade material should be removed and not be tested.
- 4.2 The requirement for the mass of sample for each specific test is detailed at Appendix 1.
- 4.3 A suggested testing request form is attached at Appendix 2. For samples to be tested by the Public Works Laboratories, appropriate test request forms available in the CEDD website should be used.

5 Reinstatement

- 5.1 The hand-dug pit on the existing road should be fully reinstated up to the relevant standards.

SOIL TESTS

A. SOIL CLASSIFICATION TESTS (BS 1377)

i) In-situ Moisture Content

This test determines the moisture content of soil as percentage of its dry mass. Test should be carried out in a laboratory.

ii) Particle density

Particle density measures the average mass per unit volume of the solid particles in a sample of soil.

iii) Particle Size Distribution (By wet sieving & pipette method)

This test covers the quantitative determination of the particle size distribution in soil from the coarse sand size down to clay size.

iv) Compaction test - Proctor test

This test covers the determination of the mass of dry soil per cubic metre when the soil is compacted over a range of moisture contents, giving the maximum dry density at optimum moisture content. In this test, a 2.5 kg rammer falls through a height of 300 mm giving 27 blows to each of three layers.

v) California Bearing Ratio (CBR) Test

California Bearing Ratio is obtained by measuring the relationship between force and penetration when a cylindrical plunger is made to penetrate the soil at a standard rate.

B. Sample Mass of Soil for Testing

Generally, the total mass of sample required depends on the soil group and the tests to be carried out. In general, the total mass should not be less than the following:

Fine-grained soils	500 g
Medium-grained soils	5 kg
Coarse-grained soils	30 kg

The actual mass of sample required can be assessed by multiplying the mass given in the table below by the maximum number of tests envisaged. Where the total mass of sample so calculated is less than the minimum mass given above for the appropriate soil group, then the minimum mass should be used.

Type of Test	Fine grained Soil	Medium grained Soil	Coarse grained Soil
Moisture Content (oven drying method)	50 g	350 g	4 kg
Particle density	300 g	600 g	600 g
Particle Size Distribution	150 g	2.5 kg	17 kg
Compaction test proctor test/set	25 kg	25 kg	25 kg
California Bearing Ratio	6 kg	6 kg	12 kg

Grouping of Soil

- i) Fine grained soils - Soils containing not more than 10% retained on a 2 mm B.S. test sieve.
- ii) Medium grained soils - Soils containing not more than 10% retained on a 20 mm B.S. test sieve.
- iii) Coarse grained soils - Soils containing not more than 10% retained on a 37.5 mm B.S. test sieve.

C. Recommendation

- i) Soil samples should be contained in a clean plastic bag and properly sealed with adhesive tape.
- ii) Sample No., soil description, sampling depth & date of sampling should be marked clearly on a paper and stapled to the plastic bag.
- iii) Samples should be kept in the shade to prevent loss of moisture.
- iv) Samples should be delivered directly to laboratories as soon as possible.

Request for Soil Test

Please find from bearers ___ bags of soil samples.

2. Please carry out the following tests to the samples in accordance with appropriate Method specified in BS1377.

<u>Soil test</u>	<u>Sample No.</u>
i) Moisture content	
ii) S.G. of soil	
iii) Particle size distribution	
iv) Proctor test	
v) Fully soaked CBR test at surcharge _____ KN	
vi) CBR test at specified moisture content _____% and surcharge _____ KN	
vii) Others specified	

Office/Department