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**Methods for Testing Hong Kong Soils  
(GEOSPEC 3 - Model Specification for Soil Testing)**

**Introduction**

This Practice Note announces the adoption of a Hong Kong soil testing standard – Geospec 3 to suit Hong Kong conditions. The standard is prepared to cater for the need of the profession for a comprehensive Hong Kong soil testing standard. It covers soil classification and compaction tests as listed in Appendix A (Expanded Phase I soil tests – 32 nos.) and soil shear strength and compressibility tests as listed in Appendix B (Phase II soil tests – 7 nos.). Geospec 3 – Model Specification for Soil Testing is published by the Geotechnical Engineering Office (GEO) of the Civil Engineering and Development Department and can be purchased online at the website of the Government Bookstore: <http://bookstore.esdlife.com>.

**Background**

2. In 1992, with an aim to produce a series of standards for the testing of soils in Hong Kong, the GEO initiated a review of standards for the testing of soils, which is based on amendment of British Standard BS 1377: 1990 – “Methods of Test for Soils for Civil Engineering Purposes”. The first phase of the review covered soil classification and compaction tests. The result of the review was the recommendation of a new standard contained in GEO Report No. 36 – “Methods of Test for Soils in Hong Kong for Civil Engineering Purposes (Phase I Tests)”. PNAP 167 was first issued in September 1994 to promulgate the new standards contained in GEO Report No. 36. The second phase of the review included the soil shear strength and compressibility tests (Phase II soil tests), as well as Phase I tests and additional tests of the same nature (Expanded Phase I soil tests). The Geospec 3 now available contains 32 standard procedures for Expanded Phase I soil tests and 7 standard procedures for Phase II soil tests.

**Approval of plans or consent application**

3. It is recommended that Authorized Persons (AP), Registered Structural Engineers (RSE) and Registered Geotechnical Engineers (RGE) should adopt Geospec 3 as the

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standard when specifying relevant soil testing for the investigation, design and construction of building development projects. Whenever a test report involving soil tests is submitted in support of a plan for approval or in compliance with a condition of approval/consent under the Buildings Ordinance section 17(1) sub-section 6(b), the Building Authority (BA) may refuse approval of plans or consent for commencement of building works if the soil tests have not been carried out in accordance with Geospec 3. The BA may also refuse approval of ground investigation plans in the Scheduled Areas, site formation plans or any other plans with geotechnical content if the soil tests are carried out at variance with the standards in Geospec 3. Likewise, if the in-situ density tests and laboratory compaction tests on fill material have not been carried out in accordance with Geospec 3, the Certificate of Completion for the filling works may not be accepted (PNAP 55 refers).

### **Selection of laboratories**

4. Where soil tests are to be carried out, only laboratories accredited under the Hong Kong Laboratory Accreditation Scheme (HOKLAS) for the relevant tests shall be employed. The BA will only accept results issued on HOKLAS-endorsed test certificates or reports. It is therefore important that the AP/RSE/RGE should ensure that the laboratory appointed has been accredited by Hong Kong Accreditation Service (HKAS) to carry out the tests ordered and is authorised to issue HOKLAS-endorsed test certificates or reports for these tests. The HKAS publishes a Directory of Accredited Laboratories (HOKLAS 009) every year listing all the laboratories accredited under HOKLAS for various tests. Information on the most updated list of laboratories and their accredited tests may be obtained from HKAS through the Quality Services Division of the Innovation and Technology Commission at telephone 2829 4840 or the HKAS website <http://www.info.gov.hk/itc/hkas>. Guidance on selection of laboratories is given in clause 2.3 of Geospec 3.

### **Credibility of soil testing data**

5. The BA attaches great importance to the representativeness and accuracy of soil testing data which are used to support the proposed investigation, design or construction for building development projects. In this regard, the BA takes a serious view of the credibility of such data and will give them due consideration in the context of both the disapproval of plans and the administration of sanctions for knowingly misrepresenting material facts in submissions to the BA. To assist APs, RSEs and RGEs, the following practical guidelines are given:

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- care should be taken in preparing the test schedule according to the geology of the site and relevant information should be provided for each test in accordance with Geospec 3, including information on soil type;
- sampling, storage and transportation of samples and preparation of test samples should be properly supervised to prevent sample disturbance and to ensure sample security;
- tests should be carried out with due care and test results are properly documented, and where appropriate, analysed and vetted; and
- any HOKLAS-endorsed test reports should not be reproduced except in full and any doubts on such reports should be clarified with HKAS for submission to the BA.

### **Laboratory Accreditation to Geospec 3 Standards**

6. For any soil tests carried out on or after 1 July 2004, the BA will only accept HOKLAS-endorsed soil test certificates or reports from laboratories which have been accredited by HKAS for the relevant tests in accordance with Geospec 3.

### **Phase I soil tests in GEO Report 36**

7. For soil tests carried out before 1 July 2004, the BA will continue to accept HOKLAS-endorsed certificates or reports for Phase I soil tests listed in Appendix C conducted in accordance with GEO Report No. 36. The BA will also accept HOKLAS-endorsed test certificates or reports for the relevant Phase I soil tests conducted in accordance with Geospec 3 as equivalent.

( H W CHEUNG )  
Building Authority

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Index under: Soil testing

**Appendix A**  
(PNAP 167)  
(APP-64)

**Testing Standard for Expanded Phase I Soil Tests in Geospec 3**

Standard methods	Specific tests
Geospec 3 – Test Method 5.1	Determination of Moisture Content by Oven-drying at $45 \pm 5^{\circ}\text{C}$
Geospec 3 – Test Method 5.2	Determination of Moisture Content by Oven-drying at $105 \pm 5^{\circ}\text{C}$
Geospec 3 – Test Method 5.3	Comparative Test for the Determination of Moisture Content by Oven-drying
Geospec 3 – Test Method 6.1	Determination of Liquid Limit, Plastic Limit and Plasticity Index
Geospec 3 – Test Method 6.2	Determination of Liquidity Index
Geospec 3 – Test Method 7.1	Determination of Particle Density by Gas Jar Method
Geospec 3 – Test Method 7.2	Determination of Particle Density by Small Pyknometer Method
Geospec 3 – Test Method 8.1	Determination of Particle Size Distribution by Wet Sieving (with Dispersant)
Geospec 3 – Test Method 8.2	Determination of Particle Size Distribution by Wet Sieving (without Dispersant)
Geospec 3 – Test Method 8.3	Determination of Particle Size Distribution by the Pipette Method (with Dispersant)
Geospec 3 – Test Method 8.4	Determination of Particle Size Distribution by the Pipette Method (without Dispersant)
Geospec 3 – Test Method 8.5	Determination of Particle Size Distribution by the Hydrometer Method (with Dispersant)
Geospec 3 – Test Method 8.6	Determination of Particle Size Distribution by the Hydrometer Method (without Dispersant)
Geospec 3 – Test Method 8.7	Construction of a Continuous Particle Size Distribution Curve from the Results of Wet Sieving and Sedimentation Tests
Geospec 3 – Test Method 9.1	Determination of Organic Matter Content
Geospec 3 – Test Method 9.2	Determination of the Mass Loss on Ignition
Geospec 3 – Test Method 9.3	Determination of Total Sulphate Content of Soils and Sulphate Content of Groundwater and of Aqueous Soil Extracts by Gravimetric Method
Geospec 3 – Test Method 9.4	Determination of Water-soluble Chloride Content
Geospec 3 – Test Method 9.5	Determination of the pH Value

**Testing Standard for Expanded Phase I Soil Tests in Geospec 3 (Cont'd)**

<b>Standard methods</b>	<b>Specific tests</b>
Geospec 3 – Test Method 10.1	Determination of Dry Density/Moisture Content Relationship of Soils Containing Particles Which are Not Susceptible to Crushing (Using 1000 cc Mould and 2.5 kg Rammer)
Geospec 3 – Test Method 10.2	Determination of Dry Density/Moisture Content Relationship of Soils Containing Particles Which are Susceptible to Crushing (Using 1000 cc Mould and 2.5 kg Rammer)
Geospec 3 – Test Method 10.3	Determination of Dry Density/Moisture Content Relationship of Soils Containing Particles Which are Not Susceptible to Crushing (Using CBR Mould and 2.5 kg Rammer)
Geospec 3 – Test Method 10.4	Determination of Dry Density/Moisture Content Relationship of Soils Containing Particles Which are Susceptible to Crushing (Using CBR Mould and 2.5 kg Rammer)
Geospec 3 – Test Method 10.5	Determination of Dry Density/Moisture Content Relationship of Soils Containing Particles Which are Not Susceptible to Crushing (Using 1000 cc Mould and 4.5 kg Rammer)
Geospec 3 – Test Method 10.6	Determination of Dry Density/Moisture Content Relationship of Soils Containing Particles Which are Susceptible to Crushing (Using 1000 cc Mould and 4.5 kg Rammer)
Geospec 3 – Test Method 10.7	Determination of Dry Density/Moisture Content Relationship of Soils Containing Particles Which are Not Susceptible to Crushing (Using CBR Mould and 4.5 kg Rammer)
Geospec 3 – Test Method 10.8	Determination of Dry Density/Moisture Content Relationship of Soils Containing Particles Which are Susceptible to Crushing (Using CBR Mould and 4.5 kg Rammer)
Geospec 3 – Test Method 11.1	Determination of In-situ Bulk Density and In-situ Dry Density of Soils by Sand Replacement Method Suitable for Fine- and Medium-grained Soils (With Small pouring Cylinder)
Geospec 3 – Test Method 11.2	Determination of In-situ Bulk Density and In-situ Dry Density of Soils by Sand Replacement Method Suitable for Fine-, Medium- and Coarse-grained Soils (With Large Pouring Cylinder)
Geospec 3 – Test Method 11.3	Determination of In-situ Bulk Density and In-situ Dry Density of Soils by Nuclear Densometer Method Suitable for Fine- and Medium-grained Soils
Geospec 3 – Test Method 11.4	Determination of Relative Compaction of Fill Material
Geospec 3 – Test Method 12.1	Determination of the California Bearing Ratio (CBR)

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**Testing Standard for Phase II Soil Tests in Geospec 3**

<b>Standard methods</b>	<b>Specific tests</b>
Geospec 3 – Test Method 14.1	The One-dimensional Consolidation Test
Geospec 3 – Test Method 14.2	The Isotropic Compression Test in a Triaxial Cell
Geospec 3 – Test Method 15.1	The Unconsolidated Undrained Triaxial Compression Test Without Pore Pressure Measurement
Geospec 3 – Test Method 15.2	The Isotropically Consolidated Undrained Triaxial Compression Test With Pore Pressure Measurement
Geospec 3 – Test Method 15.3	The Isotropically Consolidated Drained Triaxial Compression Test With Measurement of Volume Change
Geospec 3 – Test Method 16.1	The Direct Shear Test (Small Shear Box Apparatus)
Geospec 3 – Test Method 16.2	The Direct Shear Test (Large Shear Box Apparatus)

**Appendix C**  
(PNAP 167)  
(APP-64)

**Phase I Soil Tests in accordance with GEO Report No. 36**

<b>Test Method</b>	<b>Test Description</b>	<b>Equivalent Test Method in Geospec 3</b>
GEO Report No. 36 Test 2.3.2A	Determination of moisture content by oven-drying at 105°C ± 5°C	Geospec 3 – Test Method 5.2
GEO Report No. 36 Test 2.3.2B	Determination of moisture content by oven-drying at 45°C ± 5°C	Geospec 3 – Test Method 5.1
GEO Report No. 36 Test 2.3.2C	Comparative test for the determination of moisture content by oven-drying	Geospec 3 – Test Method 5.3
GEO Report No. 36 Test 2.4.3	Determination of liquid limit by the cone penetrometer method	Geospec 3 – Test Method 6.1 & 6.2
GEO Report No. 36 Test 2.5.3	Determination of plastic limit, plasticity index and liquidity index	
GEO Report No. 36 Test 2.9.2A	Determination of particle size distribution by wet sieving (with dispersant)	Geospec 3 – Test Method 8.1
GEO Report No. 36 Test 2.9.2B	Determination of particle size distribution by wet sieving (without dispersant)	Geospec 3 – Test Method 8.2
GEO Report No. 36 Test 2.9.4A	Determination of particle size distribution by the pipette method (with dispersant)	Geospec 3 – Test Method 8.3
GEO Report No. 36 Test 2.9.4B	Determination of particle size distribution by the pipette method (without dispersant)	Geospec 3 – Test Method 8.4
GEO Report No. 36 Test 2.9.5A	Determination of particle size distribution by the hydrometer method (with dispersant)	Geospec 3 – Test Method 8.5
GEO Report No. 36 Test 2.9.5B	Determination of particle size distribution by the hydrometer method (without dispersant)	Geospec 3 – Test Method 8.6
GEO Report No. 36 Test 2.9.6	Construction of a continuous particle size distribution curve from the results of wet sieving and sedimentation tests	Geospec 3 – Test Method 8.7
GEO Report No. 36 Test 4.3.3A	Determination of the dry density/moisture content relationship of soils containing particles which are not susceptible to crushing (with 1000cc mould and 2.5kg rammer)	Geospec 3 – Test Method 10.1
GEO Report No. 36 Test 4.3.3B	Determination of the dry density/moisture content relationship of soils containing particles which are susceptible to crushing (with 1000cc mould and 2.5kg rammer)	Geospec 3 – Test Method 10.2

**Phase I Soil Tests in accordance with GEO Report No. 36 (Cont'd)**

<b>Test Method</b>	<b>Test Description</b>	<b>Equivalent Test Method in Geospec 3</b>
GEO Report No. 36 Test 4.3.4A	Determination of the dry density/moisture content relationship of soils containing particles which are not susceptible to crushing (with CBR mould and 2.5kg rammer)	Geospec 3 – Test Method 10.3
GEO Report No. 36 Test 4.3.4B	Determination of the dry density/moisture content relationship of soils containing particles which are susceptible to crushing (with CBR mould and 2.5kg rammer)	Geospec 3 – Test Method 10.4
GEO Report No. 36 Test 9.2.1	Determination of the insitu bulk density and insitu dry density of soil by the sand replacement method suitable for fine- and medium-grained soils (with small pouring cylinder)	Geospec 3 – Test Method 11.1
GEO Report No. 36 Test 9.2.2	Determination of the insitu bulk density and insitu dry density of soil by the sand replacement method suitable for fine-, medium- and coarse-grained soils (with large pouring cylinder)	Geospec 3 – Test Method 11.2

- Notes : (1) The Guidelines for Laboratory General Requirements and Sample Preparation given in Appendix A of GEO Report No. 36 shall be adopted.
- (2) Information on soil type and oven-drying temperature shall be provided to the laboratory for all tests that involve the determination of moisture content.

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