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METHODS OF TEST FOR STABILIZED SOILS

PART I METHOD OF SAMPLING AND PREPARATION OF STABILIZED SOILS FOR TESTING

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METHODS OF TEST FOR STABILIZED SOILS

PART I METHOD OF SAMPLING AND PREPARATION OF STABILIZED SOILS FOR TESTING

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 20 October 1967, after the draft finalized by the Soil Engineering Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Soil stabilization, in the broadest sense, is the alteration of any inherent property of a soil to improve its engineering performance. The classification of the methods of stabilization is based on the treatment given to the soil (for example dewatering, compaction, etc), process invovled (for example thermal, electrical, etc) and on additives employed (for example asphalt, cement, etc). The choice of a particular method depends on the characteristics of the problem on hand. For studying the effectiveness of a stabilization technique under investigation, certain standard methods of test are required and these are being published in parts. This part [IS : 4332 (Part I)-1967] lays down the method of sampling and preparation of stabilized soils for testing.

0.3 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in this field in this country. This has been met by basing the standard on B.S. 1924 :1957 'Methods of test for stabilized soils' published by the British Standards Institution.

0.4 In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard (Part I) lays down the general principles of sampling for obtaining disturbed samples and the method for preparation of stabilized soils for testing.

*Rules for rounding off numerical values (*revised*).

2. SAMPLING

2.1 The purpose for which a sample is required may be considered either as being to represent as large a body of material as possible in order to study its average properties, or as being one of a series representing a relatively small body of material in order to study the variability of its properties. The former samples will be referred to as 'representative' and typical of these are those samples taken in advance of construction to assess the suitability of a given source of soil. The latter samples will be referred to as 'selected' and typical are those samples taken for control tests carried out during construction where the samples represent only a small proportion of the whole work.

2.2 Representative samples should be obtained by taking a number of sub-samples from delimited areas from which material is being sampled, and these sub-samples should be thoroughly mixed. The number of sub-samples should be a minimum of five or more depending on the area. The quantity of the resulting sample shall be reduced to that required for tests. If the quantity of the test sample is one-eighth or more of the total sample it shall be obtained by riffling or quartering. If the quantity of the test sample is less than one-eighth of the total sample it shall be obtained by mixing six small samples of appropriate quantity taken from the total sample.

2.3 Where several sub-samples are taken they should normally each be taken so as to eliminate as far as possible any segregation that occurred in the placing of the material being sampled. For example, the coarse material of a stock-pile or lorry load will normally be concentrated at the base and edges and apex will be deficient in it. Care should also be taken that the size of the sampling tool is not so small that the coarser material rolls off.

2.4 In some instances the whole of a selected sample may be taken from one place without sub-sampling. For sampling a representative sample from a quantity of material of about 4 m^3 in size about 10 sub-samples may be required. It is convenient of the size if the sub-sample can be chosen such that no reduction in the size of this mixed sample is required. Selected samples will often be taken from soil mixed with a stabilizer, and in many such instances speed of treatment will be of greater importance than thoroughness of mixing of the sub-samples. The changes in uniformity brought about by mixing may be undesirable, because the selected sample may become better mixed than the material from which it was taken.

2.5 The size of sample required will depend on the particle size distribution and the purpose to which it to be put.

NOTE — The sample taken should be sufficient to provide the weights of prepared soil specified for each test in the respective standards.

2.6 Where samples are being taken for the determination of moisture content or for testing without change of moisture content, the use of shallow trays for storing or carrying should be avoided as these expose the sample unnecessarily to evaporation or rainfall. The sample should be taken in air-tight containers. Likewise, particularly at a site laboratory where much of the work may be carried out in the open, such samples should be kept covered over if not sealed up, except when material is actually being abstracted.

3. PREPARATION OF SAMPLES FOR TESTING

3.1 Apparatus

3.1.1 *Containers or Bags* — Containers with air-tight lids or bags capable of being sealed, suitable for samples of various sizes up to 50 kg in weight.

3.1.2 *Non-corrodible Metal Trays* — Trays of sizes ranging from 450 cm^2 to 8 400 cm^2.

3.1.3 *Pulverizing Apparatus* — Either mortar and rubber covered pestle or a mechanical device consisting of a mortar and a power driven rubber covered pestle suitable for breaking up the aggregation of soil particles without reducing the size of individual grains.

3.1.4 *Balances* — capable of weighing up to 10 kg and 25 kg readable and accurate to 1 g and 5 g respectively.

3.1.5 *Oven* — thermostatically controlled, capable of maintaining a temperature of 25° to 50°C and 105° to 110°C.

3.1.6 *Mechanical Mixers* — Mixers (preferably electrically operated) of suitable capacities or suitable tools for hand mixing, for example, a spatula, a trowel and a shovel.

3.1.7 *Graduated Glass or Polythene Cylinders* — of 100 ml and 1 000 ml capacity.

3.1.8 *Sieves* — of sizes 40 mm, 20 mm, 10 mm, 4·75 mm and 2 mm IS Sieves.

3.1.9 *Sampler* — a suitable riffle sampler or sample splitter for quartering the samples (*see* IS : 1607-1960*).

3.2 Quantity of sample for determination of moisture content.

3.2.1 If the moisture content of the natural soil is required the soil sample shall be obtained and tested in accordance with IS : 2720 (Part II)-1964†.

*Methods for dry sieving.

†Methods of test for soils : Part II Determination of moisture content. (Since revised).

3.2.2 If the moisture content of stabilized soil mixtures as received is required, a representative or selected portion of the material of the following minimum weights shall be obtained [*see also* IS : 4332 (Part II)-1967*]:

Grading of Soils	*Minimum Quantity of Sample of Stabilized Soil Mixtures Weight in g*	
	Soil with non-volatile stabilizer	Soil with volatile stabilizer
(1)	(2)	(3)
For stabilized soil mixture 90 percent of which passes a 2-mm IS Sieve	30	200
For stabilized soil mixture 90 percent of which passes a 20-mm IS Sieve	300	500
For stabilized soil mixture 90 percent of which passes a 40-mm IS Sieve	3 000	3 000

3.2.2.1 Where one-eighth or more of the total sample is being used for the moisture content determination the sample shall be obtained, if practicable by riffling or quartering but otherwise by combining not less than four sub-samples taken from the main sample. Where a greater reduction in size is required it shall be obtained by combining ten sub-samples taken from the main sample, as repeated riffling or quartering would in many cases reduce the moisture content of the sample. The main sample shall be mixed before such sub-samples are taken, care being taken that the moisture content is not appreciably reduced during this process.

3.3 Samples of Natural Soil for Other Tests — If tests are to be conducted on natural soil for purposes of comparison, the sample shall be prepared as specified in IS : 2720 (Part I)-1966†.

3.4 Mixing of Natural Soils with Water and Stabilizing Agents

3.4.1 *Blending Different Soils* — If it is desired to blend two or more soils, appropriate weights of the different soils to be blended, with due allowance for moisture content, shall be thoroughly mixed to a uniform condition in the mechanical mixer, or by hand using a spatula or trowel. An appropriate quantity of the dried material shall be mixed with water and stabilizer in the manner indicated in **3.4.2** to **3.4.5**.

3.4.2 *Mechanical Stabilization* — The required amount of water shall be incorporated with the soil, by mixing thoroughly to a uniform condition in a mechanical mixer or by hand, taking care to minimize loss of moisture.

*Methods of test for stabilized soils: Part II Determination of moisture content of stabilized soil mixtures. (Since revised).

†Methods of test for soils : Part I Preparation of dry soil samples for various tests. (Since revised).

The moist soil shall then be allowed to stand for 24 hours in an air-tight container. This procedure applies either to soil which is inherently mechanically stable or to soils which are blended to achieve this result.

3.4.3 *Stabilization with Powders*

3.4.3.1 An amount of water as much close to the required moisture content as possible shall be incorporated with the soil by mixing thoroughly to a uniform condition in a mechanical mixer or by hand, taking care to minimize loss of moisture. In the case of heavy clays the moist soil shall be allowed to stand overnight in an air-tight container.

3.4.3.2 The required quantity of stabilizer shall then be added to the soil and mixed to a uniform condition either by mixing in a mechanical mixer for about one to two minutes, or by hand, using a spatula, trowel or other suitable tool. The remainder of the water shall then be added, and mixing continued for a further period of about eight minutes.

3.4.3.3 When cement stabilized soil is being mixed for compaction tests or for the making of cylinder or cube specimens, no more soil than can be used within 30 minutes of adding the cement to the soil shall be mixed. If any stabilized soil remains at the end of this period it shall be discarded.

3.4.4 *Emulsified Oil or Emulsified Asphaltic Bitumen Stabilization*

3.4.4.1 Sufficient water shall be incorporated with the soil to bring the soil mortar approximately to the plastic limit. The material shall be mixed, either in a mechanical mixer, or by hand using a spatula or other suitable tool, for 10 minutes or until it is judged by visual inspection that adequate dispersion of the water has been obtained, taking care to minimize loss of moisture in mixing. The moist soil shall be allowed to stand for 24 hours in an air-tight container.

3.4.4.2 The required quantity of emulsion diluted, if considered necessary, with distilled water, shall then be added to the soil and mixing started. Additional water shall be added if necessary during the mixing, to ensure a uniform distribution of the emulsified stabilizer. Any other additive shall be incorporated in a manner appropriate to the process of stabilization under consideration (*see* Note).

NOTE — The time of mixing cannot be specified in advance, guidance may be obtained from the suppliers of the stabilizer or by means of preliminary trials. It should be noted that excessive mixing may be deleterious in certain cases.

3.4.4.3 The mixer shall then be allowed to dry uniformly in air until it has the moisture content required for the subsequent test.

3.4.5 *Oil, Asphaltic Bitumen and Other Stabilizers* — The required amount of water shall be incorporated with the soil by mixing thoroughly to a uniform condition in a mechanical mixer, or by hand using a spatula or other suitable tool, taking care to minimize loss of moisture. The moist soil shall be allowed to stand for 24 hours in an air-tight container. The required quantity of stabilizer and any other additive shall be incorporated in the

soil in a manner appropriate to the process under consideration (*see* Note under **3.4.4.2**).

3.5 Initial Preparation of Previously Mixed Stabilized Soil Mixture for Strength Tests

3.5.1 For fine-grained cohesive soils the sample as received may have compacted aggregations that have been produced as a result of mixing. For mixes prepared in a laboratory mixer it is recommended that all the material shall be passed through a 20-mm IS Sieve by working material greater than 10 mm through the mesh. The material shall then be thoroughly re-mixed by hand before preparing the test specimens. This procedure will result in a more uniformly compacted specimen. For mixes taken from construction site work the specimens shall be made from all the mixed material and the size of the specimen used shall be determined by the size of the aggregations of stabilized soil produced by the mixing plant.

3.5.2 For materials that are stabilized with cement, it is essential that all operations including compaction are completed within about 30 minutes, after the mixing is completed, to avoid considerable loss in strength which may occur as a result of the hydration of the cement.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Conversion*
Force	newton	N	1 N = 1 kg. 1 m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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AMENDMENT NO. 1 AUGUST 1983

TO

IS:4332(Part 1)-1967 METHODS OF TEST FOR STABILIZED SOILS

PART 1 METHOD OF SAMPLING AND PREPARATION OF STABILIZED SOILS FOR TESTING

Alterations

(*Page 5, clause 3.2.1, line 2*) - Substitute 'IS:2720(Part 2)-1973† ' *for* 'IS:2720(Part 2)-1964† '.

(*Page 5, foot-note with* '†' *mark*) - Substitute the following for the existing foot-note:

'†Methods of stest for soils: Part 2 Determination of water content (*second revision*).'

(*Page 6, clause 3.3, line 3*) - Substitute 'IS:2720(Part 1)-1983† ' *for* 'IS:2720(Part 1)-1966† '.

(*Page 6, foot-note with* '†' *mark*) - Substitute the following for the existing foot-note:

'†Methods of test for soils: Part 1 Preparation of dry soil samples for various tests (*second revision*).'

(BDC 23)

Reprography Unit, ISI, New Delhi, India