GUIDELINES FOR THE USE OF SOIL-LIME MIXES IN ROAD CONSTRUCTION

(First Revision)

THE INDIAN ROADS CONGRESS
1992

MEMBERS OF THE HIGHWAYS SPECIFICATIONS AND STANDARDS COMMITTEE

GUIDELINES FOR THE USE OF SOIL-LIME MIXES IN ROAD CONSTRUCTION

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Published by

THE INDIAN ROADS CONGRESS
Jamnagar House, Shahjahan Road,
New Delhi-110011
1992

Price Rs. 40
(Plus packing & postage)

First Published: June, 1973
Reprinted: February, 1980
First Revision: June, 1992

Printed at Sagar Printers & Publishers, New Delhi
(1000 copies)

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GUIDELINES FOR THE USE OF SOIL-LIME MIXES IN ROAD CONSTRUCTION

1. INTRODUCTION

1.1. Addition of lime to soils is known to improve their strength and reduce plasticity which in turn controls volume change. Because of these advantages, this technique has been used extensively for improving quality of sub-grade and producing a high strength material for sub-bases.

1.2. Lime reacts with most of the medium, moderately fine, and fine grained soils to decrease plasticity, increase workability, reduce swell, and increase strength. In general terms, the soils that are most reactive to lime include clayey gravels, silty clays and clays. Soils classified according to the Indian Standard system as CH, CL, MH, ML, CL-ML, SC, SM, GC and GM should be considered as potentially capable of being stabilised with lime.

1.3. In the case of soil-lime construction, best results are obtained when mixing is homogeneous throughout. This is best achieved by mechanical methods of construction. Use of mechanised method is, therefore, very desirable. If for any unavoidable reason, manual method is to be adopted, care must be taken to ensure proper pulverisation of soil and uniform mixing of lime.

1.4. The guidelines were originally published as IRC: 51-1973 "Recommended Design Criteria for the Use of Soil-Lime Mixes in Road Construction". The revised document in the present form was prepared by the Geotechnical Engineering Committee (personnel given below), and considered by the Highways Specifications and Standards Committee in its meeting held on the 16th April, 1990. The Committee requested a Sub-Group consisting of Shri R.P. Sikka, Dr. P.J. Rao, Shri T.K. Natarajan and Dr. L.R. Kadiyali to modify the draft.

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1.5. The modified draft was subsequently considered and approved by the Highways Specifications & Standards Committee, the Executive Committee and the Council of the Indian Roads Congress in their meetings held on 30th October 1990, 18th November 1990 and 8th December 1990 respectively.

2. SCOPE

The guidelines relate to soil-lime mixes intended for use as improved subgrade or as a sub-base in highway pavements. It is presumed that the work will be carried out in accordance with appropriate construction specifications and adequate site supervision would be exercised as regards the quality of constituent materials and process of construction.

3. MATERIALS

3.1. Properties of lime-soil mixes are dependent on many variables viz. soil type, lime type,lime percentage, fineness of lime and lime purity in addition to the conditions of temperature and moisture. Some of the variables related to materials are discussed below.

3.2. Soil

3.2.1. **Samples**: Before taking recourse to lime stabilisation, it is desirable to examine the suitability of soil for this treatment. This is done by taking samples of the soil at appropriate locations. Disturbed samples are normally adequate for this purpose. The normal practice followed in the field is to take at least three samples in a stretch of one kilometre along the alignment of the road if the same type of soil is found throughout. In case the soil type changes earlier, at least one sample is taken from each new stretch of soil. Also, when the soil type changes with depth within a borrow pit, at least one sample should be collected from each strata.

3.2.2. **Suitability**: Clayey soils including heavy clays, moorums and other soils met within the alluvial plains can be effectively treated with lime. Since the gain in strength is based on pozollanic reactions between lime and clay minerals, it is essential that any soil selected for stabilisation should have enough clay minerals. For effective stabilisation, a soil must have a fraction passing 425 micron mesh not less than 15 per cent and its PI should be at least 10 per cent. For effective stabilisation, it is desirable that the per cent retained on 425 micron mesh should be well graded with uniformity coefficient not less than 5. Besides, clay minerals should belong to illitic, montmorillonitic or kaolinitic group. Generally clayey soils including black cotton soils, moorum and other alluvial types of soils, can be economically stabilised with lime. Organic matter in the soil selected for lime stabilisation should not be more than 2.0 per cent and sulphate content should not exceed 0.2 per cent. A pH value of 10 or 11 is desired for the pozollanic reaction to take place between clay minerals and lime for the formation of cementitious compounds. Where organic matter and soluble carbonate/sulphate contents in the soil are in excess of 2.0 and 0.2 per cent respectively, special studies would be necessary to determine whether lime stabilisation would prove to be practicable and economical.

3.3. **Lime**

3.3.1. **Type of lime:** Lime for lime-soil stabilization work shall be calcitic dry lime, commercially available, slaked at site, or pre-slaked lime delivered at site in suitable packing. Use of dolomitic lime is not considered suitable.

3.3.2. **Purity:** Purity of lime affects the strength of lime soil stabilisation. The effectiveness of lime in its reaction with clay minerals is dependent to a good extent on its chemical composition i.e. the amount of calcium oxide present in the lime. The purity of lime is expressed as the percentage of calcium oxide present in the lime. It is generally recommended that lime used for soil stabilisation should have a purity of 50 per cent. The addition of lime should be correspondingly increased whenever the field tests show a lesser purity.

Calcium oxide content in lime should be determined as specified in IS: 1514-1959 "Indian Standard Method of Sampling and Test for Quick Lime and Hydrated Lime" or IS: 712-1984 "Indian Standard Specification for Building Limes."

3.3.3. **Fineness:** For effective stabilisation with lime, uniform mixing is a pre-requisite and the degree of mixing depends on the fineness of lime. With fine lime,there will be quick and effective reaction with clay minerals to form cementitious compounds. Lime for stabilization shall conform to the fineness requirement of Class C hydrated lime as specified in IS: 1514 and IS: 712, which is as under:

Sieve size (in micron)	% Passing
850	100
300	95 (Minimum)
212	99 (Minimum)

4. DESIGN CONSIDERATIONS

4.1. Evaluation of Lime Requirement

4.1.1. Before construction of lime stabilised road is undertaken, survey

of soil deposits existing on the aligned route is done (para 3.2.1.). A small addition of lime to clayey soil results in considerable increase in the workability of the soil, possibly due to base exchange or flocculation phenomenon or a combination of the two. With such small dosages of lime, no appreciable gain in strength of the mixture results. As the dose of lime is increased, the strength of the mixture increases. This suggests that the lime added initially in small dosages is utilised in satisfying the affinity of the soil for lime. The quantity of lime needed for satisfying this affinity is termed as lime fixation point or lime retention point. Lime needed for this purpose is usually 1 to 3 per cent.

4.1.2. The strength of lime soil mixture is dependent to a great extent on the quantity of lime added above the lime fixation point. The tangible effect of lime soil stabilisation in increasing the strength of the mixture begins to be felt as the lime content is increased above lime fixation point. This is due to pozzolanic reactions resulting in the production of cementitious compounds. It is generally found that beyond a certain percentage of lime, the increase in strength ceases and in fact a lowering in strength may result due to the presence of unreacted free lime indicating that there exists an optimum lime content for maximum strength gain. Some tentative values of optimum lime content for soils of different mineralogical composition are indicated below:

Kaolinitic soil	- 4 per cent
Illitic soil	- 8 per cent
Montmorillonitic soil	- 10 per cent

The optimum lime content as explained above may be determined by one of the following methods:

(i) **pH Method**

The optimum lime requirement of soil is also determined by finding out the pH value of the treated soil with a given percentage of lime. Percentage of lime which gives soil-lime mix a pH of 12.4, is taken to be the right percentage of lime required for stabilisation of the given soil. To find the optimum lime requirement of soil 20g of the soil sample passing 425 micron mesh is taken in a bottle. A given percentage of lime is added by weight and mixed thoroughly. To this is added 100 cc of distilled water and mixed thoroughly. The slurry so formed is kept at room temperature (25°C) and after an hour, it is shaken again to ensure a uniform mixing of ingredients and its pH is determined by a pH meter. The minimum percentage of lime which gives a pH of 12.4 when mixed with soil in the form of slurry, is the optimum percentage of lime for stabilisation.

(ii) **Moisture Absorption Method**

Capillary absorption of water is an intrinsic property of every soil. Besides other factors, this depends mainly on the mineralogical composition and particle size distribution. The addition of lime to soils brings about a change in the particle size distribution due to chemical reactions and the moisture absorption characteristics of soils change with the addition of lime. The change in moisture absorption continues upto a certain lime content depending upon the soil. With further addition of lime, the change in moisture absorption is negligible. The lime content at which the soil attains a steady moisture absorption is termed as the optimum requirement of lime for a particular soil. The method to carry moisture absorption test is given in *Appendix - 1.*

4.1.3. After ascertaining optimum lime content the strength of soil-lime mix is determined either by California Bearing Ratio or Unconfined Compressive Strength (see para 4.2.). Samples of CBR/UCS should be prepared at maximum dry density and optimum moisture content as per IS: 2720 (Part VII) or IS: 2720 (Part VIII) as specified. The specimen thus prepared should be cured for 3 days followed by 4 days soaking in water. At least three specimens should be tested. UCS design procedure should be preferred since it is more realistic as compared to CBR design criteria.

4.1.4. If the strength values of the soil-lime mix obtained at optimum lime-content are much more than those required from design consideration, strength tests may be conducted with reduced lime content to fix the design mix. However, in no case should the lime content be less than the minimum value of lime required from durability (Para 4.5.) and leaching (Para 4.6.) considerations.

4.2. **Strength Criteria**

For testing the strength of stabilised soils, the CBR test is widely used in

the case of gravelly soils whereas UCS test is often used with fine textured soils. Both tests are done at an age of seven days comprising three days moist curing followed by four days immersion in water. Guiding strength criteria are as follows:

(1) **CBR Test:** Minimum CBR value for the lime-stabilised sub-base should be 15 per cent for low trafficked rural roads, 20 per cent for cumulative traffic upto 2 million standard axles (MSA) and 30 per cent for traffic exceeding 2 MSA. The CBR test should be carried out on samples compacted to the density specified and moulded at optimum moisture content.

(2) **Unconfined Compression Test:** In terms of the unconfined strength, the lime stabilised soil used for sub-base should have a strength of 700 KN/Sq. m.

For purposes of design, the CBR value in the field should be assumed as 60 to 70 per cent of the one obtained in the laboratory in consideration of the anticipated efficiency of mixing, placing, curing and other aspects of construction in the field.

4.3. **Degree of Pulverisation**

4.3.1. For effective stabilisation, the soil must be in a well pulverised state before lime is added. Yet, it may not be economical to pulverise heavy clays like black cotton soil to an appreciable degree. With this in view, the requirements of pulverisation for different soils are setforth in Table-1.

TABLE 1 . SOIL PULVERISATION REQUIREMENT FOR LIME STABILISATION

Sieve designation	Minimum per cent by weight passing the sieve	
	For black-cotton soil	For other soils
22.4 mm	100	100
4.00 mm	50	60

4.3.2. To determine the degree of pulverisation, method of sieving for wet cohesive soils as given in *Appendix - 2* shall be used.

4.4. **Evaluation of Field Strength**

Whenever a large number of strength tests are done on lime-stabilised layer, a significant variation in results is normally witnessed. This happens because of certain factors like heterogeneous character of the soil-lime mass, non-uniformity in mixing etc. Besides, a small deviation in the procedure of preparation of a sample and the testing techniques inevitably takes place. Variation in curing temperature and duration of curing also affect the strength results. In the presence of these uncertainties, test results can be interpreted statistically in two possible methods, either by taking mean of the test values or by computing standard deviation of values. From these measures, other useful quantities like coefficient of variation and confidence limit for true mean can be found. Results are taken to be fairly consistent if the coefficient of variation is upto 10 per cent. If the test results lie on either side of the design value and coefficient of variation is less than 10 per cent, the test results are taken to be in conformity with the design value. In case the mean happens to be either less or more than 10 per cent, then allowance is made in the design thickness either by effecting a corresponding increase or decrease in its value.

4.5. Durability

Durable soil-lime mixtures can be obtained when reactive soils are stabilised with lime. Although some strength reduction and volume change may occur due to alternate wetting and drying, the residual strength of stabilised material is generally adequate to meet the field service requirements. For the climatic conditions prevailing in India, durability under wetting and drying would have to be taken into consideration and durability under freeze-thaw conditions does not generally apply. The minimum seven day strength of 700 kN/Sq. m. recommended for subbase is expected to meet the durability requirements of wetting and drying under normal circumstances. However, in situations where waterlogging conditions prevail, the adoption of soil-lime stabilisation may not be a satisfactory solution from durability considerations. It would be desirable to consider such alternatives as composite stabilisation involving the use of lime and cement, which is not within the scope of these guidelines.

4.6. Prevention of Leaching

The amount of lime leached out from the lime-soil mix exposed to continual flow of water depends on the period of curing and to some extent, on the quantity of lime added. Test results have shown that if the lime stabilised sample is cured for 28 days before it is exposed to leaching process, the loss of lime due to leaching is not appreciable. The loss of lime ranges from 5 to 10 per cent of lime added. On consideration of gain in strength, it

is believed that percentage of lime to be added should be about 4.0 per cent or more. If this is done, the leaching problem is taken care of automatically.

5. MIX DESIGN

5.1. The proportion of lime for stabilisation should be determined in the laboratory in accordance with the following procedure:

(1) The soil should be tested for PI, fraction passing 425 micron sieve, sulphate content and organic content in order to evaluate its suitability for stabilisation (vide para 3.2.2.).

(2) Moisture density relationship for the soil should be established as per IS: 2720 (Part VII) - 1980 or IS: 2720 (Part VIII) - 1983.

(3) Lime to be used for stabilisation should be tested for available calcium oxide content in accordance with IS: 1514-1959 or IS: 712-1984.

(4) Evaluation of lime requirement is carried out as per para 4.1.

(5) After pulverising the soil to the degree stated in para 3.5. specimens for CBR/UCS tests are prepared with optimum percentage of lime, compacted at maximum dry density and optimum moisture content corresponding to IS: 2720 (Part VII) or IS: 2720 (Part VIII). The specimens thus prepared should be cured initially for 3 days and then soaked in water for 4 days before testing them for CBR/UCS as per IS: 2720 (Part XVI)-1979/IS: 2720 (Part X)-1973. At least 3 specimens should be tested for each lime concentration.

(6) On the basis of these results, the mix design should be selected using criteria set forth in para 4.1. and 4.2.

6. CONSTRUCTION OPERATIONS

6.1. Pulverisation and Mixing

6.1.1. Full benefit of lime stabilisation can be had only if the lime added to the soil is thoroughly mixed. From this consideration mechanical method should be preferred. Manual method of mixing may be accepted on only small or less important works. The method of mixing, whether mechanical or manual, should in any case ensure that lime is thoroughly and uniformly mixed with the soil. The compacted thickness of soil-lime layer or lift shall be in the range of 75-200 mm depending on efficiency of mixing and laying equipment.

6.1.2. **Mechanical methods:** Stabilised soil course shall preferably be constructed by mechanical method of construction. Mechanical methods of mixing lime-soil may be broadly grouped into two categories e.g. mix-in-place method and stationary plant method. Because of better controls, the stationary plant method should generally give better results.

(i) **Mix-in-place method**

The mix-in-place method permits rapid construction with a small labour force and at relatively low cost. The equipment required is simple and a large daily output can be maintained. Its disadvantages are the difficulty of obtaining uniformity of mix and difficulty of ensuring a uniform thickness of the processed soil. In the mix-in-place method, the following operations are involved:

(a) Pulverisation of soil
(b) Spreading lime
(c) Mixing
(d) Addition of water
(e) Final grading
(f) Compaction, and
(g) Curing

Pulverisation comprises of two stages, first scarifying the soil to the required depth of treatment and second pulverising the scarified soil until it is broken down to a size suitable for mixing with lime. Suitable plant for cutting up the soil to the required depth comprises a plough or robust tiller with a positive depth control. While scarifying the area the plough should move the soil towards the centre of the road; this leaves a vertical face of the soil at the shoulders and prevents processing being carried outside the limits of the road. Rotary tillers are used for pulverisation, but disc harrows can also be advantageously employed for some soils. When the pulverisation is completed, the loose material is shaped with a grader to give even distribution along the length and width of the road. Lime can be spread either mechanically or by hand. The mixing of soil with lime is usually done with the same plant as is used for pulverising the soil. Rotavators can also be used advantageously for performing the twin jobs of pulverisation and mixing. Water is added to the soil-lime mix by means of water distributors. The water distributor is followed by the mixing machine and the processing is continued till optimum moisture content is obtained. When mixing is complete, it is necessary to shape the surface again with a blade grader before compaction.

In the mix-in-place construction by using stabiliser, the plant shall be capable of pulverising the soil to the specified degree to the full thickness of the layer being processed, thereby, achieving the desired degree of mixing and uniformity of the stabilised material. The plant shall be either of single pass or multiple pass type. With single pass equipment, the forward speed of the machine will be so selected that the required degree of mixing, pulverisation and depth of processing is obtained.

In the multiple pass processing, the soil on the prepared subgrade shall be pulverised to the required depth with successive passes of the plant and moisture content adjusted to be within the prescribed limits. Lime shall then be spread uniformly and mixing continued with successive passes until the required depth and uniformity of processing has been obtained.

(ii) **Stationary plant method**

Stationary plants are essentially of two types, continuous and batch mix.

In the case of continuous mix type plant an elevating loader supplies soil to a hopper with a measuring gate. A belt conveyor discharges it to a pug mill, where water or fluid stabilizer may be added through spray nozzles and mixed into the soil. Sometime lime is added on the conveyor belt. The mixed material is then discharged into lorries.

On small jobs, concrete batch mixers can be used for mixing soil, lime and water. However, best results are achieved by double-paddle mixers, pug mills or roller pan type machines, in which soil lumps are easily broken up.

Usually mixtures produced by stationary plant cost more than those formed by the mix-in-place method, but certain advantages accrue from the use of this method. Advantages claimed for stationary plant method include greater uniformity of the mix, greater ease of control of the proportions of the mixture, greater ease in supplying water to the mix and fewer delays due to bad weather.

The sequence of operations involved in the plant mix method is as follows:

(a) Site preparation
(b) Collection and pulverisation

(c) Mixing
(d) Transporting and spreading
(e) Compaction, and
(f) Curing

After preparing the formation, the subgrade is thoroughly compacted by rolling before soil-lime layer is superimposed. The soil which has been tested and found suitable, is excavated from the road site or from borrow areas as the case may be, by means of suitable implements. All clods and lumps in the soil are broken up and when pulverisation is completed, it is stokpiled near the mixing plant. Mixing of soil, lime and water is done in the mixer. The mixed material is then transported to the site, tipped, spread and compacted in the normal manner.

6.1.3. **Manual mixing:** The manual method is more labour intensive, but because of its limitations in pulverising and mixing, it should be used for small jobs only. The success of manual method depends on strict quality control at site during pulverisation, mixing and compaction. Where manual mixing is permitted, the soil is excavated from the borrow areas after it is cleaned of all vegetation and placed on prepared subgrade. The soil shall then be pulverised with crowbars, pick axes etc. A sprinkling of water is given if the clods are dry and the soil is a heavy clay. The calculated quantity of lime stored in bags is placed on the track with equal spacings. If the soil is wet with excessive moisture, it is allowed to dry so that its moisture is reduced to the optimum value. If the soil is on the drier side, required quantity of water is added to bring it to the optimum moisture content. Lime is spread in requisite quantity on the excavated soil. To account for construction losses, uneven distribution of lime etc. add one per cent extra lime in the mix to get the designed field percentage. With the help of a shovel, the soil is turned upside down. This process is started from one end and is continued upto the other end cross-sectionally. This makes one turn and the same is repeated along the whole stretch of the road. Experience has shown that 4-5 turns are enough to obtain a thorough mixing of the material. Alternatively, the soil is excavated and is stacked along the track of the road pavement. Big clods are broken down to the desired size. Calculated amount of lime is sprinkled and water is added to bring it to the optimum moisture content. Mixing is done with shovel in the same way as stated earlier. Lime-soil mix is spread on the track and shaped with a blade grader before it is compacted.

6.2. Addition of Lime

Lime may be added to the prepared material either in slurry form or in dry state. No traffic other than mixing equipment will be allowed to pass over the spread material until the completion of mixing. Mixing shall continue till the material is free from any pocket where lime is deficient. The moisture content shall be equal to the optimum moisture content and shall not exceed OMC by more than 2.0 per cent. The lime content of samples taken from the completed mixture shall not vary above or below the designated lime content, by more than 1 per cent by weight.

6.3. Time Between Mixing and Compaction

6.3.1. Time interval between the mixing of lime and soil, and compaction of mix, has a definite effect on the gain achieved in strength. Long delay between the timings of these two operations results in less density and hence reduced strength of the soil-lime mix for the same compactive effort. If the same density and strength are to be achieved, extra compactive effort is required which involves extra cost and thus escalates the expenditure of the project. Both laboratory and field observations have shown that time gap between mixing and compaction should not exceed three to four hours.

6.4. Rolling

Immediately after spreading, grading and levelling of the mixed material, compaction shall be carried out with 8-10 tonne smooth wheel roller or vibratory roller. Rolling shall start from the edges and progress towards the centre. During rolling, the surface shall be frequently checked for grade and camber. Irregularities during rolling shall be corrected by loosening the material and removing or adding fresh material. Compaction shall continue till at least 100 per cent of the maximum dry density determined in accordance with IS: 2720 (Part VII) or IS: 2720 (Part VIII), as decided by the designer, is achieved in the field.

6.5. Curing

Duration of the curing period and the temperature at which curing takes place, have a significant influence on the strength achieved. Longer period of curing is conducive to attaining higher strengths since chemical reactions continue to take place for a long time. Normal period of curing varies from 7 to 28 days at normal temperature under wet conditions. Curing progresses faster in warm conditions. As a compromise between the objective of achieving high strength and maintaining a statisfactory schedule of progress, it is suggested that a minimum 7 days curing should be given to the lime-soil mix under moist conditions.

Two common methods employed for curing are asphaltic membrane curing and moist curing. In membrane curing, a prime coat of cut-back bitumen is applied at a rate of about 0.45 to 1.1 Litre/Sq.m within one day of rolling. The prime coat is meant to assist curing of stabilised soil by inhibiting the evaporation of moisture. No equipment or traffic should be permitted on lime stabilised surface during first 3 days after applying the prime coat. If the compacted stabilised layer is not rutted or distorted by the equipment, the immediate placement of overlay is permitted. This overlay maintains the moisture content of the compacted layer and is an adequate medium for curing.

The other method of curing is moist curing. In this method, the surface is kept damp by light sprinkling of water at frequent intervals to prevent drying with light rollers being used to keep the surface knitted together. Light vehicles may be permitted on the finished surface but heavy traffic should not be allowed for 10 to 15 days.

7. QUALITY CONTROL

7.1. Depth of the Treatment and Uniformity of Mixing

Since lime elevates the pH value of the soil, phenolphthalein alcohol indicator solution can be sprayed on the soil to determine the presence of lime. If lime is present, a reddish pink colour develops and indicates the depth of mixing.

Non uniformity of colour reaction, when the treated material is tested with the standard phenolphthalein alcohol indicator, will be considered evidence for inadequate mixing. One test per 500 Sq. m should be carried out for determination of depth and uniformity of mixing.

7.2. Purity of Lime

One test should be carried out for each consignment corresponding to IS: 1514-1959 or IS: 712-1964, subject to a minimum of one test per 5 tonnes of lime. The test shall be done just before lime is used in the stabilisation work.

7.3. Lime Content Immediately After Mixing

One test per 250 Sq.m should be carried out corresponding to IS: 4332 (Part VIII)-1969.

7.4. Degree of Pulverization

Degree of pulverization shall be checked regularly and the same shall conform to the specification given in Table 1.

7.5. Moisture Content Prior to Compaction

Moisture content should be determined as per IS: 2720 (Part II)-1973 at a rate of one test per 250 Sq. m.

7.6. Dry Density of Compacted Layer

Density should be checked according to IS: 2720 (Part XXVIII)-1974. One test per 500 Sq. m should be carried out.

7.7. Layer Thickness and Longitudinal Profile

Layer thickness should be measured regularly by thickness blocks or cores to conform to specified thickness.

Actual finished levels of different courses shall not vary from the design levels beyond the tolerances mentioned below:

Sub-grade	± 25 mm
Sub-base	± 20 mm

7.8. Surface Regularity

The surface regularity of stabilised subgrade and sub-base in longitudinal and transverse directions shall be within the tolerances indicated below:

Layer	Longitudinal Profile with 3 m straight edge			Cross profile
	Max. permissible undulations	Max. Number of Permissible undulations in any 300 m. length exceeding		Max. permissible variation from specified profile under camber template
		18 mm	12 mm	mm
Subgrade	24	30	—	15
Sub-base	15	—	30	12

7.9. CBR/UCS Tests on Mixed Materials

One test per 3000 Sq. m should be carried out corresponding to IS: 2720 (Part-XVI)-1979 for CBR and IS: 2720 (Part X)-1973 for UCS.

7.10. Deleterious Constituents of Soil

Soil should be tested regularly for deleterious constituent corresponding to IS: 2720 (Part XXII)-1972.

7.11. Curing

A record should be maintained for the curing period to ensure proper curing for 7 days or any other period as specified.

8. LIMITATIONS

Apart from organic soils and some rare soils which react unfavourably with lime because of chemical contamination, the only other physical factors limiting the use of soils for stabilisation are:

(i) That it must be possible to break the soil to a fine tilth in order to mix in a stabiliser,

(ii) That the soil should have an adequately stable grading,

(iii) That necessary clay minerals are there in the soil for the stabilisation reaction to proceed. A useful working limit is that soil should contain at least 15 per cent of fines passing 425 micron sieve and have a plasticity index of at least 10 per cent.

(iv) Lime-soil stabilisation should not be done when the air temperature in the shade is less than 10°C.

(v) Lime stabilization should not be carried out during rains.

Appendix-1

PROCEDURE FOR THE DETERMINATION OF MOISTURE ABSORPTION

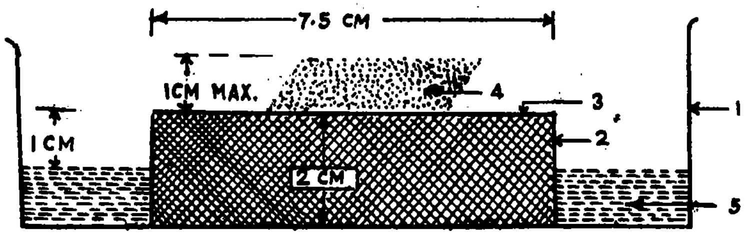
Apparatus

1. Trough
2. Porous Plate (thickness 2 cm and 7.5 cm diameter)
3. Filter paper (Whatman 42)
4. Distilled water
5. Spatula
6. Physical balance, sensitivity 0.01 gm
7. Weight box
8. Oven for drying
9. Petri dish

The porous plate is cleaned by boiling in water for about 15 minutes. The plate is taken out and placed in the trough. Distilled water is poured in the trough so that its level reaches about 1 cm below the top of the porous plate. A dry filter paper cut to the same diameter as that of the plate is carefully placed on the top of the porous plate.

15-20 gm of soil or soil-lime mix is carefully stacked loosely to a height of about 1 cm. (Fig. 1) and is allowed to absorb moisture from the trough for 1 hour. The porous plate is taken out and the excess moisture is allowed to drain off for 5 minutes. Moisture content of the sample is determined according to Indian Standards No. IS: 2720 (Part-II)-1973. This moisture content is termed as moisture absorption.

Average of 3 such determinations should be taken.



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1 Trough
2 Porous Plate
3 Filter Paper
4 Soil Sample
5 Distilled Water

Fig. 1. Assemblage for moisture absorption

Appendix-2

METHOD OF SIEVING FOR WET SOILS TO DETERMINE THE DEGREE OF PULVERISATION

1. A sample of pulverised soil approximately 1 kg by weight should be taken and weighed (W1).

2. It should be spread on the sieve and shaken gently, care being taken to break the lumps of soil as little as possible. Weight of soil retained on the sieve should be recorded (W2). Lumps of finer soils in the retained material should be broken until all the individual particles finer than the aperture size of the sieve are separated.

3. The soil should be again placed on the sieve and shaken until sieving is completed. The retained material should be weighed (W3).

4. Weight of soil by per cent passing the sieve can then be calculated from the expression:

$$\frac{(W1-W2)\ 100}{(W1-W3)}$$

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41.	The Director General	(Road Development) & Addl. Secretary to the Govt. of India (K.K. Sarin) — *(Ex-officio)*
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