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STANDARD PROCEDURE FOR EVALUATION AND CONDITION SURVEYS OF STABILISED SOIL ROADS

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1. INTRODUCTION

1.1 The Standard Procedure for Evaluation and Condition Surveys of Stabilised Soil Roads was approved by the Stabilised Soil Roads Committee (personal given below). This was later considered by the Executive Committee in their meeting held on the 24th March, 1962 and later it was circulated to the members of the Council on the 10th August, 1962. The comments of the members of the Council were considered by the Stabilised Soil Roads Committee in their meeting held on the 1st October, 1967 and later in their meeting held from the 19th to the 21st September, 1968. This was then placed before the Executive Committee in their meeting held on the 13th March, 1969 and it was approved by the council in their 71st Council meeting held at Bhubaneswar on the 26th and 27th May, 1969 for being published as the finalised standard of the Indian Roads Congress.

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1.2 There is real need for adopting a standard procedure for evaluating the condition and performance of stabilised soil roads. The approach to the rating or evaluation of a pavement may be deemed a negative one, in as much as it deals with the amount of destruction or the amount of failure that has taken place since its construction. In the case of a pavement, it is rather difficult to define precisely, what exactly constitutes its “failure”. The term unfortunately has come to signify all things to all men and there is a prevalent tendency to use it to describe all manners of phenomena, some of which are not failures at all, but merely evidence of some condition which makes the pavement less than perfect. Any reasonable definition of failure of a pavement will have to take into account a stated amount of maintenance, because maintenance is a necessary feature in any type of failure. This will naturally entail deciding what should be an acceptable amount of maintenance. It is felt that this is a matter on which a general agreement would be rather difficult. In the circumstances, for the purposes of this standard, the term “failure” is applied somewhat loosely to an unsatisfactory condition in the pavement which is of sufficient severity to warrant attention.

1.3 Failures of flexible pavements may be grouped under three distinct heads depending on the primary cause or source of the trouble. In the first group are included the types of failure or unsatisfactory performance that are attributable solely to the quality of the surfacing itself. The second group represents a type of failure which may manifest itself in many forms, but in effect indicates slip-page caused by lack of bond between the surfacing and the under-lying layer. In the third group are failures which are attributable to the deficiencies of the base, sub-base or subgrade.

1.4 In the evaluation of a pavement which show signs of distress or which does not satisfactorily perform the function for which it is intended, as a first step, it is intended, as a first step, it is important to determine the group to which the type of failure belongs or, in other words, to determine the component of the pavement in which the distress has occurred. In the following paragraphs, an attempt has been made to enumerate in brief the basic types of failures of flexible pavements, and approximate means of their identification.

2. DEFICIENCIES OF SURFACING

These would normally be noticed in the form of scaling, stripping, ravelling, disintegration, cracking and instability (or plastic distortion) of the road surface which may develop irrespective of the foundation support. Ravelling can be caused by low bitumen content, improper coating of aggregate, inadequate compaction. It may develop into pot-holing which may sometimes be attributed, by mistake, to failure in the lower layers of the pavement.

3. SLIPPAGE DUE TO LACK OF BOND WITH THE BASE

When the surfacing is not adequately keyed with the base, slippage will occur. This condition has often been noticed when the surface of the stabilised soil base is exceedingly dusty or not properly primed before the application of the wearing course. Slippage can also cause ravelling of the surface and subsequent poor riding qualities.

4. DEFICIENCIES OF UNDERLYING LAYERS

Pavement defects falling in this category may be caused by (a) inadequate thickness of sub-base and base, and (b) inadequate compaction of subgrade, sub-base, and base. These are dealt with separately hereunder:

4.1 Thickness

The thickness of sub-base, base and surfacing above a given layer is considered inadequate, if detectable shear deformation occurs in that layer. Shear deformation, which is also referred to as plastic movement or plastic deformation, may be defined as change in shape with no change in volume. During traffic, materials move out from under wheel paths, creating a depression in the traffic lane and an upheaval outside the traffic lane. Incidentally, it may be mentioned that the thicknesses shown in the standard CBR design charts are intended to prevent all shear deformation in the layer with the given CBR.

Determination of the occurrence of shear deformation in a particular layer can be made by a study of (i) deflection measurement, (ii) in-place strength tests, (iii) cracking of the pavement, (iv) upheaval of the surface, and (v) position of the layers.

(i) Deflection

Deflection in the downward movement under load. Deflections at the level being considered (e.g. the subgrade) are measured in accelerated traffic tests under standing loads at intervals throughout the period of the test. Surface deflections can also be used, if the overlying layers are of high quality and adequately compacted, so that little compression occurs under load. Curves of deflections versus coverage (on a semi-logarithmic chart) are of important value in determining whether shear deformation is taking place. Curves which show a decreasing or constant deflection with coverage are typical of conditions where there is no shear deformation.

(ii) In-place Strength Tests

In-place CBR and other strength tests can also be used to indicate the development of shear deformation in any layer, if the tests are made at intervals. Where no shear deformation occurs, the CBR value will remain constant or increase with the traffic, where shear deformation is taking place, there will be a significant drop in the CBR value.

(iii) Cracking

The cracking that develops in a bituminous pavement, when shear deformation occurs, follows a typical pattern.

In the early stages, the cracks are generally parallel to the direction of traffic. As repetitions are continued, transverse cracks are formed and an alligator pattern is developed. Closely spaced cracking indicates shear deformation in a layer near the surface, widely spaced cracking indicates shear deformation in a deep layer.

(iv) Upheaval

Upheaval of the surface adjacent to the traffic lane is definite evidence of shear deformation. The width of a rut indicates in a general way the depth of the railed layer. This should not be taken as rigid rule, but only as a criterion with some reservations. Subgrade shear failures will exhibit surface upheaval at some distance from the depressed rut, whereas shear failures in the surface will result in upheavals relatively close to the tyre track.

(v) Position of Layers

A cross-section of the face of trench, cut across the traffic lane, can show whether or not a layer has been overstressed to the point where shear deformation has occurred. A thinning of the concerned layer in the traffic lane, accompanied by its thickening outside the traffic lane, is evidence of shear deformation in the layer. Also upheaval of the subgrade outside the traffic lane is evidence of shear deformation in the subgrade.

4.2 Compaction

Compaction is defined as a change in shape accompanied by a change in volume, as opposed to shear deformation where no change in volume occurs. The compaction of the pavement is caused by repetitive and vibratory movements of traffic and results in a depression beneath the wheel path. The shape of the depression is a clue to the layer that has densified. Compaction in a layer near the surface will produce a sharp depression; compaction at a depth will cause a broader depression.

5. GENERAL

5.1 It may be stressed that although the causes of pavement distress have been neatly separated in the preceding paragraphs, in practice it will never be the case. When distress occurs in a pavement, both compaction and shear deformation are involved, an it is necessary to try to separate the two. Compaction, though contributing to undesirable surface irregularity, increases the structural strength of a pavement and becomes successively reduced under given intensity of traffic. Shear deformation, on the other hand, becomes progressively more pronounced in its resultant effects.

5.2 These points have been set down here at some length to serve for guidance in the preliminary evaluation of stabilised soil pavements.

5.3 The condition survey should give a qualitative as well as a quantitative appraisal of the defects in the pavement. The qualitative study will involve rating of the defects according to their severity, the quantitative approach will take into account the extent of the distress and relate it to the total area of the pavement.

5.4 In addition, for a proper condition survey, the authorities concerned should give detailed data regarding cost of maintenance of the stabilized soil roads in service. The average traffic volume per day of commercial vehicles, passenger cars an bullock carts should also be included in the data. The information in Tables 1 an 2 should be recorded in the manner indicated below.

6. DIRECTIONS FOR FILLING UP OF THE DATA IN TABLES 1 & 2

Table No. 1

General Columns

“Name of the road” will be main name, e.g., Delhi-Mathura road, and the section will mean a part of that road such as

Agra-Mathura section. The "section" will be chosen in such a way that the type of construction equipment employed and the "type of stabilization" (e.g., soil-lime, soil-cement, soil-moorum, etc.) are uniform for in whole length of that section. The "type of construction equipment" will include only those equipment used for soil-stabilization proper such as pulverising an mixing of soil with the stabiliser, as also adding of moisture (e.g., rotavator, disc harrows, water sprinkler, pulvimixer single-pass stabiliser, etc.). For nature of shoulders, its brief specification and whether it is surfaced or not should be mentioned.

Detailed Columns

(1) "Location" (col. 2) should be indicated by the actual kilometerage and chainage of the point relating to which the information is being supplied.

(2) Under the item "Composition and thickness of pavement layers" (col. 4) will come the details as indicated below (sample figures) :

1) Wearing coat — premixed carpet/2 coat surface dressing, etc.

2) Base coat — 10 cm w.b.m., 15 cm soling, etc.

3) Sub-base — (a) 10 cm lime-soil with 4 percent lime;

(b) 7.5 cm lime-soil with 3 percent lime, etc.

(3) "Gradation of soil" (cols, 8 & 9) — This should indicate the percentage passing by weight of soil in I.S. Sieve numbers 2.36 mm, 425 microns, and 75 microns (10, 40, 200 ASTM).

(4) "Degree of pulverisation" (col. 18) — The percentage by weight of soil passing through 25 mm and 4.75 mm I.S. Sieves should be indicated.

(5) Under the items "CBR and unconfined compressive strength of stabilised soil" (col. 19), the values should be determined on the soil-stabilised mix collected from

the field just before the commencement of rolling and compacted in the laboratory at the field moisture content to achieve the degree of compaction as is expected in the field and then cured and soaked under a surcharge equivalent to the weight of the pavement (of course, no surcharge will be necessary in case of determination of unconfined compressive strength).

Table No. 2

Detailed Columns

(1) Under col. 3, the "water table" should be determined by boring holes at the edge of the pavement at the end of the monsoon period when the water table is likely to be the highest.

(2) Cols. 4 and 5 have to be determined with the help of a bump integrator.

(3) Under col. 8, "Surface cracking", the alligator type of cracking should be indicated by area, whereas for ordinary cracking the length of the cracks should be indicated.

(4) Under col. 9, "Condition of surface", the rating should be "good", "fair", and "bad".

(5) Col. 10, "Cost of patch repairs per year" should give the figure of expenditure incurred only for repairing and maintenance of the surface for the period in between the renewals, no maintenance cost for laying of a renewal coat should be included in this figure.

TABLE NO. 1

Details of Stabilised Soil Construction

1. State ____________
2. District ____________
3. Name of Road ______ Section ______ Length in km ______
4. Type of Construction Equipment Employed
5. Type of Stabilization ____________
6. Width of Pavement ____________
7. Width and Nature of Shoulders ____________

Serial No.	Location	Months during which constructed	Composition and thickness of pavement layers	Subgrade			Soil used in stabilised layer									Field stabilised soil			Remarks
				L.L.	P.I.	C.B.R. with M.C, %	Gradation of soil		L.L. %	P.I. %	Organic Content %	Sulphate Content %	Proctor Density	O.M.C. %	M.C. at Compaction	Degree of Compaction (% of Protector)	Degree of Pulverization (% Passing Sieve No.)	C.B.R. & Unconfined Compressive Strength of Stabilized Soil	
							I.S. Sieve	% Passing by weight											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

TABLE NO. 2

Service Performance

1. State ________________ District
2. Name of Road ________________ Section ________________ Length in km
3. Rainfall : (A) Average Annual Rainfall ________________ (B) During Monsoon ________________
4. Drainage of Subgrade : (A) Well Drained /(B) Poorly Drained /(C) Waterlogged
5. Date of Opening Road to Traffic ________________ 6. Date of Observation ________________
7. No. of Commercial Vehicles of different Tonnage using up to the data of Observation : (A) 8 Tonnes ______ Nos. (B) 5 Tonnes ________ Nos. () 3 Tonnes ________ Nos. (D) Bullock Carts

Serial number	Location	Depth of highest water table below formation level	Unevenness Index		• No. of patches & total of patch area	Rut depth	Surface cracking	Condition of surface*	Cost of patch repairs per year/km	Remarks including type of failure including failed area—sq. m. per cent
			Before opening to traffic	On the date of observation						
1	2	3	4	5	6	7	8	9	10	11

*Present condition may be rated as : G for Good
F for Fair
B for Bad