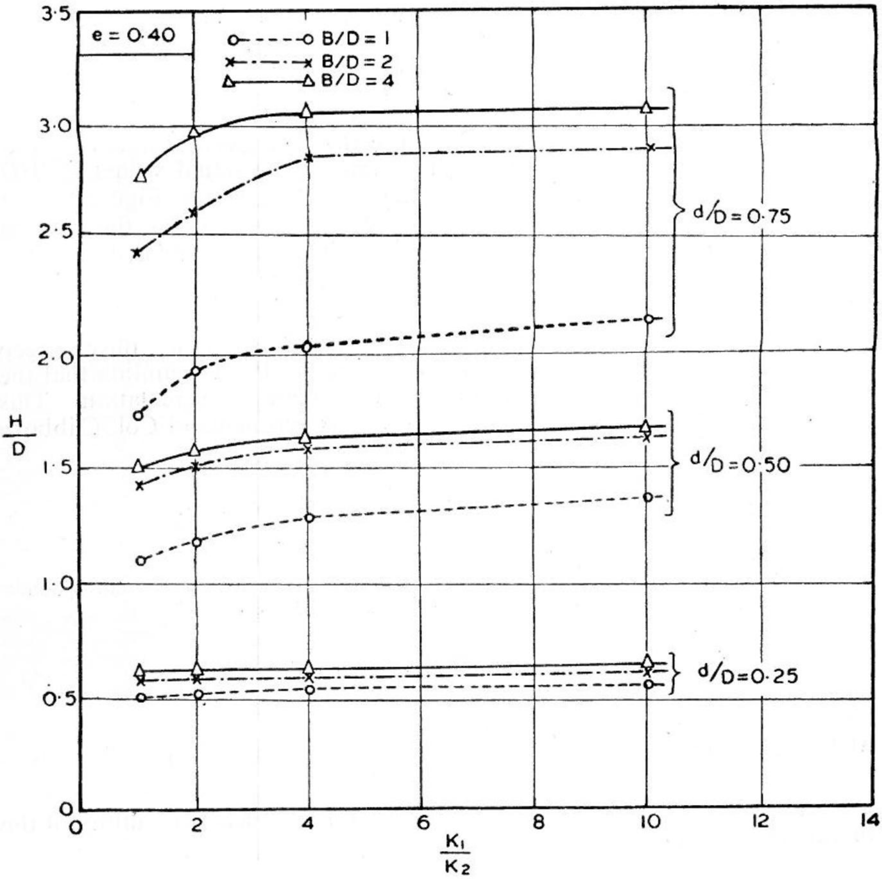

As one is interested merely in actual discharge, validity of Bligh's concepts do not come into picture at all.

Authors once again thank Shri Desai for taking deep interest in their article.

A Field Study on the Design and Construction of Roads in Waterlogged Areas*

by

S.R. Bindra

K.S. TYAGI**

One of the important aspects of the research on the optimum design of road pavements is to correlate the laboratory results with the field

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performance studies. As such the author must be congratulated for the presentation of field performance results for different types of road pavements constructed in waterlogged areas. The writer wishes to seek further information and clarifications in connection with the following points :

(*i*) In this study the author has included soil-cement bases, mechanically stabilised soil bases, and brick bases. Was a soil-lime-flyash or soil-lime-flyash-cement base considered as a possible alternative and if yes why was it not included in this investigation ?

(*ii*) This writer would like to know the cost of construction of the different types of pavements together with the maintenance cost, so that the economic aspect could be studied in terms of the annual cost.

(*iii*) Referring to Table I, it is observed that the results of sieve analysis have only been obtained. As such these results do not convey a complete picture of the soil. It is not possible to classify soils at serial Nos. 1, 2, 3 and 6 unless the grain size distribution in the fraction passing sieve No. 200 is also obtained using hydrometer analysis or other methods. This writer would like to know the method of classification according to which the soils at Sl. No. 7(*i*) and 8(*i*) in Table I, have been classified as clay. These soils contain more than 60 percent sand and thus will fall in the category of sandy clay, sandy clay loam, or sandy loam depending on the size distribution of the finer fraction (Spangler, 1963).

(*iv*) It appears that in this investigation, while constructing soil-cement base, cement was spread at a moisture content 1 to 2 per cent above OMC and then mixing was carried out. This method does not ensure uniform mixing. It has been observed by this writer in the field and it has been reported in literature that the mixing should be done dry first, and when a uniform colour is obtained, required amount of moisture be added, to be followed by further mixing and compaction. In this connection it would be interesting to know as to whether any control mixes were prepared under the laboratory conditions for determinations of CBR at various curing periods and if yes, how did these results compare with the values achieved in the field ?

(*v*) It is seen from Table II that in some cases the seal coat has considerably decreased the patchwork required for example, specification Nos. 1, 13, 19, 20, 21, 22, 23, 26, etc., whereas in some other cases construction of seal coat has considerably increased the amount of patchwork, e.g., specifications 5, 7, 8, 9, 10, etc. Could the author explain the reason for this ? Should the practice of providing seal coat be discontinued for the type of pavements where it has lead to a significant increase in the additional patchwork required ?

(*vi*) From Table II, for specifications 15 and 19, it is seen that before the seal coat is provided, the additional patchwork required is nil and 43·0 percent respectively. In specification 15, a primer coat is given whereas in specification 19, in its place a 8 cm thick soil cement layer with 5 percent cement is provided. This shows that primer coat is very efficient as compared with soil cement layer. This appears to contradict trends of results as discussed vide series I, item 1 and series IV, item 5.

Reference

SPANGLER, M.G. (1963) : "*Soil Engineering*". International Text Book Co., Pennsylvania, p. 47.

AUTHOR'S REPLY

I am thankful to Dr. Tyagi for his valuable comments on the paper. Replies to points raised by him are as follows :

1. It was not the object of the study to try all types of materials for the construction of bases. Soil-lime flyash or soil-lime-flyash-cement had not been considered feasible due to non-readily availability of quantities required of flyash, non-aptness of economics and not extensive applicability of the techniques.

2. The cost of different materials for construction of different layers of pavement at the time of construction and maintenance cost are given below :

(1)	Local compacted soil	Rs. 5·30/cu m
(2)	Graded stabilised soil	Rs. 10 ,,
(3)	Soil stabilised with soft aggregates	Rs. 16 ,,
(4)	Soil stabilised with soft aggregates and with stone grafting	Rs. 18 ,,
(5)	Soil stabilised with 2·5 percent cement	Rs. 15 ,,
(6)	Soil stabilised with 5 percent cement	Rs. 20 ,,
(7)	Water bound macadam	Rs. 25 ,,
(8)	Primer @ 20 kg/10 sq m	Rs. 16/10 sq m
(9)	2 cm Primix Carpet	Rs. 29/10 sq m
(10)	Tack coat @ 10 kg/10 sq m	Rs. 6·65/10 sq m
(11)	Patchwork	Rs. 30/10 sq m

3. Two systems of classification of soils are generally being used for classifying soil for engineering purposes, i.e., Unified Classification System and Public Roads Administration System. These classification systems are based on Liquid Limit, Plasticity Index and percent coarse grained (sand content). These three physical constants have been determined and are given in Table I.

According to Unified Classification System Soil Nos. 1, 2, 3 are CL (clayey) and Soil No. 6 is CL-ML (clay to silty). The base course soil under Serial No. 7 in Table I is mixture of 25 percent clayey soil, 37·5 percent fine sand and 37·5 percent medium sand. Soil No. 8 is mixture of 30 percent clayey soil, 30 percent fine sand and 40 percent medium sand. The sieve analysis of resultant mixes are given in Table I and not of clayey soil and more than 60 percent sand contents are of resultant mixtures. The para on soil mixture on page 83 may please be referred to for clarification.

4. There are two ways of mixing cement in the pulverised soil [90 percent passing 2·5 cm (1 in.) sieve and at least 50 percent passing 4·8 mm (3/16 in.) sieve] i.e., in dry or in wet state. It is correct that uniform mixing of cement in dry state can be achieved in pulverised soil which has got clods up to 19 mm ($\frac{3}{4}$ in.) size. On adding water to soil-cement mix, the mixture is required to be processed within one hour, i.e., before the initial setting of cement. Due to this short time, the clods of soil do not get softened by water and reduced to fine size. It is advantageous to add water to the pulverised soil about 12 hours before mixing of cement. The clods on contact with water for longer time get softened and on mixing result in fine soil. Then on further mixing with cement, the soil gets pulverised further. In case the soil-cement mix contains lot of clods and if more time is allowed on the mixing of soil-cement and water, the strength of resultant mix decreases considerably. Even in case of lime, which takes considerably more time than cement in setting, the elapse of time between compaction and mixing of water to soil-lime mix, reduction in strength has been reported (Michali and Hooper and Uppal and Bhasin). The mixing of cement in wet state is the practice recommended by Indian Roads Congress. There is a standard method for the determination of C.B.R. value of soil-cement mixes and curing period is prescribed for that. It was not the object of the study to determine CBR value after different curing periods and lot of literature is available on the effect of curing intervals on strength (Uppal and Bhasin). The C.B.R. values of soil-cement mixes were determined both under laboratory and field conditions and those values were more than 100 percent.

5. The function of seal coat is to check the infiltration of water from the top in case the bituminous surfacing is pervious. The occurrence of settlement and pot-holes which require patchwork is mainly due to apart from infiltration of water to (*i*) different types of bases which may or may not be affected by infiltration of water, (*ii*) different structural strength of bases, (*iii*) provision of different capillary cut-offs and strengthening materials on subgrade, (*iv*) Variations in subgrade conditions.

The patchwork is an indication of performance of pavement due to all components and not only due to seal coat. The increase or decrease of patchwork is not entirely controlled by the application of seal coat, though it can decrease the patchwork if the sub-bases are affected by the infiltration of the water.

6. The patchwork of a specification as mentioned above depends on a number of factors and not only on provision of primer coat or soil-cement layer. While comparing the performance of two specifications, all the factors are required to be considered. In this case subgrade has been the influencing factor.

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Plan-Dimensioning of Footings Subjected to Uniaxial Moments*

by

K.S. Subba Rao, N. Narayana Rao and B.V. Ranganatham

B S. BULSARI AND I.D. DESAI****

In proportioning a trapezoidal footing; b, B and L are the three unknowns which should be found ; minimising the area. With a trapezoidal footing normally $e > e_{max}$, and due to separation at the footing-soil contact surface, there is redistribution of pressure. This aspect gives only one relation based on the maximum pressure to be equal to its allowable value. Another relation can be obtained from the aspect of stability against overturning. With two equations and three unknowns, the solution set is uncountably infinite. In such a situation trial and error procedure or arbitrary choice cannot be avoided.

In trapezoidal footings, authors have fixed the value of L, reducing the number of unknowns to two and further, specifying the value of m i.e., ratio of B/b, reduced the number of unknowns to one. In case of the rectangular footing, they reduce the number of unknowns to one by (*i*) either fixing L for restricted dimensions, (*ii*) or fixing the value of n, i.e., the ratio of L/b in case of unrestricted value of L. In case of square footing, of course, the number of unknowns is one. In all the cases, they find only one unknown from the first condition of pressure

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