SYNOPSIS

Of the different factors that affect the performance of a highway pavement, aggregate gradation is one. Although its importance is realised by the field engineer and the laboratory investigator alike, there is no general agreement as to what gradations are satisfactory. The current standard specifications for aggregate gradings are many in number, and they differ widely. While many of the highway agencies recommended dense continuous gradings, others preferred skip gradings when they gave better performance in the field.

A review of the wide diversity and dissimilarity of requirements of aggregate gradings shows that the evaluation is mostly a matter of experience and judgement, rather than one of investigation based on accepted criteria. The few methods that are available for the design of a grading (for example, the Fuller's) are based on the criterion of minimum voids for a graded mix. However, the concept of minimum voids has not been extended to skip gradings.

The main objective of this investigation is to develop a laboratory procedure for evolving skip gradings from standard continuous gradings on the criterion of minimum voids and then compare the characteristics of such gradings with those of other gradings. A laboratory test called the 'Dry Compaction Test' was developed for this purpose. With the help of this test, in a sequence of iterations, skip gradings were developed within the limits of standard continuous gradings. To examine how the

omission of all the intermediate fractions in a grading affect the properties of the mixtures, two-component or binary gradings were formed with only the maximum and minimum-sized aggregates of selected continuous gradings. The compositions of these binary gradings are determined by the dry compaction test on the criterion of minimum voids.

The comparison is thus attempted, in this study, between four types of gradings: standard continuous gradings as per U.K. Practice, Fuller's gradings, derived skip gradings and binary gradings corresponding to the continuous gradings.

Angular dolerite stone chips and rounded to sub-rounded gravel that are used for pavement construction in this part of the country (West Bengal), were selected for the study. Aggregates with nominal maximum sizes of 20 mm (3/4 inch), 10 mm (3/8 inch) and 4.76 mm (3/16 in.) were considered.

In all, 24 gradings were studied. They include the four types of gradings for each nominal maximum size for the two types of aggregates. The two types of aggregates selected were expected to throw light on the effect of the shape of the aggregate, if any, on the resulting gradings and the characteristics of soil-aggregate mixtures formed with them.

Before a comparative study of the different gradings is attempted, a study of the packing of binary mixtures was considered in order to understand how the voids ratios of the aggregate mixtures vary with the proportions of the components and their relative sizes. These studies were also carried out by the dry compaction test.

It was observed that the skip and binary gradings attained practically the same minimum voids. Skip gradings, required large percentage of the maximum and minimum-sized components with small fractions of certain intermediate sizes. In all the skip gradings developed, irrespective of the nominal maximum size, for either type of aggregates, the same two size groups, namely (< 2.38 mm > 1.18 mm) and (< 1.18 mm > 0.60 mm), got eliminated during the process of iterations.

In the study of soil-aggregate mixtures, the binder soil content (finer than 0.075 mm size) required for minimum voids of a graded aggregate in the dry state is first determined by the dry compaction test. This binder content is called the optimum binder soil for maximum density of the grading and is found to be influenced by the type of the grading and by the nominal maximum size of the aggregate.

Modified AASHO compaction tests were carried out on soil-aggregate mixtures of different gradings to evaluate the effect of binder content and type of grading on the maximum dry density and optimum moisture content. It was observed that for all the gradings, except the binary, the modified AASHO compaction test and the dry compaction test required the same amount of binder soil for maximum density with either kind of aggregate.

C.B.R. tests were carried out for evaluating the stability of soil-aggregate mixtures of different gradings with different amounts of binder soil at their optimum moisture contents (as determined by the modified AASHO tests). It was

observed that the derived skip gradings gave higher stability values than the corresponding continuous, Fuller's, and binary gradings. Continuous, Fuller's and binary gradings gave almost the same strengths. These studies indicated that in soil-aggregate mixtures, maximum strengths are not achieved at maximum densities.

Some limited studies were carried out to evaluate the relative degradation characteristics of the four types of aggregate gradings. Two types of tests were devised for this purpose; a) the Impact Degradation test to assess the degradation of aggregates due to the impact blows of a hammer corresponding to the modified AASHO compactive effort and b) Modified Los-Angeles abrasion test to assess the degradation due to abrasion between the aggregates themselves without the charge of the steel balls.

These tests indicated that, in general, the type, size and initial grading of aggregates have a pronounced effect on the degradation of aggregates. For either type of aggregate, binary and skip gradings degraded more than either the Fuller's or continuous gradings. Continuous gradings degraded the least. Degradation of aggregates, for any type of grading, increased with the increase in maximum size of aggregate. Aggregates degraded more due to abrasion than due to impact. Gravel degraded more than dolerite stone chips. Presence of binder soil reduced the degradation of aggregates slightly.

At the end, scope for further work on the findings obtained in this investigation was suggested.