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Technical Note

Modification of the formula used in the determination of the ten per cent fines value of aggregate

J. C. Bullas

Materials & Construction Division, Highways Group, Transport and Road Research Laboratory, Crowthorne, RG11 6AU, UK

Abstract

One established method of estimating the force required for the ten per cent fines test on an aggregate is to divide the number 4000 by the aggregate impact value. However recent analysis of ten per cent fines and aggregate impact data for 79 aggregate samples of various rock types suggests that this method commonly produces too high a fines yield. From the present work it appears that use of the value 2800 in the place of 4000 would increase the probability of a valid estimate of the test load.

Introduction

The ten per cent fines value is a widely used measure of the resistance of an aggregate to crushing under compressive load. It is frequently employed in assessing aggregates for highways construction and can be used with rocks of both high and low strength. Before carrying out the test, an estimate of the force required to produce ten per cent fines can be made by using the aggregate impact value determined on another sample of the aggregate.

The ten per cent fines value (TPF) represents the force in kilonewtons, which when applied gradually over a ten minute period will produce ten per cent of material finer than 2.36 mm in a standard sample of 14–10 mm size aggregate (BS 812: Part 3: 1975). An estimate of the force for the test can be obtained in two ways: by measuring the total penetration of the plunger into the test cylinder or by dividing the number 4000 by the aggregate impact value (AIV). It is the accuracy of this second method of estimation that has been called into question by the present work.

Observations made in the course of testing aggregates

As part of a current research project, 79 samples of aggregate of various rock types (see Table 1) were tested to obtain the aggregate impact (AIV) and ten per cent fines (TPF) values. In the course of this testing it was noted that overestimates of the force for the TPF test were obtained using the formula

$$\text{Required force (kN)} = \frac{4000}{\text{AIV}}.$$

Suggested modification to existing standard procedure

In an attempt to establish a more accurate means of estimating the force for the ten per cent fines test, the range of force necessary to produce fines between 7.5 and 12.5 per cent for each aggregate was calculated from the known TPF values, this being the range of percentage fines produced for the test result to be valid:

$$\text{Force for } n\% \text{ fines (kN)} = \frac{(n+4) \times \text{TPF}}{14}.$$

A range of force that would result in the maximum number of valid results for a given AIV was established: these force ranges are shown as vertical bars in Fig. 1. A rectangular hyperbola of the form

$$\text{Force (kN)} = \frac{K}{\text{AIV}}$$

was fitted to the data. It was noted the curve with $K = 4000$ intersected only one force range, hence a number of hyperbolae were generated with K

TABLE 1. *Distribution by group classification of aggregates tested*

Petrological group (BS 812: Part 1:1975)	Frequency (% of total population)
Artificial	3 (3.8%)
Basalt	17 (21.5%)
Gabbro	3 (3.8%)
Granite	6 (7.6%)
Gritstone	17 (21.5%)
Limestone	32 (40.5%)
Quartzite	1 (1.3%)

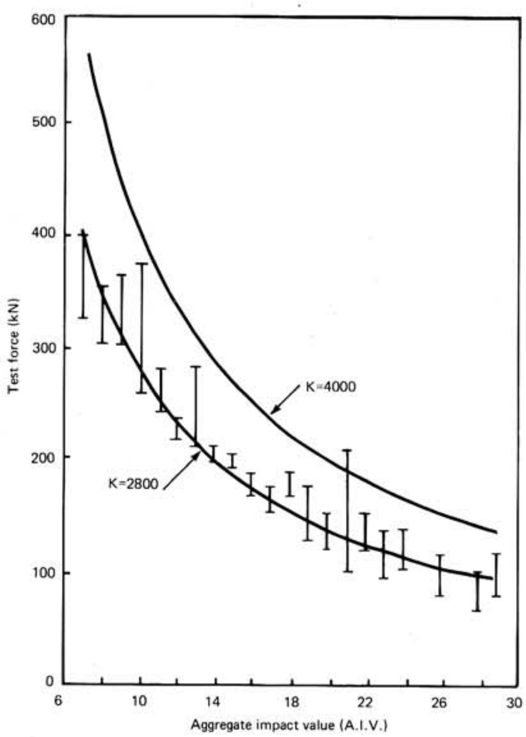

FIG. 1. Relation between test force required for ten per cent fines test and aggregate impact value.

decreasing from 4000. By trial and error it was found that the curve generated using the value $K = 2800$ intersected the greatest number of force ranges and therefore offers the highest probability of obtaining a valid test result throughout the range of aggregates. Note however that whilst it increases the probability of obtaining valid results from the estimated load, it does not maximize the chance of getting a result close to the ten per cent fines value.

The problem encountered with the existing formula has been found elsewhere (Parkinson 1989). From the present work it appears that the constant $K = 2800$ may reduce the number of unsatisfactory estimates resulting from the use of the existing formula.

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