Book review

Concrete and statistics

by J. D. McIntosh

Published by C.R. Books Ltd, London, 1963. pp. 139. Price 35s.

This book has not been written for those engaged in concrete research, who require far more statistical tools than the author provides. Even so, such readers will find much to interest them in this book, particularly from the point of view of the use of test results in Standards and Specifications.

The author has aimed at the much wider audience of all those who make or use concrete and concrete products and this book is thereby of greater importance and has been published at a very opportune moment. The use of statistical methods to assist in the control of the quality of concrete is increasing and this is being reflected in Codes of Practice and British Standards. For example, British Standard Code of Practice CP 115, *The structural use of prestressed concrete in building*, includes a special method of quality control based on the average strength and the standard deviation of the concrete, instead of minimum strength requirements. British Standard 1926, *Specification for ready-mixed concrete*, has strength requirements based on the statistical analysis of test results, and statistical theories are used to specify acceptance levels of test results in many British Standards for concrete products. The author clearly had these in mind when writing this book since he makes frequent references to such Codes and Standards.

The book is written in an easily readable style and the author has treated the statistical method as the development of a system of logical reasoning. The mathematics have been kept to the minimum necessary,

and the reader has only to accept two or three basic formulae and to perform simple arithmetic calculations.

The text is divided into seven chapters, there are three appendices and a comprehensive index. The first two chapters deal with measuring the variation of groups of numbers, the importance of proper sampling techniques and the implications of relying on the use of "minimum" values. The author advocates the use of the standard deviation as the measure of variability of concrete cube results. Chapter 3 considers the important problem of structural safety and the probability of failure, taking into account the "minimum" strength of the material and the "maximum" stress to which it is likely to be subjected. The author points out that there is a probability that "maximum" design stresses will be exceeded owing to inaccuracies in the assumptions on which the calculations are based or to abnormal loading conditions. This is followed by a section dealing with load factors.

Chapter 4 discusses the form that a specification based on statistical control should take, and the author stresses the advantages of using single cube results instead of the more usual averages of groups of three cubes. Chapter 5 describes the actual mechanical process of drawing up control charts and the implications of the results. Two very important points are made: the first is the differences in sampling technique, depending on whether the results are to be used in a minimum strength specification or in a statistical control specification; the second, which supports the need for a book such as this, is that an examination of test results indicates that adequate supervision is more likely to produce better control than the provision of expensive plant.

In chapter 6 the author considers the effect on the concrete of variation of the constituent materials and deals at some length with the question of cement variability and the difficulties associated with taking "reference samples" of aggregate. In the final chapter the author has given some very sound advice on the interpretation of non-destructive test results for concrete at the borderline of acceptance. This chapter also deals with the implications of test limits in British Standards for precast products when tests can be made on samples before a consignment of precast products is accepted. I would have liked to have seen this section expanded slightly to deal further with operating characteristics, and to include a reference to B.S. 2635, *Drafting specifications based on limiting the number of defectives permitted in small samples*.

The book concludes with three appendices and a very detailed index. Appendix 1 gives the statistical mathematical relationships, Appendix 2 gives detailed worked examples of control calculations, and Appendix 3 a list of references including some useful bibliographical reviews.

D. C. TEYCHENNÉ