unfortunate that the section on precast concrete does not provide examples and criticism of connections as used in practice. This paper does, however, give a valuable broad view over a wide range of precast construction.

Most of the papers in this section are concerned with current practice. The contribution by Braestrup and Nielsen is different in dealing with the application of the theory of perfect plasticity to the analysis and design of reinforced concrete. There are limitations to this approach, depending on ductility requirements, but it is an area of research of increasing importance for applications, and where the method of analysis and the detailing requirements are strongly linked.

A section on Construction follows the articles on Design and Analysis. This comprises just three papers concerned with maintenance, repair and demolition, construction in hot climates and concrete production, quality control and evaluation in service. These are all important topics, but clearly do not cover the whole of the construction process. From a student's point of view, an introduction to formwork and temporary works would have been valuable. Also, in dealing with repair and maintenance, the question of assessment of suspect structures is of supreme importance: this is dealt with only cursorily, as are methods of in situ testing. A further topic requiring attention is that of Quality Assurance, the change in emphasis from quality control having a major influence upon materials and component suppliers as well as upon site practice.

Following Construction, the *Handbook* deals with Structures. There are eleven papers in this category, of which two are on Tall Buildings. The first (by A. Coull and B. Stafford Smith) considers the evolution of structural form and the application of approximate methods of elastic analysis. The second (by Y. K. Cheung) provides an introduction to elastic frame analysis, finite-element and finite-strip analysis applied to tall buildings. Except for the paper on shells, the remainder of the papers in this group are more general and linked to practice.

The long article on bridges by Liebenberg is particularly worth reading. It addresses the whole field of conceptual design, reliability and analysis, and goes on to examples of the construction of a number of major bridges. This is an important source of information with over two hundred references. Similar wide-ranging reviews are provided in other papers on piled foundations, nuclear reactor structures and offshore structures. There are also papers on the detailed design of bins and silos, chimneys and water-retaining structures, together with an outstanding practical paper by A. J. Mitchell on caisson foundations.

The final section of the *Handbook* is entitled Practical Considerations and includes contributions on information sources, specifications and a discussion of the way design decisions and construction methods affect the quality and economy of the final structure. This last (by G. M. J. Williams) is an interesting contribution which brings together many of the topics raised in other parts of the *Handbook*.

No one book could cover the whole field of structural concrete. There are important omissions from the *Handbook*. It does, however, contain a wealth of information which should appeal to both students and practising engineers. The book may well be the last of its kind. The age of computer-based information and intelligent systems is already here and future handbooks will be on disc or tape.

In the meantime, the *Handbook* will occupy a place on the bookshelf and act as a friend who can be approached for basic advice and information. Sometimes this will be neither complete nor fully authoritative. More frequently, the friend on the shelf will have something valuable to contribute either on his own account or by directing the reader to original sources.

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Limit analysis and concrete plasticity

M. P. Nielsen

Englewood Cliffs, N.J., Prentice-Hall, Inc. 1984, 235 × 157 mm. pp. xii, 420. Type-set, illustrated, hardback. ISBN 0-13-536623-2. Price: £40·80. Prentice-Hall Series in Civil Engineering and Engineering Mechanics, N.N. Newmark and W.J. Hall, Editors.

The application of plastic theory to concrete structures in which the yield behaviour is dominated by the steel reinforcement is well established and widely used in engineering design practice. In the last decade, however, researchers have been attempting to apply rigid plastic theory to concrete members in which the concrete plays a dominant role as in the case of shear failure. The author of this new book and his research group at the Technical University of Denmark have been major contributors to these recent developments and this is the first book to be published which presents a comprehensive introduction to the application of plastic methods to concrete structures. It is, therefore, an important publication which aims at

unifying the hitherto diverse worlds of concrete and classical mechanics.

The author begins in Chapter 1 with a brief introduction to classical plasticity theory introducing the normality flow rule and the plastic limit theorems. He then proceeds in Chapter 2 to show that a modified Coulomb yield criterion may be used for concrete, but with an experimentally determined effectiveness factor applied to the cylinder strength to allow for the limited ductility of concrete in compression. The yield conditions for structures in which the steel reinforcement dominates, such as disks (in-plane loaded thin plates) and slabs, are also presented in this chapter and applications to reinforcement design described.

The application of plastic theory to plain concrete is described in Chapter 3, using the modified Coulomb yield criterion. The concept of planes of discontinuity in strains, geometrically admissible strain fields and plane strain problems are discussed with examples.

Chapter 4 is concerned with reinforced disks and presents all the known exact plastic solutions and some lower-bound solutions. Beams are covered in Chapter 5, both under pure flexure, which is the only case in which the effectiveness factor for concrete can be calculated, and under shear and torsion. The section on shear presents the recent important developments in determining upper- and lower-bound plastic solutions for shear failure in beams and compares the predictions with experimental evidence. Although it is freely admitted that the plastic strains may not be realistic, it is argued that the key mechanics of shear failure are correctly predicted by plastic theory.

Chapter 6 is devoted to the flexural behaviour of slabs and presents a modern view of yield-line theory and the author's interpretation of nodal forces and the anomalies associated with Johansen's original presentation. Lower-bound methods including Hillerborg's simple strip method are also briefly described. Membrane action in axially restrained slabs unfortunately only receives scant attention, though references to some recent papers are included.

The author returns to concrete-dominated problems in Chapter 7 and applies plastic theory to the prediction of punching shear failures in slabs. An extension of the plastic shear failure theory to joints is given in Chapter 8 and, finally, in Chapter 9, some preliminary work on the prediction of bond strength of reinforcing bars is described.

It is a historical curiosity of the development of plastic theory for concrete structures that so much of the work has originated in the Scandinavian countries. Its appreciation and adoption in the larger countries including the UK has been belated and this may be true of the more recent work on shear failures. This new book is, therefore, timely and deserves the attention of all researchers, teachers and designers concerned with the development of the mechanics of concrete structures: Although intended as an introduction to the subject, the treatment is rigorous and will be fairly demanding to those not already familiar with plastic theory. It should be widely read and it is, therefore, much to be regretted that it is priced so highly (£40·80).

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