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REVIEWS

Hydroelasticity of Ships. By R. E. D. Bishop and W. G. Price. Cambridge University Press, 1979. 431 pp. £32.50 (hardback).

Hydroelasticity is that branch of science which is concerned with the motion of deformable bodies through liquids. Thus this book is not a work that is principally concerned with the mechanics of fluids. A ship is moving in waves; what are the forces acting on the ship's hull, and how does the ship respond to these factors?

That a ship is really a flexible structure and might be treated as an elastic beam is not a new idea, but it is only in the light of recent advances in many branches of mechanics, in oceanography, and in computing that this idea has become a practical one. Moreover, return to the fundamentals of ship dynamics is, in the authors' view, no longer out of the question. This book is an expression of this view. It is admitted that much of the material has appeared only recently as published research, and that the techniques presented have not yet withstood the test of time. The authors have decided to present only basic theory, together with some specific results based on actual ships. The result is a book which is different from any existing text book of naval architecture.

The chapter headings are as follows: 1, Ship response; 2, The dry hull; 3, More accurate analysis of hull dynamics; 4, The characteristics of practical hulls; 5, Ship distortion in still water; 6, Wave theory; 7, Symmetric generalized fluid forces; 8, Symmetric response; 9, Transient loading; 10, Antisymmetric response to wave excitation; 11, Statistical analysis of ship response; and 12, Responses of other marine structures in waves. It will be seen that fluid dynamics does not enter until chapter 6. Readers of the *Journal of Fluid Mechanics* may be interested to know what aspects of fluid mechanics are considered relevant to this problem.

In chapter 6 wave forces are calculated on the assumption (the famous Froude–Krylov hypothesis) that the incident wave acts on the ship but is not distorted. Such calculations may be expected to give the correct order of magnitude. Mass transport in waves is mentioned, however.

In chapter 7 a more detailed theory of ship–wave interaction is presented, based on several forms of strip theory; in other words, each section is treated as if it were part of an infinitely long horizontal cylinder. (Quite a detailed discussion is given of virtual-mass and damping coefficients.) Predictions of wave damping differ markedly according to the choice of strip theory.

In chapter 8 the results of chapter 7 are used to calculate the applied forces on the ship and hence the elastic response of the ship to waves as a function of frequency for some typical cases.

In chapter 9 the problem of slamming is studied. Under certain conditions the sea imparts a severe transient loading to the hull owing to rapid and deep immersion of the bow, or owing to emergence of the hull near the bow or stern. It has been found that the hull of a ship then vibrates at a high frequency for a large number of cycles, the rate of decay being small. An attempt is here made to model slamming by a linear theory; the virtual-mass coefficients are calculated for infinite frequency. Two different approaches give different answers.

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Chapter 10 is concerned with lateral motions. Not much is known about virtual-mass and damping coefficients although the methods of the earlier chapters remain applicable. A detailed study is made for a container ship.

In chapter 12 the ideas of earlier chapters are applied to other marine structures. In particular the theory is applied to a vertical tower buoy fixed to the ocean floor. This involves many new considerations.

The authors are actively engaged in engineering in a field where traditions have been empirical rather than theoretical. Both these traditions are valuable in their appropriate place, and both still lack essential information.

In the present work the authors have made a theoretical approach to a problem where little experimental evidence is yet available, and they have made a valuable contribution in a scientific spirit. Their work should stimulate much further experimental and theoretical study in the future.

F. URSELL

SHORTER NOTICES

Viscosity of Dense Fluids. BY K. STEPHAN and K. LUCAS. Plenum Press, 1979. 268 pp. $39.50.

This book chooses fifty fluids and for each gives a comprehensive survey of the data available on the viscosity of the fluid as a function of pressure and temperature. At the start of this book, there is a highly condensed guide to the theoretical approaches that have been used to calculate viscosities from molecular theory. The great majority of the book is devoted to experimental data. For each fluid, a brief summary of the data sources is followed by a table of recommended viscosities for each combination of temperature and pressure. The same data is also presented graphically. Wherever possible, an estimate of the accuracy of the recommended values is given.

Turbulent Forced Convection in Channels and Bundles: Theory and Applications to Heat Exchangers and Nuclear Reactors. Edited by S. KAKAC and D. B. SPALDING. Hemisphere, 1979. Two volumes, 1132 pp. £40.00 (hardback).

These volumes contain papers presented at a NATO Advanced Study course held in Istanbul, 2 August 1978. The papers consist primarily of reviews – often of the author's own work – designed to familiarize heat transfer engineers with practical prediction techniques and available data correlations. 'Standard' subjects reviewed include: basic turbulence modelling; numerical methods; rod-bundle analysis; heat-transfer data correlations (including Prandtl number effects in liquid metals); bursting and coherent structures in wall layers; and measurement techniques. Other papers deal with specialized topics such as heat transfer at super-critical pressures and effects of radiation on heat transfer. The contents appear to be a somewhat unplanned collection of papers, in which the presentation of a few verges on the summary. As a whole these papers provide a useful introduction to current methods of heat-exchanger analysis. The pages are photographically reproduced from typewritten manuscripts; the reproduction is excellent, but typographical errors abound. The papers are preceded by a topical guide and followed by a comprehensive index.

Annual Review of Fluid Mechanics. Volume 12. Edited by M. VAN DYKE, J. V. WEHAUSEN and J. L. LUMLEY. Annual Reviews Inc., 1980. 490 pp. $17.50.

The contents of this year's volume are as follows:

Stratified Flows. BY CHIA-SHUN YIH. Academic Press, 1980. 418 pp. $29.50.

This is the second edition of the author's well-known 'Dynamics of Nonhomogeneous Fluids', which was reviewed in the *Journal of Fluid Mechanics*, vol. 29, 1967, p. 826. The material presented is only slightly different to that in the original version. The major change is a series of notes at the end of each chapter, often critical of other work, and written in a very personal style. The work concludes with a 35-page bibliography of papers and books on various aspects of stratified flows. Most of the references do not appear in the text.

Continuum Mechanics. BY A. J. M. SPENCER. Longmans Mathematical Texts, 1980. 183 pp. £5.50.

This book is the outcome of many years of teaching continuum mechanics by the author and provides an introduction to the subject at a level which does not require a great deal of mathematical preparation. Some specific results in matrix algebra, like the Cayley–Hamilton theorem and the polar decomposition theory, are derived in the introductory chapters, together with a definition of tensors by means of the concept of dyads. Cartesian tensors are used throughout except for a short discussion of cylindrical and spherical polars. Then follows some basic analysis of the kinematics of material particles, of Cauchy stress, and of the Cauchy–Green strain tensors, all of which are well illustrated by simple examples. After a chapter on conservation laws (of mass, momentum and energy) comes an exposition of linear constitutive relations – linear elasticity, Newtonian viscosity, etc. The last two chapters take the reader further, by means of polar decomposition, to a definition of stretch and the Piola–Kirchoff stress tensors, and finally to a discussion of nonlinear constitutive relations. Thermodynamics of deformation is not dealt with and so subjects like thermoelasticity cannot be treated.

The whole book is well provided with examples and problems and is aimed at the undergraduate/graduate level.

An Introduction to the Theory of Elasticity. By R. J. Atkin and N. Fox. Longmans Mathematical Texts, 1980. 245 pp. £6.25.

This is an introductory text, at second- or third-year undergraduate level, on the theory of elastic behaviour under finite or infinitesimal deformation. The first half of the book lays the foundations of the theory in a manner consistent with modern continuum mechanics, and contains a number of exact solutions in finite elasticity. Side by side with these exact solutions are descriptions of experimental work on elastic materials with a comparison of the predictions of theory with the results of experiment. In the second half of the book, the authors make the approximation to infinitesimal strains and describe some of the fundamental results of classical theory. Most of these are two- and three-dimensional static solutions (extension, torsion, bending, etc.) but the last chapter deals with dilatation and shear waves, and Rayleigh and Love surface waves.

The analysis is presented in terms of Cartesian tensors, and the fundamental quantities are referred in general to material coordinates (the Lagrangian description), which facilitates the transition to the classical (small-strain) form. The book contains references to detailed expositions of background material and a large number of examples and problems.