BOOK REVIEWS

Steel Diaphragm Roof Decks. A Design Guide with Tables for Engineers and Architects

Reviewed by Samuel J. Errera, consulting engineer, Bethlehem Steel Corp., Bethlehem, PA. Member of ASTM.

REFERENCE: Bryan, E. R. and Davies, J. M., *Steel Diaphragm Roof Decks. A Design Guide with Tables for Engineers and Architects*, Halsted Press Book, John Wiley and Sons, New York, 1981, ISBN 0470-27158-2, soft-cover, $19.95, 92 pp.

Steel roof decks are widely used on industrial buildings, schools, and office buildings. Stressed skin diaphragm design, which uses the roof deck to carry in-plane forces and thus brace the structure, has become an accepted practice in the United Kingdom, Australia, Canada, France, Germany, Norway, Sweden, the United States, and elsewhere. This replacement for conventional wind bracing in the plane of the roof for low-rise structures has obvious architectural and economic advantages.

As stated in the title and subtitle, this publication on steel diaphragm roof decks is a design guide with tables intended for use by engineers and architects. The authors are well-known experts on stressed skin design. The publication was commissioned by the Metal Roof Deck Association in Great Britain to furnish in simple form to engineers and architects appropriate values for the strength and stiffness of steel roof decks when acting as diaphragms. Use of the tables does not require a detailed understanding of the design expressions from which the tabulated values are derived. The publication is based upon the design information given in the European Recommendations for the Stressed Skin Design of Steel Structures, No. 19, ECCS-XVII-77-1E, to which the authors were prime contributors.

The publication treats "shallow" decking with a profile height less than 50 mm (2 in.) and "deep " decking with a profile height between 50 and 85 mm (2 to 3.3 in.). The type of profile used for calculation of the tabular values has a corrugation pitch of 150 mm (6 in.), a cover width not less than 600 mm (24 in.), and a nominal base steel thickness not less than 0.65 mm (0.026 in.). Seam fasteners are rivets or self-drilling screws, and the decking is assumed attached to supporting members by self-tapping screws, cartridge-fired pins, bolts, or other similar fasteners, all fixed through the troughs of the decking profile. Welded connections are not included. The International System of units is used throughout the publication.

The presentation is in two parts. Part 1 is entitled "Simplified Rules and Tables for Standard Diaphragms." It contains only eight pages with three tables giving the strength, stiffness, and permissible wind pressure for diaphragms with standard fastener patterns, plus a design example. Because of the simplifications made in the analysis, the tabulated values are necessarily conservative. Before using the simplified rules and tables, the reader first should be familiar with the principles, definitions, design requirements, and assumed conditions described in Part 2, but there is no need for a detailed understanding of the design expressions on which the tabulations are based.

Part 2 includes an introduction, eight chapters of text, figures and tables, three appendices, and an index. The treatment of additional variables permits a less conservative approach than in Part 1. It distinguishes between "shallow" and "deep" profiles, and allows for different span direction of the decking and additional fastener arrangements. The section includes the background information necessary for the understanding of diaphragm design, worked examples, a statement of the design expressions used for calculating the tables together with sample calculations, and a treatment of the strength and stiffness of diaphragms with openings. The design values given in Part 2 are still somewhat conservative, and the authors recommend the use of the full method of calculation as given in the European Recommendations if required in specific instances.

Chapter 1 of Part 2 describes the principles of diaphragm action; Chapter 2 covers specifications of the profiled sheets and fasteners; Chapter 3 gives definitions of terms used; and Chapter 4 outlines design requirements. Chapter 5 states the assumed conditions for calculation of the design tables and Chapter 6 provides an introduction to the tables. The eight design tables included in Part 2 are given in Chapter 7, and examples using the design tables appear in Chapter 8. The three appendices present the design expressions and data used in calculation of the design tables, describe the computer program used to produce the tables, and treat the strength and stiffness of diaphragms with openings, including examples. A useful index concludes the presentation.

The publication is well written and meets the stated objective of presenting, in simple form, values for the strength and stiffness of a broad range of mechanically fastened roof decks when acting as diaphragms, together with examples showing how these characteristics are used in design. The format is attractive; the layout, printing, and figures are well done. This design guide should be a useful tool for engineers and architects concerned with diaphragm action of steel roof decks.

The Encyclopedia of Mineralogy

Reviewed by Silve Kallmann, research director, Ledoux & Co., Teaneck, NJ. Chairman of ASTM Committee E-16 on Sampling and Analysis of Metal-Bearing Ores and Related Materials.

REFERENCE: Frye, K., *The Encyclopedia of Mineralogy*, Hutchinson Ross Publishing Co., Stroudsburg, PA, 1981, $95.00, 794 pp.

Minerals have always played a major role in human activities. Without minerals, the world as we know it could not exist. "Stone," "Copper," "Bronze," "Iron," and "Nuclear Ages" are terms used by both historians and anthropologists and denote successive stages in the advancement of civilization. Thus, tools found in Tanzania indicate that *Homo habilis* chose the mineral chalcedony (SiO_2) for chopping purposes as early as 1 750 000 years ago, and, according to historic records, salt, the mineral halite (NaCl) has been used since prehistoric times.

Turning from antiquity to our modern age, ASTM members may not be aware of it, but their activities at work and at home are also deeply touched by the role minerals and ores play in their lives.

For instance, the glassware in their laboratory, as well as the windows in their home are made or derived from minerals (SiO_2, $CaCO_3$, Na_2CO_3, $Na_2B_2O_7 \cdot 3H_2O$), so is the iron or steel grinding mill in their working place and the iron frying pan in their homes (Fe_2O_3, Fe_3O_4, FeOOH).

Their cars are "gold mines" of minerals, so are the trains they ride and the airplanes they fly.

We could also mention the major sources of energy available to industry and home all based on coal, crude oil, or uranium minerals.

Finally, the normal skeletal and dental tissues of all ASTM members, like those of other mortals consist of minerals, such as apatite, calcite, and aragonite and their cell activities are governed by traces of metallic elements derived from mineral sources.

What then is the definition of "minerals" and "ores"?

According to *The Encyclopedia of Mineralogy,* in a more narrow sense:

> a mineral is a naturally occurring homogeneous solid element or compound of definite chemical composition, having an ordered atomic structure and thus in a crystalline condition. Rocks, the solid materials of the earth, are aggregates of one or more minerals. Ore is a naturally occurring aggregate of minerals from which one or more metals may be extracted with profit or with hope of profit....

Another class of minerals is worked for nonmetallic elements or compounds, such as sulfur, phosphorus, fluorine, chlorine, silica, and salt.

As stated in the preface of *The Encyclopedia of Minerology*, this volume is mainly intended for nonmineralogists. Since all levels of scientific and technical sophistication are covered, different levels of background among the users must be expected.

This can be illustrated by the contribution the encyclopedia may make to the activities of various ASTM committees. (The volume even has an entry on the "American Society for Testing and Materials.")

For instance, members of ASTM Committee E-16 on Sampling and Analysis of Metal-Bearing Ores and Related Materials can find valuable items on the distribution, composition, and beneficiation of iron minerals before their ultimate use in blast furnaces. Committee E-16 is equally interested in various facets of other ores and minerals, such as bauxite, fluorspar, tantalite, beryl, and so forth. The cement people (ASTM Committee C-1) will find a wealth of information on the mineralogy of portland cement. However, ASTM members interested in various aspects of petroleum (D-2) and coal (C-5) have to acquire Vol. VI of the *Encyclopedia of Earth Science Series* for more detailed information.

Many ASTM members undoubtedly will be thrilled by the articles on "gemology" and "gem minerals." And in case you are interested in whether your next ASTM meeting location has a good mineral collection, you will find in the Encyclopedia information on every public mineral collection in the world (over 400).

Many of the broader aspects of mineralogical activities are extensively treated in 149 alphabetically listed articles called "entries" covering a myriad of subjects starting with "Abrasive Material" all the way to "Zeolites." Topics not directly listed among main entries, together with cross references, can be easily searched for in the subject index.

A mineral glossary contains 3000 entries, giving chemical composition, crystal system, and structure of about 2400 mineral specimens. Some 500 of the more important minerals are described in some detail in terms of abundance, distribution, or economic importance.

The Encyclopedia was prepared by 111 contributors, all mineralogists, each one an expert in his own field and many of them being associated with geology or other earth science departments of major universities in the United States, Canada, and overseas. As would be expected with so many contributors, some of the articles are somewhat uneven in scope, depth, and clarity of presentation. However, the editor of this volume, Keith Frye of the Department of Geophysical Sciences, Old Dominion University, Norfolk, VA, has done an outstanding job in providing a measure of balance and unity to the Encyclopedia as a whole.

Introduction to the Theory of Thin Shells

Reviewed by John R. Luchini, research engineer, Cooper Tire & Rubber Co., Findlay, OH. Member of ASTM.

REFERENCE: Mollmann, H., *Introduction to the Theory of Thin Shells,* John Wiley & Sons, Ltd., Bath, Avon, Great Britain, 1982, $41.00, 181 pp.

This textbook will introduce senior or graduate level structural or mechanical engineers to the theory of thin shells. The author notes that although there is a great deal of literature on the theory of shells, most are comprehensive treatises rather than texts. He also notes that most of these are quite old; his references are primarily from the 1950s and 1960s.

The first three chapters of the book are based on a set of lecture notes prepared by the author for a one-semester introductory course. While the author also presents in Chapter 4 a modern tensor treatment of shell theory, this is considered advanced material which is not used as part of his first course in shells. The author does not include other advanced topics such as stability, plasticity, or vibrations of shells. This is understandable for an introductory text. However, since current practicing stress analysts will be using numerical solution techniques, the absence of any references to finite element methods or finite difference methods belies the author's belief that the text would "be of interest to practicing stress analysts who wish to obtain some general background knowledge of shell theory..." Without the lecture to accompany the author's notes, I do not believe the text could hold their interest; therefore, I confine this review to the use of the book as a text.

Recalling the copious notes I took during a first course in shell theory, I agree with the need for a fairly brief and modern introductory text. The first three chapters cover the general theory of shells, bending of shells of revolution, and shallow shells. These 150 pages would save the student considerable note-taking during class.

However, as a text to be used alone, the work suffers from a lack of narrative. There is rarely sufficient introduction, in the sense of a statement of purpose and general results, to put the material that follows into perspective. In addition, the book contains few of the comments and discussion that a text used alone would normally have to highlight important items or to stress the significance or application of various results as they are developed.

Other items sufered in the transition from lecture notes to textbook. First, for example, the figures in the text are often line drawings of sketches which do not always convey the three-dimensional significance of the concept being illustrated. In addition, the figures occasionally appear on the back of the page that references them the most. Both drawbacks could have been minimized with the use of more figures to progressively illustrate concepts as they are developed.

Second, the slight differences in the bold face type, italic type, and Roman type used to denote variables can cause problems to the student (or proofreader). For instance, in the equation $\phi = M_{12} - M_{12}$, it is easy to assume that $\phi = 0$, when actually one M is in italics and one is in Roman type. A more distinctive denotation of variables would improve the readability of the equations.

Third, some specialized notation must have proved useful during lectures, but it seemed unnecessary in the text. For example, the encircled plus/minus notation introduced on p. 117 and then redefined on p. 118 could have been avoided. The equations could have been written out in conventional notation to save the confusion of introducing a new notation that was not used anywhere else in the book.

Apart from these minor shortcomings, I would suggest that instructors of a first course in shells compare the table of contents of this text to their own course syllabus. If compatible with their own lecture sequence, this text would reduce the amount of material the student would have to copy from a blackboard or look up in references after class. The course lecturer could then concentrate on the narrative and discussion needed to flesh out the skeleton of the text.

Ultrasonic Testing—Non-Conventional Testing Techniques

Reviewed by Robert W. McClung, group leader, Metals and Ceramics Division, Oak Ridge National Laboratory,[1] *Oak Ridge, TN. Member of ASTM.*

REFERENCE: Szilard, J., Ed., *Ultrasonic Testing—Non-Conventional Testing Techniques,* Wiley, New York, 1982, ISBN 0471-27938-2, $66.50.

This book on "non-conventional techniques" of ultrasonic testing is a coordinated collection of chapters by the editor and other recognized specialists to provide a survey of techniques apart from the "conventional" mainstream of ultrasonic testing, for example, pulse-echo flaw detection. With the increasing interest in quantitative characterization of flaws and materials, the book should be useful as a reference for potential solutions to problems when the conventional techniques are unsatisfactory. The first two chapters, by the editor, cover the basics of ultrasonic physics and conventional techniques. The next twelve chapters include new imaging techniques, ultrasonic holography, ultrasonic spectroscopy, examining the grain structure of metals, resonance methods, surface elastic waves for examining surface mechanical properties, techniques using dry or noncontact coupling, testing at high temperatures, ultrasonic measurement of stress, acoustic emission, acoustic methods for adhesively bonded structures, and wave propagation techniques in determining the dynamic elastic properties of wires and fibers. The last chapter is a collection of miscellaneous testing problems and methods.

Each chapter has a table of contents for the numbered sections and subsections, extensive references, and lists of symbols in some cases. In general, the chapters begin with establishment of the basic principles with both historical and theoretical aspects and extend the survey into experimental and practical applications. The book has an overall subject index and author index. Although there are many authors, each bringing his viewpoint from his background of research, the result is coherent and easy to read. The most probable audience would be research and development organizations, engineering and science departments of academic institutions, and the professional practitioner who is obliged to develop his own "new" approach to inspection problems when the conventional techniques are inadequate. The illustrations and mechanical aspects of the book are of high quality and have a professional appearance.

[1] Operated by Union Carbide Corp. for the U.S. Department of Energy under Contract W-7405-eng-26.

Soares' Grounding Electrical Distribution Systems for Safety

Reviewed by Einar M. Overn, Nanton, Alberta, Canada. Member of ASTM.

REFERENCE: Summers, W. I., Ed., *Soares' Grounding Electrical Distribution Systems for Safety,* International Association of Electrical Inspectors, Park Ridge, IL, 1982, $10.00, 226 pp.

This book is an update of the original 1966 edition. It is a valuable companion document to the 1981 edition of the National Electric Code. It belongs in the hands of the electrical tradesman (student or practicing), the electrical engineer (student or graduate), the electrical contractor, the electrical inspector, and particularly the layman who takes it upon himself to do electrical wiring on his own premises.

The opening chapter provides an interesting history of the slow and sometimes contentious development of the philosophy and practice of distribution grounding.

The author makes a thorough analysis of the definition and intent of the term "effective grounding." This analysis clearly breaks down that intent into three basic requirements of a grounding system:

(1) to limit voltage level,
(2) to have adequate capacity to safely carry any fault current likely to be impressed upon it, and
(3) to have an impedance sufficiently low to facilitate operation of circuit protective devices.

The importance of meeting all three of these requirements with every grounding installation is emphasized by effective repetition in several chapters.

Careful treatment is given to the definitions of terms and circuit elements, and to the description of the function of each element in a distribution grounding system. The book is written in tradesman's language. References to the National Electric Code are to specific paragraphs. There are clear illustrations of correct and incorrect grounding installations with explicit reasons why incorrect installations do not meet all requirements. Examples of the effects of inadequate grounding are provided.

The section dealing with the impedances of grounding circuits is particularly well done. Appropriate tables are included.

Reference to this document will resolve the differences of interpretation of the specific parts of the National Electric Code to which it pertains.

Elements of Materials Science and Engineering, Fourth Edition

Reviewed by David P. Pope, Department of Materials Science and Engineering, University of Pennsylvania, Philadelphia, PA.

REFERENCE: Van Vlack, L. H., *Elements of Materials Science and Engineering, Fourth Edition*, Addison-Wesley Publishing Co., Inc., Reading, MA, 1980, code 8090, hardcover, $21.95, 557 pp.

The teaching of an introductory course in Materials Science is profoundly difficult, to the extent that I am convinced that anyone who realizes the difficulty beforehand would be very reluctant to proceed. There are the obvious difficulties of the enormous breadth of the subject, as shown by the various categories of materials to be discussed (metals, ceramics, polymers, glasses, wood, and so on), the range of disciplines (metallurgy, ceramics, chemistry, physics, and so on), and the variety of topics (bonding, atomic structure, defects, diffusion, and so on), but in addition, there are more subtle difficulties. This second category of difficulties did not even occur to me until I had taught such a course at least twice, using an earlier addition of Professor Van Vlack's text. At whom is such a course as this aimed? Of course the obvious answer is that it is aimed at students of engineering who will later be using materials to construct various kinds of useful devices. More specifically, however, such a course is aimed at engineering students who are still in the early phases of their education, perhaps most typically freshmen and sophomores, since we generally want students to start thinking about materials early on in their education. But what does a sophomore know about engineering, per se? In most engineering curricula the first two years are spent primarily on physics, chemistry, mathematics, humanities, and computer programming, with only the lightest sprinkling of engineering courses. As a result, for many students, their elementary course in Materials Science is one of their first engineering courses, and consequently the instructor (and the text book author) must carefully take this into account. All students at this level "know" that wood is old fashioned, that steel rusts, and that plastics are cheap. All "know" that materials should be "strong" but very few have any notion about toughness or how that property relates to materials performance.

The "ideal" introductory text would (somehow) be able to make students, who have had almost no engineering training, think like engineers about materials. I tried several different texts before realizing that this is absolutely an impossible task. The instructor himself must use welding as an example of solidification and heat treatment, single crystalline turbine blades as an example of the importance of directionality on materials properties, and so on. A text that includes all this information would either neglect other topics or be unmanageably long. So, after a number of years of use, I have concluded that Professor Van Vlack's approach to the subject matter is the best one possible. His approach is the tried and true one: emphasize in every possible way, in every possible context, and at every microstructural level the relationship between structure and properties. This does not mean that I have no criticism of the book; I have. For example, I have always felt that Chapter 1, Selected Characteristics, is an attempt to produce instant engineers and I have therefore never used it. Chapter 8, Ceramic Materials, has always seemed a bit thin to me.

The fourth edition contains several improvements over previous editions, the most notable of which are the increased number of homework problems and worked example problems; the expanded treatment of corrosion in Chapter 12; and the foray into messy materials like concrete, cast irons, wood, and composites in Chapter 13. I, personally, would like to see Chapter 13 expanded, since this category of materials is so important. In summary, the fourth edition is an improved version of an already excellent text.

Experimental Evaluation of Stress Concentration and Intensity Factors

Reviewed by John E. Srawley, scientific consultant, Fatigue and Fracture Branch, National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH.

REFERENCE: Sih, G. C., Ed., *Experimental Evaluation of Stress Concentration and Intensity Factors*, seventh volume of the series "Mechanics of Fracture," Martinus Nijhoff Publishers, 1982, hardcover, $78.00, 354 pp.

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This book is an up-to-date reference work of excellent quality which will be indispensable to workers in the field of fracture mechanics. It contains six numbered chapters in addition to the introductory chapter "Experimental Fracture Mechanics: Strain Energy Density Criterion" by Professor Sih. The purpose of this chapter is "to impart a better understanding of the mutual dependence of theory and experiment in fracture mechanics." The author covers much ground in short space and succeeds in his purpose.

Chapter 1, "Stress Concentrations," by Professor A. J. Durelli is by far the longest (146 pages and 120 references) and is a major reference work in itself. It contains much original material as well as comprehensive treatments of all aspects of the subject, including, for example, material heterogeneity and microstructure.

Chapter 2, "Use of Photoelasticity in Fracture Mechanics," by Professor C. W. Smith is relatively brief, but naturally authoritative. It is mainly concerned with the frozen stress method and does not mention the scattered light method of three-dimensional analysis. Professors G. Villereal and G. C. Sih discuss an important application of the same method in Chapter 4, "Three-Dimensional Photoelasticity: Stress Distribution Around a Through Thickness Crack." The results are compared with the Hartranft-Sih theory which is explained, and which agrees well with the experimental results.

Two chapters deal with the method of caustics, or shadow patterns. Chapter 3, "Elastic Stress Intensity Factors Evaluated by Caustics," by Professor P. S. Theocaris is comprehensive and authoritative. It is nicely complemented by Chapter 5, "Experimental Determination of Dynamic Stress Intensity Factors by Shadow Patterns," by Drs. J. Beinert and J. F. Kalthoff.

The final chapter on "Experimental Determination of Stress Intensity Factor by COD Measurements," by Dr. E. Sommer is a brief account of the application of the interference optical technique. The method is difficult to apply and restricted to transparent materials, but it is valuable for the study of variation of stress intensity factor values around curved crack fronts.

Several important experimental methods are not covered in this volume, for example, compliance calibration. However, this and other topics have been covered in an earlier book: *Experimental Techniques in Fracture Mechanics*, A. S. Kobayashi, Ed., SESA Monograph No. 1, Society for Experimental Stress Analysis, 1971.

Synfuels: the Problems and the Promise

Reviewed by Forrest E. Walker, director of technical services, Geochemical Testing, Somerset, PA. Chairman of ASTM Committee D-5 on Coal and Coke.

REFERENCE: Hoffman, E. J., *Synfuels: the Problems and the Promise*, The Energon Co., Laramie, WY, 1982, ISBN 0-9601552-4-4, hardcover, $29.50 net, 350 pp., indexed.

The scope of this book as stated is clearly defined in the title: the problems and promises of "Synfuels." The book is written for the lay person as well as technical people.

The book covers most energy sources, their advantages and disadvantages. It is written in an easy to read, informative narrative style.

Existing knowledge in synfuels, both chemical and biological conversion, is surveyed with the view as to whether it is economically feasible at this point in time. The author also covers fuels now in use and their existing problems, especially nuclear.

The book reasonably satisfies the objectives as outlined in the preface as to the problems of energy. The viewpoint is balanced and realistic with a look at the needs and resources and optimism for what must be done in the energy field in the future.

There is an abundance of credit given for sources of information. The book is well organized and the style is clear and concise. The referencs are up to date to 1981.

The index is comprehensive and easy to use. The illustrations are of good quality, although there are only two in the book, inside the front and back covers.