BOOK REVIEWS

Powder Metallurgy, Principles & Applications

Reviewed by Harry D. Ambs, Manager, Iron and Alloy Products, SCM Corp., Glidden Metals, Cleveland, OH. Member of ASTM.

REFERENCE: Lenel, F. V., *Powder Metallurgy, Principles & Applications,* Metal Powder Industries Federation, Princeton, NJ, $55.00, 1980, 608 pages.

A comprehensive, up-to-date text on the subject of powder metallurgy has been long overdue. Therefore, this book, *Powder Metallurgy, Principles & Applications,* especially from an author of Dr. Lenel's stature, is doubly welcome.

Dr. Lenel's career in powder metallurgy has spanned 40 years and started with industrial experience with both metal powder and part production. In 1947 he began his association with Rennselaer Polytechnic Institute as a researcher and educator. In this book he has been able to combine his own extensive knowledge of powder metallurgy with current industrial practice provided by his many colleagues. This marriage, often difficult to achieve, results in a valuable text that combines the proper balance of theory and practice.

The book has over 550 pages of text and is organized in a very logical and readable manner. Basically, it follows the normal flow of the powder metallurgy (P/M) process, starting with the production of metal powders, followed by principles and practices of pressing and sintering, and ending with a number of chapters devoted to the engineering aspects and specialized P/M materials. Much of the information contained is current and has not been previously presented. The book can also be used for quick reference if information on a specific subject is desired.

The chapters on production of metal powders accurately describe the important commercial processes that are currently used. He has purposely omitted production methods that are only of historical or laboratory interest. The scanning electron micrographs (SEM) of various particle shapes are particularly good. The major powders and alloys, iron, copper, stainless, and aluminum are covered in detail, but the minor materials also receive their proper examination.

He next describes powder characteristics and the testing methods used. Much emphasis is placed on those techniques that determine performance behavior. A proper percentage of the chapter is devoted to some of the newer tests and instruments coming into use. The reader readily understands that metal powders are engineered materials designed to perform a function.

Dr. Lenel devotes three chapters to the subject of compaction of metal powders. He covers the principles and behavior of metal powders under pressure as well as excellent descriptions of commercial practice. Both lower punch ejection and withdrawal systems are explained in detail. There is good coverage of powder rolling and cold isostatic pressing as well as some of the new extrusion and molding techniques.

From a theoretical viewpoint, the subject of sintering is given the most extensive treatment. Even so, he manages to strike the balance between theory and practice needed in a texbook. Sintering atmospheres including nitrogen base and furnaces are well explained. Dr. Lenel seems most at home teaching the metallurgy of sintering and bringing science and understanding to a subject that many still consider an art.

The greatest tonnage of metal powders produced is used to manufacture structural parts by the P/M process. A full chapter is devoted to this subject, but it deserves more coverage to balance the applications of P/M with the principles. The chapter contains a wealth of information in charts and graphs on material properties and standards and is a good reference for these. It is, however, somewhat lacking in pictures of parts. Coverage of the design criteria for P/M and some of the unique characteristics of the P/M process would help complete this subject.

A very good and current chapter deals with the general economics of the powder metallurgy process and energy related topics.

There is also good coverage of fully dense products which illustrates how the P/M process has been used to produce a metallurgically superior product.

This book very definitely accomplishes its objective to be a comprehensive textbook on powder metallurgy. The bibliography with each chapter is extensive and mostly current. A student using this book in school will be well prepared for industry. Dr. Lenel has been able to take a lifetime of knowledge and experience in powder metallurgy and present it in one concise and most worthwhile volume.

Contaminants and Sediments, Vols. 1 and 2

Reviewed by Robert H. Brink, Senior scientist, Chemical Fate Branch, Exposure Evaluation Division, Office of Toxic Substances, U.S. Environmental Protection Agency, Washington, DC. Member of ASTM.

REFERENCE: Baker, R. A., Ed., *Contaminants and Sediments, Vols. 1 and 2,* Ann Arbor Science Publishers Inc., Ann Arbor, MI, ISBN Nos. 40270-X and 40307-2, respectively, 1980, $39.95 each.

These volumes contain 50 papers dealing with the pollution of natural sediments and the potential for pollution of the environment by the redeposition of dredged sediments. In his preface, Robert Baker concludes that those papers "should prove valuable references to organic, physical and analytical chemists, hydrogeologists, aquatic biologists, limnologists, soil scientists, environmental engineers, and those concerned in legal and management aspects of surface and ground waters." There is no doubt that most of the papers will be of great interest and value to professionals in those disciplines as well as to a wider audience of scientists, managers, and advanced students concerned with environmental problems.

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While the intent is to present a wide variety of papers for use as reference material, these volumes should also succeed as a primer for all who may be interested in a good review of the state of the art with respect to studies on sediment pollution problems in the late 1970s.

The papers are grouped into seven major categories: Fate and Transport, Case Studies, Modeling, Toxicity, Analysis, Chemistry, and Biology. In general the papers are very readable and informative, and they satisfy the stated objectives of the books. There is a good balance of material and representative variety of topics in each category. For this reviewer, who is more familiar with laboratory and field fate and effects studies, it was especially fascinating to read in the Case Studies section a report on the ten-year litigation history on the contamination of Lake Superior by asbestos-containing wastes from iron ore processing plants, including evidence presented in court and various court findings. The authors, reviewers, and editor deserve to be congratulated for pulling together a wide variety of excellent presentations on an area of environmental concern that is too often ignored or simply dismissed as a sink or repository of pollutant substances.

The papers in these volumes were originally presented at a symposium sponsored by the American Chemical Society and it would have been informative if the editor had noted when and where the symposium was held. As with most symposia, the quality of the papers varies. However, in contrast with many symposia, the papers presented in these two volumes are all good to excellent except for one poor paper in the Case Studies section.

It is especially gratifying that these papers have been published as a set since, to date, the problems associated with contaminants in sediments have not received the attention they deserve. As pointed out by several of the authors, sediments can act as sinks for a variety of pollutants which may persist there for extended time periods and accumulate to relatively high concentrations, often to be released again to the overlying water column or air. The complexity of the potential chemical, physical, and biological interactions and their importance to the general environment are evident to anyone who reads through these symposium papers.

The reader of these papers, however, will not be provided with much in the way of philosophical discussions of the environmental impacts of various activities. These are mostly straightforward reports of laboratory and field studies. Sometimes the conclusions are very general and they often are open to other interpretations. Nearly all of the papers are authored by representatives from government, universities, or consulting firms and authors from industrial organizations are conspicuous by their absence. It is not clear whether the low representation from industry is due to a lack of interest by industry, an unwillingness to participate, not being asked by the organizers, or some other factor.

The newcomer to these studies should note that the state of the art is rather poorly developed in some of the categories. There is considerable room for advancement in our capabilities for studying and understanding chemical fate and environmental effects and the use of mathematical modeling to calculate potential exposures and hazards is in its infancy. There is much to be done to obtain a clearer picture of the problems associated with the contamination of or by sediments and this collection of papers will be indispensible for anyone seriously concerned with those problems.

The Physical Metallurgy of Steels

Reviewed by Vernon W. Butler, Metallurgical engineer, Houston, TX. Member of ASTM.

REFERENCE: Leslie, W. C., *The Physical Metallurgy of Steels*, Hemisphere Publishing Corp., Washington, DC, ISBN 0-07-037780-4, $29.50, 1981, 396 pages.

The Physical Metallurgy of Steels covers the basic principles of body-centered cubic metals in the light of present day knowledge and also discusses, in turn, each of the various categories of steels. These categories extend from carbon steels through modern high-strength low-alloy steels to stainless and tool steels.

The author has recognized the need for the especial study of steels, something that has not always been adequately recognized in recent years. Thus the book, while intended primarily for advanced undergraduates and first-year graduate students, also serves as an excellent means of bringing practicing engineers and metallurgists up to date on the subject.

Based on a series of lectures, the material is presented in narrative form interspersed with numerous graphs. Mathematical demonstrations are included where appropriate. Photomicrographs are few in number. The discussions of the various subjects strike a fine balance, being neither too brief nor too exhaustive.

The book is well-organized and, while the material is not entirely new, very little can be considered "old hat."

The first four chapters, some 140 pages, are highly technical and presuppose some knowledge of physical chemistry as well as dislocations and lattice theory. These chapters cover the basic reasons why many things occur.

The remaining nine chapters, about 230 pages, discuss the different categories of steels. These are the chapters that should be of particular interest to practicing engineers. These chapters also give the student up-to-date information on present-day steels, information not usually found in textbooks. Many of the steels discussed have only been developed and have come into use within the last ten or fifteen years.

In footnotes on each page, numerous references are cited. Most of the references are recent and thus give credit to the sources of information. As stated in the Preface, many additional references can be found in the references cited in the book, so readers can easily pursue the original sources of all the material as they desire.

The material is presented in a clear and concise manner, with no repetition. The illustrations, primarily graphs, are informative, easily interpreted, and of excellent quality. Tables are few in number, clear, and informative. Some of the tabular material is "old hat" (that is, chemical compositions of standard steels) but furnishes desirable information that might not be readily available to some students.

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Both name and subject indices are included, as well as an Appendix which gives some useful information. Both the Name Index and the Subject Index appear to be comprehensive.

The overall quality of the book (paper, binding, layout, printing, and so forth) is excellent. But it is not without faults. There are some minor omissions, untrue statements, and repeated use of at least one inappropriate term. The exclusive use of SI units is also considered to be a fault by the reviewer.

The author states that stainless steels are used because of their corrosion resistance, oxidation resistance, and pleasing appearance. He fails to mention their retention of strength at elevated temperatures.

The author states that all steels containing more than about 0.30% carbon are killed and that the normal range of grain size in commercial steels is about 5 to 12 per the ASTM Method for Estimating the Average Grain Size of Metal (E 112). Both of these statements are not correct. And, in referring to "grain size," the author is guilty of the common fault of failing to clarify whether he means "austenitic" or "ferritic." The term "getter" is used in several places. This term is not used in the steel industry.

The book jacket claims that the use of SI units is an indication of the international scope of the book. One would be hard-pressed to prove this claim since the steels discussed are almost entirely North American steels.

Despite the few minor faults, *The Physical Metallurgy of Steels* is a book that should be valuable for students and practicing engineers alike. The reviewer recommends it as an addition to any technical library related to steels.

Thermal Insulation Handbook: A Practical Guide for Engineers, Contractors, Architects, and Plant Managers

Reviewed by David M. Greason, Dow Chemical USA, Granville, OH. Member of ASTM.

REFERENCE: Turner, W. C. and Malloy, J. F., *Thermal Insulation Handbook: A Practical Guide for Engineers, Contractors, Architects, and Plant Managers,* McGraw-Hill, New York, ISBN 0-07-039805-4, $59.95, 1981, 629 pages.

This book tries to offer something for everyone concerned with the subject of thermal insulation, but most readers are likely to be disappointed in its overall quality. Almost one-quarter of the book consists of:

(1) examples, calculations, and tables repeated in their entirety with metric units after the same material has already been presented in inch-pound units (referred to as English Units by the author), despite the acknowledgment that the equations are the same and any consistent system of units may be used;

(2) voluminous tables of data derived from simple mathematical relationships more readily solved with a hand calculator than looking them up in the tables; and

(3) extraneous information on steam heating systems, mechanical refrigeration systems, electrical resistance and inductance-heating systems, types of electrical insulations, electric heating cables and tapes, electrical theory, steam tables, and so on.

The text is characterized by awkward and sometimes ungrammatical sentences, and contains far too many typographical errors, many of them serious. Numerous definitions appear in several chapters as well as in the appendix, and the admission that they "...would not be acceptable to a physicist..." is something of an understatement. The difference between energy (or work) and power, with appropriate units for each, is mangled in the discussion, formulas, and tables throughout.

Symbols chosen for some familiar terms are unusual and are not used consistently; units and notation for those units are not consistent and are frequently incorrect. Use of additional subscripts in formulas to distinguish metric units is irritating and unnecessarily confusing, and subscripts sometimes change unaccountably from those just identified above. Arithmetic operation signs are frequently incorrect, decimal points are missing or misplaced, exponents are missing, numbers are transposed, and sometimes a formula does not agree with subsequent discussion of the steps involved in making the calculation. Cross-references to earlier equations are sometimes incorrect, and it is difficult to go back and locate the numbered equations. Some material is also presented out of sequence and out of context.

It is disconcerting to find misinformation such as "...saturated steam...has the maximum Btu content at a given temperature;" data in the voluminous tables of properties of thermal insulations that do not agree with the manufacturers' literature; and suggestions to the effect that two vapor barriers may be used in the insulated walls of buildings that are both heated and cooled.

The major emphasis in the text is on mechanical, power, and process systems insulation, with detailed calculations to keep below-ambient surfaces above the dew point, and above-ambient surfaces from presenting a personnel safety hazard. The chapters on physical design of industrial insulation systems and installation details are good, reflecting the authors' many years of practical experience in the chemical process industry.

The Theory of Thin Walled Bars

Reviewed by James R. Harris, Principal, Structural Consultants, Inc., Denver, CO.

REFERENCE: Gjelsvik, A., *The Theory of Thin Walled Bars,* Wiley, New York, ISBN 0471-08594-4, $31.50, 1981.

In *The Theory of Thin Walled Bars,* Professor Gjelsvik presents a highly developed theory of bending and torsion for thin-walled structures. The theory is applicable in the engineering of build-

ings, bridges, ships, and aircraft. The text includes an exposition of various facets of the problem field, including open and closed sections, linear and nonlinear buckling, and rigid-plastic theories.

Particular attention is paid to torsion, both classic St. Venant torsion and warping torsion. This subject requires a fairly high degree of complexity. Perhaps because of this, books on the subject are not common. The author acknowledges a debt to the reknowned V. Z. Vlasov for the development of warping torsion theory.

Most of the references cited are of a classic nature. Other texts on similar subjects (such as *Structural Members and Frames* by T. V. Galambos, Prentice-Hall, 1968) contain more complete lists of references.

The author claims, probably correctly, to introduce a substantial amount of new material. The explanation of St. Venant torsion by means of shell forces rather than the membrane analogy is an innovation designed to improve physical understanding. Bridge engineers should welcome the method of calculating forces in diaphragms for girders.

Several important examples are used to illustrate the theory. The presentation would be aided somewhat by the inclusion of slightly more explanation in the examples and the adoption of even more explanation in the way of physical interpretation of the results. More detailed discussion of appropriate simplifications of the general theory would also be welcome.

The style of the text is primarily a continuous exposition. The intended audience of graduate students and researchers in mechanics should find the book a useful reference. Practicing structural engineers will find that the book requires a large amount of time for use as a reference. This is due partly to style and partly to the complex nature of the subject.

The illustrations of cross sections are very good (complex graphical problems well done). More illustrations of entire members would be welcome.

Probabilistic Mechanical Design

Reviewed by Emil H. Jebe, Statistician Emeritus, Environmental Research Institute of Michigan, Chairman of ASTM Committee E-11.

REFERENCE: Haugen, E. B., *Probabilistic Mechanical Design*, Wiley-Interscience, New York, ISBN 0471-05847-5, $42.50, 1980, 630 pages.

The author is an Associate Professor in Aerospace and Mechanical Engineering, University of Arizona, Tucson. From the Preface, one learns that the author has used this material for teaching "upper division" undergraduate engineering students. Further, in the author's words, this volume is a "textbook as well as a reference book for engineers."

There are twelve chapters, ten Appendices (mostly tables, either distributions from mathematical statistics or engineering data), References (127), and an Index. All this material is encompassed in 630 pages. Chapter titles are as follows:

1. Introduction
2. Supporting Mathematics
3. Loading Random Variables
4. Describing Component Geometry with Random Variables
5. The Stress Random Variable
6. Random Deflection Variables
7. Geometric Stress Concentrations
8. Describing Materials Behavior with Random Variables
9. Design and Analysis
10. Strength of Mechanical Components
11. Mechanical Element Optimization
12. Reliability Confidence Intervals

With this minimal description of the contents, I return to the author's Preface. Is this book suitable as a "textbook" and is it useful as a "reference book?" No prerequisites are stated as such although a previous course in mechanical design is assumed since the author intends the book for a second course. This reviewer's reading of Chapter 2 indicates that necessary prequisites would be a course in probability and a course in mathematical statistics. The mathematical sophistication demanded of the students also appears to be more than what I understand most engineering students would handle at the end of their sophomore year. Without such background a student cannot thread his way through Chapter 2 with adequate understanding. Chapter 2, is, of course, basic to following the presentations of the remaining chapters.

Next, I am concerned about the students' confusion in encountering Haugen's terminology. Students should have the material in Chapter 2 presented to them by an instructor in probability and an instructor in statistics. Then the correct definitions and terminology will be acquired. Without this needed background the students will find Haugen's use of terminology confusing. Many examples can be cited. The Fig. 2.1, which is copied from an excellent source [*1*], uses the term "parameters" as most statisticians use it, but at essentially all other places in Chapter 2 and throughout the book, the author refers to "statistics" when he means "parameters" of a population of interest.

These differences in terminology and usages from the literature in probability and statistics bring to mind a fine article by Robert Hooke [*2*]. It is useful to quote Dr. Hooke in this context.

> People are writing books and papers on applications of statistics to their own fields, assuming that their ability to speak the language of their colleagues will compensate for frequent serious shortcomings in their statistical competence. Some of these authors are very popular because they aren't afraid to provide solutions to problems that have not yet been solved. So the problem is not to get people to use statistics, but to get them to use it properly.

Hooke's statement applies to this Haugen book as will become more evident below.

There is no basic discussion of sampling in Chapter 2, and no real attention is given to the matter in later chapters. Nor is there discussion of techniques used in the design of experiments (for

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material tests). One reference is given, Haugen's Ref *81*, which is not to be recommended, see Ref *3*. Checking the index on use of that reference incorrect pages were listed so I could not pursue it. The references that I would suggest in these two areas, sampling and experimental design, are Refs *4-7*. Perhaps, the author thinks that the students should obtain this background elsewhere, but he misses a golden opportunity to direct them to the right path; staying up in the clouds of mathematics, probability, and mathematical statistics is not helpful to the engineers who are to design and *make* things that will work and perform the desired functions.

This Haugen book is extremely uneven in presentation. I cite p. 132 where a correct statement about statistical tolerance limits is given although the statement could have been considerably elaborated to help understanding of the concept (a mere reference to Appendix 7—a Student's t table—does nothing to help the understanding). Then one encounters the next two-line paragraph that is just wrong statistically. Sample averages obtained from normal distributions are normally distributed—not t distributed as stated. A few pages later this matter is stated correctly. Another example is 5.3.1, p. 167, which is totally unintelligible to this reviewer. Checking with a design engineer was no help; we could not make sense out of it.

One could continue with further examples. I give a few. One remarkable example is the introduction of the "Bayesian view" in 7 lines on page 85. The Bayes discussion is continued later, pp. 429-433, but the treatment is not understood by this reviewer. In another one, p. 430, the author seems to pull rabbits out of a hat, "The probability of Euler buckling (B_1) is $P(A/B_1) = P_{f1} \leq 0.00100 = 100 \cdot 10^{-5}$." The reader is given no hint as to where this probability value was obtained. The example continues in the same vein with numerous probabilities stated to more decimal places than I believe any engineer could justify. The example places altogether too much emphasis on the observance of a single "random failure." Students should not get the idea that a sample size of *one* will provide useful information for design engineering action.

Haugen's treatment of reliability must be noted. The discussion opens with an examination of "General Reliability Model" on p. 361. The two and one-half pages given are sketchy. It seems as if the author is just reviewing for students what they are already supposed to know. Chapter 12 continues the subject in a short 17 pages with only elementary examples. With such scanty coverage, references should be given to some of the relevant reliability literature, for example, Refs *8* and *9*. In my own experience, I have found that the "confidence interval" concept is the most difficult of all statistical ideas to get across to beginning students from any field of science. Thus, I am not sure that students using this book will have a sound understanding of the reliability confidence statements when they get to Chapter 12. Again, I have the impression that students are supposed to understand the concept before opening Haugen for the first time.

From all these considerations, I must conclude that this Haugen work is not suitable as a text in spite of the author's claim. What remains is to consider whether or not it is a useful reference work. There appears to be a wealth of information scattered throughout the book and in Appendices 5, 9, and 10. Examples are numerous. What Haugen does, however, is to present copious laboratory test data, but he does not make clear that these data are useful *sometimes* for only *comparative purposes*. In a design application, these laboratory data may indicate a choice of Material A over Material B, but such data do not provide a basis for extrapolation to credible probability statements about performance in a specific real world application. This issue was well addressed by Little for the fatigue area [*10*].

It will be useful to quote Little from his examination of this Haugen work.[1]

> Experienced designers know that considerable engineering judgement must be used in attempting to relate the results of conventional laboratory strength tests to service proven performance. Specifically, design requires both judgement and common sense in an engineering context to interpret strength data properly... With few if any exceptions the discrepancies between service operations and conventional laboratory tests are so obvious that even extrapolative comparisons of medians are risky, and analyses comparing dispersions could be categorized as foolish if the analyses were not so dangerous.
>
> Let the problem of correct interpretation of laboratory data, however, be completely set aside. The analyses given in Haugen's book are still dangerous. The variability estimates used by Haugen for his fatigue data pertain to test programs that measured only repeatability, not reproducibility... (see ASTM Practice for Conducting an Interlaboratory Test Program to Determine the Precision of Test Methods [E 691] for these terms). If one considers the additional variability associated with materials, processing, production, assembly, etc., it appears foolish to use only repeatability (as Haugen has done) as an index to service strength variability...

Little summarizes, "...The purpose of an engineering design calculation is to extrapolate service-proven information to the pending application. In this context, the only reliable test method is to test the given device in actual service operation. The greater the discrepancy between service conditions and those for the test actually conducted, the greater the hazard of the extrapolation process."

With this critique of Haugen's use of his tables of material behavior in his many examples, it appears that these applications cannot be used for real world design problems. The tabular data may be used for comparative purposes but should not be pushed any further. The student and the practicing design engineer must look elsewhere for a useful reference work.

In conclusion then, I cannot recommend Haugen's book for use as a text or a reference. It is a poor book and may even be characterized as a disaster in missing the intended mark by so much. It is tragic to expend over 600 pages and miss so many opportunities to direct his readers in the right directions.

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[1] R. E. Little, Private Communication, 16 Dec. 1981.

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Photovoltaics Sunlight to Electricity in One Step

Reviewed by Gary Nuss, Solar Energy Research Institute, Golden, CO. Member of ASTM.

REFERENCE: Maycock, P. D. and Stirewalt, E. N., *Photovoltaics Sunlight to Electricity in One Step*, Brick House Publishing Co., Andover, MA, ISBN 0-931790-17-4—$9.95 paper, ISBN 0-931790-24-7—$19.95 cloth, 1981, 224 pages.

Photovoltaics is a book written for the general public and requires little or no technical background for understanding. The author's purpose in writing this book is to provide "the average person" with background and rationales for evaluating the photovoltaic energy option with respect to other new and conventional energy technologies. The scope is broad—from semiconductor physics to economics and future energy scenarios. The level of technical sophistication addressed, however, limits the depth of discussion and detail. Moreover, the authors' undisguised bias and enthusiasm for photovoltaics inhibit a balanced evaluation of photovoltaics vis-a-vis other energy services.

In keeping with the authors' purpose, the book is a general information, introductory discussion of photovoltaics. The material largely is drawn from research, development, and application activities in the U.S. Department of Energy photovoltaic program and reflects work accomplished through 1980.

The chapters on "Technology" and "Options" are comprehensive and the technical approaches are explained clearly in the text and through easy-to-understand diagrams. The "Technology" chapter is an excellent explanation of the photovoltaic effect and of the most common configurations of cells. The "Options" chapter describes various technological alternatives with respect to cell materials, potential methods of production, advanced cell designs, and concentrator designs. The breadth of coverage in this latter chapter is so broad that significant technical detail is sacrificed. This observation is made for the benefit of technical readers; the intended "average person" audience may not miss a greater depth of technical detail.

A serious omission (particularly for the readers of this journal) is any discussion and explanation of testing methods for photovoltaic devices which, in practice, are not straightforward. The authors discuss efficiencies and peak watt performance but do not include "efficiency" in their glossary—or its measurement in their discussion—and do not remind the reader consistently that peak-watt performance is optimum and occurs at noon, on a clear day, at 1000 W/m^2 insolation (geographically dependent) with normal incidence. These terms are conventional within the technology but are apt to be misunderstood or misconstued by the lay reader. A desirable addition to these chapters—or more appropriately a separate chapter—is a discussion on testing and performance evaluation methods. A table displaying the various photovoltaic material/cell options, their associated *nominal* efficiencies, status (commercial, experimental, and so forth), and manufacturers would be informative.

The remaining sections describe applications, system economics, and societal aspects, with a concluding chapter that surveys conventional energy sources and argues for a Manhattan Project-style commitment by the Federal government to implement photovoltaic systems within the U.S. energy infrastructure. The arguments offered by the authors are logical and can lead to the desirable conclusions they have reached if their assumptions prove to be true or partially true. These assumptions are: that the industry adopt volume production means in time to meet expected demand; that utility policies regarding buy-back prices, rates, energy quality, and safety are favorable or, at least, not prohibitively restrictive at high penetration rates; that systems will evolve that will be as competitive for the retrofit housing market as for new houses that can be designed to optimize photovoltaic use; and that experience will bear out expectations of minimal operation and maintenance costs and 20-year operating lives.

The book concludes with 13 appendices—ranging from photovoltaic history to conversion factors—a glossary, and an index. Several of the appendices are short and could be included as tabular information in the body of the text. Diagrams are clear, easy to understand, and informative. Photographs are black-and-white and relatively small in keeping with the book's 9- by 6-in. size; in some cases detail is lost because of the distance from which the photograph is taken.

In summary, *Photovoltaics* is an informative book for the nontechnical, general interest reader. It is not directed at the professional engineer or technologist who wants, or needs, a thorough discussion of technical issues.

Construction Materials Evaluation and Selection. A Systematic Approach

Reviewed by H. J. Schneiter, Senior research chemist, Jim Walter Research Corp., St. Petersburg, FL. Member of ASTM.

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REFERENCE: Rosen, H. J. and Bennett, P. M. *Construction Materials Evaluation and Selection. A Systematic Approach*, M. D. Morris, Ed., John Wiley & Sons, Inc. Somerset, NJ, ISBN 0471-73565-5, 1979, 163 pages, hardcover, $19.95.

Building materials available for construction, in today's market, exhibit a diversity of properties that need to be known before purchase and use. Evaluation and selection of specific building materials for a particular structure is not an easy task.

The purpose of this book is to outline a rational approach that a building owner, architect, engineer, construction manager, or subcontractor can pursue to evaluate properly various building components, allowing the appropriate selection of materials for the intended construction.

A master list of nine major requirements or attributes for a building material is used. The design professional makes use of certified tests from available literature (requesting such from manufacturers, if necessary) to develop a rating for each attribute of a building material. He then weighs the attributes and concludes, from his data, which building material is best suited for his purpose.

The style is both terse and concise as the authors systematically present their material, using charts and examples where required, to illustrate and clarify certain points. As a result, their subject matter can be readily comprehended by persons with experience in the building materials field.

This book is professionally written, one of definite value to persons responsible for specifying construction materials. The authors have quite adequately covered this limited, but important, aspect of building materials and construction. The contents are as follows: Part 1: A Recommended Approach to Evaluation and Selection—Harold J. Rosen and Part 2: Developing The Systematic Approach—Philip M. Bennett.

Tunnels: Planning, Design, Construction

Reviewed by T. P. Smirnoff, Howard Needles Tammen & Bergendoff, Kansas City, MO.

REFERENCE: Magaw, T. G. and Bartlett, J. V., *Tunnels: Planning, Design, Construction*, Vol. 1, Wiley, New York, $79.95, 1981, 284 pages.

This, the first of a two-volume series in tunnelling, presents the basic principles and practices of tunnel planning, lining and support alternatives, and construction methods and techniques for the full range of ground conditions from soft ground to rock including tunnelling methods in unfavorable conditions of soft rock and mixed face.

The book succeeds in covering the major facets of tunnelling including excavation survey control, control of water, and tunnel boring machine selection and use in a very straightforward, descriptive manner without reliance on any theoretical soil or rock mechanics and detailed structural engineering. The book would make an attractive and useful addition to a general tunnelling library as a good tunnelling primer and is well-suited for the owner's representative or administrator who may be concerned with the planning or direction of tunnelling projects or consideration of tunnel alternatives.

The coverage of soft ground tunnelling, including the historical development of tunnel shields to the modern advent of the first bentonite shield tunnelling machine, is comprehensive. Descriptions of compressed air horizontal and vertical air locks, plenums, and shaft gates greatly enhance the novice's understanding of the intricacies and complexities of plant design and tunnelling under air.

However, the book does suffer from a lack of any detailed design or construction guidelines and examples which might provide the direction required for the engineer actually faced with the tunnel siting or design selection.

As most of us know, the applicability of tunnelling as opposed to most other construction techniques is most often dictated by economics. The designer's task is to try to combine the myriad of combinations, restraints, and methods to produce a cost-effective tunnel scheme. The authors have chosen to avoid comparisons and cost estimates which they feel will become timely or dated. The authors have also avoided trying to present all the latest technical innovations and trends in novel design and support methods which are continually being improved or modified by enterprising contractors and designers alike.

The authors' experience has been mainly European and mostly in soft ground; American engineers must supplement discussions of worker and occupational safety with federal, Occupational Safety and Health Administration, and state safety orders and be cognizant of local, state, and federal environmental requirements for air, water, and noise pollution when considering site specific problems.

The succeeding second volume will describe other techniques including tunnels in trench under land and water and the ancillary operations of shaft sinking and ground treatment, and discuss the important topics of relevance of geology and tunnel ventilation.

A bibliography and list of references are attached to each chapter to supplement the coverage and specific reference is made to the forthcoming Volume II bibliography data which apparently will be more complete and supplement that in this first volume.

The closing chapter contrasting and comparing the English Channel tunnel to the Seikan tunnel crossing in Japan is interesting but academic.