
REVIEWED BY MONGI BIDA

The Modeling and Analysis of Solar Thermal Systems would have been a more descriptive title of this comprehensive work about solar systems modeling. The book can serve as an excellent initiation to the various aspects of this topic, and its extensive coverage of recently developed simplified models for analysis and sizing of solar systems makes it a good addition to any solar library.

The modeling techniques provided outline the concepts underlying their development and use. However, the book does not cover the fundamental principles dealing with heat transfer and thermodynamics of solar systems. It rather assumes that the reader is familiar with those fundamentals easily found in earlier solar literature.

The author states that the book is intended for beginners in both research and practice and can be used as the principal text for a one-semester course. However, a two-semester graduate course would be more accommodating to the extent of material covered in the book. The material is clearly presented. In a methodical way the reader is systematically led from one chapter to the following one. The work has a definite international flavor containing worked examples set in different areas of the world and using S.I. units throughout the book.

Although the title implies the inclusion of all types of active thermal systems, the book focuses on liquid systems using flat-plate collectors. Air collectors are discussed in one of the appendices and so is the topic of solar concentrators.

The book starts with a good introduction defining various solar systems. Major issues dealing with the different design options for active solar systems are introduced up front: open versus closed-loop systems, parallel versus series auxiliary boilers, control strategies, etc. The discussion of the various active solar system configurations is concise but thorough, and the author sets the tone for the book which emphasizes the use of simplified methods in the analysis and sizing procedures of active solar systems.

The next chapter deals with the modeling of solar thermal system components and introduces the basic elements of system simulation procedures. It should be noted, however, that little attention was paid to load estimation and the author does not point out that the conventional degree-day method is not adequate for estimating heating requirements of spaces. In fact, it has been shown that residential buildings require at least a variable base degree-day approach and that other types of buildings will require at least a bin method. The chapter ends with a revealing comparison between the performance of an open and a closed-loop active solar system using the presented simulation methodology.

The third chapter deals with the economics of solar systems and it is the weakest section in the book. The author focused on a simplified approach for optimizing solar system sizes. The topic was not covered in great detail and further discussion presenting various economic optimization models should have been included. The importance of economic parameters such as the fuel escalation rate versus inflation and the selection of discount rates should have been further emphasized. The more complex economic analysis approaches based on an array of economic forecasting scenarios should have been discussed in more detail.

Chapter 4 presents an up-to-date account on the various models available for estimating solar radiation statistics. The author treats the reader to an extensive coverage of recent developments in the estimation and simulation of solar radiation statistics, namely, the newest correlations developed for generating probability density functions and cumulative frequency distributions of solar radiation. A good discussion of the applicability and accuracy of these correlations is included and several examples illustrate the use of the correlations. Although this chapter was comprehensive in its coverage, the effects of autocorrelations on solar radiation statistics, a very important aspect of stand-alone solar system analysis, was not covered.

The remaining chapters cover the elements governing the long-term performance of solar collectors. The author starts by classifying active solar systems into five modes of operation according to the fluid inlet temperature variation. He then proceeds to propose an appropriate analysis tool for each of the five classes of active solar systems defined. An enlightening discussion of the solar utilizability concept and its various applications was presented, including some mathematical insights into the utilizability functional forms. The coverage of the topic is very comprehensive and useful discussions are provided to allow a comparison between the different methods of empirical correlations proposed in the literature. Examples are used to illustrate the sometimes complex concepts, including a numerical example provided as a framework for comparing several utilizability correlation functions.

Chapter 6 covers various applications of the solar utilizability concept to the evaluation of solar thermal system performance. A discussion of the different ways of using the utilizability method to estimate the long-term performance of various active solar system types was presented thoroughly. Clear step-by-step procedures were outlined for a variety of system configurations including no-storage solar systems with and without heat exchangers and solar systems with seasonal storage.

The impact of thermal storage size on the long-term performance of solar systems is discussed dealing with storage...
sizes ranging from no-thermal storage systems to infinite storage systems. The chapter ends with an informative discussion of the compatibility between the different utilization correlations and their time scale.

The following three chapters dealt with the prediction of long-term solar performance using the F-chart method in its different formulations, the simplified analytical approach, and the one-repetitive-day simulation approach.

The last chapter provides a synopsis of concepts dealing with solar system design that were covered in the book. The author offers some concluding remarks on philosophical issues surrounding the development of simplified solar systems analysis tools and discusses some practical consideration and potential applications for solar thermal systems.

A table summarizing the characteristics of simplified solar systems design methods provides the reader with a quick way to select the appropriate analysis tool for the task at hand.

Six appendices contain information dealing with relevant material not covered in the main body of the book. The first appendix provides detailed elements of the solar geometry pertinent to the analysis of solar systems. The second and third appendices deal with the long-term performance of concentrating solar collectors and provide some coverage of solar thermal systems for hot-air applications. A set of relevant climatic data for selected locations of the world is provided in the fourth appendix. This is a welcome source of information for solar designers and researchers around the world. The fifth appendix provides a series of assignments leading to the development of a solar computer package. These exercises are suitable as class assignments for a solar course using this book. The last appendix provides some unit conversion factors.

Overall, this book is a valuable addition to a solar energy library.


REVIEWED BY T. AGAMI REDDY

This comprehensive reference volume, the culmination of eight years of effort, is an updated version of a solar design handbook originally prepared in 1978 to accompany a series of week-long courses. The intent of the authors is to provide sufficient knowledge to engineers and architects to design and install active solar energy systems for meeting the heating and cooling thermal energy demands of commercial buildings.

The volume is divided into three parts. Part I covers fundamentals and is made up of three chapters. Chapter 1 gives a short perspective of energy and how it relates to the building sector, while Chapter 2 is a well-written chapter describing energy use patterns in commercial buildings and design methods (along with illustrative examples) of calculating energy use in commercial buildings. Chapter 3 presents fundamental aspects of solar energy, climate, and human comfort. Though the material in this chapter is clear, the contents are cursory and do not do proper justice to the topics it wishes to address. It would have been much better to have broken the chapter up into at least two separate chapters.

Part II, consisting of Chapters 4-7, covers active solar system design and sizing. An overview of the different heating and cooling system configurations is given in Chapter 4, while the next two chapters give an overview of the various components of active solar systems: solar collectors, thermal storage, and subsystem components (heat exchangers, pumps, controls, . . .). Finally, Chapter 7 presents some design methods for sizing solar systems (F-chart, SLR, . . .) and also gives an all too brief description of detailed computer simulation programs. Chapter 7 is narrow in content, makes no mention of the latest design methods, and does a poor job of presenting the scientific notions upon which the design methods are based. The danger in trying to be too practical at the expense of understanding the basic scientific principles involved is that one could be unwittingly using a design tool that is inappropriate for the occasion.

Part III, which covers the installation, construction, and operation of active solar systems is made up of six chapters (Chapter 8 to 13), which are very comprehensive: the practical aspects of designing and installing solar systems (Chapter 8), instructions on how to develop prebidding performance specifications (Chapter 9), checklists of start-up and acceptance testing (Chapter 10), instruction on how to develop manuals for maintaining records of operation and maintenance (Chapter 11), description of the variety of sensor types and data collection systems available commercially (Chapter 12), and, finally, the type of cost figures and the methodology for estimating system costs. The entire section is an original contribution and I have not seen such a good and comprehensive treatment anywhere else.

There are bound to be drawbacks to any book. An annex would have been very useful, and also the inclusion of concepts developed within the last few years. For example, while discussing methods of testing solar thermal collectors (Chapter 5), dynamic testing methods are overlooked. Another instance of omission is the concept of operating solar collectors subsystems following the one-pass strategy against the conventional multipass mode of operation. Finally, a chapter including case studies of solar energy systems actually built and how they performed would have made this book more valuable.

Despite these drawbacks, this volume contains a great deal of valuable practical information relating to the engineering aspects of active solar systems for use in commercial buildings, as also in other types of solar energy systems. The book is well conceived and is probably the most comprehensive reference book available on this subject. The clear diagrams along with many useful tables, graphs, checklists, and worked-out examples make it a valuable book for engineers and architects involved in designing solar energy systems. It could also be used as a training guide and is clearly a good complement to other solar energy textbooks.