Engineering Design Graphics
Fifth Edition

JAMES H. EARLE

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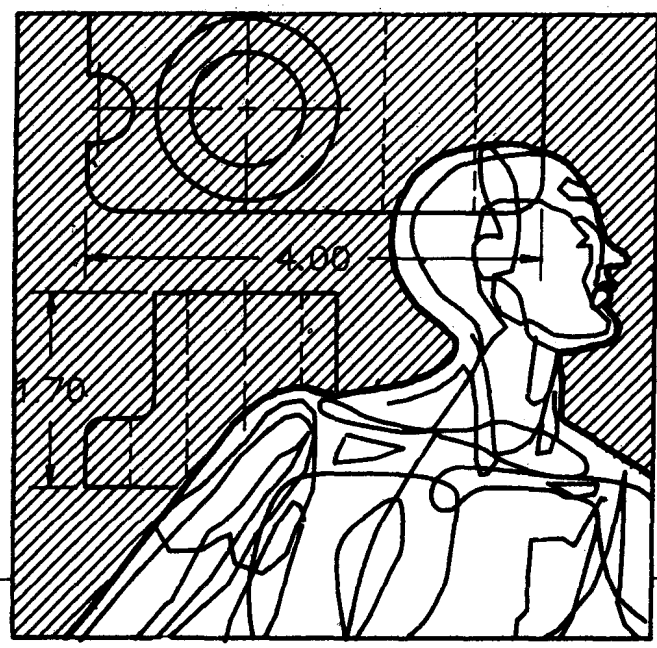

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Preface

Engineering Design Graphics covers the principles of engineering drawing, computer graphics, descriptive geometry, design, and problem solving for a college-level course. The fifth edition is a major revision of the previous edition, but it retains the same class-tested format and general sequence of topics.

Computer graphics

Two chapters, 10 and 38, are devoted to computer graphics. Chapter 10 provides a general introduction to the use of computer graphics in design and drafting and covers the fundamentals of AutoCAD Version 2.15 and its usage with microcomputers. Chapter 38 covers updated features of Version 2.5 that was released in late summer of 1986 and other applications of AutoCAD. Additionally, computer graphics techniques have been integrated throughout other chapters to offer an easy and natural transition from traditional graphics with a pencil to graphics by a computer.

AutoCAD software was selected as the example program to use because it is the most widely sold microcomputer software in the computer graphics field. Therefore, it is likely that more students will encounter AutoCAD in the industrial employment environment than any other software. The IBM XT/AT computer (and their compatibles) were chosen as the microcomputer because they too dominate the market.

Essentially all computer graphics principles have been presented in illustrations that use a two-step format and are supplemented with the prompts from AutoCAD that would be seen on the screen and the response from the user. By this means, the teacher and student will be able to cover the principles of computer graphics with the greatest ease.

Major topics

Other major areas in this text are communications, working drawings, descriptive geometry, and design

concepts. Each of these areas is important to the engineer, technologist, and technician.

Communications is covered as it relates to the presentation of ideas, three-dimensional concepts, data analysis, and pictorials. The methods of making working drawings are given in accordance with ANSI standards and include materials, tolerances, welding specifications, pipe drafting, and electric/electronics drafting. The design process is covered in Chapters 2 through 9 to illustrate the importance of engineering graphics in developing creative solutions to technical problems. Descriptive geometry is covered in Chapters 27 through 32. Vectors, nomography, empirical equations, and graphical calculus are other specialty areas receiving emphasis.

Objectives

The objective of this book is to support courses in which the student learns the various standards and techniques of preparing engineering drawings and specifications, learns how to read and interpret drawings, learns how to supervise the preparation of drawings by others, and learns how to solve three-dimensional technical problems that require the application of descriptive geometry and graphical analysis. Once the principles of preparing drawings correctly have been mastered, the student should be able to utilize these techniques in preparing drawings made by computer graphics methods. Above all, this textbook is designed to help students expand their creative talents and communicate their ideas in an effective manner.

Format

Engineering Design Graphics can be used as a self-instructional book enabling the student to work independently. Many problems are presented in a step-by-step sequence that shows the progressive steps in solving a problem and a second color is used to emphasize important points of construction. There are over 600 problems, many of which are new. These problems offer a range of assignments that can be solved by students to aid them in grasping principles covered in each chapter.

Revision features

The fifth edition of *Engineering Design Graphics* has been updated to reflect important developments in the field, including the use of new tools and technologies, recent changes in governing standards, and others. In addition this revision has benefited in numerous ways from the close and continuous scrutiny of the author, colleagues at the author's and other institutions, and students. The opportunity to use the book over the course of several years has enabled us to refine and improve the material in hundreds of ways.

Some of the major revision features are

- the revision of several hundred illustrations to enhance clarity and student learning
- the inclusion of several hundred new drawings
- Chapter 10, "The Computer in Design and Drafting," replaces Chapter 37 from the fourth edition. This chapter is much changed in content: it provides a general introduction to the area of computer-aided design and drafting and then gives a detailed description of the AutoCAD software program and its application to engineering design graphics
- the insertion of computer graphics techniques in all appropriate chapters
- the addition of a new chapter, Chapter 38, which details the updated features of AutoCAD's Version 2.5 and offers some applications of these features to engineering design graphics
- the major rewriting of the chapter on tolerances (Chapter 22)
- the addition of many new problems
- the editing of existing material in all chapters, including: extensive updating of references, illustrations, and photographs; the enlargement of many problem illustrations from the fourth edition for easier student use; correction of minor inaccuracies that were brought to our attention by students, colleagues, and reviewers

Supplementary problems

Seventeen different problem books and teachers' guides are available to be used with this textbook. A listing of these books and their source is given on the page preceding the Preface. Twelve of the manuals have computer graphics problems on the backs of the problem sheets that allow the coverage of the problems by both computer and traditional methods with the same problem books.

Acknowledgments

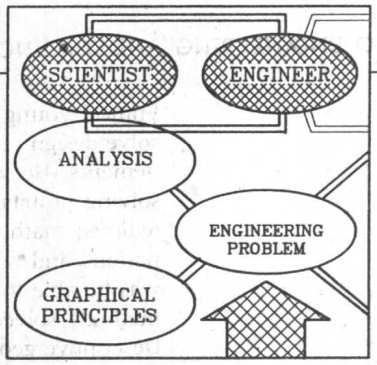
We are grateful for the assistance of many who have influenced the development of this volume. We have been aided by the use of illustrations developed by the late William E. Street and Carl L. Svensen for their earlier publications. Many industries have furnished photographs and drawings that have been acknowledged in the legends where they are used. The Engineering Design Graphics staff of Texas A&M University has been helpful in making suggestions for the preparation of this book. Professor Tom Pollock provided valuable information on various metals and their designations.

We are indebted to Mary Ann Zadfar, Josef Woodman, and Joseph Oakey of Autodesk Inc. for their assistance with AutoCAD. We appreciate the assistance and cooperation of Karen Kershaw of MEGA CADD, INC. After our association with these individuals and their companies, it is easy to understand why they are leaders in their respective fields.

We are appreciative of the many institutions who have thought enough of our publications to adopt them for classroom use. It is an honor for one's work to be accepted by his colleagues. We are hopeful that this textbook will fill the needs of engineering and technology programs. As always, comments and suggestions for improvement and revision of this book will be appreciated.

College Station, Texas J. H. E.

Contents



CHAPTER 1

Introduction to Engineering and Technology

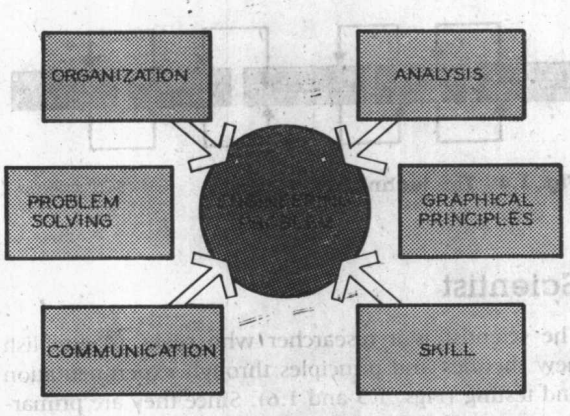


FIG. 1.1 Problems in this text require a total engineering approach with the engineering problem as the central theme.

1.1 Introduction

This book is devoted to the introduction of elementary design concepts of engineering and to the application of engineering graphics to the design process. Examples are given that have an engineering problem at the core and that require organization, analysis, problem-solving graphical principles, communication, and skill (Fig. 1 1).

Creativity and imagination are essential ingredients of the engineering profession. Albert Einstein said, "Imagination is more important than knowledge, for knowledge is limited, whereas imagination embraces the entire world . . . stimulating progress, or, giving birth to evolution" (Fig. 1.2).