Mc Graw Hill Education

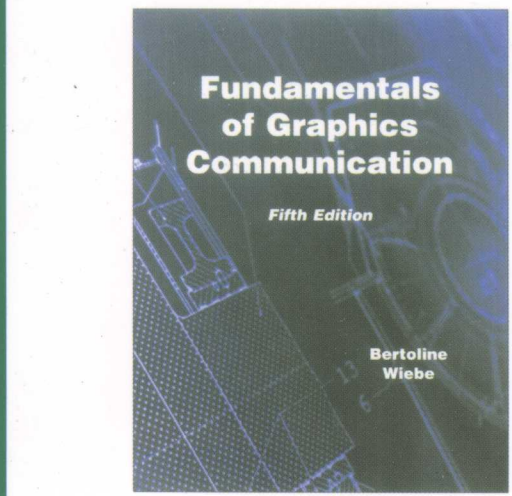
中国工程图学学会图学教育专业委员会推荐

国外大学优秀教材 —— 工程图学系列(影印版)

Gary R. Bertoline, Eric N. Wiebe 著

童秉枢 改编

图形信息表达基础教程(第5版)



清华大学出版社

Mc Graw Education

中国工程图学学会图学教育专业委员会推荐

国外大学优秀教材 —— 工程图学系列(影印版)

图形信息表达基础教程(第5版)

Fundamentals of Graphics Communication (Fifth Edition)

Gary R. Bertoline
Eric N. Wiebe 著
童秉枢 改编

清华大学出版社
北京

Gary R. Bertoline, Eric N. Wiebe
Fundamentals of Graphics Communication (Fifth Edition)
EISBN: 007-322078-7

Copyright ©2007 by The McGraw-Hill Companies, Inc.

Original language published by The McGraw-Hill Companies, Inc. All rights reserved. No part of this publication may be reproduced or distributed by any means, or stored in a database or retrieval system, without the prior written permission of the publisher.
Authorized English language reprint edition jointly published by McGraw-Hill Education (Asia) Co. and Tsinghua University Press. This edition is authorized for sale in the People's Republic of China only, excluding Hong Kong, Macao SAR and Taiwan. Unauthorized export of this edition is a violation of the Copyright Act. Violation of this Law is subject to Civil and Criminal Penalties.
本书英文影印版由清华大学出版社和美国麦格劳-希尔教育出版(亚洲)公司合作出版。此版本仅限在中华人民共和国境内（不包括香港、澳门特别行政区及台湾）销售。未经许可之出口，视为违反著作权法，将受法律之制裁。
未经出版者预先书面许可，不得以任何方式复制或抄袭本书的任何部分。

北京市版权局著作权合同登记号　图字：01-2007-3126

本书封面贴有 McGraw-Hill 公司防伪标签，无标签者不得销售。
版权所有，侵权必究。侵权举报电话：010-62782989　13501256678　13801310933

图书在版编目（CIP）数据

图形信息表达基础教程=Fundamentals of Graphics Communication（Fifth Edition）：第5版：英文/（美）贝尔托林(Bertoline, G.R.)，（美）维贝(Wiebe, E.N.)著；童秉枢改编. —影印本. —北京：清华大学出版社，2007.8
（国外大学优秀教材. 工程图学系列）

ISBN 978-7-302-15624-6

Ⅰ. 图…　Ⅱ. ①贝…　②维…　③童…　Ⅲ. 工程制图：计算机制图—高等学校—教材—英文　Ⅳ. TB237
中国版本图书馆 CIP 数据核字(2007)第 100482 号

责任编辑：曾　洁
责任印制：何　芊

出版发行：清华大学出版社
http://www.tup.com.cn
c-service@tup.tsinghua.edu.cn
社 总 机：010-62770175
投稿咨询：010-62772015
地　　址：北京清华大学学研大厦 A 座
邮　　编：100084
邮购热线：010-62786544
客户服务：010-62776969

印 刷 者：北京牛山世兴印刷厂
装 订 者：三河市新茂装订有限公司
经　　销：全国新华书店
开　　本：185×230　**印　张：**44.5
版　　次：2007 年 8 月第 1 版　**印　　次：**2007 年 8 月第 1 次印刷
印　　数：1~3000
定　　价：65.00 元

本书如存在文字不清、漏印、缺页、倒页、脱页等印装质量问题，请与清华大学出版社出版部联系调换。联系电话：010-62770177 转 3103　产品编号：025723-01

教师反馈表

McGraw-Hill Education，麦格劳-希尔教育公司，美国著名教育图书出版与教育服务机构，以出版经典、高质量的理工科、经济管理、计算机、生命科学以及人文社科类高校教材享誉全球，更以网络化、数字化的丰富的教学辅助资源深受高校教师的欢迎。

为了更好地服务中国教育界，提升教学质量，2003 年麦格劳-希尔教师服务中心在京成立。在您确认将本书作为指定教材后，请您填好以下表格并经系主任签字盖章后寄回，麦格劳-希尔教师服务中心将免费向您提供相应教学课件，或网络化课程管理资源。如果您需要订购或参阅本书的英文原版，我们也会竭诚为您服务。

书名：			
所需要的教学资料：			
您的姓名：			
系：			
院/校：			
您所讲授的课程名称：			
每学期学生人数：	_____ 人 _____ 年级	学时：	
您目前采用的教材：	作者：_____ 出版社：_____ 书名：_____		
您准备何时用此书授课：			
您的联系地址：			
邮政编码：		联系电话	
E-mail：（必填）			
您对本书的建议：		系主任签字 盖章	

我们的联系地址：

清华大学出版社

理工事业部第一编辑室
清华大学学研大厦 A711
邮编：100084
电话：010-62770175-4121
传真：010-62784897
邮箱：zengj@tup.tsinghua.edu.cn

麦格劳-希尔教育出版公司教师服务中心
北京-清华科技园创业大厦 A 座 907 室
北京 100084
电话：010-62790298-108
传真：010-62790292
教师服务热线：800-810-1936
教师服务信箱：instructorchina@mcgraw-hill.com
网址：http://www.mcgraw-hill.com.cn

丛书序言

本套丛书是由清华大学出版社和中国工程图学学会图学教育专业委员会共同策划的。

双语教学是近年来国内高校的教学改革热点之一，目前在数十所高校中已经开展了制图课程的双语教学。

从目前国内开展双语教学的高校使用的教材来看，大体上有以下几种情况：①直接选用欧美原版教材；②中国的制图教师根据我国的教学基本要求改编的原版教材，并以附录的形式讲解投影法和标准方面的差异；③中国的制图教师编写的英文教材；④中国的制图教师编写的中英文对照的双语教材等。

为了给我国高校的制图教师开展双语教学时提供更多的教材选择，也为了使我国高校的广大师生对美国制图课程的现状有更多的了解，清华大学出版社和中国工程图学学会图学教育专业委员会决定出版这套丛书。经过编委会一年多的分析与研究，我们从数十本美国原版教材中选择了 6 本构成了本套丛书，分别为机械类的制图教材两本，近机械类与非机械类的制图教材两本，CAD 与计算机图形学方面的教材两本。需要说明的是美国的制图教材并未按照上述方式分类，所谓不同的类别是由本套丛书的编委会根据其内容来确定的。

由于美国原版教材的内容远远多于我国同类教材的内容，编委会根据我国的实际情况，以“教学基本要求”为依据，对其内容进行了删减，在这一过程中，未对原版教材作任何改写，以保证其“原汁原味”的风格。我们希望通过这种方法，给开展制图课双语教学的院校提供一套既能保持原版教材风貌，又符合我国实际情况的英语教材。

最后，清华大学出版社及本套丛书的编委会对积极提供样书供编委会选择的美国麦格劳-希尔公司和培生公司表示衷心的感谢，是他们的积极配合使得这套丛书得以顺利出版。

限于改编者的水平，书中不当之处在所难免，欢迎广大读者批评指正。

国外大学优秀教材——工程图学系列编委会

2007 年 3 月

此为试读，需要完整PDF请访问：www.ertongbook.com

影印版序言

本书原版有 12 章、一个附录、一个词汇表、一个索引和一套书后练习题，共计 804 页。较好地反映了现代工程图学的体系结构与内容安排，具有时代气息，对我国工程图学的课程改革及教材编写具有借鉴作用，也为双语教学提供了一本良好的教材。

考虑到我国课程设置、教学学时以及教材市场的实际情况，在本书影印时作了必要的删节。

(1) 删去附录。附录中包括 56 项内容，主要是美国国家标准的相关表格，有 55 页。因不符合我国标准，故删去。

(2) 删去书后练习题。这些练习题由学生完成后从书上撕下上交，有 64 页。考虑到该书每章后面均有大量的“复习题”、“思考题”、“典型题”等，已有足够的资源供学生练习，故删去。

以上共删去 119 页。

经过删节处理后，页眉保留原版书的页码，页脚是连续的新书页码。文中提到的页码均为原版书页码。本书目录保留原版书目录,目录中的页码为原版书页码,使用时请参照页眉处页码。有的内容或页码有可能已被删除从而无法找到，由此给读者带来不便，请读者谅解。

清华大学　童秉枢

2007 年 3 月

Preface

Engineering and technical graphics have gone through significant changes in the last decade, due to the use of computers and CAD software. It seems as if some new hardware or software development that impacts technical graphics is occurring every year. Although these changes are important to the subject of technical graphics, there is much about the curriculum that has not changed. Engineers and technologists still find it necessary to communicate and interpret designs, using graphics methods such as drawings or computer models. As powerful as today's computers and CAD software have become, they are of little use to engineers and technologists who do not fully understand fundamental graphics principles and 3-D modeling strategies or do not possess a high-level visualization ability.

To the authors of this text, teaching graphics is not a job; it is a "life mission." We feel that teaching is an important profession, and that the education of our engineers is critical to the future of our country. Further, we believe that technical graphics is an essential, fundamental part of a technologist's education. We also believe that many topics in graphics and the visualization process can be very difficult for some students to understand and learn. For these and other reasons, we have developed this text, which addresses both traditional and modern elements of technical graphics, using what we believe to be an interesting and straightforward approach.

In Chapter 1, you will learn about the "team" concept for solving design problems. The authors of this text used this concept, putting together a team of authors, reviewers, industry representatives, focus group, and illustrators, and combining that team with the publishing expertise at McGraw-Hill to develop a modern approach to the teaching of technical graphics.

This new-generation graphics text therefore is based on the premise that there must be some fundamental changes in the content and process of graphics instruction. Although many graphics concepts remain the same, the fields of engineering and technical graphics are in a transition phase from hand tools to the computer, and the emphasis of instruction is changing from drafter to 3-D geometric modeler, using computers instead of paper and pencil. We realize that hand sketching will continue to be an important part of engineering and technical graphics for some time to come. Therefore, the text contains an appropriate mix of hand sketching and CAD instruction.

Goals of the Text

The primary goal of this text is to help the engineering and technology student learn the techniques and standard practices of technical graphics, so that design ideas can be adequately communicated and produced. The text concentrates on the concepts and skills necessary for sketching, 2-D, and 3-D CAD. The primary goals of the text are to show how to:

1. Clearly represent and control mental images.
2. Graphically represent technical designs, using accepted standard practices.
3. Use plane and solid geometric forms to create and communicate design solutions.
4. Analyze graphics models, using descriptive and spatial geometry.
5. Solve technical design problems, using traditional tools or CAD.
6. Communicate graphically, using sketches, traditional tools, and CAD.
7. Apply technical graphics principles to many engineering disciplines.

What Is Different and Why

Much thought has gone into designing a complete instructional approach to the teaching and learning of engineering and technical graphics. The instructor is provided with a number of tools to assist in the instruction aspects, and the student is provided with tools to assist in the learning process.

This text was written specifically using techniques that will prepare students to use engineering and technical graphics concepts, practices, and modern tools, to solve design problems and communicate graphically. One goal was to provide a textbook that was clear, interesting, relevant, and contemporary.

Some of the distinguishing features of this text include the following:

1. *Modern topics*—The book is filled with modern examples, illustrations, and industry examples so students can relate to the material being presented.
2. *Emphasis on visualization*—Integrated throughout the text are visualization topics, explanations, and assignments to constantly reinforce and improve the student's visualization skills.
3. *3-D modeling chapter*—This *unique* chapter is devoted exclusively to the theory and practice of 3-D modeling.
4. *Modern parts used for problem assignments*—Most end-of-chapter problems are parts or assemblies of modern devices and products.
5. *Integration of CAD*—CAD concepts and practices have been integrated through all the chapters when they are relevant to the topic. They are not simply "tacked onto" the end of a chapter.
6. *Integration of design*—Design concepts are integrated through the text to give relevance and understanding of the relationship of design to technical graphics.

Coverage of Modern Topics

One of the primary reasons we wrote the text is that many modern topics either are not found or not covered in sufficient detail in traditional texts. Examples of contemporary topics covered in this book include:

Computer simulation
Mechanism analysis
Human factors
Product data management (PDM)
Design for manufacturability (DFM)
Knowledge-based engineering (KBE)
Virtual reality (VR)
Visualization
3-D modeling problems, concepts, and practices
Coordinate space
Product Lifecycle Management (PLM)
Multiviews from 3-D CAD models
Right-hand rule
Polar, cylindrical, spherical, absolute, relative, world, and local coordinate systems
Freeform curves
Spline curves
Bezier curves
Geometric surfaces
Double-curved surfaces
NURBS
Fractals
IGES
PDES
Missing lines
Concurrent engineering
Collaborative engineering
Designer's notebook
Contour sketching
Upside-down sketching
Negative space sketching

Extensive Coverage of Traditional Topics

Even though we firmly believe our coverage results in the most modern text available, we have been very careful to include all the traditional topics normally found in a technical drawing textbook. Students must learn the fundamentals whether using hand tools or CAD to communicate graphically. Therefore, coverage of traditional topics is comprehensive and in many cases includes step-by-step procedures and enhanced color illustrations to facilitate teaching and learning. The text includes the latest ANSI standard practices used in industry. Following are some of the major traditional topics covered in detail in this text.

Orthographic projection
Descriptive geometry
Intersections and developments
Geometry and construction
Isometric drawings
Oblique drawings
Auxiliary views
Section views

Multiview drawings
Dimensioning
Geometric dimensioning and tolerancing (GDT)
Working drawings
Gears, cams, and bearings
Welding drawings

Chapter Features

Every chapter has been planned carefully and written with a consistent writing, illustration, and design style and pedagogy. Students and instructors will learn quickly where to find information within chapters. The book was written as a part of a more global instructional approach to engineering and technical graphics and will serve as a starting point for instructor and student.

Here is a sampling of the features inside *Fundamentals:*

Objectives Each chapter has a list of measurable objectives that can be used as a guide when studying the material presented in the text. Instructors also can use the objectives as a guide when writing tests and quizzes. The tests and quizzes included in the Online Learning Center (OLC) for the text include questions for each objective in every chapter. This feature allows instructors to make sure that students learn and are tested based on the listed objectives.

Color as a Learning Tool This textbook uses four-color illustrations throughout to better present the material and improve learning. The selection and use of color in the text are consistent to enhance learning and teaching. Many of the color illustrations also are available to the instructor in the image library found in the Online Learning Center to supplement lectures, as explained in detail later in this Preface.

The use of color in the text was used specifically to enhance teaching, learning, and visualization. Workplanes are represented as a light pink (Figure 4.10). Projection and picture planes are a light purple color (Figure 5.10).

Important information in a figure is shown in red to highlight the feature and draw the attention of the reader (Figure 3.6). Color shading is often used on pictorial illustrations so the user can better visualize the three-dimensional form of the object (Figure 5.43). This is especially important for most students who are being asked to use their visual mode to think and create. Color shading highlights important features, more clearly shows different sides of objects, and adds more realism to the object being viewed.

Some texts use two colors, which are adequate for some illustrations, but our research with students clearly demonstrates that having the ability to display objects and

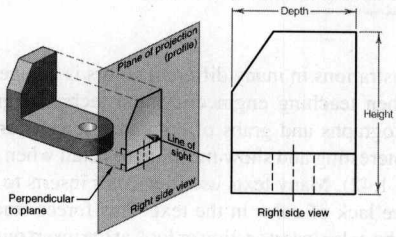


Figure 5.10 **Profile view**
A right side view of the object is created by projecting onto the profile plane of projection.

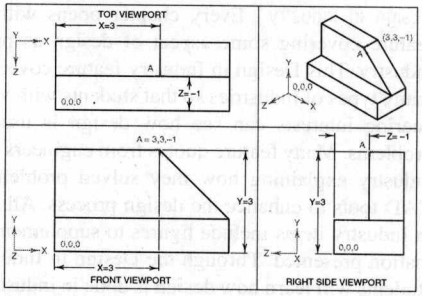


Figure 3.6 **Display of coordinate axes in a multiview CAD drawing**
Only two of the three coordinates can be seen in each view.

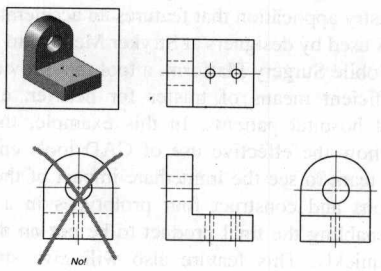


Figure 5.43 **Most descriptive views**
Select those views that are the most descriptive and have the fewest hidden lines. In this example, the right side view has fewer hidden lines than the left side view.

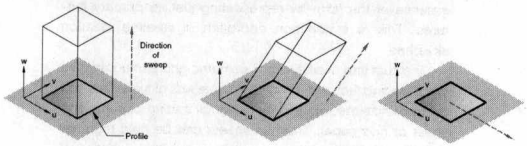


Figure 4.10 **Types of linear sweeping operations**
In some systems, linear sweeps are restricted to being perpendicular to the workplane.

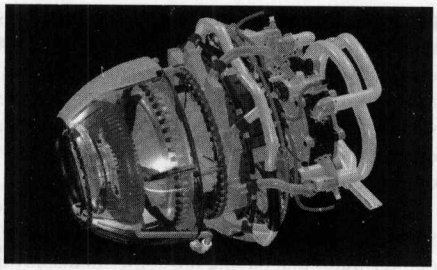


Figure 1.42 High-resolution rendered image of a CAD model
(Courtesy of Simon Floyd Design Group.)

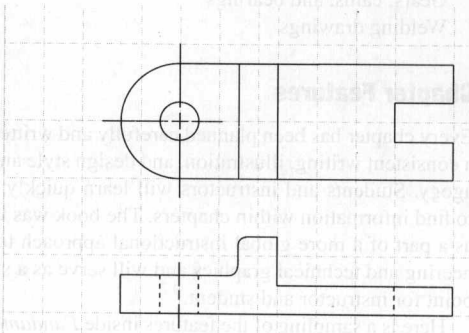
text illustrations in many different colors is a huge advantage when teaching engineering and technical graphics.

Photographs and grabs of computer screens are much more interesting and show much more detail when in color (Figure 1.42). Many texts use four-color inserts to supplement the lack of color in the text. This forces students to search the color insert section or look at the insert out of context of the readings. In some aspects of engineering design, such as finite element analysis, color is the method used to communicate or highlight areas of stress or temperature.

Design in Industry Every chapter opens with a special feature covering some aspect of design as practiced in industry. This Design in Industry feature covers design in many types of industries so that students with varied engineering interests can see how design is used to solve problems. Many feature quotes from engineers working in industry explaining how they solved problems or used CAD tools to enhance the design process. All the Design in Industry items include figures to supplement the information presented. Through the Design in Industry boxes, students will learn how design is done in industry from interesting stories presented by practicing engineers and technologists. For example, Chapter 12, "Geometric Dimensioning and Tolerancing (GDT)," includes a Design in Industry application that features an accelerated design process used by designers at Stryker Medical to create the Trio Mobile Surgery Platform, a tool that provides a safe and efficient means of trasfer for heavier, elderly, or sedated hospital patients. In this example, the student learns how the effective use of CAD tools enabled the design team to see the immediate impact of their design variations and construct four prototypes in a two-year span, enabling the final product to be put on the market more quickly. This feature also will give students an increased awareness and appreciation for the role of graphics in engineering design.

Practice Problem 9.1

Sketch dimensions in decimal inches for the object shown in the multiview drawing.



Practice Problems This feature gives students drawing practice as they learn new concepts. Through immediate hands-on practice, students more readily can grasp the chapter material. To illustrate, in Chapter 9, "Dimensioning and Tolerancing Practices," Practice Problem 9.1 provides a grid for students to sketch dimensions in a multiview drawing.

Practice Exercises A unique feature of the text is the use of practice exercises, which cause the student to pause and actively engage in some activity that immediately reinforces their learning. For example, Practice Exercise 7.2 in Chapter 7, "Pictorial Projections," asks the student to find a few familiar objects and begin making isometric

Practice Exercise 7.2

Using isometric grid paper, sketch common, everyday objects. Some examples are given in Figure 7.22. Sketch objects with a variety of features. Some should require sketching isometric ellipses, while others should have angled surfaces that require nonisometric lines. Start with simpler forms that only contain isometric lines and work toward more complex forms. Another approach is simply to leave out some of the details. You can capture the *essence* of the form by representing just its primary features. This is a common approach in creating ideation sketches.

The cost and availability of isometric grid paper can be a discouraging factor in using it to create lots of sketches. You can minimize the expense by using roll tracing paper over a sheet of grid paper. The two sheets can be held together with low-tack tape or put in a clipboard. With practice, you will find that grid paper is not needed and you can create sketches on the tracing paper alone.

sketches. This exercise allows a student to experience and try making isometric sketches without the pressure of graded assignments. Students have the opportunity to try to sketch isometric features, such as ellipses, and practice before having a formal assignment. They also are working with known objects that they can pick up and move, which is important in the visualization process. Being able to pick up objects is especially important for that segment of the population who are haptic learners and learn best when able to manipulate objects to be visualized.

Step-by-Step Illustrated Procedures Most chapters include many drawing examples that use step-by-step procedures with illustrations to demonstrate how to create graphics elements or to solve problems. These step-by-step procedures show the student in simple terms how a drawing is produced. Most of the illustrations accompanying the step-by-step procedures are in multiple parts so the student can see how the drawing is created. In many cases, the color red is used in each step of the illustration to show what is being added or created. This effective use of color draws the attention of the student so there is less chance for confusion or making errors when they reference the illustration and steps, or when given drawing assignments.

Integration of CAD Every chapter includes specific references to CAD rather than simply adding them to the end of the chapter. By integrating the references in the text, the student learns how CAD is used in the context of the topic being explained. Students begin to understand that CAD is another tool used by the engineer and technologist to communicate. Traditional topics and CAD topics are integrated seamlessly because the text was written that way in its first edition. CAD is not an add-on or afterthought. It is integrated fully and embraced as a means of creating graphics for engineers and technologists (Figure 5.35).

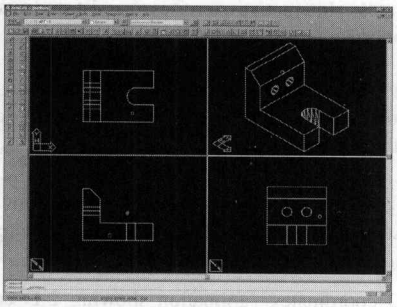


Figure 5.35 Predefined multiviews on a CAD system

Dream High Tech Jobs This feature is included in many chapters and explains how engineers and technologists have found interesting jobs after completing their education. You will read about how they are using their knowledge and skills to design precuts, devices, and systems.

Historical Highlights This chapter feature includes information about important events and people in the history of graphics. Historical Highlights are presented as a special boxed feature that contains an overview of the person or event along with photographs and drawings. They are used as a means of giving the student an historical context to graphics. Students will gain an understanding of the slow evolution of the "science" of graphics as it was painstakingly developed throughout the history of humankind.

Questions for Review Each chapter includes an extensive list of questions for review. Included are questions meant to measure whether students learned the objective listed at the start of each chapter. Other questions are used to reinforce the most important information presented in the chapter. The types of questions used require students to answer through writing or through sketching and drawing. Answers to all questions are included in the instructor material included with the text.

Further Reading Many of the chapters include a list of books or articles from periodicals relevant to the content covered in the text. The Further Reading list can be useful for the instructor seeking additional information about a topic. Students will also find it useful to supplement their reading, studying, and learning.

Tear-Out Worksheets To give students extra drawing and sketching practice, this edition includes 64 perforated worksheets. The questions and directions for the worksheets are found under "Workbook Problems" at the end of each corresponding chapter. For instance, in Chapter 3, "Engineering Geometry," the workbook problems have students sketch a ridge gasket and centering plate (on the given rectangular grid), plot coordinates, and cut out the patterns in 3-D cubes and prisms.

Problems Every chapter in the text includes an extensive number and variety of problem assignments. Most chapters include text-based problems that describe a problem to solve or drawing to create. The figure-based problems are very extensive and range from the very simple to complex. This arrangement allows the instructor to carefully increase the complexity of the problems as students learn

此为试读，需要完整PDF请访问：www.ertongbook.com

and progress. The most complex drawings can be used to supplement assignments given to the most talented students or for group-based projects.

Most of the problems are of real parts made of plastic or light metals, materials commonly found in industry today.

The wide range and number of problems allow the instructor to frequently change assignments so that fresh problems are used from semester to semester. Additional problems are available on the website and through our workbooks. All problems' solutions are provided to the instructor. Instructors may receive access to these password-protected solutions by contacting their local McGraw-Hill sales representative.

Classic Problems Many chapters include Classic Problems, which are additional problems that can be assigned. They have been taken from the seminal technical graphics textbooks by Thomas E. French, published by McGraw-Hill. Many of the problems are castings with machined surfaces, giving the student experience with additional materials and machining processes.

Glossary, Workbook Sheets, Appendixes, and Index

At the end of the text is an extensive glossary containing the definitions of all key terms shown in bold in the text. This glossary contains over 600 terms related to engineering and technical drawing, engineering design, CAD, and manufacturing.

Fundamentals of Graphics Communication, 5th edition contains supplementary information in the Appendixes useful to students, such as metric equivalents, trigonometry functions, ANSI standard tables, welding symbols, and more.

An extensive index is included at the end of the text to assist the reader in finding topics quickly. This index is carefully cross-referenced so related terms easily can be found by the user.

The perforated drawing workbook sheets, described earlier in the "Tear-Out Worksheets" section, are found after the index.

Online Learning Center (OLC)

The OLC Website follows the textbook chapter by chapter. As students study, they can refer to the OLC for learning objectives, chapter summaries, video, a glossary, and more. They require no building or maintenance on your part. In fact, they are ready to go the moment you and your students type in www.mhhe.com/bertoline. Before taking an exam, students will know if they're ready thanks to interactive exercises and self-grading quizzes.

A secured Instructor Center stores your essential course materials to save you prep time before class. The Instructor's Manual, Solutions Manual, and presentation materials are now just a couple of clicks away. You will also find additional problem material and exercises.

OLC Features

Many supplements for each chapter are found on the book's OLC site, including the following:

Learning Objectives A listing of all learning objectives for each chapter in the text.

Chapter Outline An extensive outline of each chapter.

Multiple-Choice Quiz An interactive online quiz covering important topics in the chapter. Answers are submitted for automatic and immediate grading for review by the student.

Questions for Review The questions include a hint button if a student cannot answer the question. The hint button refers the student to the chapter page where the material relevant to answering the question can be found.

True or False Questions An interactive online true and false test covering important topics in the chapter. Answers are submitted for automatic and immediate grading for review by the student.

Key Terms Key terms from each chapter are listed with their definition and page reference from the text.

Flashcards Interactive exercises to assist students in learning important terms from each chapter of the text.

Website Links Many chapters include numerous website links that can be used by students and faculty to supplement the textbook material.

Animations Many chapters include animations that can be downloaded and played on a computer showing how to visualize and understand concepts.

- 2-D coordinates—animation showing 2-D coordinate concepts such as origin, X and Y axes, and ordered pairs.

- 3-D coordinates—animation showing 3-D coordinate concepts such as origin, X and Y and Z axes.
- Right-hand rule—animation showing "finger" relationship to axes and positive rotation concepts.
- Glass box—animation showing the glass box projection concept.
- World and local coordinates—world and local coordinate concepts
- Section views—animations showing the concept of section views.

Related Readings A listing of additional books that can be used as references or further reading on topics covered in the chapter.

Image Library The image library contains all the images in each chapter that can be viewed, printed, or saved to disk.

AutoCAD Exercises Some chapters contain additional mechanical, civil, and architectural AutoCAD problems in PDF format for viewing and printing hard copies. These problems include step-by-step procedures useful in drawing the problem using AutoCAD software.

Career Opportunities An extensive list of links to websites containing job opportunities.

Visualization Exercises Some chapters include links to additional visualization exercises that students can use to improve their understanding and ability.

Stapler 3-D Modeling Project 3-D modeling projects are included in the Online Learning Center. The purpose of the integrated 3-D modeling project is to further assist and motivate students to learn engineering and technical graphics concepts through a real project. The 3-D modeling project uses a real product, a stapler made by Swingline. The instructor and student are given information in Chapter 1 on the exact type of stapler to purchase, which will be reverse engineered. The stapler is a fairly simple device with some challenging surfaces. The range of complexity allows students to begin with simple parts and move on to increasingly sophisticated graphics and models as they become more knowledgeable and experienced in using computer graphics.

The stapler project can be assigned to each student or to small teams. Students can begin to experience the design process by redesigning the stapler given some parameters or by receiving an engineering change order. Virtually every major topic covered in the text can be related to the stapler project, such as dimensioning, section views, multiviews, sketching, 3-D modeling, design, working drawings, geometry, tolerancing, surface modeling, assemblies, pictorial views, simulation, and renderings. The culmination of the project could be a presentation of their stapler project redesign and the documentation produced throughout the semester or term by each student or the group. This project can be a powerful tool to motivate and enhance learning by all students. It can serve as an excellent resource for the instructor to supplement lectures and laboratory assignments and can result in better learning and retention by students.

Case Studies Interesting case studies for each chapter describing how CAD is used in the real world.

Acknowledgments

The authors wish to thank the reviewers for their contribution to the content, organization, and quality of this book and its supplements.

Dianne Amuso,
Rochester Institute of Technology

David Baldwin,
University of Oklahoma

Tom Bledsaw,
ITT Technical Institute

Marvin Bollman,
Milwaukee School of Engineering

Lisa D. Bostick,
Mississippi State

Robert Conroy,
California Polytechnic State University, San Luis Obispo

Malcolm Cooke,
Case Western Reserve University

Nicholas F. Di Pirro,
State University of New York at Buffalo

Ralph Dirksen,
Western Illinois University

Gary Furbish,
University of Maine

Janos Gergely,
University of North Carolina, Charlotte

M. Stephen Kaminaka,
California Polytechnic State University

Hong Liu,
Western Illinois University

Fahmida Masoom,
University of Wisconsin, Platteville

Rafiq Noorani,
Loyola Marymount University

Charles Nunoo,
Florida Institute of Technology

Kenneth Perry,
University of Kentucky

Robert Pieri,
North Dakota State University

Gang (Gary) Qi,
University of Memphis

Jeff Raquet,
University North Carolina at Charlotte

Lee Reynolds,
Texas Tech University

Lilia Sanchez,
Santa Clara University

Michael D. Stewart,
Georgia Institute of Technology

Vivek Tandon,
University of Texas at El Paso

Robert Twardock,
College of Lake County

Paul Zsombor-Murray,
McGill University

We would like to thank Len Nasman for all his work in the first edition; Tom Sweeney, an expert in GDT from Hutchinson Technical College, for authoring parts of Chapter 12; Pat McQuistion for his review and updating of Chapter 12 to conform to ASME Y-14.5M–1994 standards in the second edition, and to Ted Branoff for his major changes in the third edition; William A. Ross, Purdue University, for his numerous ideas on designing the text and end-of-chapter problems; Terry Burton for his review and input into the sketching chapter; and H. J. de Garcia, Jr., University of Missouri–St. Louis, for contributing problems used in this book. This edition includes a fresh accuracy check by Professor Nathan Hartman from Purdue University. Accuracy checking of end-of-chapter problems was done by Ted Branoff, North Carolina State University; Ed Nagle, Tri-State University; Jim Hardell, Virginia Polytechnic Institute; and Murari Shah, Purdue University. Special thanks to Peter Booker for the use of historical figures found in his text, *A History of Engineering Drawing*. Cover art was created by Professor James Mohler from Purdue University. Thanks to Kevin Bertoline for the solutions to some of the "Classic Problems" and sketches in the third edition. Jason Bube and Travis Fuerst contributed updated and new illustrations in the third edition. Special thanks must go to Michael Pleck from the University of Illinois. Professor Pleck has spent countless hours reviewing the text and giving the authors many ideas on how to improve the content. Professor Pleck has shared his vast knowledge in graphics because of his dedication to the profession. The authors truly are indebted to him and greatly appreciate all he has done.

The authors also would like to thank the publisher, McGraw-Hill, for its support of this project. This has been an expensive and time-consuming process for the authors and the publisher. Few publishers are willing to make the investment necessary to produce a comprehensive, modern graphics text from scratch. The technical graphics profession is indebted to McGraw-Hill for taking the risk of defining a discipline in transition.

Gary Bertoline would like to especially thank his wife, Ada, and his children, Bryan, Kevin, and Carolyn, for the sacrifices they made so that he might fulfill this important mission in his life. His thanks also go to Caroline and Robert Bertoline, who encouraged him to pursue his studies. He also would like to thank all of his colleagues, especially those at Purdue University and The Ohio State University, his instructors at Northern Michigan University who inspired him to pursue graphics as a discipline, and Wallace Rigotti, who taught him the basics.

Eric Wiebe would like to thank his wife, Cynthia Shimer, for the support she has given and to recognize the sacrifices his children, Ellery and Colin, have made over the years of authoring this and other editions of the text. He would also like to thank his father, Robert Wiebe, who provided the best role model of a scholar, author, and father one could hope for. His thanks also extend to his fellow faculty in the Graphic Communications program at North Carolina State University for the collegiality they

have provided over the years. Finally, thanks go to Nate Hartman and Ted Branoff for the discussions, advice, and specific input they have given over the last few years that have helped to shape his writing.

Finally, we would like to know if this book fulfills your needs. We have assembled a "team" of authors and curriculum specialists to develop graphics instructional material. As a user of this textbook, you are a part of this "team," and we value your comments and suggestions. Please let us know if there are any misstatements, which we can then correct, or if you have any ideas for improving the material presented. Write in care of the publisher, McGraw-Hill, or E-mail Gary R. Bertoline at bertoline@purdue.edu.

Gary R. Bertoline
Eric N. Wiebe

Design in Industry

Going Virtual

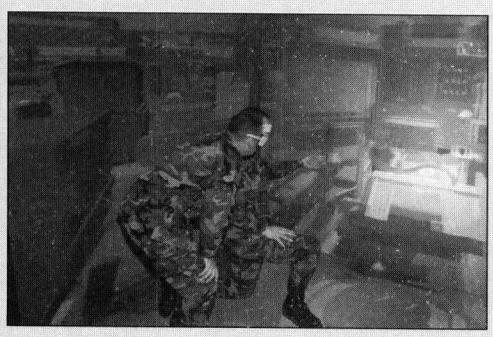
Virtual reality and simulation software tools hold the promise of drastically slashing product development costs through the elimination of expensive physical prototypes. With costs for the latest virtual reality (VR) tools and simulation systems coming down, automotive and aerospace manufacturers increasingly are seeking to deploy sophisticated, collaborative visualization systems throughout their product development planning organizations, as well as using virtual simulations for designing overall plant layouts and within manufacturing cells.

Although VR tools historically have been the domain of researchers, commercial applications in automotive, aerospace, and medical device manufacturing are becoming much more common. Using VR systems like the CAVE (Computer Automated Visualization Environment), developed in the early 1990s by the Electronic Visualization Laboratory at the University of Illinois at Chicago (EVL, UIC), automakers and aircraft manufacturers can review realistic virtual model prototypes, avoiding the expense of $200,000 for a fiberglass auto prototype to upwards of $3 million for an aircraft prototype.

Over the past few years, the addition of more realistic visualization software also has furthered VR's acceptance, with efforts like the partnership between software developer Engineering Animation Inc. (Ames, IA), workstation supplier Silicon Graphics Inc. (Mountain View, CA), and General Motors Corp. (Detroit) offering EAI's VisConcept, a software suite providing a true 1:1, or human-scale, immersive visualization environment. In addition, projection and display technologies have improved to the point where it's possible to easily create high-resolution stereoscopic images—seeing an image in each eye with depth and volume just as in the real world.

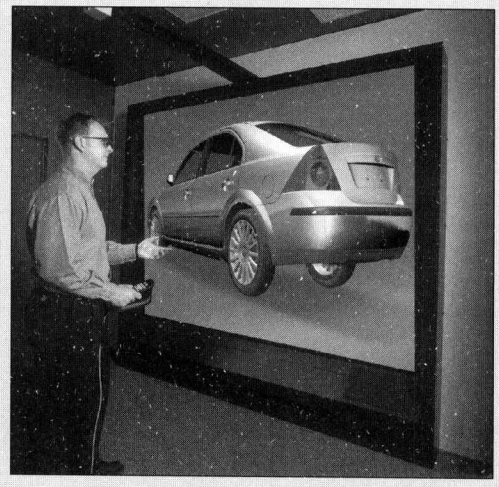
Collaborative visualization may represent a new opportunity to manufacturers, particularly in the automotive industry where many major auto manufacturers are trying to persuade their top suppliers to adopt visualization technology. Large-scale displays like the WorkWall enable manufacturing teams to collaborate in much the same way they used to work around drafting tables, but with realistic, full-scale 3-D models.

This article (or excerpts thereof) appears with permission from Manufacturing Engineering®, the official publication of the Society of Manufacturing Engineers (SME). The SME provides its members with the world's most comprehensive library of information related to manufacturing technology and new manufacturing methods. To learn more about SME and what it can do for you, please call (800) 733-4763 (USA), or visit the SME web site at www.sme.org.



With Fakespace Systems' WorkWall, teams can view realistic stereoscopic images during product development team design reviews.

(Image courtesy of Fakespace Systems Inc.)



Users of the Fakespace wall can review styling and component changes on virtual models before committing to final product designs.

(Image courtesy of Fakespace Systems, Inc.)

Contents

此为试读，需要完整PDF请访问：www.ertongbook.com