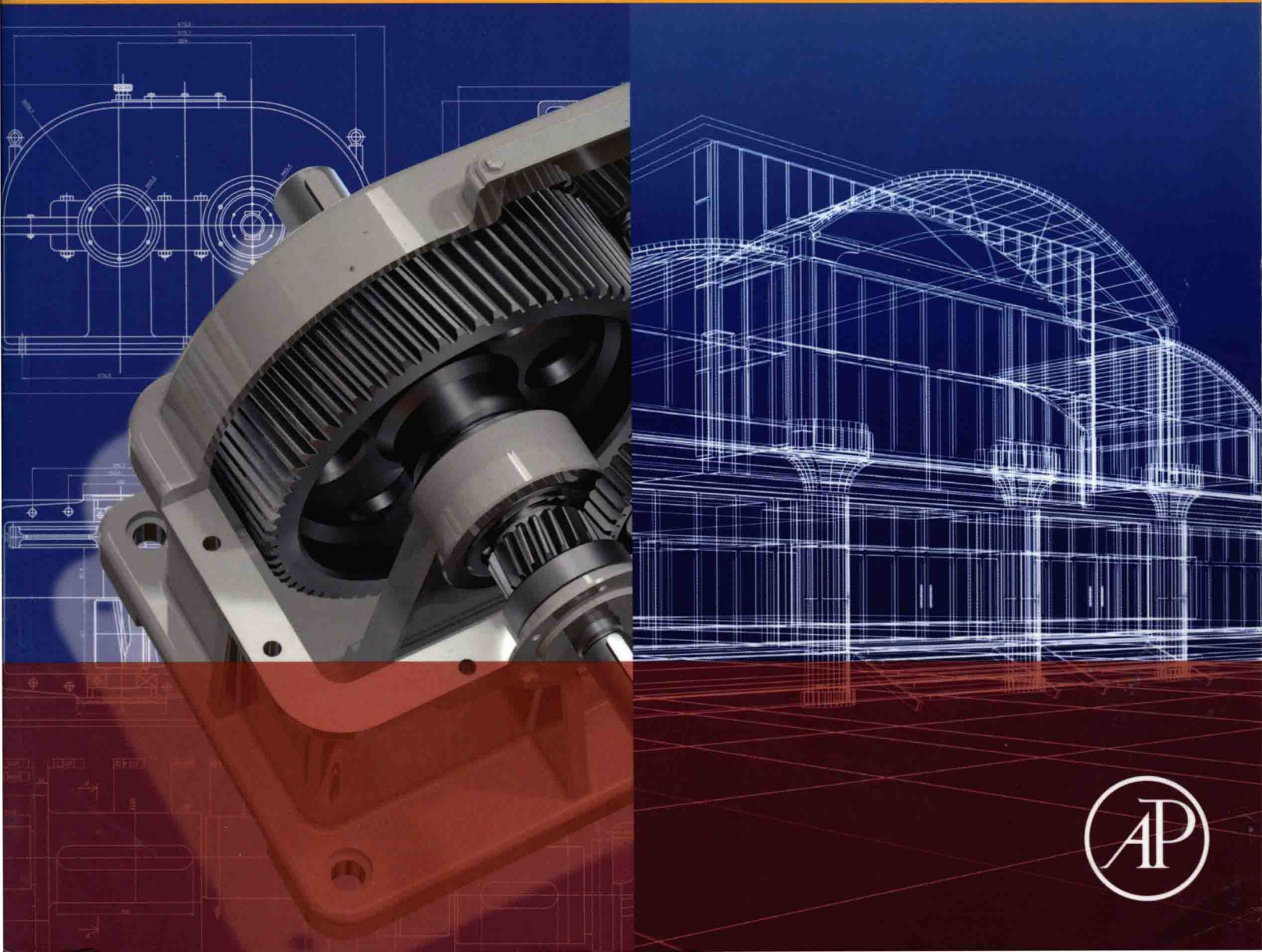


Up and Running with **AutoCAD® 2014**

2D and 3D Drawing and Modeling

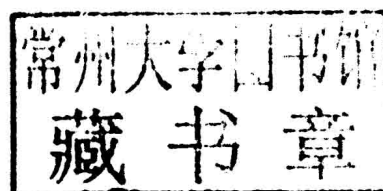
Elliot Gindis



Up and Running with AutoCAD[®] 2014

2D and 3D Drawing and Modeling

Elliot Gindis



AMSTERDAM • BOSTON • HEIDELBERG • LONDON
NEW YORK • OXFORD • PARIS • SAN DIEGO
SAN FRANCISCO • SINGAPORE • SYDNEY • TOKYO

Academic Press is an imprint of Elsevier



Academic Press is an imprint of Elsevier
225 Wyman Street, Waltham, MA 02451, USA
The Boulevard, Langford Lane, Kidlington, Oxford, OX5 1GB, UK

Copyright © 2014 Elsevier Inc. All rights reserved

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: www.elsevier.com/permissions.

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data

A catalog record for this book is available from the Library of Congress

ISBN: 978-0-12-410492-1

For information on all Academic Press publications
visit our website at elsevierdirect.com

Printed and bound in the USA
14 15 16 10 9 8 7 6 5 4 3 2 1



Working together
to grow libraries in
developing countries

www.elsevier.com • www.bookaid.org

ACKNOWLEDGMENTS

A textbook of this magnitude is rarely a product of only one person's effort. I thank all the early and ongoing reviewers of this text and Chris Ramirez of Vertical Technologies Consulting for research and ideas when most needed as well as using the text in his classroom. A big thank you also to Karen Miletsky at Pratt Institute of Design, Russell and Titu Sarder at Netcom Information Technology, and everyone at New York Institute of Technology, RoboTECH CAD solutions, and other premier training centers for their past and present support.

Extensive gratitude also goes to Joseph P. Hayton, Stephen R. Merken, Jeff Freeland, Gnomi Gouldin, Kathleen Chaney, and the rest of the team at Elsevier for believing in the project and for their invaluable support in getting the book out to market. Thank you also to Jan Neff-Sinclair for painstaking proofreading and for providing detailed errata of the previous edition and to Denis Cadu of Autodesk for all the support at the Autodesk Developers Network. Special thanks also to Rick and Ken at Computer Resellers of Macon for all the fixes needed to keep my PC in tip top shape to enable me to make my deadlines!

Finally, I thank my friends and family, especially my parents, Boris and Tatyana Gindis, for their patience and encouragement as well as standing by me as months of work turned into years.

This book is dedicated to the hundreds of students who have passed through my classrooms and made teaching the enjoyable adventure it has become.

Elliot Gindis
April 2014



Elliot J. Gindis started out using AutoCAD professionally in a New York City area civil engineering company in September 1996, moving on to consulting work shortly afterward. He has since drafted in a wide variety of fields ranging from all aspects of architecture and building design to electrical, mechanical, civil, structural, aerospace, and rail design. These assignments, including lengthy stays with IBM and Siemens Transportation Systems, totaled over 50+ companies to date.

In 1999, Elliot began teaching part-time at Pratt Institute of Design, followed by positions at Netcom Information Systems, RoboTECH CAD solutions and more recently at New York Institute of Technology. In 2003, he formed Vertical Technologies Consulting and Design (www.VTCDesign.com), an AutoCAD training firm that continues to train corporate

clients nationwide in using and optimizing AutoCAD.

Elliot holds a bachelor's degree in aerospace engineering from Embry Riddle Aeronautical University, and a master's degree in mechanical engineering from Mercer University. As of 2009, he resides in the Atlanta area and is a structural and systems engineer for the United States Air Force. He also continues to be involved with AutoCAD education and CAD consulting. *Up and Running with AutoCAD 2014*, which carefully incorporates lessons learned from 17 years of teaching and industry work, is his seventh overall textbook on the subject. His 2012 textbook has also been translated, and is available in Spanish from Anaya Multimedia. He can be reached at: Elliot.Gindis@gmail.com.

Previous textbooks by Elliot Gindis:

- Operational AutoCAD 2008, New York (NY): Netcom Inc. (out of print)
- Up and Running with AutoCAD 2009 [e-book only], Waltham (MA): Elsevier, Inc.
- Up and Running with AutoCAD 2010, – Waltham (MA): Elsevier, Inc.
- Up and Running with AutoCAD 2011—2D Drawing and Modeling, Waltham (MA): Elsevier, Inc.
- Up and Running with AutoCAD 2011—2D and 3D Drawing and Modeling, Waltham (MA): Elsevier, Inc.
- Up and Running with AutoCAD 2012—2D Drawing and Modeling, Waltham (MA): Elsevier, Inc.
- Up and Running with AutoCAD 2012—2D and 3D Drawing and Modeling, Waltham (MA): Elsevier, Inc.
- Up and Running with AutoCAD 2013—2D Drawing and Modeling, Waltham (MA): Elsevier, Inc.
- Up and Running with AutoCAD 2013—2D and 3D Drawing and Modeling, Waltham (MA): Elsevier, Inc.
- AutoCAD 2012—Dibujar y Modelar en 2D y 3D [in Spanish], Madrid (Spain): Anaya Multimedia.

WHAT IS AUTOCAD?

AutoCAD is a drafting and design software package developed and marketed by Autodesk®, Inc. As of 2013, it has been around for approximately 31 years—several lifetimes in the software industry. It has grown from modest beginnings to an industry standard, often imitated, sometimes exceeded, but never equaled. The basic premise of its design is simple and is the main reason for AutoCAD's success. Anything you can think of, you can draw quickly and easily. For many years, AutoCAD remained a superb 2D electronic drafting board, replacing the pencil and paper for an entire generation of technical professionals. In recent releases, its 3D capabilities finally matured, and AutoCAD is now also considered an excellent 3D visualization tool, especially for architecture and interior design.

The software has a rather steep learning curve to become an expert but a surprisingly easy one to just get started. Most important, it is well worth learning. This is truly global software that has been adopted by millions of architects, designers, and engineers worldwide. Over the years, Autodesk expanded this reach by introducing add-on packages that customize AutoCAD for industry-specific tasks, such as electrical, civil, and mechanical engineering. However, underneath all these add-ons is still plain AutoCAD. This software remains hugely popular. Learn it well, as it is still one of the best skills you can add to your resume.

ABOUT THIS BOOK

This book is not like most on the market. While many authors certainly view their particular text as unique and novel in its approach, I rarely reviewed one that was clear to a beginner student and distilled AutoCAD concepts down to basic, easy to understand explanations. The problem may be that many of the available books are written by either industry technical experts or teachers but rarely by someone who is actively both. One really needs to interact with the industry and the students, in equal measure, to bridge the gap between reality and the classroom.

After years of AutoCAD design work in the daytime and teaching nights and weekends, I set out to create a set of classroom notes that outlined, in an easy to understand manner, exactly how AutoCAD is used and applied, not theoretical musings or clinical descriptions of the commands. These notes eventually were expanded into the book that you now hold. The rationale was simple: I need this person to be up and running as soon as possible to do a job. How do we make this happen?

TEACHING METHODS

My teaching approach has its roots in a certain philosophy I developed while attending engineering school many years ago. While there, I had sometimes been frustrated with the complex presentation of what in retrospect amounted to rather simple topics. My favorite quote was, "Most ideas in engineering are not that hard to understand but often become so upon explanation." The moral of that quote was that concepts can usually be distilled to their essence and explained in an easy and straightforward manner. That is the job of a teacher: Not to blow away students with technical expertise but to use experience and top-level knowledge to sort out what is important and what is secondary and to explain the essentials in plain language.

Such is the approach to this AutoCAD book. I want everything here to be highly practical and easy to understand. There are few descriptions of procedures or commands that are rarely used in practice. If we talk about it, you will likely need it. The first thing you must learn is how to draw a line. You see this command on the first few pages of Chapter 1. It is essential to present the “core” of AutoCAD, essential knowledge common to just about any drafting situation, all of it meant to get you up and running quickly. This stripped down approach proved effective in the classroom and was carefully incorporated into this text.

TEXT ORGANIZATION

This book comes in three parts: Level 1, Level 2, and Level 3:

- Level 1** (Chapters 1–10) is meant to give you a wide breadth of knowledge on many topics, a sort of “mile wide” approach. These ten chapters comprise, in my experience, the complete essential knowledge set of an intermediate user. You then can work on, if not necessarily set up and manage, moderate to complex drawings. If your CAD requirements are modest or if you are not required to draft full time, then this is where you stop.
- Level 2** (Chapters 11–20) is meant for advanced users who are CAD managers, full-time AutoCAD draftspersons, architects, or self-employed and must do everything themselves. The goal here is depth, as many features not deemed critically important in Level 1 are revisited to explore additional advanced options. Also introduced are advanced topics necessary to set up and manage complex drawings.
- Level 3** (Chapters 21–30) is all about 3D. Solid knowledge of the previous two levels is highly recommended before starting these chapters. The 3D material covers all aspects of AutoCAD solid modeling including lights and rendering.

Throughout the book, the following methods are used to present material:

- Explain the new concept or command and why it is important.
- Cover the command step by step (if needed), with your input and AutoCAD responses shown so you can follow and learn them.
- Give you a chance to apply just-learned knowledge to a real-life exercise, drawing, or model.
- Test yourself with end-of-chapter quizzes and drawing exercises that ask questions about the essential knowledge.

You will not see an extensive array of distracting “learning aids” in this text. You will, however, see some common features throughout, such as

Commands: These are presented in almost all cases in the form of a command matrix, such as the one shown here for a line. You can choose any of the methods for entering the command.	<i>Keyboard:</i> Type in line and press Enter <i>Cascading menus:</i> Draw→Line <i>Toolbar icon:</i> Draw toolbar  <i>Ribbon:</i> Home tab→Line 
Tips and tricks: These are seen mostly in the first few chapters and one is shown here. They are very specific, deliberate suggestions to smooth out the learning experience. Do take note.	TIP 1: The Esc (escape) key in the upper left-hand corner of your keyboard is your new best friend. It gets you out of just about any trouble you get yourself into. If something does not look right, just press the Esc key and repeat the command. Mine was worn out learning AutoCAD, so expect to use it often.

Step-by-step instructions: These are featured whenever practical and show you exactly how to execute the command, such as the example with line here. What you type in and what AutoCAD says are in the default font: Courier New. The rest of the steps are in the standard print font.	Step 1. Begin the line command via any of the previous methods. • AutoCAD says: Specify first point: Step 2. Using the mouse, left-click anywhere on the screen. • AutoCAD says: Specify next point or [Undo]: Step 3. Move the mouse elsewhere on the screen and left-click again. You can repeat Step 2 as many times as you wish. When you are done, click Enter or Esc.
Learning objectives and time for completion: Each chapter begins with this, which builds a “road map” for you to follow while progressing through the chapter, as well as sets expectations of what you will learn if you put in the time to go through the chapter. The time for completion is based on classroom teaching experience but is only an estimate. If you are learning AutoCAD in school, your instructor may choose to cover part of a chapter or more than one at a time.	In this chapter, we introduce AutoCAD and discuss the following: • Introduction and the basic commands • The Create Objects commands • The Edit and Modify Objects commands • The View Objects commands, etc. By the end of the chapter, you will... Estimated time for completion of chapter: 3 hours.
Summary, review questions, exercises: Each chapter concludes with these. Be sure to not skip these pages and to review everything you learned.	SUMMARY REVIEW QUESTIONS EXERCISES

WHAT YOUR GOAL SHOULD BE

Just learning commands is not enough; you need to see the big picture and truly understand AutoCAD and how it functions for it to become effortless and transparent. The focus after all is on your design. AutoCAD is just one of the tools to realize it.

A good analogy is ice hockey. Professional players do not think about skating; to them it is second nature. They are focused on strategy, scoring a goal, and getting by the defenders. This mentality should be yours as well. You must become proficient through study and practice, to the point where you are working with AutoCAD, not struggling against it. It then becomes “transparent” and you focus only on the design, to truly perform the best architecture or engineering work of which you are capable.

If you are in an instructor-led class, take good notes. If you are self-studying from this text, pay very close attention to every topic; nothing here is unimportant. Do not skip or cut corners, and complete every drawing assignment. Most important, you have to practice, daily if possible, as there is no substitute for sitting down and using the software. Not everyone these days has the opportunity to learn while working and getting paid; companies want ready-made experts and do not want to wait. If that is the case, you have to practice on your own in the evening or on weekends. Just taking a class or reading this book alone is not enough.

It may seem like a big mountain to climb right now, but it is completely doable. Once on top, you will find that AutoCAD is not the frustrating program it may have seemed in the early days but an intuitive software package that, with proficiency of use, becomes a natural extension of your mind when working on a new design. That, in the end, is the mark of successful software; it helps you do your job easier and faster. Feel free to contact me with questions or comments at Elliot.Gindis@gmail.com, or visit my website at www.vtcdesign.com. Good luck!

ACKNOWLEDGMENTS	xvii
ABOUT THE AUTHOR	xix
PREFACE	xxi

LEVEL 1 • Chapters 1–10.....1

CHAPTER 1 AutoCAD Fundamentals Part I.....3

1.1 Introduction and Basic Commands4

1.2 The AutoCAD Environment5

1.3 Interacting with AutoCAD9

Method 1. Type in the Commands on the Command Line.....9

Method 2. Select the Commands from the Drop-down Cascading Menus 10

Method 3. Use Toolbar Icons to Activate the Commands..... 10

Method 4: Use the Ribbon Tabs, Icons, and Menus 11

1.4 Practicing the Create Objects Commands.....13

Line 13

Circle..... 14

Arc..... 15

Rectangle..... 16

1.5 View Objects19

Zoom 19

Pan 19

Regen 19

1.6 Practicing the Edit/Modify Objects Commands.....20

Erase.....20

Move20

Copy.....21

Rotate.....22

Scale23

Trim24

Extend25

Offset26

Mirror.....27

Fillet.....28

1.7 Selection Methods.....29

1.8 Drawing Accuracy—Part 130

Ortho (F8).....30

1.9 Drawing Accuracy—Part 230

OSNAPs30

1.10 Osnap Drafting Settings32

Summary.....33

CHAPTER 2	AutoCAD Fundamentals Part II	41
2.1	Grips	42
2.2	Units and Scale	43
2.3	Snap and Grid	44
	To Set Snap	44
	To Set Grid	45
2.4	Cartesian Coordinate System	45
2.5	Geometric Data Entry	46
	Dynamic Input	46
	Manual Input	49
2.6	Inquiry Commands	50
	Area	51
	Distance	51
	List	52
	ID	53
	Radius and Angle	54
2.7	Additional Drafting Commands	54
	Explode	55
	Polygon	55
	Ellipse	57
	Chamfer	58
	Templates	59
	Limits	60
	Save	60
	Help Files	60
	Tangent OSNAP	63
	Time	64
	Summary	65
	SPOTLIGHT ON: ARCHITECTURE	71
CHAPTER 3	Layers, Colors, Linetypes, and Properties	77
3.1	Introduction to Layers	78
	What Are Layers?	78
	Why Use Them?	78
	Creating and Deleting Layers	78
	Making a Layer Current	79
	Assigning Layer Colors	79
	Layer Freeze/Thaw and On/Off	82
	Layer Lock/Unlock	82
3.2	Introduction to Linetypes	83
3.3	Introduction to Properties	84
	Properties Palette	85
	Match Properties	86
	Layers Toolbar	86
3.4	In-Class Drawing Project: Floor Plan Layout	87
	Basic File Preparation	88
	Starting the Floor Plan	89
	Drawing the Inner Wall Geometry	90
	Drawing the Doors and Windows	91
	Summary	93

CHAPTER 4	Text, Mtext, Editing, and Style	99
4.1	Introduction to Text and Mtext	100
4.2	Text	100
	Editing Text	101
4.3	Mtext	102
	Formatting Mtext	103
4.4	Style	107
4.5	Spell Check	108
4.6	In-Class Drawing Project: Adding Text and Furniture to Floor Plan Layout	110
	NEArest OSNAP	112
	Summary	113
CHAPTER 5	Hatch Patterns	119
5.1	Introduction to Hatch	120
5.2	Hatch Procedures	121
	Step 1. Pick the Hatch Pattern you Want to Use	121
	Step 2. Indicate Where you Want the Pattern to Go	122
	Step 3. Fine-Tune the Pattern by Adjusting Scale and Angle (If Necessary)	124
	Step 4. Preview the Pattern and Accept it if OK	125
5.3	Working with Hatch Patterns	126
	Exploding Hatch Patterns	126
	Hatch Pattern Layers and Colors	127
	Advanced Hatch Topics	127
5.4	Gradient and Solid Fill	129
	Solid Fill	129
5.5	In-Class Drawing Project: Adding Hatch to Floor Plan Layout	132
	Summary	133
	SPOTLIGHT ON: MECHANICAL ENGINEERING	139
CHAPTER 6	Dimensions	143
6.1	Introduction to Dimensions	144
6.2	Types of Dimensions	144
	Linear Dimensions	145
	Aligned Dimension	146
	Diameter Dimension	147
	Radius Dimension	148
	Angular Dimension	149
	Continuous Dimensions	150
	Baseline Dimensions	151
	Leader and Multileader	152
	Secondary Dimensions	156
6.3	Editing Dimensions	157
6.4	Customizing Dimensions	158
	Dimstyle	158
6.5	In-Class Drawing Project: Adding Dimensions to Floor Plan Layout	163
	Summary	164
CHAPTER 7	Blocks, Wblocks, Dynamic Blocks, Groups, and Purge	169
7.1	Introduction to Blocks	170
	Difference between Blocks and Wblocks	170
	Creating a Block	170

7.2	Insert	173
7.3	Purge	174
7.4	Wblocks	175
	Inserting Wblocks	176
7.5	Dynamic Blocks	176
7.6	Groups	179
	Summary	183
CHAPTER 8	Polar, Rectangular, and Path Arrays	189
8.1	Polar Array	190
	Steps in Creating a Polar Array	190
	Additional Operations with Polar Array	192
	Legacy Polar Array (Pre-AutoCAD 2012)	195
8.2	Rectangular Array	195
	Steps in Creating a Rectangular Array	196
	Additional Operations with Rectangular Array	197
	Legacy Rectangular Array (Pre-AutoCAD 2012)	198
8.3	Path Array	199
	Steps in Creating a Path Array	199
	Additional Operations with Path Array	201
8.4	In-Class Drawing Project: Mechanical Device	202
	Summary	205
	SPOTLIGHT ON: ELECTRICAL ENGINEERING	209
CHAPTER 9	Basic Printing and Output	213
9.1	Introduction to Printing and Plotting	214
9.2	The Essentials	214
	What Printer or Plotter to Use	214
	What Paper Size to Use	215
	What Area to Plot	215
	At What Scale to Plot	216
	What Pen Settings to Use	216
	What Orientation to Use	217
	What Offset to Use	217
	Miscellaneous	217
9.3	The Plot Dialog Box	217
	Preview	219
9.4	Page Setup Manager	219
	Summary	221
CHAPTER 10	Advanced Output—Paper Space	225
10.1	Introduction to Paper Space	226
	What is Paper Space?	226
10.2	Paper Space Concepts	227
	Layouts	227
	Viewports	233
	Scaling	236
	Layers	239
	Text and Dims	243
	Annotation	246
	Summary	248

LEVEL 1 • Answers to Review Questions.....	253
LEVEL 2 • Chapters 11–20.....	259
CHAPTER 11 Advanced Linework.....	261
11.1 Introduction to Advanced Linework.....	262
11.2 Pline (Polyline)	262
Pedit.....	262
Exploding a Pline.....	264
Additional Pline Options	264
11.3 Xline (Construction Line)	265
11.4 Ray	267
11.5 Spline.....	268
11.6 Mline (Multiline).....	270
Modifying the Mline.....	271
Mlstyle (Multiline Style).....	271
Mledit (Multiline Edit)	275
Other Mline Properties	276
11.7 Sketch	276
Applications of Sketch	278
11.8 Level 2 Drawing Project (1 of 10): Architectural Floor Plan.....	278
Summary 279	
CHAPTER 12 Advanced Layers	283
12.1 Introduction to Advanced Layers	284
12.2 Script Files.....	284
12.3 Layer State Manager.....	285
12.4 Layer Filtering.....	289
12.5 Level 2 Drawing Project (2 of 10): Architectural Floor Plan.....	291
Summary.....	293
SPOTLIGHT ON: INTERIOR DESIGN	295
CHAPTER 13 Advanced Dimensions.....	299
13.1 Introduction to Advanced Dimensions.....	300
13.2 Dimension Style Manager.....	300
Lines Tab.....	301
Symbols and Arrows Tab	302
Text Tab.....	302
Fit Tab	304
Primary Units Tab	305
Alternate Units Tab	306
Tolerances Tab	307
13.3 Introduction to Constraints	309
13.4 Geometric Constraints	310
Types of Geometric Constraints.....	310
Adding Geometric Constraints.....	311
Hiding, Showing, and Deleting Geometric Constraints.....	312
13.5 Dimensional Constraints	313
Working with Dimensional Constraints.....	315
13.6 Dimension-Driven Design.....	316
13.7 Level 2 Drawing Project (3 of 10): Architectural Floor Plan.....	317
Summary.....	318

CHAPTER 14	Options, Shortcuts, CUI, Design Center, and Express Tools	321
14.1	Options	322
	Files Tab	322
	Display Tab	324
	Open and Save Tab	326
	Plot and Publish Tab	328
	System Tab	330
	User Preferences Tab	330
	Drafting Tab	332
	3D Modeling Tab	333
	Selection Tab	333
	Profiles Tab	335
	Online Tab	336
14.2	Shortcuts	336
	PGP File	336
	Altering the PGP File	337
14.3	Customize User Interface	338
14.4	Design Center	342
14.5	Express Tools	345
	Blocks	346
	Text	347
	Layout Tools	348
	Dimension	348
	Selection Tools	348
	Modify	348
	Draw	349
	File Tools	350
	Web Tools	350
	Tools	350
	Layer Express Tools	351
14.6	Level 2 Drawing Project (4 of 10): Architectural Floor Plan	354
	Summary	355
CHAPTER 15	Advanced Design and File Management Tools	357
15.1	Introduction to Advanced Design and File Management Tools	358
15.2	Align	358
15.3	Action Recording	360
15.4	Audit and Recover	362
15.5	Blend	363
15.6	Break and Join	364
	Break, Method 1	364
	Break, Method 2	365
	Join	365
15.7	CAD Standards	366
15.8	Calculator	367
15.9	Defpoints	370
15.10	Divide and Point Style	370
15.11	Donut	371
15.12	Draw Order	371
15.13	eTransmit	372
15.14	Filter	374
15.15	Hyperlink	376
15.16	Lengthen	377