

SEVENTH EDITION

Architectural Drafting & Design



ALAN JEFFERIS | DAVID A. MADSEN | DAVID P. MADSEN



Architectural Drafting and Design


Seventh Edition

Alan Jefferis

Principal of Residential Designs
Former architectural drafting instructor at Mt Hood
Community College
Faculty Emeritus at Clackamas Community College
Former member of the American Institute of Building
Designers
Former Autodesk Developer Network Member
Author of *Residential Design, Drafting, and Detailing*
Coauthor of *Commercial Drafting and Detailing; AutoCAD®
for Architecture; and Print Reading for Architecture and
Construction Technology*

David A. Madsen

President, Madsen Designs Inc.
www.madsendesigns.com
Faculty Emeritus
Former Department Chairperson
Drafting Technology, Autodesk Premier Training Center
Clackamas Community College, Oregon City, Oregon
Former Instructor, Drafting Technology
Centennial High School, Gresham, Oregon
Autodesk Developer Network Member 
Authorized Author

Director Emeritus, American Design
Drafting Association 
Author of *Engineering Drawing and Design; Print Reading
for Engineering and Manufacturing Technology; and
Geometric Dimensioning and Tolerancing*
Coauthor of *AutoCAD and its Applications; Architectural
Drafting Using AutoCAD; Civil Drafting Technology;
and Print Reading for Architecture and Construction
Technology*

David P. Madsen

President, Engineering Drafting and Design, Inc.
Vice President, Madsen Designs Inc.
Computer-Aided Design and Drafting Consultant
and Educator
Autodesk Developer Network Member 
Authorized Author
SolidWorks Research Associate
American Design Drafting Association Member
Author of *Inventor and its Applications*
Coauthor of *AutoCAD and its Applications; Architectural
Drafting Using AutoCAD; Civil Drafting Technology;
Engineering Drawing and Design; Geometric
Dimensioning and Tolerancing; Print Reading for
Engineering and Manufacturing Technology; and Print
Reading for Architecture and Construction Technology*



Australia • Brazil • Mexico • Singapore • United Kingdom • United States

This is an electronic version of the print textbook. Due to electronic rights restrictions, some third party content may be suppressed. Editorial review has deemed that any suppressed content does not materially affect the overall learning experience. The publisher reserves the right to remove content from this title at any time if subsequent rights restrictions require it. For valuable information on pricing, previous editions, changes to current editions, and alternate formats, please visit www.cengage.com/highered to search by ISBN#, author, title, or keyword for materials in your areas of interest.

Important Notice: Media content referenced within the product description or the product text may not be available in the eBook version.

**Architectural Drafting & Design,
Seventh Edition****Alan Jefferis, David A. Madsen,
David P. Madsen**SVP, GM Skills & Global Product Management:
Dawn Gerrain

Product Director: Matt Seeley

Product Team Manager: James Devoe

Product Manager: Vanessa Myers

Senior Director, Development:
Marah BellegardeSenior Product Development Manager:
Larry Main

Senior Content Developer: Sharon Chambliss

Product Assistant: Jason D. Koumourdas

Vice President, Marketing Services:
Jennifer Ann Baker

Marketing Director: Michele McTighe

Senior Production Director: Wendy Troeger

Production Director: Andrew Crouth

Senior Content Project Manager: Glenn Castle

Senior Art Director: Bethany Casey

Software Development Manager:
Pavan K. EthakotaCover image(s): moodboard/Getty image &
Collection: Cultura

© 2017, 2011 Cengage Learning

WCN: 02-200-203

ALL RIGHTS RESERVED. No part of this work covered by the copyright herein may be reproduced, transmitted, stored, or used in any form or by any means graphic, electronic, or mechanical, including but not limited to photocopying, recording, scanning, digitizing, taping, Web distribution, information networks, or information storage and retrieval systems, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without the prior written permission of the publisher.

For product information and technology assistance, contact us at
Cengage Learning Customer & Sales Support, 1-800-354-9706

For permission to use material from this text or product,
submit all requests online at www.cengage.com/permissions.
Further permissions questions can be e-mailed to
permissionrequest@cengage.com

The ICC logo is a registered trademark of the International Code Council. Inclusion of the ICC's name and logo does not signify approval, sponsorship, or endorsement of this title.

Library of Congress Control Number: 2015944029

Book Only ISBN: 978-1-285-16573-8

Cengage Learning20 Channel Center Street
Boston, MA 02210
USA

Cengage Learning is a leading provider of customized learning solutions with employees residing in nearly 40 different countries and sales in more than 125 countries around the world. Find your local representative at www.cengage.com.

Cengage Learning products are represented in Canada by Nelson Education, Ltd.

To learn more about Cengage Learning, visit www.cengage.com

Purchase any of our products at your local college store or at our preferred online store www.cengagebrain.com

Notice to the Reader

Publisher does not warrant or guarantee any of the products described herein or perform any independent analysis in connection with any of the product information contained herein. Publisher does not assume, and expressly disclaims, any obligation to obtain and include information other than that provided to it by the manufacturer. The reader is expressly warned to consider and adopt all safety precautions that might be indicated by the activities described herein and to avoid all potential hazards. By following the instructions contained herein, the reader willingly assumes all risks in connection with such instructions. The publisher makes no representations or warranties of any kind, including but not limited to, the warranties of fitness for particular purpose or merchantability, nor are any such representations implied with respect to the material set forth herein, and the publisher takes no responsibility with respect to such material. The publisher shall not be liable for any special, consequential, or exemplary damages resulting, in whole or part, from the readers' use of, or reliance upon, this material.



Brief Contents

Preface, xiii

Acknowledgments, xix

Prologue, xxv

SECTION 1 Introduction to Architectural Design and Drafting

- 1 Professional Architectural Careers, Office Practices, and Opportunities, 3
- 2 Architectural Drafting Setup, 38
- 3 U.S. National CAD Standard, 51
- 4 Computer-Aided Design and Drafting in Architecture, 73
- 5 Architectural Lines and Text, 114
- 6 Sketching Applications, 130
- 7 Construction Procedures, 150

SECTION 2 Residential Design

- 8 Construction Specifications, 169
- 9 Guidelines and Codes That Affect Design, 186
- 10 Room Relationships and Sizes, 212
- 11 Exterior Design Factors, 245
- 12 Conservation and Environmental Design and Construction, 269

SECTION 3 Site Planning

- 13 Site Orientation, 297
- 14 Legal Descriptions and Site Plan Requirements, 308
- 15 Site Plan Layout, 326

SECTION 4 The Floor Plan

- 16 Floor Plan Symbols, 351
- 17 Floor Plan Dimensions and Notes, 397
- 18 Floor Plan Layout, 414

SECTION 5 Supplemental Floor Plan Drawings

- 19 Electrical Plans, 465
- 20 Plumbing Plans, 495
- 21 Heating, Ventilating, and Air-Conditioning, 519

SECTION 6 Roof Plans

- 22 Roof Plan Components, 549
- 23 Roof Plan Layout, 573

SECTION 7 Elevations

- 24 Introduction to Elevations, 593
- 25 Elevation Layout and Drawing Techniques, 614
- 26 Millwork and Cabinet Technology, Cabinet Elevations, and Layout, 642

SECTION 8 Framing Methods and Plans

- 27 Framing Methods, 663
- 28 Structural Components of Framed Construction, 688
- 29 Design Criteria for Structural Loading, 732
- 30 Sizing Joists and Rafters Using Span Tables, 741
- 31 Determining Beam Sizes, 755
- 32 Drawing Framing Plans, 777

SECTION 9 Foundation Plans

- 33 Foundation Systems, 829
- 34 Floor Systems and Foundation Support, 861
- 35 Foundation Plan Layout, 887

SECTION 10 Wall Sections and Details

- 36 Sectioning Basics, 919
- 37 Section Layout, 930
- 38 Drawing Sections with Alternative Materials, 945
- 39 Stair Construction and Layout, 973
- 40 Fireplace Construction and Layout, 989

SECTION 11 Commercial Drafting

- 41 Building Codes and Commercial Design, 1009
- 42 Common Commercial Construction Materials, 1056
- 43 Commercial Construction Projects, 1081
- 44 Commercial Drafting, 1134

Glossary, 1165

Index, 1191



Contents

Preface, xiii
Acknowledgments, xix
Prologue, xxv

SECTION 1 Introduction to Architectural Design and Drafting

1

1 Professional Architectural Careers, Office Practices, and Opportunities, 3

Introduction, 3
Drafter, 3
Designer, 8
Interior Decorator, 9
Kitchen and Bath Designer, 9
Interior Designer, 10
Architect, 11
Engineer, 12
Related Fields, 13
Design Basics, 17
The Design Process, 17
Professional Architectural Careers, Office Practices, and Opportunities Test, 36

2 Architectural Drafting Setup, 38

Introduction, 38
Drawing Scales, 38
Sheet Sizes, Sheet Format, Title Blocks, and Borders, 43
Sharing Construction Documents and Making Prints, 44
How to Fold Prints, 45
Architectural Drafting Setup Test, 47
Architectural Drafting Setup Problems, 48

3 U.S. National CAD Standard, 51

Introduction, 51
U.S. National CAD Standard (NCS), 51
Uniform Drawing System, 51
Model and Sheet File Naming Standards, 53

Sheet Identification, 57
File Management, 58
Sheet Organization, 59
Schedules, 61
Drafting Conventions, 61
CADD Graphics, 62
CADD Layer Standards, 64
Building Information Modeling (BIM), 67
U.S. National CAD Standard Test, 68
U.S. National CAD Standard Problems, 70

4 Computer-Aided Design and Drafting in Architecture, 73

Introduction, 73
Architectural CADD Software Products, 73
The CADD Workstation, 77
Using CADD Templates and Design Defaults, 77
Template Drawings on the Student Companion Website, 79
Architectural CADD Symbols, 79
Using Architectural Symbols, 79
Creating Your Own CADD Symbols, 80
Drawing on CADD Layers, 81
CADD Reproduction Guidelines, 83
Creating a Set of Architectural CADD Drawings and Documents, 93
Computer-Aided Design and Drafting in Architecture Test, 112
Computer-Aided Design and Drafting in Architecture Problems, 113

5 Architectural Lines and Text, 114

Introduction, 114
Types of Lines, 114
Line Techniques, 119
Text, 121
Hints for Professional Text, 123
Architectural Lines and Text Test, 127
Architectural Lines and Text Problems, 128

6 Sketching Applications, 130

Introduction, 130
 Sketching Tools and Materials, 130
 Sketching Straight Lines, 130
 Sketching Circular Lines, 131
 Measurement Lines and Proportions, 132
 Introduction to Multiview Sketches, 135
 Isometric Sketches, 137
 Orthographic Projection, 139
 Multiview Projection, 139
 Projection of Features from an Inclined Plane, 143
Sketching Applications Test, 147
Sketching Applications Problems, 148

7 Construction Procedures, 150

Introduction, 150
 Loan Applications, 150
 Individual Appraisal Requirements, 151
 Master Appraisal Requirements, 151
 Building Permits, 151
 Contracts, 152
 Change Orders, 152
 Completion Notices, 152
 Construction Estimates, 153
 Construction Inspections, 161
Construction Procedures Test, 162
Construction Procedures Problems, 163

SECTION 2 Residential Design

167

8 Construction Specifications, 169

Introduction, 169
 Residential Description of Materials, 169
 Construction Specifications, 169
 Specifications for Residential Design, 169
 Specifications for Commercial Construction, 174
 Construction Documents, 176
 Preparing Professional Documents, 177
Construction Specifications Test, 183
Construction Specifications Problems, 184

9 Guidelines and Codes That Affect Design, 186

Introduction, 186
 Green Building Guidelines, 186
 National Building Codes, 187

Climate and Geographic Design Criteria, 189
 Code Requirements Affecting Building Design, 195
 International Energy Conservation Code, 204
 International Green Construction Code, 209
Guidelines and Codes That Affect Design Test, 210

10 Room Relationships and Sizes, 212

Introduction, 212
 The Floor Plan, 212
 Living Area, 212
 Sleeping Area, 222
 Service Areas, 224
 Traffic Patterns, 239
Room Relationships and Sizes Test, 244

11 Exterior Design Factors, 245

Introduction, 245
 Site Considerations, 245
 Elements of Design, 247
 Principles of Design, 249
 Floor Plan Styles, 250
 Exterior Styles, 253
Exterior Design Factors Test, 268

12 Conservation and Environmental Design and Construction, 269

Introduction, 269
 Energy-Efficient Design, 269
 International Energy Conservation Code (IECC), 270
 The LEED Program, 270
 National Association of Home Builders Model Green Home Building, 272
 Energy Star, 273
 The Envirohome Initiative, Canadian Home Builders' Association, 274
 Building Energy-Modeling (BEM), 274
 Energy-Efficient Construction Practices, 275
 Solar Energy Design, 276
 Passive Solar Systems, 277
 Envelope Design, 280
 Active Solar Systems, 280
 Geothermal Systems, 283
 Wind Energy, 284
 Hydroelectric Power, 285
 Biopower, 285

Healthy Architectural Design and Construction, 285
 Hazardous Waste Storage and Disposal, 286
*Conservation and Environmental Design
 and Construction Test, 291*
*Conservation and Environmental Design
 and Construction Problems, 293*

Drawing Contour Lines, 332
 Drawing Profiles, 333
 Drawing Grading Plans, 334
Site Plan Layout Test, 344
Site Plan Layout Problems, 344

SECTION 3 Site Planning 295

13 Site Orientation, 297

Introduction, 297
 Terrain Orientation, 297
 View Orientation, 297
 Solar Orientation, 299
 Wind Orientation, 300
 Sound Orientation, 304
Site Orientation Test, 306
Site Orientation Problems, 307

14 Legal Descriptions and Site Plan Requirements, 308

Introduction, 308
 Public and Private Land Use Restrictions, 308
 Metes and Bounds System, 309
 Rectangular Survey System, 309
 Lot and Block System, 312
 Site Plan Requirements, 313
 Topography, 313
 Drawing Site Plans, 314
 Grading Plan Features, 317
 Site Analysis Plan, 317
 Subdivision Plans, 320
 Planned Unit Development, 321
 Metrics in Site Planning, 321
Legal Descriptions and Site Plan Requirements Test, 324
Legal Descriptions and Site Plan Requirements Problems, 325

15 Site Plan Layout, 326

Introduction, 326
 Site Design Considerations, 327
 Rural Residential Fire Department Access
 and Site Planning, 328
 Laying Out Property Lines, 329
 Steps in Site Plan Layout, 330
 Site Plan Drawing Checklist, 332

SECTION 4 The Floor Plan 349

16 Floor Plan Symbols, 351

Introduction, 351
 Wall Symbols, 351
 Wall Shading and Material Indications, 356
 Door Symbol Representations, 358
 Window Symbol Representations, 361
 Schedules, 364
 Cabinets, Fixtures, and Appliances on Floor Plans, 372
 Common Sizes of Architectural Features, 377
 Floor Plan Materials, 377
 Stair Planning and Floor Plan Representation, 377
 Hallways on Floor Plans, 382
 Fireplaces on Floor Plans, 384
 Solid Fuel Burning Appliances, 387
 Room Titles on Floor Plans, 389
 Other Floor Plan Symbols, 389
 Conclusion, 392
Floor Plan Symbols Test, 395
Floor Plan Symbols Problems, 396

17 Floor Plan Dimensions and Notes, 397

Introduction, 397
 Aligned Dimensions, 397
 Floor Plan Dimensions, 397
 Placing Exterior Dimensions, 398
 Placing Interior Dimensions, 401
 Standard Feature Dimensions, 401
 Omitting Dimensions Established by the Foundation, 402
 Dimensioning Arc and Circular Floor Plan Features, 402
 Common Sizes of Architectural Features for
 Dimensions, 404
 Masonry Veneer on the Floor Plan, 404
 Concrete-Block and Structural Masonry Construction
 on the Floor Plan, 405
 Solid Concrete Construction on the Floor Plan, 406
 Floor Plan Notes and Specifications, 406

Designing Floor Plans Using Standard Construction Modules, 408

Using Metric Dimensions, 408

Floor Plan Dimensions and Notes Test, 412

Floor Plan Dimensions and Notes Problems, 413

18 Floor Plan Layout, 414

Introduction, 414

Steps for Laying Out a Floor Plan, 414

Second-Floor Plan Layout, 425

Basement Plan Layout, 427

Floor Plan Drawing Checklist, 431

Floor Plan Layout Test, 437

Floor Plan Layout Problems, 438

SECTION 5 Supplemental Floor Plan Drawings

463

19 Electrical Plans, 465

Introduction, 465

Electrical Terms and Definitions, 465

Electrical Circuit Design, 467

Basic Electrical Design Recommendations, 467

Home Automation, 468

Electrical Design Considerations, 469

Smoke Detectors, 471

Carbon Monoxide Alarms, 471

Universal Electrical Installations, 472

Electrical Symbols, 472

Light Fixture Design and Placement, 474

Reflected Ceiling Plans, 481

Electrical Schedules, 481

Electrical Wiring Specifications, 482

Metric Values in Electrical Installations, 482

Steps in Drawing the Electrical Plan, 482

Drawing the Upper Floor Electrical Plan, 483

Electrical Plan Drawing Checklist, 488

Electrical Plans Test, 493

Electrical Plans Problems, 494

20 Plumbing Plans, 495

Introduction, 495

Plumbing Terms and Definitions, 496

Sizing of Plumbing Piping, 498

Universal Plumbing Installations, 498

Plumbing Schedules, 499

Plumbing Drawings, 499

Water Systems, 500

Drainage and Vent Systems, 503

Isometric Plumbing Drawings, 504

Sewage Disposal, 506

Fire Sprinkler Systems, 507

Metrics in Plumbing, 508

Adding Plumbing Information to the Floor Plan, 508

Commercial Plumbing Drawings, 509

Plumbing Plan Drawing Checklist, 512

Plumbing Plans Test, 517

Plumbing Plans Problems, 518

21 Heating, Ventilating, and Air-Conditioning, 519

Introduction, 519

Central Forced-Air Systems, 519

Forced-Air Heating Plans, 520

Hot Water Systems, 524

Heat Pump Systems, 524

Zone Control Systems, 526

Radiant Heating and Cooling, 526

Thermostats, 527

Heat Recovery and Ventilation, 527

Calculating Minimum Heat Exchanger Capacity, 529

Central Vacuum Systems, 529

HVAC Symbols, 529

Universal HVAC Design, 531

HVAC Requirements, 532

Thermal Calculations for Heating and Cooling, 532

HVAC Drawings, 535

HVAC Plan Drawing Checklist, 539

Heating, Ventilating, and Air-Conditioning Test, 543

Heating, Ventilating, and Air-Conditioning Problems, 543

SECTION 6 Roof Plans

547

22 Roof Plan Components, 549

Introduction, 549

Types of Roof Plans, 549

Common Roof Terms, 550

Roof Shapes, 555

Roofing Materials, 562

Roof Ventilation and Access, 569

Roof Plan Components Test, 572

23 Roof Plan Layout, 573

Introduction, 573
 Representing Roof Plan Components, 573
 Representing Structural Materials, 580
 Representing Nonstructural Material, 580
 Dimensions, 583
 Annotation, 584
 Drawing Gable Roof Plans, 584
 Drawing Hip Roof Plans, 586
 Drawing Dutch Hip Roof Plans, 587
Roof Plan Layout Problems, 589

SECTION 7 Elevations 591**24 Introduction to Elevations, 593**

Introduction, 593
 Major Considerations of Drawing Elevations, 593
 Representing Materials in Elevation, 599
Introduction to Elevations Test, 613

25 Elevation Layout and Drawing Techniques, 614

Introduction, 614
 Layout, 614
 Layout of a Multilevel Home, 628
 Representing Alternative Roof Intersections, 631
 Creating Presentation Drawings, 637
Elevation Layout and Drawing Techniques Test, 641
Elevation Layout and Drawing Techniques Problems, 641

26 Millwork and Cabinet Technology, Cabinet Elevations, and Layout, 642

Introduction, 642
 Types of Millwork, 642
 Cabinets, 647
 Cabinet Elevations and Layout, 651
 Bathroom Cabinet Layout, 653
 Cabinet Elevations Drawing Checklist, 653
Millwork and Cabinet Technology, Cabinet Elevations, and Layout Test, 659
Millwork and Cabinet Technology, Cabinet Elevations, and Layout Problems, 660

SECTION 8 Framing Methods and Plans 661**27 Framing Methods, 663**

Introduction, 663
 Wood Framing Methods, 663

Energy-Efficient Framing Methods, 668
 Green Construction Goals, 684
Framing Methods Test, 686

28 Structural Components of Framed Construction, 688

Introduction, 688
 Floor Construction, 688
 Framed Wall Construction, 701
 Roof Construction, 711
 Common Connection Methods, 720
Structural Components of Framed Construction Test, 730

29 Design Criteria for Structural Loading, 732

Introduction, 732
 Types of Loads, 732
 Load Design, 735
 Load Distribution, 737
Design Criteria for Structural Loading Test, 739
Design Criteria for Structural Loading Problems, 740

30 Sizing Joists and Rafters Using Span Tables, 741

Introduction, 741
 Wood Characteristics, 741
 Determining Size and Span, 741
 Working with Engineered Lumber, 750
Sizing Joists and Rafters Using Span Tables Test, 753
Sizing Joists and Rafters Using Span Tables Problems, 753

31 Determining Beam Sizes, 755

Introduction, 755
 Structural Lumber, 755
 Loading and Support Patterns of Structural Members, 758
 Loading Reactions of Wood Members, 758
 Methods of Beam Design, 761
 Sizing Wood Beams Using Standard Formulas 762
 Wood Adjustment Factors, 768
 Laminated Beams, 769
 Working with Engineered Beams, 769
 Determining Beams with Complex Loads, 771
Determining Beam Sizes Test, 775
Determining Beam Sizes Problems, 775

32 Drawing Framing Plans, 777

Introduction, 777
 Framing Drawings, 777

Resisting Lateral Loads Using the Prescriptive Path of the *IRC 785*

Completing a Framing Plan, 805

Drawing Framing Plans Test, 824

Drawing Framing Plans Problems, 826

SECTION 9 Foundation Plans 827

33 Foundation Systems, 829

Introduction, 829

Soil Considerations, 829

Types of Foundations, 833

Retaining Walls, 849

Dimensioning Foundation Components, 855

Foundation Systems Test, 858

Foundation Systems Problems, 859

34 Floor Systems and Foundation Support, 861

Introduction, 861

On-Grade Floor Systems, 861

Wood Floor Systems Above a Crawl Space, 872

Floor Systems and Foundation Support Test, 885

35 Foundation Plan Layout, 887

Introduction, 887

Drawing Planning, 887

Concrete Slab Foundation Layout, 889

Foundation Plan with Joist Construction, 892

Standard Foundation with Post-and-Beam Floor System, 897

Combination Slab and Crawl Space Plans for a Partial Basement, 902

Full Basement, 907

Foundation Plan Layout Test, 915

Foundation Plan Layout Problem, 916

SECTION 10 Wall Sections and Details 917

36 Sectioning Basics, 919

Introduction, 919

Section Origination, 919

Types of Sections, 919

Basics of Drawing Sections, 922

Representing and Locating Materials, 924

Presentation Sections, 928

Sectioning Basics Test, 929

37 Section Layout, 930

Introduction, 930

Creating Sections by Assembling Blocks, 930

Creating Sections Without Blocks, 931

Stage 1: Evaluate Needs, 932

Stage 2: Lay Out the Section, 933

Stage 3: Representing Structural Materials, 936

Stage 4: Representing Nonstructural Materials, 939

Stage 5: Dimensioning, 941

Stage 6: Placing Annotation, 941

Stage 7: Evaluating Your Work, 943

Section Layout Test, 944

38 Drawing Sections with Alternative Materials, 945

Introduction, 945

Joists Floor System, 945

Post-and-Beam Foundations, 948

Basement with Concrete Slab, 951

Conventional Roof Framing, 957

Garage/Residence—Section, 964

Drawing Sections with Alternative Materials Test, 966

Drawing Sections with Alternative Materials Problems, 968

39 Stair Construction and Layout, 973

Introduction, 973

Stair Terminology, 973

Determining Rise and Run, 975

Straight Stair Layout, 976

Open Stairway Layout, 981

U-Shaped Stairs, 983

L-Shaped Stairs, 984

Stairs with Non-Parallel Edges, 984

Exterior Stairs, 987

Stair Construction and Layout Test, 988

Stair Construction and Layout Problems, 988

40 Fireplace Construction and Layout, 989

Introduction, 989

Premanufactured Fireplaces and Inserts, 989

Masonry Fireplace Construction, 993

Drawing a Fireplace Section, 1000

Fireplace Elevations, 1004

Fireplace Construction and Layout Test, 1006

Fireplace Construction and Layout Problems, 1006

SECTION 11 Commercial Drafting 1007

41 Building Codes and Commercial Design, 1009

Introduction, 1009
 Codes and Standards of the *International Code Council*, 1009
 Using the *IBC*, 1010
 Determining Design Categories of the *IBC* 1016
 An Overview of ADA Requirements for Public Structures, 1032
 An Overview of the *IECC* and Commercial Structures, 1040
 An Overview of the *International Green Construction Code*, 1047
Building Codes and Commercial Design Test, 1053

42 Common Commercial Construction Materials, 1056

Introduction, 1056
 Wood, 1056
 Concrete Block, 1060
 Poured Concrete, 1064
 Steel Construction, 1069
Common Commercial Construction Materials Test, 1079

43 Commercial Construction Projects, 1081

Introduction, 1081
 Office Practice, 1081
 Drawing Organization, 1084
 Site Drawings, 1086
 Architectural Drawings, 1090
 Structural Drawings, 1110
Commercial Construction Projects Test, 1133

44 Commercial Drafting, 1134

Introduction, 1134
 Plan the Drawing, 1134
 Drawing Procedure, 1134
 Order of Precedence, 1136
Commercial Drafting Project, 1137

BOXED FEATURES

An Introduction to Green Design, 16
 Sustainable Design Opportunity, 87
 GreenFormat, 176
 Green Codes, 209
 Green Design Considerations, 243
 Green Styles, 266

An Overview, 270
 The Ultimate Urban Green Home, 288
 Environmentally Sound Landscaping Practices, 305
 Designing an Ecosystem, 342
 Windows and Energy Loss, 365
 The International Energy Conservation Code, 430
 Living Smart, 432
 Energy Conservation, 468
 Electricity Generation from Wind Power, 491
 Energy Conservation, 504
 Solar Hot Water, 506
 Aerobic Treatment System (ATS), 509
 Indoor Water Use, 515
 Building Energy-Modeling (BEM), 529
 Improving Indoor Air Quality, 532
 Green Roofing, 570
 Green Applications of Exterior Elevations, 612
 Green Framing, 683
 Environmentally Friendly Design and Construction, 729
 Green Foundations, 858
 Green Floor Systems, 885
 Energy-Efficient Fireplace Units, 999
 Green Design Considerations, 1077

CADD APPLICATIONS

CADD Software Application, 75
 Drawing Lines, 119
 CADD Text, 124
 Using CADD for Conceptual Design and Presentation Sketches, 144
 Using Surveyor's Units, 329
 Automated Site Plans, 337
 Drawing Walls Accurately, 353
 Drawing on Wall Layers, 356
 Drawing Floor Plan Walls Using CADD, 357
 U.S. National CAD Standard for Schedules, 370
 Placing Material Symbols with CADD, 377
 Designing and Drawing Stairs with CADD, 383
 CADD Floor Plan Symbols, 392
 Placing Architectural Dimensions with CADD, 410
 CADD Floor Plan Applications, 432
 Using CADD to draw a Presentation Floor Plan, 435
 Drawing CADD Electrical Symbols, 488
 Drawing Plumbing Symbols with CADD, 513
 CADD in the HVAC Industry, 540

Elevation Symbols, 609
Creating Blocks, 611
Drawing Elevations with Varied CADD Programs, 614
Using Layers for CADD Elevations, 633
Using CADD to Make Presentation Drawings, 640
Options for Creating Cabinet Elevations, 656
CADD Layers for Cabinet Drawings, 658
Drawing Sections, 930
The Code and Computers, 1016
Using CADD to Draw Commercial Drawings, 1081

Mathematical Calculations, 1084
Working Drawings, 1111
Drawing Structural Details, 1120
Structural Drawings, 1123

END MATTER

Glossary, 1165
Index, 1191



Preface

For over 28 years, students have relied on *Architectural Drafting and Design* for easy-to-read, comprehensive coverage of architectural drafting and design instruction that complies with and reinforces architectural, engineering, and construction industry standards and practices.

This seventh edition of *Architectural Drafting and Design* is a practical, comprehensive textbook that is easy to use and understand. The content can be used as presented by following a logical sequence of learning activities for residential and light commercial architectural drafting and design, or the chapters can be rearranged to accommodate alternate formats for traditional or individualized instruction.

 **American Design
Drafting Association
(ADDA) Approved Publication**

The content of this text is considered a fundamental component to the design-drafting profession by the American Design Drafting Association. This publication covers topics and related material, as stated in the ADDA Curriculum Certification Standards and the ADDA Certified Drafter Examination Review Guide. Although this publication is not conclusive, with respect to ADDA standards, it should be considered a key reference tool in pursuit of a professional design-drafting career.

 **About the International
Code Council**

The International Code Council is a member-focused association. It is dedicated to developing model codes and standards used in the design, build and compliance process to construct safe, sustainable, affordable and resilient structures. Most U.S. communities and many global markets choose the International

Codes. ICC Evaluation Service (ICC-ES) is the industry leader in performing technical evaluations for code compliance fostering safe and sustainable design and construction.

Headquarters: 500 New Jersey Avenue, NW,
6th Floor, Washington, DC 20001-2070

Regional Offices: Eastern: Birmingham, AL; Central:
Chicago, IL;

Western: Los Angeles, CA

1-888-422-7233 - HYPERLINK

“<http://www.iccsafe.org>” www.iccsafe.org

Approach

Architectural Drafting and Design provides a practical and realistic approach to solving problems that are encountered in the world of architectural design.

Practical

Architectural Drafting and Design provides a practical approach to architectural drafting and design as it relates to current standard practices. The emphasis on standardization is an excellent and necessary foundation for drafting training as well as for implementing a common approach to drafting nationwide. After students become professional drafters, this text will serve as a valuable desk reference.

Realistic

Chapters contain professional examples, illustrations, step-by-step layout techniques, drafting problems, and related tests. The examples demonstrate recommended drafting presentation with actual architectural drawings used for reinforcement. The correlated text explains drafting practices and provides useful information for knowledge building and skill development. Step-by-step layout methods provide a logical approach to beginning and finishing complete sets of working drawings.

Practical Approach to Problem Solving

The responsibility of the professional architectural drafter is to convert architects', engineers', and designers' sketches and ideas into formal drawings. This textbook explains how to prepare formal drawings from design sketches by providing the learner with basic guidelines for drafting layout and minimum design and code requirements in a knowledge-building format. One concept is learned before the next is introduced. The concepts and skills learned from one chapter to the next allow students to prepare complete sets of working drawings for residential and light commercial construction projects. Problem assignments are presented in order of difficulty and in a manner that provides students with a wide variety of architectural drafting experiences.

Real-World Architectural Problems

The problems are presented as preliminary designs or design sketches in a manner that is consistent with actual architectural office practices. It is not enough for students to duplicate drawings from given assignments. Students must be able to think through the process of drawing development with a foundation based on how drawing and construction components are put into practice. The goals and objectives of each problem assignment are consistent with recommended evaluation criteria based on the progression of learning activities. The drafting problems and chapter tests recommend that work be done using drafting skills with actual drafting materials using computer-aided drafting applications. A problem solution or test answer should be accurate and demonstrate proper drafting practice.

Team Problems

Problems can be assigned as team problems. Team problems that involve designing and drawing a set of plans for a home can be used as projects that help foster leadership and cooperation between team members. Teams are established with any desired number of members based on the project and curriculum goals. Teams can select a manager by voting in a democratic process, by selecting the person with the highest course evaluation, or as determined by the instructor. A manager is the person in charge of the project. The manager coordinates the teamwork, monitors the progress, and provides answers and instructions to

the team members in cooperation with the instructor. The manager divides the project into tasks and assigns portions of the project to the drafting team members. The manager works with team members to establish design alternatives. Team members are drafters, with one drafter responsible for sheet layout and reproduction. Each drafter is assigned specific drawings for the completion of the entire set of drawings. The manager provides coordination between team members to confirm all parts of the project match. Final team assignments and members are determined by your instructor.

Team project evaluation includes:

- Project coordination: organization of project assignments.
- Project completion: complete set of working drawings finished.
- Team member cooperation.
- Project quality: drawings completed accurately and in a professional manner

Architectural artistic decisions include:

- Project properly interpreted.
- Design decisions properly evaluated and completed.

Features of the Textbook

Major features of this textbook guide you through the world of architectural design and drafting, including: realistic application of the information presented throughout each chapter, professional illustrations of each concept to be explored, CADD applications of each type of working drawing, and exploration of the 2015 building codes and standards produced by the *International Code Council*, the National Association of Home Builders (NAHB), and Leadership in Energy and Environmental Design (LEED).

Chapter Tests

Chapter tests are found at the end of each chapter. Select the Chapter Tests link on the Student Companion Website to access chapter tests using Microsoft Word. The chapter tests allow you to review or test your knowledge of the related chapter content, depending on your course objectives. Open the related link and answer the questions electronically, unless otherwise directed by your instructor.

Real-World Problems

Special emphasis has been placed on providing realistic drafting problems. Problems are presented as design layouts or preliminary drawings in a manner that is consistent with architectural practices. The problems have been supplied by architects, engineers, and architectural designers. Each problem solution is based on the step-by-step layout procedures provided in chapter content.

Problems are given in order of complexity to expose students to a variety of drafting experiences. Problems require students to go through the same thought and decision-making processes that a professional drafter faces daily, including scale and sheet size selection, view layout, dimension placement, section placement, and many other activities. Problems are solved using computer-aided drafting, as determined by individual course guidelines. Chapter tests provide complete coverage of each chapter and can be used for student evaluation or as review.

Illustrations

Drawings and photos are used liberally throughout this textbook to strengthen the concepts presented. Full-color treatment enhances the clarity. Abundant step-by-step instructions and illustrations take students through the detailed stages of the drafting process for each application. The step-by-step illustrations are created using computer-aided drafting for the highest accuracy and quality.

Computer-Aided Design and Drafting (CADD)

CADD is presented as a valuable tool that has revolutionized the architectural design and drafting industry. The complete discussion of CADD introduces terminology, drafting techniques, and sample drawings. Drawings displayed throughout this textbook are created using CADD.

Construction Techniques and Building Codes

Construction techniques differ throughout the country. This text clearly acknowledges the difference in construction methods and introduces the student to the format used to make a complete set of working drawings for each method of construction. Students

can learn to prepare drawings for each construction method or, more commonly, for the specific construction techniques that are used in their locality. The problem assignments are designed to provide drawings that involve a variety of construction alternatives.

To provide oversight of the wide range of construction methods and materials used throughout the country, the 2015 model codes written by the *International Code Council (ICC)* are referenced throughout this textbook. The major ICC codes addressed in this textbook include the *International Residential Code (IRC)* in Chapter 1 through Chapter 41, the *International Building Code (IBC)* in Chapter 42 through Chapter 44, and the *International Energy Conservation Code (IECC)* and the *International Green Construction Code (IgCC)* in Chapters 9 and 41. Although many municipalities have adopted their own versions of these codes, the use of these model codes provides a firm background before exploring local variations.

Codes and Standards Compliance

Each chapter is based on information provided by the following major industry leaders:


- 2015 editions of the *International Residential Code* and the *International Building Code* published by the *International Code Council*. The *International Energy Conservation Code (IECC)* and the *International Green Construction Code (IgCC)* will be explored in Chapter 9 and Chapter 41.
- National CAD Standards® V6.
- *MasterFormat* and *UniFormat* published by The Construction Specifications Institute (CSI) and Construction Specifications Canada (CSC).
- LEED rating system published by the U.S. Green Building Council (USGBC).
- Model Green Home Building Guidelines (MGHBG) developed by the National Association of Home Builders (NAHB) and the *International Code Council (ICC)*, which publishes the *International Residential Code (IRC)*.

Going Green

Protecting the environment is one of the most important worldwide issues today. A flagship feature called *Going Green* is found throughout this textbook, providing current, practical, and experimental energy-efficient architectural design and construction techniques that result in a significant reduction in energy consumption. As the building industry grows to meet the demands of our

increasing population, we must take care of the environment and allow for current and future development.

As a student, and when you enter the architecture profession, it is very important for you to learn what is available today and to find ways to improve energy efficiency in architectural design and construction in the future in an effort to protect the earth. National and local programs have been established to meet this need. A leading program is often referred to as *green building*. The U.S. Green Building Council (USGBC) is a key organization developed to promote building design and construction that is environmentally responsible and healthy, while allowing construction to remain profitable. Modern advances in building construction are available to designers, builders, and owners who want to “build green” and make the most of environmental protection in the architectural and construction industries. The following is an example of one of the *Going Green* features found in this edition:




GreenFormat

The Construction Specifications Institute has established *GreenFormat: The Construction Product Sustainability Information Reporting Guide*. *GreenFormat* is a CSI format allowing manufacturers to accurately report the sustainability measuring properties of their products, and providing designers, contractors, and building operators with basic information to help meet green requirements. When using *GreenFormat*, construction product manufacturers complete an online *GreenFormat* reporting questionnaire that collects the sustainability information about their product. Data from the questionnaires are displayed in a standardized style designed to ease sustainable design decision making. Access to the *GreenFormat* report and the resulting data is provided through <http://www.greenformat.com>.

Those using the website can print reports on specific products based on their questions within the database. Sustainable information reported in *GreenFormat* is grouped into categories, each containing individual topics and questions about product sustainability. The categories are organized with topics more likely to be important to design decisions first. This flexible structure can adapt to anticipated changes in the industry. As sustainability issues evolve, new topics and questions are added in the appropriate category, and existing topics and questions that become obsolete or change are dropped if necessary. The structure can be applied to all construction products and product categories. Refer to www.greenformat.com to see the categories and their contents and to view additional information about *GreenFormat*.

CADD Applications

CADD Applications is a special boxed feature that provides a variety of real-world examples, professional presentations, software applications, tips, standards, and procedures used with computer-aided design and drafting. The following is an example of one of the *CADD Applications* found in the seventh edition:



CADD APPLICATIONS

Drawing Sections

Using a computer to draw sections has some advantages: Standard sections and details can be brought into the drawing from a library, and placing notes on the section is easy with CADD. Also, some architectural CADD packages automatically draw a preliminary section from information you provide in relationship to the floor plan. This type of parametric design requires that an imaginary cutting-plane line be placed through the floor plan in the desired section location. This is followed by computer prompts requesting information such as roof pitch and structural floor thicknesses. In programs of this type, the floor plan walls are drawn with heights established, so these dimensions automatically convert to wall height information in the sectional view. All you do

to complete the section is add material symbols, dimensions, and notes.

Some architectural CADD packages contain typical section elements such as details, materials, and tags. After architects have used the CADD system for a while, they begin to save all typical or standard construction details as blocks. These blocks are commonly placed in a library manual for easy reference and can be called up and displayed at any time in any drawing. The standard details should be clearly labeled with an identification code for easy reference. Each CADD user should have a copy of the library reference manual, and every time a new detail is drawn, the reference manual should be updated with a drawing of the detail and the reference code. ■

Note

The Note feature is provided throughout this textbook to provide brief information related to the specific content where the note is found. The following is an example of a seventh edition note:

Note: Although both groups have produced “guidelines,” many municipalities are starting to move beyond the recommendation stage and are incorporating portions of these guidelines into their design and building requirements. The 2015 edition of the ICC codes, the NGBS-ICC 700, has moved from guidelines to law. Verify with the municipality that will govern each specific building project to determine whether specific aspects of a green guideline are required. The ICC has also developed a green building code for buildings that are not covered by the NGBS-ICC 700, titled International Green Construction Code (IgCC).

Supplemental Chapter Readings

Students are directed to supplemental chapter readings that are found on the Student Companion Website and are identified by a website icon in appropriate locations throughout this textbook. The supplemental reference material provides optional learning opportunities. The supplemental material ranges from commonly known topics available for students desiring a review, to advanced information that is beyond the scope of this textbook for students interested in further exploration. The supplemental chapter readings are identified within chapter content in the following manner.

The Student Companion Website

Although not new to the seventh edition, the Student Companion Website has new and improved content.

A website icon found throughout this textbook guides students to features found on the website. Refer to the Prologue for a complete description of each component and how to use the Student Companion Website.

The following features are found on the Student Companion Website:

- Supplemental Chapter Readings
- Step-by-Step Layout Drawings

- Chapter Tests
- Drawing Checklists
- Drawing Problems
- Drawing Templates
- Architectural Blocks and Symbols
- Related Web Links
- Workbook
- Video Clips of Major Concepts
- Review Questions

Organizing Your Course

Architectural drafting is the primary emphasis of many technical drafting curricula, while some schools offer only an exploratory course in this field. This textbook is appropriate for either application, as the content reflects common elements in any architectural drafting curriculum.

Prerequisites

An interest in architectural drafting and design, plus basic arithmetic, written communication, and reading skills are the only prerequisites required. Basic drafting skills, and layout techniques are presented as appropriate. Students with an interest in architectural drafting who begin using this text can end with the knowledge and skills required to prepare complete sets of working drawings for residential and light commercial architectural construction projects.

Fundamental through Advanced Coverage

This textbook can be used in an architectural drafting and design curriculum that covers the basics of residential architecture in a one-, two-, or three-semester sequence. In this application, students use the chapters directly associated with the preparation of a complete set of working drawings for a residence, where the emphasis is on the use of fundamental skills and techniques. The rest of the textbook can remain as a reference for future study or as a valuable desk reference.

This textbook can also be used in the comprehensive architectural drafting and design program where a four- to six-semester sequence of residential and light commercial architectural drafting and design is required. In this application, students can expand on the primary objective of preparing a complete set of working drawings for the design of residential and light commercial projects with the coverage of any one or all of the following areas: energy-efficient construction techniques,

solar and site orientation design applications, heating and cooling thermal performance, structural load calculations, and presentation drawings.

Section Length

Chapters are presented in individual learning segments that begin with fundamental concepts and build until each chapter provides complete coverage of every topic. Instructors can choose to present content in short, 15-minute discussions or divide each chapter into 40- to 50-minute discussions.

Drafting Equipment and Materials

Identification and use of computer-aided drafting equipment is described in a supplement. Students need an inventory of equipment available for use as listed in the content. Professional drafting materials are explained, and it is recommended that students prepare problem solutions using actual drafting materials.

Supplements

Instructor Companion Website

The Instructor Companion Website, found on cengagebrain.com, includes the following components to help minimize instructor preparation time and engage students.

- **Syllabus:** Lesson plans created by chapter. You have the option of using these lesson plans with your own course information.
- **Chapter Hints:** Objectives and teaching hints that provide the basis for a lecture outline that helps you to present concepts and material. Key points and concepts can be graphically highlighted for student retention.
- **PowerPoint Presentation:** Slides for each chapter of the text provide the basis for a lecture outline that helps you to present concepts and material. Key points and concepts can be graphically highlighted for student retention.
- **Solutions Manual:** Contains answers to end-of-chapter review questions and solutions to end-of-chapter problems.

Cengage Learning Testing Powered by Cognero is a flexible online system that allows you to:

- Author, edit, and manage test bank content from multiple Cengage Learning solutions.

- Create tests from your LMS, your classroom, or wherever you want.

MindTap for Architectural Drafting & Design

MindTap is a personalized teaching experience with relevant assignments that guide students to analyze, apply, and improve thinking, allowing you to measure skills and outcomes with ease.

- **Personalized Teaching:** Becomes YOURS with a Learning Path that is built with key student objec-

tives. Control what students see and when they see it—match your syllabus exactly by hiding, rearranging, or adding your own content.

- **Guide Students:** Goes beyond the traditional “lift and shift” model by creating a unique learning path of relevant readings, multimedia, and activities that move students up the learning taxonomy from basic knowledge and comprehension to analysis and application.
- **Measure Skills and Outcomes:** Analytics and reports provide a snapshot of class progress, time on task, engagement, and completion rates.



Acknowledgments

The authors would like to thank and acknowledge the many professionals who reviewed this and previous editions of *Architectural Drafting and Design*. A special acknowledgment is due the instructors who reviewed the chapters in detail.

Reviewers

Wen M. Andrews
J. Sargeant Reynolds Community College

Sharon Bagby
Texas State Technical College, Sweetwater, Texas

Amanda Boyle
Texas State Technical College, Marshall, Texas

Rebecca R. Brining
Virginia College, Mobile, Alabama

Clark Cory
Purdue University, West Lafayette, Indiana

Tom Felton
Western Technical College, La Crosse, Wisconsin

Cheryl Gardner
Hinds Community College, Jackson, Mississippi

Andy Jacobs
West-Oak High School, Westminster, South Carolina

David K. Landry
Louisiana Technical College, Lafayette, Louisiana

Richard Rodriques
Red Rocks Community College, Lakewood, Colorado

Edward J. Rother
Cerritos College, Norwalk, California

Contributing Companies

The quality of this textbook is also improved by the support and contributions from architects, designers, engineers, and vendors. The list of contributors is extensive, and acknowledgment is given at each illustration. The following individuals and companies gave an

extraordinary amount of support with technical information and art for this edition.

Chief Architect Software

Special thanks are given to Derek Pedersen, the Sales Manager of Chief Architect Software. Mr. Pedersen has an AKBD and a background in real estate sales, development, and construction. Derek provided CADD content, images, and a technical review.

Chief Architect® was created in 1992 for the professional Home Design Software market and was the first object-based 3D CAD system with smart object design principles; known as building information modeling (BIM). Chief Architect is the market-leading home design software product for residential design.

Chief Architect Software is professional 3D architectural design software for architects, builders, remodelers, kitchen and bath designers, and interior designers. The software is specifically designed for residential and light commercial projects. The software's powerful building, drafting, construction document, and 3D tools provide a design process that flows naturally and allows the designer to complete the design process quickly and efficiently.

Chief Architect includes design tools for photo-realistic renderings, artistic renderings and virtual tours to help clients visualize designs. Visit the Chief Architect website to download a free trial version of Chief Architect Software at www.chiefarchitect.com/freetrial.

Energy-models.com

Special thanks are given to Bob Fassbender for Building Energy-Modeling (BEM) content. Bob is the owner of Energy-models.com, with the goal of more efficiently teaching the world about energy modeling. Bob continues training and energy modeling as a LEED accredited professional. He has worked with multiple universities teaching energy-modeling, and worked as adjunct professor for the University of Philadelphia. Energy-models.com is the world's largest website devoted to building energy simulation and allows users to learn energy-modeling from anywhere in the

world, without the need for travel and unnecessary carbon footprints.

International Code Council (ICC)

Special thanks go to Hamid Naderi, vice president of product development of the *International Code Council (ICC)*, for reviewing the content of this text related to the ICC codes and for allowing us to use text from the *2015 International Residential Code* and *The International Building Code*.

Portions of this publication reproduce text from the *2015 International Residential Code*, © 2015, with the permission of the publisher, the International Conference of Building Officials, under license from the International Code Council Inc., Falls Church, Virginia. The *2015 International Residential Code* is a copyrighted work of the *International Code Council*. Reproduced with permission. All rights reserved.

Alan Mascord Design Associates, Inc.

Alan Mascord Design Associates (www.mascord.com) provides more than 600 stock home plans in a wide range of architectural styles, from single-family homes to multifamily dwellings, including detached garage plans. An active custom design business serves clients with specific and unique requirements, and Efficient Living Services provides builders with tools and resources for building green.

Mascord Efficient Living (ISBN-10 0-9788-1131-3) is a guide to the philosophies and practicalities of green building for builders and consumers. Presenting more than 50 home plans detailed to meet nationally recognized green building standards, this book explains the elements to consider before, during, and after construction.

Special thanks are given to Jon Epley and Gary Higginbotham for their professional support for this edition in providing content, photographs, and illustrations for several *Going Green* features found throughout this textbook. Mascord Design Associates also provided several sets of working drawings used for problems in Chapter 18.

3D.DZYN

Special thanks to Ron Palma, 3D.DZYN, for providing feedback related to professional architectural CADD applications. Palma has more than 20 years of experience in the architectural industry as a drafter, designer, lead project designer, and as a CAD manager implementing Architectural Desktop for a residential design firm. He is an Autodesk Certified Instructor, trainer, and support technician for an Autodesk reseller. Palma

has professional experience as an educator at two community colleges and is a U.S. Army certified instructor. In addition, he taught the Instructor Trainer's Course for the U.S. Army and has taught courses at Autodesk University. Palma is the coauthor of several architectural drafting and AutoCAD books.

Res Communis (www.rescommunis.org)

A design collective started by Garrett and Dustin Moon, Res Communis is dedicated to the creation and dissemination of “good” design for all, not just for those who can afford it. Their goal is to contribute to the solving of problems, not the concentration and collection of intellectual property. To that end, every idea and design created is released to the public to use and refine for the good of all. Garrett and Dustin Moon provided the content and illustrations for the *Going Green* content in Chapter 12. The *Going Green* feature titled *The Ultimate Urban Green Home* is the flagship of the *Going Green* features found in this textbook, demonstrating perfect, sustainable, and self-sufficient design using super energy-efficient, environmentally safe materials, and clean energy technologies.

Construction Specifications Institute (www.csinet.org)

Information used in this text is from *MasterFormat* and *UniFormat*, is published by The Construction Specifications Institute (CSI) and Construction Specifications Canada (CSC), and is used with permission from CSI, 2008.

The Construction Specifications Institute (CSI)
99 Canal Center Plaza, Suite 300
Alexandria, VA 22314
800-689-2900; 703-684-0300

Autodesk, Inc. (www.autodesk.com)

Catherine Palmer, marketing manager, AEC Initiatives, provided the *Going Green* feature content in Chapter 7.

DeSantis Landscapes

Dean DeSantis, CLP, president of DeSantis Landscapes, provided the content and photographs used in a *Going Green* feature found in Chapter 12.

Solatube International, Inc. (www.solatube.com)

Bridget Palitz, vice president of The McRae Agency, Public Relations for Solatube International, Inc., provided the content, photographs, and illustrations for a *Going Green* feature in Chapter 16.

National Fenestration Rating Council (NFRC) (www.nfrc.org)

The NFRC provided content and illustrations for a *Going Green* feature in Chapter 16.

Bryan Higgins

Architect Bryan Higgins, AIA, LEED AP, from Portland, Oregon, provided a set of working drawings and photographs of his design of one of the winning homes in the Living Smart program in Portland, Oregon. The Living Smart program design competition created a catalog of affordable home plans designed for narrow lots, called small footprint houses. His Living Smart small footprint design is used in Problem 18–1. Higgins also provided the content for the *Going Green* feature in Chapter 18 of this textbook.

Leann Collins and Laura Numbers

Leann Collins and Laura Numbers contributed a complete set of working drawings and related photographs for a small footprint residential architectural design. This small footprint is one of the winning homes in the Living Smart program, in Portland, Oregon, and the design is used in Problem 18–3.

TKP Architects, PC, Golden, Colorado (www.keating-partnership.com)

Thanks to Erin Elston with TKP Architects for the contribution of residential architectural plans and impressive photographs.

Southwest Windpower (www.windenergy.com)

Michael French, Graphics Coordinator for Southwest Windpower, provided the content, photographs, and illustrations for the *Going Green* feature in Chapter 19.

Engineering Drawing and Design

Approximately 180 illustrations are reproduced from *Engineering Drawing and Design*, by David A. Madsen and David P. Madsen, from Delmar Publishers.

Step-by-Step Model Home Plan Drawings

The authors greatly appreciate the efforts of David P. Madsen, Tereasa Jefferis, and Connie Wilmon for their work with the step-by-step drawings found in layout chapters. In addition, we would like to thank the many staff members of Cengage Learning who worked so hard to make this book possible. We're especially grateful for all of the hard work and encouragement of Sharon

Chambliss and Glenn Castle. We also appreciate the efforts of the senior project manager Charu Khanna at MPS Ltd. We would also like to thank the following people for their contributions:

Janice Jefferis for her photo contributions, as well as David Jefferis, Michael Jefferis, Sara Jefferis, Tereasa Jefferis, Aaron Jefferis, Jordan Jefferis, Zachary Jefferis, Megan Jefferis, and Matthew Jefferis, who provided photos of homes from across the country. Kenneth D. Smith AIA, Gisela Smith, Dean K. Smith and Ginger M. Smith, Jamie Smith, Robin Smith, Shana Smith, Kahlil Sabbagh, Kylan Sabbagh, and Samaya Sabbagh of Kenneth D. Smith Architects and Associates, Inc.

Terrel Broiles, AEC Architectural Illustrator

APA—The Engineered Wood Association

Ron Lee, Architects Barrentine, Bates & Lee AIA

Pamela Allsebrook, California Redwood Association

Scott R. Beck, Architect

Bill Berry, Berry-Nordling Engineers, Inc.

Eric Brown, Eric S. Brown Design Group, Inc.

Charles J. Conlee P.E., Conley Engineers, Inc.

David Rogencamp, KPFF Consulting Engineers

Kathleen M. Arnett, Louisiana-Pacific Corporation

Tom Kuhns, Michael & Kuhns Architects, P.C.

Richard Branham, National Concrete Masonry Association

David P. Schulze AIBD, CPBD, DPS-Labs.com

Richard R. Chapman and Robert C. Guzikowski, Simpson Strong-Tie, Inc.

Richard Wallace, Southern Forest Products Association

Havlin G. Kemp P.E., VLMK Consulting Engineers
Western Wood Products Association

Steven Merrill, Mechanical Designer

To the Student

Architectural Drafting and Design is designed for you, the student. The development and format of the presentation have been tested in conventional and individualized classroom instruction. The information presented is based on the U.S. National CAD Standards, drafting room practice, and trends in the architectural design industry. This textbook is the only architectural drafting reference that you need. Use the textbook as a learning

tool while in school, and take it along as a desk reference when you enter the profession. The amount of written text is complete but kept to a minimum. Examples and illustrations are used extensively. Drafting is a graphic language, and most drafting students learn best by observation of examples. Here are a few helpful hints for using this textbook:

1. *Read the text.* The text content is intentionally designed for easy reading. Content is given in as few, easy-to-understand words as possible. You should do the reading because the content can help you to understand the drawings clearly.
2. *Look carefully at the examples.* The figure examples are presented in a manner that is consistent with architectural drafting standards and the U.S. National CAD Standard. Look at the examples carefully in an attempt to understand specific applications. If you are able to understand why something is done a certain way, it will be easier for you to apply the concepts to the drawing problems in this textbook and to similar issues when working as an architectural drafter. Drafting is a precise technology based on standards and guidelines. The goal of a drafter is to prepare drawings that are easy to read and understand. There are times when rules need to be altered to handle a unique situation. Rely on judgment based on your knowledge of accepted standards in these situations. Drafting is often like a puzzle—there is often more than one way to solve a problem.
3. *Use the text as a reference.* Few drafters know everything about drafting standards, techniques, and concepts. Always be ready to use this textbook as the reference if you need to verify how a specific application is handled. Become familiar with the definitions and use of technical terms. It is difficult to memorize everything in this text, but architectural drafting applications should become second nature as you gain experience.
4. *Learn each concept and skill before you continue to the next.* The text is presented in a logical learning sequence. Each chapter is designed for learning development, and chapters are sequenced so drafting knowledge grows from one chapter to the next. Problem assignments are presented in the same learning sequence as the chapter content and also reflect progressive levels of difficulty.
5. *Practice.* Development of good computer-aided drafting skills depends to a large extent on practice. Some individuals have an inherent talent for drafting, and some people are readily compatible with

computers. If you fit into either group, great! If you have difficulty, then practice may be all you need. Practice computer skills to improve your skills and efficiency with communication and drafting.

6. *Use sketches or preliminary drawings.* Even when drawing with a CADD program, the proper use of a sketch or preliminary drawing can save a lot of time in the long run. Prepare a layout sketch or preliminary layout for each problem. This preliminary step gives you a chance to organize your thoughts about drawing scale, view selection, dimension and note placement, and sheet size. After you become an experienced drafter, you may be able to design a sheet layout in your head, but until then, you should use sketches.

About the Authors

Alan Jefferis

Alan Jefferis is Faculty Emeritus of Drafting Technology at the Autodesk Premier Training Center at Clackamas Community College in Oregon City, Oregon. He was an architectural drafting and CAD instructor at Clackamas Community College for over 30 years. He also taught at Mt. Hood Community College in Gresham, Oregon, for four years. In addition to community college experience, Alan had eight years of experience drawing for architects, engineers, and residential designers prior to working for 35 years as the principal of Residential Designs, a design firm specializing in custom, energy-efficient homes. He is also a former member of the American Institute of Building Designers. In addition to his design work, he is a coauthor of several standard reference works from Cengage Delmar Learning including *Residential Design Drafting and Detailing*; *Print Reading for Architectural Construction Technology*; *Commercial Drafting and Detailing*; and *AutoCAD® for Architecture*.

David A. Madsen

Madsen Design Inc.

David A. Madsen is the president of Madsen Designs Inc. (www.madsendesigns.com).

David is Faculty Emeritus of Drafting Technology and the Autodesk Premier Training Center at Clackamas Community College in Oregon City, Oregon. David was an instructor and department chairperson at Clackamas Community College for nearly 30 years. In addition to community college experience, David was a drafting

technology instructor at Centennial High School in Gresham, Oregon. David is a former member of the American Design and Drafting Association (ADDA) Board of Directors, and was honored by the ADDA with Director Emeritus status at the annual conference in 2005. David is an Autodesk Authorized Author. David has extensive experience in mechanical drafting, architectural design and drafting, and building construction. David holds a master of education degree in vocational administration and a bachelor of science degree in industrial education. David is the author of *Engineering Drawing and Design*; *Geometric Dimensioning and Tolerancing*; *Print Reading for Engineering and Manufacturing Technology*; and coauthor of *Architectural AutoCAD*; *Architectural Desktop and its Applications*; *Architectural Drafting and Design*; *Architectural Drafting Using AutoCAD*; *AutoCAD and Its Applications: Basics, Advanced, and Comprehensive*; *AutoCAD Architecture and Its Applications*; *AutoCAD Essentials*; *Civil Drafting Technology*; and *Print Reading for Architecture and Construction Technology*.

David P. Madsen

Engineering Drafting & Design, Inc.

David P. Madsen is the president of Engineering Drafting & Design, Inc. and the vice president of Madsen Designs Inc. (www.madsendesigns.com). Dave provides

drafting and design consultation and training for all disciplines. Dave is an Autodesk Authorized Author. Dave has been a professional design drafter since 1996, and has extensive experience in a variety of drafting, design, and engineering disciplines. Dave has provided drafting and computer-aided design and drafting instruction to secondary and post-secondary learners since 1999 and has considerable curriculum, program coordination, and development experience. Dave holds a master of science degree in educational policy, foundations, and administrative studies with a specialization in post-secondary, adult, and continuing education; a bachelor of science degree in technology education; and an associate of science degree in general studies and drafting technology. Dave is the author of *Inventor and Its Applications*, and coauthor of *Architectural Drafting and Design*; *Architectural Drafting Using AutoCAD*; *AutoCAD and Its Applications: Basics and Comprehensive*; *Civil Drafting Technology*; *Engineering Drawing and Design*; *Geometric Dimensioning and Tolerancing*; *Print Reading for Architecture and Construction Technology*; and *Print Reading for Engineering and Manufacturing Technology*.



Prologue

Student Companion Website

To access the Student Companion Website:

- Open your browser and go to www.cengagebrain.com.
- Type the author's name, or the title or ISBN of this book in the search window. (The ISBN is on the back cover.)
- Click the book title in the list of search results.
- When the book's main page is displayed, click on the link at the bottom of the page for Student Companion Website.
- On the next screen, click on Student Downloads.

The following is a list and description of each component found under the Student Downloads button.

Supplemental Chapter Readings

Throughout this textbook, a Student Companion Website icon guides you to chapter-related content provided for additional reading and research. The Supplemental Chapter Reading features found on the Student Companion Website include chapter-related content, basic information, advanced content that is beyond the scope of the main textbook, and commonly used abbreviations.

Step-by-Step Layout Drawings

Several chapters throughout this textbook use the same model home to describe step-by-step techniques for laying out drawings required in a set of residential working drawings. Click the Step-by-Step Drawings link to view Acrobat Portable Document Format (PDF) files of many of the textbook figures related to the step-by-step layout process. Use the files to display the figures on your computer screen, and to look more closely at the layout steps and details.

Chapter Tests

Chapter tests are found at the end of each chapter. Pick the Chapter Tests link to access chapter tests using

Microsoft Word. The chapter tests allow you to review or test your knowledge of the related chapter content, depending on your course objectives. Open the related link and answer the questions electronically, unless otherwise directed by your instructor.

Drawing Checklists

Drawing checklists are provided for the model home layout chapters on the Student Companion Website. The checklists allow you to check your work to be sure everything is included in the drawing that you are completing.

Drawing Problems

The Chapter 18 drawing problems are found on the Student Companion Website. These problems are identified in the textbook with a website icon. The Chapter 18 drawing problems can be used for creating the floor plans of the selected or assigned house that continue throughout this textbook to create a set of working drawings.

Drawing Templates

Select the Drawing Templates link to access a page containing a link to architectural and civil AutoCAD drawing template (.dwt) files. Use the Drawing Templates link and the available drawing template files to create new drawings, as a resource for drawing content, or for inspiration when developing your own templates. The architectural drafting templates are set up to allow you to prepare architectural drawings, whereas the civil drafting templates include preset civil drawing content for site plans and other civil drafting projects. Use the U.S. templates to draw using U.S. customary, or feet and inch, units. Use the metric templates to draw using metric units. Each template includes a variety of appropriate drawing settings and content, such as layers, layouts, and object styles. You can also use a utility

such as DesignCenter to add content from the drawing templates to your own drawings and templates. Consult with your instructor to determine which template drawing and drawing content to use.

Architectural Blocks and Symbols

The Architectural Symbols link provides access to an AutoCAD drawing (.dwg) file that contains several common architectural drafting symbols. These symbols are stored in folders named for the drawings in which they are most typically used. Many of the symbols are in AutoCAD block form and are drawn on the 0 layer; others are common symbols that should be made into blocks before inserting into the drawing. Use a utility such as DesignCenter, or copy and paste, to add the blocks to your own drawings. Use the blocks as desired or as directed by your instructor. Additional symbols are available through a variety of resources. Some software programs, such as AutoCAD, include and allow you to access many architectural symbols. Many other symbols are available through the Internet for free download or purchase. The U.S. National CAD Standard (NCS) includes separate .dwg files of the symbols presented in the standard.

Related Web Links

Internet research is an excellent way to gain additional knowledge about architectural drafting and the professional organizations related to architectural drafting and design. The Related Web Links section contains a variety of related website links for you to explore as preferred or as directed by your instructor. The website links are provided in alphabetical order covering the entire textbook content, and chapter by chapter. Click a link to go automatically to the designated website.

Workbook

Additional problems have been provided to reinforce the knowledge and skills introduced throughout the

textbook. These problems are divided into these sections and chapters:

Section I: Basic Residential Projects

Chapter 1 Basic Architectural Drafting Practices

Chapter 2 Site Plans

Chapter 3 Floor Plan Fundamentals

Chapter 4 Basic Floor Plan Problems

Chapter 5 Floor Plan Dimensions

Chapter 6 Electrical Plans

Chapter 7 Plumbing and HVAC Plans

Chapter 8 Roof Plans

Chapter 9 Elevations

Chapter 10 Cabinet Elevations

Chapter 11 Foundation Plans

Chapter 12 Details

Chapter 13 Sections

Chapter 14 Stair Sections

Chapter 15 Fireplace Sections

Chapter 16 Design Criteria for Structural Loading

Chapter 17 Construction Specifications, Permits, and Contracts

Chapter 18 Presentation Drawings

Section II: Advanced Residential Projects

Section III: Additional Advanced Residential Projects

Section IV: Advanced Research Projects

Review Questions

This feature provides you with review questions that are in addition to the chapter-by-chapter test questions provided throughout the textbook. Use the review questions for additional opportunities to test your knowledge and review textbook content.

Introduction to Architectural Design and Drafting



Professional Architectural Careers, Office Practices, and Opportunities

INTRODUCTION

As you begin working with this text, you are opening the door to many exciting careers in the field of architecture, engineering, and construction (AEC). Each career in turn has many different opportunities within it. Whether your interest lies in theoretical problem solving, artistic creations, or working with your hands to create something practical, a course in architectural drafting and design will help you satisfy that interest. An architectural drafting class can lead to a career as a CAD drafter, CAD technician, designer, interior decorator, interior designer, architect, or engineer. Mastering the information and skills presented in this text will prepare you for a job as a drafter and serve as a solid foundation for each of the other listed professions, as well as many others.

Note: *If you've followed employment trends in the AEC fields, you know that the availability of jobs in all phases of the field is down. The good news, though, is that according to the International Code Council® (ICC) studies, permit applications for multiunit housing and commercial structures have been up since the end of 2012, with predictions for continued growth. Don't be discouraged from completing your studies in the field. The market will get better, but to be prepared to compete for a job, you'll need a well-rounded education.*

Drafter

A **drafter** is the person who creates the drawings and details for another person's creations. The U.S. Bureau of Labor Statistics defines a drafter as a person who uses software to convert the designs of architects and engineers into the technical drawings used to construct a structure. It is the drafter's responsibility to use the proper line and lettering standards and to properly lay out the required drawings necessary to complete a project. Such a task requires great attention to detail, as the drafter creates the working drawings from the supervisor's sketches. Although the terms are used interchangeably, professionals often use the term *drafter* to refer to a person who draws manually using pencils or pens. The terms *CAD drafter* and *CAD technician* are

used to describe a person who creates the same type of drawings using a computer. In addition to these terms, job listings may also be described using the terms CAD designer, engineering technician, CAD operator, CAD design technician, CAD engineering design technician, technician, and design drafter. Throughout this book, the term *drafter* will be used to describe both those who create drawings using software and a computer and those who draw manually. Although most firms in the AEC industry now work with electronic drawings, some firms still require manual drafting skills in order to update older drawing projects.

The Beginning Drafter

Your job as a beginning or junior drafter will generally consist of making corrections to drawings created by others. There may not be a lot of mental stimulation to making changes, but it is a very necessary job. It is also a good introduction to the procedures and quality standards within an office. As you master the company standards, your responsibilities will be expanded. In addition to mastering basic CAD commands, you'll need to become familiar with the U.S. National CAD Standards® (NCS). These are guidelines assembled by the National Institute of Building Sciences® (NIBS) that incorporate the Uniform Drawing System (UDS) published by the Construction Specifications Institute® (CSI), CAD Layer Guidelines published by the American Institute of Architects®, and the U.S. Coast Guard. These guidelines are aimed at bringing uniformity among consulting firms to ensure quality plans. Future chapters in this text will introduce key concepts from the NCS. You'll also need to become proficient using the firm's computer standards and any special menus and list processing language (LISP) routines needed to work efficiently.

No matter what software is used to create drawings, as a new drafter your supervisor will typically give you a rough draft and expect you to complete the required drawing. **FIGURE 1.1** shows a project manager's sketch.

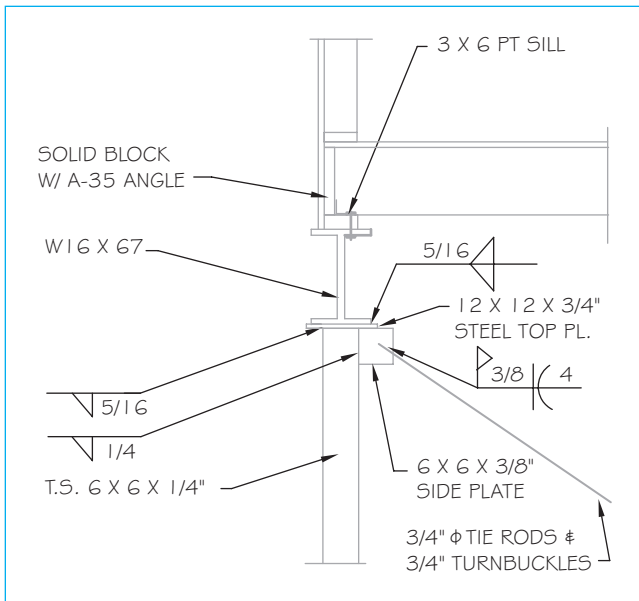


FIGURE 1.1 A rough draft created by the project manager is usually given to a junior drafter to follow for a first drawing. The drafter can find information for completing the drawing by examining similar jobs in the office.

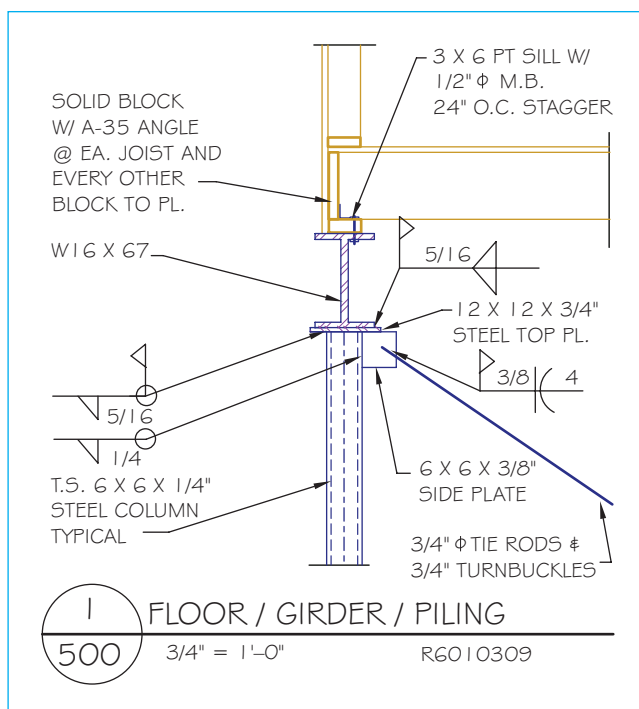


FIGURE 1.2 A detail completed by a drafter using the rough draft shown in in Figure 1.1.

FIGURE 1.2 shows the drawing created by a drafter. As you gain an understanding of the drawings that you are making and gain confidence in your ability, the sketches that you're given generally will become more simplified. Eventually your supervisor may just refer you to a similar drawing and expect you to be able to make the necessary adjustments to fit it to the new application.

The decisions involved in making drawings without sketches require the drafter to have a good understanding of what is being drawn. This understanding does not come from a textbook alone. To advance as a drafter and become a leader on the drawing team will require you to become an effective manager of your time. This will include the ability to determine what drawings need to be created, selected from a stock library, and edited; and to estimate the time needed to complete these assignments and meet deadlines established by the team captain, the client, the lending institution, or the building department. An even better way to gain an understanding of what you are drafting is to spend time at a construction site watching projects that you've worked on become a reality. Gaining an understanding of what a craftsman must do as a result of what you have drawn will greatly aid you as you assume more responsibility on projects.

Note: A visit to a construction site requires preparation. Because of the high risk of injury and the dangers construction firms face from theft and liability, not everyone is welcome as a guest at a construction site. If possible, call and schedule visits ahead of time, especially if visiting a large construction site, so that someone will be available to guide you on your tour. You'll rarely be welcome when overhead deliveries are in progress, so knowing when crews take rest breaks, break for lunch, or end their day will make it more likely that you'll be allowed to tour the site. When you do go to the site, report immediately to the job supervisor to verify that your visit is approved. Don't show up in flip-flops and expect to tour the construction site. Hard-soled shoes are generally required, and steel-toed work boots are preferred. An orange or yellow shirt will increase your visibility, and a hard hat is a must. The site supervisor will typically supply an orange vest and hard hat so that you comply with OSHA safety standards.

Your role in the development of architectural drawings will vary depending on the size and structure of the firm where you work. Most small architectural and engineering firms consist of a single office. As the size of the firm increases, they may have multiple offices located throughout the country, and some very large companies are international. The size of the company will also affect the types of structures they work with. Some design firms are very specialized and work only in one field, such as educational or institutional facilities. As the size of the firm increases, they may have several different divisions within the company for designing various areas of occupancy. Chapters 9 and 41 will introduce specific areas of construction based on the occupancy of the structure.

Depending on the size of the office where you work, you may also spend a lot of your time as a beginning CAD technician editing stock details, running prints, obtaining permits, and doing other office chores. Don't get the idea

that a drafter does only the menial chores around an office. But you do need to be prepared, as you go to your first drafting job, to do things other than drafting.

The Experienced Drafter

Although your supervisor may prepare the basic design for a project, experienced CAD technicians are expected to make decisions about construction design. These decisions might include determining structural sizes and connection methods for intersecting beams, drawing renderings, visiting job sites, and supervising beginning drafters. As you gain experience, you will be assigned drawings that are more complex. Instead of revising existing details or drawing site plans, cabinet elevations, or roof plans, an experienced CAD drafter and team leader may be working on the floor and foundation plans, elevations, and sections. Your supervisor probably will still make the initial design drawings, but will pass these drawings on to you as soon as a client approves the preliminary drawings.

In addition to drawing with a computer, you may work with the many city and state building departments that govern your work. This will require you to research the codes that govern the building industry. You will also need to become familiar with vendors' materials. Information can be obtained from individual manufacturers and suppliers or their websites. Another valuable resource is Sweets.construction.com. *Sweets*TM is a collection of information on a wide variety of building products arranged by their *MasterFormat*[®] system numbers. Information is listed by manufacturer, trade name, and type of product.

Educational Requirements

In order to get your first CAD drafting job, you will need a solid education, good computer-aided drafting (CAD) skills, a good understanding of basic computer skills, and the ability to sell yourself to an employer. Although AutoCAD[®] is used in most midsize and larger architectural and engineering firms to aid in collaboration with consulting firms, many smaller design professionals use a variety of software programs such as Revit[®], Google SketchUp Pro[®], Graphisoft ArchiCAD[®], Chief Architect[®], or SoftPlan[®]. Especially in smaller cities, taking time to research what software is in demand with most of the area's design professionals will aid you in finding future employment. Making scheduled visits with design professionals to discuss the hiring and educational requirements for their firm is also a great way to get your foot in the door for a future job interview.

CAD skills must include a thorough understanding of drawing and editing commands, as well as the ability to quickly decide which option is best for a given situation. This ability will also come with practice. If you work full-time editing details, you'll quickly become proficient at determining the best commands to use. The education required for a drafter can range anywhere from one or more years in a high school drafting program, to a diploma from a one-year accredited technical school, to a degree from a two-year college program, all the way to a master's degree in architecture. The required education is greatly affected by the size of the city where you're seeking employment and the strength of the economy in that area.

Note: *In some areas of the country, and in a thriving economy, a high school student could obtain an entry-level drafting intern position. In a stagnant job market, that same student may find himself competing against someone with a four-year degree. Even in a strong economy, because of the complexities involved in creating architectural drawings, most offices require college training.*

Educational Recommendations

Helpful areas of study for an entry-level CAD technician include math, science, English, writing, drawing, and computer drafting. Taking a class or seminar on learning how to study will help you maximize these areas of study.

Math

The math required ranges from simple addition to calculus. Although the CAD technician may spend most of the day adding dimensions expressed in feet and inches, knowledge of advanced math is helpful for solving many building problems. You'll often be required to use basic math skills to determine quantities, areas, percentages, and volumes. Clients are always concerned with room sizes and areas devoted to specific tasks. Building departments are also concerned with the size of individual rooms, living areas, openings required for escape, and the percentages of openings/wall areas to be calculated for determining heat loss or gain. Many firms provide their clients with a list of the quantities of specific materials required to construct the project. Area calculations determine the size of each room, areas to meet basic building code requirements, the loads on a structural member, or the size of the structure.

Science

Any science class that you can squeeze into your schedule will be helpful in your design career. Classes in biology are helpful as you work on environmental

areas of a project, including managing and tracking LEED credits. Chemistry classes will prove helpful as you work to ensure that chemicals contained in the products specified on the drawings are environmentally friendly. An understanding of the potential chemicals at a jobsite will be helpful during job supervision visits and for completing safety reports related to each project site. Physics classes will prove useful as you advance in your design career. Understanding how forces act on a structural member, as well as the entire structure, will help you size and specify structural materials. Understanding how energy, momentum, temperature, and pressure affect a structure will be helpful in all areas of the design process.

English, Grammar, and Technical Writing

Writing skills are also helpful to a new employee entering the design world. Your writing ability is an important key just to get an interview to show your work. Although many smaller design firms still accept paper resumes, most mid to large sized firms only accept electronic applications. Your grammar, your ability to write clear and concise statements that can be easily understood by coworkers and customers from different cultures, and your willingness to use spell check will all aid you in getting that first interview.

Once you're hired, you'll often be required to complete the paperwork that accompanies a set of plans, such as permit applications, requests for variances, written specifications, and environmental impact reports. You'll also need to effectively communicate using the Internet, email, text messaging, and tweets. Although many have used these methods of communicating for years, messages that you send professionally must forsake the grammar shortcuts associated with texting, and use proper grammar and English. While our methods of communicating have changed, the need for proper grammar, sentence structure, and good technical writing skills has not. You will need effective writing skills that meet professional standards as you prepare written estimates, work orders, and memos throughout the design and the construction process. Most likely, your company will require you to be able to:

- Prepare simple written documents and reports using existing company procedures
- Retrieve and edit existing documents
- Format text using basic formatting functions
- Employ word processing utility tools such as spell check, grammar check, and a thesaurus

Technical writing courses will introduce you to the skills needed to master these requirements in a professional manner. Chapter 8 will further explore professional writing opportunities and requirements.

Miscellaneous Education Recommendations

In addition to standard CAD drafting classes and core educational classes, knowledge of several other fields will be helpful. Classes in public speaking will prove beneficial in a wide range of professional activities. Skills learned in speech classes will aid you in demonstrating your confidence by making eye contact with those you're speaking with, and in giving you the confidence to stand and describe a project at a community advisory committee. Speech classes will also help you organize your thoughts for collecting information to clarify the exact expectations of the client, your team leader, or building officials. The ability to ask intelligent questions is the first step in being able to deliver a quality project that meets the needs of the client.

Classes in art offer skills in the use of light, balance, and color that will be helpful to you as a designer or an illustrator. Classes in photography are invaluable in moving beyond using your cell phone to snap a photo to developing skills to capture images using good lighting techniques, as well as learning methods to mount and display photos. Classes related to construction skills, such as surveying, estimating, and construction methods, are also helpful.

In addition to learning how to use CAD drawing programs, most companies require new employees to be able to effectively use the Internet for research purposes. You will be expected to:

- Effectively search for job specific products and materials without wasting time looking at inappropriate material.
- Select and use appropriate search engines and search procedures.
- Navigate websites using software functions.
- Access and evaluate Internet resources for accuracy. (Just because you find information on the Internet doesn't make it true. Take time to verify the source and the accuracy of the information you've found.)
- Access business and technical information using the Internet.
- Use the Internet to secure needed supplies and resources.

Many large firms require employees to use software such as Microsoft® Word, Microsoft® Excel, or other programs designed to manipulate spreadsheets. Most

offices expect a CAD drafter to perform the following skills using a spreadsheet:

- Create, retrieve, edit, save, and print spreadsheets.
- Input and process data using spreadsheet functions.
- Locate and replace data using the search and replace functions.
- Process data using database functions such as structure, format, attributes, and relationships.
- Perform company-related calculations and analysis on spreadsheet data.
- Create charts and graphs from a spreadsheet.
- Perform calculations using simple formulas.

Personal Requirements

In addition to a solid education, professionals working in the design field need to function well in group settings. As a CAD drafter, you will generally be working for several architects and engineers and collaborating with a multitude of drafters within an office; therefore, you must be able to get along well with others. You also must be reliable. Reliability within an office is measured by the maintenance of good attendance patterns and the production of drawings as scheduled. Little things like showing up on time, performing your job assignments on time, and offering to help around the office are greatly rewarded in the long run. Occasionally coming in early to do research regarding company standards or staying late without pay or whining helps to show that you want to be a respected part of the design team.

To become a valued member of the drawing team will require you to become an effective manager of your time. This includes the ability to determine what drawings will need to be created, to select drawings from a stock library and edit them, and to estimate the time needed to complete these assignments and meet deadlines established by the team captain, the client, the lending institution, or the building department. It is also important that you be able to accurately estimate the time required to complete each project. You can develop this skill while working on school projects by estimating the amount of time that will be required to complete the project prior to starting the drawing. In the planning stage, break the project into components and estimate how long each component will take. When the drawing is complete, review your estimates and use the AutoCAD® TIME command to determine the actual time required to complete the drawing. Although most firms would prefer a drafter who can

quickly complete a project, speed is no substitute for accuracy. Push yourself as a student to meet a self-imposed time deadline while maintaining quality and accuracy. Reliability is also important because a team completes the drawings for a large structure and most multiunit residential projects. The ability to get along with others, to complete assigned projects in a timely manner, and to coordinate different parts of a project with others will greatly affect how fast you will advance.

To advance and become a good team leader, you will also need to develop skills that promote a sense of success among your teammates. It is against the law to discriminate on the basis of race, color, religion, gender, sexual orientation, age, marital status, or disability. A good team leader moves beyond complying with the law and creates a friendly and productive work environment for coworkers of different cultures, genders, and backgrounds. Other key skills for a good team leader include:

- Speaking clearly and conveying information accurately.
- Providing clear written and verbal directions to teammates using email and written memos.
- Matching team members to appropriate projects based on skill levels.
- Accurately estimating time requirements for each aspect of a project, as well as the amount of time various team members will require based on their CAD skills, experience, and areas of expertise.
- Managing daily, weekly, and monthly schedules using the appropriate software.
- Maintaining clear communication with other project leaders in the office to coordinate the use of team members among teams.
- Evaluating the efficiency and effectiveness of team members and reviewing their progress for job advancement.
- Recognizing and encouraging the efforts of coworkers.
- Maintaining positive interpersonal skills to enhance the advancement potential of teammates and accurately measuring their growth.

Note: Although you've been exposed to a variety of people in school and college, in the workplace you'll be expected to work, share ideas, and produce results with people from diverse cultures, varied backgrounds, and contrasting lifestyles from what you view as typical. To advance in an office setting, you'll need to treat your fellow employees with respect. Failure to treat others as you want to be treated could lead to your dismissal and place you in the middle of a lawsuit.

Workplace Ethics

A key quality required in any of the design professions that you might enter is to be ethical. Ethics are rules and principles that define right and wrong conduct. When you are a student, your school will typically have guidelines in a student handbook or web page outlining what is and is not acceptable behavior in the classroom. As a design professional, one of your first jobs should be to determine what is expected of you. Information can be gained from a discussion as you complete the required documents for receiving a paycheck and paying taxes or from a company website link that outlines acceptable behavior. As a new employee, you must be able to access appropriate resources to identify roles, rights, and responsibilities for both you and your employer.

Although ethics guidelines can be as simple as treating others as you would like to be treated, most mid size and larger offices have a formal code of ethics that employees are required to sign in order to obtain a job. This is a formal document that states an organization's values and the rules and principles that employees are expected to follow. In general, a code of ethics contains these main elements: be dependable, obey the laws, and be good to customers. The following list is an example of an architectural firm's standards for ethical business conduct:

1. **Honesty:** to be truthful in all our endeavors, to be honest and forthright with one another, with our customers, and with our communities.
2. **Integrity:** to say what we mean, to deliver what we promise, and to stand for what is right.
3. **Respect:** to treat one another with dignity and fairness, appreciating the diversity of our workforce and the uniqueness of each employee.
4. **Trust:** to build confidence through teamwork and open, candid communication.
5. **Responsibility:** to speak up, without fear of retribution, and report concerns in the workplace, including violations of published or unpublished works that are copyrighted.

Copyright Protection

Occasionally clients come to an architectural firm hoping to use the plan of a competitor as the basis for the design for their project. It's important to understand that architectural drawings are protected by copyright. A copyright is secured automatically by the person who created the design. The work is created when it is fixed in a copy for the first time. Copies are material objects from which the work can be read or visually perceived

either directly or with the aid of a machine or device. In the world of architecture, you'll be most affected by copyright laws as clients present you with plans from magazines and ask you to recreate the design. There is nothing illegal when a client gives you several stock plans and expects you to combine features from these plans into a new plan. However, it is very illegal to take one stock plan, make minor changes, and pass it off as your design. That's copyright infringement.

***Note:** Professional designers and architects have donated the plans in this book, knowing that they will be copied and redrawn. It is perfectly legal for you to reproduce these plans for school projects. It is important to realize, however, that it is not acceptable to reproduce these drawings for resale. Laws vary for each state, but as a general rule, unless you've changed more than 50% of the plan, or significantly altered the appearance of the design, you may be found guilty of copyright infringement. Never take a plan from another professional, make minor changes, and then call it your design. That's lazy, unethical, and illegal.*

Employment Opportunities

CAD drafters can find employment in firms of all sizes. Job opportunities can be found by searching the categories of architectural drafter, architectural design, architectural CAD operator, CAD drafter, CAD technician, and engineering technician while looking on the Internet at sites such as monster.com, jobs.com, careerbuilder.com, jobdango.com, or a link to local job listings. Many smaller firms place listings for employment in the classified ads of local newspapers.

Designers, architects, and engineers all require entry-level and advanced technicians to help produce their drawings. Architectural fabricators and equipment suppliers also employ CAD technicians. This work might include drawing construction details for a steel fabricator, making layout drawings for a cabinet shop, or designing ductwork for a heating and air-conditioning installer. Many manufacturing companies hire CAD operators with an architectural background to help draw and sometimes sell a product or draw installation diagrams for instruction booklets or sales catalogs. Drafters are also employed by many government agencies. These jobs include working in planning, utility, or building departments; on survey crews; or in other related municipal jobs.

Designer

The meaning of the term *designer* varies from state to state. Many states restrict its use by requiring those calling themselves **designers** to have had formal training and have passed a competency test. A designer's

responsibilities are very similar to those of an experienced drafter and are usually based on both education and experience. A designer is usually the coordinator of a team of drafters. The designer may work under the direct supervision of an architect, an engineer, or both and supervise the work schedule of the drafting team.

In addition to working in a traditional architectural office setting, designers often have their own office practice in which they design residential, multifamily, and some types of light commercial buildings. State laws vary regarding the types and sizes of buildings a designer may work on without an architect or engineer's stamp. The *American Institute of Building Design* (AIBD) is a national association of designers and CAD technicians who are certified to be knowledgeable in the field of residential design. The *National Council of Building Designer Certification* (NCBDC) provides third-party testing, accreditation, and certification of AIBD design professionals. Started in 1951, the AIBD and NCBDC work together to ensure that building industry professionals exceed minimum design requirements so that prospective clients can be assured that they are hiring qualified professional designers for their residential projects. Members must have a minimum of six years of professional practice including working 20 hours per week minimum for a professional building designer, architect, or professional engineer. Applicants must pass a national test to ensure their understanding of the design process and basic building standards, as well as demonstrate their ability to create residential drawings that meet the NCBDC drawing standards. Designers who pass the NCBDC certification process can then place the certification stamp of CPBD (Certified Professional Building Designer) in their title blocks and letterheads. These individual drawing standards will be described throughout this text as each drawing is introduced.

As a drafter gains experience, completing the certification process and becoming a licensed designer allows a drafter the opportunity to become self-employed and complete residential, multifamily, and small retail buildings. State laws vary regarding the types and sizes of buildings a designer may work on without the stamp of an architect or engineer. Students wishing more information about a career as an architectural designer can contact one of the following groups.

American Institute of Building Design (AIBD)
7059 Blair NW Suite 201
Washington, DC 200012
1-800-366-2423
Website: www.aibd.org
Email: info@aibd.org

Students wishing more information about becoming a certified designer should contact:

The National Council of Building Designer Certification (NCBDC)
7059 Blair Road NW Suite 201
Washington, DC 20012
1-888-726-7659
Website: www.ndbdc.com
Email: information@ncbdc.com

Students can also contact the American Design and Drafting Association (ADDA), the U.S. Department of Labor, or the U.S. Office of Education.

Interior Decorator

An **interior decorator** decorates the interiors of buildings, with the aim of making rooms more attractive, comfortable, and functional. Most interior decorators are hired to decorate homes, but they may also be hired to decorate interiors of businesses such as boutiques, restaurants, and offices. They may work on the entire interior of a building or a single room. An interior decorator's work may involve a variety of elements, including space planning, determination of color schemes, furniture placement, and the coordination of interior finishes such as paint and wallpaper, window coverings, and flooring. It may also include the arrangement of lighting fixtures, art objects, furnishing accessories, and interior plants. Specific job requirements may include:

- Meeting with clients to determine the scope of a project.
- Reviewing and measuring the space to be decorated.
- Preparing proposed room layouts and obtaining cost estimates.
- Providing samples and colors of materials to be used.
- Arranging and overseeing painting, wallpapering, and flooring.
- Selecting and purchasing furnishings and other items.

There are no formal educational requirements to enter this career. You can start calling yourself an interior decorator as soon as you start doing interior decorating.

Kitchen and Bath Designer

Some drafters and designers choose to specialize in the area of residential kitchen and bath design. This might include design work for a client, working with a residential contractor, or working with manufacturers of kitchen