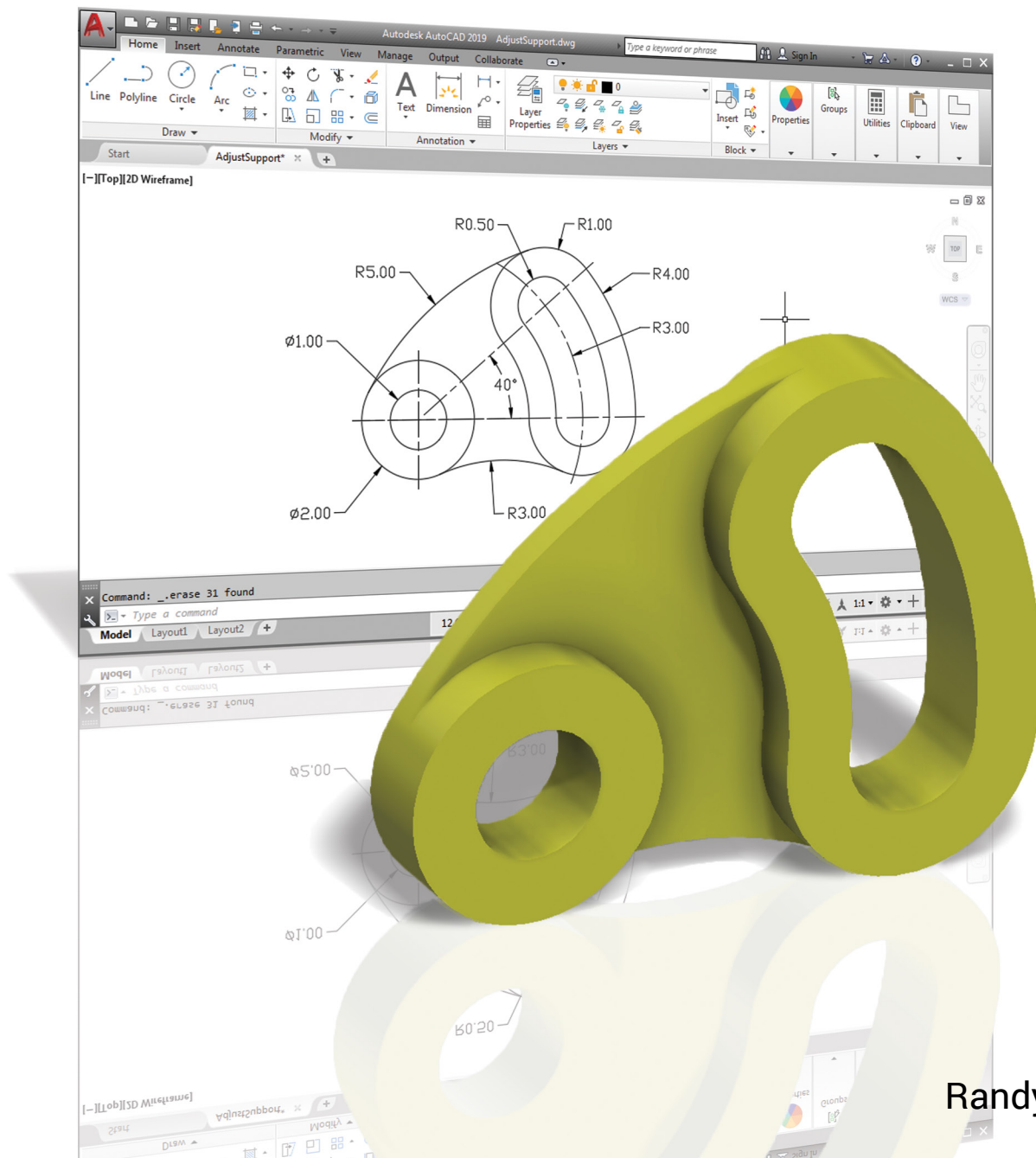


Principles and Practice

An Integrated Approach to
Engineering Graphics and AutoCAD® 2019



Randy H. Shih

Visit the following websites to learn more about this book:



amazon.com

Google books

BARNES & NOBLE

Table of Contents

Preface	i
Acknowledgments	ii
Table of Contents	iii
AutoCAD Certified User Examination Reference Guide	xiii
Tips about Taking the AutoCAD Certified User Examination	xx

Chapter 1

Introduction and AutoCAD Fundamentals

Introduction	1-3
Drawing in CAD Systems	1-5
Development of Computer Geometric Modeling	1-5
Why use AutoCAD 2019?	1-8
Getting Started with AutoCAD 2019	1-10
AutoCAD 2019 Screen Layout	1-11
Application Menu	1-12
Quick Access Toolbar	1-12
AutoCAD Menu Bar	1-12
Layout Tabs	1-12
Drawing Area	1-13
Graphics Cursor or Crosshairs	1-13
Command Prompt Area	1-13
Cursor Coordinates	1-13
Status Toolbar	1-13
Ribbon Tabs and Panels	1-14
Draw and Modify Toolbar Panels	1-14
Layers Control Toolbar Panel	1-14
Viewport/View/Display Controls	1-14
Mouse Buttons	1-15
[Esc] - Canceling Commands	1-15
Online Help	1-16
Leaving AutoCAD 2019	1-17
Creating a CAD File Folder	1-17
Drawing in AutoCAD	1-18
Starting Up AutoCAD 2019	1-18
Drawing Units Setup	1-20
Drawing Area Setup	1-21
Drawing Lines with the Line Command	1-23
Visual Reference	1-25
Grid On	1-26
Snap Mode On	1-27
Using the Erase Command	1-28
Repeat the Last Command	1-29

The CAD Database and the User Coordinate System	1-30
Changing to the 2D UCS Icon Display	1-31
Cartesian and Polar Coordinate Systems	1-32
Absolute and Relative Coordinates	1-32
Defining Positions	1-33
GRID Style Setup	1-33
The GuidePlate	1-34
Creating Circles	1-38
Save the CAD Design	1-40
Close the Current Drawing	1-41
The Spacer Design	1-42
Start a New Drawing	1-42
Drawing Units Setup	1-43
Drawing Area Setup	1-44
Using the Line Command	1-46
Using the Erase Command	1-48
Using the Arc Command	1-48
Using the Circle Command	1-50
Saving the CAD Design	1-51
Exit AutoCAD 2019	1-51
Review Questions	1-52
Exercises	1-53

Chapter 2

Geometric Constructions

Geometric Constructions	2-3
Geometric Constructions - Classical Methods	2-4
Bisection of a Line or Arc	2-4
Bisection of an Angle	2-5
Transfer of an Angle	2-6
Dividing a Given Line into a Number of Equal Parts	2-7
Circle through Three Points	2-8
Line Tangent to a circle from a Given Point	2-9
Circle of a Given Radius Tangent to Two Given Lines	2-10
Circle of a Given Radius Tangent to an Arc and a Line	2-11
Circle of a Given Radius Tangent to Two Arcs	2-12
Starting Up AutoCAD 2019	2-13
Dynamic Input	2-13
Object Snap Toolbar	2-17
Geometric Construction - CAD Method	2-18
Bisection of a Line or Arc	2-18
Bisection of an Angle	2-21
Transfer of an Angle	2-23
Dividing a Given Line into a Number of Equal Parts	2-27
Circle through Three Points	2-29

Line Tangent to a Circle from a Given Point	2-30
Circle of a Given Radius Tangent to Two Given Lines	2-31
The RockerArm Design	2-34
Activate the Startup Option	2-34
Drawing Units Display Setup	2-36
GRID and SNAP Intervals Setup	2-36
Drawing Area Setup	2-37
Referencing the World Coordinate System	2-38
Creating Circles	2-39
Using the Line Command	2-40
Creating TTR Circles	2-42
Using the Trim Command	2-44
Using the Polygon Command	2-46
Creating a Concentric Circle	2-48
Using the QuickCalc Calculator to Measure Distance and Angle	2-49
Saving the CAD File	2-53
Exit AutoCAD	2-53
Review Questions	2-55
Exercises	2-56

Chapter 3

Object Properties and Organization

Introduction	3-3
The Floor Plan Design	3-3
Starting Up AutoCAD 2019	3-4
Using the Setup Wizard	3-4
Drawing Units Setup	3-5
Reference Area Setup	3-5
Grid and Snap Intervals Setup	3-6
Using the Zoom Extents Command in the Navigation Bar	3-7
The AutoCAD Multiline Command	3-7
Object Snap Toolbar	3-10
Drawing Multilines	3-11
Creating Interior Walls	3-14
Joining the Walls Using Multiline Edit	3-17
Using Layers and Object Properties	3-19
Using Zoom Realtime	3-22
Modeling the Bathroom	3-23
Controlling Layer Visibility	3-25
Adding a New Layer	3-25
Moving Objects to a Different Layer	3-26
Matching Layer Properties	3-27
Review Questions	3-29
Exercises	3-30

Chapter 4**Orthographic Projections and Multiview Constructions**

Introduction	4-3
Basic Principles of Projection	4-4
Orthographic Projection	4-4
Multiview Orthographic Projection	4-5
First-Angle Projection	4-6
Rotation of the Horizontal and Profile Planes	4-7
Getting the 3D Adjuster Model through the Internet	4-8
Dynamic Rotation – 3D Orbit	4-9
General Procedure: 1 st Angle Orthographic Projection	4-10
1 st Angle Orthographic Sketching Exercises	4-11
Third-Angle Projection	4-13
Rotation of the Horizontal and Profile Planes	4-14
Examining the 3 rd Angle Projection	4-15
The Glass Box and the Six Principal Views	4-16
Examining the Glass Box Model	4-18
General Procedure: 3 rd Angle Orthographic Projection	4-19
Example 2: 3 rd Angle Orthographic Projection	4-20
3 rd Angle Orthographic Sketching Exercises	4-21
Alphabet of Lines	4-23
Precedence of Lines	4-25
The Locator Part	4-26
Starting Up AutoCAD 2019	4-26
Layers Setup	4-27
Drawing Construction Lines	4-28
Using the Offset Command	4-28
Set Layer Object as the Current Layer	4-30
Using the Running Object Snaps	4-30
Creating Object Lines	4-32
Turn OFF the Construction Lines Layer	4-33
Adding More Objects in the Front View	4-33
AutoCAD's AutoSnap™ and AutoTrack™ Features	4-34
Adding More Objects in the Top View	4-36
Drawing Using the Miter Line Method	4-40
More Layers Setup	4-42
Top View to Side View Projection	4-43
Completing the Front View	4-45
Object Information Using the List Command	4-47
Object Information Using the Properties Command	4-48
Review Questions	4-49
Exercises	4-50

Chapter 5**Pictorials and Sketching**

Engineering Drawings, Pictorials and Sketching	5-2
--	-----

Isometric Sketching	5-7
Isometric Sketching Exercises	5-9
Oblique Sketching	5-19
Oblique Sketching Exercises	5-20
Perspective Sketching	5-26
One-point Perspective	5-27
Two-point Perspective	5-28
Perspective Sketching Exercises	5-29
Review Questions	5-35
Exercises	5-36

Chapter 6

Dimensioning and Notes

Introduction	6-3
Dimensioning Standards and Basic Terminology	6-4
Selection and Placement of Dimensions and Notes	6-5
Machined Holes	6-12
Baseline and Chain Dimensioning	6-15
Dimensioning and Tolerance Accumulation	6-16
(1) Tolerance Accumulation – Baseline Dimensioning	6-17
(2) Tolerance Accumulation – Chain Dimensioning	6-18
(3) Avoid Tolerance Accumulation – Dimensioning Features	6-19
Dimensioning Tools in AutoCAD	6-20
The P-Bracket Design	6-20
Starting Up AutoCAD 2019	6-21
Layers Setup	6-22
The P-Bracket Design	6-23
LineWeight Display Control	6-23
Drawing Construction Lines	6-24
Using the Offset Command	6-24
Set Layer Object_Lines as the Current Layer	6-26
Creating Object Lines	6-26
Creating Hidden Lines	6-27
Creating Center Lines	6-28
Turn Off the Construction Lines	6-28
Using the Fillet Command	6-29
Saving the Completed CAD Design	6-30
Accessing the Dimensioning Commands	6-31
The Dimension Toolbar	6-32
Using Dimension Style Manager	6-32
Dimensions Nomenclature and Basics	6-33
Using the Center Mark Command	6-36
Adding Linear Dimensions	6-37
Adding an Angular Dimension	6-38
Adding Radius and Diameter Dimensions	6-39

Using the Multiline Text Command	6-40
Adding Special Characters	6-41
Saving the Design	6-42
A Special Note on Layers Containing Dimensions	6-42
Review Questions	6-43
Exercises	6-44

Chapter 7

Tolerancing and Fits

Precision and Tolerance	7-2
Methods of Specifying Tolerances – English System	7-3
Nomenclature	7-4
Example 7.1	7-5
Fits between Mating Parts	7-6
Selective Assembly	7-7
Basic Hole and Basic Shaft Systems	7-7
American National Standard Limits and Fits – Inches	7-8
Example 7.2 Basic Hole System	7-13
Example 7.3 Basic Hole System	7-14
Example 7.4 Basic Shaft System	7-15
Example 7.5 Basic Shaft System	7-16
Tolerancing – Metric System	7-17
Metric Tolerances and Fits Designation	7-18
Preferred ISO Metric Fits	7-19
Example 7.6 Metric Hole Basis System	7-20
Example 7.7 Shaft Basis System	7-21
Updating the Bracket Drawing	7-22
The Dimension Style Manager	7-22
Tolerances Settings in the Dimension Style Manager	7-23
Determining the Tolerances Required	7-24
Review Questions	7-28
Exercises	7-29

Chapter 8

Symmetrical Features in Designs

Introduction	8-3
The GenevaCam Design	8-3
Starting Up AutoCAD 2019	8-4
Setting Up the Plot Style Mode	8-5
Starting a New File	8-7
Grid and Snap Intervals Setup	8-8
Layers Setup	8-9
Adding Borders and Title Block in the Layout	8-10
Create a Template File	8-13

Exit AutoCAD 2019	8-14
Starting Up AutoCAD 2019	8-14
The Geneva Cam Drawing	8-15
Drawing Construction Lines	8-16
Creating Object Lines	8-17
Using the Offset Command	8-18
Using the Mirror Command	8-20
Using the Array Command	8-21
Creating a Viewport Inside the Title Block	8-24
Viewport Properties	8-25
Hide the Viewport Borders	8-26
Adjusting the Dimension Scale	8-26
Plot/Print the Drawing	8-28
Create a B size Layout of the design	8-30
Adjust the Dimension Scale for the B size Print	8-34
Review Questions	8-36
Exercises	8-37

Chapter 9

Auxiliary Views

Introduction	9-3
Normal View of an Inclined Surface	9-4
Construction Method I – Folding Line Method	9-6
Construction Method II – Reference Plane Method	9-8
Partial Views	9-10
Creating Auxiliary Views in AutoCAD	9-11
The V-Block Design	9-11
The V-Block Example	9-12
Starting Up AutoCAD 2019	9-12
Setting Up the Principal Views	9-13
Setting Up the Top View	9-16
Using the Offset Command	9-17
Creating Object Lines in the Front View	9-19
Setting the Polar Tracking Option	9-20
Setting Up an Auxiliary View	9-23
Aligning the Auxiliary View to the Front View	9-24
Creating the V-cut in the Auxiliary View	9-24
Creating the V-cut in the Front View and Top View	9-27
Setting the Polar Tracking Option	9-29
Completing the Top View	9-29
Edit the Plot Style Table	9-32
Using the Area Inquiry Tool to Measure Area and Perimeter	9-35
Start a new drawing for a Metric Template File	9-39
Layers Setup	9-40
Set up Metric Borders and Title Block by Copy & Paste	9-41

Review Questions	9-46
Exercises	9-47

Chapter 10

Section Views

Introduction	10-3
General Rules of Section Views	10-5
Section Drawing Types	10-6
Full Section	10-6
Half Section	10-6
Offset Section	10-7
Broken-Out Section	10-7
Aligned Section	10-8
Half Views	10-8
Thin Sections	10-8
Revolved Section	10-9
Removed Section	10-9
Conventional Breaks	10-10
Ribs and Webs in Sections	10-10
Parts Not Sectioned	10-10
Section Views in AutoCAD	10-11
The Bearing Design	10-11
Starting Up AutoCAD 2019	10-12
The Bearing Example	10-13
Setting up the Principal Views	10-13
Creating Object Lines in the Front View	10-15
Editing the Circles	10-17
Setting Up the Side View	10-18
Adding Hidden Lines in the Side View	10-20
Changing the Linetype Scale Property	10-22
Stretching and Moving Objects with Grips	10-23
Drawing a Cutting Plane Line	10-24
Converting the Side View into a Section View	10-27
Adding Section Lines	10-29
Review Questions	10-32
Exercises	10-33

Chapter 11

AutoCAD 2D Isometric Drawings

Introduction	11-2
The Angle Support Design	11-2
Starting Up AutoCAD 2019	11-3
AutoCAD Isoplane and Isodraft Commands	11-4
Layers Setup	11-5

Create the Base Box of the Design	11-6
Create the Design inside the Base Box	11-10
Create the Isocircle on the top face	11-13
Using the Editing Tools in an Isometric drawing	11-16
The Tube Anchor Design – Modeling Strategy	11-16
Start a New Drawing and Layers Setup	11-17
Create a Base Box of the Design	11-18
Locate the Centers for the Isocircles	11-21
Create the Isocircles	11-23
Using the Object Snap tools to complete the drawing	11-29
Review Questions	11-34
Exercises	11-35

Chapter 12

Threads and Fasteners

Introduction	12-2
Screw-Thread Terminology	12-3
Thread Forms	12-5
Thread Representations	12-6
Detailed Representation	12-7
Schematic Representation	12-8
Simplified Representation	12-9
Thread Specification – English Units	12-10
Unified Thread Series	12-11
Thread Fits	12-12
Thread Specification – Metric	12-12
Thread Notes Examples	12-13
Specifying Fasteners	12-14
Commonly used Fasteners	12-15
Drawing Standard Bolts	12-17
Bolt and Screw Clearances	12-17
Review Questions	12-18
Exercises	12-19

Chapter 13

Working Drawings

General Engineering Design Process	13-3
Working Drawings	13-4
Detail Drawings	13-4
Assembly Drawings	13-5
Bill of Materials (BOM) and Parts List	13-5
Drawing Sizes	13-6
Drawing Sheet Borders and Revisions Block	13-6
Title Blocks	13-7

Working Drawings with AutoCAD	13-8
The Shaft Support Subassembly	13-9
Additional Parts	13-9
Cap-Screw	13-9
Collar	13-10
Base-Plate	13-10
Starting Up AutoCAD and Loading Multiple Drawings	13-11
Using AutoCAD with the Internet	13-12
Rearrange the Displayed Windows	13-13
Defining a Block	13-14
Inserting a Block	13-16
Starting an Assembly Drawing	13-17
Copying and Pasting with the Windows Clipboard	13-18
Converting the View into a Section View	13-19
Adding the Bearing to the Assembly	13-21
Adding the Cap-Screws to the Assembly	13-24
Creating Callouts with the Multileader Command	13-26
Creating a Viewport in the A-size Layout	13-29
Viewport Properties	13-30
Adding a Parts List to the Assembly Drawing	13-31
Review Questions	13-37
Exercises	13-38

Appendix

- A. Running and Sliding Fits – American National Standard
- B. Metric Limits and Fits
- C. Unified Nation Thread Form
- D. Metric Thread Form
- E. Fasteners (Inch Series)
- F. Metric Fasteners
- G. Bolt and Screw Clearance Holes
- H. References

Index