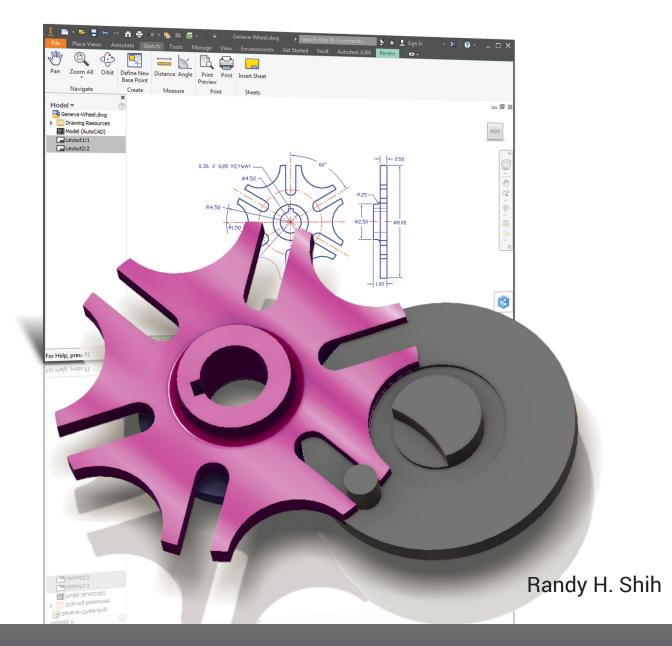
Tools for Design Using AutoCAD 2018 and Autodesk Inventor 2018

Hand Sketching, 2D Drawing and 3D Modeling





Better Textbooks. Lower Prices. www.SDCpublications.com

Visit the following websites to learn more about this book:



Table of Contents

Preface Acknowledgments

Introduction Getting Started

Intro-2
Intro-2
Intro-5
Intro-6
Intro-7

Section I – AutoCAD

Chapter 1 Fundamentals of AutoCAD

Getting Started with AutoCAD 2018	1-2
AutoCAD 2018 Screen Layout	1-3
Application Menu	1-4
Quick Access Toolbar	1-4
AutoCAD Menu Bar	1-4
Layout Tabs	1-4
Drawing Area	1-5
Graphics Cursor or Crosshairs	1-5
Command Prompt Area	1-5
Cursor Coordinates	1-5
Status Toolbar	1-5
Ribbon Tabs and Panels	1-6
Draw and Modify Toolbar Panels	1-6
Layers Control Toolbar Panel	1-6
Viewport/View/Display Controls	1-6
Mouse Buttons	1-7
[Esc] – Canceling Commands	1-7
Online Help	1-8
Leaving AutoCAD 2018	1-9
Creating a CAD File Folder	1-9
Drawing in AutoCAD	1-10
Starting Up AutoCAD 2018	1-10
Drawing Units Setup	1-12
Drawing Area Setup	1-13

i ii

Drawing Lines with the Line Command	1-15
Visual Reference	1-17
GRID ON	1-18
SNAP MODE ON	1-19
Using the Erase Command	1-20
Repeat the Last Command	1-21
The CAD Database and the User Coordinate System	1-22
Changing to the 2D UCS Icon Display	1-23
Cartesian and Polar Coordinate Systems	1-24
Absolute and Relative Coordinates	1-24
Defining Positions	1-25
Grid Style Setup	1-25
The GuidePlate	1-26
Creating Circles	1-30
Saving the CAD Design	1-32
Close the Current Drawing	1-33
The Spacer Design	1-34
Start a New Drawing	1-34
Drawing Units Setup	1-35
Drawing Area Setup	1-36
Using the Line Command	1-38
Using the Erase Command	1-40
Using the Arc Command	1-40
Using the Circle Command	1-42
Saving the CAD Design	1-43
Exit AutoCAD 2018	1-43
Review Questions	1-44
Exercises	1-45

Chapter 2 Basic Object Construction and Dynamic Input - AutoCAD

Introduction	2-2
Starting Up AutoCAD 2018	2-2
Dynamic Input	2-3
The RockerArm Design	2-6
Activate the Startup Option	2-7
Drawing Units Display Setup	2-8
Grid and Snap Intervals Setup	2-9
Drawing Area Setup	2-10
Referencing the World Coordinate System	2-11
Creating Circles	2-12
Object Snap Toolbar	2-13
Using the Line Command	2-14
Creating TTR Circles	2-16
Using the Trim Command	2-18

Using the Polygon Command	2-20
Creating a Concentric Circle	2-22
Using the QuickCal Calculator to Measure Distance and Angle	2-23
Saving the CAD File	2-27
Exit AutoCAD	2-27
AutoCAD Quick Keys	2-28
Review Questions	2-29
Exercises	2-30

Chapter 3 Geometric Construction and Editing Tools - AutoCAD

Geometric Constructions	3-2
Starting Up AutoCAD 2018	3-3
Geometric Construction - CAD Method	3-4
Bisection of a Line or Arc	3-4
Bisection of an Angle	3-7
Transfer of an Angle	3-9
Dividing a Given Line into a Number of Equal Parts	3-13
Circle through Three Points	3-15
Line Tangent to a Circle from a Given Point	3-16
Circle of a Given Radius Tangent to Two Given Lines	3-17
The Gasket Design	3-20
Drawing Units Display Setup	3-21
Grid and Snap Intervals Setup	3-22
Using the Line Command with ORTHO Option	3-23
Object Snap Toolbar	3-25
Using the Extend Command	3-28
Using the Trim Command	3-29
Creating a TTR Circle	3-30
Using the Fillet Command	3-31
Converting Objects into a Polyline	3-32
Using the Offset Command	3-33
Using the Area Inquiry Tool to Measure Area and Perimeter	3-34
Using the Explode Command	3-36
Create another Fillet	3-36
Saving the CAD File	3-37
Exit AutoCAD	3-37
Review Questions	3-38
Exercises	3-39

Chapter 4 Orthographic Views in Multiview Drawings - AutoCAD

Introduction	4-2
The Locator Design	4-2

The Locator Part	4-3
Starting Up AutoCAD 2018	4-3
Layers Setup	4-4
Drawing Construction Lines	4-5
Using the Offset Command	4-5
Set Layer Object as the Current Layer	4-7
Using the Running Object Snaps	4-7
Creating Object Lines	4-9
Turn Off the Construction Lines Layer	4-10
Adding More Objects in the Front View	4-10
AutoCAD's AutoSnap TM and AutoTrack TM Features	4-11
Adding More Objects in the Top View	4-13
Drawing Using the Miter Line Method	4-17
More Layers Setup	4-19
Top View to Side View Projection	4-20
Completing the Front View	4-22
Object Information Using the List Command	4-24
Object Information Using the Properties Command	4-25
Review Questions	4-26
Exercises	4-27

Chapter 5 Basic Dimensioning and Notes - AutoCAD

Introduction	5-2
The Bracket Design	5-2
Starting Up AutoCAD 2018	5-3
Layers Setup	5-4
The P-Bracket Design	5-5
LineWeight Display Control	5-5
Drawing Construction Lines	5-6
Using the Offset Command	5-6
Set Layer Object_Lines as the Current Layer	5-8
Creating Object Lines	5-8
Creating Hidden Lines	5-9
Creating Center Lines	5-10
Turn Off the Construction Lines	5-10
Using the Fillet Command	5-11
Saving the Completed CAD Design	5-12
Accessing the Dimensioning Commands	5-13
The Dimension Toolbar	5-14
Using the Dimension Style Manager	5-14
Dimensions Nomenclature and Basics	5-15
Using the Center Mark Command	5-18
Adding Linear Dimensions	5-19
Adding an Angular Dimension	5-20

vii

Adding Radius and Diameter Dimensions	5-21
Using the Multiline Text Command	5-22
Adding Special Characters	5-23
Saving the Design	5-24
A Special Note on Layers Containing Dimensions	5-24
Review Questions	5-25
Exercises	5-26

Chapter 6 Pictorials and Sketching

Engineering Drawings, Pictorials and Sketching	6-2
Isometric Sketching	6-7
Chapter 6 - Isometric Sketching Exercises	6-9
Oblique Sketching	6-19
Chapter 6 - Oblique Sketching Exercises	6-20
Perspective Sketching	6-26
One-point Perspective	6-27
Two-point Perspective	6-28
Chapter 6 - Perspective Sketching Exercises	6-29
Review Questions	6-35
Exercises	6-36

Section II – Autodesk Inventor

Chapter 7 Parametric Modeling Fundamentals – Autodesk Inventor

Getting Started with Autodesk Inventor	7-2
The Screen Layout and Getting Started Toolbar	7-3
The New File Dialog Box and Units Setup	7-4
The Default Autodesk Inventor Screen Layout	7-5
File Menu	7-6
Quick Access Toolbar	7-6
Ribbon Tabs and Tool Panels	7-6
Online Help Panel	7-6
3D Model Toolbar	7-7
Graphics Window	7-7
Message and Status Bar	7-7
Mouse Buttons	7-8
[Esc] – Canceling Commands	7-8
Autodesk Inventor Help System	7-9
Data Management Using Inventor Project Files	7-10
Setup of a New Inventor Project	7-11
The Content of the Inventor Project File	7-14

Leaving Autodesk Inventor	7-14
Feature-Based Parametric Modeling	7-15
The Adjuster Design	7-16
Starting Autodesk Inventor	7-16
The	
Sketch Plane – It is an XY Monitor, but an XYZ World	7-18
Creating Rough Sketches	7-20
Step 1: Creating a Rough Sketch	7-21
Graphics Cursors	7-21
Geometric Constraint Symbols	7-22
Step 2: Apply/Modify Constraints and Dimensions	7-23
Dynamic Viewing Functions – Zoom and Pan	7-26
Modifying the Dimensions of the Sketch	7-26
Step 3: Completing the Base Solid Feature	7-27
Isometric View	7-28
Dynamic Rotation of the 3D Block – Free Orbit	7-29
Dynamic Viewing – Quick Keys	7-31
Viewing Tools – Standard Toolbar	7-32
Display Modes	7-36
Orthographic vs. Perspective	7-36
Disable the Heads-Up Display Option	7-37
Step 4-1: Adding an Extruded Feature	7-38
Step 4-2: Adding a Cut Feature	7-42
Step 4-3: Adding another Cut Feature	7-45
Save the Model	7-48
Review Questions	7-49
Exercises	7-50

Chapter 8 Constructive Solid Geometry Concepts – Autodesk Inventor

Introduction	8-2
Binary Tree	8-3
The Locator Design	8-4
Modeling Strategy – CSG Binary Tree	8-5
Starting Autodesk Inventor	8-6
Base Feature	8-7
Grid Display Setup	8-8
Model Dimensions Format	8-11
Modifying the Dimensions of the Sketch	8-11
Repositioning Dimensions	8-12
Using the Measure Tools	8-13
Completing the Base Solid Feature	8-16
Creating the Next Solid Feature	8-17
Creating a Cut Feature	8-21
Creating a Placed Feature	8-24

Creating a Rectangular Cut Feature	8-26
Save the Model	8-28
Review Questions	8-29
Exercises	8-30

Chapter 9 Model History Tree – Autodesk Inventor

Introduction	9-2
The Saddle Bracket Design	9-3
Starting Autodesk Inventor	9-3
Modeling Strategy	9-4
The Autodesk Inventor Browser	9-5
Creating the Base Feature	9-5
Adding the Second Solid Feature	9-8
Creating a 2D Sketch	9-9
Renaming the Part Features	9-11
Adjusting the Width of the Base Feature	9-12
Adding a Placed Feature	9-13
Creating a Rectangular Cut Feature	9-15
History-Based Part Modifications	9-16
A Design Change	9-17
Assigning and Calculating the Associated Physical Properties	9-20
Review Questions	9-22
Exercises	9-23

Chapter 10 Parametric Constraints Fundamentals - Autodesk Inventor

Constraints and Relations	10-2
Create a Simple Triangular Plate Design	10-2
Fully Constrained Geometry	10-3
Starting Autodesk Inventor	10-3
Displaying Existing Constraints	10-4
Applying Geometric/Dimensional Constraints	10-6
Over-Constraining and Driven Dimensions	10-10
Deleting Existing Constraints	10-11
Using the Auto Dimension Command	10-12
Constraint and Sketch Settings	10-17
Parametric Relations	10-18
Dimensional Values and Dimensional Variables	10-20
Parametric Equations	10-21
Viewing the Established Parameters and Relations	10-23
Saving the Model File	10-24
Using the Measure Tools	10-25
Review Questions	10-29

Exercises

10-30

Chapter 11 Geometric Construction Tools - Autodesk Inventor

Introduction	11-2
The Gasket Design	11-2
Modeling Strategy	11-3
Starting Autodesk Inventor	11-4
Create a 2D Sketch	11-5
Edit the Sketch by Dragging the Sketched Entities	11-7
Add Additional Constraints	11-9
Use the Trim and Extend Commands	11-10
The Auto Dimension Command	11-12
Create Fillets and Completing the Sketch	11-14
Fully Constrained Geometry	11-15
Profile Sketch	11-17
Redefine the Sketch and Profile	11-18
Create an Offset Cut Feature	11-22
Review Questions	11-25
Exercises	11-26

Chapter 12 Parent/Child Relationships and the BORN Technique - Autodesk Inventor

Introduction The BORN Technique The U-Bracket Design	12-2 12-2 12-3
Sketch Plane Settings	12-4
Apply the BORN Technique	12-5
Create the 2D Sketch for the Base Feature	12-7
Create the First Extrude Feature	12-10
The Implied Parent/Child Relationships	12-11
Create the Second Solid Feature	12-11
Create the First Cut Feature	12-15
The Second Cut Feature	12-16
Examine the Parent/Child Relationships	12-18
Modify a Parent Dimension	12-19
A Design Change	12-20
Feature Suppression	12-21
A Different Approach to the Center_Drill Feature	12-22
Suppress the Rect_Cut Feature	12-24
Create a Circular Cut Feature	12-25
A Flexible Design Approach	12-27
View and Edit Material Properties	12-28

х

Review Questions	12-30
Exercises	12-31

Chapter 13 Part Drawings and 3D Model-Based Definition - Autodesk Inventor

Drawings from Parts and Associative Functionality	13-2
3D Model-Based Definition	13-3
Starting Autodesk Inventor	13-4
Drawing Mode – 2D Paper Space	13-4
Drawing Sheet Format	13-6
Using the Pre-defined Drawing Sheet Formats	13-8
Delete, Activate, and Edit Drawing Sheets	13-10
Add a Base View	13-11
Create Projected Views	13-12
Adjust the View Scale	13-13
Repositioning Views	13-14
Display Feature Dimensions	13-15
Repositioning and Hiding Feature Dimensions	13-17
Add Additional Dimensions – Reference Dimensions	13-19
Add Center Marks and Center Lines	13-20
Complete the Drawing Sheet	13-23
Associative Functionality – Modifying Feature Dimensions	13-24
3D Model-Based Definition	13-27
Review Questions	13-35
Exercises	13-36

Chapter 14 Symmetrical Features in Designs - Autodesk Inventor

Introduction	14-2
A Revolved Design: Pulley	14-2
Modeling Strategy – A Revolved Design	14-3
Starting Autodesk Inventor	14-4
Set Up the Display of the Sketch Plane	14-4
Creating the 2D Sketch for the Base Feature	14-5
Create the Revolved Feature	14-9
Mirroring Features	14-10
Create a Pattern Leader Using Construction Geometry	14-12
Circular Pattern	14-17
Examine the Design Parameters	14-19
Drawing Mode – Defining a New Border and Title Block	14-19
Create a Drawing Template	14-23
Create the Necessary Views	14-24
Retrieve Model Annotations – Features Option	14-27

Associative Functionality – A Design Change	14-29
Add Centerlines to the Pattern Feature	14-31
Complete the Drawing	14-32
Review Questions	14-35
Exercises	14-36

AutoCAD and Autodesk Inventor

Chapter 15 Design Reuse Using AutoCAD and Autodesk Inventor

Introduction	15-2
The Geneva Wheel Design	15-3
Internet Download of the Geneva-Wheel DWG File	15-3
Opening AutoCAD DWG File in Inventor	15-4
Switch to the AutoCAD DWG Layout	15-5
2D Design Reuse	15-7
Complete the Imported Sketch	15-11
Create the First Solid Feature	15-13
Create a Mirrored Feature	15-14
Circular Pattern	15-15
Complete the Geneva Wheel Design	15-16
Export an Inventor 2D Sketch as an AutoCAD Drawing	15-20
Design Reuse – Sketch Insert Option	15-21
Review Questions	15-27
Exercises	15-28

Chapter 16 Assembly Modeling - Putting It All Together - Autodesk Inventor

Introduction	16-2
Assembly Modeling Methodology	16-3
The Shaft Support Assembly	16-4
Additional Parts	16-4
(1) Collar	16-4
(2) Bearing	16-5
(3) Base-Plate	16-5
(4) Cap-Screw	16-6
Starting Autodesk Inventor	16-7
Placing the First Component	16-8
Placing the Second Component	16-9
Degrees of Freedom and Constraints	16-10
Assembly Constraints	16-11
Apply the First Assembly Constraint	16-14
Apply a Second Mate Constraint	16-15

Constrained Move	16-16
Apply a Flush Constraint	16-17
Placing the Third Component	16-19
Applying an Insert Constraint	16-20
Assemble the Cap-Screws	16-21
Exploded View of the Assembly	16-22
Editing the Components	16-24
Adaptive Design Approach	16-25
Delete and Re-apply Assembly Constraints	16-29
Set Up a Drawing of the Assembly Model	16-31
Creating a Parts List	16-33
Edit the Parts List	16-34
Change the Material Type	16-36
Add the Balloon Callouts	16-38
Completing the Title Block Using the iProperties Option	16-38
Bill of Materials	16-40
(a) BOM from Parts List	16-40
(b) BOM from Assembly Model	16-41
Review Questions	16-42
Exercises	16-43

Chapter 17 Design Analysis - Autodesk Inventor Stress Analysis Module

Introduction	17-2
Problem Statement	17-4
Preliminary Analysis	17-4
Maximum Displacement	17-5
Finite Element Analysis Procedure	17-6
Create the Autodesk Inventor Part	17-7
Create the 2D Sketch for the Plate	17-7
Assigning the Material Properties	17-10
Switch to the Stress Analysis Module	17-11
Apply Constraints and Loads	17-14
Create a Mesh and Run the Solver	17-16
Refinement of the FEA Mesh – Global Element Size	17-18
Refinement of the FEA Mesh – Local Element Size	17-20
Comparison of Results	17-23
Create an HTML Report	17-24
Geometric Considerations of Finite Elements	17-25
Conclusion	17-26
Summary of Modeling Considerations	17-26
Review Questions	17-27
Exercises	17-28

Index

Bonus Chapters Available at: www.SDCpublications.com

Chapter 18 Assembly Modeling with the LEGO MINDSTORMS NXT Set – Autodesk Inventor

Introduction	18-2
The Basic Car Assembly	18-2
Modeling Strategy	18-3
Starting Autodesk Inventor	18-4
Creating a Subassembly	18-5
Placing the Next Component	18-6
Degrees of Freedom Display	18-7
Apply the Assembly Constraints	18-8
Assemble the Next Components	18-13
Assembling Bushing and Axel	18-15
Completing the Motor-Right Subassembly	18-18
Starting the Main Assembly	18-20
Assemble the Frame and Motors	18-23
Assemble the Motor Assemblies	18-25
Adding the Motor-Right Subassembly to the Main Assembly	18-30
Assemble the Rear Swivel Assembly and Wheels	18-31
Assemble the NXT Micro-controller	18-37
Assemble the Sensors	18-40

Chapter 19 Assembly Modeling with the TETRIX by Pitsco Building System – Autodesk Inventor

Introduction	19-2
The ST1 Assembly	19-2
Modeling Strategy	19-3
Starting Autodesk Inventor	19-4
Creating a Subassembly	19-5
Placing the Next Component	19-6
Degrees of Freedom Display	19-7
Apply Assembly Constraints	19-8
Starting the Main Assembly	19-18
Adjusting the Orientation of a Grounded Part	19-20
Adjusting the Orientation of Parts	19-22
Assemble the DC Motor Controller	19-25
Assemble the Servo Controller	19-27
Completing the Chassis	19-29
Assemble the Front-Wheel Assembly	19-30

Assemble the Motor-Wheel Assembly	19-33
Assemble the NXT Micro-controller	19-38
Assemble the NXT Touch-Sensor	19-39
Conclusion	19-41

Chapter 20 Assembly Model with Vex Robot Kit - Autodesk Inventor

Introduction The Tumbler Assembly	20-2 20-2
Starting Autodesk Inventor	20-2
Creating a Subassembly	20-3
Placing the Second Component	20-5
Degrees of Freedom Display	20-6
Adjusting the Component's Orientation	20-7
Apply Assembly Constraints	20-8
Assemble the Next Component	20-11
Assembling Bearing Rivets and Screws	20-13
Assembling Shaft Collars, Shafts and Motors	20-16
Assemble the Wheels	20-23
Modifying the Wheel Directions	20-27
Starting the Tumbler Assembly	20-30
Assemble the Chassis	20-33
Assemble the Chassis Plate	20-37
Adding the Battery Pack under the Chassis Plate	20-39
Adding the RF Receiver on the Rear Chassis Bumper	20-40
Assemble the VEX Microcontroller	20-43
Assemble the Antenna	20-46
Conclusion	20-47
Review Questions	20-48
Exercise	20-49