

Essentials, Volume 1

Autodesk Official Training Courseware (AOTC)

Autodesk[®]
Inventor[®]

2009

© 2008 Autodesk, Inc. All rights reserved.

Except as otherwise permitted by Autodesk, Inc., this publication, or parts thereof, may not be reproduced in any form, by any method, for any purpose.

Certain materials included in this publication are reprinted with the permission of the copyright holder.

Trademarks

The following are registered trademarks or trademarks of Autodesk, Inc., in the USA and other countries: 3DEC (design/logo), 3December, 3December.com, 3ds Max, ActiveShapes, Actrix, ADI, Alias, Alias (swirl design/logo), AliasStudio, Alias|Wavefront (design/logo), ATC, AUGI, AutoCAD, AutoCAD Learning Assistance, AutoCAD LT, AutoCAD Simulator, AutoCAD SQL Extension, AutoCAD SQL Interface, Autodesk, Autodesk Envision, Autodesk Insight, Autodesk Intent, Autodesk Inventor, Autodesk Map, Autodesk MapGuide, Autodesk Streamline, AutoLISP, AutoSnap, AutoSketch, AutoTrack, Backdraft, Built with ObjectARX (logo), Burn, Buzzsaw, CAiCE, Can You Imagine, Character Studio, Cinestream, Civil 3D, Cleaner, Cleaner Central, ClearScale, Colour Warper, Combustion, Communication Specification, Constructware, Content Explorer, Create>what's>Next> (design/logo), Dancing Baby (image), DesignCenter, Design Doctor, Designer's Toolkit, DesignKids, DesignProf, DesignServer, DesignStudio, Design|Studio (design/logo), Design Web Format, Design Your World, Design Your World (design/logo), DWF, DWG, DWG (logo), DWG TrueConvert, DWG TrueView, DXF, EditDV, Education by Design, Exposure, Extending the Design Team, FBX, Filmbox, FMDesktop, Freewheel, GDX Driver, Gmax, Heads-up Design, Heidi, HOOPS, HumanIK, i-drop, iMOUT, Incinerator, IntroDV, Inventor, Inventor LT, Kaydara, Kaydara (design/logo), LocationLogic, Lustre, Maya, Mechanical Desktop, MotionBuilder, Mudbox, NavisWorks, ObjectARX, ObjectDBX, Open Reality, Opticore, Opticore Opus, PolarSnap, PortfolioWall, Powered with Autodesk Technology, Productstream, ProjectPoint, ProMaterials, Reactor, RealDWG, Real-time Roto, Recognize, Render Queue, Reveal, Revit, Showcase, ShowMotion, SketchBook, SteeringWheels, StudioTools, Topobase, Toxik, ViewCube, Visual, Visual Bridge, Visual Construction, Visual Drainage, Visual Hydro, Visual Landscape, Visual Roads, Visual Survey, Visual Syllabus, Visual Toolbox, Visual Tugboat, Visual LISP, Voice Reality, Volo, Wiretap, and WiretapCentral.

The following are registered trademarks or trademarks of Autodesk Canada Co. in the USA and/or Canada and other countries: Backburner, Discreet, Fire, Flame, Flint, Frost, Inferno, Multi-Master Editing, River, Smoke, Sparks, Stone, and Wire.

All other brand names, product names, or trademarks belong to their respective holders.

Disclaimer

THIS PUBLICATION AND THE INFORMATION CONTAINED HEREIN IS MADE AVAILABLE BY AUTODESK, INC. "AS IS." AUTODESK, INC. DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE REGARDING THESE MATERIALS.

Published by:
Autodesk, Inc.
111 McInnis Parkway
San Rafael, CA 94903, USA

Contents

Volume 1

- Introduction** **xiii**

- Chapter 1: Getting Started** **1**
 - Lesson: Autodesk Inventor User Interface..... 2
 - Overview..... 2
 - About Multiple Environments..... 3
 - About Project Files 7
 - Inventor File Types 8
 - Menus and Toolbars..... 11
 - Context-Sensitive Tools..... 13
 - Online Help and Tutorials..... 21
 - Exercise: Explore the Autodesk Inventor User Interface..... 26
 - Lesson: View Manipulation..... 29
 - Overview..... 29
 - About the Graphics Window..... 30
 - Orbit Tools 32
 - About the ViewCube 35
 - Using the ViewCube..... 36
 - Using Home View..... 43
 - Restoring Your Views 46
 - Exercise: Manipulate Your Model Views 48
 - Lesson: Designing Parametric Parts 52
 - Overview..... 52
 - About Parametric Part Models 53
 - Capturing Design Intent 56
 - Creating Parametric Part Models 60
 - Part Design Environment 61
 - Exercise: Create a Parametric Part 63
 - Chapter Summary..... 65

Chapter 2: Basic Sketching Techniques..... 67

- Lesson: Creating 2D Sketches 68
 - Overview..... 68
 - About Sketching 69
 - Point Alignment..... 73
 - Reorienting the Initial Sketch 74
 - Basic Sketching Tools..... 76
 - Guidelines for Successful Sketches 81
 - Exercise: Create 2D Sketches 82
- Lesson: Geometric Constraints..... 85
 - Overview..... 85
 - About Geometric Constraints 86
 - About Constraint Inference and Persistence..... 88
 - Applying Geometric Constraints 91
 - Showing and Deleting Constraints 95
 - Guidelines for Successful Constraining 97
 - Toggle Sketch Degrees of Freedom Glyph Display..... 99
 - Exercise: Constrain Sketches 101
- Lesson: Dimensioning Sketches..... 104
 - Overview..... 104
 - About Dimensional Constraints 105
 - Creating Dimensional Constraints..... 107
 - About Dimension Display and Relationships..... 113
 - Guidelines for Dimensioning Sketches 117
 - Exercise: Dimension Sketches 119
- Chapter Summary 122

Chapter 3: Basic Shape Design 123

- Lesson: Creating Basic Sketched Features 124
 - Overview..... 124
 - About Sketched Features 125
 - Creating Extruded Features 127
 - Creating Revolved Features..... 131
 - Specifying Operation and Extents..... 135
 - Orienting Sketches 142
 - Exercise: Create Extruded Features..... 144
 - Exercise: Create Revolved Features..... 149
- Lesson: Intermediate Sketching..... 154
 - Overview..... 154
 - About Sketch Linetypes..... 155
 - Creating and Using Construction Geometry 158
 - Creating and Using Reference Geometry 162
 - Exercise: Create a Part Using Construction and Reference Geometry..... 167

Lesson: Editing Parametric Parts	171
Overview	171
Editing Features	172
Editing Sketches	175
Using Parameters	178
Exercise: Edit Parametric Parts	185
Exercise: Create Parameters and Equations	188
Lesson: 3D Grip Editing	192
Overview	192
About 3D Grip Editing	193
Using the 3D Grips Tool	195
Exercise: Edit with 3D Grips	198
Lesson: Creating Work Features	201
Overview	201
About Work Features	202
Creating Work Planes	206
Creating Work Axes	211
Creating Work Points	213
Exercise: Create Work Planes	218
Exercise: Create Work Axes	221
Exercise: Create Work Points	225
Lesson: Creating Basic Swept Shapes	229
Overview	229
About Swept Shapes	230
Creating Sweep Features	231
Guidelines for Creating Swept Shapes	236
Exercise: Create Sweep Features	238
Chapter Summary	241

Chapter 4: Detailed Shape Design 243

Lesson: Creating Chamfers and Fillets	244
About Chamfers and Fillets	245
Creating Chamfers	247
Creating Fillets	251
Guidelines for Creating Chamfers and Fillets	254
Exercise: Create Chamfers	255
Exercise: Create Fillets	257
Lesson: Creating Holes and Threads	260
About Hole Features	261
Creating Holes	263
Creating Threads	274
Exercise: Create Holes and Threads	279
Lesson: Patterning and Mirroring Features	286
About Feature Reuse	287
Lesson: Creating Rectangular Patterns	290
Lesson: Creating Circular Patterns	295
Lesson: Mirroring Features	300
Exercise: Create Pattern Features	305
Exercise: Mirror Part Features	308

Lesson: Creating Thin-Walled Parts.....	312
About Thin-Walled Part Design	313
Creating Shell Features	314
Exercise: Create and Edit Shell Features	318
Chapter Summary	321
Chapter 5: Assembly Design Overview	323
Lesson: Designing Assemblies	324
About Assembly Design	325
Constraints.....	326
Assembly Design Approaches.....	327
Using Existing Components.....	328
Designing Components In-Place	329
Subassemblies	330
Guidelines.....	330
Assembly Design Environment.....	331
Assembly Browser	333
Recommended Assembly Design Workflow	334
Exercise: Use the Assembly Environment	335
Lesson: Using Project Files in Assembly Designs	337
About Project Files	338
Project File Configuration.....	341
Creating a Project File	348
Editing Project Files.....	350
Recommendations for Project Files.....	352
Exercise: Create a Project File	355
Chapter Summary	357
Chapter 6: Placing, Creating, and Constraining Components	359
Lesson: Placing Components in an Assembly.....	360
Overview.....	360
About Placing Components in an Assembly	361
Placing Components in an Assembly	363
Exercise: Place Components in an Assembly.....	368
Lesson: Constraining Components.....	370
Overview.....	370
About Assembly Constraints	371
The Constraint Tool.....	373
Placing Constraints	378
Viewing and Editing Constraints	380
Proper Constraining Techniques	386
Exercise: Constrain Components	387
Lesson: Placing Standard Components Using the Content Center	392
Overview.....	392
About the Content Center	393
About Content Center Consumers	394
Using the Content Center Consumer Environment.....	395
Using the Supplier Content Center.....	401
Exercise: Use Content Center Data	402

Lesson: Basic Part Design in an Assembly	405
Overview	405
About Designing and Editing in an Assembly	406
Capturing Design Intent	408
Creating Components in Place	409
Editing Components in Place	413
Guidelines for In-Place Component Design	415
Exercise: Create Components in an Assembly	416
Chapter Summary	422

Volume 2

Chapter 7: Interacting with an Assembly 1

Lesson: Identifying Parts in an Assembly	2
Overview	2
Selecting Components	3
About Isolating Components	7
About Browser Filters	8
About Locating Components in the Browser and Graphics Window ...	8
Creating Assembly Sections	10
Exercise: Identify Parts in an Assembly	13
Lesson: Analysis and Motion Tools	17
Overview	17
Calculating Physical Properties	18
Checking for Interferences	22
Driving Constraints for Simple Motion and Analysis	25
Exercise: Calculate Properties and Analyze Interference	29
Exercise: Drive Constraints	32
Lesson: Presenting Your Assembly	35
Overview	35
About Presentations	36
Creating Presentation Views	38
Creating Tweaks and Trails	43
About Animating Presentations	48
Animating Presentations	50
Exercise: Create an Exploded Presentation	55
Exercise: Animate an Exploded Presentation View	58
Chapter Summary	60

Chapter 8: Basic View Creation 61

Lesson: Drawing Creation Environment	62
Overview	62
About Creating Drawings	63
Creating Drawings	65
About the Drawing Creation Environment	66
Using the Drawing Environment	68
Exercise: Use the Drawing Creation Environment	71

Lesson: Base and Projected Views	73
Overview	73
Creating Base Views	74
Creating Exploded Drawing Views	77
Creating Projected Views	78
Properties of Editing Base and Projected Views	80
Exercise: Create and Edit Base and Projected Views	82
Lesson: Section Views	85
Overview	85
Creating Section Views	86
Editing Section Views	89
Properties of Assembly Section Views	92
Exercise: Create and Edit Section Views	94
Lesson: Detail Views	99
Overview	99
About Detail Views	100
Creating Detail Views	101
Moving and Editing Detail Views	104
Exercise: Create and Edit Detail Views	107
Exercise: Create and Edit Detail View Edge Shapes and Connections	109
Lesson: Crop Views	112
Overview	112
Supported View Types and Displays	113
Creating Quick Cropped Views	115
Creating Cropped Views with Sketches	117
Exercise: Create and Edit Cropped Views	119
Lesson: Managing Views	122
Overview	122
About View Organization	123
About Moving, Aligning, and Editing Views	124
Moving, Aligning, and Editing Views	126
About Line Visibility	135
Controlling Line Visibility in Drawings	136
Exercise: Manage Views	141
Chapter Summary	144

Chapter 9: Dimensions, Annotations, and Tables 145

Lesson: Automated Dimensioning Techniques	146
Overview	146
About Automatically Placed Dimensions	147
Retrieving Model Dimensions	148
Editing Model Dimensions	152
Exercise: Dimension a Drawing View	157

Lesson: Manual Dimensioning Techniques	159
Overview	159
About General, Baseline, and Ordinate Dimensioning	160
Creating General Dimensions	161
Creating Baseline Dimensions	163
Creating Ordinate Dimensions	166
Exercise: Create General Dimensions	170
Exercise: Create Baseline Dimensions	173
Exercise: Create Ordinate Dimensions	175
Lesson: Annotating Holes and Threads	178
Overview	178
About Hole and Thread Notes	179
Working with Hole and Thread Notes	180
Creating Linear Dimension Thread Notes	183
About Hole Tables	185
Working with Hole Tables	188
Exercise: Create and Edit Hole Notes	197
Exercise: Create and Edit Hole Tables	200
Lesson: Creating Centerlines, Symbols, and Leaders	203
Overview	203
About Centerlines and Center Marks	204
Creating Centerlines and Center Marks	205
About Symbols	212
Documenting Views with Symbols	213
About Leaders and Text	219
Adding Leaders and Text	221
Editing Leaders and Text	225
Exercise: Add Centerlines, Center Marks, and Symbols	227
Lesson: Revision Tables and Tags	231
Overview	231
About Revision Tables and Tags	232
Process of Working with Revision Tables and Tags	233
Revision Table Styles	234
Adding a Revision Table	236
About Editing Revision Tables	238
Adding and Editing Revision Tags	242
Exercise: Configure, Add, and Edit Revision Tables and Tags	244
Chapter Summary	250

Chapter 10: Annotating Assembly Drawings..... 251

Lesson: Assembly-centric Bill of Materials	252
About the Bill of Materials	253
Using the Bill of Materials	254
Item Number Manipulation	257
Exercise: Edit an Assembly Bill of Materials	260
Lesson: Creating and Customizing Parts Lists	265
About Parts Lists	266
Creating Parts Lists	268
Editing Parts Lists	270
Exercise: Create and Customize a Parts List	275

Lesson: Creating Balloons.....	281
About Balloons.....	282
Placing Balloons Manually.....	284
Placing Balloons Automatically.....	287
Editing Balloons.....	291
Exercise: Create Balloons.....	295
Chapter Summary.....	299

Chapter 11: Drawing Standards and Resources 301

Lesson: Setting Drawing Standards.....	302
About Styles.....	303
Creating Styles with the Style Editor.....	304
About Drawing Standards.....	310
Properties of Drawing Standards.....	312
Defining the Active Standard.....	317
Using Layers.....	319
Exercise: Set Drawing Standards.....	325
Lesson: Drawing Resources.....	328
About Drawing Sheets.....	329
Creating Sheets.....	330
About Custom Borders and Title Blocks.....	333
Creating Custom Borders.....	335
Creating Custom Title Blocks.....	338
Exercise: Use Drawing Resources.....	341
Exercise: Customize a Title Block.....	344
Chapter Summary.....	346

Appendix A: Additional Support and Resources 347

Courseware from Autodesk.....	348
Autodesk Services & Support.....	349
Autodesk Subscription.....	350
Autodesk Consulting.....	350
Autodesk Partners.....	350
Autodesk Authorized Training Centers.....	351
Autodesk Student Community.....	351
Autodesk Certification.....	352
Autodesk Store.....	352
Useful Links.....	352

Acknowledgements

The Autodesk Official Training Courseware (AOTC) team wishes to thank everyone who participated in the development of this project, with special acknowledgement to the authoring contributions and subject matter expertise of Ron Myers and CrWare, LP.

CrWare, LP began publishing courseware for Autodesk Inventor in 2001. Since that time, the company has grown to include full-time curriculum developers, subject matter experts, and technical writers, each with a unique set of industry experiences and talents that enables CrWare to create content that is both accurate and relevant to meeting the learning needs of its readers and customers.

The company's Founder and General Partner, Ron Myers, has been using Autodesk products since 1989. During that time, Ron Myers worked in all disciplines of drafting and design, until 1996 when he began a career as an Applications Engineer, Instructor, and Author. Ron Myers has been creating courseware and other training material for Autodesk since 1996 and has written and created training material for AutoCAD, Autodesk Inventor, AutoCAD Mechanical, Mechanical Desktop, and Autodesk Impression.

Introduction

Welcome to the *Autodesk Inventor 2009 Essentials* Autodesk Official Training Courseware (AOTC), a training course for use in Authorized Training Center (ATC®) locations, corporate training settings, and other classroom settings.

Although this courseware is designed for instructor-led courses, you can also use it for self-paced learning. The courseware encourages self-learning through the use of the Autodesk® Inventor® 2009 Help system.

This introduction covers the following topics:

- Course objectives
- Prerequisites
- Using this courseware
- CD contents
- Completing the exercises
- Installing the exercise data files from the CD
- Projects
- Notes, tips, and warnings
- Using this courseware to prepare for Certification exams
- Feedback

This courseware is complementary to the software documentation. For detailed explanations of features and functionality, refer to the Help system in the software.

Course Objectives

After completing this course, you will be able to:

- Capture design intent using the proper techniques and recommended workflows for creating intelligent 3D parametric parts.
- Create, place, and constrain custom and standard components in an assembly, simulate mechanisms, animate assembly designs, and check for interferences.
- Document designs using base, projected, section, detail, and isometric drawing views, and document assemblies using standard and exploded drawing views.
- Follow drafting standards while dimensioning and annotating drawing views with centerlines, symbols, leaders, hole and thread notes, hole tables, automated balloons, and parts lists.

Prerequisites

This course is designed for new Autodesk Inventor users who want to learn the essential tools and principles of 3D parametric part design, assembly design, and how to create production-ready part and assembly drawings using Autodesk Inventor.

It is recommended that you have:

- A basic understanding of mechanical drafting or design.
- A working knowledge of Microsoft® Windows® 2000 or Microsoft® Windows® XP.

Using This Courseware

The lessons are independent of each other. However, it is recommended that you complete these lessons in the order that they are presented unless you are familiar with the concepts and functionality described in those lessons.

Each chapter contains:

- **Lessons** – Usually two or more lessons in each chapter.
- **Exercises** – Practical, real-world examples for you to practice using the functionality you have just learned. Each exercise contains step-by-step procedures and graphics to help you complete the exercise successfully.

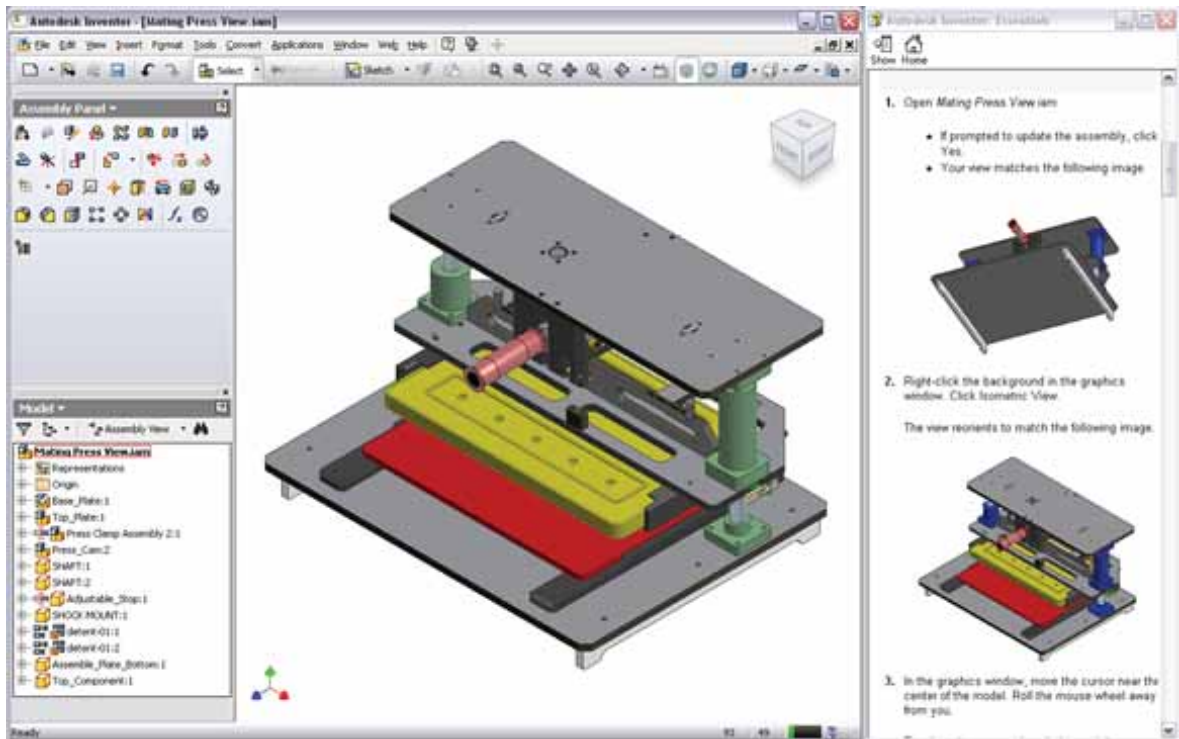
CD Contents

The CD attached to the back cover of this book contains all the data and drawings you need to complete the exercises in this course.

Completing the Exercises

You can complete the exercise in two ways: using the book or on screen.

- **Using the book** – Follow the step-by-step exercises in the book.
- **On screen** – Click the AOTC - Autodesk Inventor 2009 Essentials icon on your desktop, installed from the CD, and follow the step-by-step exercises on screen. The onscreen exercises are the same as those in the book. The onscreen version has the advantage that you can concentrate on the screen without having to glance down at your book.



After launching the onscreen exercises, you might need to alter the size of your application window to align both windows.

Installing the Exercise Data Files from the CD

To install the data files for the exercises:

1. Insert the courseware CD.
2. When the setup wizard begins, follow the instructions on screen to install the data.
3. If the wizard does not start automatically, browse to the root directory of the CD and double-click *Setup.exe*.

Unless you specify a different folder, the exercise files are installed in the following folder:

C:\Documents and Settings\All Users\Autodesk Learning\Inventor 2009\Essentials

After you install the data from the CD, this folder contains all the files necessary to complete each exercise in this course. You can also use the Autodesk Learning shortcut on your desktop to quickly access the datasets for each AOTC course on your system.

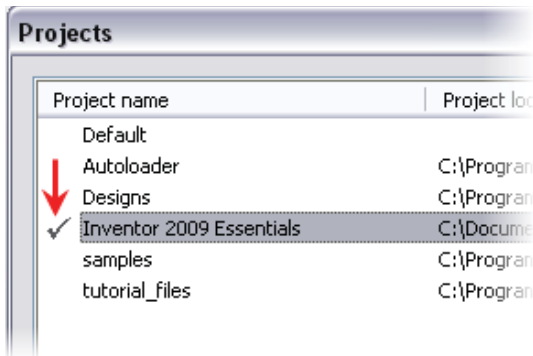
Projects

Most engineers work on several projects at a time, and each project might consist of a number of files. You can use Autodesk Inventor projects to organize related files and maintain links between files. This courseware has a project file that stores the paths to all the files related to the exercises. When you open a file, Autodesk Inventor uses the paths in the current project file to locate other required files. To work on a different project, you make a new project active in the Project Editor.

Follow the instructions below to locate the *Inventor 2009 Essentials* project file for this courseware and make it active.

1. Start Autodesk Inventor.
2. Click File menu > Projects.
 - In the Projects dialog box, click Browse.
 - In the Choose project file dialog box, navigate to *C:\Documents and Settings\All Users\Autodesk Learning\Inventor 2009\Essentials*.
 - Select *Inventor 2009 Essentials.ipj*.
 - Click Open.
3. In the Projects dialog box, double-click *Inventor 2009 Essentials* to activate the project. Click Done.

Note: The check mark designates the active project.



Notes, Tips, and Warnings

Throughout this courseware, notes, tips, and warnings are called out for special attention.



Notes contain guidelines, constraints, and other explanatory information.



Tips provide information to enhance your productivity.



Warnings provide information about actions that might result in the loss of data, system failures, or other serious consequences.

Using this Courseware to Prepare for Autodesk Certification Exams

This book supports preparation for Autodesk Certification Exams. If you are planning to become Autodesk Certified on Autodesk Inventor 2009 this book can help you prepare. The learning objectives of the lessons and exercises in this book map directly to the objectives and questions on the Autodesk Certification Exams.

For more guidance on how to use this book to prepare for the exams, visit www.autodesk.com/certification.

Feedback

We always welcome feedback on Autodesk Official Training Courseware. After completing this course, if you have suggestions for improvements or if you want to report an error in the book or on the CD, please send your comments to AOTC.feedback@autodesk.com.

