



A Practical Guide to AutoCAD® 2021

Tracy Chadwick and Rick Ellis

Foreword written by Lynn Allen



A CADapult Press Publication

Copyright

Copyright © CADapult Press, Inc. 2020

All rights reserved. No part of this publication may be reproduced in any form, or by any means electronic, mechanical, recording, photocopying, or otherwise, without written permission from the publisher, except for brief quotations used in reviews, or for marketing purposes specific to the promotion of this work.

ISBN: 978-1-934865-52-1

Although CADapult Press has made every attempt to ensure the accuracy of the contents of this book, the publisher and author make no representations or warranty with respect to accuracy or completeness of the contents in this book, including without limitation warranties of fitness for a particular purpose. The datasets included in this book are for training purposes only.

Autodesk screen shots reprinted with the permission of Autodesk, Inc.

Autodesk, AutoCAD, DWG, and the DWG logo are registered trademarks or trademarks of Autodesk, Inc., and/or its subsidiaries and/or affiliates in the USA and other countries. All other trademarks are the property of their respective owners.

Published in the United States of America by:

CADapult Press

(503) 829-8929

books@cadapult-software.com

Printed and manufactured in the United States of America

About the Authors

Tracy Chadwick serves as coordinator and instructor for the Computer Drafting Technology program at Hutchinson Community College in Hutchinson, Kansas. He is responsible for teaching a wide range of courses, including those on engineering graphics, AutoCAD software, Inventor software, and Revit Architecture software.

Tracy has been an AutoCAD user since 1995, and has been teaching AutoCAD classes to working professionals and college students since 2001. His experience and dedication to teaching led to him being recognized by Autodesk, Inc. with the North America Award for Distinguished Performance in AutoCAD Software Training.

Tracy has also been recognized as a top rated speaker at Autodesk University, where he has presented for several years. He has recently begun serving as a mentor to first-time Autodesk University speakers.

Tracy can be reached at: tracy@cadapult-software.com

Rick Ellis has worked with and taught AutoCAD Map 3D since the mid-90s, along with Civil 3D and other Autodesk products. He is the Author of several critically acclaimed books on AutoCAD Map 3D, Civil 3D and Land Desktop.

Rick continues to use AutoCAD Map 3D on projects in a production environment, in addition to teaching classes to organizations both large and small.

This practical background and approach has made him an award winning speaker at Autodesk University and a sought after instructor by organizations around the world.

Rick can be reached at: rick@cadapult-software.com

Acknowledgements

Thank you to my wonderful wife Candace, and my two amazing daughters Sydney and Casey. Without their support I could never have completed this book. Thank you to all the students of the Computer Drafting Technology program at Hutchinson Community College. I am honored to have played a part in helping so many students achieve fulfilling careers over the last two decades. Thank you to Vince Puyear, who first introduced me to AutoCAD back in 1995. He started as my instructor, then later became my colleague, mentor, and friend. Thank you to Amber Brawner for lending her graphic design talent to this book, and for being a great friend. Last, but not least, thank you to Rick Ellis and CADapult Press for helping me to achieve my dream of being an author, so that I may spread my love for AutoCAD from beyond central Kansas to the world!

-Tracy Chadwick

A Practical Guide to AutoCAD® 2021

Introduction

Congratulations on choosing this course to help you learn how to use AutoCAD 2021. The term “practical” is used in the title because this course focuses on what you need to effectively use AutoCAD 2021, and does not complicate your learning experience with unnecessary details of every feature in the product. Should you want to pursue aspects of features and functionality in greater detail than provided in this course, you are directed and guided to that information.

Each lesson contains the concepts and principles of each feature to provide you with the background and foundation of knowledge that you need to complete the lesson. You then work through exercises to reinforce your understanding and provide you with practice on common tasks that other professionals are performing with AutoCAD 2021 in the workplace every day.

Most lessons include a *Challenge Exercise* at the end. These exercises ask you to perform tasks based on what you learned in the lesson without the step-by-step instructions to test your skills and understanding of the new material.

When you complete this course, you will be armed with the background and knowledge to apply AutoCAD to your job tasks, and become more effective and productive in your job.

Course Objectives

The objectives of this course are performance based. In other words, once you have completed the course, you will be able to perform each objective listed. If you are already familiar with AutoCAD, you will be able to analyze your existing workflows, and make changes to improve your performance based on the tools and features that you learn and practice in this course.

After completing this course, you will be able to:

- Understand the user interface
- Navigate through drawings with pan and zoom commands
- Create drawing objects, including lines, arcs, and circles
- Create and modify polylines, including rectangles and polygons
- Use Layers to differentiate drawing objects
- Draw using Polar Tracking and coordinate methods
- Use Object Snaps and Object Snap Tracking
- Modify drawing objects
- Duplicate drawing objects
- Extract information from drawings with measuring tools
- Create and modify hatch patterns
- Create, insert, and modify blocks
- Work with external references
- Import a PDF
- Create and scale paper space layouts and viewports
- Print scale drawings and check plots
- Detail drawings with text, dimensions, and leaders

Downloading and Installing the Datasets

In order to perform the exercises in this book, you must download a zip file and install the datasets.

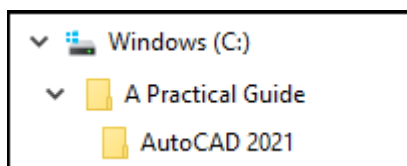
Type the address below into your web browser to load the page where you can download the dataset.

www.cadapult-software.com/data

Unzip the Files

Unzip the file **APG_AutoCAD2021.zip** directly to the C drive. The zip file will create the following folder structure:

C:\A Practical Guide\AutoCAD 2021\Files for Exercises



Exercises

The exercises in this course have been carefully chosen and designed to represent common tasks that are performed by design professionals.

The exercise files are from many different industries and are meant only to be examples. It's important to focus on the tools being shown and how you could apply them to your project and industry.

Exercises provide higher level process information throughout the exercise tasks. You are given information about not only what to do, but why you are doing it. In most cases, an image is included to help guide you.

Most lessons include a *Challenge Exercise* at the end. These exercises ask you to perform tasks based on what you learned in the lesson without the step-by-step instructions to test your skills and understanding of the new material. If you get stuck in these exercises go back and review the information in the lesson for guidance.

Table of Contents

Chapter 1 Introduction to AutoCAD	1
1.1. Lesson: Navigating the AutoCAD User Interface	2
1.1.1 Navigating the AutoCAD Interface	8
1.2. Lesson: Working with AutoCAD Drawing Files	10
1.2.1 Working with AutoCAD Drawings	17
1.3. Lesson: Basic AutoCAD Tools	20
1.4. Lesson: Selection Techniques.....	26
1.4.1 Selection Techniques.....	29
Chapter 2 Drawing Lines and Working with Layers	31
2.1. Lesson: Drawing Lines	32
2.1.1 Drawing Lines	35
2.2. Lesson: Drawing with Cartesian Coordinates	37
2.2.1 Drawing a Rectangle with Absolute Coordinates.....	41
2.2.2 Drawing a More Complex Shape with Absolute Coordinates.....	42
2.2.3 Drawing a Rectangle with Relative Coordinates.....	43
2.2.4 Drawing a More Complex Shape with Relative Coordinates	44
2.2.5 Drawing a Rectangle with Polar Coordinates	46
2.2.6 Drawing a More Complex Shape with Polar Coordinates.....	47
2.3. Drawing with Polar Tracking.....	49
2.3.1 Drawing a Rectangle with Polar Tracking	56
2.3.2 Drawing a More Complex Shape with Polar Tracking	58
2.3.3 Drawing with Additional Polar Tracking Angles	60
2.3.4 Drawing with Architectural Units	62
2.3.5 Challenge Exercise - Polar Tracking.....	64
2.4. Drawing with Layers	65
2.4.1 Drawing with Layers.....	72
2.4.2 Changing the Layers of Existing Objects	74
2.4.3 Modifying Layer States	75
2.4.4 Creating and Modifying Layers	77
2.4.5 Challenge Exercise - Layers	80
Chapter 3 Drawing Additional Objects (Part I)	81
3.1. Drawing Circles.....	82
3.1.1 Drawing Circles with the Center, Radius and Center, Diameter Methods.....	85
3.1.2 Additional Practice with the Center, Radius and Center, Diameter Methods	86

3.1.3	Drawing Circles with the 2-Point and 3-Point Methods	87
3.1.4	Drawing Circles with Tangent Methods	88
3.1.5	Challenge Exercise - Drawing Circles	90
3.2.	Drawing Rectangles	91
3.2.1	Drawing Rectangles	93
3.2.2	Challenge Exercise - Drawing Rectangles	95
3.3.	Drawing Polygons	96
3.3.1	Drawing Polygons	99
3.3.2	Additional Practice Drawing Polygons	100
3.3.3	Challenge Exercise - Drawing Polygons	101
Chapter 4	Object Snaps and Object Snap Tracking	103
4.1.	Drawing with Object Snaps	104
4.1.1	Drawing with Endpoint, Midpoint, and Quadrant Object Snaps	111
4.1.2	Drawing with Center and Tangent Object Snaps	114
4.1.3	Drawing with Node and Perpendicular Object Snaps	116
4.1.4	Drawing with Intersection and Geometric Center Object Snaps	118
4.1.5	Drawing with Object Snap Overrides	120
4.1.6	Additional Practice Drawing with Object Snap Overrides	122
4.1.7	Challenge Exercise - Objects Snaps #1	124
4.1.8	Challenge Exercise - Objects Snaps #2	125
4.2.	Drawing with Object Snap Tracking	126
4.2.1	Tracking Off of a Single Point with Object Snap Tracking	131
4.2.2	Object Snap Tracking of Multiple Points	133
4.2.3	Challenge Exercise - Objects Snap Tracking	135
Chapter 5	Drawing Additional Objects (Part II)	137
5.1.	Drawing Arcs	138
5.1.1	Drawing Arcs	144
5.1.2	Additional Practice Drawing Arcs	146
5.1.3	Challenge Exercise - Drawing Arcs	149
5.2.	Drawing and Editing Polylines	150
5.2.1	Drawing Polylines	157
5.2.2	Drawing Polylines with Varying Widths	159
5.2.3	Editing Polylines	162
5.2.4	Challenge Exercise - Drawing Polylines	164

Chapter 6 Modifying Drawing Objects	167
6.1. Moving Drawing Objects.....	168
6.1.1 Moving Drawing Objects	170
6.1.2 Additional Practice Moving Objects	171
6.1.3 Challenge Exercise - Moving Drawing Objects.....	176
6.2. Scaling Drawing Objects	177
6.2.1 Scaling Objects	180
6.2.2 Scaling Drawing Objects with the Reference Option	183
6.2.3 Challenge Exercise - Scaling Drawing Objects	185
6.3. Stretching Drawing Objects	186
6.3.1 Stretching Drawing Objects	188
6.3.2 Challenge Exercise - Stretching Drawing Objects	191
6.4. Rotating Drawing Objects.....	192
6.4.1 Rotating Drawing Objects	196
6.4.2 Rotating Objects with Polar Tracking.....	199
6.4.3 Rotating Objects with the Reference Option.....	201
6.4.4 Challenge Exercise - Rotating Drawing Objects.....	203
6.5. Trimming Drawing Objects	204
6.5.1 Trimming Drawing Objects.....	211
6.6. Extending Drawing Objects	214
6.6.1 Extending Drawing Objects.....	220
6.6.2 Additional Practice Trimming and Extending Objects.....	222
6.6.3 Challenge Exercise - Trimming and Extending Drawing Objects	226
6.7. Creating Rounded Corners with the Fillet Command.....	227
6.7.1 Filleting Drawing Objects	232
6.7.2 Additional Practice Filleting Drawing Objects	236
6.7.3 Challenge Exercise - Filleting Drawing Objects.....	238
6.8. Creating Angled Corners with the Chamfer Command.....	239
6.8.1 Chamfering Drawing Objects	247
6.8.2 Challenge Exercise - Chamfering Drawing Objects.....	253
Chapter 7 Duplicating Drawing Objects.....	255
7.1. Copying Drawing Objects	256
7.1.1 Copying Drawing Objects	258
7.1.2 Exercise: Additional Practice Copying Objects.....	260
7.1.3 Challenge Exercise - Copying Drawing Objects	262
7.2. Mirroring Drawing Objects	263
7.2.1 Mirroring Drawing Objects	266

7.2.2	Additional Practice Mirroring Objects	268
7.2.3	Challenge Exercise - Mirroring Drawing Objects	271
7.3.	Creating Rectangular Arrays of Drawing Objects	272
7.3.1	Creating a Rectangular Array	276
7.3.2	Additional Practice Creating Rectangular Arrays	280
7.3.3	Challenge Exercise - Rectangular Array	283
7.4.	Creating Polar Arrays of Drawing Objects	284
7.4.1	Creating a Polar Array	290
7.4.2	Additional Practice Creating Polar Arrays	294
7.4.3	Creating Polar Arrays with Multiple Rows	296
7.4.4	Challenge Exercise - Polar Array	298
7.5.	Creating Path Arrays of Drawing Objects	299
7.5.1	Creating Path Arrays Using the Measure Method.....	304
7.5.2	Creating Path Arrays Using the Divide Method.....	307
7.5.3	Challenge Exercise - Path Array	309
7.6.	Offsetting Drawing Objects	310
7.6.1	Offsetting Drawing Objects.....	314
7.6.2	Additional Practice Offsetting Objects	317
7.6.3	Challenge Exercise - Offsetting Drawing Objects	320
7.7.	Modifying Drawing Objects with Grips	321
7.7.1	Grip Editing Drawing Objects	326
Chapter 8	Inquiry Tools.....	331
8.1.	Measure commands.....	332
8.1.1	Measuring Distance, Area, and Perimeter	348
8.1.2	Measuring Distance, Radius, Area, and Angle	351
8.1.3	Measuring Angles.....	355
8.1.4	Measuring with the Quick Measure Tool.....	357
8.1.5	Challenge Exercise - Measure Commands.....	358
8.2.	Object Properties	361
8.2.1	Viewing and Modifying Object Properties.....	368
Chapter 9	Adding and Modifying Hatch Patterns.....	373
9.1.	Adding and Modifying Hatch Patterns.....	374
9.1.1	Adding Hatch Patterns.....	381
9.1.2	Additional Practice Adding Hatch Patterns.....	385
9.1.3	Challenge Exercise - Adding Hatch Patterns	390

Chapter 10 Working with Blocks, External References, and PDF Files.....	391
10.1. Inserting Blocks	392
10.1.1 Inserting Blocks with the Blocks Palette	402
10.1.2 Inserting Dynamic Blocks.....	409
10.1.3 Inserting Blocks with Tool Palettes	412
10.1.4 Inserting Blocks with DesignCenter	415
10.1.5 Challenge Exercise - Inserting Blocks	419
10.2. Creating Blocks.....	420
10.2.1 Creating Local Blocks	426
10.2.2 Creating Global Blocks	432
10.2.3 Challenge Exercise - Creating Blocks.....	437
10.3. Attaching External References	438
10.3.1 Working with External References.....	443
10.3.2 Challenge Exercise - External References	447
10.4. Importing PDF Files	448
10.4.1 Importing PDF Files	452
10.4.2 Challenge Exercise - Importing PDF Files	457
 Chapter 11 Plotting Drawings	 459
11.1. Plotting Drawings from Model Space	460
11.1.1 Plotting from Model Space.....	463
11.1.2 Challenge Exercise - Plotting from Model Space	468
11.2. Plotting Drawings from Paper Space.....	469
11.2.1 Plotting from Paper Space	475
11.2.2 Challenge Exercise - Plotting from Paper Space.....	482
 Chapter 12 Annotating Drawings.....	 483
12.1. Adding and Modifying Text	484
12.1.1 Adding Text Notes to a Drawing	488
12.1.2 Additional Practice Adding Text Notes to a Drawing	491
12.1.3 Challenge Exercise - Adding Text.....	494
12.2. Adding and Modifying Dimensions	495
12.2.1 Adding Linear Dimensions	505
12.2.2 Adding Aligned and Angular Dimensions	507
12.2.3 Adding Radius and Diameter Dimensions	509
12.2.4 Adding Continuous and Baseline Dimensions.....	513
12.2.5 Challenge Exercise - Adding Dimensions #1.....	515
12.2.6 Challenge Exercise - Adding Dimensions #2.....	516

12.3. Adding and Modifying Leaders.....	517
12.3.1 Adding Leaders	524
12.3.2 Adding Balloons with the Multileader Command.....	527
12.3.3 Challenge Exercise - Adding Leaders	532
Index	535

Foreword

Welcome to the wonderful world of AutoCAD. I say that somewhat tongue and cheek as learning AutoCAD can be somewhat daunting – and no doubt why you’ve chosen to pick up this book. I commend you for not trying to learn AutoCAD completely on your own (a dreadful route to take) but for relying on the skillful guidance of Tracy Chadwick and Rick Ellis. These two award winning authors have been teaching AutoCAD for many years and know exactly what it takes to lead the beginning user through the oft overwhelming tools inside of AutoCAD. This ***A Practical Guide of AutoCAD 2021*** will focus on the all-important basics of the product and steer you clear of the nonessential tools (you can tackle those later when you are more seasoned!) There is a right and a wrong way to use AutoCAD...this book will ensure that you learn how to use it the “right” way!

I taught AutoCAD at the collegiate and professional level for 11 years before joining Autodesk in their training department. I know the importance of good training materials and I know a great AutoCAD book when I see it. You are looking at one right now. Tracy and Rick have mastered the art of writing in terms that we can all understand without a need to impress or complicate the task at hand. Their goal is simple: to help you successfully use AutoCAD for your design work. They have taken their many years of training expertise and rolled it all into this well massaged book. How I wish I’d had this book when I was training people how to use AutoCAD!

In my 20+ year role as Autodesk Evangelist, I had the distinct privilege of working with Tracy and Rick at Autodesk University and other conferences. Their presentations are always highly rated and very popular with attendees. They have that special knack of connecting with an audience and making the difficult sound easy – which is exactly what you need when you are learning to use AutoCAD. You will experience this as you make your way through the chapters of this book.

A Practical Guide of AutoCAD 2021 also includes real-world examples from many different industries. You won’t be drawing any Mickey Mouses or smiley faces, but actual drafting examples. Let’s face it – you wouldn’t get a job with that limited skillset (well...unless you go work for Disney). The variety of practical examples used with practical commands is the perfect combination to get you prepared for drafting and designing in the real world.

Use this book to build a firm foundation for designing with AutoCAD. Those users with a firm foundation of the product do best overall in successfully mastering the product (another reason to read this book). Physically do as many exercises in the book as possible and you’ll be on the road to becoming a great AutoCAD user!

I’m pretty sure that your first thought when you’re finished with this book is going to be...”When are Tracy and Rick going to come out with an ***Advanced Practical Guide of AutoCAD?***” I know that’s my question!

Lynn Allen

Global Technology Evangelist

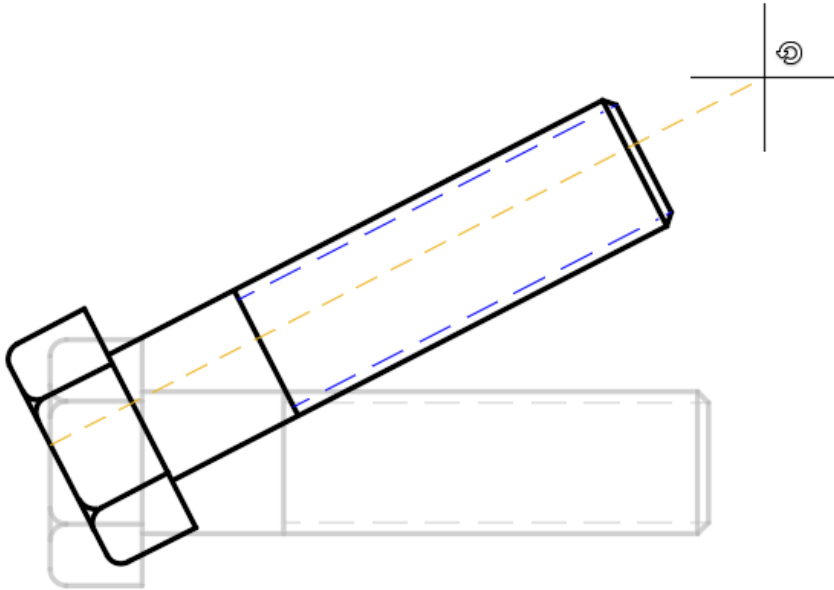
In her 20+ year career as Autodesk Technology Evangelist, Lynn Allen has spoken to more than a half million design professionals in over 50 countries throughout the world. Her online reach over the years easily reaches into the millions. An early CAD entrepreneur, Lynn taught AutoCAD at the corporate and collegiate level for 11 years before joining Autodesk. A popular columnist for Cadalyst magazine for over two decades, she is the face behind hundreds of software videos including the series “AutoCAD Tips and Tricks with Lynn Allen”. A sought-after public speaker with a unique comedic style, Lynn was the host of Autodesk University for over a decade and is always one of the highest rated presenters at the many worldwide Autodesk Universities. She is also the author of three technical books focused on AutoCAD software.

Sample Lesson

6.4. Rotating Drawing Objects

Introduction

In this lesson, you learn how to rotate drawing objects.



Key Concepts

Concepts and key terms covered in this lesson are:

- Rotating Objects
- Base Point
- Rotation Angle
- Reference Angle

Objectives

After completing this lesson, you will be able to:

- Rotate drawing objects.

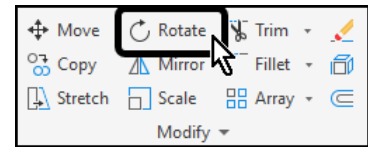
About the Rotate Command

Many times while drawing you will have the need to adjust the orientation of drawing objects by rotating them. The Rotate command can achieve this in a few simple steps.

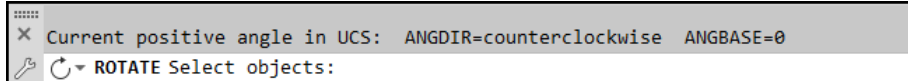
Starting the Rotate Command

The **Rotate** command is located at **Ribbon: Home** ⇒ **Modify** ⇒ **Rotate**.

Alternatively, you can type **RO** then press **[Enter]** at the keyboard.



After starting the Rotate command, you are prompted to select the objects to be rotated.



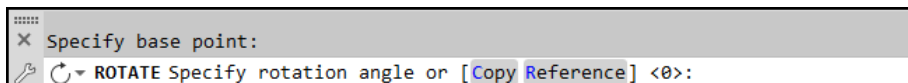
The Rotate command will allow you to select as many objects as you want. When you are finished selecting objects you must press **[Enter]** at the keyboard to move on to the next step.



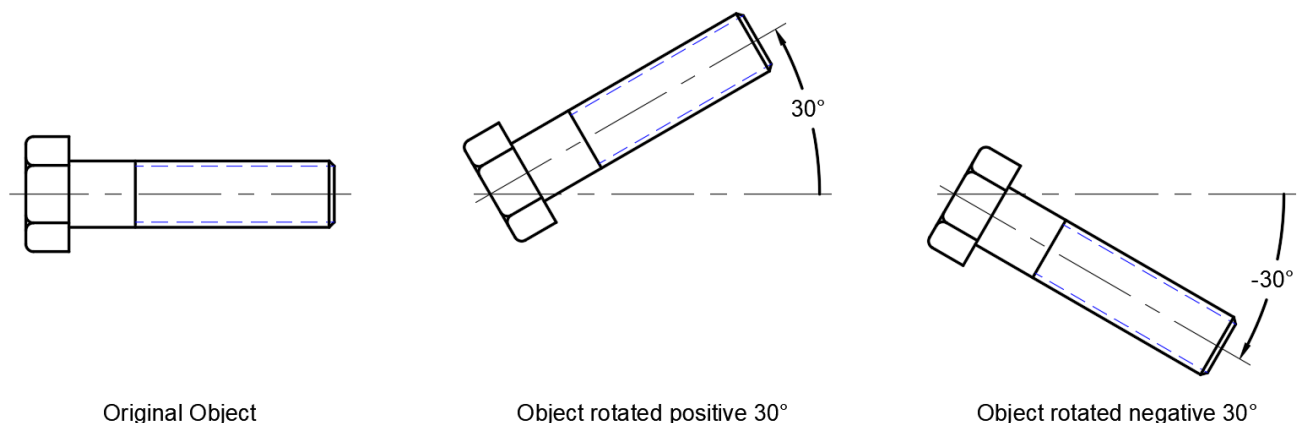
Next you will specify the base point. This point will remain in the same location while the rest of the selected objects rotate around it.



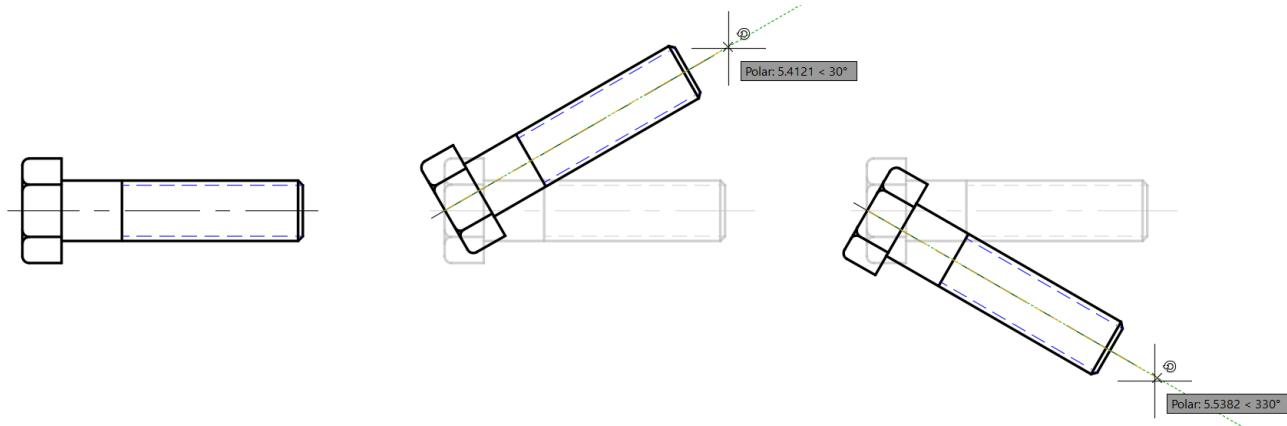
Finally, the Command line asks for the rotation angle. The angle can be specified by typing a value or by selecting a point on-screen.



When entering a rotation angle value, it is important to remember that by default in AutoCAD, angles are positive when rotating in the counterclockwise direction; angles are negative when rotating in the clockwise direction.

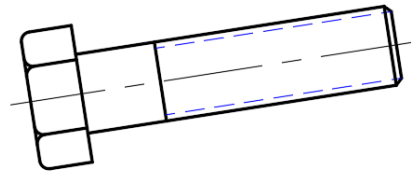


Instead of typing the rotation angle value, you can also pick a point on-screen. Turn on *Polar Tracking* to ensure that the rotation angle is precise. In the example below the Incremental Angle value of *Polar Tracking* has been set to 30 degrees. This could be a more efficient workflow because you do not need to be concerned with whether or not an angle is positive or negative. Instead, you simply click when the object is located on the appropriate tracking angle.



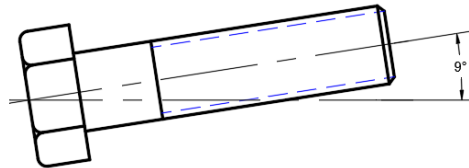
Specifying the Reference Angle

Occasionally when working in a drawing, you may find the need to rotate an object to return it to a standard orientation. For example, the bolt in the image to the right is currently at an angle, and it needs to be rotated until it is back to horizontal.

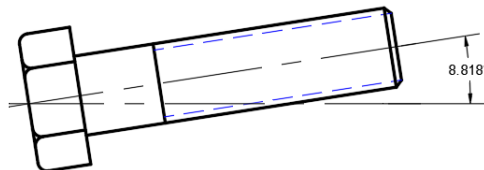


This is a fairly simple process if the object was rotated at a known angle, such as 30 degrees; you could simply rotate the object negative 30 degrees to return it to horizontal. However, if the object has been rotated at an unknown angle, the process could be more difficult. One possibility is to measure the angle from horizontal, then rotate using a negative value.

In the image to the right, the angle of the bolt has been measured and found to be nine degrees.



The first instinct might be to rotate the object negative nine degrees to return it to horizontal. This might not work precisely, because the nine degree dimension could be rounded off. A closer look reveals that the angle is slightly less.

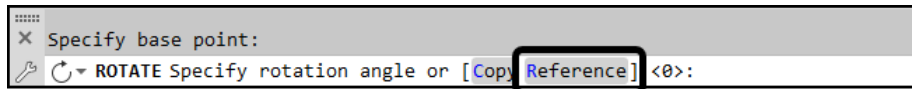
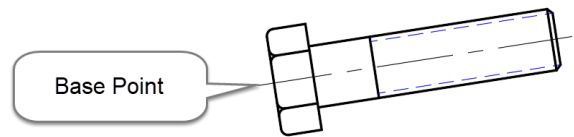


Using this new, more precise value could still lead to an incorrect drawing because this value is most likely rounded off as well.

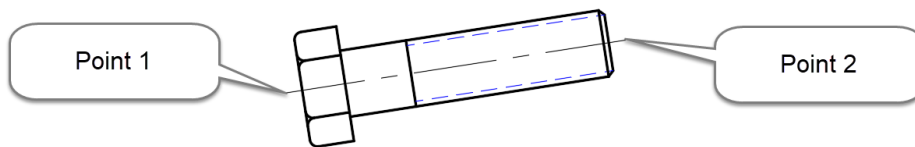
The much more precise and quicker solution is to use the Reference option of the Rotate command.

In this example the centerline of the bolt will serve as the reference angle. Therefore, the left endpoint of the centerline will serve as the basepoint.

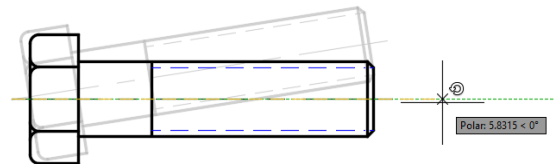
1. Begin the Rotate command and select the objects to be rotated.
2. Specify the basepoint.
3. Choose the **[Reference]** option in the Command line.



4. Select the two endpoints of the centerline to represent the new reference angle.



5. Move the crosshairs horizontally to the right of the basepoint along the **0** degree *Polar Tracking* angle.
6. Select a point to rotate the bolt into place.



Exercises: Rotating Drawing Objects

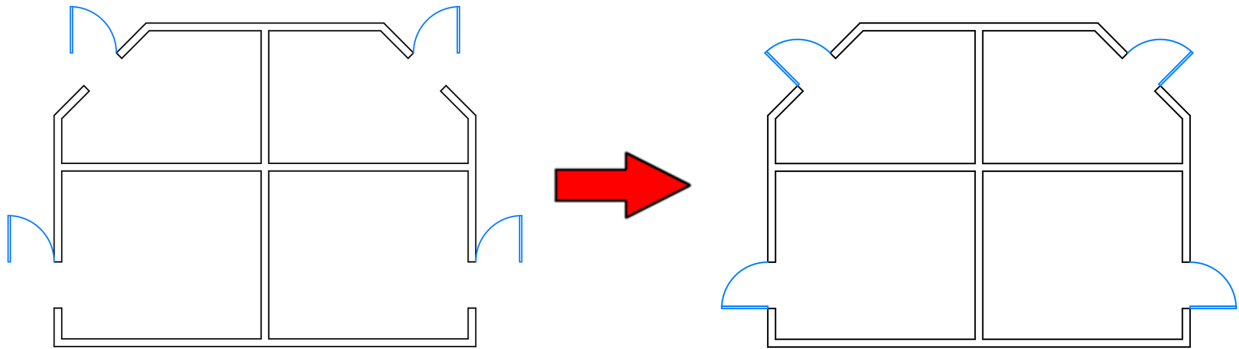
In these exercises, you will rotate several drawing objects.

You do the following:

- Start the Rotate command.
- Select objects.
- Specify base points.
- Specify a rotation angle by typing a value.
- Specify a rotation angle with *Polar Tracking*.
- Use the reference option to orient drawing objects.

6.4.1 Rotating Drawing Objects

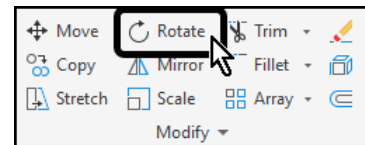
In this exercise you will use the Rotate command to adjust the orientation of several doors.



1. **Open** drawing **6.4.1 Rotating Objects 1.dwg**.
2. Set **Endpoint** as a *Running Object Snap*.

Four doors have been placed, but they need to be rotated into place. Start with the door in the lower left, then work clockwise around the building.

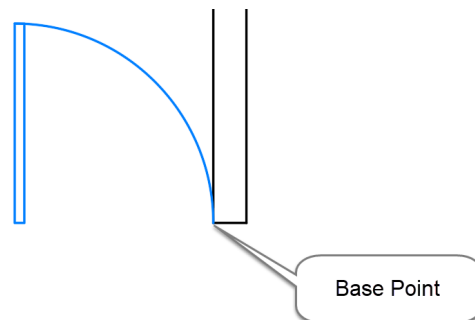
3. Zoom to the lower-left quadrant of the building.
4. Select **Ribbon: Home** ⇒ **Modify** ⇒ **Rotate**.



5. Select the door.
6. Press **[Enter]** at the keyboard to finish selecting objects.

You are now prompted to select the base point.

7. Select the point where the arc touches the wall to specify it as the base point.



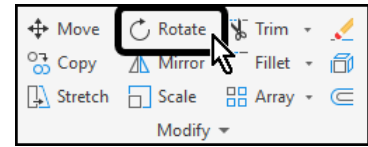
You are now prompted to specify the rotation angle.

8. At the Command line type **90** then press **[Enter]** at the keyboard.

The door is rotated into place.

9. Zoom to the upper-left quadrant of the building.

10. Select **Ribbon: Home** ⇒ **Modify** ⇒ **Rotate**.

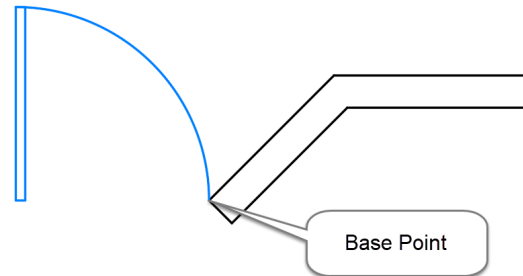


11. Select the door.

12. Press **[Enter]** at the keyboard to finish selecting objects.

You are now prompted to select the base point.

13. Select the point where the arc touches the wall to specify it as the base point.



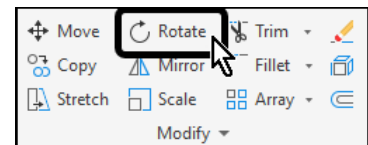
You are now prompted to specify the rotation angle.

14. At the Command line type **45** then press **[Enter]** at the keyboard.

The last two doors will be rotated in the clockwise direction, which will require negative rotation angles.

15. Zoom to the upper-right quadrant of the building.

16. Select **Ribbon: Home** ⇒ **Modify** ⇒ **Rotate**.

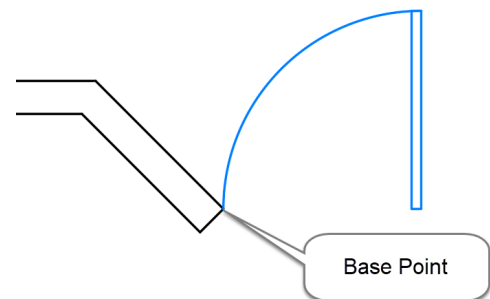


17. Select the door.

18. Press **[Enter]** at the keyboard to finish selecting objects.

You are now prompted to select the base point.

19. Select the point where the arc touches the wall to specify it as the base point.



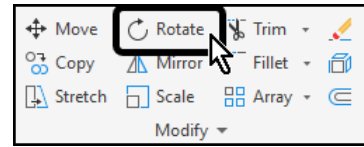
You are now prompted to specify the rotation angle.

20. At the Command line type **-45** then press **[Enter]** at the keyboard.

Next you will rotate the final door.

21. Zoom to the lower-right quadrant of the building.

22. Select **Ribbon: Home** ⇒ **Modify** ⇒ **Rotate**.

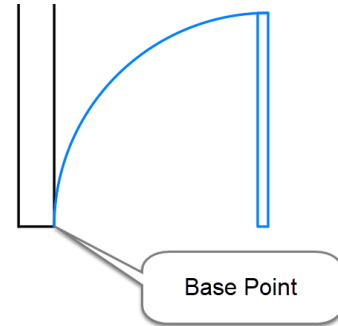


23. Select the door.

24. Press **[Enter]** at the keyboard to finish selecting objects.

You are now prompted to select the base point.

25. Select the point where the arc touches the wall to specify it as the base point.

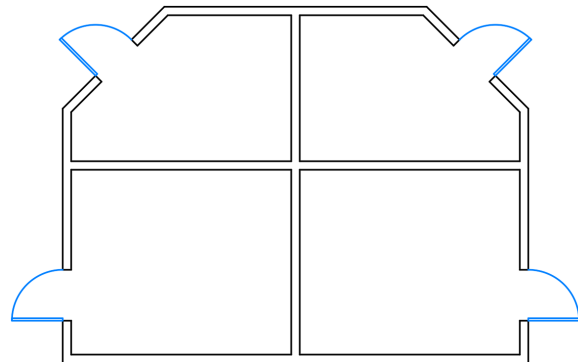


You are now prompted to specify the rotation angle.

At the Command line type **-90** then press **[Enter]** at the keyboard.

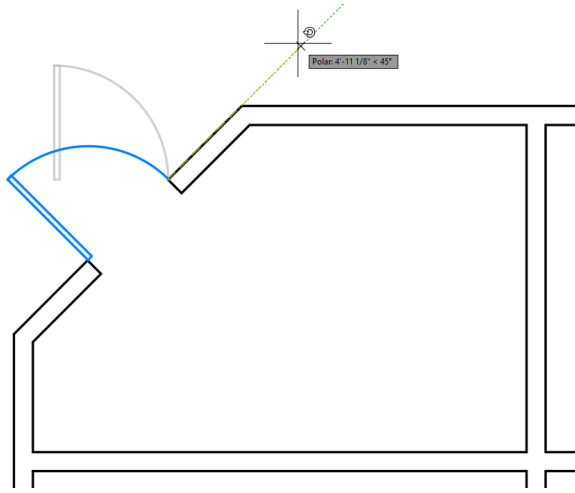
The completed drawing appears as shown.

26. **Save** the drawing.

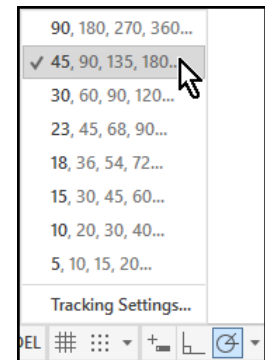


6.4.2 Rotating Objects with Polar Tracking

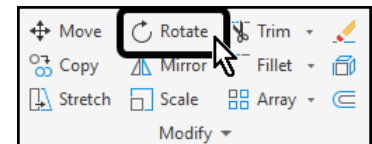
In this exercise you will use the Rotate command and *Polar Tracking* to speed up the rotate process.



1. **Open** drawing **6.4.2 Rotating Objects 2.dwg**.
2. Set **Endpoint** as a *Running Object Snap*.
3. Select the fly-out arrow next to the *Polar Tracking* button and select **45** degree increment angles.
4. If necessary, select the *Polar Tracking* button to turn it on.



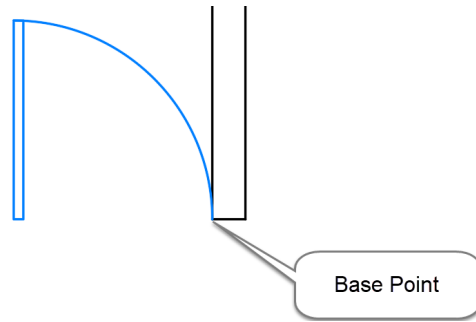
5. Zoom to the lower-left quadrant of the building.
6. Select **Ribbon: Home** ⇒ **Modify** ⇒ **Rotate**.



7. Select the door.
8. Press **[Enter]** at the keyboard to finish selecting objects.

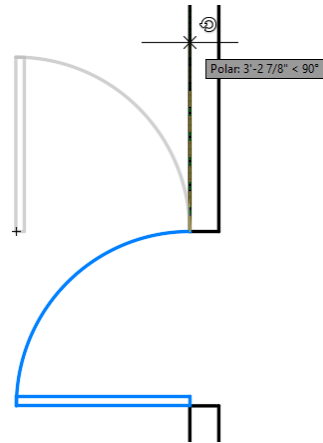
You are now prompted to select the base point.

9. Select the point where the arc touches the wall to specify it as the base point.



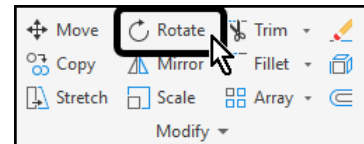
You are now prompted to specify the rotation angle.

10. Move the crosshairs above the previous point, until it snaps on to the **90 degree Polar Tracking** angle, then select a point.



The door is rotated into place.

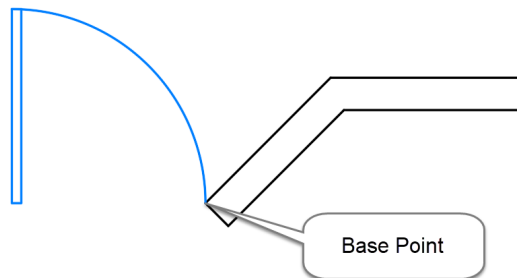
11. Zoom to the upper-left quadrant of the building.
12. Select **Ribbon: Home ⇒ Modify ⇒ Rotate**.



13. Select the door.
14. Press **[Enter]** at the keyboard to finish selecting objects.

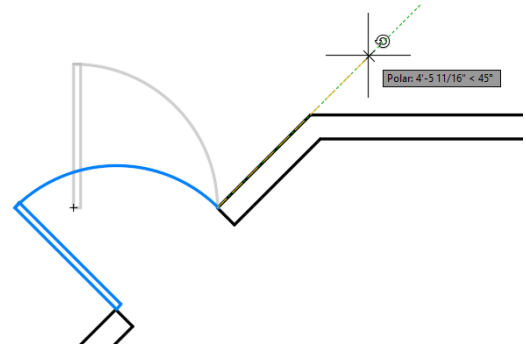
You are now prompted to select the base point.

15. Select the point where the arc touches the wall to specify it as the base point.



You are now prompted to specify the rotation angle.

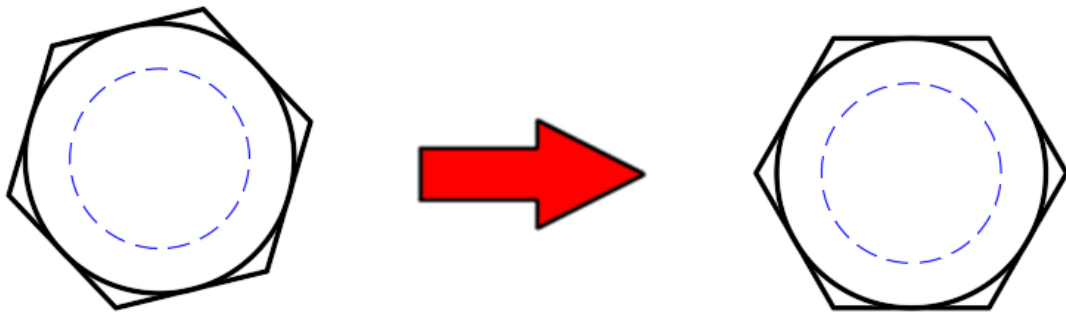
16. Move the crosshairs above and to the right of the previous point, until it snaps on to the **45** degree *Polar Tracking* angle, then select a point.



17. Repeat the process to complete the right side of the drawing.
18. **Save** the drawing.

6.4.3 Rotating Objects with the Reference Option

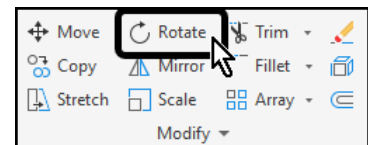
In this exercise you will use the Reference option of the Rotate command to adjust the orientation of an object.



1. **Open** drawing **6.4.3 Rotating Objects 3.dwg**.
2. Set **Endpoint** as a Running Object Snap.

A bolt head has been rotated at an unknown angle. You will rotate it until the top and bottom edges are horizontal.

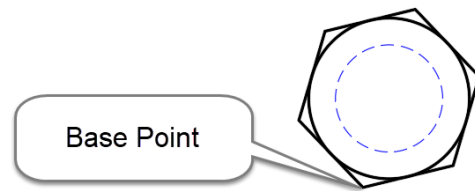
3. Select **Ribbon: Home** ⇒ **Modify** ⇒ **Rotate**.



4. Select the objects that make up the bolt head.
5. Press **[Enter]** at the keyboard to finish selecting objects.

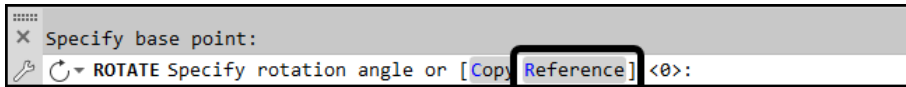
You are now prompted to select the base point.

6. Select the lower-left corner to specify it as the base point.



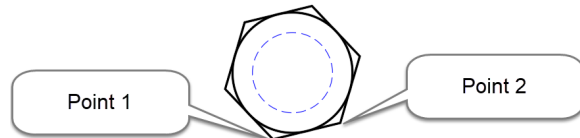
You are prompted for a rotation angle. By default, AutoCAD uses 0 as the reference angle, meaning that you are rotating from horizontal. In this case the reference angle should match the bottom edge of the bolt head. Since that value is unknown, you will select the two endpoints of that line to specify it as the new reference angle.

7. At the Command line select the **[Reference]** option.

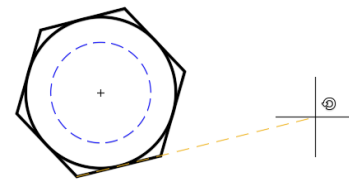


You are prompted to specify the reference angle.

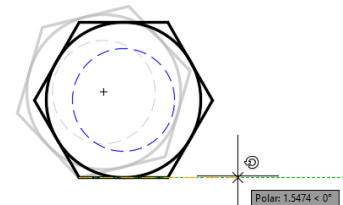
8. Click the lower-left point.
9. Click the lower-right point.



The reference angle now matches the bottom edge of the bolt head.



10. Move the crosshairs horizontally to the right along the **0** degree *Polar Tracking* angle.
11. Select a point to rotate the bolt head into place.

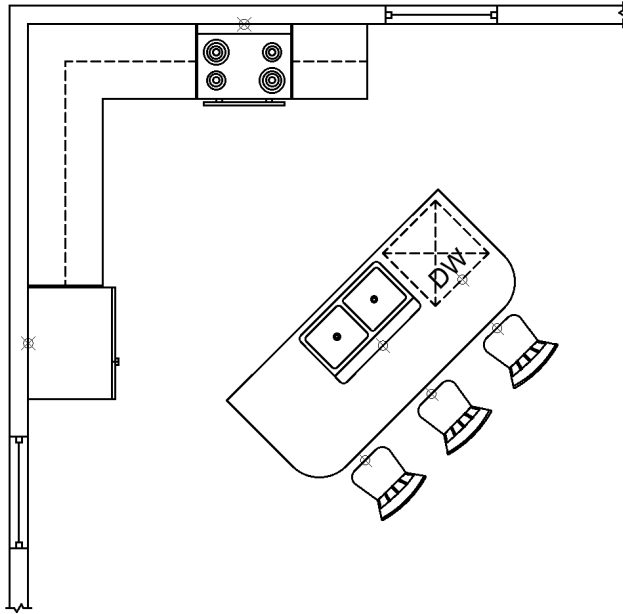


The top and bottom edges of the bolt head are now horizontal.

12. **Save** the drawing.

6.4.4 Challenge Exercise - Rotating Drawing Objects

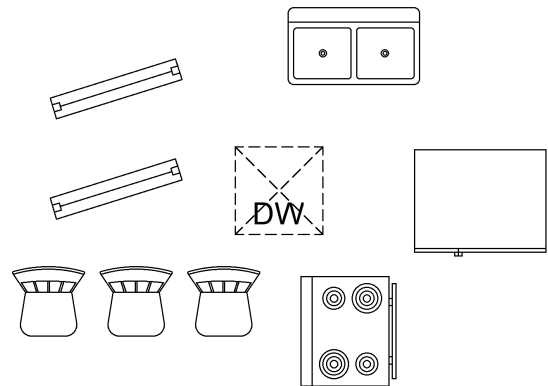
In this exercise you will use the Rotate and Move commands to complete the kitchen layout.



1. **Open drawing 6.4.4 Rotating Objects 4.dwg.**

The drawing contains a partial floorplan of a kitchen layout.

Also included are several objects that need to be placed in the floorplan including appliances, furniture, and windows.



2. Rotate each object the appropriate angle, then move the object to the correct location as shown in the image above.

Points have been provided to aid in locating the objects properly. Enable the Node object snap to move the objects to the points.

The windows have been rotated to non-standard angles. Use the Reference option of the rotate command to rotate the windows to the proper angles.

3. **Save** the drawing.


Lesson Review

In this lesson, you learned how to rotate drawing objects both by typing angle values at the Command line and with the aid of *Polar Tracking*.

Index

[F2]	22	External Reference Fading	441
Absolute Coordinates	38	External Reference Path Type	441
Additional Tracking Angles	52	External Reference Type	440
Aligned Dimension	499	External Reference Updating	441
Angles	40	External References	438
Angular Dimension	499	External References Palette	439
Application Menu	5	File Tabs	6
Arc	139	File Types	11
Area	342	Fillet command	228
Associative Dimensions	503	Freezing and Thawing Layers	67
automatic save	15	Geometric Center Snap	108
automatic save files	15	Grip Editing	322
backup copy	15	Hatch patterns	375
Baseline Dimension	502	Help	6
Block Editor	424	Increment Tracking Angles	50
Blocks	393, 439	Inscribed	97
Boundary edges	215	Insert command	439, 449
Boundary Edges in Quick Mode	216	Insert Snap	110
Cartesian Coordinates	38	Inserting Blocks	393
Center Snap	108	Intersection Snap	108
Chamfer command	240	Joining Lines and Arcs	155
Changing the Layer of Existing Objects	66	Keyboard Options	21
Circle	83	Lasso	28
Circumscribed	98	Layer Properties Manager	69
Closing a File	16	Layer States	67
Closing a Polyline	154	Layers	66
Command Line	7	Layout Tabs	7
Command Line Options	22	Layouts	472
Continue Dimension	501	Leaders	518
Copy command	257	Line	33
Create Block command	421	Linear Dimension	498
Crosshairs	6	Linetype	70
Crossing selection method	27	Lineweight	71
Current Layer	66	List command	363
Cutting edges	205, 208, 218	Locking Layers	68
Cutting Edges in Quick Mode	206	Match Properties	362, 378
DesignCenter	401	Measure Angle	339, 340
Diameter Dimension	500	Measure Area	342
Dimensioning	496	Measure Commands	333
Direct Distance Entry	50	Measure Distance	335
Drafting Settings Dialog Box	106	Measure Radius	337
Drawing Units	334	Midpoint Snap	107
Drawing Window	6	Mirror command	264
Dynamic Blocks	399	Model Space	461, 473
Edit Polyline	153	Move command	169
Endpoint Snap	107	Multileader	518
Erasing Objects	25	Multiline Text	485
Explode	156, 287, 396	Multiple Drawings	16
Extend command	215	Navigation Bar	24
Extend Quick Mode	215	Nearest Snap	110
Extend Standard Mode	218	New	11
Extension Snap	129	Node Snap	110

Object Snap Tracking	127	Redo	25
Object Snaps	105, 129	Reference Angle	194
Offset command	311	Reference Option	178
Open	13	Relative Coordinates	39
ORTHO	50	Removing objects from a selection set	28
OSNAP	105	Ribbons	5
OTRACK	127	Right-Click Context Menus	23
Page Setup Manager	470	Rotate command	193
Pan	24	Running Object Snaps	105
Paper Space	470	Save	14
Parallel Snap	130	Save As	14
Path Array	300	Scale command	178
PDF data to import	450	Selection Techniques	26
PDF Import	449	Status Bar	7
Perpendicular Snap	109	Stretch command	187
Plot style table	462	Tangent Snap	109
Plotting	461, 470	Text	485
Polar Array	285	Text Window	22
Polar Coordinates	40	Tool Palettes	400
Polar Tracking	50	Tracking Angles	129
Polygon	97	Trim command	205
polyline	92	Trim Quick Mode	205
Polyline Width	152, 154	Trim Standard Mode	208
Polylines	151	Turning Layers On and Off	67
Properties palette	365	UCS Icon	7
Properties Panel	362	Undo	25, 34
QNew	11	Units	53, 334
Quadrant Snap	109	View Cube	6, 24
Quick Access Toolbar	6	Viewport Scale	474
Quick Measure	346	Viewports	472
Quick Select	367	Window selection method	27
Radius Dimension	500	Write Block command	423
Rectangle	92	Zoom	24
Rectangular Array	273		



A Practical Guide to Carlson Software Fundamentals 2021

**Rick Ellis
Douglas L. Aaberg, PLS
Duke Gardner**



A CADapult Press Publication

Copyright

Copyright © CADapult Press, Inc. 2020

All rights reserved. No part of this publication may be reproduced in any form, or by any means electronic, mechanical, recording, photocopying, or otherwise, without written permission from the publisher, except for brief quotations used in reviews, or for marketing purposes specific to the promotion of this work.

ISBN: 978-1-934865-53-8

Although CADapult Press has made every attempt to ensure the accuracy of the contents of this book, the publisher and author make no representations or warranty with respect to accuracy or completeness of the contents in this book, including without limitation warranties of fitness for a particular purpose. The datasets included in this book are for training purposes only.

Carlson Survey and Carlson Civil are registered trademarks of Carlson Software. AutoCAD Civil 3D, AutoCAD Map 3D, and AutoCAD® are registered trademarks of Autodesk, Inc. All other trademarks are the property of their respective owners.

Published in the United States of America by:

CADapult Press, Inc,

(503) 829-8929

books@cadapult-software.com

Printed and manufactured in the United States of America

About the Author

Rick Ellis has worked with and taught Civil/Survey CAD software since the mid-90s. He is the Author of several critically acclaimed books on AutoCAD Map 3D and other CAD packages. He continues to work on projects in a production environment, in addition to teaching classes to organizations both large and small.

This practical background and approach has made him an award winning speaker at Autodesk University, a member of the national speaker team for the AUGI CAD Camps and a sought after instructor by organizations around the world.

Rick can be reached at: rick@cadapult-software.com

Douglas L. Aaberg, PLS is a licensed Professional Land Surveyor in the Commonwealth of Massachusetts and in the State of Colorado. His career in the Land Surveying/Civil Engineering business spans four decades. Having used Carlson Software exclusively since 1998, Doug is a recognized expert in applying the continually expanding capability of Carlson's programming to the everyday "work flow" of land surveyors and engineers. After owning and operating his own company for fifteen years, Doug now works directly for Carlson Software as their Survey Product manager. Besides being involved in development, he dedicates his time consulting to both large and small land survey and engineering firms through on-site training, remote support and individually tailored documentation.

Doug can be reached at: daaberg@carlsonsw.com

Duke Gardner has served the land surveying and civil engineering communities for over 35 years in a wide variety of support roles. His focus on the theory as well as the practice skills needed to achieve successful implementation made him an excellent partner in the author team for this guide.

Acknowledgements

Thank you to Carlson Software for their cooperation. A special thanks to Gary Rosen and Lauren Lax from Carlson Software for their assistance and encouragement. Without it this book would not have been possible.

Exercise Data

I would like to thank the City of Springfield, Oregon for providing the data for this book. The dataset provided is for illustration purposes only. While it is based on real world information to add relevance to the exercises, it has been altered and modified to more effectively demonstrate certain features as well as to protect all parties involved. The data should not be used for any project work and may not represent actual places or things. It is prohibited to redistribute this data beyond your personal use as a component of training.

A Practical Guide to Carlson Software Fundamentals 2021

Introduction

Congratulations on choosing this course to help you learn how to use Carlson 2021. The term “practical” is used in the title because this course focuses on what you need to effectively use Carlson Software, and does not complicate your learning experience with unnecessary details of every feature in the product.

Each lesson contains the concepts and principles of each feature to provide you with the background and foundation of knowledge that you need to complete the lesson. You then work through real world exercises to reinforce your understanding and provide you with practice on common tasks that other professionals are performing with Carlson Software in the workplace every day.

You can take the lessons in this course in whatever order is appropriate for your personal needs. If you want to concentrate on specific features, the lesson for those features does not require that you complete prior lessons. With this course organization, you can customize your own individual approach to learning Carlson.

When you complete this course, you will have the background and knowledge to apply Carlson Software to your job tasks, and become more effective and productive in your job.

Course Objectives

The objectives of this course are performance based. In other words, once you have completed the course, you will be able to perform each objective listed. If you are already familiar with Carlson Software, you will be able to analyze your existing workflows, and make changes to improve your performance based on the tools and features that you learn and practice in this course.

After completing this course, you will be able to:

- Navigate the Pull-down Menus and Ribbon Menus
- Set up Carlson Software to use the Project approach
- Work with Coordinate Files
- Draw Points into the Drawing
- Edit Points in the Drawing and External Point Database
- Create Point Groups
- Prepare Surface Data using Points and 3D Polylines
- Create Surface Models
- View and Edit Surfaces
- Perform Surface Inquiries
- Generate and Label Contours
- Perform Basic Drawing and Editing in CAD
- Import and Export Land XML Data
- Work with Google Earth and World files
- Work with Centerlines
- Generate Linework Labels
- Convert Carlson Point Blocks to Civil 3D Points
- Convert Civil 3D Point, Surface, Alignment and Label objects to Carlson data

Prerequisites

Before starting this course, you should have a basic working knowledge of AutoCAD®. A deep understanding of AutoCAD is not required, but you should be able to:

- Pan and Zoom in the AutoCAD drawing screen.
- Describe what layers are in AutoCAD, and change the current layer.
- Create basic CAD geometry, such as lines, polylines and circles.
- Use Object Snaps.
- Describe what blocks are, and how to insert them.
- Perform basic CAD editing functions such as Erase, Copy, and Move.

If you are not familiar with these functions, you can refer to the AutoCAD Help system throughout the course to gain the fundamental skills needed to complete the exercises.

For a more in-depth AutoCAD tutorial check out our book, ***A Practical Guide to AutoCAD 2021***.

Conventions

The course uses the following icons and formatting to draw your attention to guidelines that increase your effectiveness in Carlson Software, or provide deeper insight into a subject.



The magnifying glass indicates that this text provides deeper insights into the subject.



The compass indicates that this text provides guidance that is based on the experience of other users of Carlson Software. This guidance is often in the form of how to perform a task more efficiently.

Downloading and Installing the Datasets

In order to perform the exercises in this book, you must download a zip file and install the datasets.

Type the address below into your web browser to load the page where you can download the dataset.

www.cadapult-software.com/data

Unzip the Files

Unzip the file **APG_CARLSON_FUND_2021.zip** directly to the C drive. The dataset will be copied to the folder:

C:\Carlson Projects

A folder called **APG 2021 Data** is created that contains several folders with source data for the exercises in this book.

There are also folders created called **APG 2021 Lesson X_X** These folders contain project files and drawings where the lesson number of the folder corresponds to the lesson numbers in the book. This will allow you to jump in at the beginning of many of the lessons in the book, and do just the specific exercises that you want, if you do not have time to work through the book from cover to cover.

Exercises

The exercises in this course have been designed to represent common tasks that are performed by civil engineers, surveyors, designers and drafters. The data included in the exercises are typical drawings, point files and other data used by professionals like you. Exercises provide higher level process information throughout the exercise tasks. You are given information about not only what to do, but why you are doing it. Many images are included to help guide you.

Table of Contents

Chapter 1	A First Look at Carlson Software 2021	1
1.1	Lesson: A Guided Tour through the Pull-down Menus	2
1.2	Lesson: A Guided Tour through the Ribbon Menus	12
Chapter 2	Working with Data, Settings, and Start Ups	17
2.1	Lesson: Working with External Data	18
2.1.1	Setting up Carlson desktop applications to Work with External Data	22
2.2	Lesson: Setting Up General Settings	28
2.2.1	Working with General Settings	31
2.3	Lesson: Creating a New Drawing	33
2.3.1	Starting Up a New Drawing	37
2.3.2	Defining Text Styles	40
Chapter 3	Working with Points	43
3.1	Lesson: Introduction to Point Data	44
3.2	Lesson: Importing a Text/ASCII File	46
3.2.1	Importing a Text/ASCII File	50
3.3	Lesson: Point Defaults	55
3.3.1	Setting Up Point Defaults	58
3.4	Lesson: Draw - Locate Points	60
3.4.1	Draw Points in a Drawing	63
3.4.2	Creating new Points with Draw – Locate Points	66
3.5	Lesson: Controlling Point Display	69
3.5.1	Scaling Attributes	73
3.5.2	Using Dynamic Point Attributes	75
3.5.3	Moving Attributes	76
3.5.4	Editing Specific Attributes	77
3.6	Lesson: Editing Point Data	79
3.6.1	Editing Point Data with the Edit Points command	81
3.6.2	Editing Point Data with the Edit Point Attributes command	83
3.7	Lesson: Erasing Points	85
3.7.1	Erasing Point Blocks from a Drawing	86
3.7.2	Deleting Point Data from the External Point Database	89
3.8	Lesson: Using Point Groups	91
3.8.1	Creating a Point Group	94

3.8.2	Drawing Points by Point Group	97
Chapter 4	Working with Surfaces	101
4.1	Lesson: Introduction to Surfaces	102
4.2	Lesson: Preparing Surface Data	104
4.2.1	Creating a New Drawing for the Surface	108
4.2.2	Creating a Point Group to Be Used as Surface Data	111
4.2.3	Creating a Point Group to Connect with 3D Polylines	114
4.2.4	Drawing 3D Polylines by Point Number	116
4.2.5	Drawing 3D Polylines by Point Selection	120
4.3	Lesson: Using Triangulate and Contour	123
4.3.1	Using Triangulate and Contour	129
4.4	Lesson: Working with Contour Labels	138
4.4.1	Adding Contour Labels	140
4.4.2	Moving Contour labels	141
4.5	Lesson: Viewing Surfaces	142
4.5.1	Using the Surface File Viewer.....	145
4.5.2	Using the Drawing Viewer.....	147
4.6	Lesson: Editing Surfaces.....	149
4.6.1	Editing a Surface with the Surface Manager	152
4.7	Lesson: Surface Inquiries	157
4.7.1	Quick Profile.....	159
4.7.2	Creating Spot Elevations	163
4.7.3	Using the Drawing Inspector to show Surface Elevation	165
4.7.4	Slopes Zone Analysis.....	166
Chapter 5	Basic CAD Drawing and Editing in Carlson Software	171
5.1	Lesson: Introduction to Basic CAD Drawing and Editing	172
5.2	Lesson: Basic Cad Drawing and Editing	184
5.2.1	Initial Drawing Setup	185
5.2.2	Drawing Polylines by Point Group	189
5.2.3	Edit a polyline.....	191
5.2.4	Drawing an Arc.....	192
5.2.5	Draw a 2D Polyline from points.....	192
5.2.6	Offset a Polyline	193
5.2.7	Extending and Trimming Entities	194
5.2.8	Lengthen a Line	195
5.2.9	Drawing Lines by Angle and Distance	195

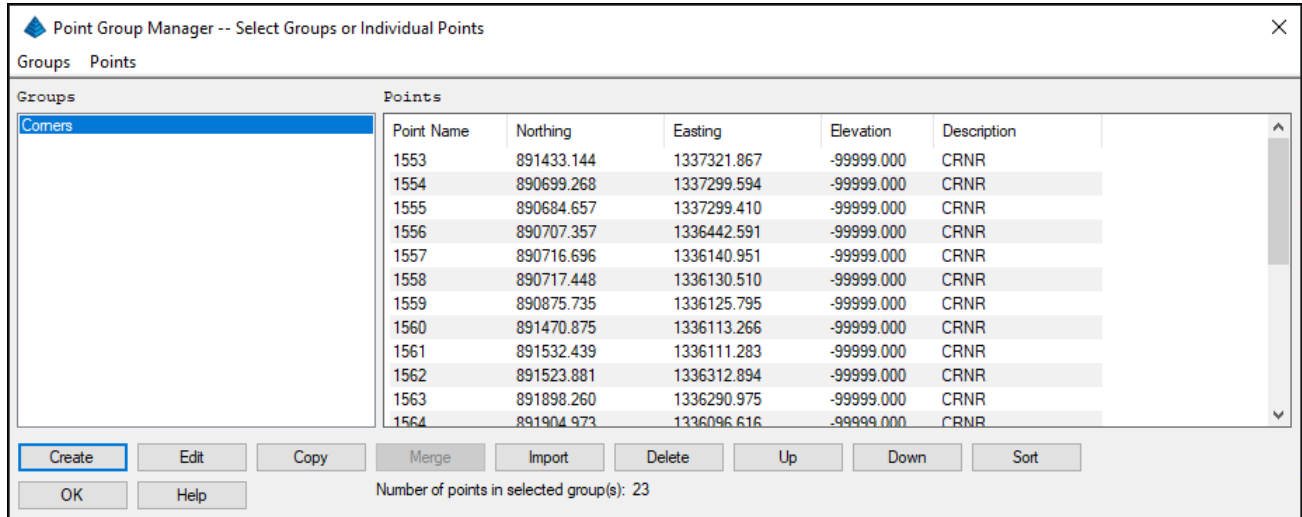
5.2.10	Draw Polyline by Nearest Found	198
5.2.11	Adding Symbols.....	199
5.2.12	Drawing a Rectangle	201
5.2.13	Drawing Special Line Types	202
5.2.14	Inserting an External DWG File (with AutoCAD).....	203
5.2.15	Inserting an External DWG File (with IntelliCAD).....	205
5.3	Lesson: Drawing Presentation and Creating a Final Plan	207
5.3.1	Drawing Orientation.....	211
5.3.2	Adding Text	212
5.3.3	Drawing a Hatch Pattern (with AutoCAD)	218
5.3.4	Drawing a Hatch Pattern (with IntelliCAD)	220
5.3.5	Drawing Variable Offsets.....	221
5.3.6	Create/Change Layers by Selection.....	222
5.3.7	Adding Dimensions and Leaders	223
5.3.8	Drawing a Border and Title Block.....	229
5.3.9	Adding a North Arrow	231
5.3.10	Adding a Bar Scale.....	233
Chapter 6	More Essential Tools	235
6.1	Lesson: Using Drawing Cleanup.....	236
6.1.1	Using Drawing Cleanup.....	238
6.2	Lesson: Labeling Lines	240
6.2.1	Set Linework Label Linking.....	247
6.2.2	Annotate Defaults	248
6.2.3	Auto Annotate.....	250
6.3	Lesson: Annotative Text and Points	252
6.3.1	Setting up Annotative Text and Points	254
6.3.2	Annotate the Plan	257
6.3.3	Change the Annotative Scale.....	259
6.4	Lesson: Working with Centerlines.....	260
6.4.1	Define a Centerline	263
6.4.2	Edit a Centerline	264
6.4.3	Station a Centerline	267
6.4.4	Export a Centerline.....	269
6.5	Lesson: LandXML Export/Import	270
6.5.1	LandXML Export.....	273
6.5.2	LandXML Import.....	275

6.6 Lesson: Google Earth Export/Import	279
6.6.1 Google Earth Export.....	281
6.6.2 Google Earth Import.....	283
6.7 Lesson: Working with Quick Keys	285
6.7.1 Creating Quick Keys	287
6.8 Lesson: Working with the Symbol Library	289
6.8.1 Editing the Symbol Library	291
6.9 Lesson: Importing Esri SHP Files.....	295
6.9.1 Configure GIS Settings	297
6.9.2 Import Esri SHP	299
6.9.3 Viewing the GIS Data.....	303
6.10 Lesson: Place Image by World File	306
6.10.1 Place Image by World File	309
6.11 Lesson: Working with Civil 3D Data	311
6.11.1 Create a Drawing with Civil 3D Point Objects.....	312
6.11.2 Import a Drawing with Civil 3D Data	314
Index	317

3.8 Lesson: Using Point Groups

Introduction

In this lesson we look at the use of Point Groups to organize your point data, and some of the subsequent uses of those groups.



Key Concepts

Concepts and key terms covered in this lesson are:

- Point Groups
- Filters
- Applications of Point Groups

Objectives

After completing this lesson, you will be able to:

- Learn what Point Groups are
- Learn how to Create Point Groups
- Learn various applications of Point Groups

Advantages of using Point Groups

Point Groups are a powerful and versatile tool to organize your point data. Some uses of Point Groups include:

- Controlling Point Display
- Editing Points
- Drawing Points
- Field to Finish
- Selecting Points to build a Surface
- Exporting specific Points
- Creating Point Tables
- Generating Reports

Creating Point Groups

Point Groups are saved selection sets of points. They can be created by setting up a query (or filter) that sorts through all the points in the current .CRD and selects the ones that match the criteria. Point groups can be based on a variety of criteria including point numbers, point elevations, point descriptions and logical combinations thereof.

The *New Point Group* dialog box consists of an *Include* tab and an *Exclude* tab. First the filtering criteria specified on the *Include* tab is applied to the entire current coordinate file. The resulting list of points is created and held in memory. Note that on the *Include* tab, all specified filter criteria must be met for a point to be included.

Components of the Query can include any combination of:

- A Range of point numbers, selected from the Drawing or the .CRD, found in the Drawing or the .CRD that fall within a drawn Circle, or found within the Drawing or the .CRD within a drawn Polyline
- Elevation Range
- Descriptions
- All Points in the database

Next, the filtering criteria specified on the *Exclude* tab is applied to that temporary list. Any points in the list that match the exclude criteria are removed from the list to create the final Point Group.

On the *Exclude* tab, the user specifies whether the points to be excluded must match *All* of the filter criteria, or *Any* of the filtering criteria. Using all of these variables in different combinations can produce a very specific set of points.

Components of the Query can exclude any combination of:

- A range of point numbers, using the same methods as described for Include
- Elevation Range
- Descriptions

How Point Groups Work

The parameters that define Point Groups are stored in files with a .GRP file extension, and the same filename as the .CRD coordinate file they are to be applied to. Each Point Group file is associated with one and only one CRD file, as determined by the filename. For example, Test.grp will only refer to points in Test.crd in the same directory.

Each Point Group file contains a number of Point Groups. Each Point Group contains rules for selecting the points within the *.crd file. This file is not intended to be edited manually. The Point Group Manager in Carlson Software is the correct tool to use to edit the Point Group rules and/or to add or remove Point Groups.



Point Groups are dynamic, inasmuch as the .CRD file is read in its current state whenever Point Groups are employed. So if Points that belong in a specific Point Group are added to or deleted from the .CRD, the next time Point Groups are used, they will be updated to the current state of the .CRD.

Exercises: Working with Point Groups

In these exercises you create a Point Groups, using filtering of descriptions, and then use the new Point Group with *Draw-Locate* to draw that specific set of Points in the Drawing.

You do the following:

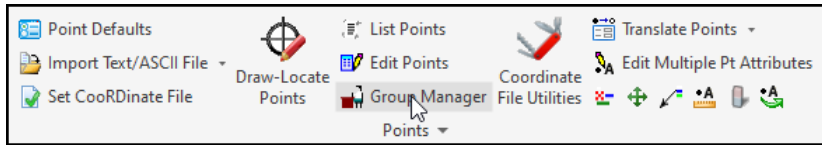
- Create a Point Group
- Draw a Point Group

3.8.1 Creating a Point Group

1. Continue working in the drawing **Basemap.dwg**.

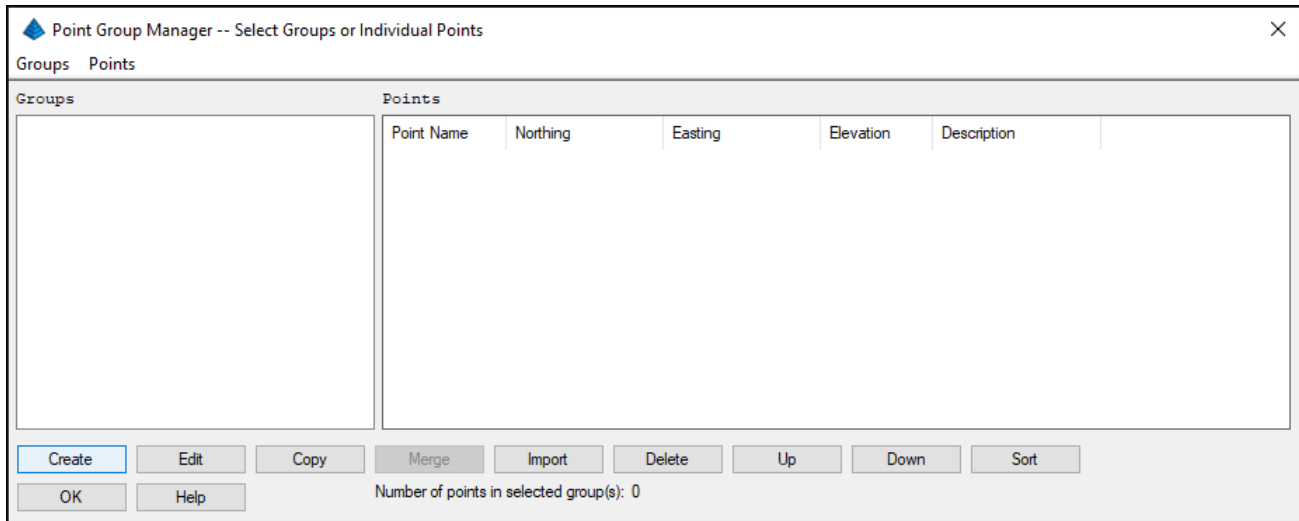
If you have not completed the previous lessons:
Open *3_8.dwg* from the project folder *APG 2021 Lesson 3_8*.

2. Select **Ribbon: Points**
⇒ **Points** ⇒ **Group Manager**.



Alternatively, from the pull-down menu:
Select **Points** ⇒ **Point Group Manager**.

The *Point Group Manager* opens.



3. Click <<**Create**>>.

New Point Group

Group Name:

Description:

Include | Exclude

Inclusion rules are applied before exclusion rules.
A point that meets all of following rules is included.

Include All

Point List

Elevation Range Minimum: Maximum:

Description

4. In the *New Point Group* dialog box for the **Group Name** enter **Corners**.
5. On the *Include* tab disable **Include All**.
6. Enable **Description**.
7. Click <<**Set From List**>>.

This opens the *Select points from coordinate file* dialog box. Here you can see all the points in the current .CRD file, sort them, and select the descriptions that you want to use to create the point group. It saves time and reduces errors by allowing you to see the description of points that are in the point database so you don't have to type them in from memory.

Select points from coordinate file

Name	North	East	Elevation	Description
1217	890766.84	1336237.95	448.67	BC
1404	891766.15	1336375.48	449.69	BC
1403	891765.63	1336349.72	449.69	BC
1402	891725.28	1336350.53	449.69	BC
1212	890780.29	1336231.65	452.34	BC
1401	891725.80	1336376.30	449.69	BC
1340	890917.04	1336103.61	-99999.00	CL
1338	891229.48	1337115.72	-99999.00	CL
1337	891271.35	1336094.87	-99999.00	CL
1339	890890.23	1337104.82	-99999.00	CL
1556	890707.36	1336442.59	-99999.00	CRNR
1553	891433.14	1337321.87	-99999.00	CRNR
1554	890699.27	1337299.59	-99999.00	CRNR
1557	890716.70	1336140.95	-99999.00	CRNR
1555	890684.66	1337299.41	-99999.00	CRNR
1558	890717.45	1336130.51	-99999.00	CRNR

8. Click <<**Description**>> to sort the list by the description.
9. Find a point with a **CRNR** description and select it.
10. Click <<**OK**>>.

New Point Group [X]

Group Name:

Description:

Include | Exclude

Inclusion rules are applied before exclusion rules.
A point that meets all of following rules is included.

Include All

Point List

Elevation Range Minimum: Maximum:

Description

11. Back in the *New Point Group* dialog box click <<Save>>.

Point Group Manager -- Select Groups or Individual Points [X]

Groups Points

Groups: **Corners**

Point Name	Northing	Easting	Elevation	Description
1553	891433.144	1337321.867	-99999.000	CRNR
1554	890699.268	1337299.594	-99999.000	CRNR
1555	890684.657	1337299.410	-99999.000	CRNR
1556	890707.357	1336442.591	-99999.000	CRNR
1557	890716.696	1336140.951	-99999.000	CRNR
1558	890717.448	1336130.510	-99999.000	CRNR
1559	890875.735	1336125.795	-99999.000	CRNR
1560	891470.875	1336113.266	-99999.000	CRNR
1561	891532.439	1336111.283	-99999.000	CRNR
1562	891523.881	1336312.894	-99999.000	CRNR
1563	891898.260	1336290.975	-99999.000	CRNR
1564	891904.973	1336096.616	-99999.000	CRNR

Number of points in selected group(s): 23

12. In the *Point Group Manager* notice the new point group **Corners**. It contains 23 points and is limited to points with the description **CRNR**.

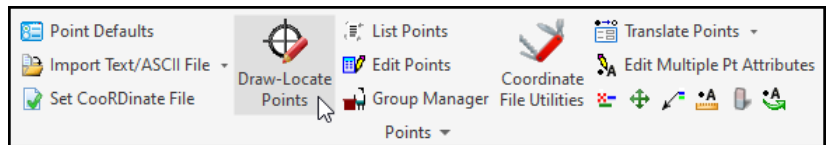
13. Click <<OK>>.

3.8.2 Drawing Points by Point Group

1. Continue working in the drawing from the previous exercise.
2. From the pull-down menu: Select **Points** ⇒ **Erase Point**.
3. At the command line respond to the prompts as follows:
4. Select points from screen, group or by point number [<Screen>/Group/Number]? **S**
5. Graphically select all the points in the drawing and press **Enter**.
6. Delete points from coordinate file [Yes/<No>]? **N**
7. Delete point symbols, attributes or both [<Both>/Symbols/Attributes]? **B**

All the points are now removed from the drawing, however, they still exist in the point database.

8. Select **Ribbon: Points**
⇒ **Points** ⇒ **Draw –**
Locate Points.



Alternatively, from the pull-down menu:
Select **Points** ⇒ **Draw – Locate Points**.

The *Draw-Locate Points* dialog box opens.

Many of the settings within the *Draw-Locate Points* dialog box are already set to the choices you made in the *Point Defaults* dialog. However, they can be changed here, and the changes will be used for this specific point creation.

9. Confirm **Layer by Description** is enabled.
10. Confirm the **Layer Prefix** is set to **PT_**.
11. Confirm the remaining settings are set like the graphic above.
12. Click <<**Draw Point Group**>>.

This opens the *Select Point Group(s)* dialog box. Here you can select one or more point groups to draw into the drawing.

Point Name	Northing	Easting	Elevation	Description
1553	891433.144	1337321.867	-99999.000	CRNR
1554	890699.268	1337299.594	-99999.000	CRNR
1555	890684.657	1337299.410	-99999.000	CRNR
1556	890707.357	1336442.591	-99999.000	CRNR
1557	890716.696	1336140.951	-99999.000	CRNR
1558	890717.448	1336130.510	-99999.000	CRNR
1559	890875.735	1336125.795	-99999.000	CRNR
1560	891470.875	1336113.266	-99999.000	CRNR
1561	891532.439	1336111.283	-99999.000	CRNR
1562	891523.881	1336312.894	-99999.000	CRNR
1563	891898.260	1336290.975	-99999.000	CRNR
1564	891904.973	1336096.616	-99999.000	CRNR

13. Confirm the point group **Corners** is selected.

14. Click <<OK>>.

Only the points representing corners are created in the drawing and should look like the graphic below.



Lesson Review

In this lesson you learned about using *Points Groups* in *Carlson Software*. First you created a *Point Group* by including all the points in the .CRD file with a certain description. Then you used that *Point Group* to draw the points into the drawing.

Chapter Review

In this chapter you learned about many aspects of working with points in *Carlson Software*. You looked at the use of the external point database, the coordinate file, known as the Carlson .CRD file. You also learned about several methods for the creation of point blocks in the drawing to represent the records in the external point database. You then learned how to edit the point blocks in the point data, how to erase point blocks and point data.


A solid understanding of the use of points in Carlson is essential. Practice these exercises and try other commands on the points menu that we did not cover. You are on your way to becoming a Carlson Software master and being a master of points is a solid step along the way.

Next we look at creating Surfaces using points and break lines.

Index

3D Polylines	106	General Settings	28, 29
Annotate Defaults	241	GIS Features File	296
Annotation Scale	253	GIS Inspector Settings	303
Annotative Points	57	GIS Settings	296
Annotative Text	252	Google Earth	280
Attribute Layout ID	57	Grey Scale	308
Auto Annotate	244	Hatch	218, 220
Bar Scale	233	Hatch Patterns	210
Bitonal	308	Header Lines	48
Blocks	180	Ignore Zero Elevations	125
Breakline Generation	105	Importing Esri SHP Files	295
Breaklines	105, 106	Importing a Text/ASCII File	46
Carlson Software 3D Viewer	143, 144	Importing LandXML Data	272
Centerline	261	Inclusion/Exclusion Areas	124
Civil 3D	312	Input-Edit Centerline File	261
Civil 3D Objects	312	IntelliCAD	1
Contour Label Options	139	KML	280
Contour Labels	101, 138	KMZ	280
Contour Settings	126	Label Contours	127
Contour Smoothing	126	Labeling Lines	240
Contours	105	LandXML	271
Correlation Files	308	Layer for Points	57
Crossing polygon	183	Leaders	223
Data Folder Setup	19	Link Labels with Linework	241
Data Type Sub-Folders	20	Listing Points	47
Deleting Point Data	86	Locate on Real Z Axis	56, 174
Design Centerline	262	Maximum Triangle Length	125
Dimensions	223	Move Point Attributes with Leader	71
Draw Contours	126	Multiline Text	212
Draw Points	49	North Arrow	231
Drawing Cleanup	236, 237	Object Linking	30
Drawing Coordinate Base	173	Osnap	181
Drawing Folder	19	Place Image by World File	306
Drawing Inspector	62, 158	Point Blocks	45
Drawing Orientation	208	Point Data	45
Drawing Template	178	Point Defaults	55, 56
Drawing Viewer	144, 145	Point Display	69
Drawing with accuracy	181	Point Groups	48, 91, 92
Draw-Locate Points	61	Point Number Settings	57
Edit Multiple Point Attributes	72	Point Protect	49
Edit Point Attributes	8	Points	43
Editing Point Data	79, 80	Polyline 3D Options	107
Editing Surfaces	149	Polyline to Centerline File	261
Entering Angles	173	Polyline to Special Line	178
Erasing Points	85	Printing	180
Esnap	181	Project Folder	19
External Data	18	Project Sub-Folders	20
Faults	105	Quick Keys	285
Fence	182	Quick Keys Editor	286
Field to Finish for Point Styles	57	Quick Profile	158, 159
Fixed Folder	20	Raster Images	307

Resize Point Attributes	70	Surface Inquiries	157
Ribbon	13	Surface Manager	150, 152
Running Osnaps	182	Surface Manager Properties	151
Settings Folder	21	Surfaces	101
Shrink-Wrap	125	Symbol Library	289, 290
Simplify Surface	125	Templates	178
Slope Zone Analysis	158	Text Styles	36, 209
Special Line Types	177	Text/ASCII File	47, 48
Spot Elevation	158, 163	Title Block	229
Standards	178	Triangulate and Contour	101, 123, 129
Startup Drawing Wizard	34	Triangulation File	124
Startup Project/Data Folder	21	Variable Offsets	221
Station a Centerline	267	Vector Objects	307
Supersonic Viewer	5	Viewing Surfaces	142
Surface Data Types	105	Wildcard	48
Surface Editing	150	Window polygon	183
Surface File Viewer	143, 145	Working with 3D and 2D Data	174



A Practical Guide to Carlson Survey 2021

Douglas L. Aaberg, PLS
Rick Ellis
Duke Gardner



A CADapult Press Publication

Copyright

Copyright © CADapult Press, Inc. 2020

All rights reserved. No part of this publication may be reproduced in any form, or by any means electronic, mechanical, recording, photocopying, or otherwise, without written permission from the publisher, except for brief quotations used in reviews, or for marketing purposes specific to the promotion of this work.

ISBN: 978-1-934865-54-5

Although CADapult Press has made every attempt to ensure the accuracy of the contents of this book, the publisher and author make no representations or warranty with respect to accuracy or completeness of the contents in this book, including without limitation warranties of fitness for a particular purpose. The datasets included in this book are for training purposes only.

Carlson Survey and Carlson Civil are registered trademarks of Carlson Software. AutoCAD Civil 3D, AutoCAD Map 3D, and AutoCAD® are registered trademarks of Autodesk, Inc. All other trademarks are the property of their respective owners.

Published in the United States of America by:

CADapult Press, Inc,

(503) 829-8929

books@cadapult-software.com

Printed and manufactured in the United States of America

About the Author

Douglas L. Aaberg, PLS is a licensed Professional Land Surveyor in the Commonwealth of Massachusetts and in the State of Colorado. His career in the Land Surveying/Civil Engineering business spans four decades. Having used Carlson Software exclusively since 1998, Doug is a recognized expert in applying the continually expanding capability of Carlson's programming to the everyday "work flow" of land surveyors and engineers. After owning and operating his own company for fifteen years, Doug now works directly for Carlson Software as their Survey Product manager. Besides being involved in development, he dedicates his time consulting to both large and small land survey and engineering firms through on-site training, remote support and individually tailored documentation.

Doug can be reached at: daaberg@carlsonsw.com

Rick Ellis has worked with and taught Civil/Survey CAD software since the mid-90s. He is the Author of several critically acclaimed books on AutoCAD Map 3D and other CAD packages. He continues to work on projects in a production environment, in addition to teaching classes to organizations both large and small.

This practical background and approach has made him an award winning speaker at Autodesk University, a member of the national speaker team for the AUGI CAD Camps and a sought after instructor by organizations around the world.

Rick can be reached at: rick@cadapult-software.com

Duke Gardner has served the land surveying and civil engineering communities for over 35 years in a wide variety of support roles. His focus on the theory as well as the practice skills needed to achieve successful implementation made him an excellent partner in the author team for this guide.

Acknowledgements

Thank you to Carlson Software for their cooperation. A special thanks to Gary Rosen and Lauren Lax from Carlson Software for their assistance and encouragement. Without it this book would not have been possible.

Exercise Data

We would like to thank the City of Springfield, Oregon and McKenzie Engineering Group from Norwell, Massachusetts for providing the data for parts of this book. The dataset provided is for illustration purposes only. While it is based on real world information to add relevance to the exercises, it has been altered and modified to more effectively demonstrate certain features as well as to protect all parties involved. The data should not be used for any project work and may not represent actual places or things. It is prohibited to redistribute this data beyond your personal use as a component of training.

A Practical Guide to Carlson Survey 2021

Introduction

Congratulations on choosing this course to help you learn how to use Carlson Survey 2021. The term “practical” is used in the title because this course focuses on what you need to effectively use Carlson Software, and does not complicate your learning experience with unnecessary details of every feature in the product.

Each lesson contains the concepts and principles of each feature to provide you with the background and foundation of knowledge that you need to complete the lesson. You then work through real world exercises to reinforce your understanding and provide you with practice on common tasks that other professionals are performing with Carlson Survey in the workplace every day.

You can take the lessons in this course in whatever order is appropriate for your personal needs. If you want to concentrate on specific features, the lesson for those features does not require that you complete prior lessons. With this course organization, you can customize your own individual approach to learning Carlson Survey.

When you complete this course, you will have the background and knowledge to apply Carlson Survey to your job tasks, and become more effective and productive in your job.

Course Objectives

The objectives of this course are performance based. In other words, once you have completed the course, you will be able to perform each objective listed. If you are already familiar with Carlson Software, you will be able to analyze your existing workflows, and make changes to improve your performance based on the tools and features that you learn and practice in this course.

After completing this course, you will be able to:

- Navigate the Pull-down Menus and Ribbon Menus
- Set up Carlson Software to use the Project approach
- Utilize various COGO tools
- Enter Raw Survey Data at the Command Prompt
- Enter Raw Survey Data in the Carlson Raw Data Editor
- Adjust a Traverse with Compass and Angle Balance
- Adjust a Traverse with Carlson SurvNet
- Enter Deed Data to Create a Deed File
- Perform a Deed Correlation with Field Data
- Create and Edit Lots and Areas
- Utilize Carlson LotNet to Generate Lots and Setbacks
- Edit and Annotate LotNet Lots
- Setup Field to Finish Codes and Generate 2D and 3D Geometry
- Utilize Various Critical Coordinate File Utilities
- Utilize the Point History to Record all Edits to Coordinate Files
- Use Special Linetypes for Map Creation

Prerequisites

Before starting this course, you should have a basic working knowledge of CAD. While a deep understanding of all CAD functionality is not required, but you should be able to:

- Pan and Zoom in the drawing screen.
- Describe what layers are and change the current layer.
- Create basic CAD geometry, such as lines, polylines and circles.
- Use Object Snaps.
- Describe what blocks are, and how to insert them.
- Perform basic CAD editing functions such as Erase, Copy, and Move.

If you are not familiar with these functions, you can refer to the Help system throughout the course to gain the fundamental skills needed to complete the exercises.

This text builds on the foundation of knowledge established in *A Practical Guide to Carlson Software Fundamentals 2021*. While a mastery of the material in that book is not mandatory to the successful completion of this text, it is highly recommended as a prerequisite to this courseware. Those topics include:

- Working with Points and Point Data
- Managing Point Groups
- Working with Surfaces
- Generating and Labeling Contours
- Performing Basic Drawing and Editing in CAD
- Importing and Exporting Land XML Data
- Working with Google Earth and World files
- Generating Linework Labels

Conventions

The course uses the following icons and formatting to draw your attention to guidelines that increase your effectiveness in Carlson Software, or provide deeper insight into a subject.



The magnifying glass indicates that this text provides deeper insights into the subject.



The compass indicates that this text provides guidance that is based on the experience of other users of Carlson Software. This guidance is often in the form of how to perform a task more efficiently.

Downloading and Installing the Datasets

In order to perform the exercises in this book, you must download a zip file and install the datasets.

Type the address below into your web browser to load the page where you can download the dataset.

www.cadapult-software.com/data

Unzip the Files

Unzip the file **APG_SURVEY2021.zip** directly to the C drive. The dataset will be copied to the folder:

C:\Carlson Projects

A folder called **APG Survey 2021 Data** is created that contains several folders with source data for the exercises in this book.

There are folders called **APG Survey 2021 Chapter X** These folders contain project files and drawings that are used to start the corresponding Chapters.

There are also folders created called **APG 2021 Lesson X_X** These folders contain project files and drawings where the lesson number of the folder corresponds to the lesson numbers in the book. This will allow you to jump in at the beginning of many of the lessons in the book, and do just the specific exercises that you want, if you do not have time to work through the book from cover to cover.

Exercises

The exercises in this course have been designed to represent common tasks that are performed by civil engineers, surveyors, designers and drafters. The data included in the exercises are typical drawings, point files and other data used by professionals like you. Exercises provide higher level process information throughout the exercise tasks. You are given information about not only what to do, but why you are doing it. Many images are included to help guide you.

Table of Contents

Chapter 1	A First Look at Carlson Survey 2021	1
1.1	Lesson: A Guided Tour through the Pull-down Menus	2
1.2	Lesson: A Guided Tour through the Ribbon Menus	14
Chapter 2	Working with Coordinate Geometry and Survey	19
2.1	Introduction to Coordinate Geometry	20
2.2	Lesson: Setting up and Configuring Carlson Survey	24
2.2.1	Setting up Carlson Survey to Work with External Data	28
2.2.2	Create a New Drawing	32
2.2.3	Configure General Settings and Points Default Settings	35
2.3	Lesson: Two Methods for Entering Field Survey Data	38
2.3.1	Entering Traverse and Sideshot Data Using Carlson COGO	42
2.3.2	Entering Data Using the Carlson Raw Data Editor	50
2.4	Lesson: Adjusting and Modifying Field Data	54
2.4.1	Adjusting a Traverse	55
2.5	Lesson: Entering Deeds and Record Information	60
2.5.1	Setting up Deed Defaults	62
2.5.2	Entering Record Deed Information	63
2.6	Lesson: Creating a "Fit"	70
2.6.1	Creating New Points for Record Locations	71
2.6.2	Making an Initial Analysis of Field vs Record Data	74
2.6.3	Deed Correlation	75
Chapter 3	Data Collectors and Post Processing	83
3.1	Lesson: Introduction to Data Collectors	84
3.1.1	Working with the Data Collector Programs	88
3.2	Lesson: Working with the Raw Data Editor	93
3.2.1	Processing, Editing and Reporting a Traverse Closure	94
3.3	Lesson: SurvNET	100
3.3.1	Creating a SurvNET Project	108
3.3.2	Processing Data with SurvNET	115
3.3.3	Adding Additional Traverse Data	121
3.3.4	Constraining the Network	124
3.3.5	Add Sideshot Ellipses	129
3.3.6	Generating Final Coordinates	131

Chapter 4	Area/Layout	133
4.1	Lesson: Offsets, Intersections and Cul-De-Sacs	134
4.1.1	Creating Right of Way and Offset Lines	137
4.1.2	Creating a Cul-De-Sac	139
4.2	Lesson: Creating and Sizing Lots	141
4.2.1	Selection Cycling	143
4.2.2	Creating Lots	144
4.2.3	Resizing Lots with Hinged Area	145
4.2.4	Resizing Lots with Sliding Side Area	146
4.2.5	Modify a lot by using AutoCAD Grips	147
4.3	Lesson: Lot Areas, Annotations and Setback Lines	148
4.3.1	Setting the Area Defaults	150
4.3.2	Annotating the Lot Areas	154
4.3.3	Setting up the Auto Annotate by Layer defaults Geometry (<i>by Layers</i>)	155
4.3.4	Alternate Setup - Load the Supplied Default Settings	176
4.3.5	Annotating the Plan	179
4.3.6	Cleaning up The Annotations	180
4.3.7	Creating Setback Lines	188
Chapter 5	LotNET	191
5.1	Lesson: The Automated Process of Creating Lots and Roadways	192
5.1.1	Setting up LotNET	194
5.1.2	Designing a Subdivision	199
5.2	Lesson: Modifications and Redesign	207
5.2.1	Modifying Lots Created by LotNET	209
5.2.2	Checking your Design for Conformance	214
5.2.3	Storing your design as an external .LOT file	214
5.3	Lesson: Annotations, Cleanup and Subareas	218
5.3.1	Annotating the Subdivision	219
5.3.2	Renumber Lots	221
5.3.3	Sub-Areas	222
Chapter 6	Working with Field to Finish	225
6.1	Lesson: Introduction to Field to Finish	226
6.2	Lesson: Setting up Field to Finish Codes and Settings	229
6.2.1	Creating a New Drawing for Field to Finish	236
6.2.2	Creating a Field to Finish Code File (.FLD file)	239
6.2.3	Creating/Editing a Field to Finish Code	242

6.2.4	Printing the Code List	249
6.2.5	Setting the Special Codes	252
6.3	Lesson: Drawing with Field to Finish	255
6.3.1	Drawing Field to Finish Entities	258
6.4	Lesson: Using the Field to Finish Inspector	260
6.4.1	Using the Field to Finish Inspector	262
6.5	Lesson: Using the Tree Feature	264
6.5.1	Drawing a User Defined Tree Feature	269
6.6	Lesson: High Octane Field to Finish	282
6.6.1	Adding Multiple Codes.....	287
6.6.2	Advanced Special Codes	299
6.6.3	Working with Offset Codes	302
6.6.4	Using Fixed Parameters	303
6.6.5	Working with Companion Codes	305
6.6.6	Cleaning Up Linework with the GAP and JPN Special Codes	309
6.6.7	Customizing Special Codes.....	311
6.6.8	Working with Templates	313
6.7	Lesson: Annotating with Field to Finish	319
6.7.1	Field Code Table Using Attributes.....	322
6.7.2	Creating a Block with Custom Attributes	335
6.7.3	Using a Block with Custom Attributes	338
6.7.4	Field Code Table Using Text.....	343
6.7.5	Adding Text from Field Notes.....	349
6.7.6	Adding Equations to Notes	353
6.8	Lesson: Editing the Plan	357
6.8.1	Setting Drawing Orientation.....	358
6.8.2	Controlling the Display with Layer Filters	360
6.8.3	Editing a Plan with Attribute Labels.....	362
6.8.4	Setting Drawing Orientation.....	365
6.8.5	Controlling the Display with Layer Filters	367
6.8.6	Editing a Plan with Text Labels	369
6.9	Lesson: Another Example of What Can be Done with Field to Finish	375
6.9.1	Putting it all Together.....	376
6.10	Special Codes Appendix	385
Chapter 7	Ten More Essential Tools.....	393
7.1	Lesson: Using the Carlson Survey Inverse Command	395
7.1.1	Inverse Between Two Points	397

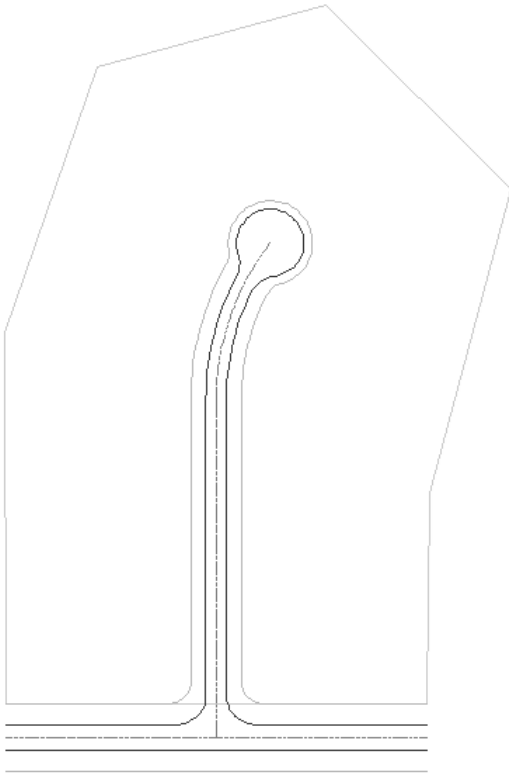
7.2 Lesson: Creating a Coordinate File from an Existing Drawing.....	400
7.2.1 Update CRD from Drawing	402
7.3 Copying or Merging Two Coordinate Files	406
7.3.1 The Copy/Merge CRD File Command.....	408
7.3.2 Updating the Drawing.....	412
7.4 Lesson: Creating a Point Comparison Report.....	414
7.4.1 Creating a Point Comparison Report.....	416
7.5 Lesson: Point History and the QA/QC of Coordinate Files	419
7.5.1 Reviewing Point History	420
7.6 Lesson: Aligning Geometry to Points	428
7.6.1 The 2D Align Command.....	429
7.7 Lesson: Calculating Curves.....	431
7.7.1 Using Curve Calc	433
7.7.2 Plotting a Curve.....	434
7.8 Lesson: Creating and Editing Polylines	436
7.8.1 Using Join Nearest.....	439
7.8.2 Editing Polylines.....	440
7.9 Lesson: Drawing Special Line Types	444
7.9.1 Change Polyline Linetype	446
7.9.2 Create a Tree Line	448
7.10 Lesson: Legal Description Writer.....	449
7.10.1 Creating a Legal Description.....	456
Index	459

Sample Lesson

4.1 Lesson: Offsets, Intersections and Cul-De-Sacs

Introduction

Much time is often spent creating roadways and cul-de-sacs. In this lesson you will learn how to utilize some of Carlson's design commands to highly automate these processes and work much more efficiently.



Key Concepts

- Creating offsets and intersections
- Creating cul-de-sacs

Objectives

After completing this lesson you will:

- Be able to efficiently create drawing geometry for roadways and cul-de-sacs using Carlson tools.

Introduction

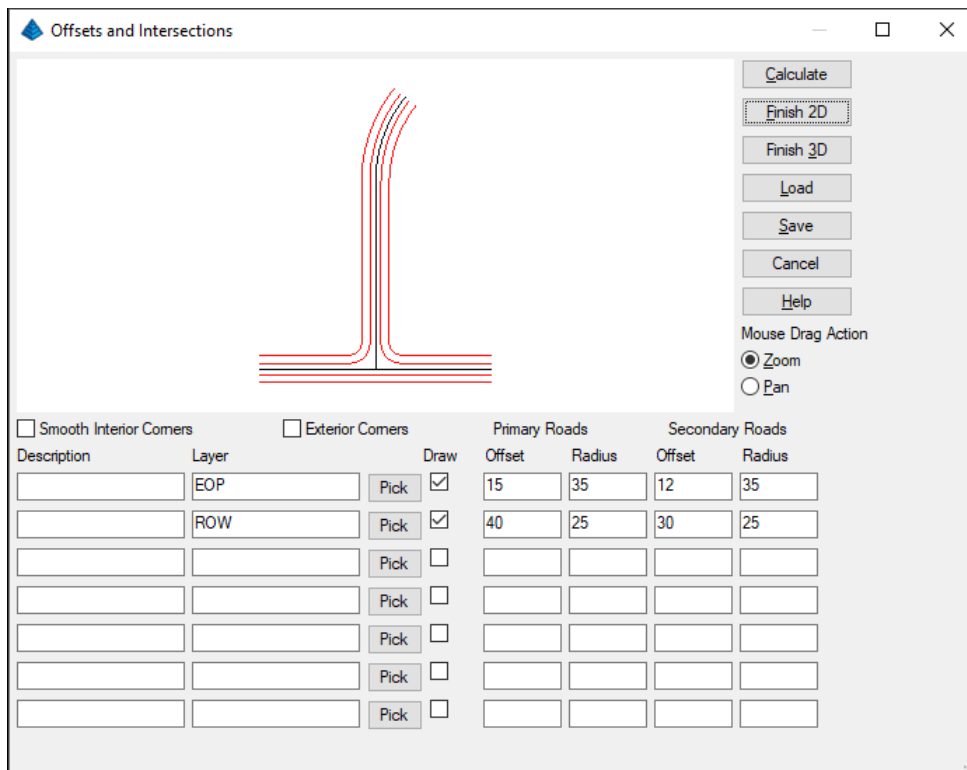
For the surveyor, calculating lot lines within an existing boundary can be a tedious and time consuming task. In days not so long ago, a surveyor or design engineer would sit and "number crunch" entering in COGO commands like bearing/bearing intersections or bearing/distance intersections to create lines, arcs and offsets.

In today's CAD climate, you have graphic tools that can perform those same tasks in a fraction of the time. However, the design of a subdivision (*Roads and Lots*) is still a constantly changing environment, with modifications from clients, overlaying regulations and budget constraints.

It is imperative to learn the many methods of designing a subdivision utilizing every tool available to ensure that the process is completed as quick and accurate as possible and that the inevitable revisions can be made easily.

It is important to mention that in a later chapter, you will be introduced to a powerful program called LotNET. LotNET combines all of the steps in creating roads and lots, automates the process and ties it directly to other civil design programs such as RoadNET.

Offsets and Intersections



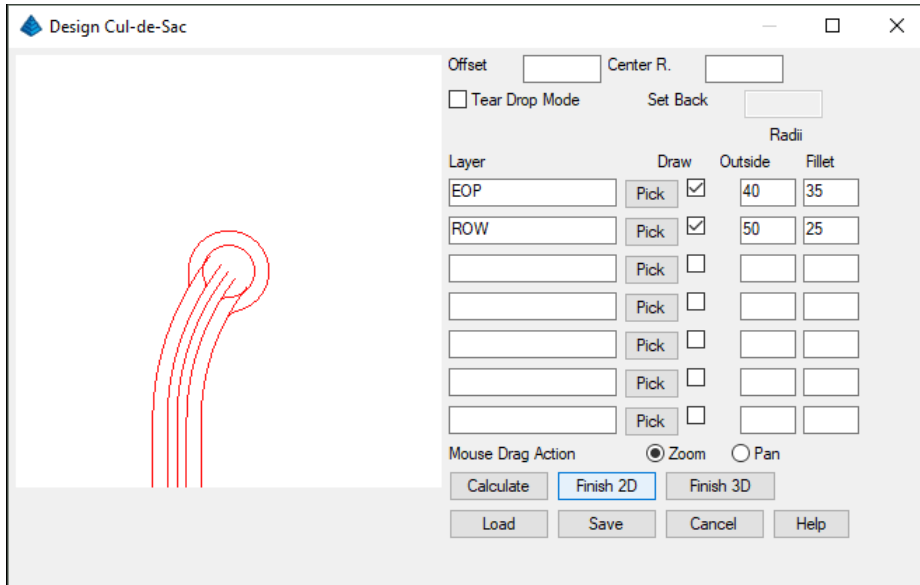
The *Offsets and Intersections* layout utility automates the process of creating geometry for roads, including intersections, based on selected centerlines.

The *Layer column* is the layer on which each offset will be created. In this case the default is **EOP** (edge of pavement) and **ROW** (right of way).

The Primary Roads column has two sub columns: **Offset** is the offset distance from the centerline for the corresponding layer. **Radius** is the return radii created at each intersection of roads for the corresponding layer.

The Secondary Roads columns are set up identically to the primary roads. Additional offsets and layers may be created as desired.

Design Cul-de-Sac



The *Design Cul-de-Sac* layout utility automates the process of creating geometry for Cul-de-Sacs. Similar to the Offsets and Intersection dialog box, this dialog box is where you set the desired geometric properties for the cul-de-sac.

The **Offset** field is for creating an offset cul-de-sac. The offset is calculated from the picked point in the previous step and is measured perpendicular to the incoming tangent bearing.

The **Center R.** creates an island at the center of the cul-de-sac at the specified radius.

Tear Drop Mode creates a tear drop style cul-de-sac at the specified Set Back.

Under the **Radii** column:

Outside specifies the outside radius for each of the corresponding layers

Fillet specifies the return radii where the cul-de-sac meets the incoming offset lines

Exercises: Create Right of Ways and a Cul-De-Sac

Creating right of way lines and cul-de-sacs can done easily by setting factors like offset widths and radii in the Carlson Offset and Intersection command.

You do the following:

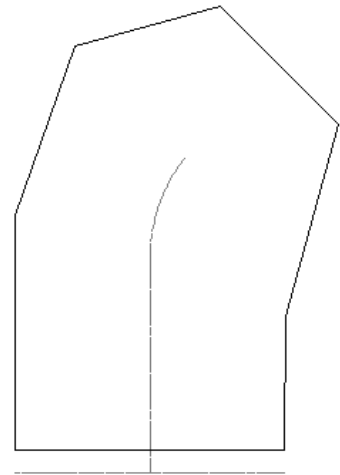
- Open a supplied drawing
- Create Right of Way lines from centerlines
- Create a Cul-de-Sac

4.1.1 Creating Right of Way and Offset Lines

In this exercise you will create right of way and edge of pavement offset lines at specified distances with connecting radii. You will use the Carlson Area/Layout Utilities' Offsets and Intersections command.

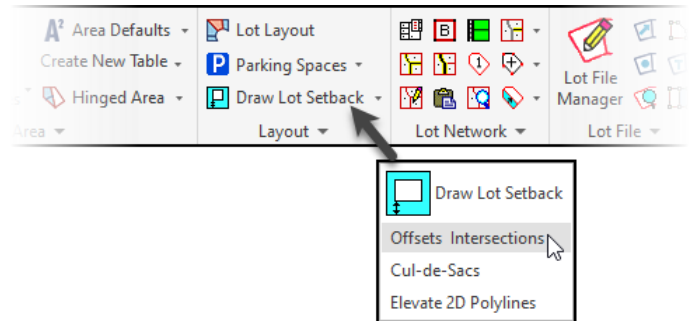
1. Open the drawing: **C:\Carlson Projects\APG Survey 2021 Chapter 4\DWGS\Lots.dwg**

The drawing file contains a perimeter boundary line and two centerlines.

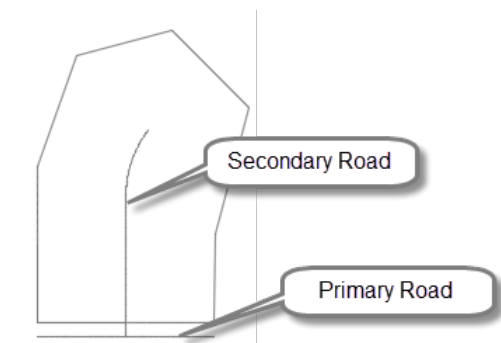


2. Select **Ribbon: Area/Layout ⇒ Layout ⇒ Offsets & Intersections.**

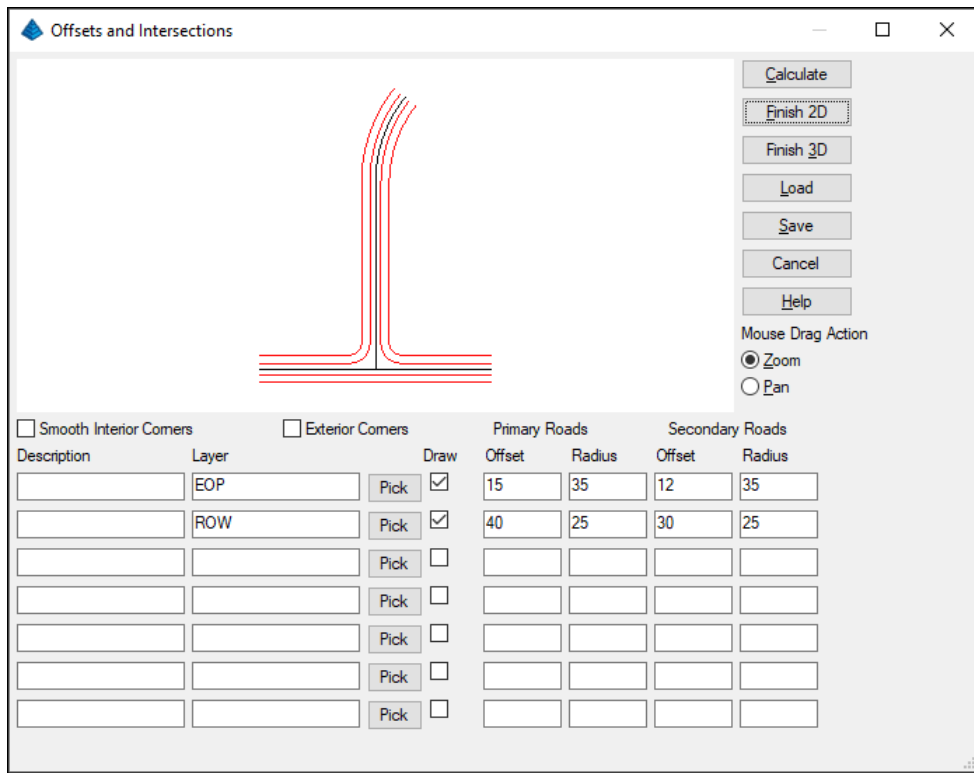
Alternatively, from the pull-down menu:
Select: **Area/Layout ⇒ Layout Utilities ⇒ Offsets & Intersections.**



3. At the command line prompt: *Select all PRIMARY road polylines* select the **Horizontal Polyline on the south side of the boundary.**
4. Press **[Enter]** to complete the selection.
5. At the command line prompt: *Select all SECONDARY road polylines* select the **Vertical Polyline within the boundary.**
6. Press **[Enter]** to complete the selection.



This opens the *Offsets and Intersections* dialog box.



7. Enter the offset dimensions as shown:

Primary Roads

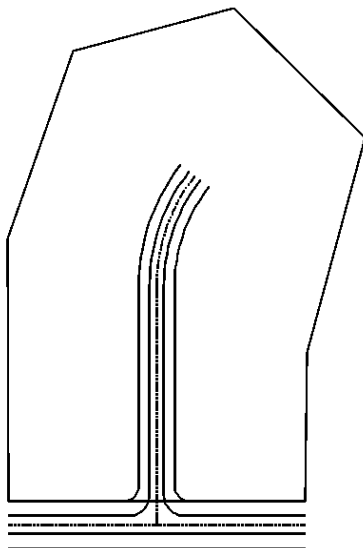
- EOP Offset 15 Radius 35
- ROW Offset 40 Radius 25

Secondary Roads

- EOP Offset 12 Radius 35
- ROW Offset 30 Radius 25

8. Click <<Finish 2D>>.

The 2D polylines representing the Right of Way and Edge of Pavement lines are placed in the drawing and look like the graphic below.

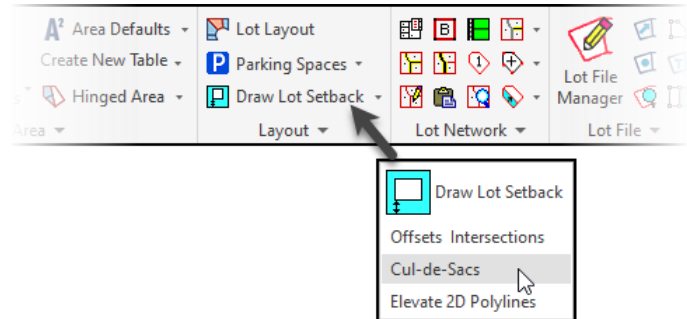


4.1.2 Creating a Cul-De-Sac

In this exercise you will attach a cul-de-sac to the dead end road centered within the boundary lines.

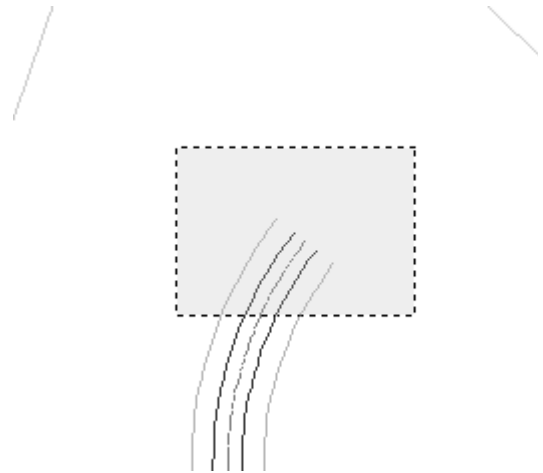
1. Continue working in the drawing from the previous exercise.
2. Select **Ribbon: Area/Layout ⇒ Layout ⇒ Cul-de-Sacs**.

Alternatively, from the pull-down menu:
Select **Area/Layout ⇒ Layout Utilities ⇒ Cul-De-Sacs**.



3. At the command line prompt: *Select all offset polylines to end with cul-de-sac* Select by a crossing window (upper right to lower left) the 5 lines at the end of the roadway.
4. Press **[Enter]** to complete the selection set.

These are the lines created in the previous step that correspond to ROW and EOP as well as the original centerline.

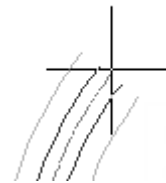


5. At the command line prompt: *Pick cul-de-sac center projection onto centerline*: Select the **End Point** at the end of the centerline.

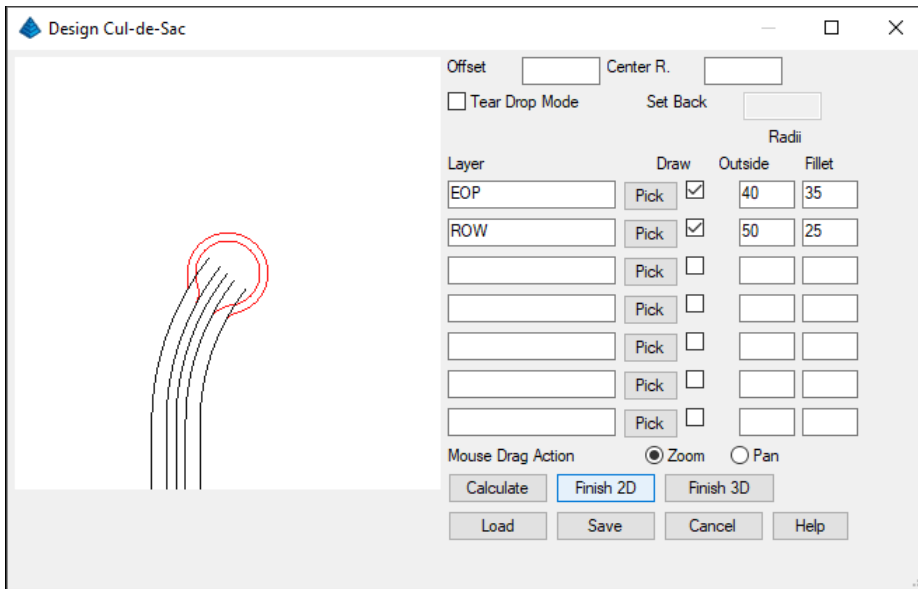
This represents the base point of the cul-de-sac.



Note the **End Point** object snap is provided by the program automatically.



This opens the *Design Cul-De-Sac* dialog box.



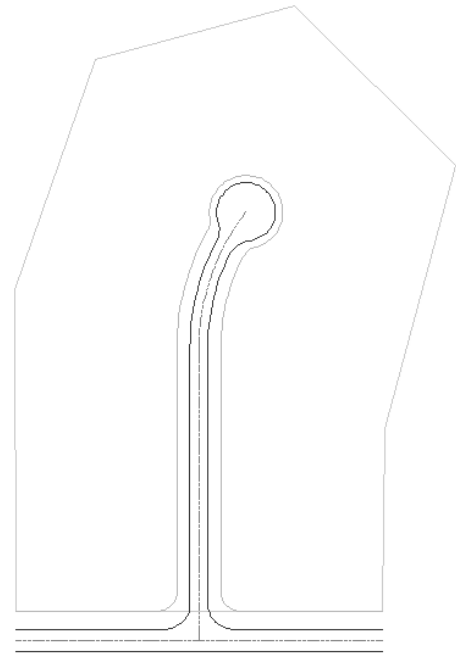
6. Set the EOP **Outside** offset to **40**.
7. Set the EOP **Fillet** to **35**.
8. Set the ROW **Outside** offset to **50**.
9. Set the ROW **Fillet** to **25**.

Note: It is important the layers used are the same as those in the previous exercise.

10. Click <<**Finish 2D**>>.

The resulting cul-de-sac is placed in the drawing and is connected to the previous entities to create a continuous polyline.

11. **Save** the drawing.



Lesson Review:

In this lesson you created right of way lines, edge of pavement lines and a cul-de-sac all from two existing centerlines.

Index

AAN file	149	Field to Finish Inspector	260, 261
Add or Remove Lot line Edges	208	File Menu	3
Add, Remove or modify Lot Line points	208	File Tab	15
ADF file	149	Fit	71
Aligning Entities	429	Fixed Folder	26
Angles	21	Fixed Parameters	284, 303
Annotate Menu	11	GIS Menu	12
Annotating	319	Inquiry Menu	6
Annotating a Line	182	Instances	261
Annotating Arcs	185	IntelliCAD	1
Annotating Areas	149	Inverse	74, 395, 396
Annotating Lot Areas	154	Inverse Options	396
Annotating Point to Point	183	Join Nearest	437
Annotation	219	LAY file	149
Area/Layout Menu	11	Layer Filters	360, 367
Area/Layout Tab	17	Legal Description Writer	449
attribute	320	Lot Layout	142
Auto-Annotate by Layer	149	Lot Line Modifications	208
Begin Codes	284	LotNET	193
C&G Survey Menu	13	LTN file	194
Carlson COGO	39, 42	Merge Points	407
Carlson Raw Data Editor	50	Moving Annotations with Leaders	183
Centerline Menu	10	Multiple Codes	283
closing angle	49	Nearest Found	234
COGO	22	Notes	349
COGO Menu	10	Offset Codes	284, 302
Companion Codes	285, 305	Offsets and Intersections	135
Compare Points	415	PDD File	61
Compass Rule	57	Point History	419
Constraining the Network	124	Points Menu	8
Create or modify a lot by a predetermined area	208	Points Tab	16
Creating Lots	144	Polyline Editing Tools	437
Cul-de-Sac	136	Polyline Linetypes	445
Curve Calculator	432	Project Folder	25
Custom Attributes	335	Project Sub-Folders	26
Data Collector Programs	85	Raw Data Editor	39
Data Folder Setup	25	Raw Data Editor Menus	40
Data Type Sub-Folders	26	Raw Data Toolbars	39
Deed Correlation	75	Renumber Lots	221
Deed Defaults	62	Renumbering Lots	219
Deed File	61	Resizing Lots	143, 145
Draw Field to Finish	256	Ribbon	15
Draw Menu	6	RoadNET	193
Drawing Folder	25	RW5	22
Drawing Orientation	358, 365	Setting Standard Errors	124
Edit Menu	4	Settings Folder	27
Edit Point Attributes	8	Settings Menu	7
End Codes	284	Setup Tab	16
Entering Record Deed Information	63	Sideshot Ellipses	129
Equations	353	Special Codes	235, 252, 285, 299, 311
Field to Finish	225, 226, 227, 255	Special Codes Appendix	385
Field to Finish Codes	230	Startup Project/Data Folder	27

Sub-Areas	219, 222	Traverse in the Raw Data Editor	94
Surface Menu	12	Tree Description Codes	267
Surface Tab	18	Tree Entity Options	265
SurvCE	86	Tree Feature	264
SurvCom	85	Tree Input Values	266
Survey Menu	9	Tree Labels	268
Survey Tab	17	Tree Line	448
SurvNET	101	Tree Survey Settings	265
Templates	286, 313	Update a CRD File from Drawing	401
The .FLD File	230	View Menu	5
Traverse Adjustment	55		