A Practical Guide to AutoCAD® 2021

Tracy Chadwick and Rick Ellis

Foreword written by Lynn Allen

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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.

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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.

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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

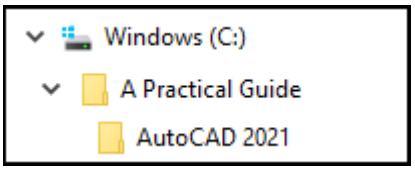
In order to perform the exercises in this book, you must download a zip file and install the datasets.

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.

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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

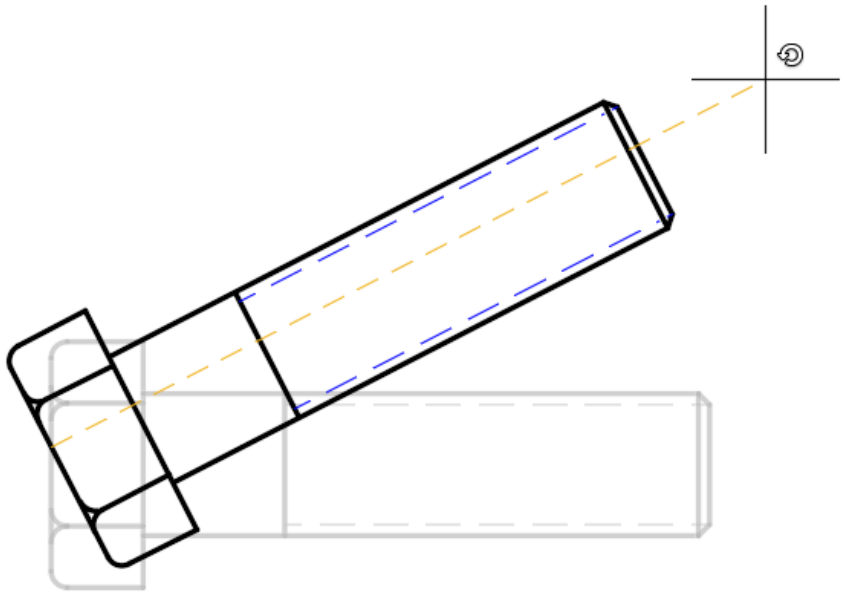
In her 20+ year career as Autodesk Technology Evangelist, Lynn Allen has spoken to more than a half million design professionals in over 50 countries throughout the world. Her online reach over the years easily reaches into the millions. An early CAD entrepreneur, Lynn taught AutoCAD at the corporate 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:

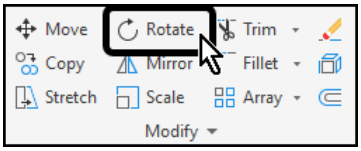
- Rotate drawing objects.

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.

```
Current positive angle in UCS:  ANGDIR=counterclockwise  ANGBASE=0
ROTATE Select objects:
```

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.

```
Select objects: 1 found, 3 total
ROTATE Select objects:
```

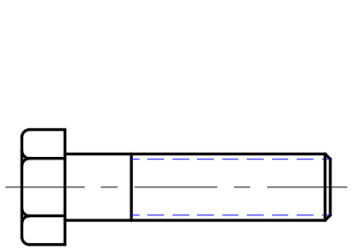
Next you will specify the base point. This point will remain in the same location while the rest of the selected objects rotate around it.

```
Select objects:
ROTATE Specify base point:
```

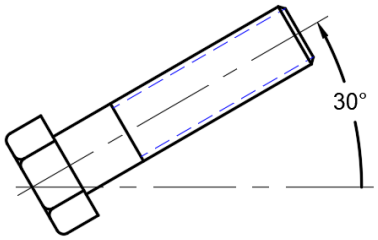
Finally, the Command line asks for the rotation angle. The angle can be specified by typing a value or by selecting a point on-screen.

```
Specify base point:
ROTATE Specify rotation angle or [Copy Reference] <0>:
```

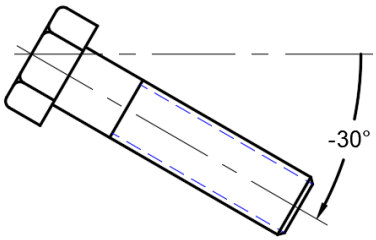
When entering a rotation angle value, it is important to remember that by default in AutoCAD, angles are positive when rotating in the counterclockwise direction; angles are negative when rotating in the clockwise direction.



Original Object

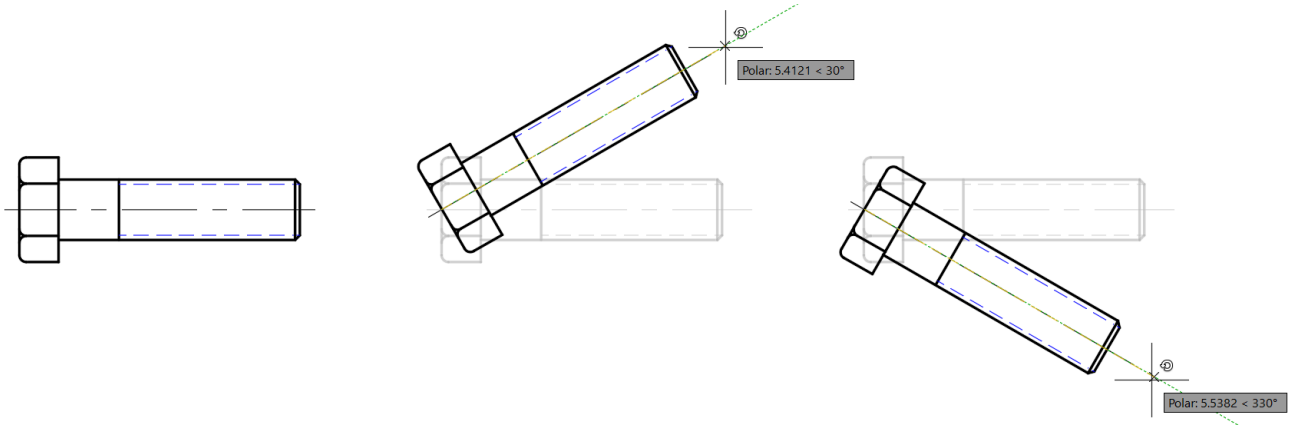


Object rotated positive 30°



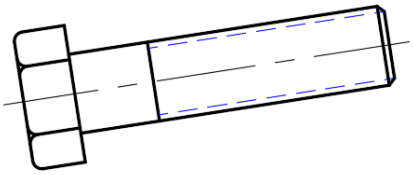
Object rotated negative 30°

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.



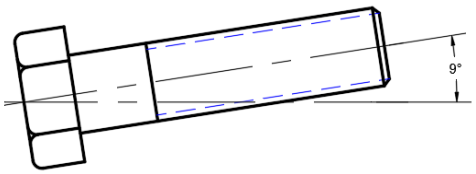
Specifying the Reference Angle

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.

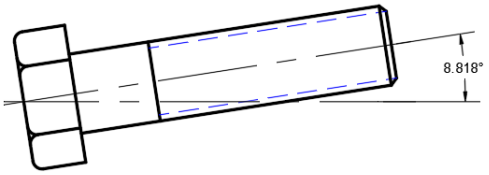


This is a fairly simple process if the object was rotated at a known angle, such as 30 degrees; you could simply rotate the object negative 30 degrees to return it to horizontal. However, if the object has been rotated at an unknown angle, the process could be more difficult. One possibility is to measure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

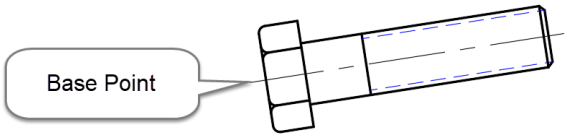


Using this new, more precise value could still lead to an incorrect drawing because this value is most likely rounded off as well.

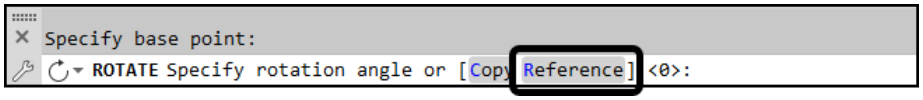
The much more precise and quicker solution is to use the Reference option of the Rotate command.

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.

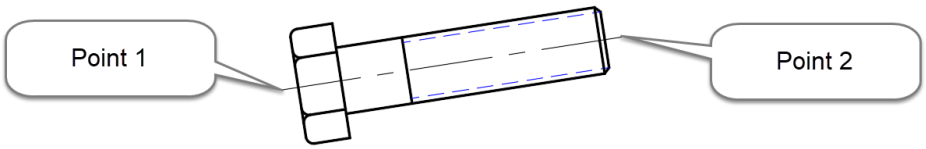
1. Begin the Rotate command and select the objects to be rotated.
2. Specify the basepoint.



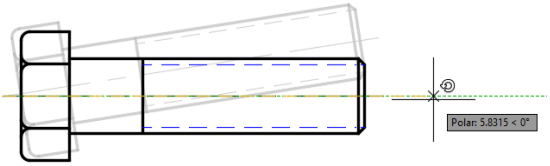
3. Choose the **[Reference]** option in the Command line.



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

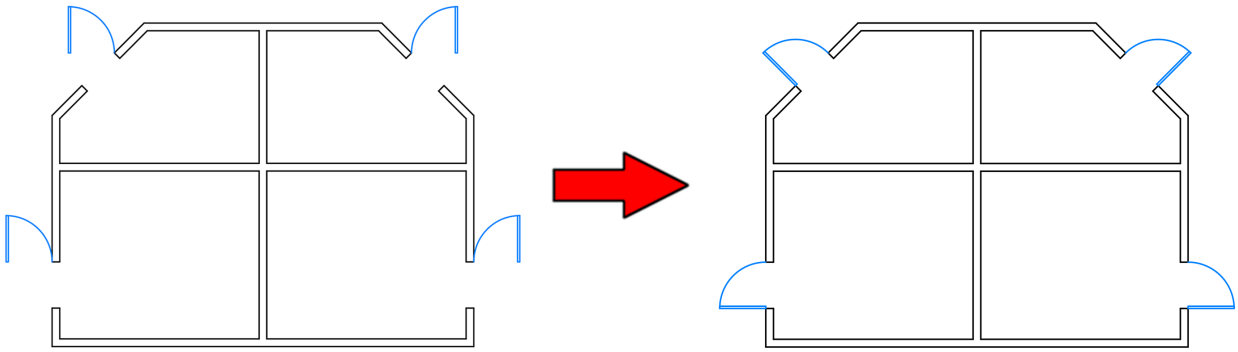
In these exercises, you will rotate several drawing objects.

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

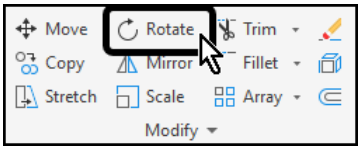
In this exercise you will use the Rotate command to adjust the orientation of several doors.



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.

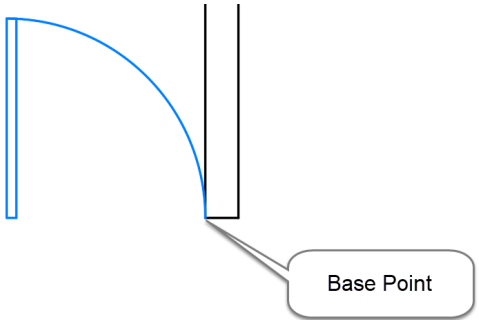
3. Zoom to the lower-left quadrant of the building.
4. Select **Ribbon: Home ⇒ Modify ⇒ Rotate**.



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.



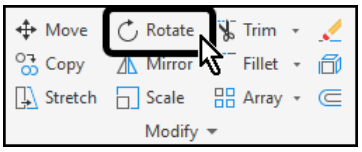
You are now prompted to specify the rotation angle.

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**.

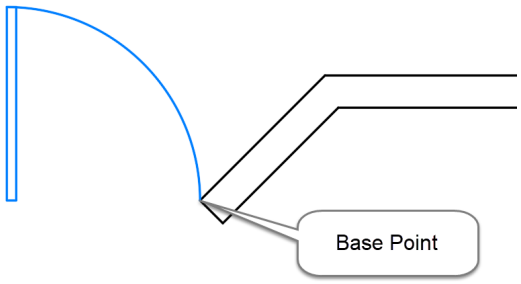


11. Select the door.

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.



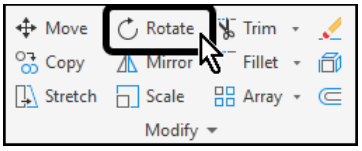
You are now prompted to specify the rotation angle.

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**.

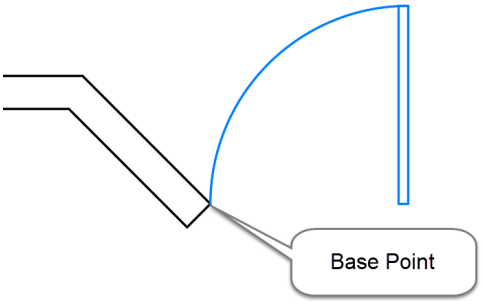


17. Select the door.

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.



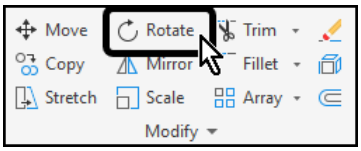
You are now prompted to specify the rotation angle.

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**.

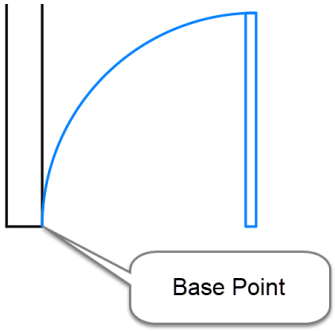


23. Select the door.

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

You are now prompted to select the base point.

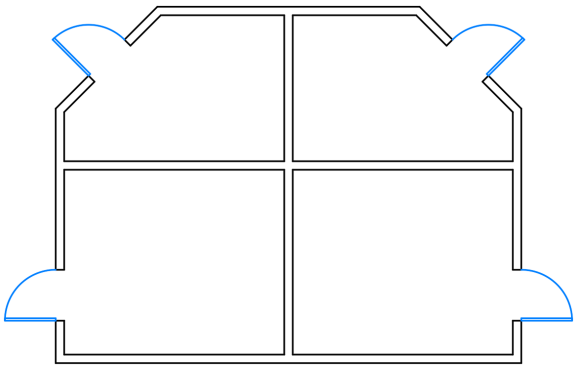
25. Select the point where the arc touches the wall to specify it as the base point.



You are now prompted to specify the rotation angle.

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

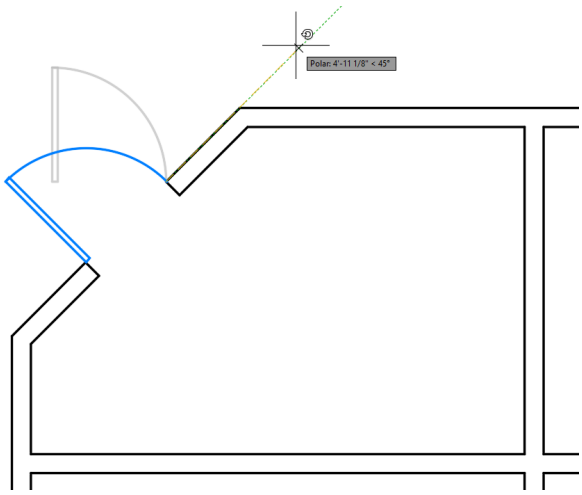
The completed drawing appears as shown.



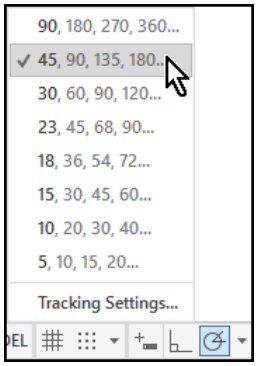
26. **Save** the drawing.

6.4.2 Rotating Objects with Polar Tracking

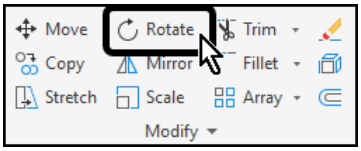
In this exercise you will use the Rotate command and *Polar Tracking* to speed up the rotate process.



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.



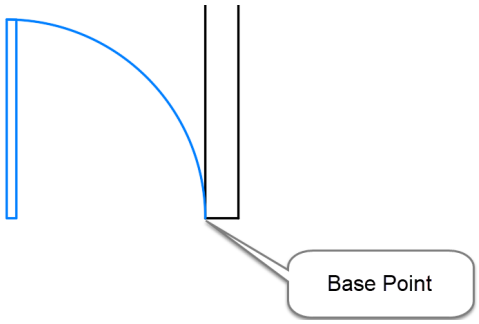
5. Zoom to the lower-left quadrant of the building.
6. Select **Ribbon: Home ⇒ Modify ⇒ Rotate**.



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

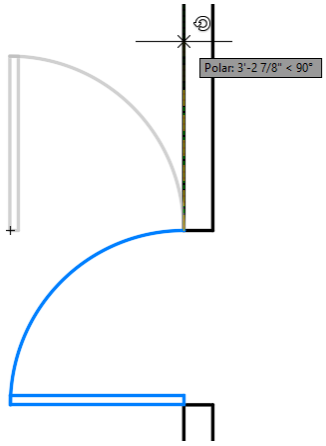
You are now prompted to select the base point.

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.

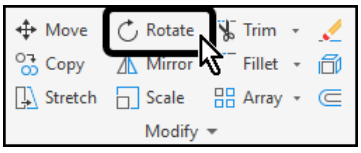
10. Move the crosshairs above the previous point, until it snaps on to the **90** degree *Polar Tracking* angle, then select a point.



The door is rotated into place.

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

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

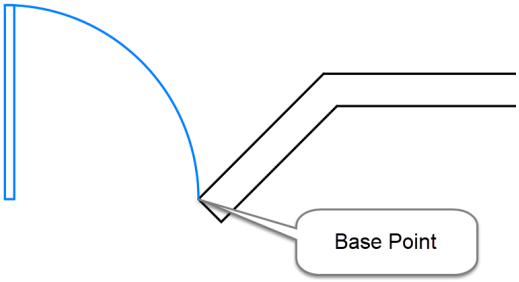


13. Select the door.

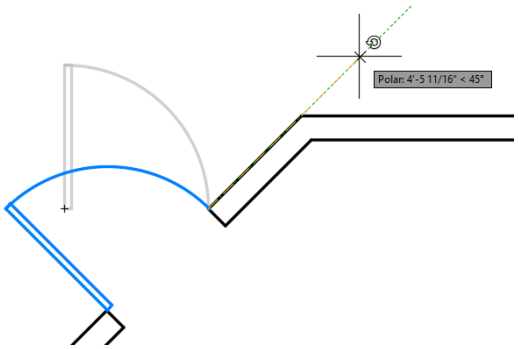
14. Press **[Enter]** at the keyboard to finish selecting objects.

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.



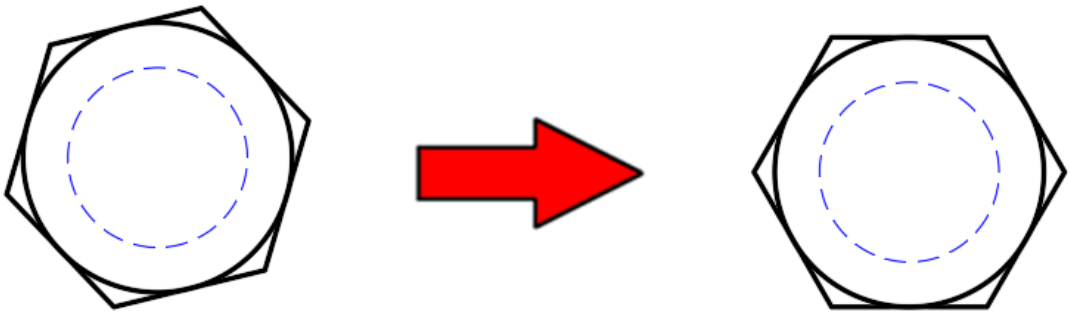
16. Move the crosshairs above and to the right of the previous point, until it snaps on to the **45** degree *Polar Tracking* angle, then select a point.

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.

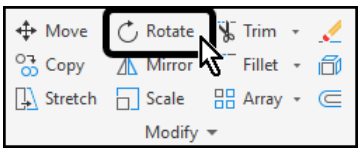


1. **Open** drawing **6.4.3 Rotating Objects 3.dwg**.

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**.

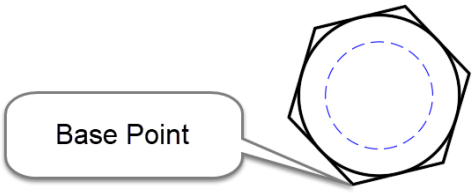


4. Select the objects that make up the bolt head.

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

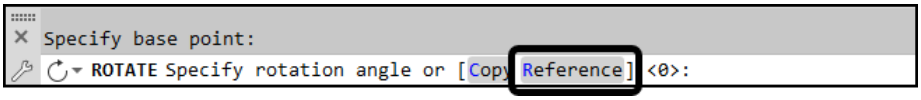
You are now prompted to select the base point.

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.

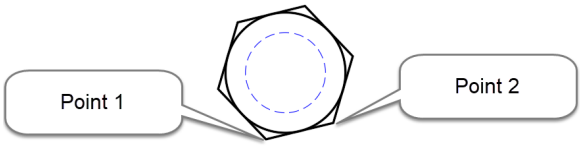
7. At the Command line select the **[Reference]** option.



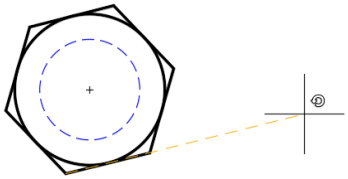
You are prompted to specify the reference angle.

8. Click the lower-left point.

9. Click the lower-right point.

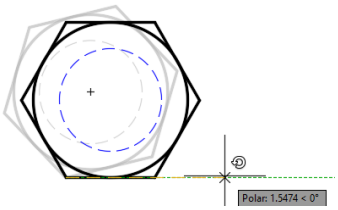


The reference angle now matches the bottom edge of the bolt head.



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.

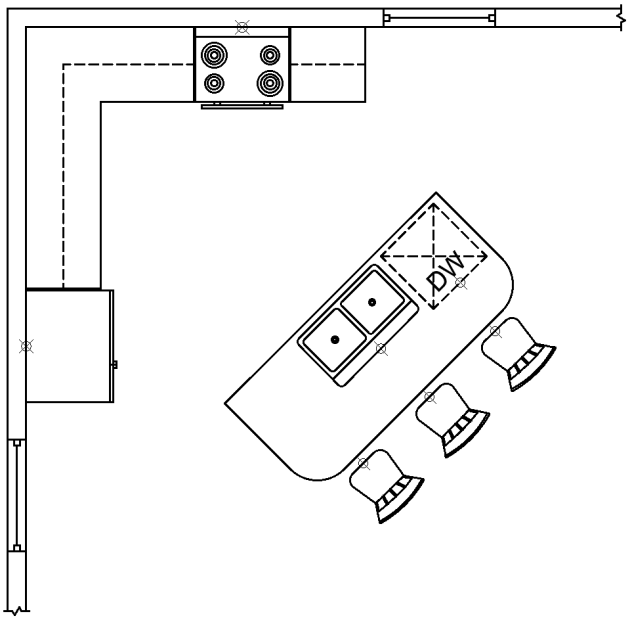


The top and bottom edges of the bolt head are now horizontal.

12. **Save** the drawing.

6.4.4 Challenge Exercise - Rotating Drawing Objects

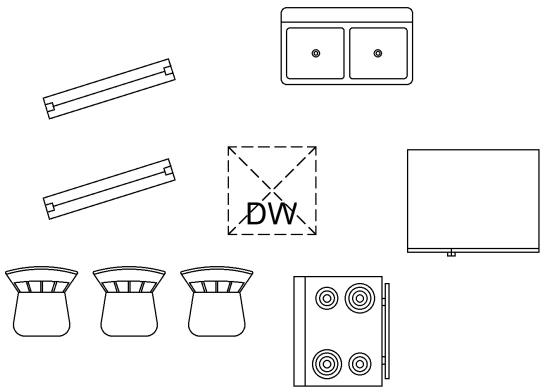
In this exercise you will use the Rotate and Move commands to complete the kitchen layout.



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*.

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