QCAD

An Introduction to Computer-Aided Design (CAD)

Andrew Mustun

Trademarks
All mentioned trademarks are trademarks of their respective holder.

Mustun, Andrew
QCAD - An Introduction to Computer-Aided Design (CAD)

Table of Contents

Part II

First Steps with QCAD

Alternatively, you can also click the right button of your mouse to return back to the neutral state step by step. Depending how far you have progressed with a tool, you might have to click the right mouse button more than once to fully return to the neutral state. The same can also be achieved by hitting the Escape key on your keyboard a multiple times.

Hands-on: Drawing a Rectangle

The following instructions guide you through the complete procedure of drawing a simple rectangle. You will probably not yet understand all steps involved but it is crucial that you successfully complete these steps since all CAD tools work in a similar way like the rectangle tool.

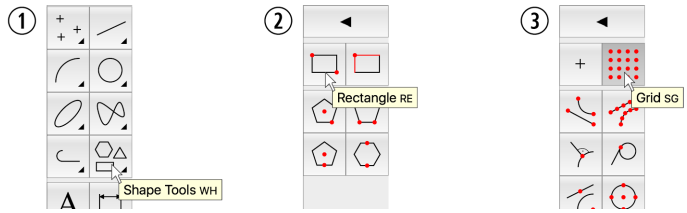
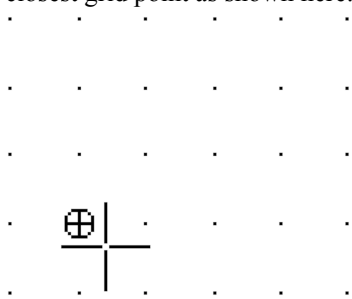


Figure 3-3: Choosing the CAD tools for drawing rectangles and activating the *Snap to grid* tool.

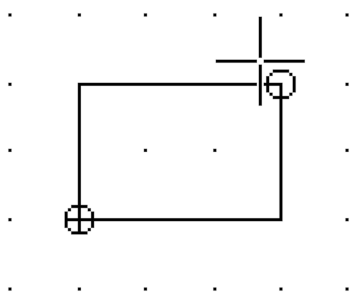
1. Launch QCAD if it is not already running. QCAD shows its application window and creates a new, empty drawing.
2. Before you start drawing anything, save this empty drawing to a file on your disk. To do so, choose the menu *File - Save As...*
   The dialog for saving a drawing is shown. The dialog automatically suggests a location for your file. This location is usually not a bad place to start with. You might want to use a sub-folder *drawings* in this location instead, but to keep things simple the following steps assume that you use this default location for saving your drawing.
3. Type the filename *example* into the input field with the label *File name,* then click the *Save* button to save the empty drawing. The dialog window closes and you are now ready to start drawing.
   Although is is not necessary to first save the empty drawing, it is good practice to do so as it forces you to think about where you want to store the file before you start drawing.
4. Move your mouse cursor to the shape button as shown in Figure 3-3 at the left (1). Click the left mouse button to show the shape tools (2).
5. Click the button with a rectangle on it as shown in Figure 3-3 (2). QCAD now knows that you intend to draw a rectangle and shows the CAD toolbar with the snap tools.
6. Click the button with a grid on it as shown in Figure 3-3 (3).
7. Move the mouse cursor around in the drawing area. There are two things to notice:
   - The mouse cursor has changed its shape and is now shown as a pair of cross hairs.
   - There is a small yellow circle that follows the mouse cursor around whenever you move it. This circle is not positioned exactly under the mouse cursor. It ‘snaps’ always to the grid point in the drawing area that is the closest to the mouse cursor.
     This yellow circle indicates what position QCAD is currently working with. The exact position of the crosshair mouse cursor is irrelevant to QCAD as long as the

yellow circle is in the correct place. In the previous step you have chosen to use the grid for positioning *(Snap to grid)*. QCAD is now automatically restricting the options for choosing a position to the grid points.

8. Click somewhere into the drawing area. A little red circle with a cross appears at the closest grid point as shown here:

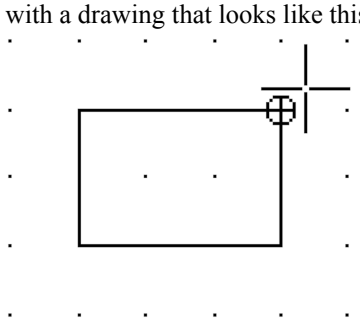


You have now set the first corner of the rectangle you are about to draw. If you move the mouse cursor around in the drawing area, you will see that QCAD draws a rectangle from the chosen position to the grid point that is closest to the mouse cursor as shown below:



Note that this rectangle is not yet part of your drawing and keeps changing whenever you move the mouse. This is called a *preview*. QCAD uses these previews to show you what *would* be drawn if you would click the mouse button at this point.

9. Move the mouse cursor until the rectangle that is shown is three grid spacings wide and two grid spacings high. Your rectangle should look like that one in the figure above.
10. Click the left mouse button to set the second corner of the rectangle. This leaves you with a drawing that looks like this:



The rectangle that is shown now, is a part of your drawing.

11. QCAD is ready to draw the next rectangle and waits for the first corner of the next rectangle. Since we don't want to draw more rectangles, we will terminate this tool now. To do so, click the right mouse button twice. If you don't have a right mouse button, press the *Escape* or *Esc* key on your keyboard twice. The mouse cursor is back to normal and the CAD toolbar shows the same tools as it did after starting QCAD. Your

rectangle should still be visible. If that is not the case, you did something wrong and you need to carefully repeat the steps 4 to 10.

12. Save your drawing by choosing the menu *File - Save*.

In the example you have just completed, you have used a tool called *Snap to grid*. As a result, the corners of the rectangle are exactly aligned to the grid points. Snap tools are a central concept of any CAD system and there are many other snap tools you will get to know later in this book.

Hands-on: A Line through the Middle

To emphasize the importance of snap tools, we will now extend our drawing with a vertical line that separates the rectangle in two equal halves.

Vertical means that the line extends from a first point to another point directly under or above it. In our case, the line starts in the middle of the top line of the rectangle and ends in the middle of the bottom line. The top and bottom lines of the rectangle are *horizontal*, that means they extend from left to right. You can easily remember what *horizontal* means by thinking that the *horizon* at the seaside looks *horizontal*.

Note that there are no grid dots at the center of the top and the bottom line of the rectangle. For this line we will have to use a different snap tool.

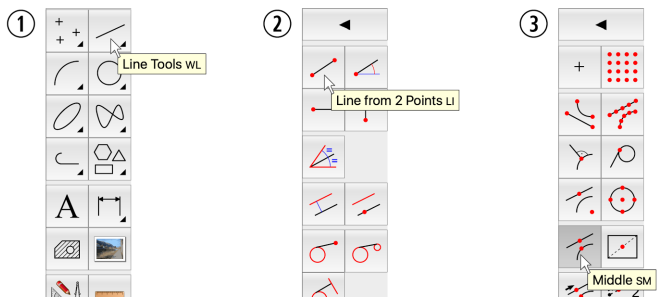


Figure 3-4: Choosing the CAD tool for drawing lines with two points and changing the snap tool to *Snap to middle points*.

1. Choose the *Line Tools* button again from the CAD toolbar as shown in Figure 3-4 (1).
2. This time, select the tool *Line from 2 Points* (2).
3. Click the button *Middle* (3). This activates the snap tool to snap to middle points of lines and arcs. Note that only one snap tool can be active at any time.
4. Move the mouse cursor around in the drawing area like we did before with the grid snaptool. As you can see, the yellow circle no longer jumps from grid point to grid point. Instead it now only shows up in four different positions which are the middle points of the four lines that form the rectangle. One such possibility is shown here:

Chapter 8

Coordinates

Objective

In this chapter, you will

- learn what coordinates are,
- get to know the different types of coordinates QCAD supports,
- learn how to define positions by entering coordinates.

The Cartesian Coordinate System

In the previous chapters you have already seen and used the drawing area of QCAD. Like a sheet of paper, the drawing area is a flat area onto which you can draw something.

When working with a CAD system, you will often be confronted with the coordinate system of the drawing area. A coordinate system uniquely defines each point in the drawing area and in your drawing. If you point with a pen to any position in the drawing area, that position has a unique coordinate that defines where this point is in the drawing.

By far the most commonly used coordinate system is the *Cartesian coordinate system*. A coordinate system is not something that is given by nature. Coordinate systems were defined once by someone (in this case René Descartes in 1637) to define a standard for specifying the position of a point on a two dimensional surface. The Cartesian coordinate system is not only used in CAD applications but in many areas of mathematics, physics and engineering.

The Cartesian coordinate system is based on two axes that are at right angles (orthogonal) to each other. The horizontal axis is commonly called the *X-axis* while the vertical one is called the *Y-axis* as shown in Figure 8-1.

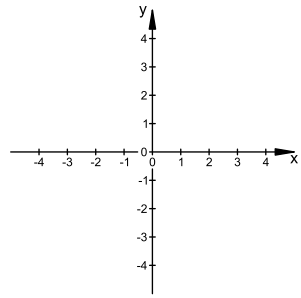


Figure 8-1: The coordinate axes of the Cartesian coordinate system.

The *origin* of the coordinate system is the point where the X and the Y axes cross each other. This point is also referred to as the *absolute zero point* or just *absolute zero*.

Both axes have a direction. The X-axis is directed to the right and the Y-axis upwards. This is not necessarily a logical choice, it was simply defined this way. As you can see in Figure 8-1, the axes are divided into smaller sections, each one unit long.

Any particular position can be described by its distance from the origin in X-direction and in Y-direction. For example the position of the point *P* in Figure 8-2 is 3 units away from the origin in X-direction and 2 units away from the origin in Y-direction. Or, to use the correct notation, the point *P* is located at (3,2). This notation in brackets indicates the location of a point as a pair of an X-distance and a Y-distance (X,Y).

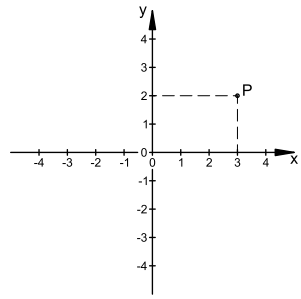


Figure 8-2: The location of the point *P* can be noted as (3,2) where 3 is the distance to the origin in X-direction and 2 is the distance to the origin in Y-direction.

If a point is located left of the origin, its X-coordinate turns negative. If it is located below the origin, its Y-coordinate turns negative. Figure 8-3 shows some points in the Cartesian coordinate system and their (X,Y) notation. The (X,Y) notation for the origin is (0,0).

Preparations before Drawing

Before you draw anything you should set up the layers of your drawing as described in a previous chapter. The drawing tools of QCAD always draw all objects on the layer that is currently active. After creating a new empty drawing, spend some time to think about the layers you will be using for your drawing and create them. Whenever you are about to draw something, have a look at the layer list at the right to make sure that you are on the correct layer. It can be helpful to assign different colors to different layers, so you immediately realize that something is wrong if you draw on the wrong layer.

Line Tools

Menu:	Draw > Line
Keycode:	WL

QCAD offers a variety of tools for drawing lines. They are all available in the CAD toolbar of QCAD after clicking the line button shown in Figure shows the CAD toolbar with the various tools for drawing lines.

Note that you can click the button at the top with the left arrow to return to the main menu.

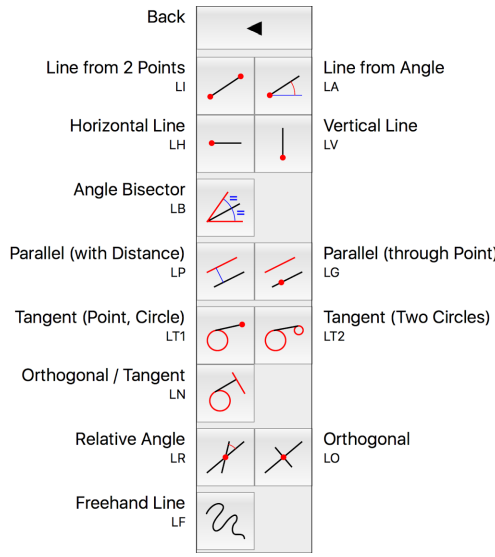


Figure 9-2: The CAD toolbar showing the drawing tools for drawing lines.

Line from two Points

Menu:	Draw > Line > Line from 2 Points
Keycode:	LI

With this tool you can draw a single line by directly defining its start point and end point. It is also possible to draw a series of connected lines.

Drawing a single line

1. Click the start point of the line.
2. Click the end point of the line.
3. Terminate the tool by clicking the right mouse button twice or by pressing the Escape key on your keyboard twice.

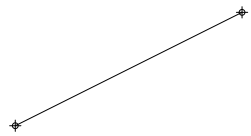


Figure 9-3: Example for drawing a single line with startpoint and endpoint.

Drawing a series of connected lines

1. Click the start point of the first line.
2. Click the end point of the first / next line. Repeat this until you have drawn all connected lines you want to draw.
3. Terminate the tool by clicking the right mouse button twice or by hitting the Escape key on your keyboard twice.

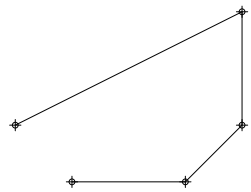


Figure 9-4: Example for drawing a series of connected lines.

Drawing a series of disconnected lines

1. Click the start point of the first / next line.
2. Click the end point of the first / next line.
3. Click the right mouse button once or hit the Escape key on your keyboard once.
4. Repeat steps 1-3 until you are finished with drawing lines.
5. Terminate the tool by clicking the right mouse button twice or by hitting the Escape key on your keyboard twice.

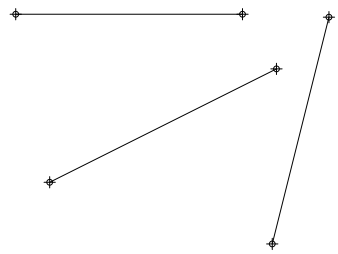


Figure 9-5: Example for drawing a series of disconnected lines.

Line with fixed Angle

Menu:	Draw > Line > Line from Angle	
Keycode:	LA	

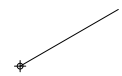
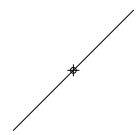
This tool lets you draw lines at a fixed angle. The length of the line can be specified and you can choose if you want to position the line by defining its start point, middle point or end point.

When you are using this tool, you will often find that the length of the line is irrelevant at first and can be better adjusted later using a trim tool.

Usage

1. Enter the angle of the line in the options toolbar. Type a length for the line and choose how you want to position it.
2. Click the position of the line. You can also repeat this to place more than one line with the same angle or change the angle in the options toolbar at any time.
3. Terminate the tool by clicking the right mouse button twice or by hitting the Escape key on your keyboard twice.

Table 9-1 shows three example uses of this tool.

Table 9-1	**Line with Fixed Angle**
Tool options	**Click point and constructed line**
Angle: 30 Length: 20 Snap Point: Start	
Angle: 45 Length: 30 Snap Point: Middle	
Angle: 60 Length: 20 Snap Point: End	

Rounding Corners (Fillet)

Menu:	Modify > Round
Keycode:	RN

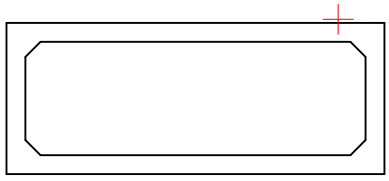
This tool is used to round corners. It works very similarly to the chamfering tool.

Usage

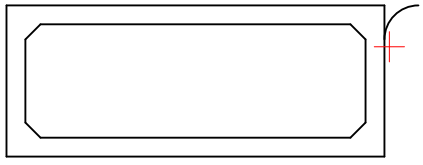
1. Start the round tool.

2. Enter the radius of the rounding in the options toolbar.
   Make sure that the *Trim* check box is ticked if you want to automatically trim the corner lines to the rounding.
   For this example, we want to create a rounding with a radius of 4.5 units with trimming enabled:

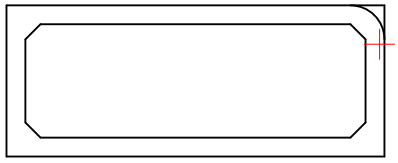
3. Pick the first entity that forms the corner you want to round.
   In our example, we click the top line of the rectangle as the first line of the top right corner which we want to round:



4. Move the mouse cursor to the second line of the corner. QCAD shows a preview of the rounding you are about to create. At this point it is important to place the mouse cursor at the correct side of the line since there are two roundings possible.
   If you place the mouse cursor somewhat to the right of the vertical line, an alternative rounding is shown:

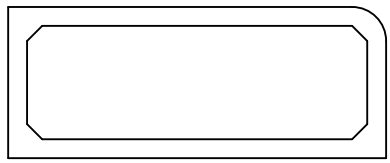


   Move the mouse cursor somewhat to the left of the vertical line to show the rounding we want to create:

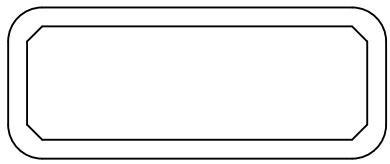


5. Click the left mouse button when the preview shows the correct rounding.

6. QCAD creates an arc that is tangential to the two chosen lines and trims the lines to the arc as shown here:



7. The other corners can be rounded in the same way:



Dividing Entities

Menu:	Modify > Divide
Keycode:	DI

This tool divides (or cuts) an entity at a given point. You can for example divide a line into two parts. The division point must be on the entity and is in most cases an intersection point with another entity.

Entities often have to be divided to change the line style in the middle of an entity or to form closed contours for hatching or solid fills.

In the example in Figure , the original shape of a mechanical part before bending is shown with a dash-dot-dot line in the view at the bottom.

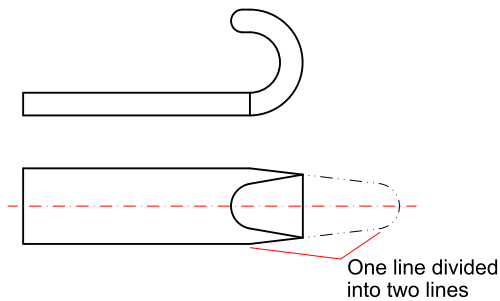


Figure 10-14: Lines often need to be divided to apply different layers or line styles to the two separate parts.

Usage

1. Start the dividing tool:

Index

Symbols

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

U

V

W

X

Y

Z