

Cartesian and polar coordinates, normal ("absolute") and relative coordinates

ThanCad and any other CAD software use normal, non-relative ("absolute") cartesian coordinates to store the various drawing elements (lines, circles etc.). ThanCad also supports relative cartesian coordinates, polar coordinates and relative polar coordinates. ThanCad internally transforms these coordinates to non-relative cartesian. The various types of coordinates are best explained with an example.

Example

Draw a rectangular floor plan of dimensions 10.00×8.00 m. The coordinates of the southwest point of the rectangle are 20.00,50.00

a. Cartesian coordinates

At first we calculate the cartesian coordinates of all points of the rectangle:



Then we use the line command to do the drawing:

Command: **L** <enter>

line

First line point (c=continue existing line): **20,50** <enter>

Next line point: **30,50** <enter>

Next line point (undo/<enter>): **30,58** <enter>

Next line point (undo/close/<enter>): **20,58** <enter>

Next line point (undo/close/<enter>): **20,50** <enter>

Next line point (undo/close/<enter>): <enter>

Command:

See appendix a for screenshots of this procedure.

b. Cartesian coordinates with "close"

Note that, at the end, we had to type the coordinates of the first point again, because otherwise the rectangle is open (not closed). This case is not infrequent, so ThanCad makes this easier. If the last point coincide with the first, instead of the coordinates of the last point we type "close", or just "c" and then <enter> (from now on <enter> is assumed at the end of the command):

Command: **L**

line

First line point (c=continue existing line): **20,50**

Next line point: **30,50**

Next line point (undo/<enter>): **30,58**

Next line point (undo/close/<enter>): **20,58**

Next line point (undo/close/<enter>): **c**

Command:

See appendix b for screenshots of this procedure.

c. Relative cartesian coordinates

Note that we had to do some arithmetic to compute the cartesian coordinates, which in real world would more difficult as the coordinates of the southwest point might be 480688.182,4203028.616 and the dimensions of the floor plan 9.85×8.25 (by the way these are valid coordinates in the EGSA87 coordinate

system used in Greece).

Instead of ("absolute") cartesian coordinates we can use relative cartesian coordinates. The first (southwest) point is always given in cartesian coordinates. The second is given in coordinates relative to the first point (actually the previous point), the third point is given in coordinates relative to the second point and so on.

The relative coordinates of a point can also be thought of as the cartesian coordinates of the point when the origin of the axes is the previous point.

In order to inform ThanCad that we use relative cartesian coordinates, when we type, we prepend the coordinates with the "@" symbol.

In the example, the relative coordinates are essentially the dimensions of the rectangle (10.00x8.00). We will also use the "c" command to close the rectangle:

Command: **L**

line

First line point (c=continue existing line): **20,50**

Next line point: **@10,0**

Next line point (undo/<enter>): **@0,8**

Next line point (undo/close/<enter>): **@-10,0**

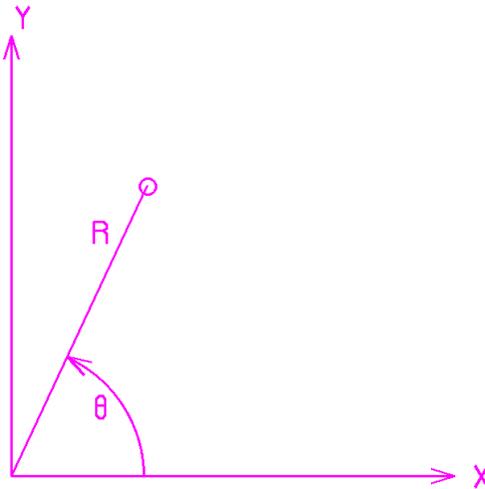
Next line point (undo/close/<enter>): **c**

Command:

See appendix c for screenshots of this procedure.

d. Polar coordinates

The polar coordinates of a point are its distance R from the origin of the axes and the direction angle θ (2-argument arctangent [1]) between the x-axis and the line which connects the origin of axes with the point:



Note that the meaning of θ can change with the "units" command.

In order to inform ThanCad that we use polar coordinates, we type first R and then θ , and we separate R and θ with the symbol "<" instead of ",".

In the example, the polar coordinates can be computed from the cartesian coordinates x,y:

$$R = \sqrt{x^2 + y^2} \quad , \quad \theta = \text{atan2}(y, x) = \tan^{-1} \frac{y}{x}$$

The coordinates of the corners of the rectangle in polar coordinates are:

X	Y	R	θ
20.000	50.000	53.852	68.199
30.000	50.000	58.310	59.036
30.000	58.000	65.299	62.650
20.000	58.000	61.351	70.974

Again, we will use the "c" command to close the rectangle:

```
Command: L
line
First line point (c=continue existing line): 53.852<68.199
Next line point: 58.310<59.036
Next line point (undo/<enter>): 65.299<62.650
Next line point (undo/close/<enter>): 61.351<70.974
Next line point (undo/close/<enter>): c
Command:
```

See appendix d for screenshots of this procedure.

e. Relative polar coordinates

Polar coordinates are useful when they are known for some physical problem. Otherwise it is an unnecessary burden to calculate them.

Often, the relative polar coordinates are much easier. The relative polar coordinates of a point can be thought of as the polar coordinates of the point when the origin of the axes is the previous point.

In order to inform ThanCad that we use relative polar coordinates, when we type, we prepend the coordinates $R<\theta$ with the "@" symbol.

In the example, the relative polar coordinates are essentially the dimensions of the rectangle (10.00×8.00) and a multiple of 90°. We will use normal coordinates for the first point:

```
Command: L
line
First line point (c=continue existing line): 20,50
Next line point: @10<0
Next line point (undo/<enter>): @8<90
Next line point (undo/close/<enter>): @10<180
Next line point (undo/close/<enter>): @8<270
Next line point (undo/close/<enter>):
Command:
```

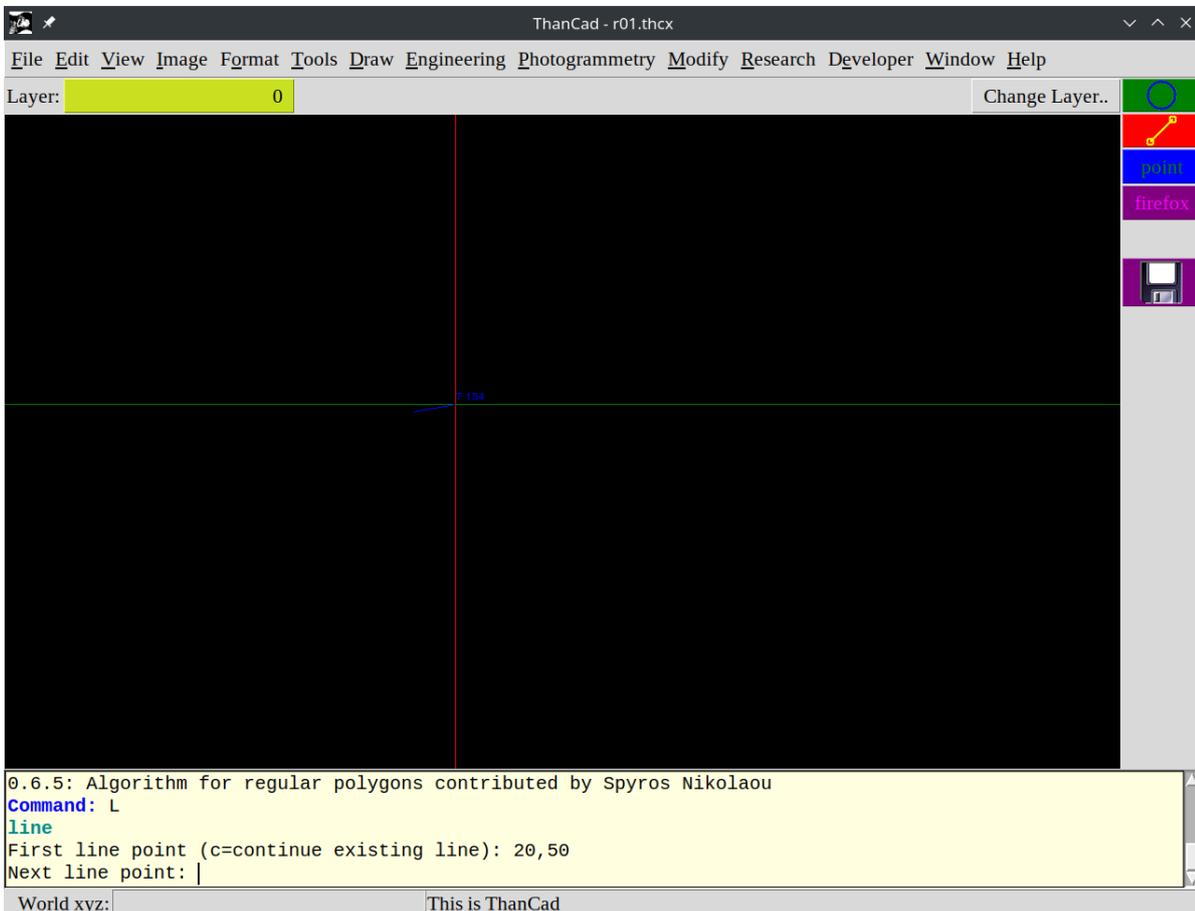
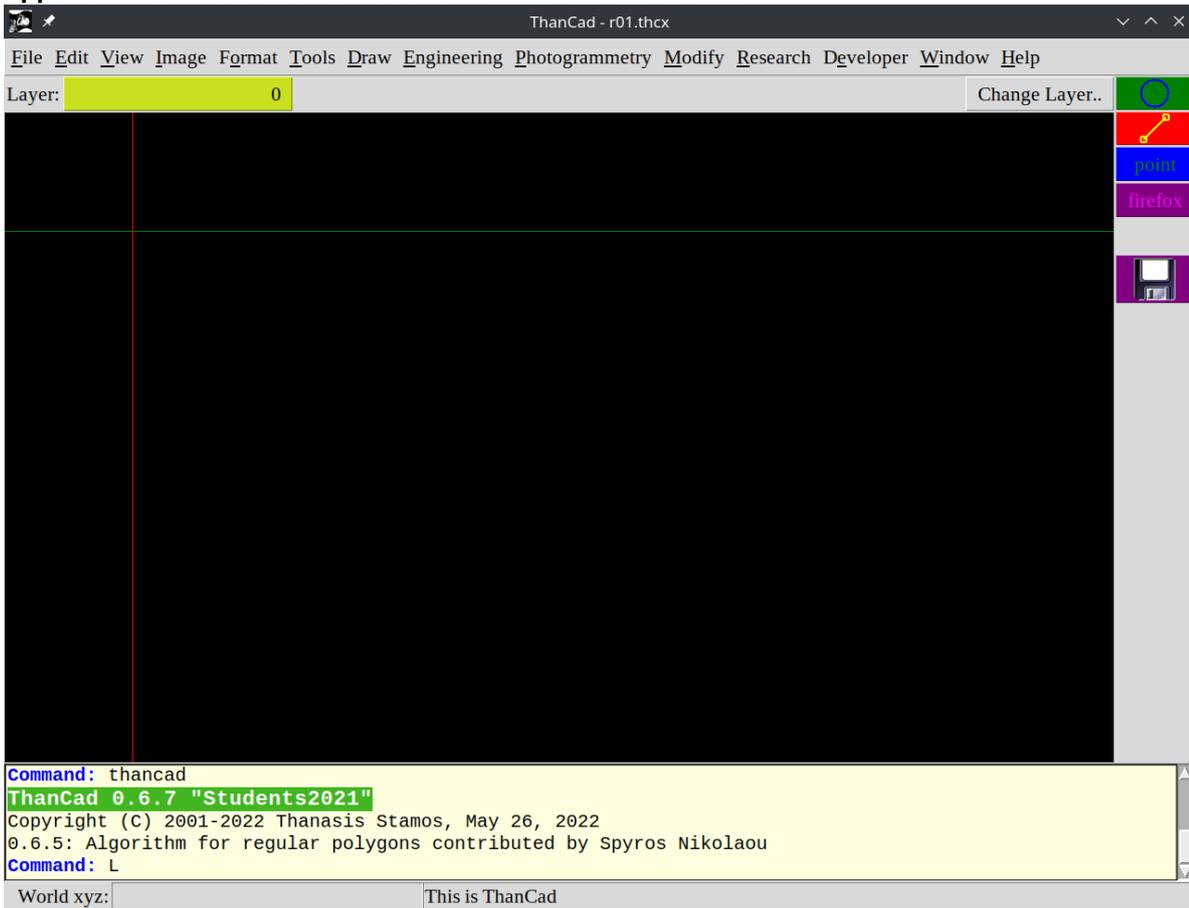
Instead of the last point with coordinates @8<270 we could (and really should) use the "c" command to close the rectangle.

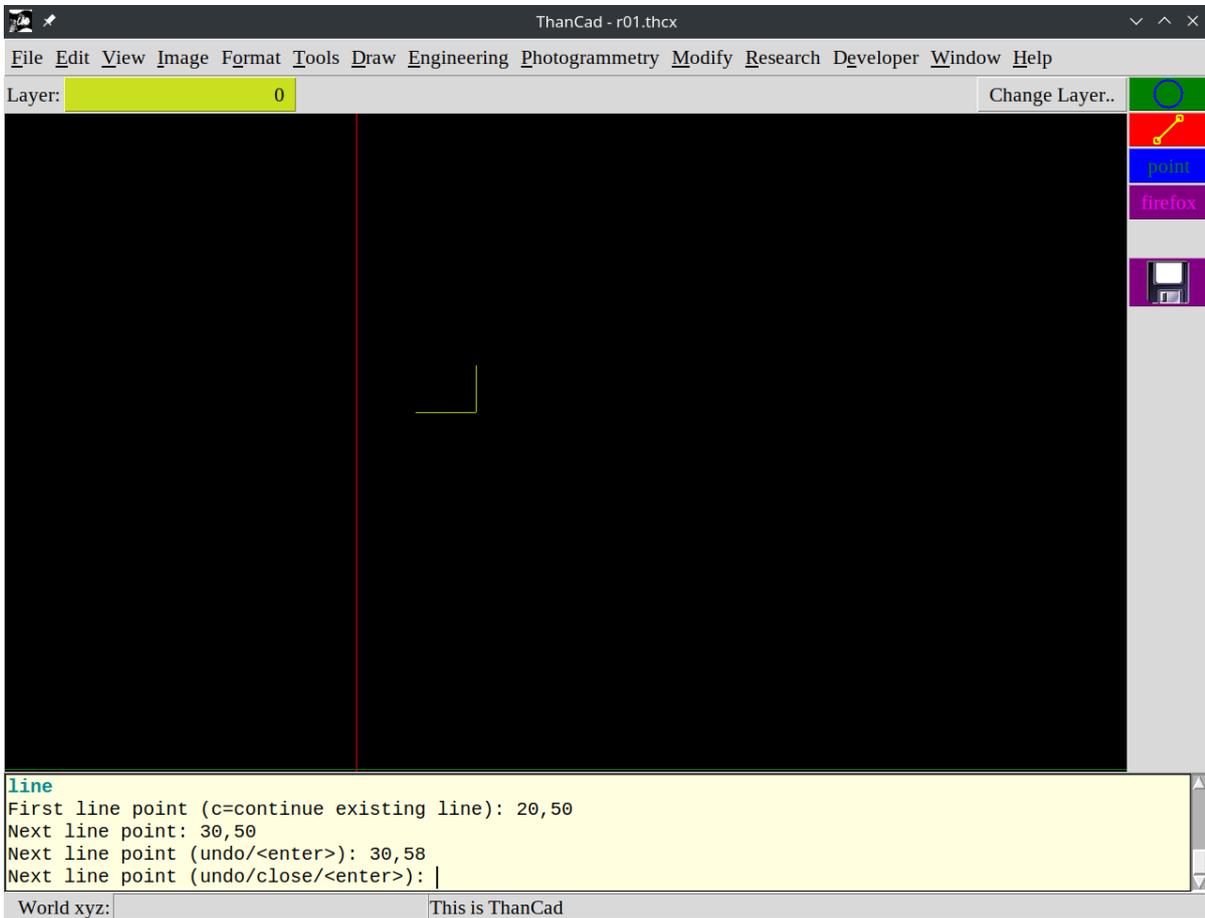
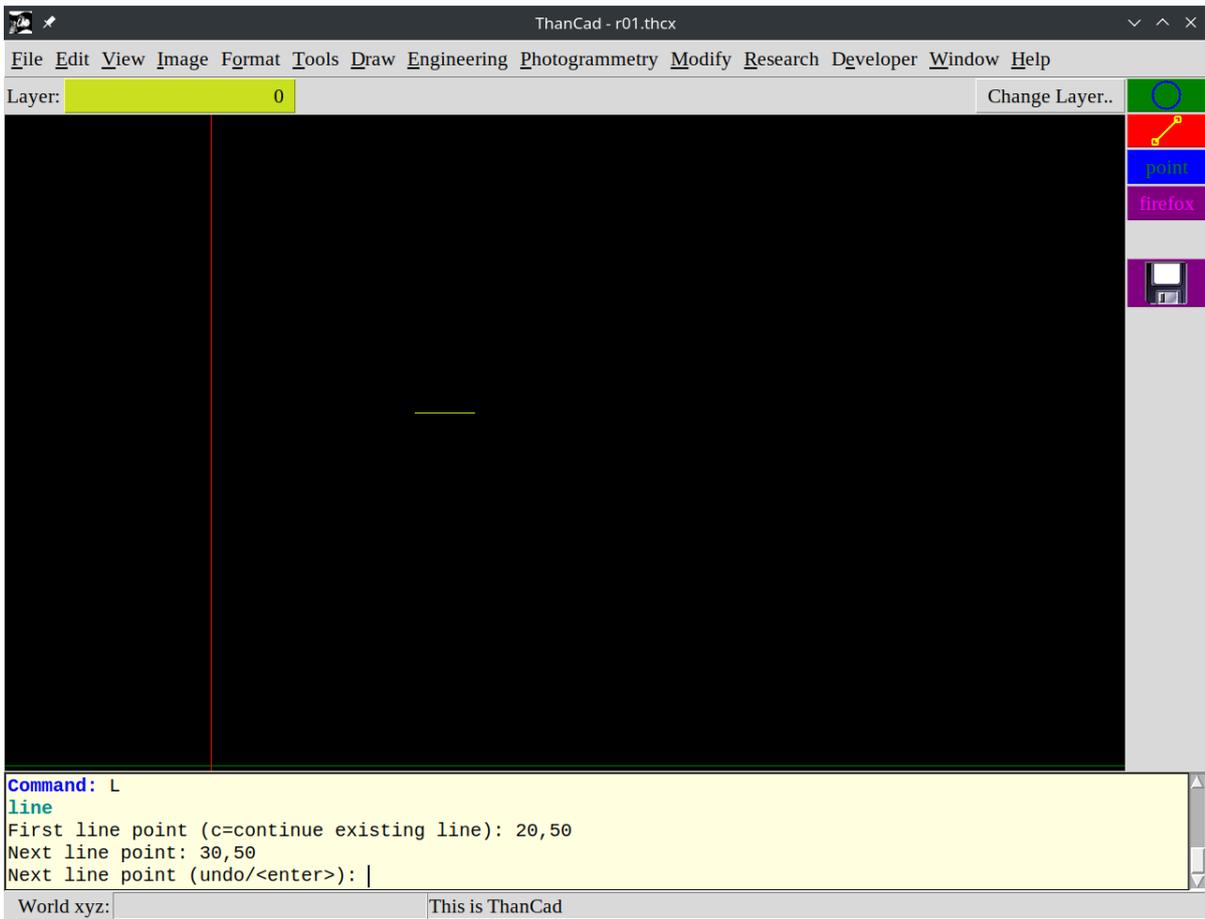
See appendix e for screenshots of this procedure.

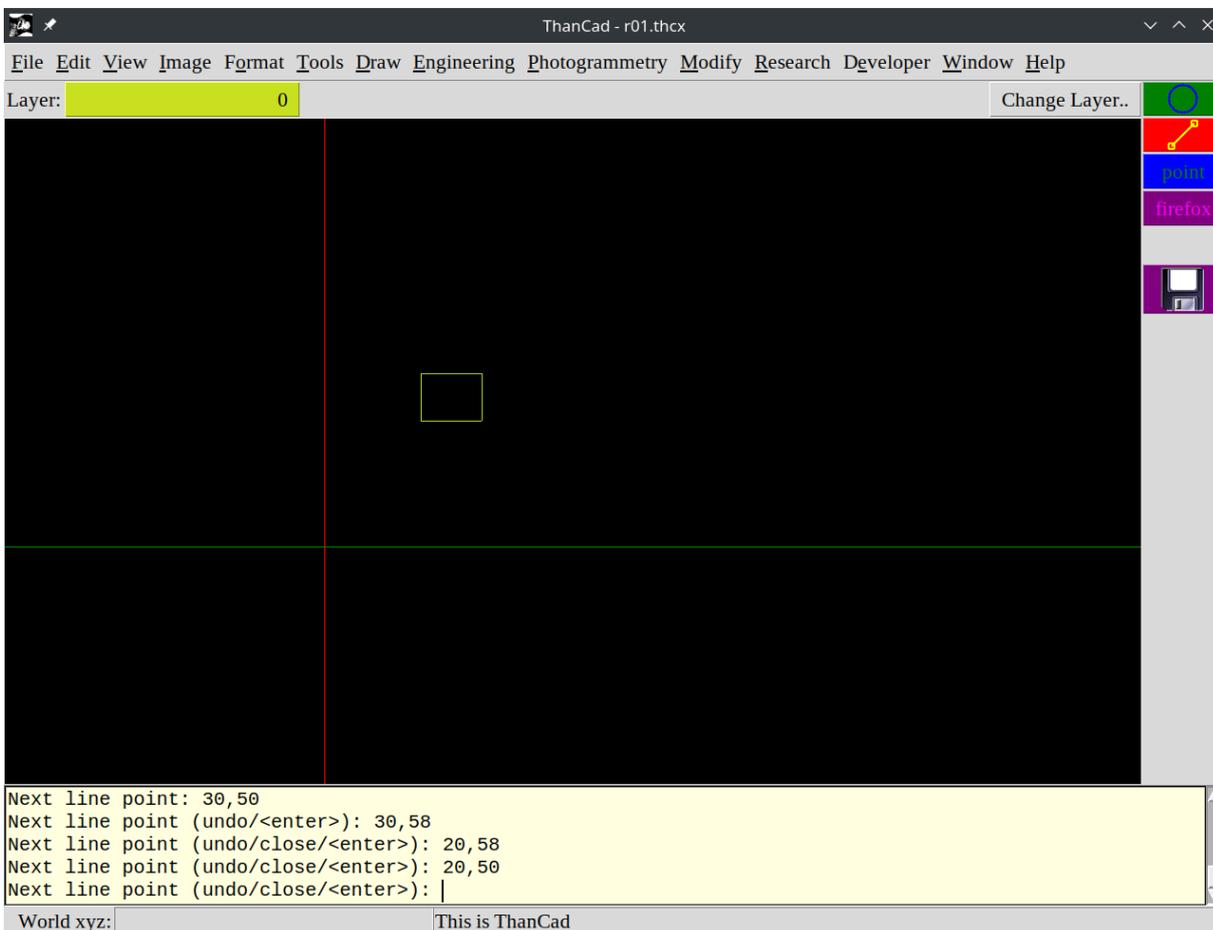
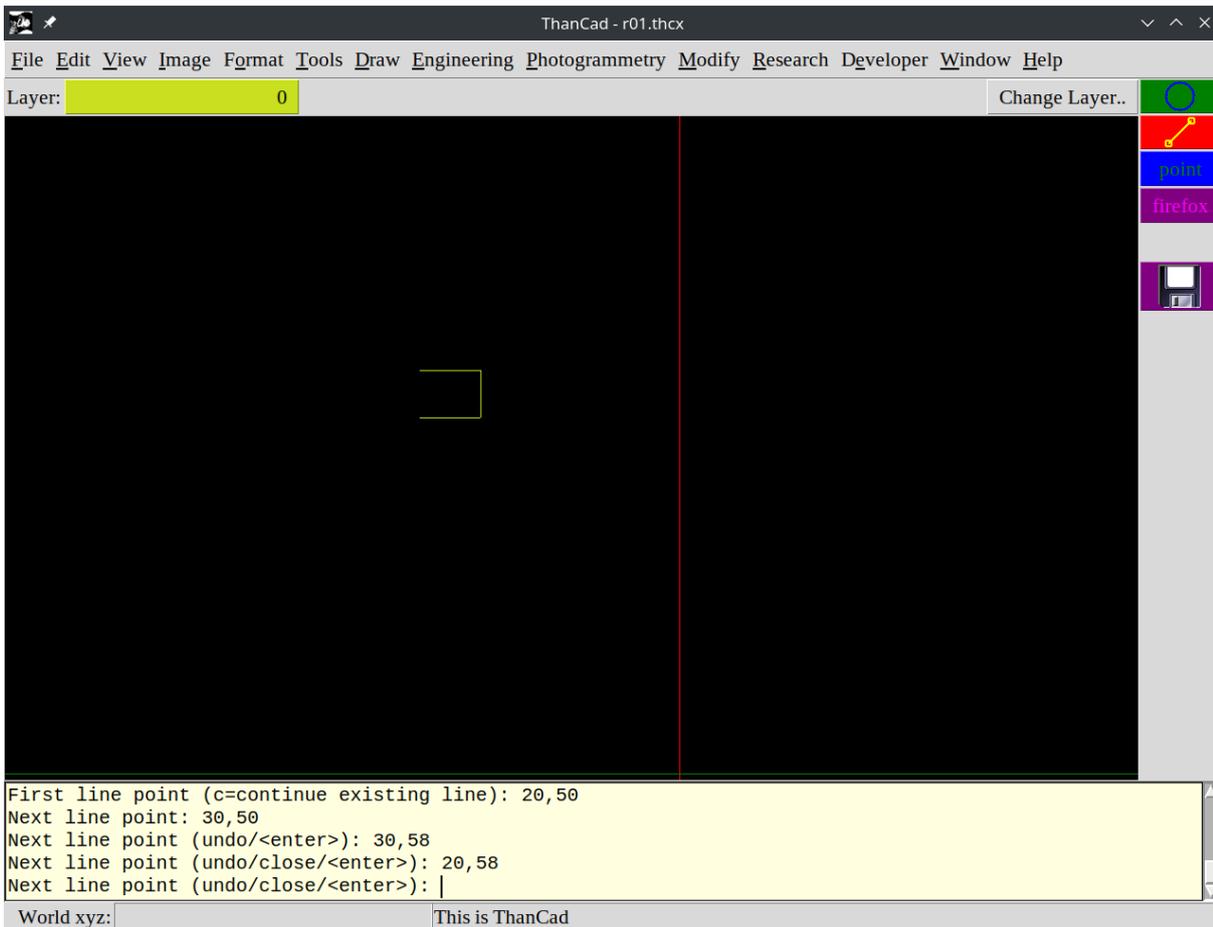
Bibliography

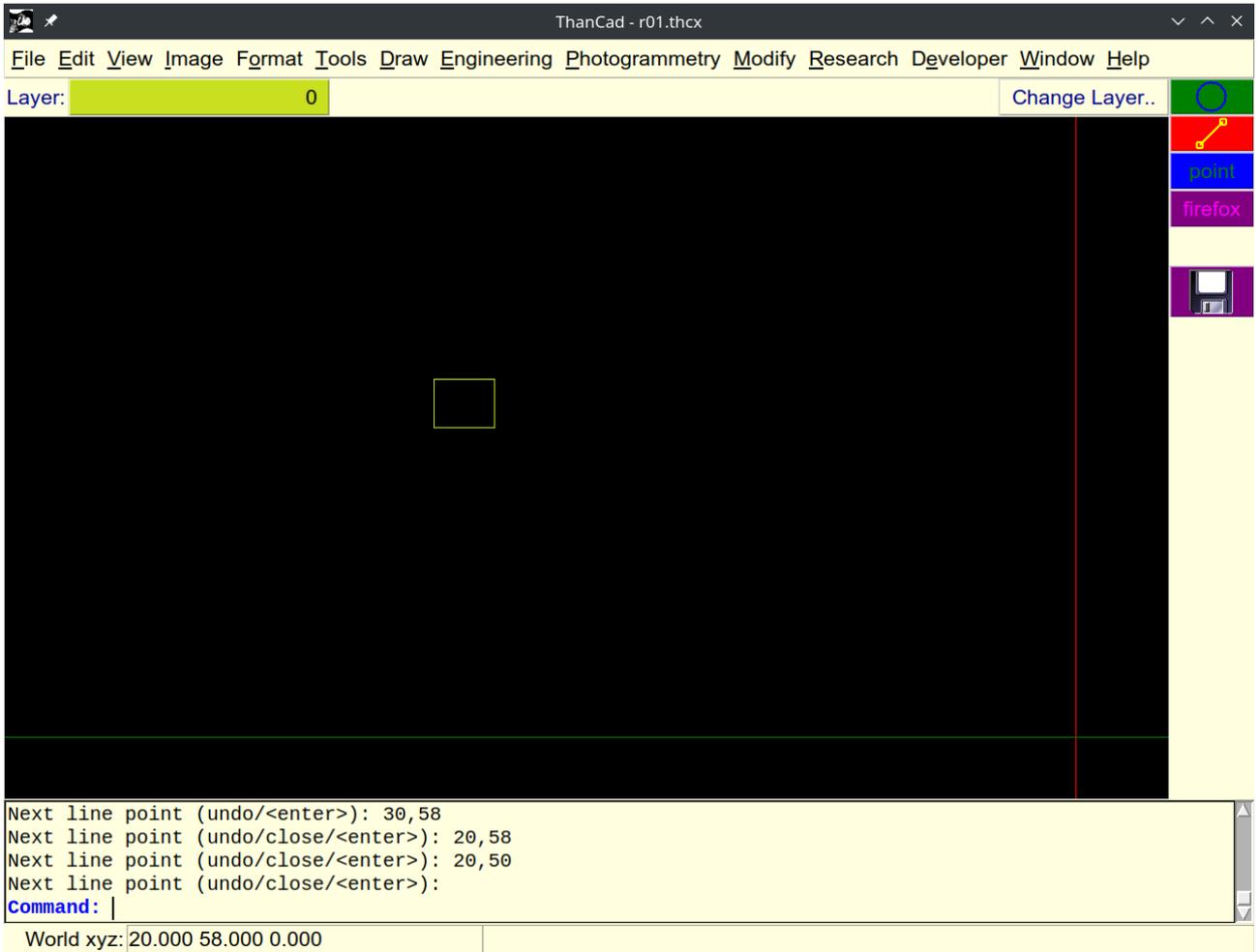
[1] <https://en.wikipedia.org/wiki/Atan2>

Appendix a - Cartesian coordinates screenshots

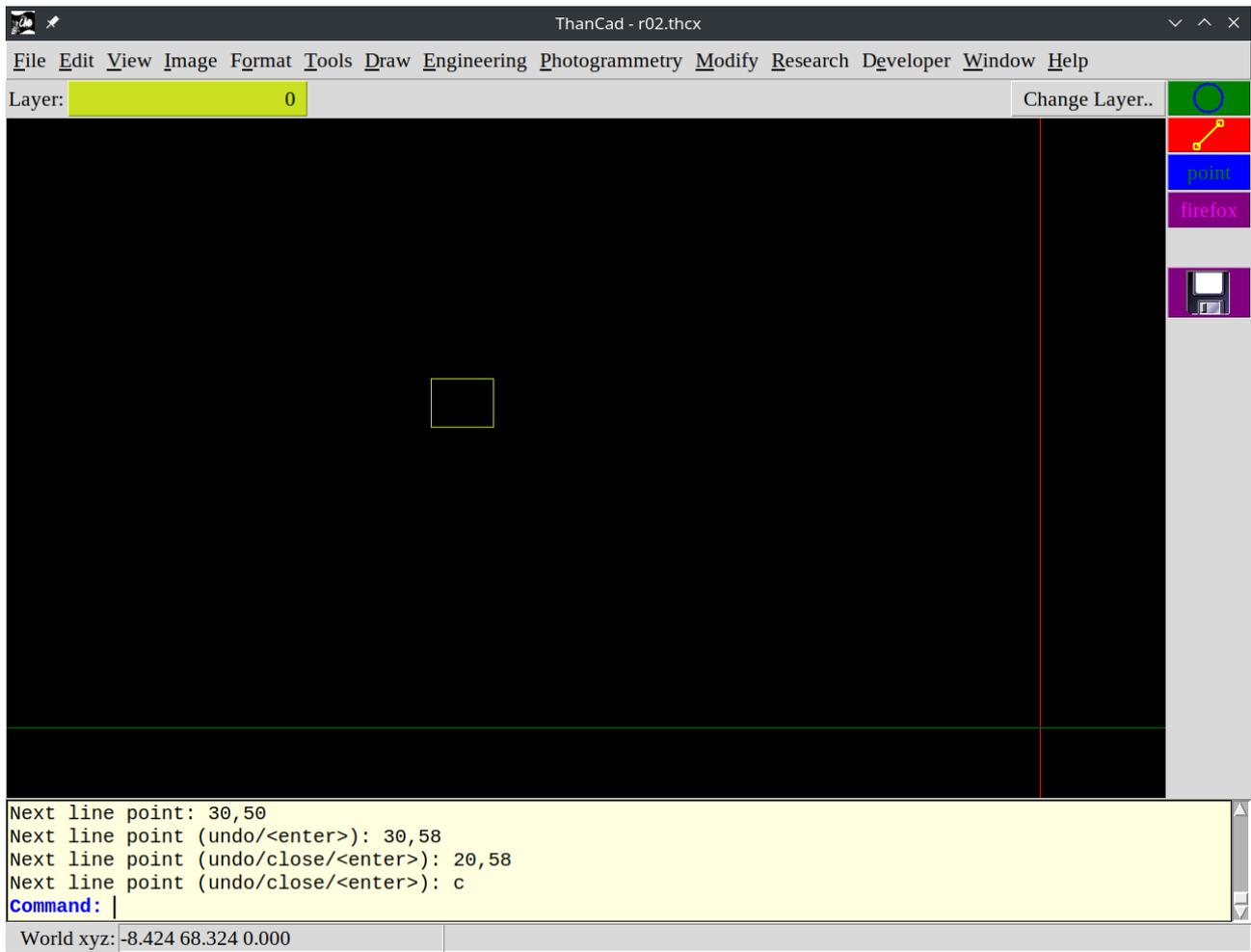




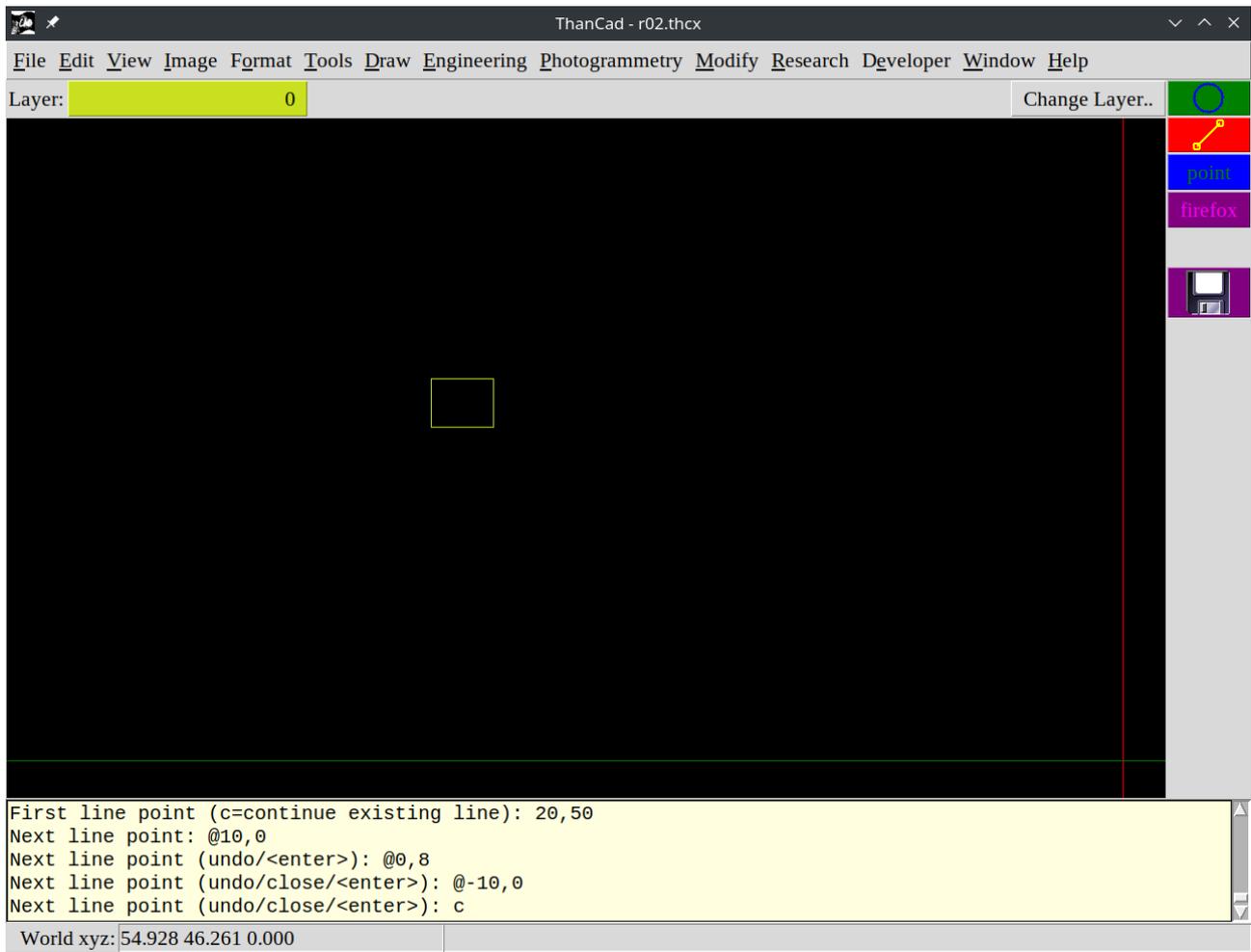




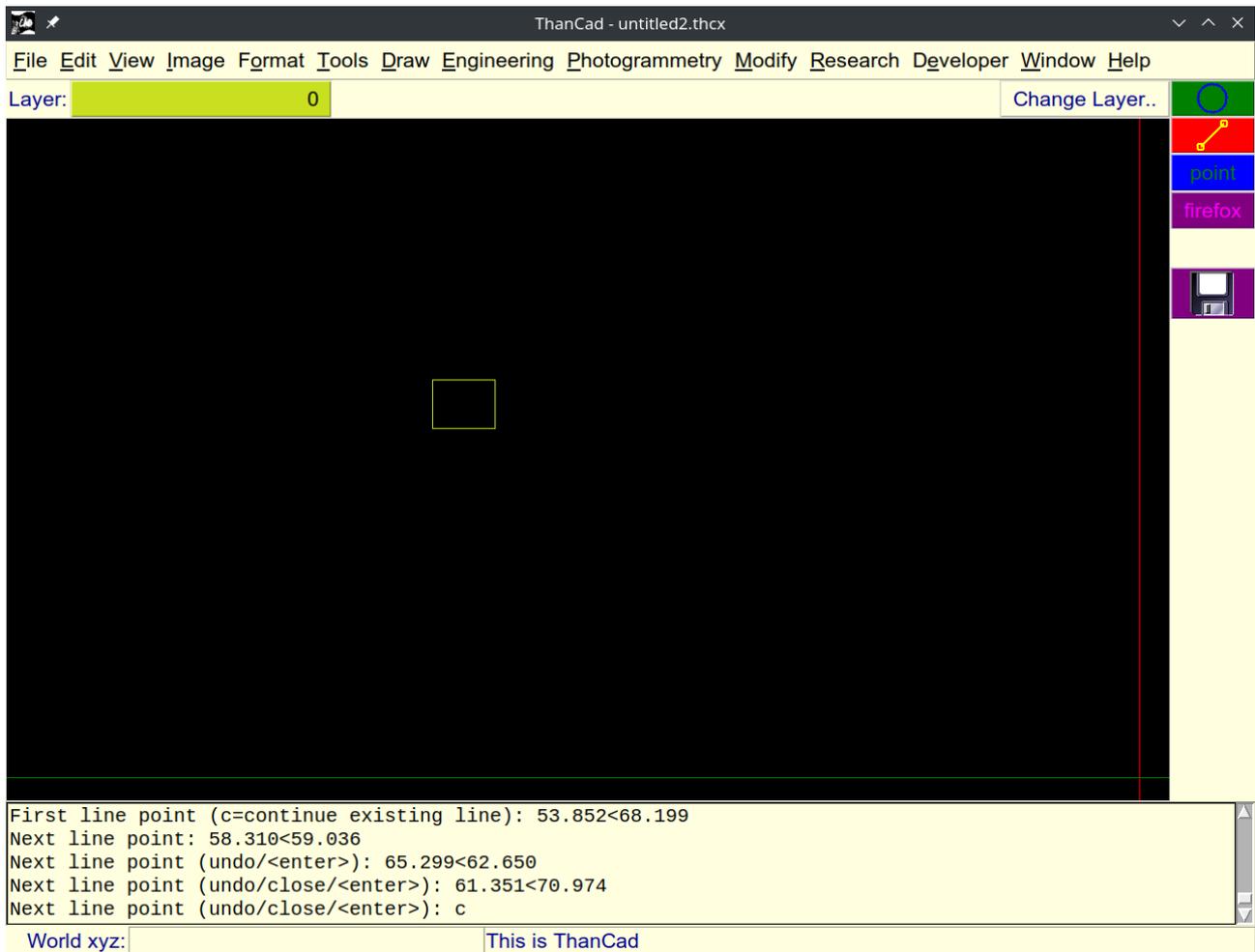
Appendix b - Cartesian coordinates screenshots - close



Appendix c - Relative cartesian coordinates screenshots



Appendix d - Polar coordinates screenshots



Appendix e - Relative polar coordinates screenshots

