Use of Graphical Synthesis to Design a European Hinge

The first step to determining the correct link lengths of this four-bar linkage was to define the given information in SolidWorks. This means sketching the 3 given positions of the cabinet door relative to the hinge mount at the given 0, 45, and 90-degree intervals. The critical dimensions for the shape of the cabinet were given, and the other aesthetic dimensions were chosen arbitrarily. The only condition is that the dimensions remain consistent at each angle, or else the next steps of the analysis will fail. Shown below is a picture of the given dimensions translated into SolidWorks.
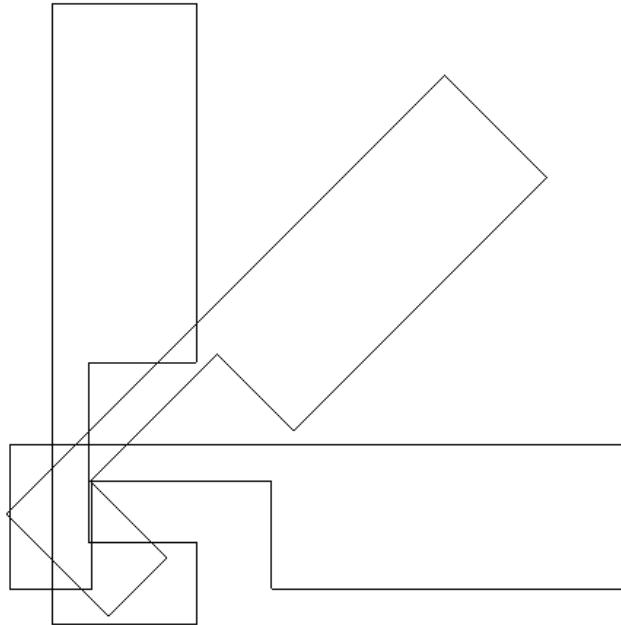

The next step is to arbitrarily draw the link BC, with its correct length at each position. These lines should not have their position relative to the cabinet door dimensioned as that comes later. Shown below is the link BC drawn at each position.
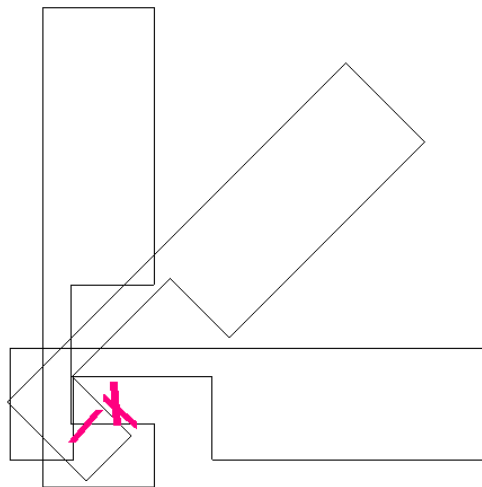
The next step is to constrain the positions of link BC relative to each cabinet door position. To do this, 3 lines are needed. I chose to use the end corners of the cabinet doors as a reference point. Shown below are the 3 lines drawn connecting each link BC to the correct cabinet door.
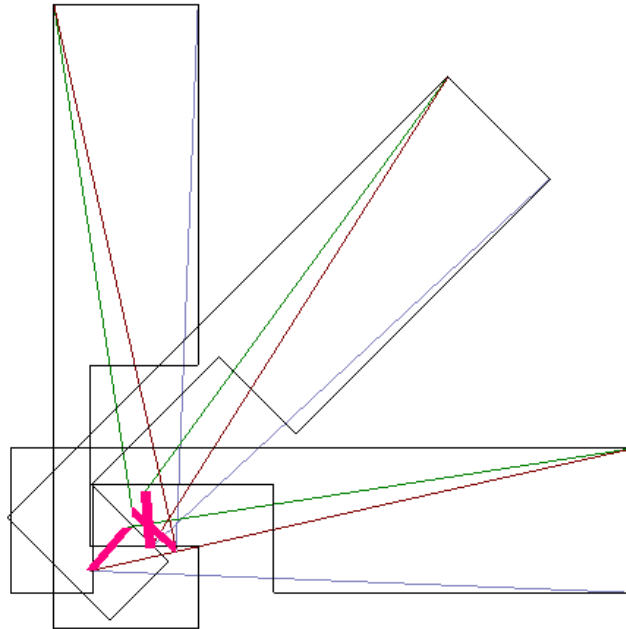
The required solid works constraints are added to ensure that each line is equal to its respective lines. Now the lengths of the other links can begin to be solved. To accomplish this, connect each end of each link BC to the same endpoint on the respective other links with lines. The result should be an arc of lines connecting all 3 links shown below. Next at the midpoint of each of these connecting lines, a perpendicular bisector is extended. These bisectors are extended until they intersect. Since there are 2 sets of ars, and therefore 2 sets of intersecting bisectors, two points are created. The picture shown below is an exaggeration to show the bisection and their intersections.

Points defined by bisectors that show ground pin locations.
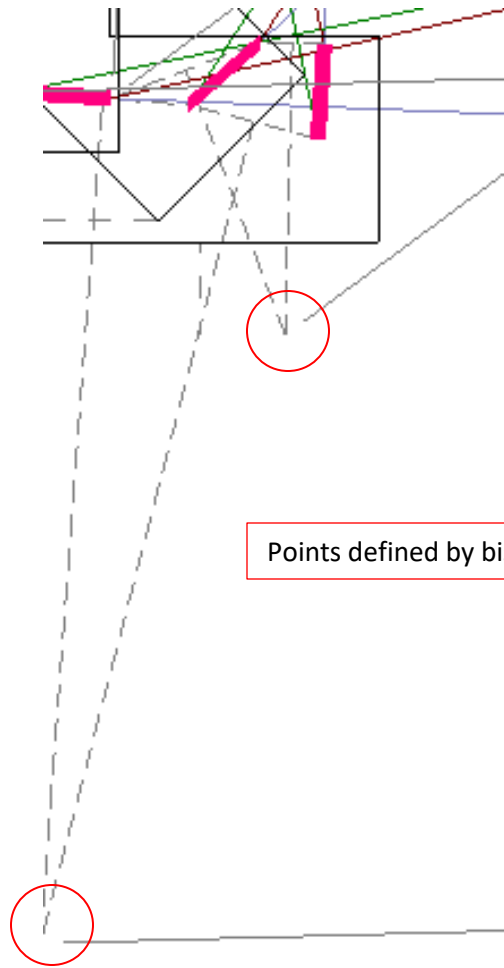
Below is a picture that shows the correct placement of the ground pins once the given dimensions are applied to the locations of the ground pins. It is paramount that the bisectors and their intersections are defined before specifying the given dimensions for the locations of the ground pins. Failure to do this will cause there to be over definitions and a myriad of other problems. Once the 18 mm separation distance, and angles are entered the ground part, the sketch will become fully defined. After the ground pins are set simply tracing from the edges of link BC to the location of the ground pins will give the link lengths for the crank and rocker. The link positions are drawn as if the cabinet door is closed.
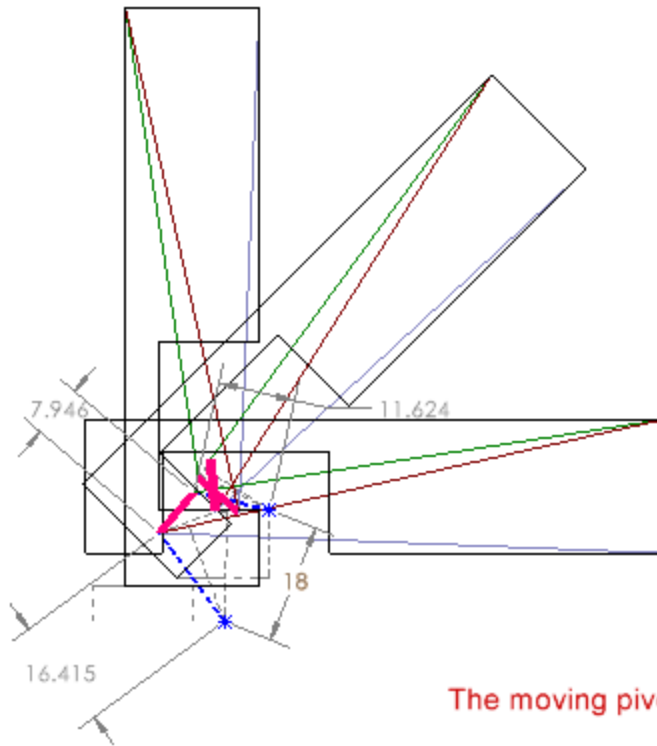
The moving pivots are shown in red

The scale shown here is 1:1, and the complete solid works drawing is attached below. To get the project to fit nicely on the given wood material, I divided the calculated lengths by 4 and changed the units from mm to in. The ground pins are shown by the blue "*" points.

Link Name	Calculated length in part B (mm)	Scaled length (in)
Ground (d)	18	4.5
Crank (a)	16.415	4.10
Coupler (b)	7.946	1.991
Rocker (c)	11.624	2.906

Shown below is an enlarged drawing of the links with each point and link is labeled.