Working Model 2D: Tutorial 3

Example 12-5

Bar AB of the linkage shown in Figure 1 rotates at 20 rad/sec clockwise. For the position shown, determine the velocity of pin C and the angular velocity of link CD.

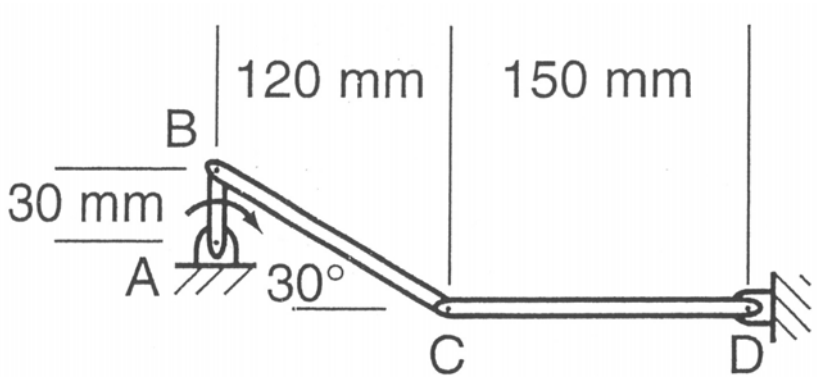

Figure 1

Initial Setup:

1. Set the Unites to SI(radians) on Numbers and Unites… sub menu and click on the More Choices. Set the distance to Millimeters on the Distance pull-down menu.

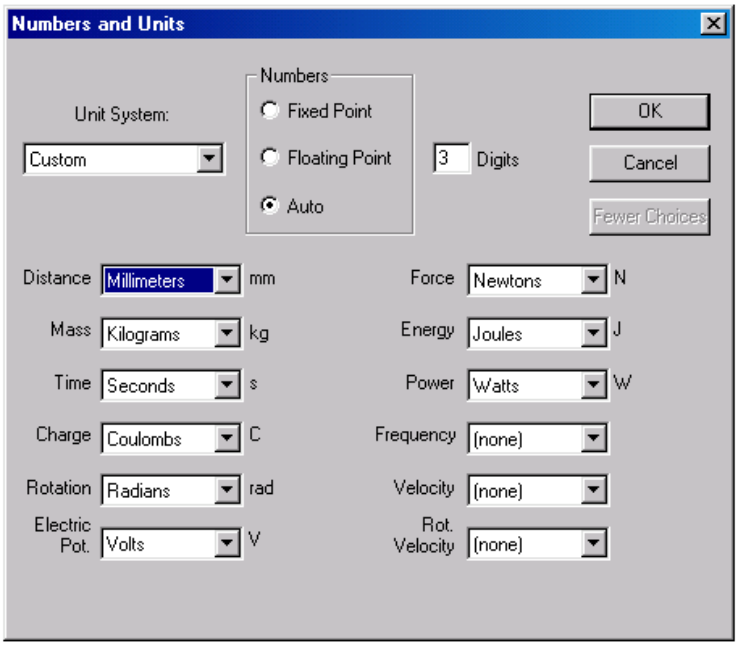

Figure 2

2. Select the View Size menu from View and set the Window Width to 500 mm.

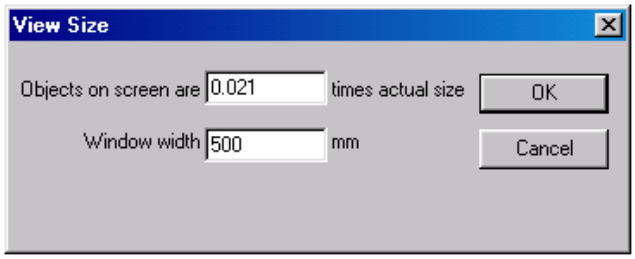

Figure 3

3. Set the Gravity to None.

Creating Geometry

1. Draw the following entities on the drawing area. You can use the Rectangle drawing entity to draw them. You can quickly edit the position, orientation, and dimensions of the rectangle using the coordinate bar. The X and Y coordinates are the center coordinates of the rectangle.

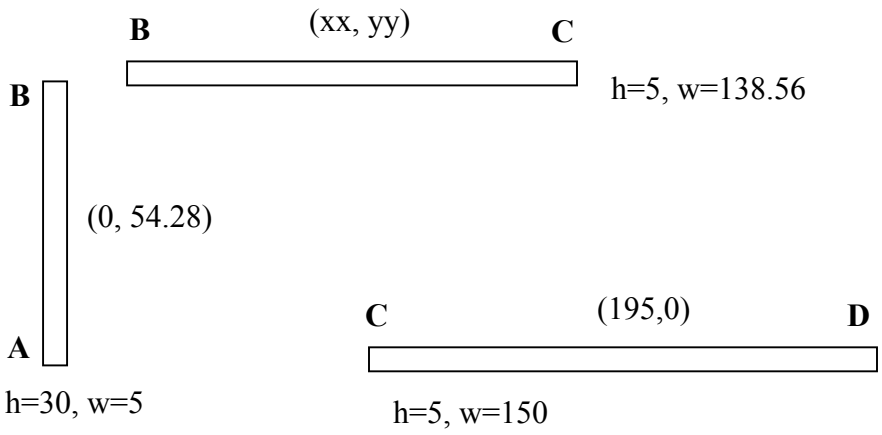

Figure 4

(Center coordinates for BC can be any value, but position the BC in the vicinity of AB and CD rectangles)

2. In order to place BC with respect to AB and CD, anchor the later two using Anchor  .

3. Place two point elements at middle of the B end of AB and BC links.

4. Now select the B point on one link, and hold down the Shift key and select the other point (see figure 5).

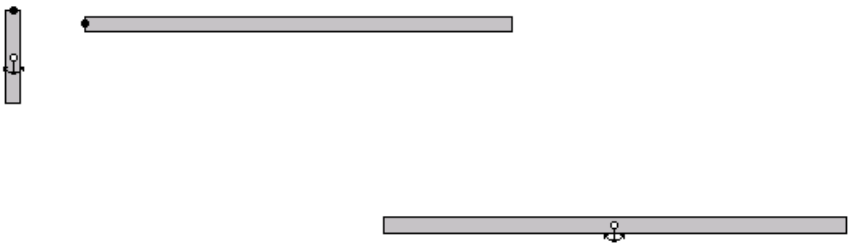

Figure 5

5. Click on Join button  to join these two elements.

Notice that BC moves towards AB to make a pin join as shown in the Figure 6 below.

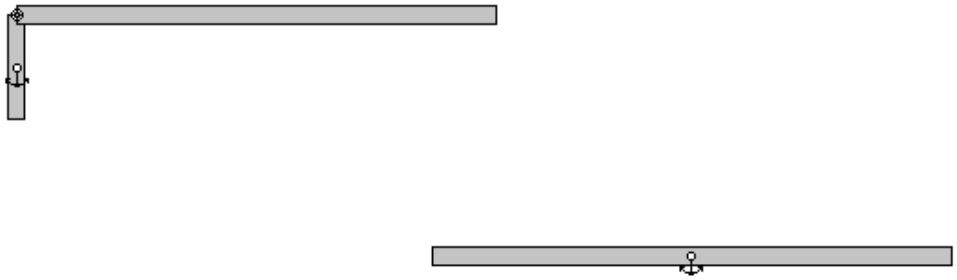

Figure 6

6. Repeat steps 3 to 5 C end of BC and CD links.
7. Place a motor at point A and Pin Joint  at point D.
8. Now, select each anchor and delete them (press the Delete Key on the computer key board to delete any entity). Final setup is shown in Figure 7.

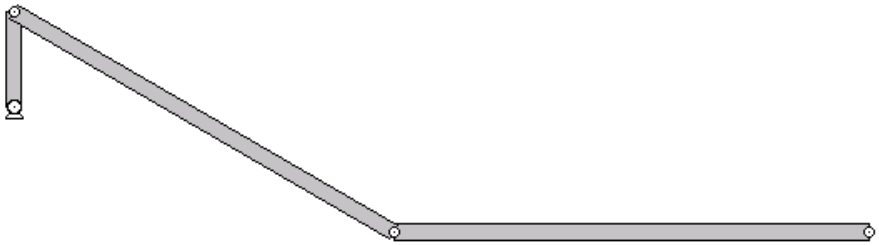

Figure 7

9. Set the rotational velocity of the motor to 20 rad/s clockwise (-20 rad/s in WM2D).
10. Since we want to observe the velocity conditions on the current configuration, set the accuracy to a high value (0.0001). Also, set the pause condition to $t > 0$ since we would like to observe the velocity values at the present setup.

Post Processing

1. The problem has already been set-up. It is necessary to measure the velocity of the point C and rotational velocity of link CD.

2. To measure the velocity at point C, you have to place a new point on top of pin joint and select the Velocity from Measure menu.

3. Select the link CD and go to Measure menu and get the Rotation Graph from Velocity menu.

4. Change the display option to Numerical values in all graphs.

5. Click on Time on the Measure menu to place the time graph.Now, the workspace should look similar to the following Figure 8.

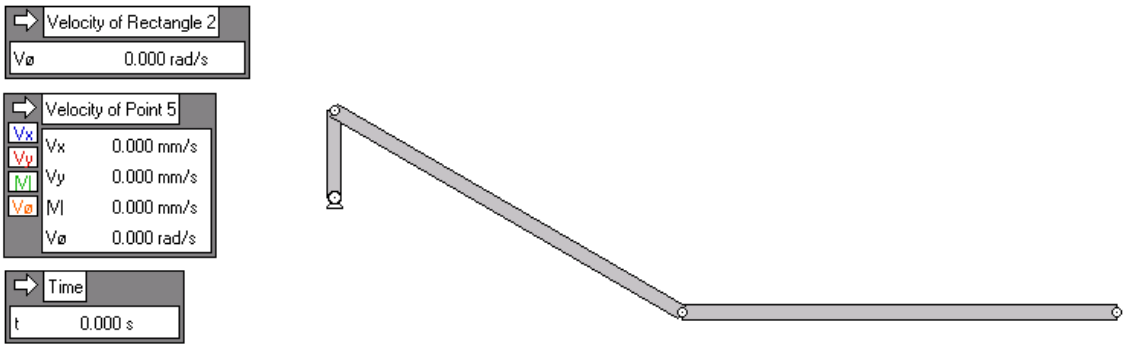

Figure 8

6. Click on the Run button to get the results similar to the Figure 9.

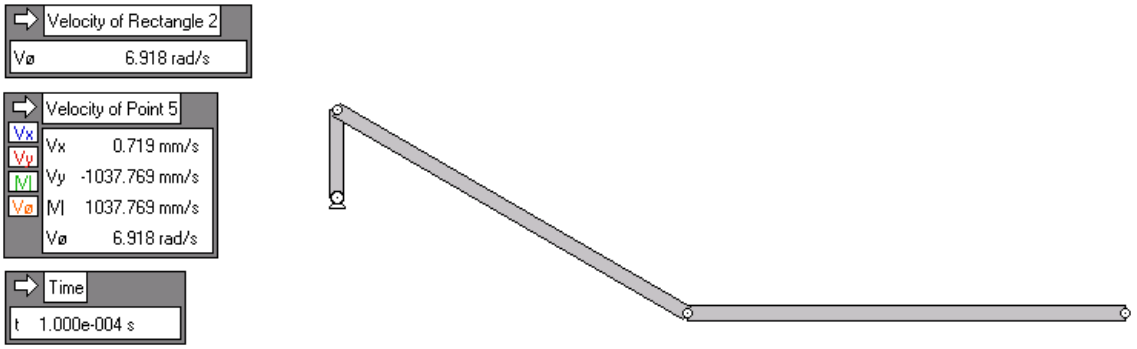

Figure 9

Even though we wanted to stop the simulation at t = 0, the time has increased to 0.0001 s, and there is a velocity component in X direction for point C. But this velocity component is very small compared to Vy component. Also, the rotational velocity and Vy component are very close to the hand-calculated values in the example.