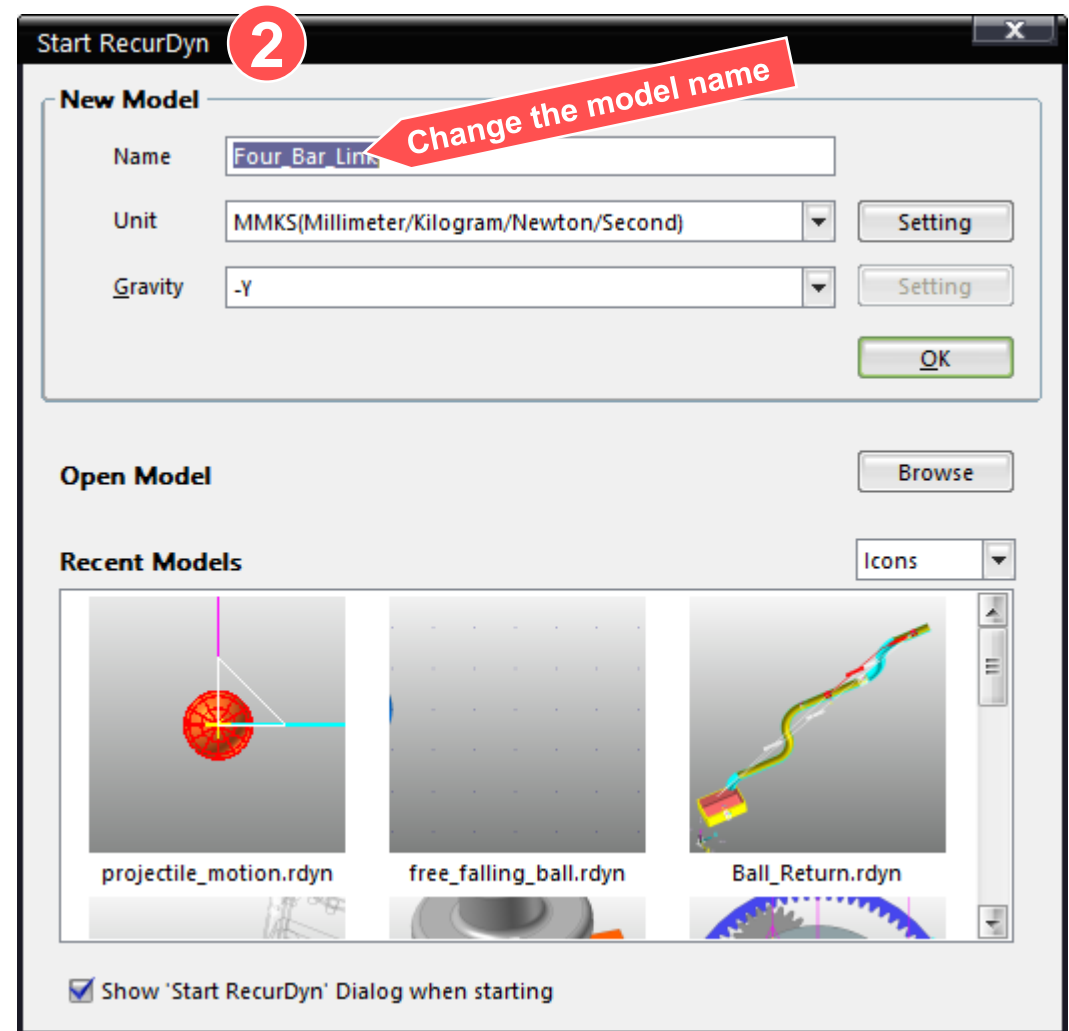
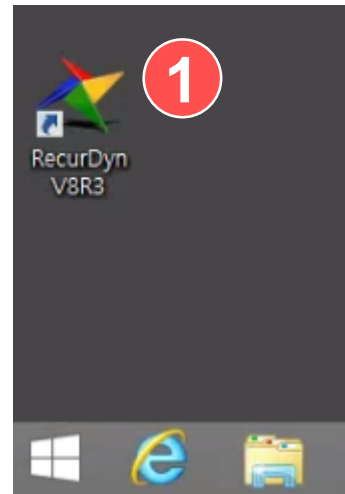


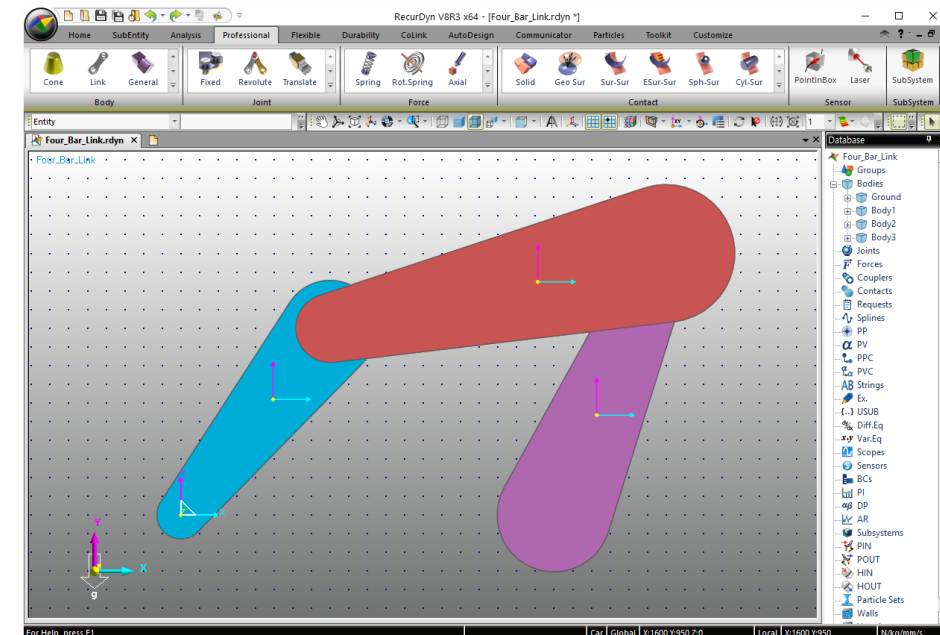
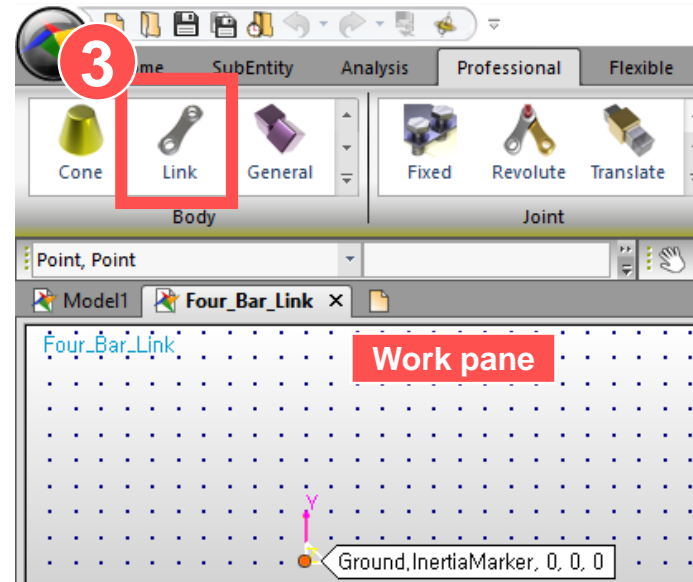
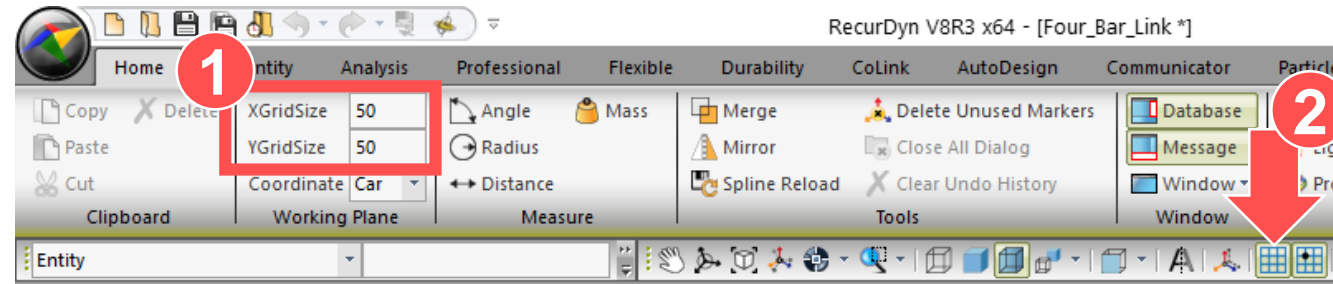
# 1. Running RecurDyn and Creating a New Model

1. Double-click the RecurDyn icon on the Desktop to run RecurDyn.
2. Enter "Four\_Bar\_Link" in the Name box and click **OK** to create a new model.



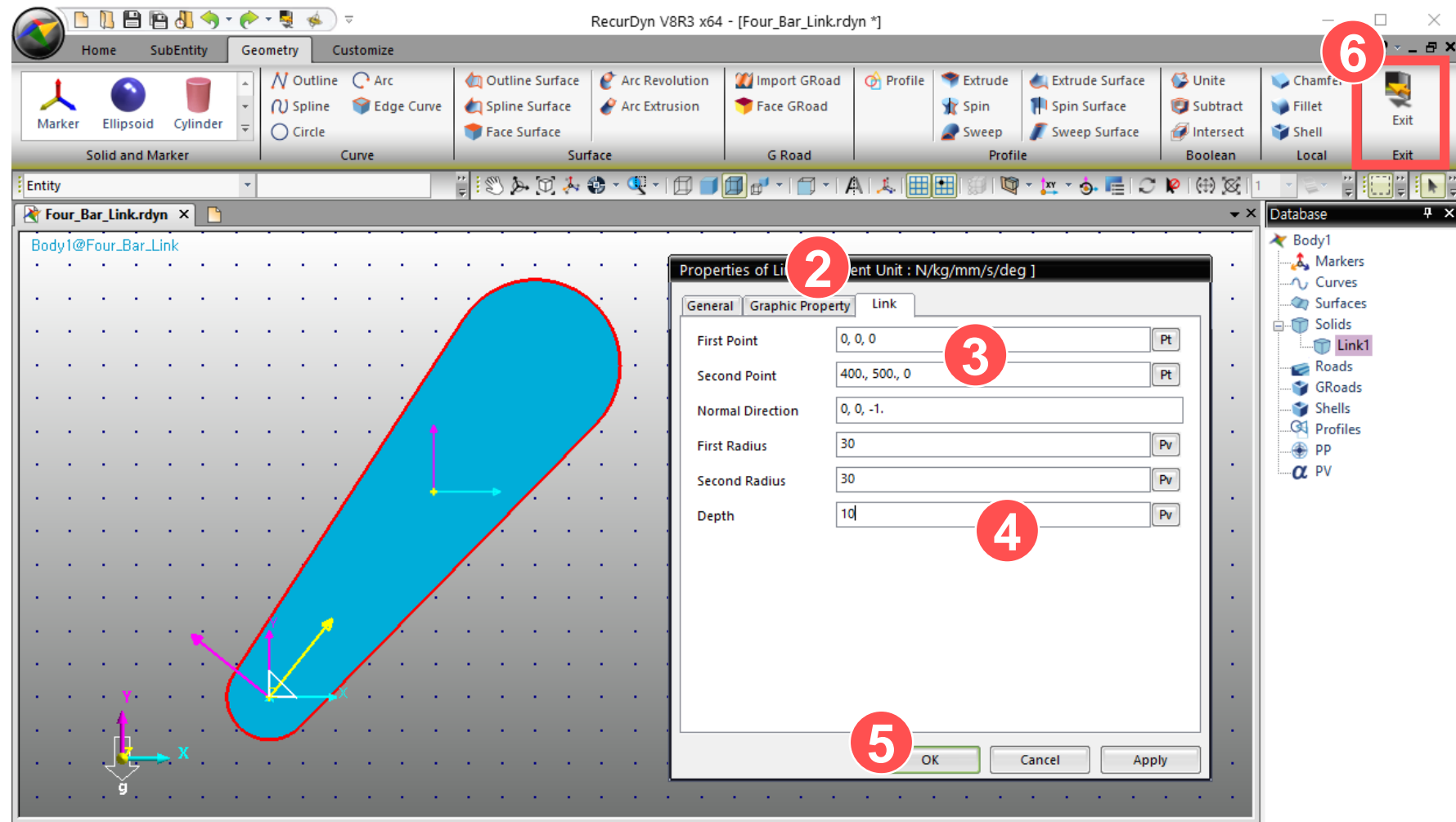
## 2. Creating a Four-Bar

1. On the Home tab, in the Working Plane group, enter "50" for the XGridSize and YGridSize coordinates respectively.
2. On the toolbar, click the Grid button to display the grid.
3. On the Professional tab, in the Body group, click Link, and then select the Point to Point option. Click the origin (0, 0, 0) and then point (400, 500, 0) on the work pane to create Body1.
4. Repeat step 3 to create two more bodies.
  - Body2: [400,500,0], [1300,700,0]
  - Body3: [1300,700,0], [1000,0,0]



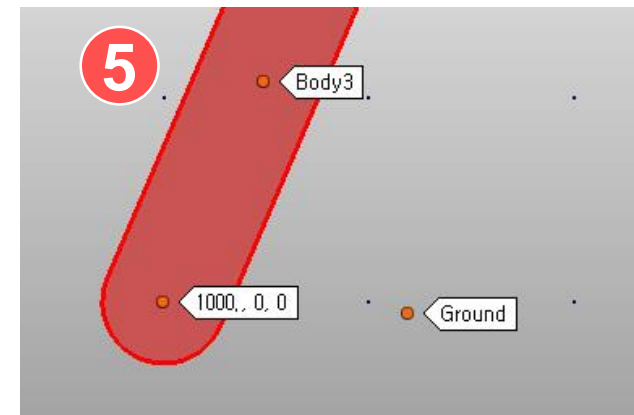
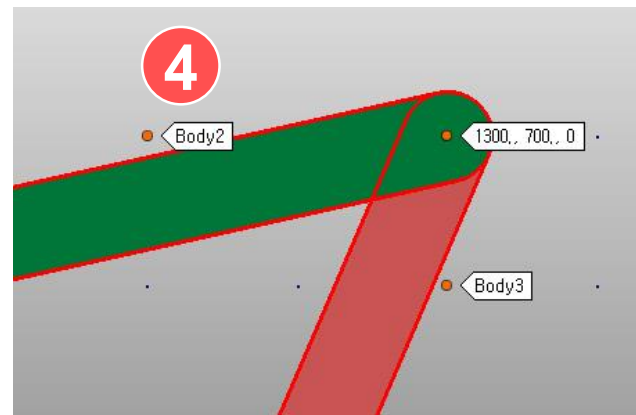
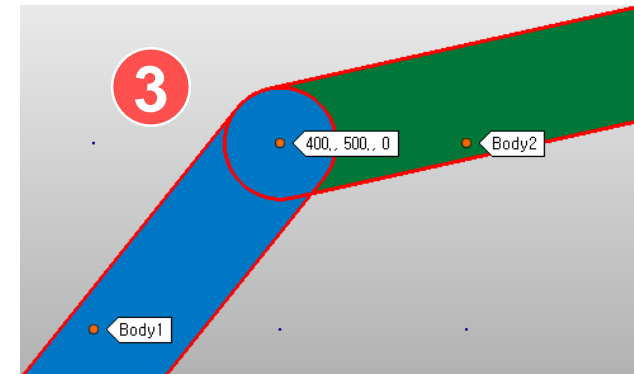
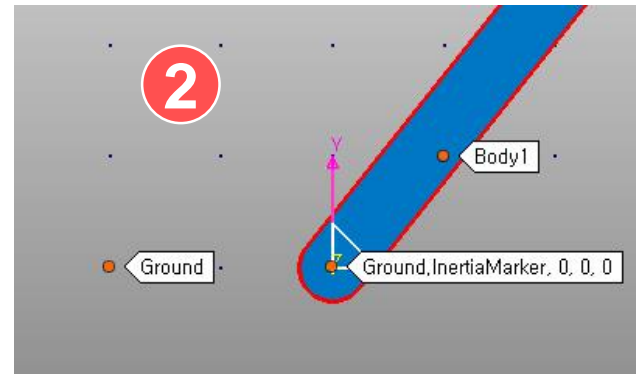
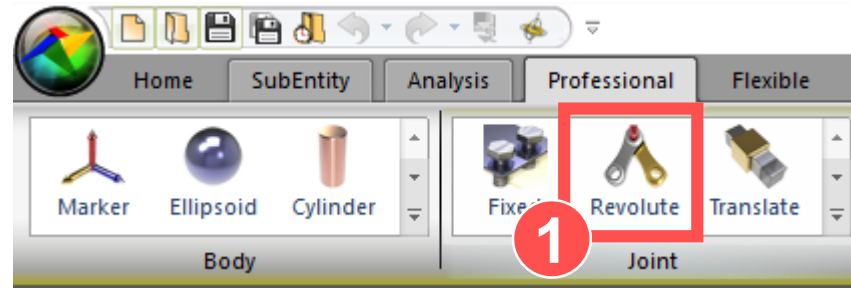
# 3. Adjusting the Body Size

1. On the work pane, double-click Body1 to enter Body Edit mode.
2. Select the Link1 body and press **P** to open the Properties dialog box.
3. In the Properties of Link1 dialog box, click the Link tab, and enter "30" for the First Radius and Second Radius.
4. Enter "10" for the Depth.
5. Click **OK** to close the dialog box.
6. Click the Exit button to exit Body Edit mode.
7. Repeat the same procedure for both Body2 and Body3.



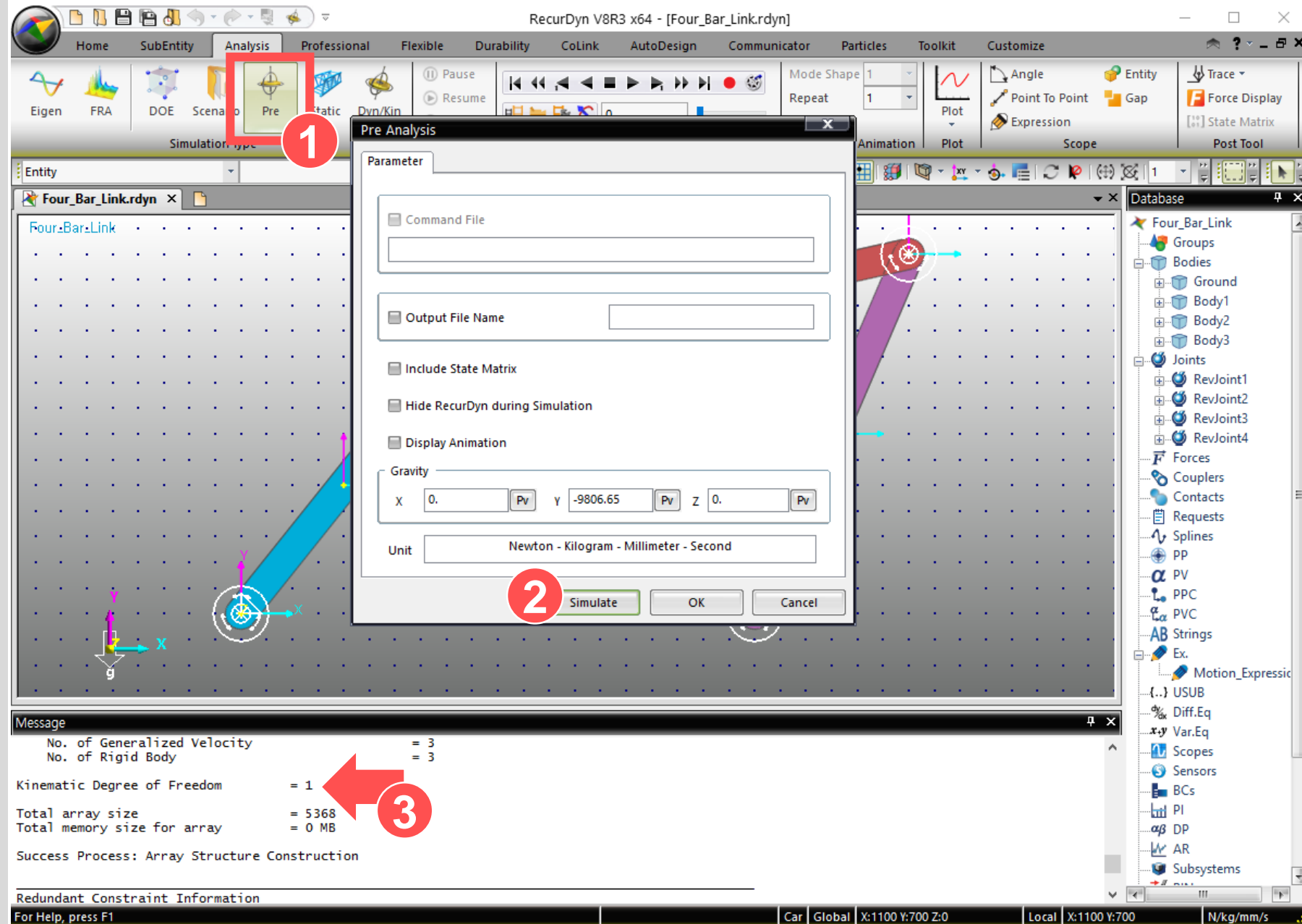
# 4. Creating a Joint

1. On the Professional tab, in the Joint group, click Revolute.
2. On the work pane, click Ground, click **Body1**, and then click the origin  $(0, 0, 0)$ .
3. Repeat step 1 and click **Body1**, click **Body2**, and then click point  $(400, 500, 0)$  on the work pane.
4. Repeat step 1 and click **Body2**, click **Body 3**, and then click point  $(1300, 700, 0)$  on the work pane.
5. Repeat step 1 and click **Body3**, click **Ground**, and then click point  $(1000, 0, 0)$  on the work pane.



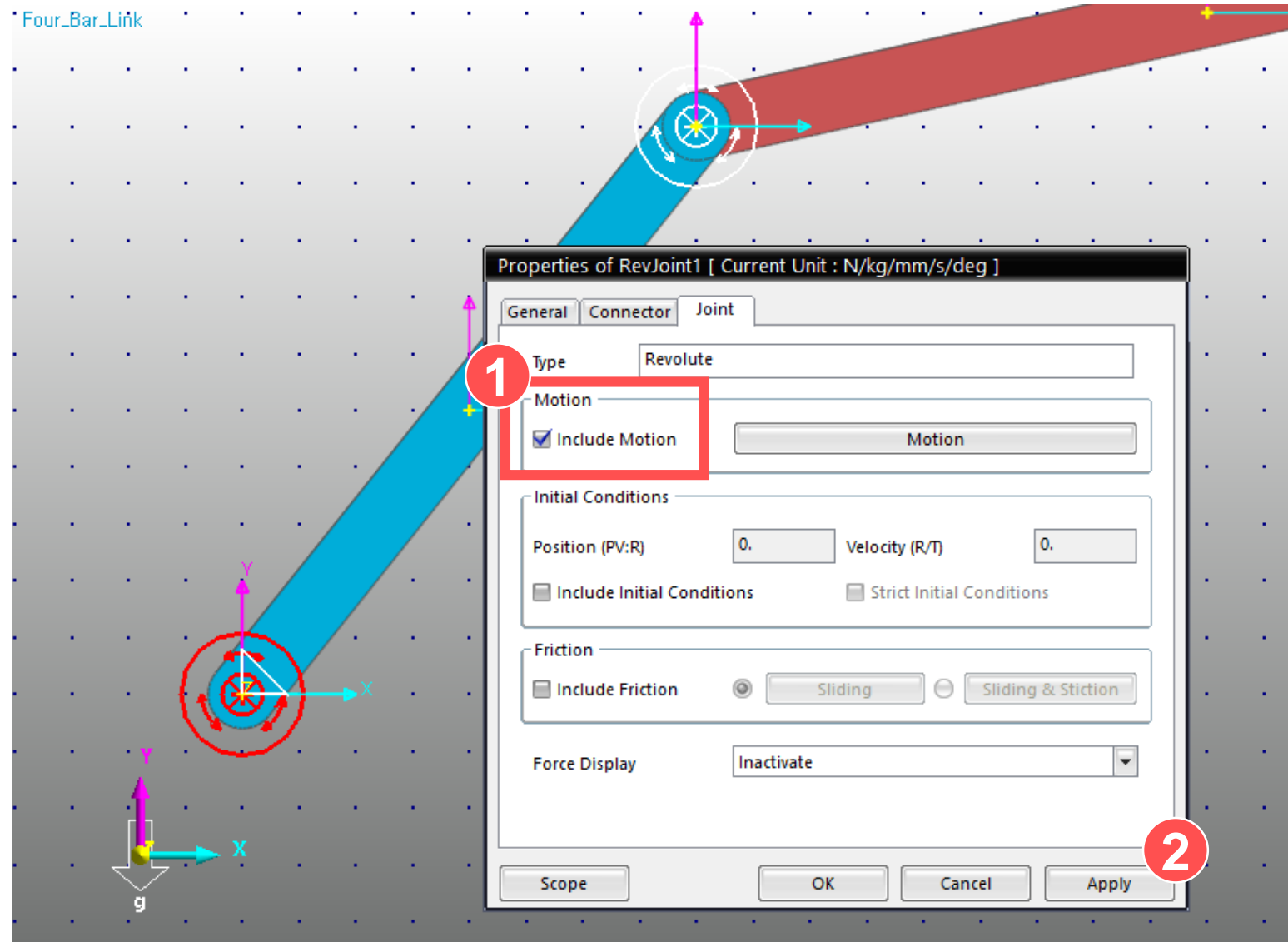
# 5. Checking the Degrees of Freedom

1. On the Analysis tab, in the Simulation Type group, click Pre Analysis.
2. Click **Simulate**.
3. After running the simulation, scroll through the Message window at the bottom to see if "Kinematic Degree of Freedom = 1" is displayed.



## 6. Creating a Joint Motion

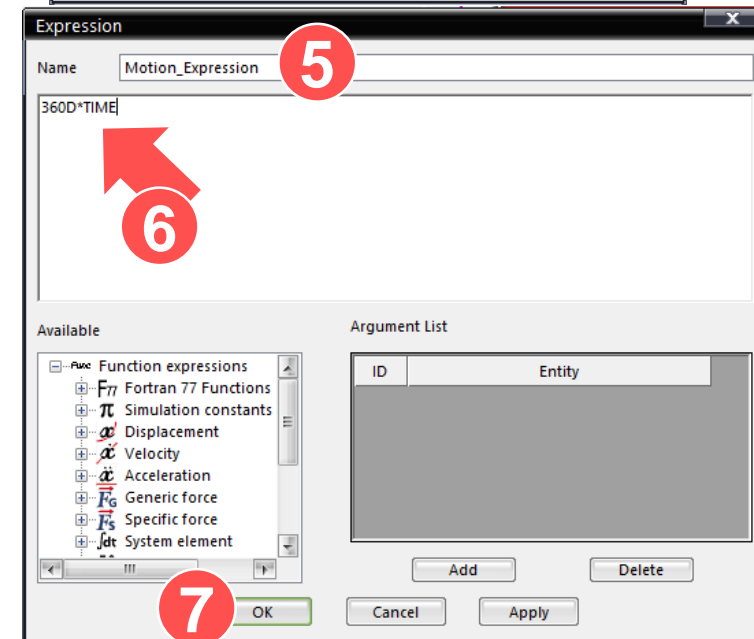
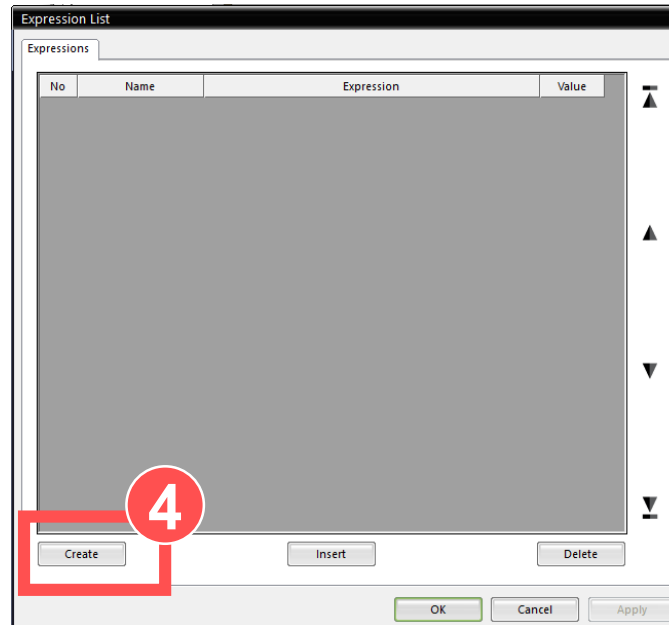
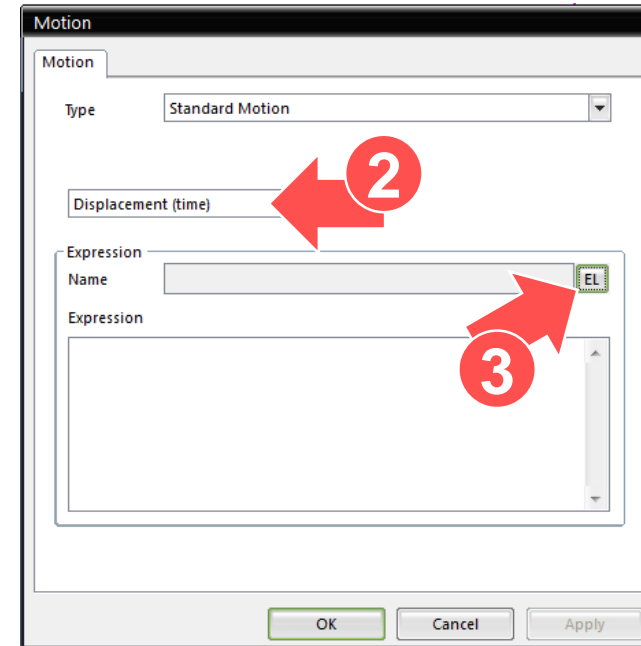
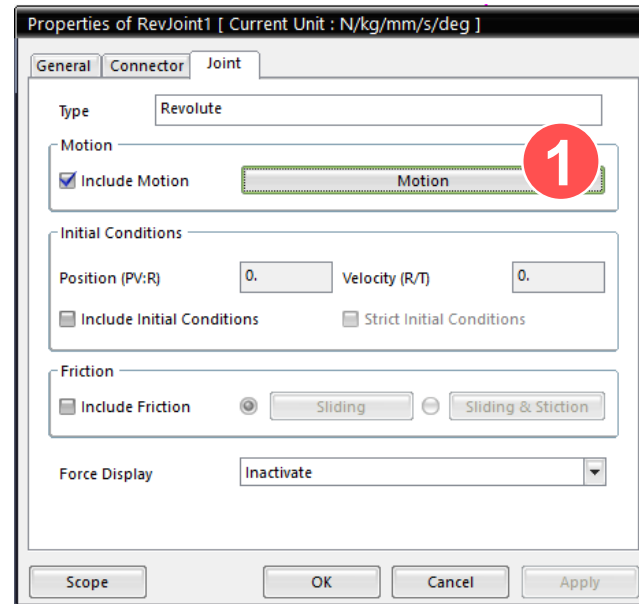
1. On the work pane, select RevJoint1 and press **P** to display the Properties dialog box. In the Properties of RevJoint1 dialog box, click the Joint tab, and select the **Include Motion** check box.
2. Click **Apply** to apply the changes.





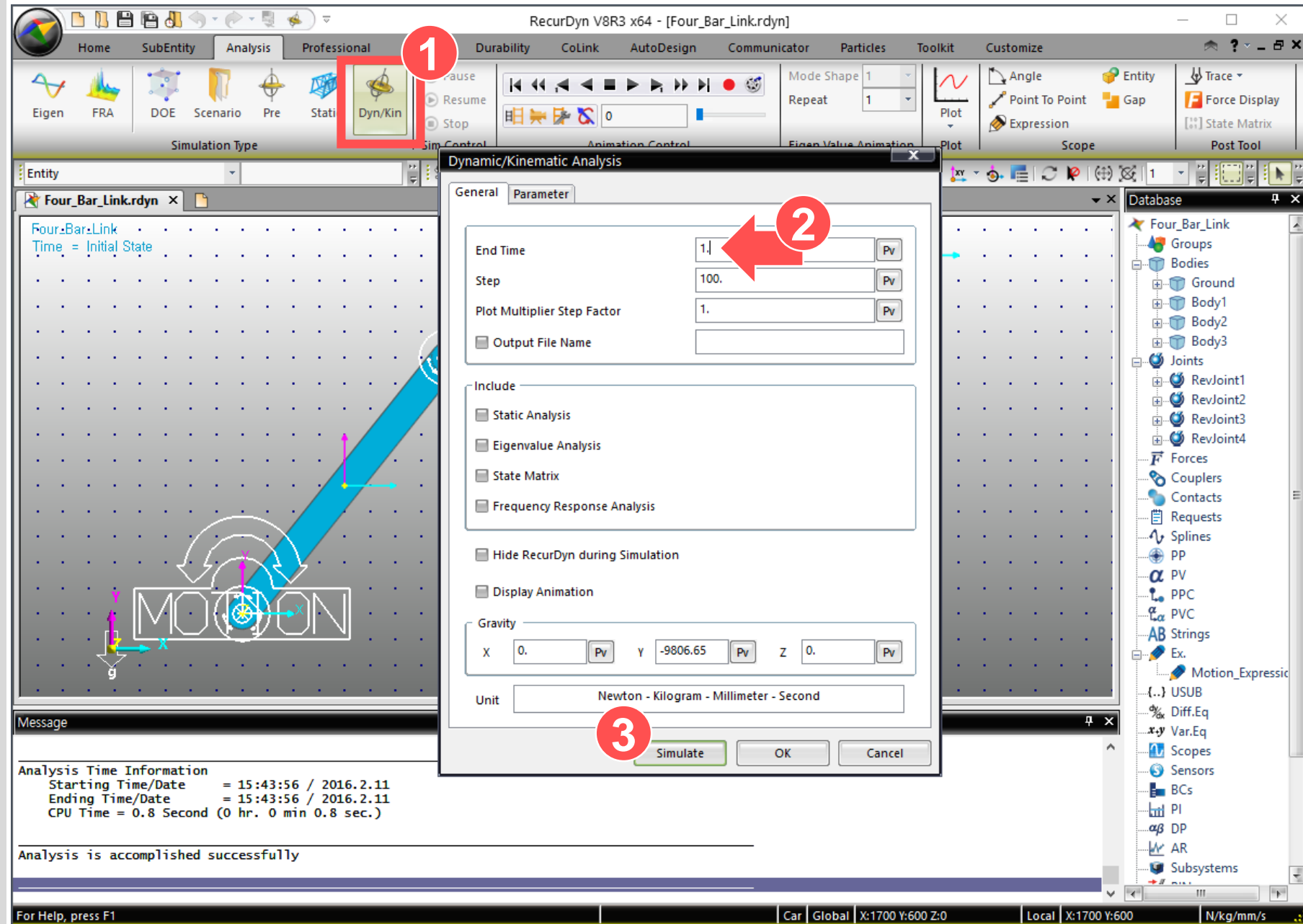
# 7. Creating a Motion Expression

1. In the Properties of RevJoint1 dialog box, click the Joint tab, and then click the **Motion** button.
2. In the Motion dialog box, click to select **Displacement (time)**.
3. Click the **EL** button.
4. In the Expressions List dialog box, click **Create** in the bottom-left corner.
5. In the Expression dialog box, enter "Motion\_Expression" in the Name box.
6. Enter "360D\*TIME" in the Expression input box.
7. Click **OK** four times until the Properties of RevJoin1 dialog box closes.



# 8. Performing Dynamic Analysis

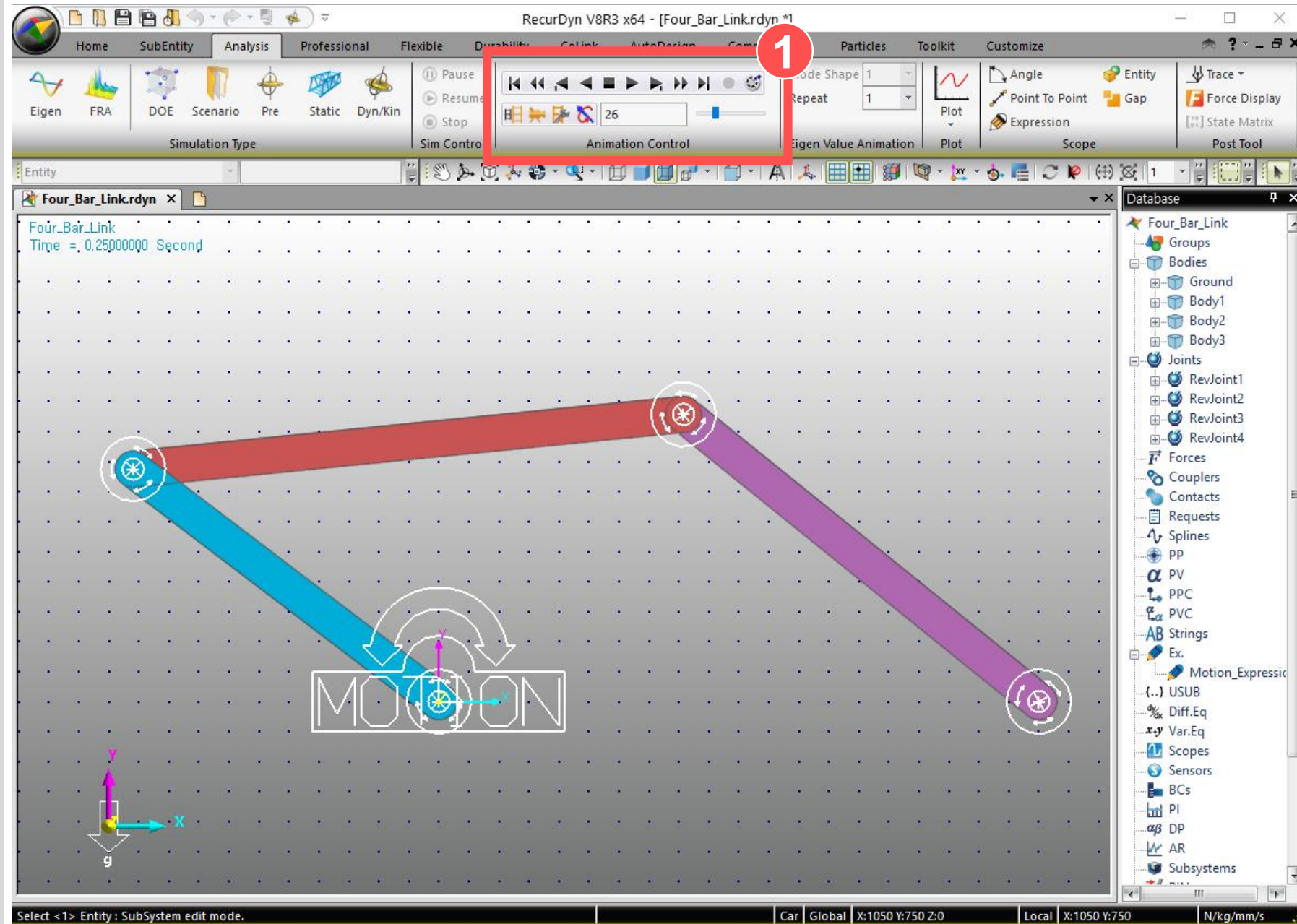
1. On the Analysis tab, in the Simulation Type group, click Dyn/Kin.
2. In the Dynamic/Kinematic Analysis dialog box, click the General tab, and enter "1" for the End Time.
3. Click Simulate to run the simulation.





# 9. Playing the Animation

1. On the Analysis tab, in the Animation Control group, use the Play and Stop buttons to play the animation of the analysis results.



# 10. Analytical Solution

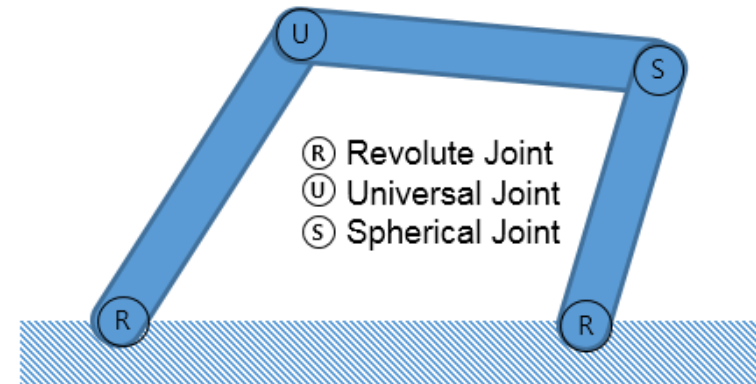
- Equation for calculating the degrees of freedom
- Example calculation of the degrees of freedom of a four-bar linkage

The degrees of freedom of a model are determined by the number of rigid bodies, and the number and type of joints. Each object has a total of 6 degrees of freedom. You can calculate the total number of constraint equations by multiplying the number of constraint equations per joint type with the number of joints, and then adding the products of all the joint types.

Calculating the degrees of freedom of a system :

$$\text{System DOF} = \sum \text{Body Num.} \times 6 - \sum \text{Jnt Num} \times \text{Cnst Num.}$$

The following is an example calculation of the degrees of freedom of a four-bar linkage model. The total degree of freedom of the model is 1. This example is a desirable modeling of a four-bar linkage system.



$$\begin{aligned} & 3 \times 6 = 18 \\ & - (\text{Rev } 2 \times 5 + \text{Univ } 1 \times 4 + \text{Sph } 1 \times 3) = 17 \\ & \hline & \text{System DOF} = 1 \end{aligned}$$