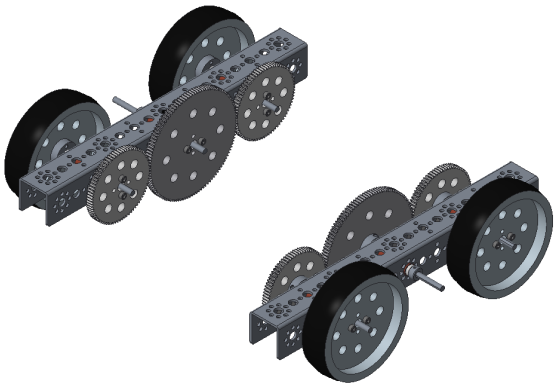
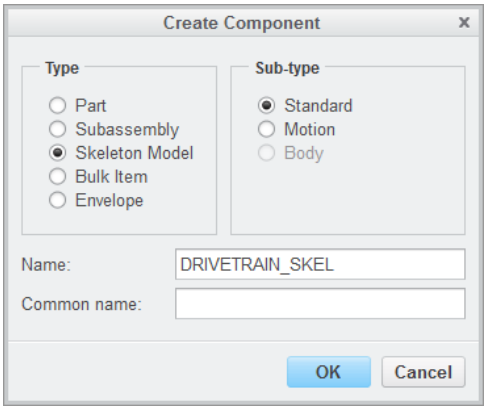
Creating a Drivetrain Subsystem with Working Gear Mechanisms

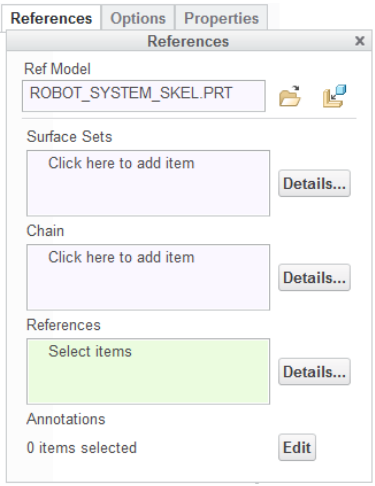


1. In the Robot System model, click **Create** from the Model tab.
2. Select **Subassembly** as the file type.
3. Name the new assembly file. In the example, we choose the name "**Drivetrain**". Click **OK**.
4. Leave the default settings for Creation Method and Copy From. Check the box next to **Leave component unplaced**.
5. Right-click on the Drivetrain subassembly in the model tree and select **Open**.

6. The first part we create for the Drivetrain assembly is a skeleton model.
7. From the Model tab, click **Create**. Choose **Skeleton Model** as the file type. Click **OK**. Leave the default Creation Method settings and click **OK**.
8. In the model tree, right-click on **DRIVETRAIN_SKEL.PRT** and select **Open**.

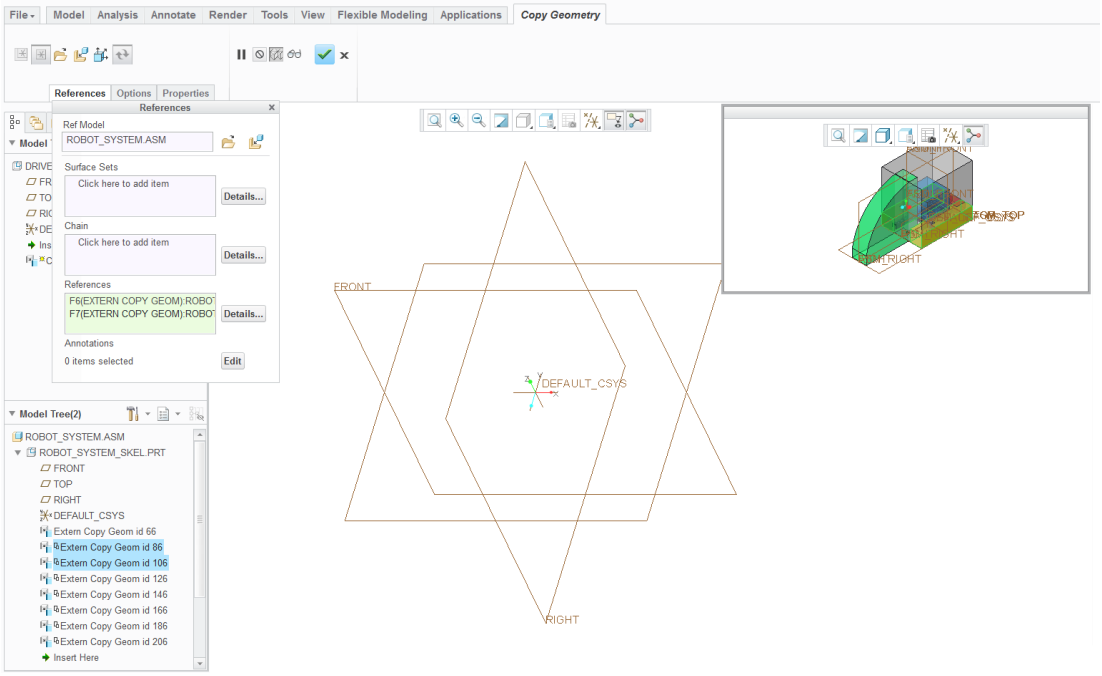


9. To assemble the drivetrain subsystem, we need to reference the drivetrain envelopes.
10. From the Model tab, click **Copy geometry**.
11. Click to disable **Published geometry only**.
12. Open the red References tab.
13. Click and select the Robot System assembly as the reference model.
14. Click in the References field to enable selecting your reference set
15. In Model Tree(2), expand ROBOT_SYSTEM_SKEL.PRT to show the reference geometry features.
16. Select the two **Extern Copy Geom id *XX*** features that represent the drivetrain envelopes.



In the example the second and third Extern Copy Geom features represent the drivetrain envelopes.

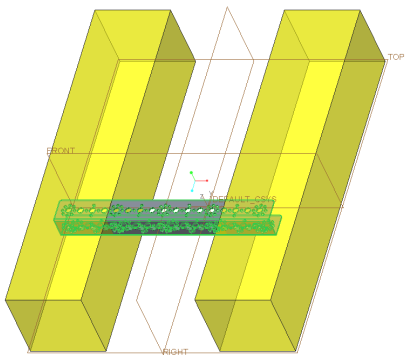
17. Hold Ctrl as you click on the second Extern Copy Geom feature to make multiple selections. The subsystem envelopes are highlighted in the small graphical window.



18. Click ✔ to finish selecting references.

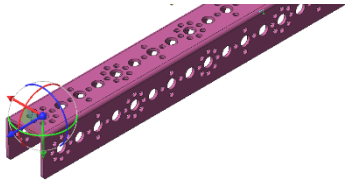
The drivetrain envelopes appear in your skeleton model.

19. We will also copy the crossbar from the chassis model into our Drivetrain skeleton model in order to guide the placement of the drivetrain components.
20. From the Model tab, click **Copy geometry**.
21. Follow the same procedure as before to set the Robot System assembly as the reference model.
22. Click in the Surface Sets field.
23. In Model Tree(2), expand the chassis subassembly and select the crossbar part. It is the second part placed in our example. Click ✔ to finish selecting references.



24. Your Drivetrain skeleton model now includes a copy of the chassis crossbar. You will use this reference to place the structural channel piece of the drivetrain subassembly. Save and close the skeleton model.
25. In the drivetrain assembly window, select **Assemble** from the Model tab.

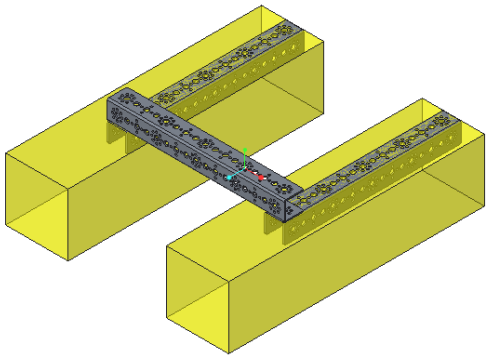
26. Choose the 288mm channel, **tetrix_739068.PRT**.
27. Click in the graphical area to temporarily place the part near the chassis crossbar.
28. Use the orientation sphere to rotate the part 180 degrees so the flat surface is on top and the channel is open at the bottom.



29. Create coincident constraints between two of the small holes in the first hole set of the drivetrain channel part and two of the small holes in the hole set at the end of the chassis crossbar.

The channel part should now be perpendicular to the chassis crossbar with the end hole set aligned to the hole set in the crossbar.

30. Click to select the top surface of the drivetrain channel and create a coincident constraint with the bottom surface of the crossbar.
31. Repeat the procedure to place a second channel on the left end of the chassis crossbar.



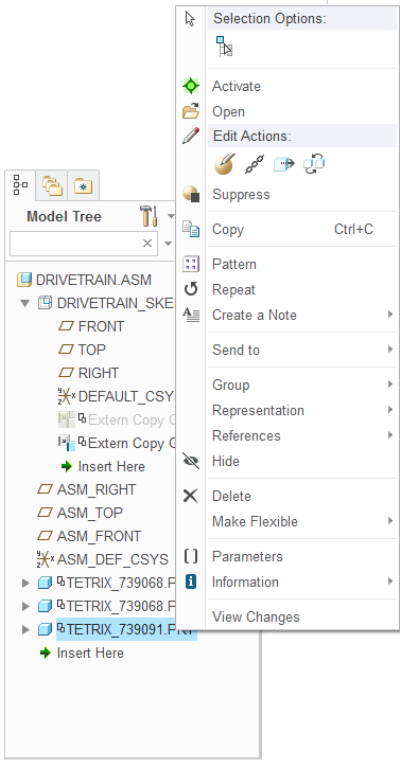
32. Next we will place bronze bushings in each of the six holes that will hold an axle.
33. In the model tree, right-click on DRIVETRAIN_SKEL.PRT and select **Hide**.

It will be easier to select surfaces without the envelope models in the way.

34. From the Model toolbar, select **Assemble**.
35. Choose the bronze bushing part, **tetrix_739091.PRT**.

36. Place the bushing in the fourth large hole from the front of the drivetrain channel by creating coincident constraints between the cylindrical surface of the bushing shaft and the inside surface of the large hole and another between the underside of the bushing cap and the right surface of the drivetrain channel. Click ✔ to finishing placing the bushing.

37. In the model tree, right-click on the bushing part file, **TETRIX_739091.PRT**. Select **Repeat** ↺.



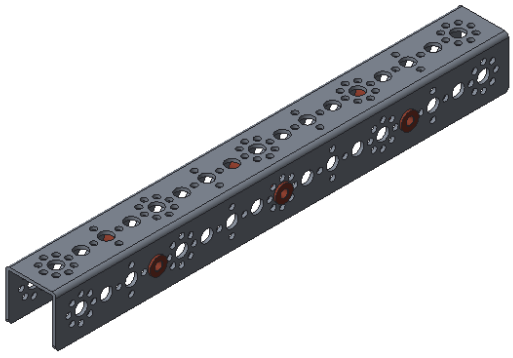
38. In the Repeat Component window, select both coincident constraints. Click **Add**.

39. Place bushings in the ninth hole from the front (middle hole) and the fourth hole in from the back of the channel by selecting the inside surface of the large hole and then the side surface of the channel.

40. Make the same bushing placements on the other channel piece and also place bushings in all of the holes on the opposite side of the channels as the first set of bushings.

41. When you are done placing bushings, click **OK** in the Repeat Component window.

Both drivetrain channels should appear like the image.



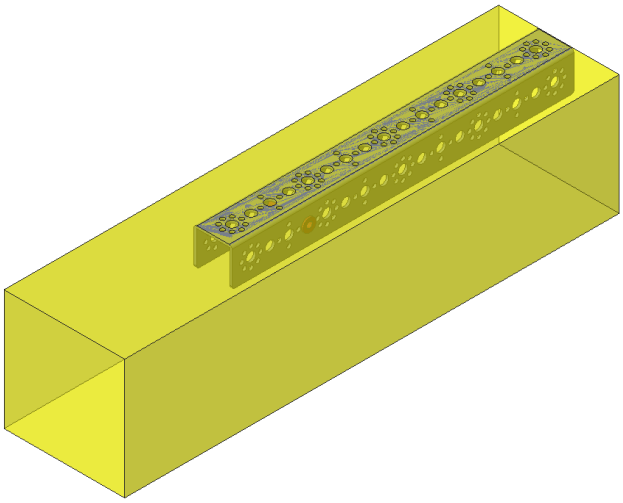
42. In the model tree, select all of the bushing part files and right-click on the set. Select **Group** and choose **Group**.

A feature called Group LOCAL_GROUP appears in the model tree. It contains the bushing part files.

43. Save your drivetrain subsystem model.

You are now ready to create the wheel and gear assemblies.

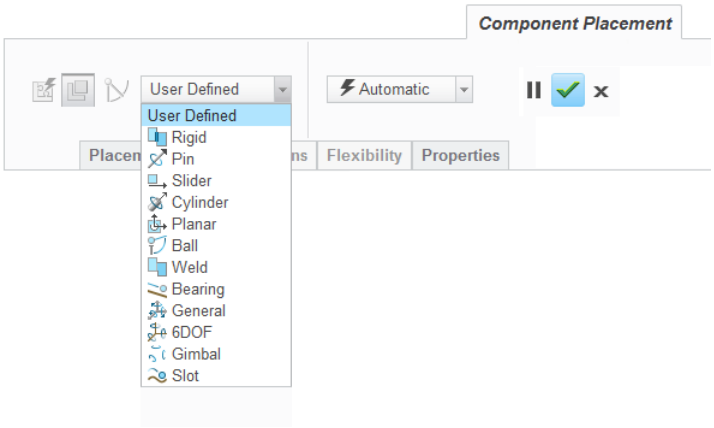
44. From the Model toolbar, select **Create**.
45. Select **Subassembly** for file type. Name the new subassembly. The example uses the name, "**Wheel**".
46. Leave the default options for Creation Method and Copy From. Check the box next to **Leave component unplaced**.
47. In the model tree, right-click on **WHEEL.ASM** and select **Open**.
48. The first part we add to the wheel subassembly is a skeleton model.
49. From the Model toolbar, select **Create**. Choose **Skeleton Model**. Click **OK**. Leave the default options and click **OK**.
50. In the model tree, right-click on **WHEEL_SKEL.PRT**. Select **Open**.
51. Click **Copy Geometry** and set the Drivetrain subsystem as the reference model.
52. Copy the right channel part and the two bronze bushings in the large hole at the front of the channel.
53. Next, set the Robot System assembly as the reference model and copy the right drivetrain envelope into the wheel skeleton model.



You are now ready to begin placing the parts of the wheel assembly.

54. In the model tree, expand WHEEL_SKEL.PRT. Right-click on the reference that represents the drivetrain envelope and select **Hide**.
55. From the Model tab, click **Assemble**.
56. Choose an axle, **tetrix_739088.prt**.
57. Use the orientation sphere to turn axle perpendicular to the channel part.

58. From the Component Placement tab, select **Pin** .

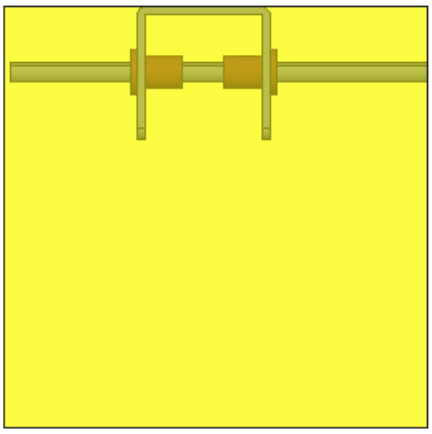


59. Click to select the surface of the axle shaft and the inside surface of the bushing.
60. Next, click the right end surface of the axle and create a distance constraint with the surface of the bushing. Set the distance offset to 4 or greater. Click .
61. In the model tree, right-click on the reference that represents the drivetrain envelope in the wheel skeleton model and select **Unhide** .

We will now replace the axle using a coincident constraint between its end surface and the right surface of the drivetrain envelope.

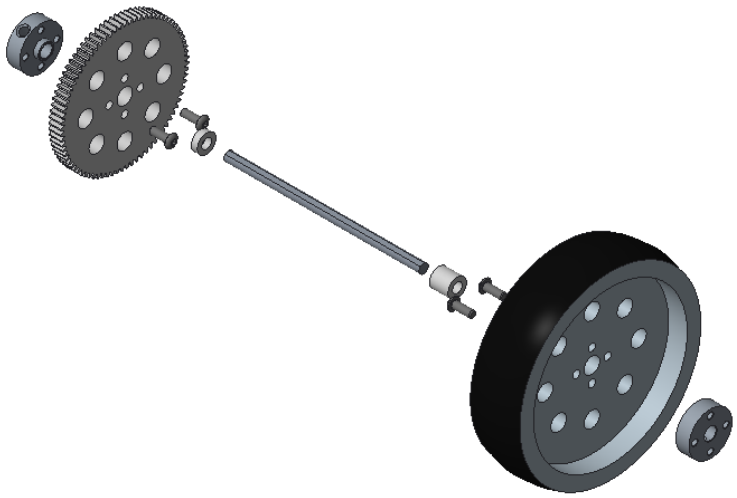
62. In the model tree, right-click on the axle part file. Select **Edit Definition** .
63. Click to open the Placement tab in the Component Placement toolbar.
64. The Translation constraint is the one we need to change.
65. Click the Translation constraint. Right-click the bushing surface selection (it will be the second one listed) and choose **Remove**.
66. Change the constraint type to **Coincident**.
67. In the model, click to select the right surface of the drivetrain envelope as the second surface in the Translation constraint. (If the constraint type automatically changes to Distance, simply change it back manually.)

68. Your axle is now centered in the drivetrain envelope.



69. Hide the drivetrain envelope reference again to make it easier to place the rest of the wheel assembly components into the model.

The wheel assembly require two spacers, the wheel and gear, two axle hubs, and screws to hold the wheel and gear to the hubs.



70. Place the spacers first by clicking Assemble from the Model tab and selecting the large spacer.
71. Make a coincident constraint between the inside surface of the spacer and the rounded surface of the axle.
72. Make a second coincident constraint between the left surface of the spacer and the surface of the bushing.
73. Notice that the spacer doesn't turn orange. This indicates that the part isn't fully constrained.
74. Open the Placement tab, in the Component Placement toolbar. Open the second coincident constraint that you just placed.
75. Right-click and remove both surface selections from the constraint.
76. Change the constraint type to **Distance**. Select the right surface of the spacer and the right end surface of the axle. The offset distance will automatically be set to the current

distance between the two surface. Notice that the spacer is now orange indicated that it is fully constrained.

77. Use the same procedure to constrain a small spacer on the other side of the axle.
78. Now that the spacers are fully constrained, we can place the wheel and gear by aligning the large center hole with the axle and their surfaces to the spacer surfaces.
79. Assembly two axle hubs into the model by constraining them to the wheel and to the gear.
80. Check that your pin joint is working correctly by holding **Ctrl +Alt** while clicking and dragging on the wheel. You should see both the wheel and gear rotating if the pin constraint is correct.
81. In the model tree, hide the wheel skeleton model. It will be easier to place the final hardware without it in the graphical area.
82. Assemble four screw parts in the model, two holding the wheel to its axle hub, and two holding the gear to its axle hub.
83. The wheel assembly is complete!
84. Repeat the process you used to create the wheel subassembly to create a gear subassembly that uses the parts shown below.