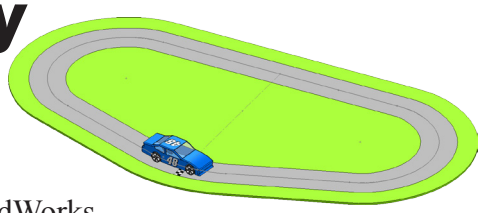
Chapter 8

Speedway

Motion Study



A. Enable SolidWorks Motion.

Step 1. If necessary, open your **Speedway Assembly** file.

Step 2. If necessary, turn on SolidWorks Motion. To turn on SolidWorks Motion, click Tools Menu > Add-Ins.

Step 3. Check **SolidWorks Motion** check box under **Active Add-Ins** and **Start-Up**, **Fig. 1**. Click OK.

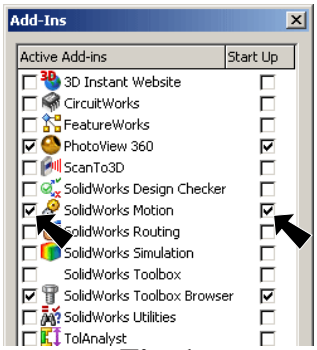


Fig. 1

B. Type of Study.

Step 1. Click **Motion Study 1** tab Motion Study 1 at the lower left of the drawing area, **Fig. 2**.

Step 2. Set Type of Study to **Motion Analysis**, **Fig. 2**.

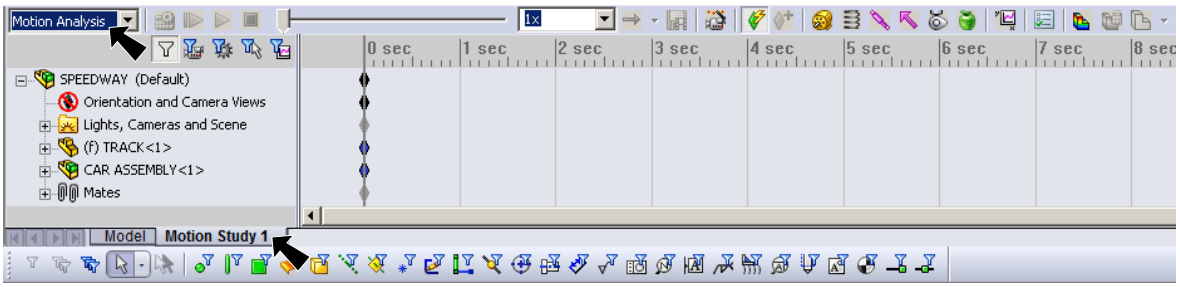


Fig. 2

C. Solve as Flexible.

Step 1. **Right click Car Assembly** in the Motion Manager design tree and click **Component Properties**, **Fig. 3**.

Step 2. In the Component Properties dialog box set:

Solve as to **Flexible**, **Fig. 4**
click OK.

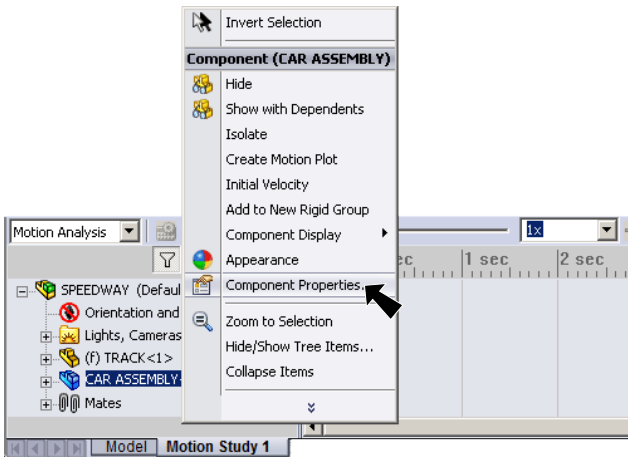


Fig. 3

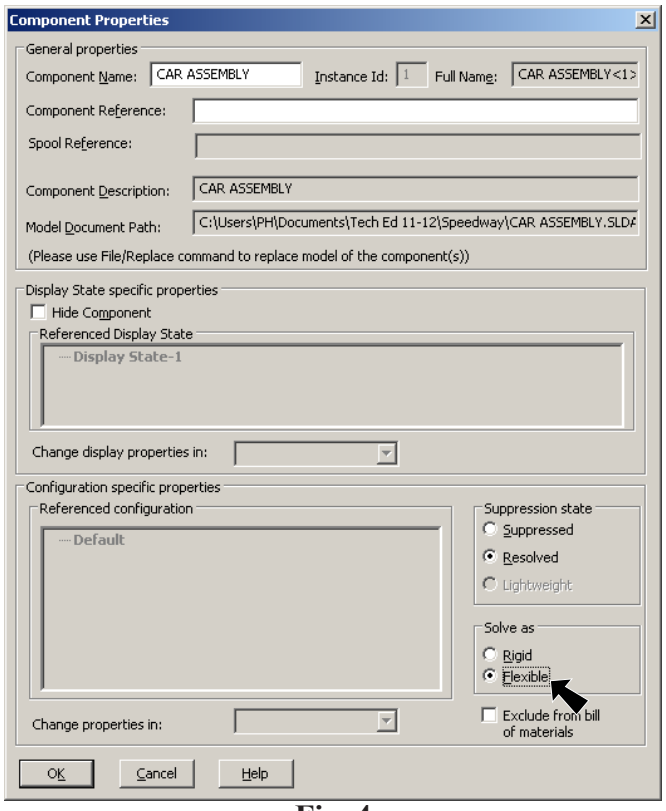


Fig. 4

D. Add Motor.

Step 1. Zoom in around **Car Assembly**, **Fig. 5**. To **zoom**, hold down **Shift key** and drag with middle mouse button (wheel). To **pan**, hold down **Ctrl key** and drag with middle mouse button (wheel).

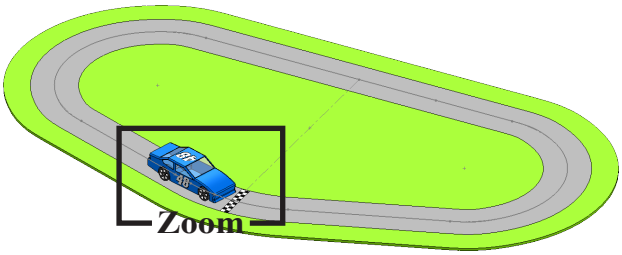


Fig. 5

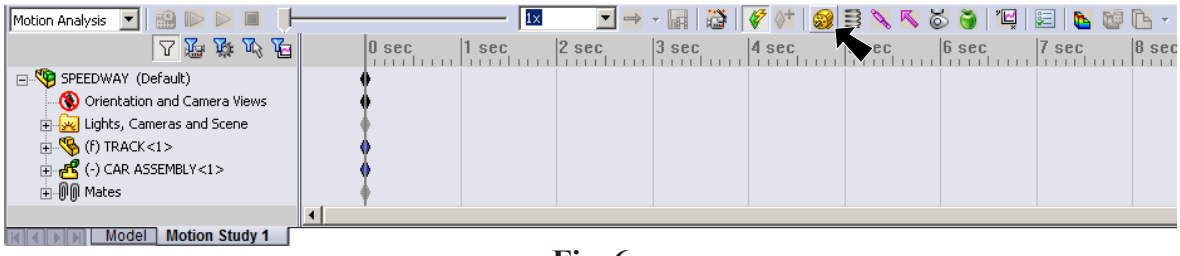


Fig. 6

Step 2. Click **Motor** on the Motion Manager toolbar, **Fig. 6**.

Step 3. In the Motor Property Manager set:

under Motor Type, **Fig. 7**

select **Rotary Motor**

under Component/Direction

for Motor Location

click the **cylindrical face of rear Wheel**, **Fig. 8**

for Motor Direction

Motor direction arrow should point CW, **Fig. 8.**

If arrow is pointing in wrong direction, click **Reverse Direction**, **Fig. 7**.

click in **Component to Move Relative to** box, **Fig. 7**

click **FIT SPLINE PATH**, **Fig. 8**

RPM 500

click OK.

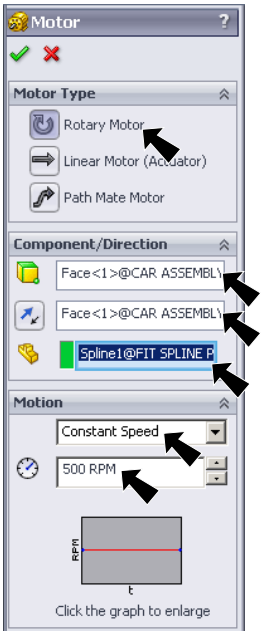


Fig. 7

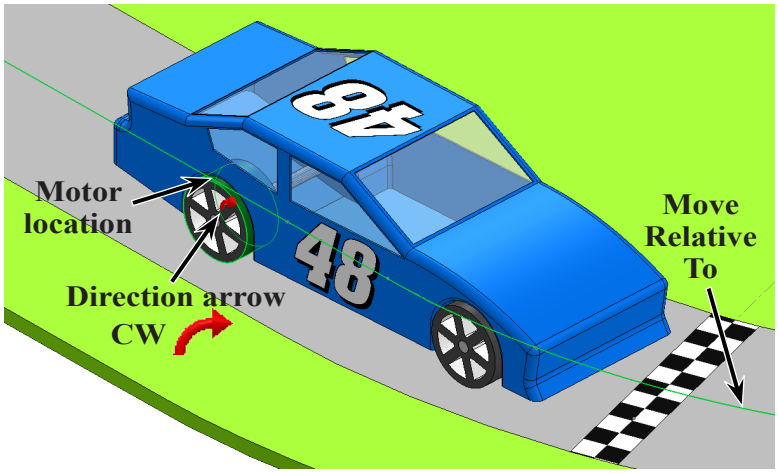


Fig. 8

E. Contact.

Step 1. Click **Contact**  on the Motion Manager toolbar, **Fig. 9**.

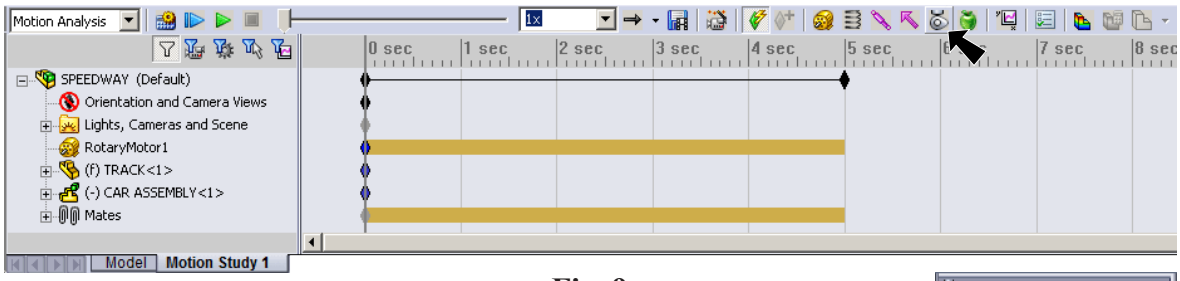


Fig. 9

Step 2. In the Property Manager set:

expand **Selections**, **Fig. 10**

check **Use contact groups**

in **Group 1** box

click **all four Wheels**, **Fig. 11**. Rotate view to select wheels on back side **Fig. 12**. To rotate, hold down middle mouse button (wheel) and drag.

click in **Group 2** box, **Fig. 10**

click **Track**, **Fig. 12**

uncheck **Material**

under Friction

Dynamic Friction Velocity v_k **.4**

Dynamic Friction Coefficient μ_k **.8**

uncheck **Static friction**

click OK  .

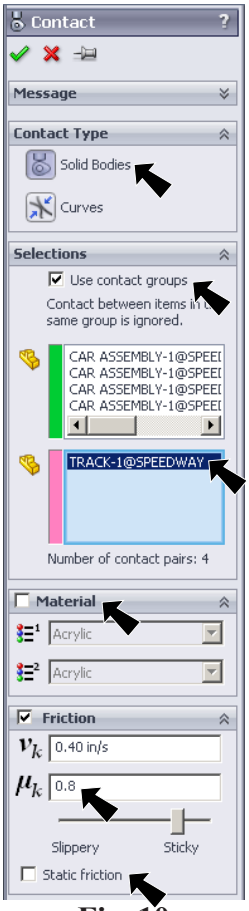


Fig. 10

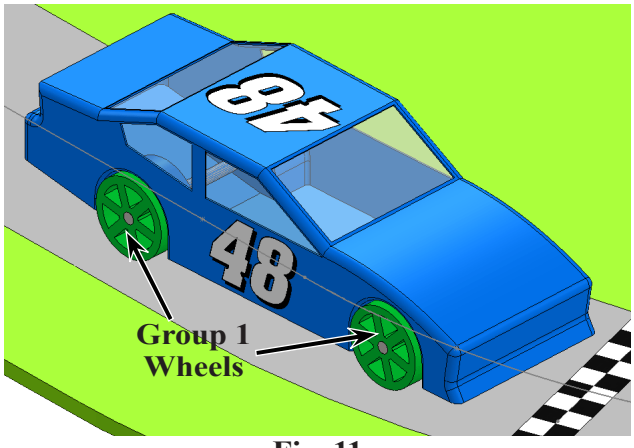


Fig. 11

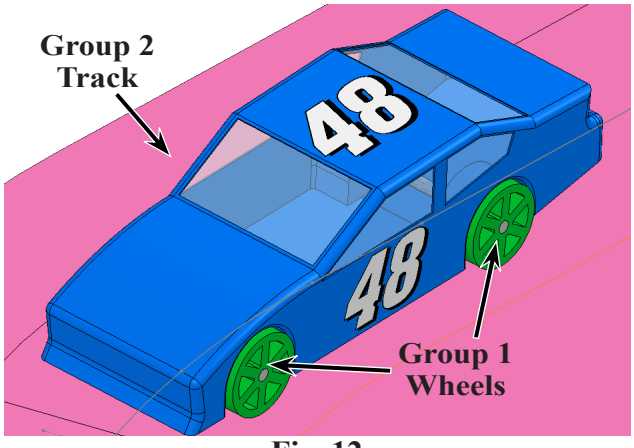


Fig. 12

F. Gravity.

Step 1. Click **Gravity**  on the Motion Manager toolbar, **Fig. 13**.

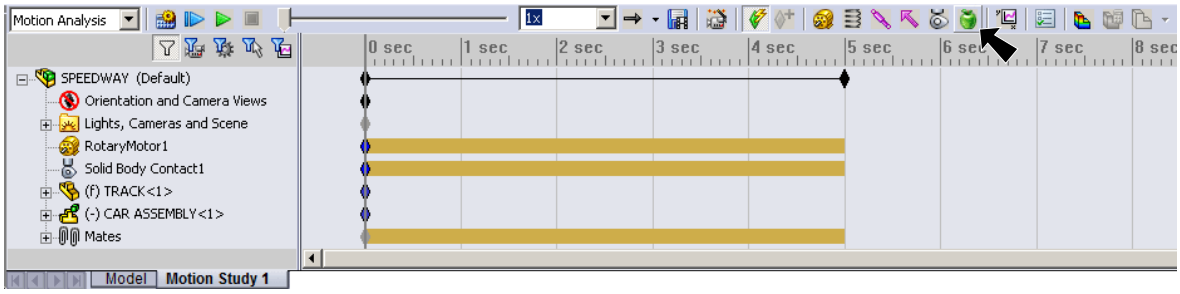


Fig. 13

Step 2. In the Gravity Property Manager set:

under Gravity Parameters, **Fig. 14**

select **Y**

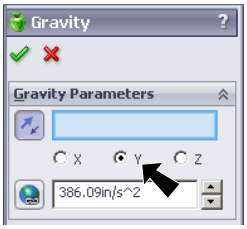


Fig. 14

the **green arrow**  in the bottom right corner of the drawing area should **point down**, **Fig. 15**

click OK  .

Step 3. Save. Use **Ctrl-S**.

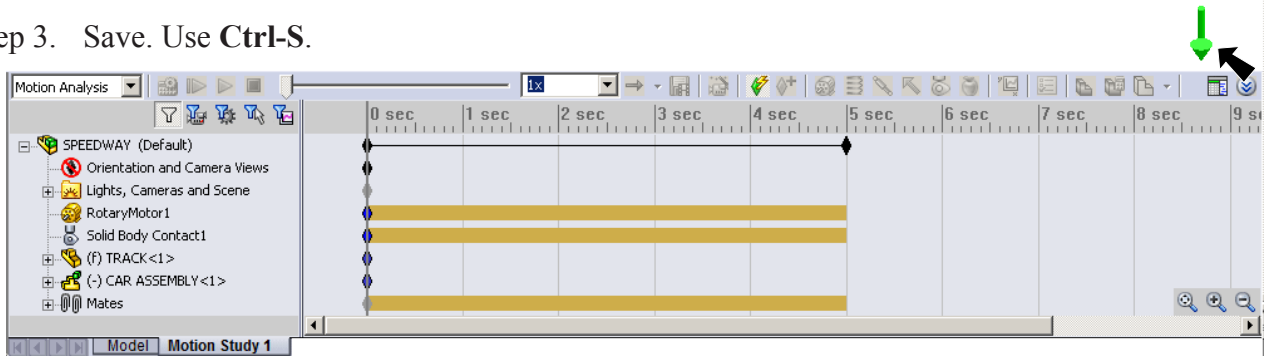


Fig. 15

G. Results and Plots.

Step 1. Click **Trimetric** on the Standard Views toolbar.

Step 2. Click **Results and Plots** on the Motion Manager toolbar, **Fig. 16**.

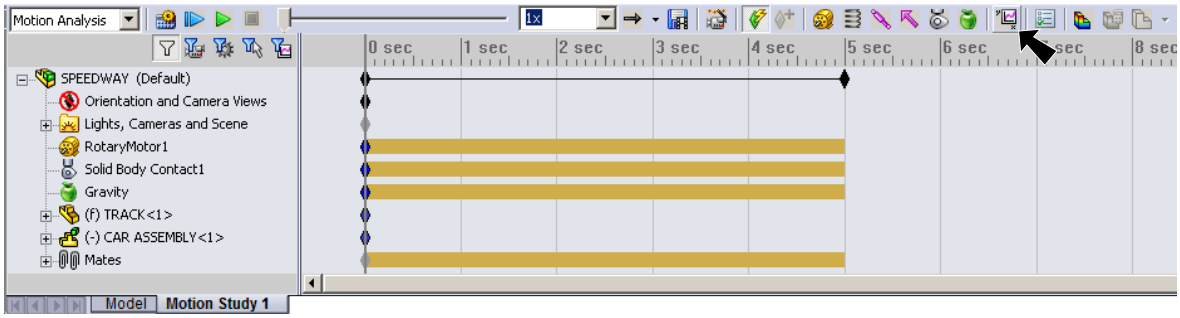


Fig. 16

Step 3. In the Property Manager set:

under **Result**, **Fig. 27**

Category **Displacement/Velocity/Acceleration**

Sub Category **Linear Velocity**

Result Component **Magnitude**

for Feature

click side face of Car Body, Fig. 18

click OK .

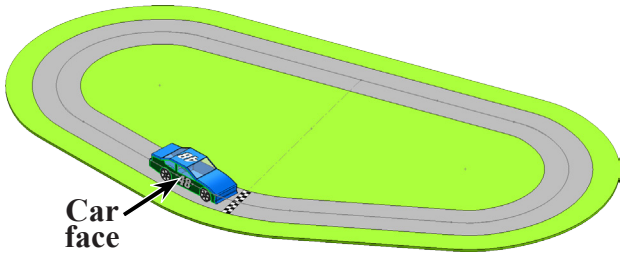


Fig. 18

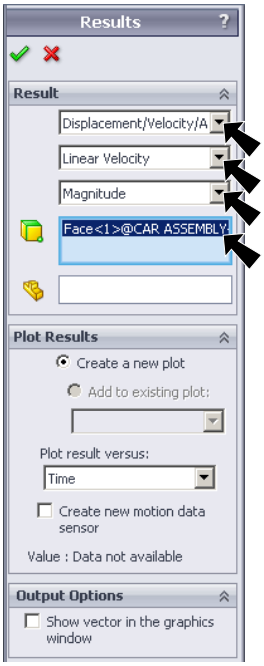


Fig. 17

Step 4. Save. Use **Ctrl-S**.

H. Motion Study Properties.

Step 1. Click **Motion Study Properties**  on the Motion Manager toolbar, **Fig. 19**.

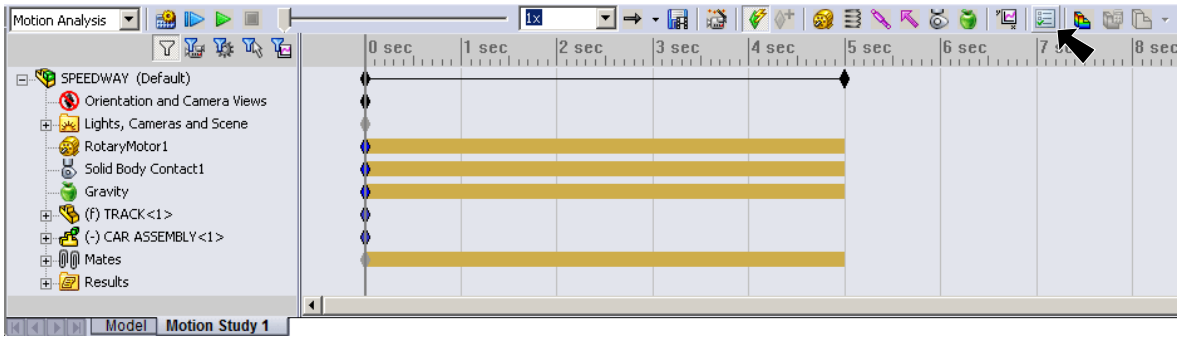


Fig. 19

Step 2. In the Property Manager set:

under Motion Analysis, **Fig. 20**

Frames per second: 250

check **Use Precise Contact**

click **Advanced Options** button

under Advanced Motion analysis Option, **Fig. 21**

Integrator Type **WSTIFF**

click **OK**

click OK  .

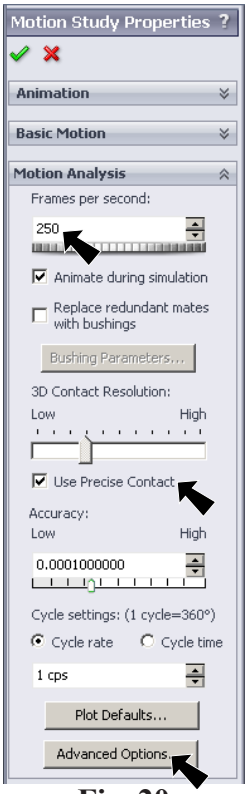


Fig. 20

Step 3. Solver: The default GTIFF solver is limited to around 7200 RPMs. Hopefully we will be using more RPMs to power our motor so that is why we switched to the WSTIFF solver.

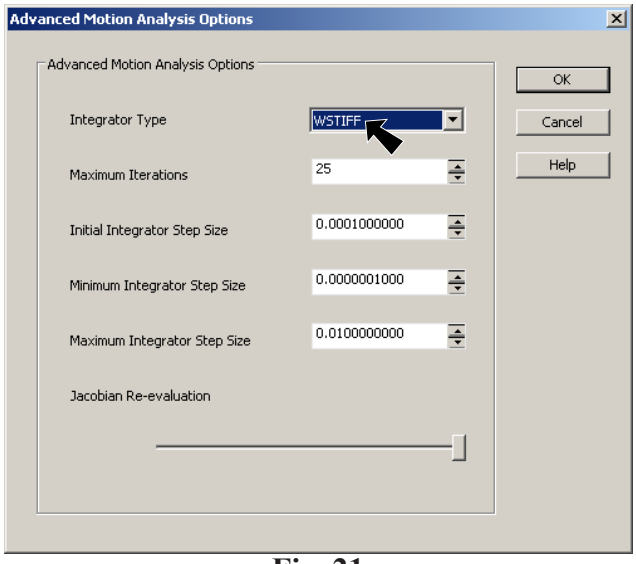


Fig. 21

I. Disable Playback View Keys.

Step 1. **Right click**  **Orientation and Camera Views** in the Motion Manager design tree and click **Disable Playback of View Keys**, **Fig. 22**. Disabling View Keys will allow viewing Motion Study from any view.

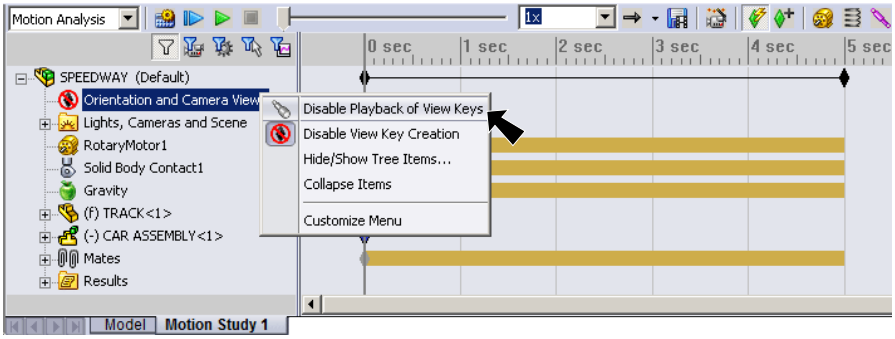


Fig. 22

J. Suppress Mates.

Step 1. Click **Zoom in**  in lower right corner of the Motion Manager to increase the Time Bar with finer time increments, **Fig. 23**.

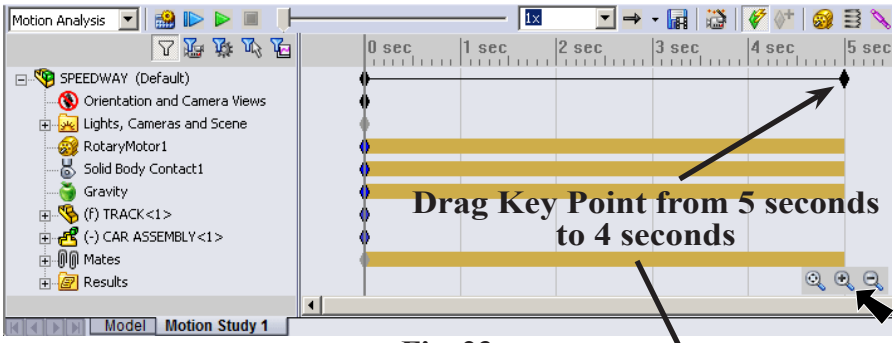


Fig. 23

Step 2. **Set the Motion Study duration to 4** seconds on the Timeline. To change duration, in the top Timeline drag the **Key Point**  **at 5 seconds to 4 seconds**, **Fig. 24**.

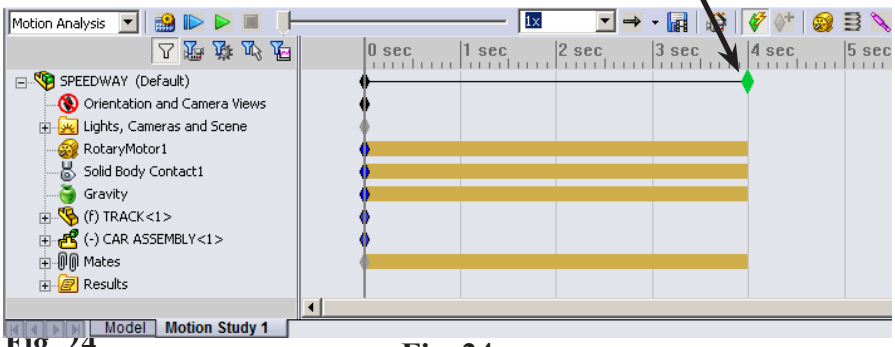


Fig. 24

Step 4. **Suppress the 2 Tangent Mates in the Motion manager tree**. To suppress the Mates, expand Mates, click the first Tangent Mate, then hold down the **Shift key** and click the 2nd Tangent Mate. Release the Shift key, **right click** and click **Suppress**  from the menu, **Fig. 25**.

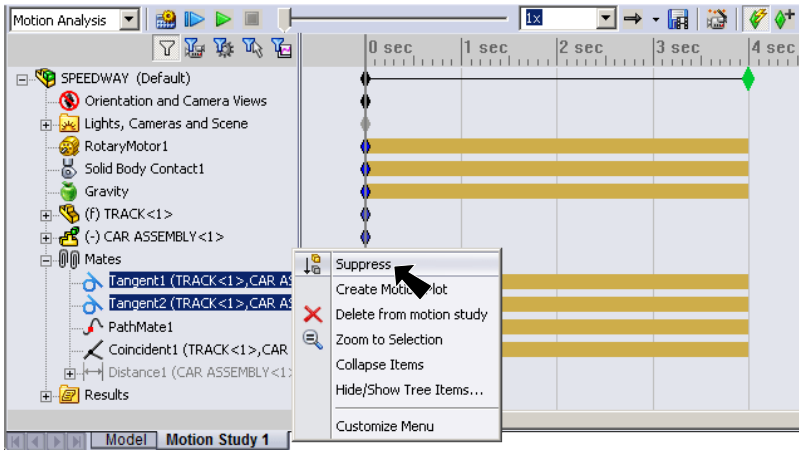


Fig. 25

Step 5. Save. Use **Ctrl-S**.

K. Calculate and Play.

Step 1. Click **Calculate**  on the Motion Manager toolbar, **Fig. 26**.

Step 2. Set the **Playback Speed** to **.25**, **Fig. 26**.

Step 3. Click **Play from Start**  on the Motion Manager toolbar, **Fig. 26**.

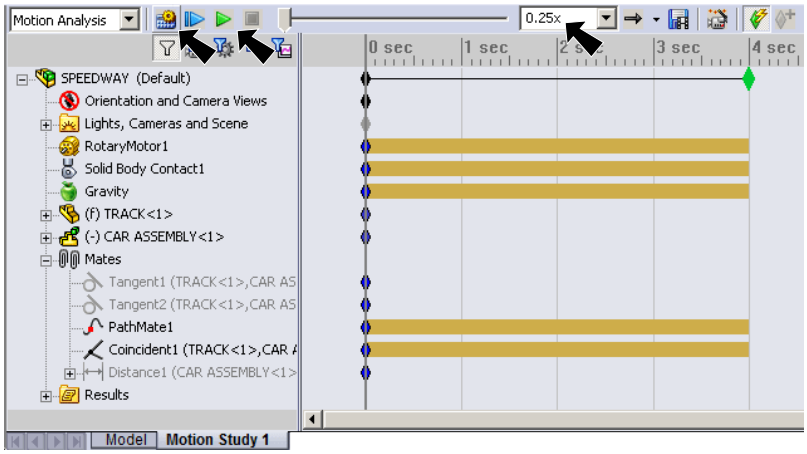


Fig. 26

Step 4. What's the Velocity, **Fig. 37**?

Step 5. Save. Use **Ctrl-S**.

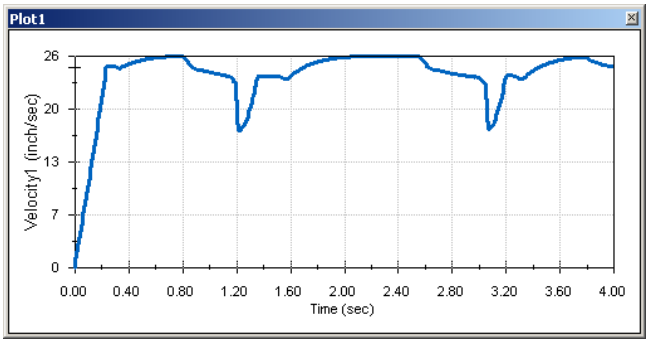


Fig. 27

L. More RPMs.

Step 1. **Rewind Motion Study to 0 seconds.** To rewind, either **drag the Play Head**  back to the beginning in the Motion Manager toolbar or **drag the Time Bar**, the gray vertical line back to 0 in the Timeline, **Fig. 28**. It's good practice to rewind before you make changes in the Timeline, otherwise you could create unwanted Keys.

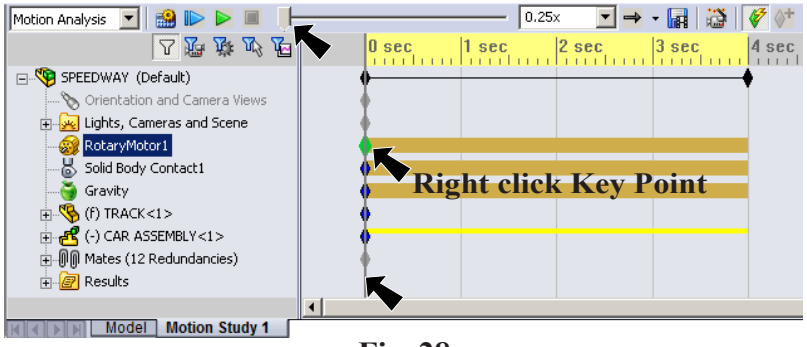


Fig. 28

Step 2. **Double click Key Point**  at **Time = 0** in the **RotaryMotor1** Timeline, **Fig. 28**. Or, you can right click RotaryMotor1 in the Motion Manager design tree and Edit Feature. Be sure to rewind before edit the motor using this method.

Step 3. In the Motor Property Manager set:

RPM 800 **Fig. 29**

click OK  .

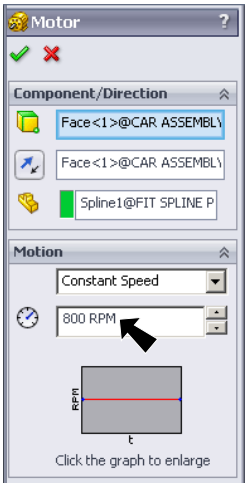


Fig. 29

Step 4. **Set the Motion Study duration to 2.8** seconds on the Timeline. To change duration, in the top Timeline drag the **Key Point** ⧫ **at 4 seconds to 2.8 seconds**, **Fig. 30**.

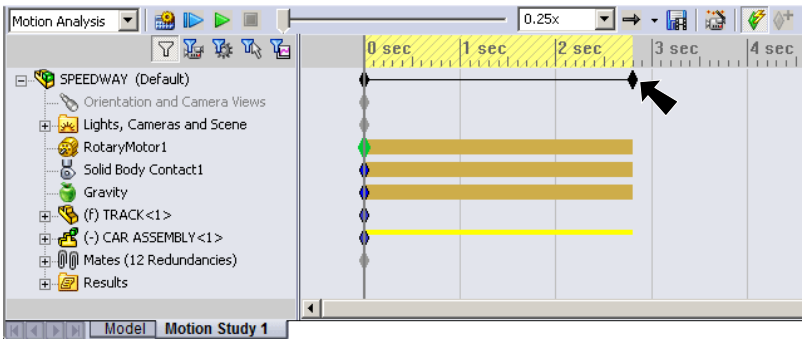


Fig. 30

Step 5. Click **Calculate**  and **Play from Start**  on the Motion Manager toolbar.

Step 6. What's the Velocity, **Fig. 31**?

Step 7. Continue and increase RPMs to determine the maximum velocity. Be sure to rewind before editing motor.

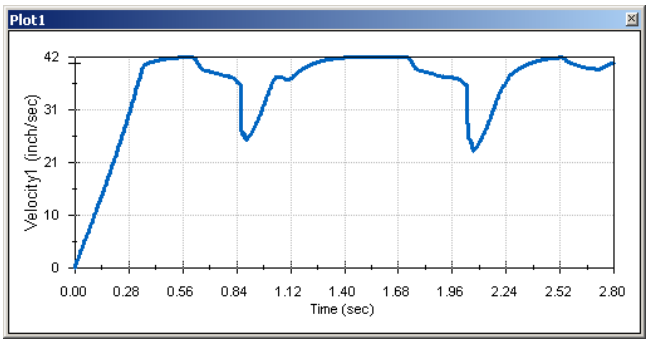


Fig. 31