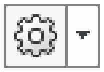
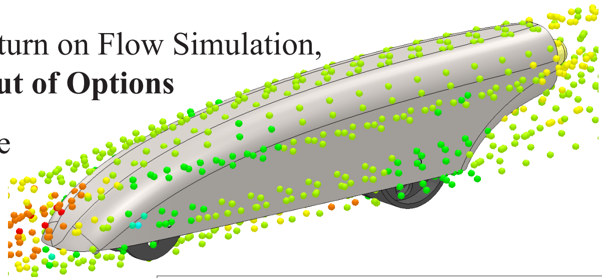
Chapter 14

CO2 Shell Car
Flow Sim

A. Enable Flow Simulation.

Step 1. If necessary, open your **ASSEMBLY** file.

Step 2. If necessary, turn on Flow Simulation, click the **flyout of Options**  on the Standard toolbar and click **Add-Ins**.



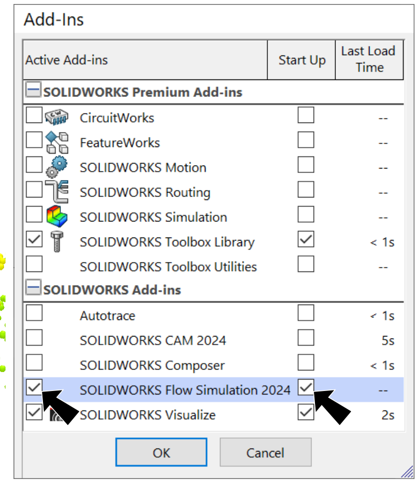


Fig. 1

Step 3. In the dialog box, scroll down to **Flow Simulation** and place a check in the check box under **Active Add-Ins** and **Start-Up**, **Fig. 1**. Click OK.

B. Create Project.

Step 1. Click **Flow Simulation** tab  on the Command Manager toolbar.

Step 2. Click **Wizard**  on the Flow Simulation toolbar.

Step 3. Use **Project(1)** for Project name, **Fig. 2**.

Step 4. Click Next.

Step 5. **Unit System:** Select **SI (m-kg-s)** for Unit system, **Fig. 3**.

Step 6. Under Parameter, set **Velocity** units to **Mile/hour**, **Fig. 3**.

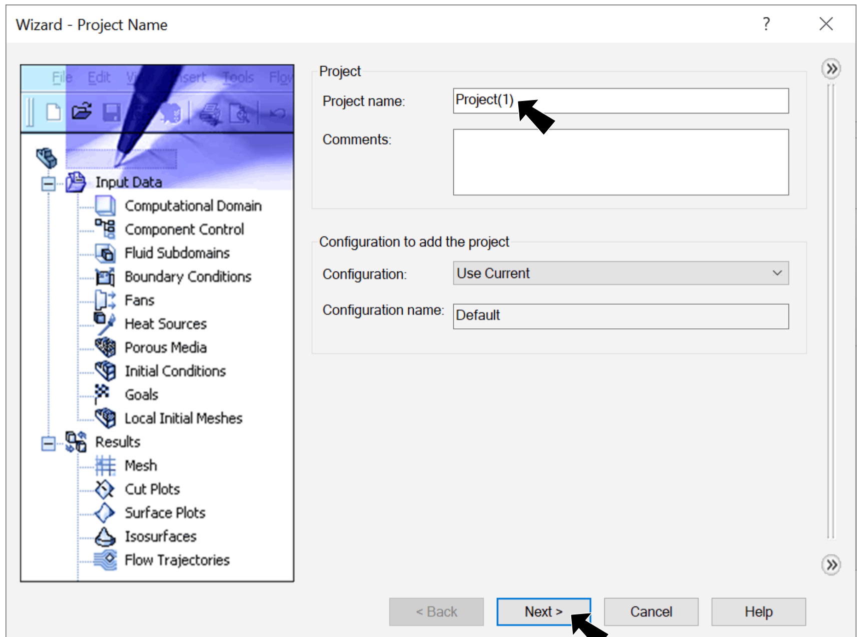


Fig. 2

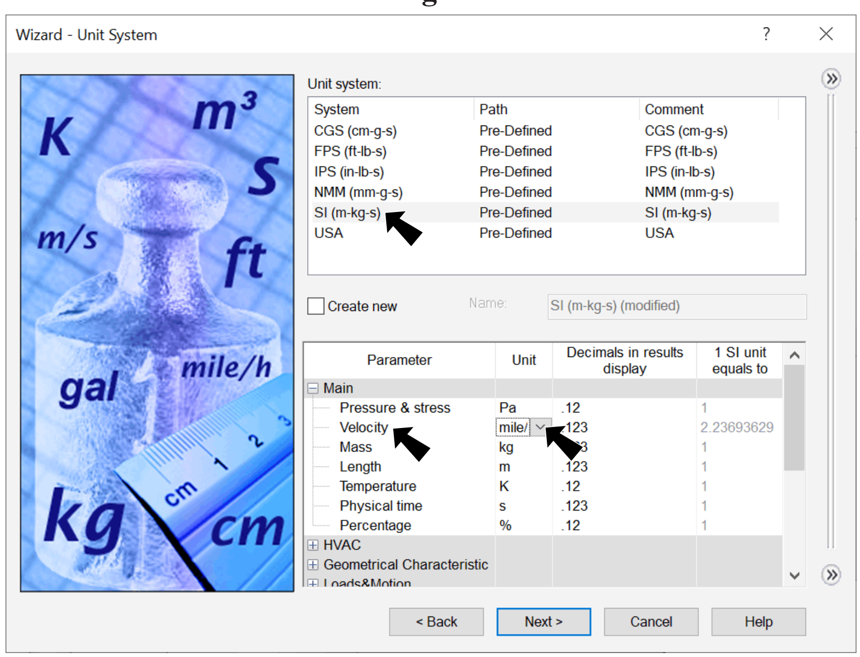


Fig. 3

Step 7. Scroll down Parameters, expand **Loads & Motion** and set **Force** units to **Gram force**, **Fig. 4**. Gram force unit is p.

Step 8. Click Next.

Step 9. **Analysis Type:** Under Analysis type, select **External**, **Fig. 5**.

Step 10. Check **Exclude cavities without flow conditions**
Check **Exclude internal space**, **Fig. 5**.

Step 11. Click Next.

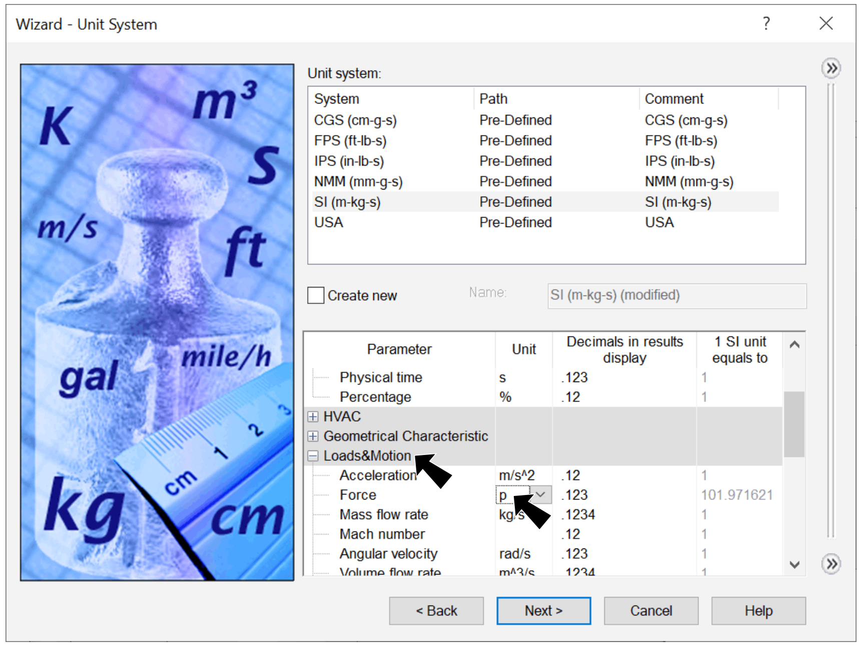


Fig. 4

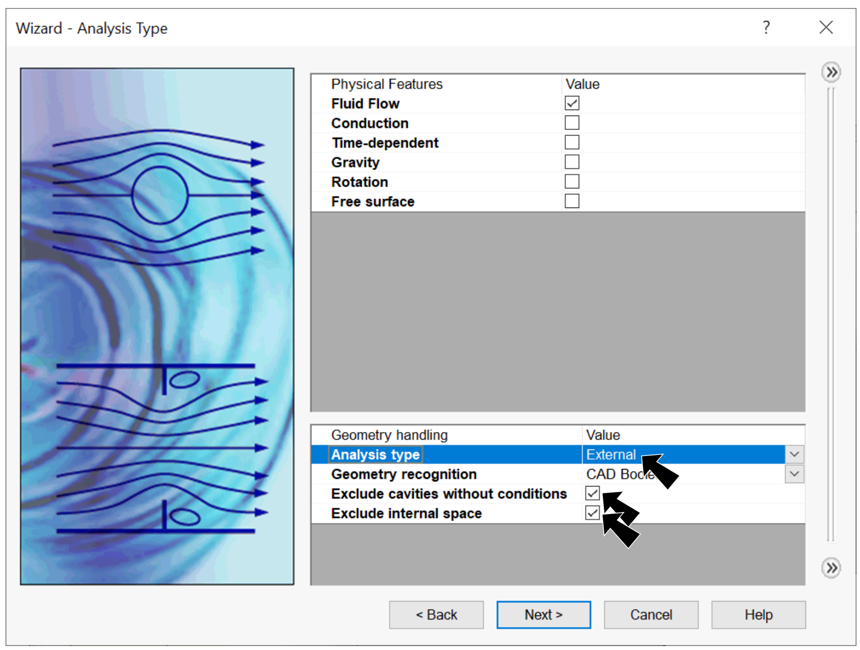


Fig. 5

Step 12. **Default Fluid:** Expand Gases, select **Air** and click **Add**, **Fig. 6**.

Step 13. Click Next.

Step 14. **Wall Conditions:** Use the default values for wall condition, **Fig. 7**.

Step 15. Click Next.

Step 16. **Initial Conditions:** Under Velocity parameters set **Velocity in Z direction** to **-75 Mile/h**, **Fig. 8**. (click and key-in **-75**).

Negative -75

Step 17. Click Finish.

Tip: Good idea to turn off decals. View Menu > Hide\Show > Decals.

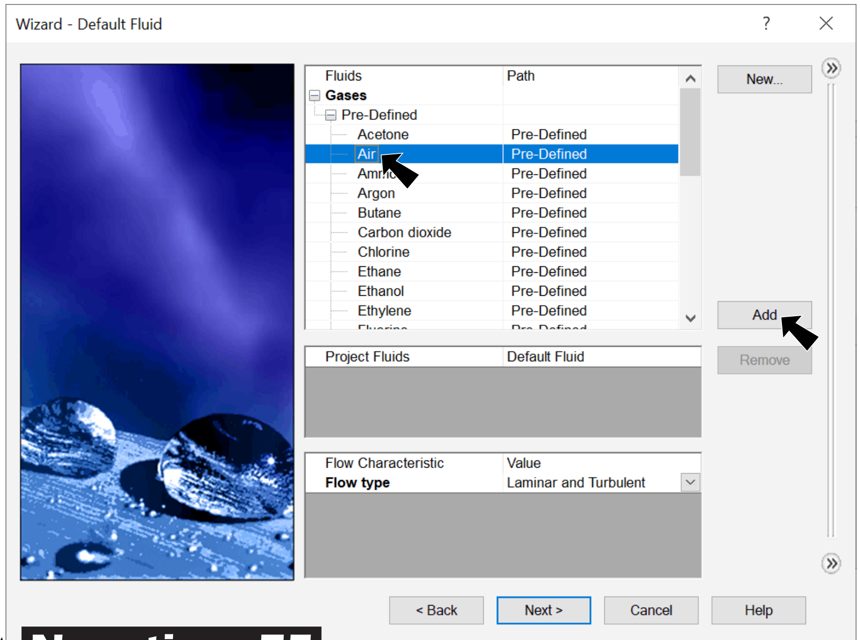


Fig. 6

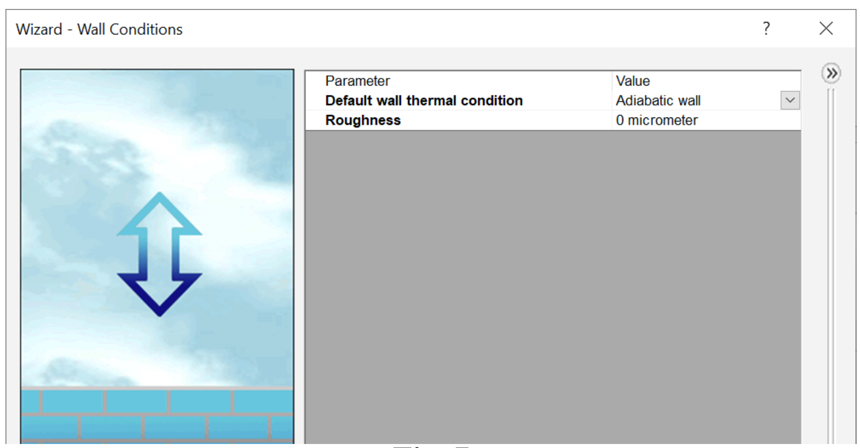


Fig. 7

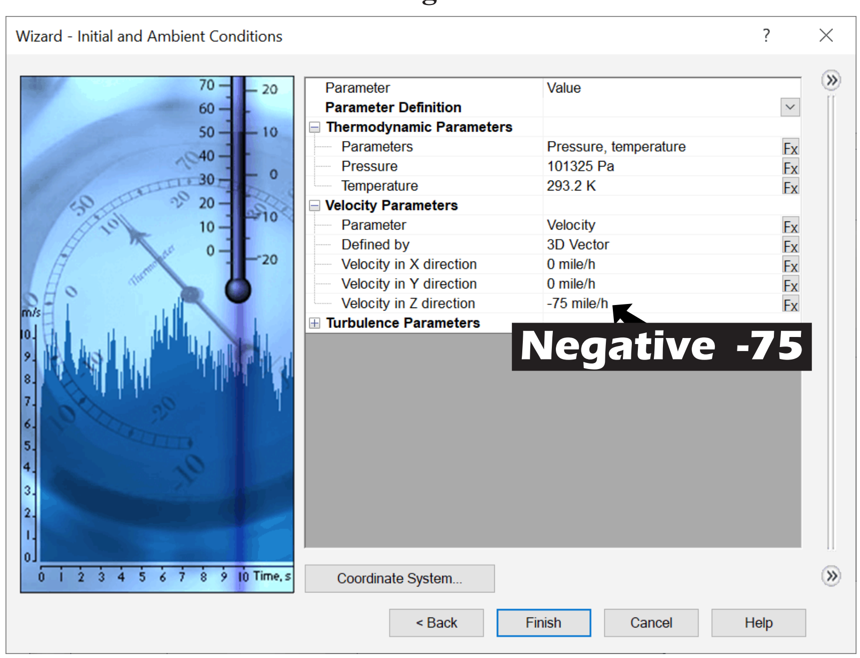


Fig. 8

C. Computational Domain.

Step 1. Click **Computational Domain** [Computational Domain] on the Flow Simulation toolbar.

Step 2. In the Computational Domain Property Manager:
set values, **Fig. 9**

X max **.15**
X min **-.15** **Negative**

Y max **.2**
Y min **-.02** **Negative**

Z max **.3**
Z min **-.4** **Negative**

click OK .

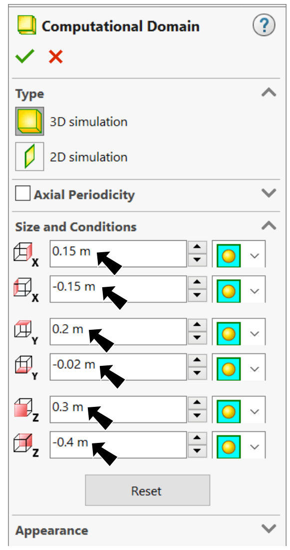


Fig. 9

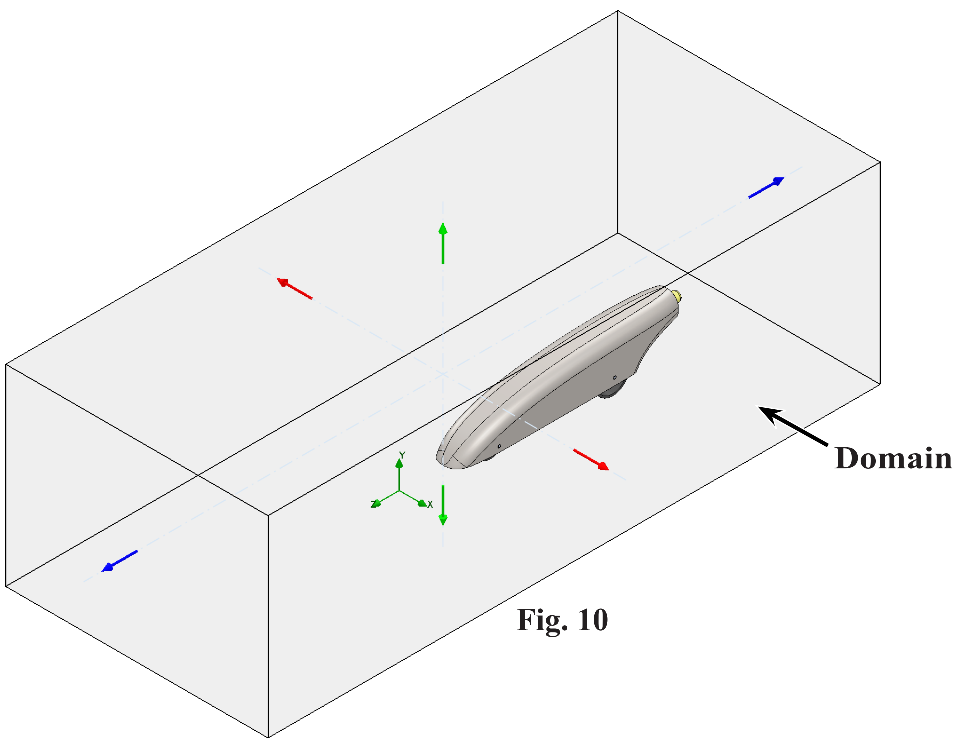


Fig. 10

D. Insert Global Goals.

Step 1. Click **Global Goals** [Global Goals] in the **Goals flyout** [Goals] on the Flow Simulation toolbar.

Step 2. Drag the edge of the Feature Manager to the right to expand, **Fig. 11**.

Step 3. In the Global Goals Property Manager:
scroll down the Parameters to **Force (Y)**, **Fig. 11** and **check:**
Force (Y)
Force (Z)
click OK ✔.

Step 4. Rename the goals to **Lift** and **Drag**. To rename, click **Force (Y)**, press **F2** key and key-in **Lift**, **Fig. 13**. Re-name **Force (Z)** to **Drag**.

Step 5. Save (**Ctrl-S**).

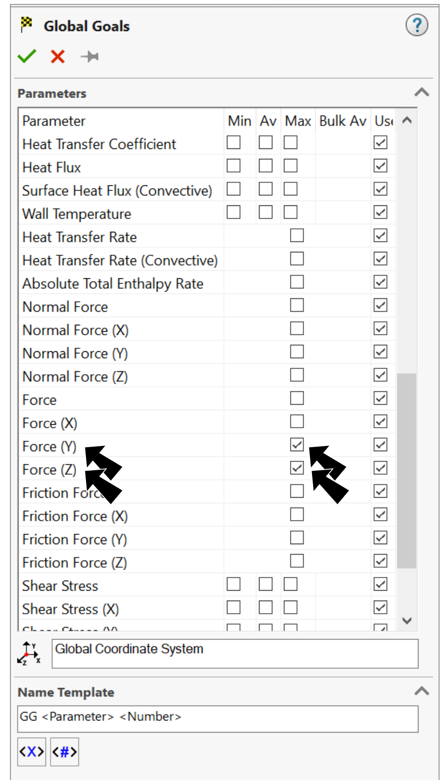


Fig. 11

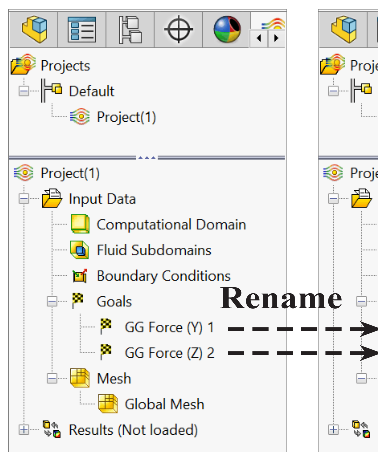


Fig. 12

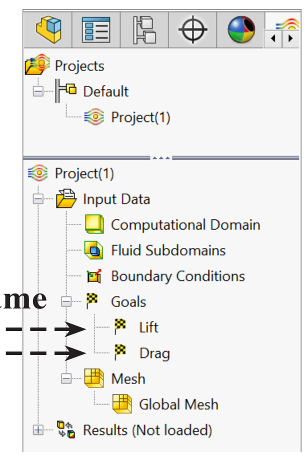


Fig. 13

E. Run Analysis.

Step 1. Click **Run** [Run] on the Flow Simulation toolbar.

Step 2. Click **Run** in the Run dialog box, **Fig. 14**.

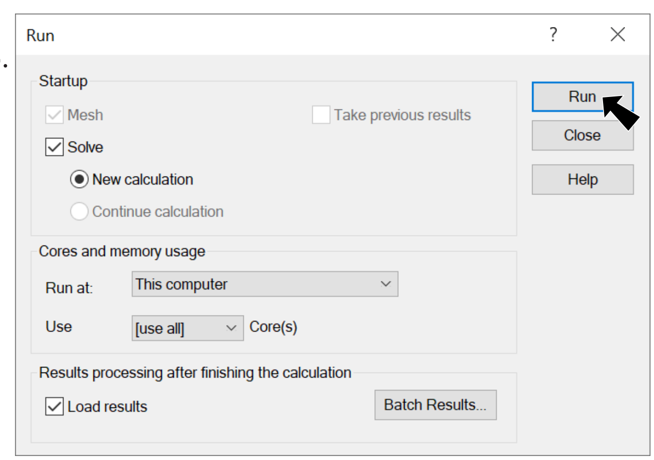


Fig. 14

F. Solver.

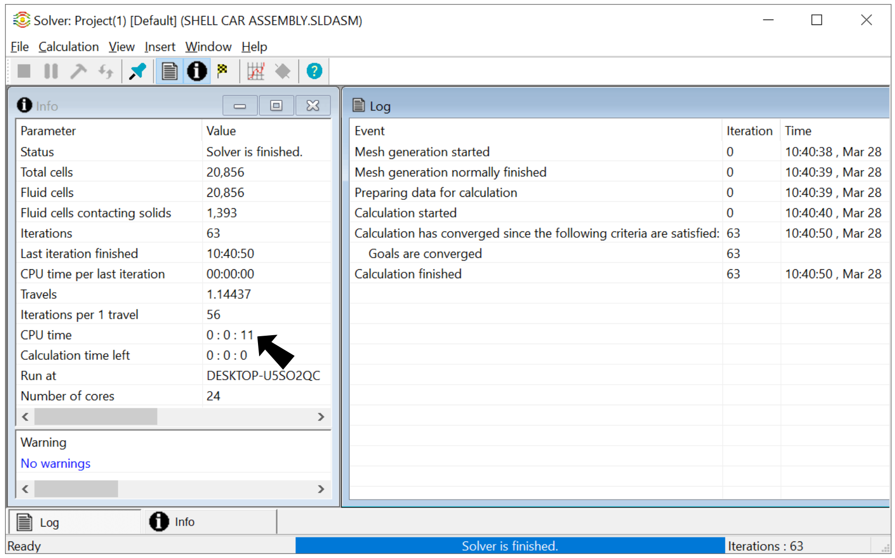


Fig. 15

Step 1. In the Solver dialog box you can view Calculation time left, **Fig. 15**. The CPU time runs depends design and computer.

Step 2. When the calculation is done view the drag in the Solver, click Insert Menu > Goal Table, **Fig. 16**. Our drag was **-32.48**.

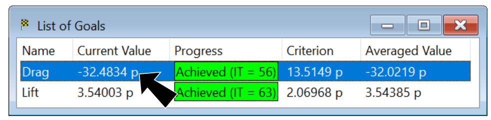


Fig. 16

Step 3. Close Solver dialog box .

G. Surface Plots.

Step 1. **Right click Computational Domain** in Flow Simulation tree and click **Hide**, **Fig. 17**.

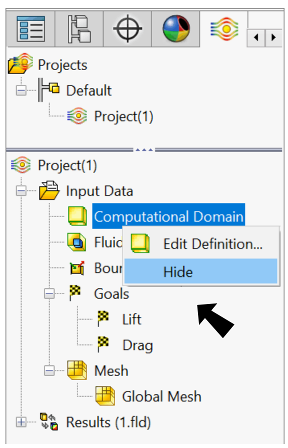
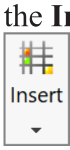
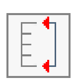


Fig. 17

Step 2. Click **Surface Plot** 

in the **Insert flyout** 

on the Flow Simulation toolbar.

Step 3. In the Surface Plot Property Manager set:
under Selection, **Fig. 18**
check **Use all faces**
under Display
select **Contours**
under Contours
click **Adjust Minimum and Maximum** 
101575 for Maximum  pressure
100930 for Minimum  pressure
click OK .

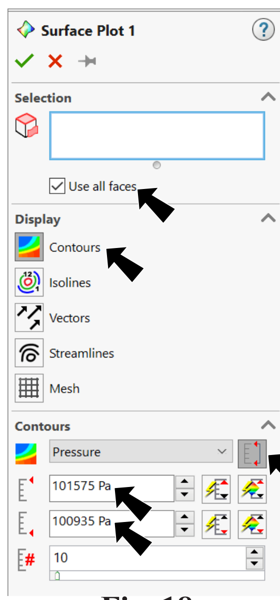


Fig. 18

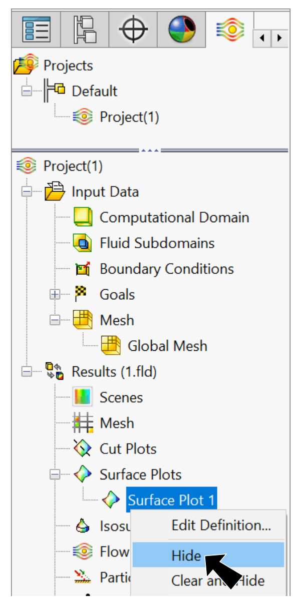


Fig. 20

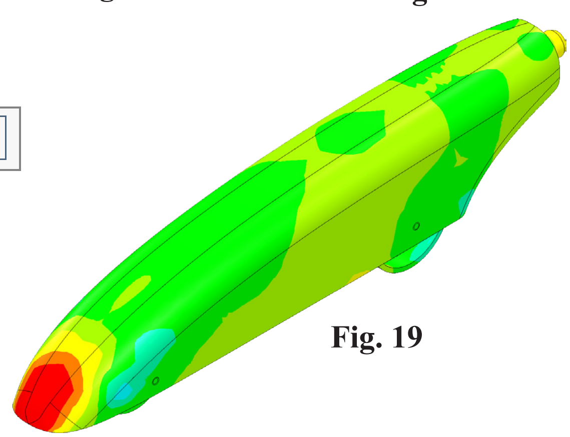


Fig. 19

Step 4. After viewing Surface Plot, expand **Results** in Flow Simulation tree and expand Surface Plots. **Right click Surface Plots 1** and click **Hide**, **Fig. 20**.

H. Flow Trajectories.

Step 1. Click **Flow Trajectories** Flow Trajectories in the **Insert flyout** Insert on the Flow Simulation toolbar.

Step 2. In the Flow Trajectories Property Manager:
under Starting Points, **Fig. 21**
in the selection box
Drag a selection to left to **select only the Body**, **Fig. 22**
Number of Points # **50**

under Appearance
Draw Trajectories As **Arrows**
Arrow Size **.002**
click OK .

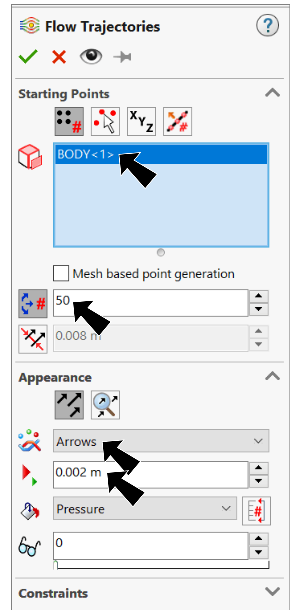


Fig. 21

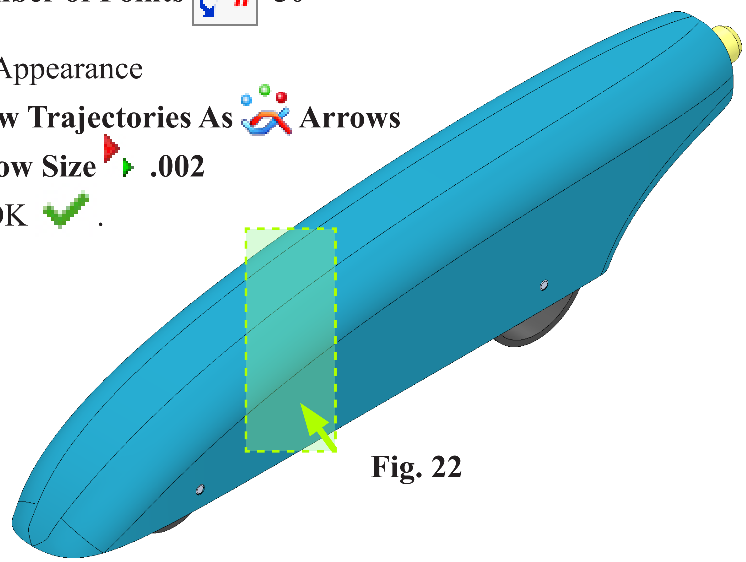


Fig. 22

Step 3. After viewing the flow trajectories, **right click Flow Trajectories 1** in Flow Simulation tree and click **Hide**, **Fig. 24**.

Step 4. Save **(Ctrl-S)**.

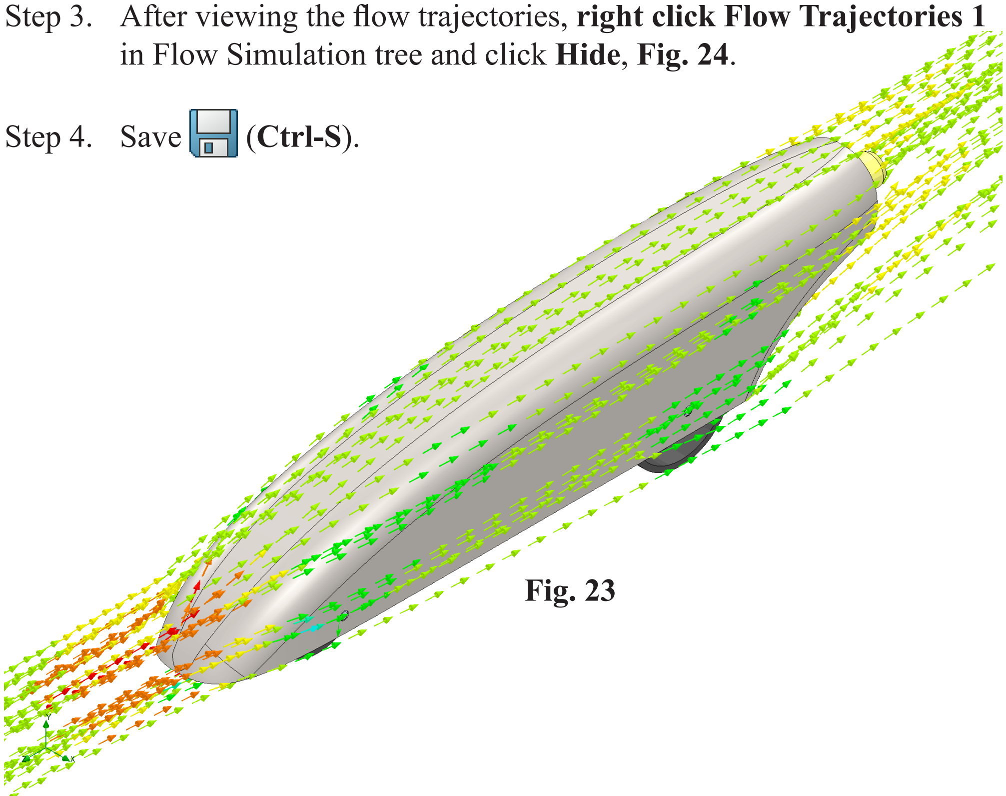


Fig. 23

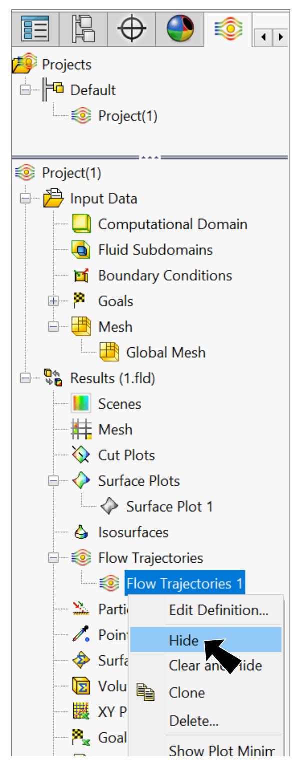


Fig. 24

I. Goal Plot.

Step 1. Click **Goal Plot** Goal Plot in the **Insert flyout** Insert on the Flow Simulation toolbar.

Step 2. In the Goal Plot Property Manager:
under Goals, **Fig. 25**
check **All**
under Options
click **Export to Excel** Export to Excel
An Excel file is opened. Note the Drag, **Fig. 26**.
Click the **Drag tab** at the bottom of the Excel file to view chart, **Fig. 26**.
Close Excel file.
Click OK .

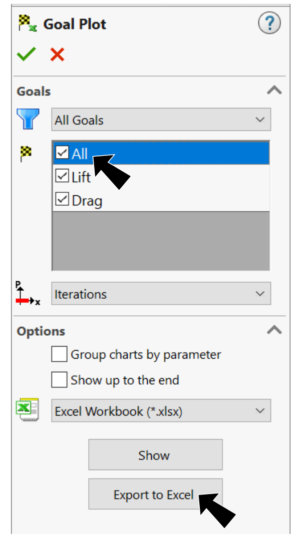


Fig. 25

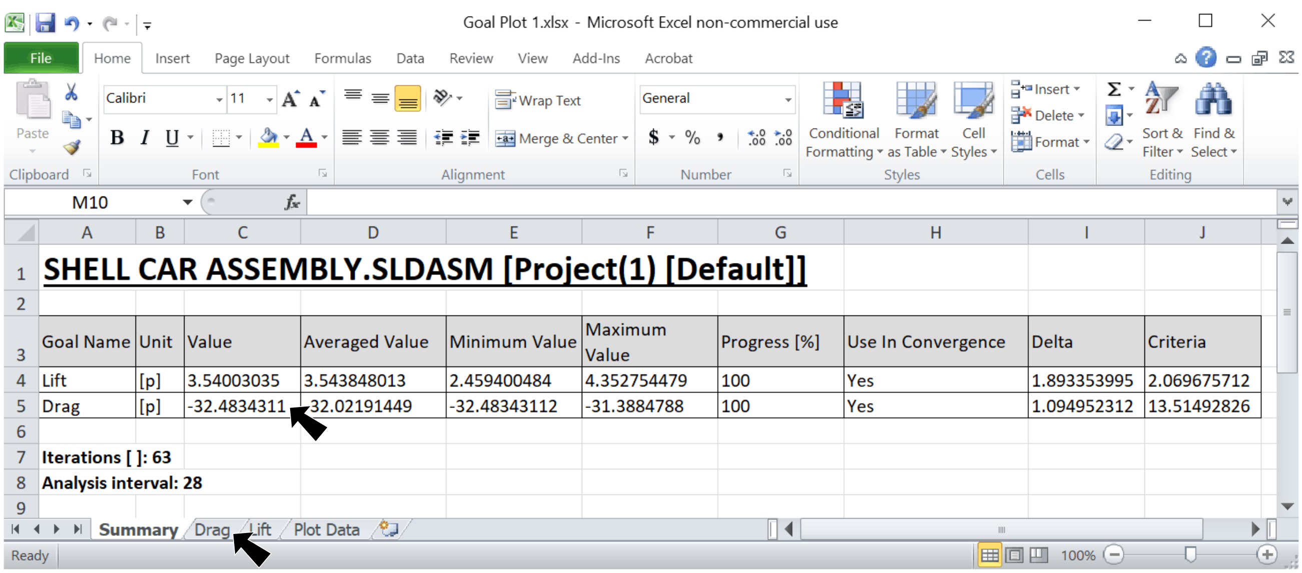


Fig. 26

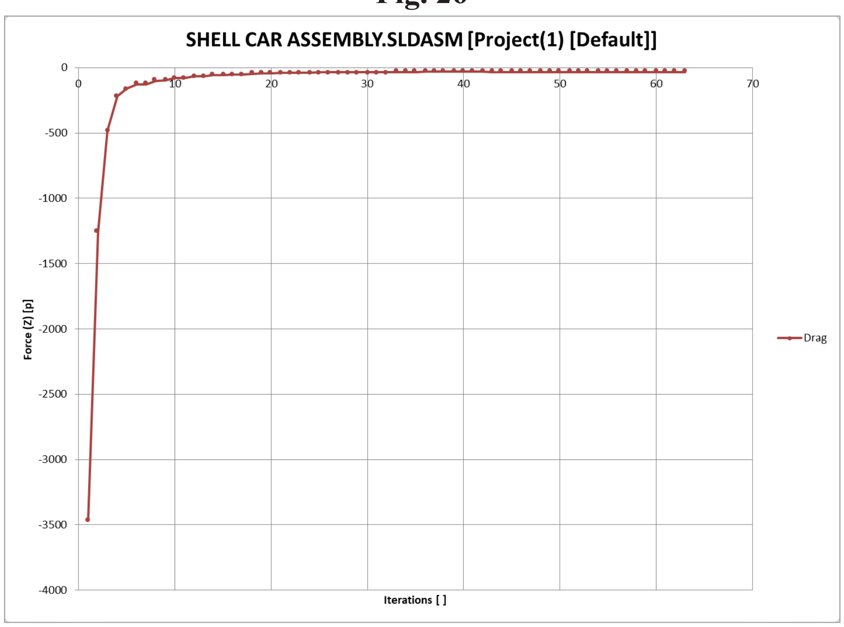


Fig. 27

J. Animate Flow Trajectories.

Step 1. Click **Right** on the Standard Views toolbar. **(Ctrl-4)**

Step 2. **Right click Flow Trajectories 1** in Flow Simulation tree and click **Animation**, **Fig. 28**.

Step 3. If necessary, **Expand** to expand the panel at the bottom right of the display in the animation control panel, **Fig. 29**.

Step 4. Click **Play** in animation control panel, **Fig. 29**.

Step 5. **Right click Flow Trajectories 1** in the Animation tree and click **Edit Definition**, **Fig. 29**.

Step 6. In the Flow Trajectories Property Manager:
under Appearance, **Fig. 30**

Draw Trajectories As **Spheres**

Width **.003**

click OK .

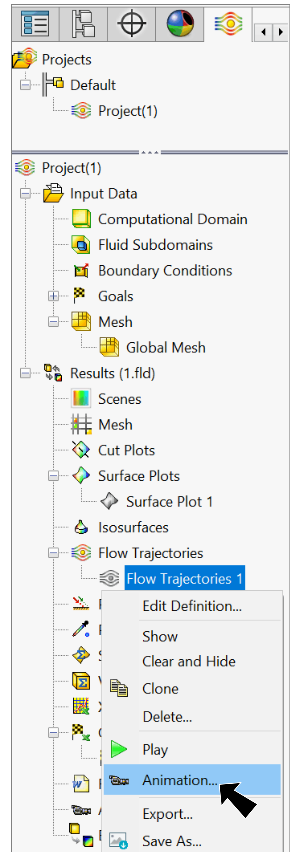


Fig. 28

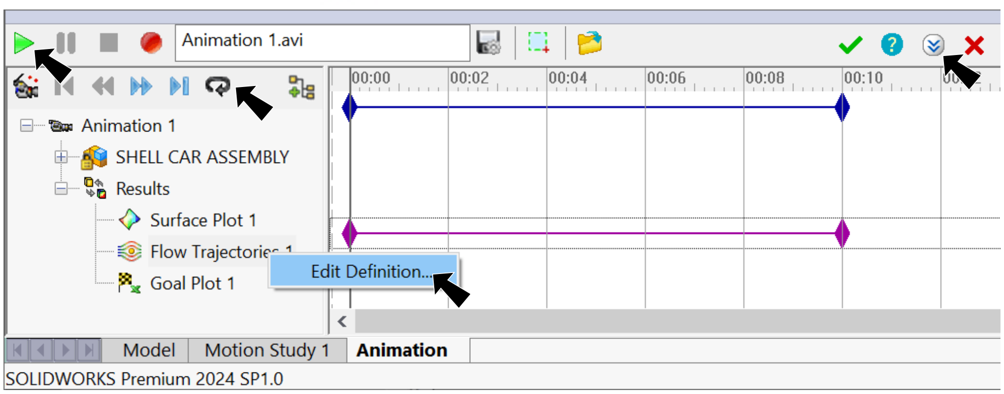


Fig. 29

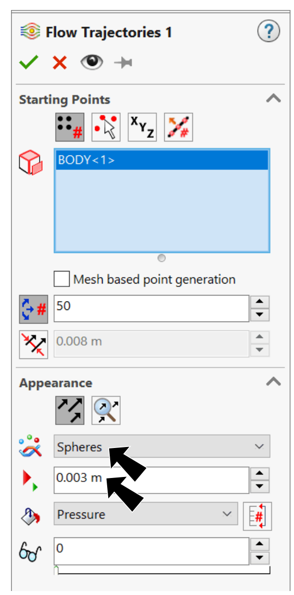


Fig. 30

Step 7. Click **Loop** and **Play** in animation control panel, **Fig. 29**.
Click Stop .

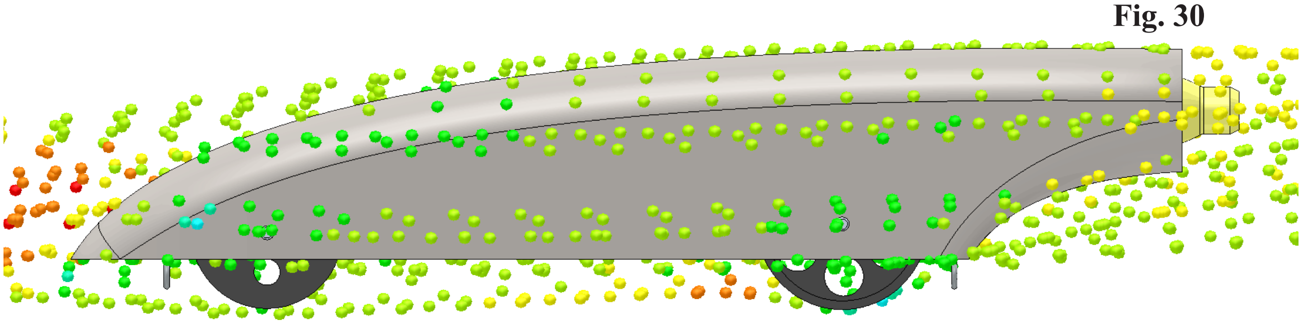


Fig. 31

K. Create Animation Movie.

Step 1. Click **Isometric** on the Standard Views toolbar. (**Ctrl-7**)

Step 2. In the Animation control panel turn on **Capture Region**, **Fig. 32**.

Step 3. Drag the red frame capture region in graphics area to resize/move capture region, **Fig. 33**.

Step 4. Click **Record**, **Fig. 32**.

Step 5. Click **Open Folder** to view Animation AVI file.

Step 6. To exit, click **OK** in Animation control panel.

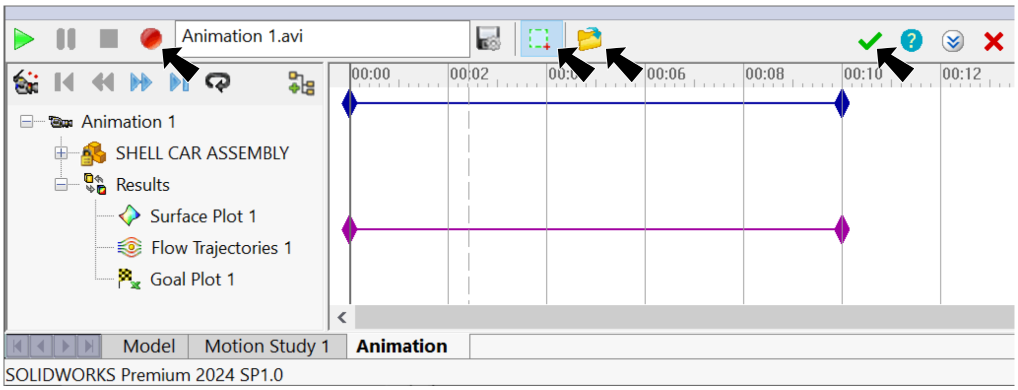


Fig. 32

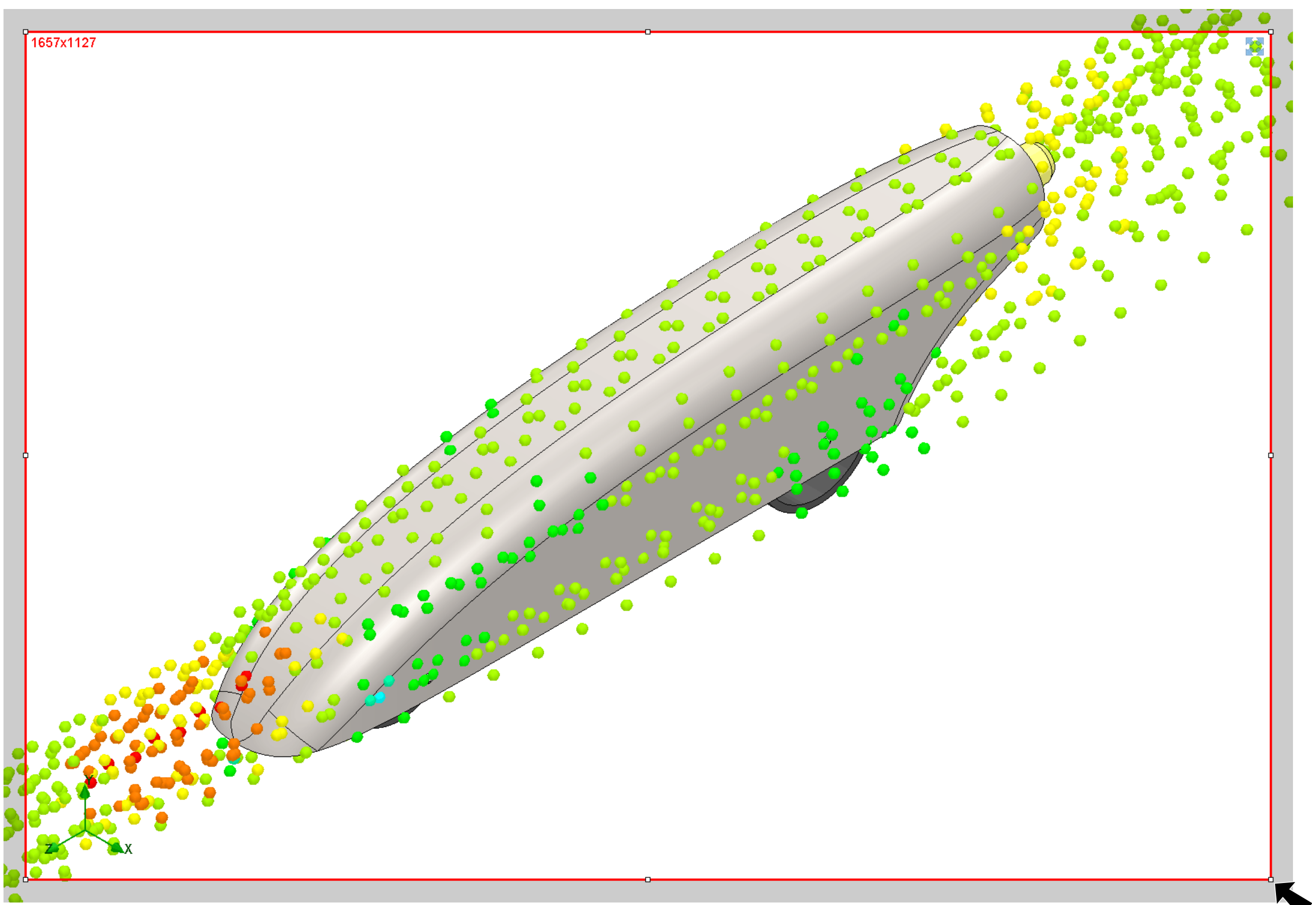


Fig. 33