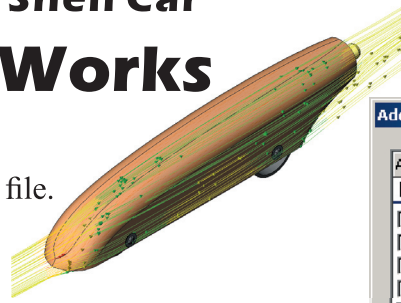


CO2 Shell Car FloWorks



A. Set Up.

Step 1. If necessary, open your ASSEMBLY file.

Step 2. Click Tools Menu > Add-Ins.

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

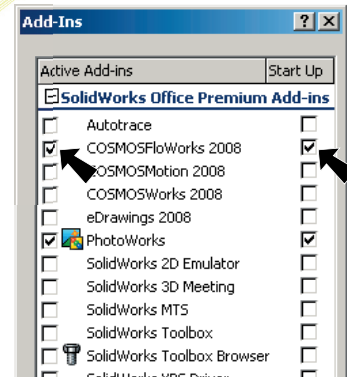


Fig. 1

B. Create FloWorks Project.

Step 1. Click **COSMOS-**
FloWorks
COSMOSFloWorks on
the Command Manager
toolbar.

Step 2. Click **Wizard**
Wizard on the COS-
MOSFloWorks toolbar.

Step 3. Use **Default** for Con-
figuration name, **Fig. 2**.

Step 4. Click Next.

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

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

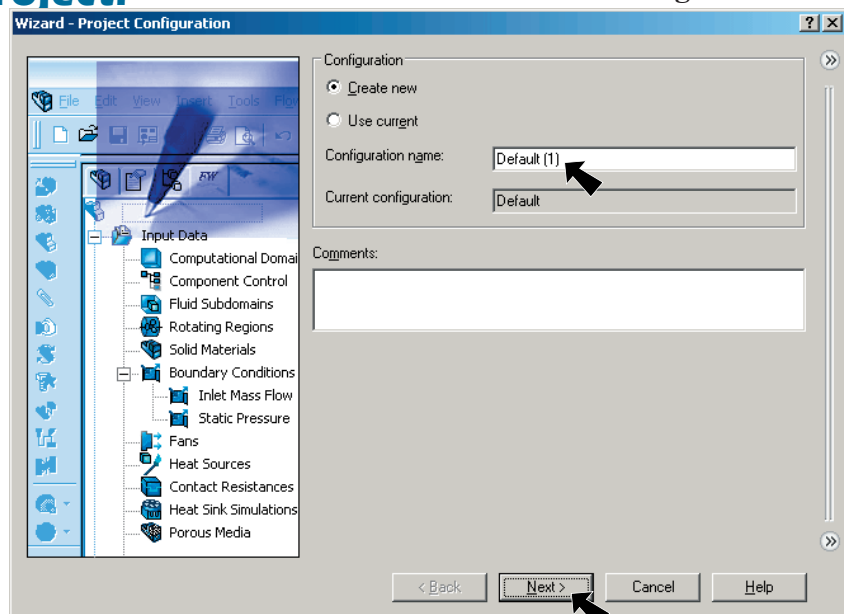


Fig. 2

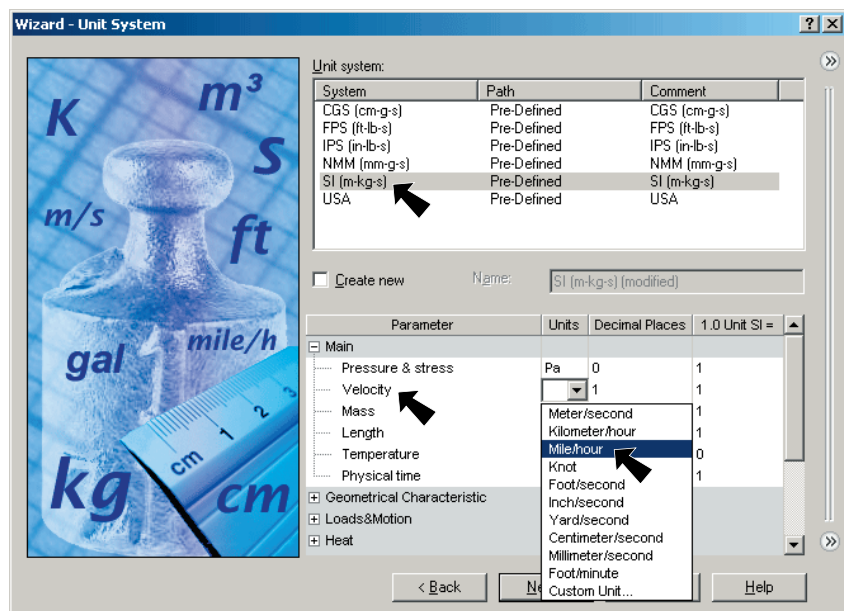


Fig. 3

Step 7. 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** and **Exclude internal space**, Fig. 5.

Step 11. Set **Reference axis** to **Z**, Fig. 5.

Step 12. Click Next.

Step 13. **Default Fluid:**
Expand **Gases**, select **Air** and click **Add**, Fig. 6.

Step 14. Click Next.

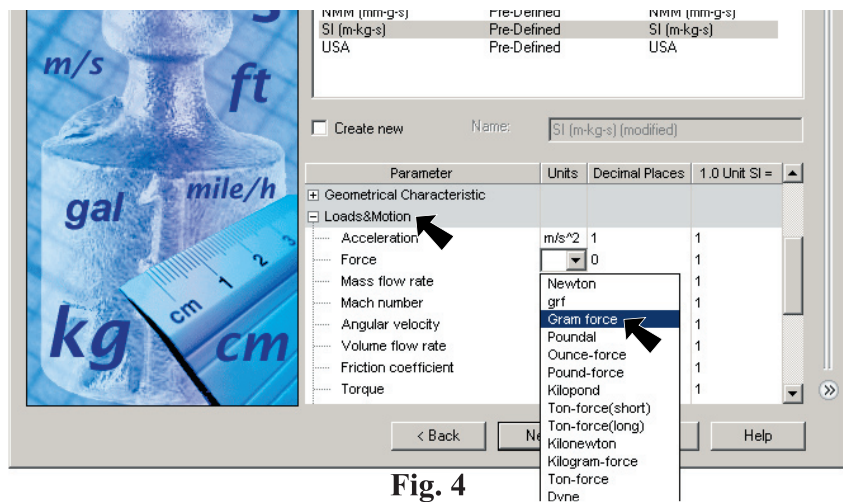


Fig. 4

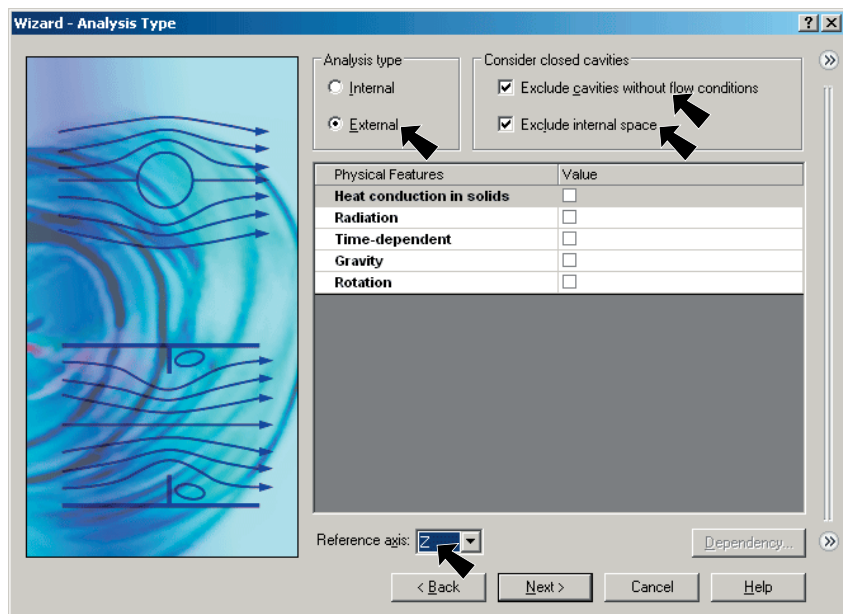


Fig. 5

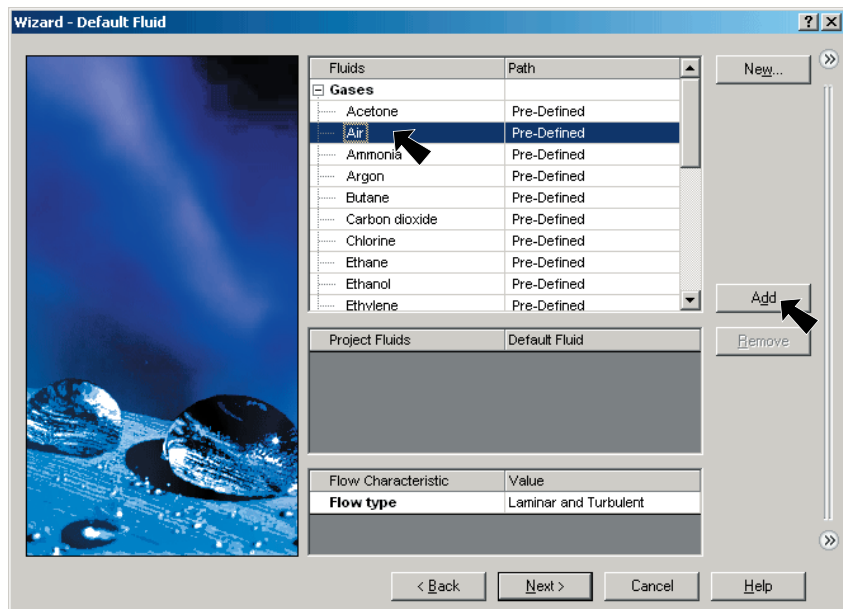


Fig. 6

Step 15. **Wall Conditions:**
Use the default values for wall condition,
Fig. 7.

Step 16. Click Next.

Step 17. **Initial Conditions:**
Under Velocity parameters set **Velocity in Z direction to -55 Mile/h, Fig. 8.** (click and key-in -55).

Step 18. Click Next.

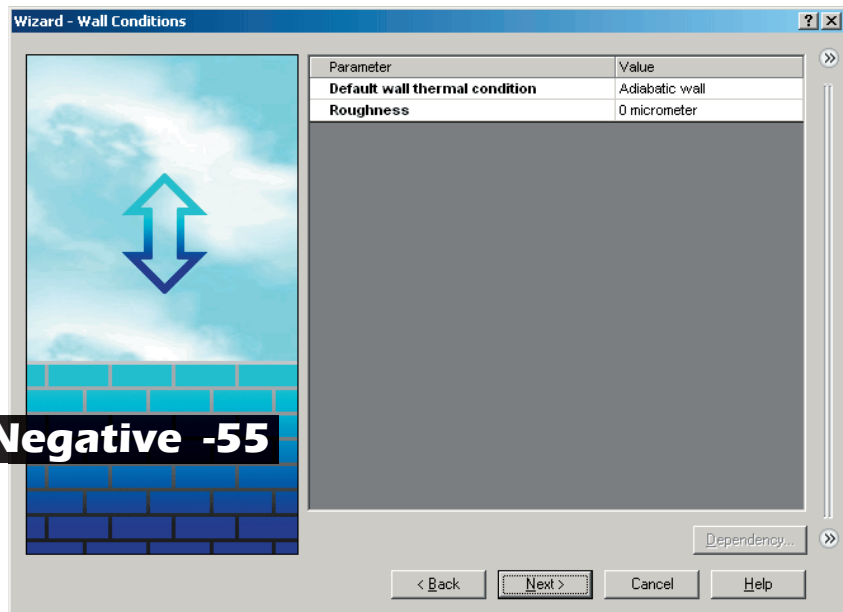


Fig. 7

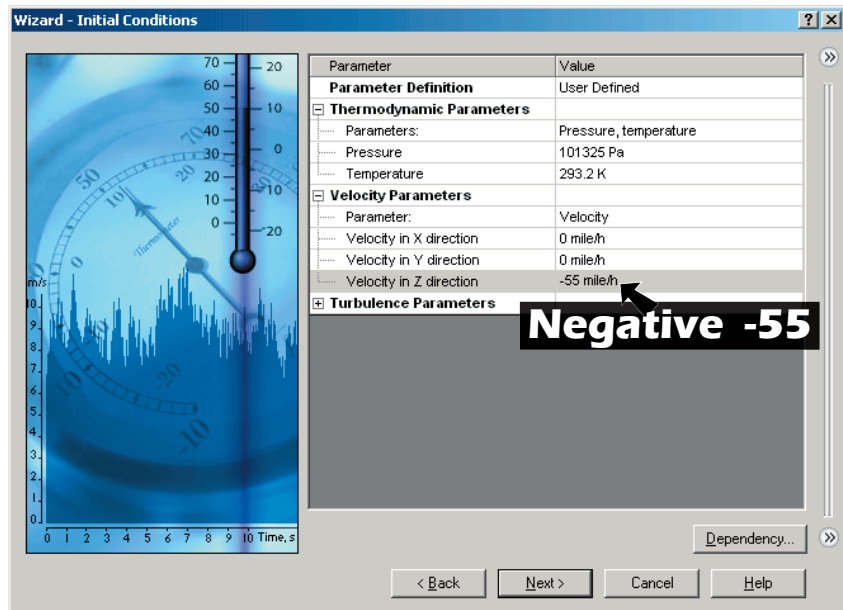


Fig. 8

Step 19. **Results and Geometry Resolution:**
Set Result resolution to 4, Fig. 9.

Step 20. Click Finish.

C. Computational Domain.

Step 1. Click FloWorks Menu > Computational Domain.

Step 2. Set values as shown here and Fig. 10.

X min 0
X max .15
Y min -.02
Y max .2
Z min -.4
Z max .3

Step 3. Click **Boundary Condition** tab at the top of the dialog box, Fig. 10.

Step 4. Set At X min to Symmetry, Fig. 12.

Step 5. Click OK.

Step 6. Click **Front**  on the Views toolbar. (Ctrl-1). Use Z key to zoom out to see domain, Fig. 13.

Step 7. **Only half the car** should be inside the domain as shown in Fig. 13. This will reduce the solver time which can take several minutes.

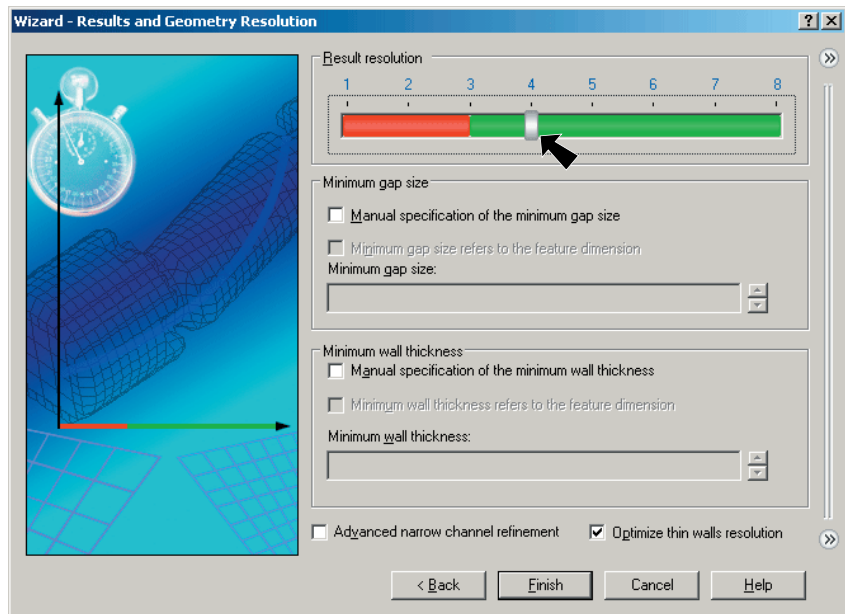


Fig. 9

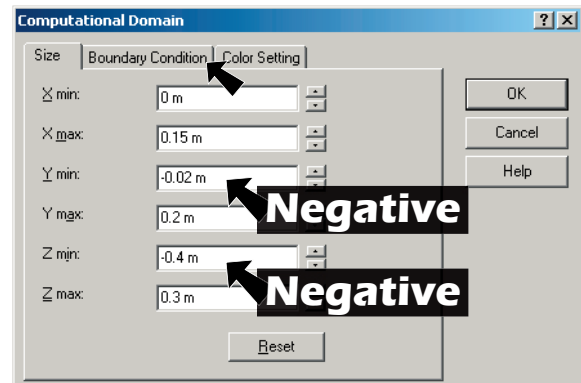


Fig. 10

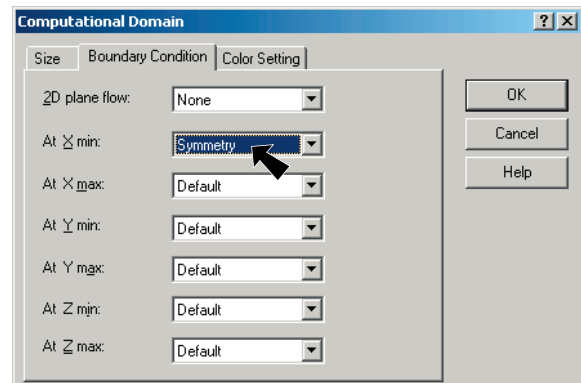


Fig. 11

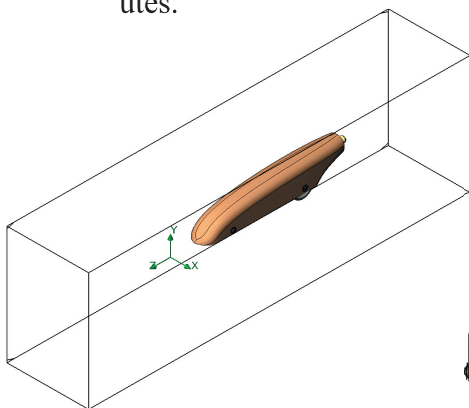


Fig. 12

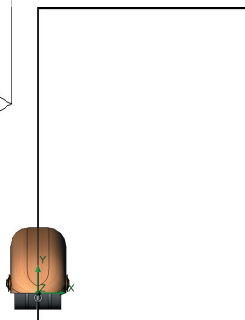


Fig. 13

D. Insert Global Goals.

- Step 1. Click **Isometric**  on the Standard Views toolbar. (**Ctrl-7**)
- Step 2. Click the COSMOSFloWorks tab  in the Feature Manager, **Fig. 14**.
- Step 3. Click **COSMOSFloWorks Features**  on the COSMOSFloWorks toolbar and click **Global Goals** from the menu.
- Step 4. Drag the edge of the Feature Manager to the right to expand, **Fig. 14**.
- Step 5. Scroll down the Parameters to **Force** and check:
Y- Component of Force
Z- Component of Force **Fig. 15**.
- Step 6. Click OK .
- Step 7. Rename the goals to **Lift and Drag**. To rename, click and hold over **Y- Component of Force** and key-in **Lift**, **Fig. 15**. Rename **Z- Component of Force** to **Drag**.

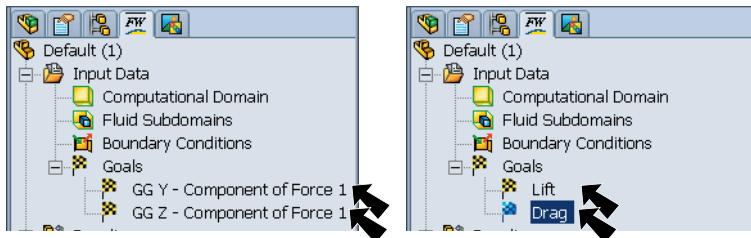


Fig. 15

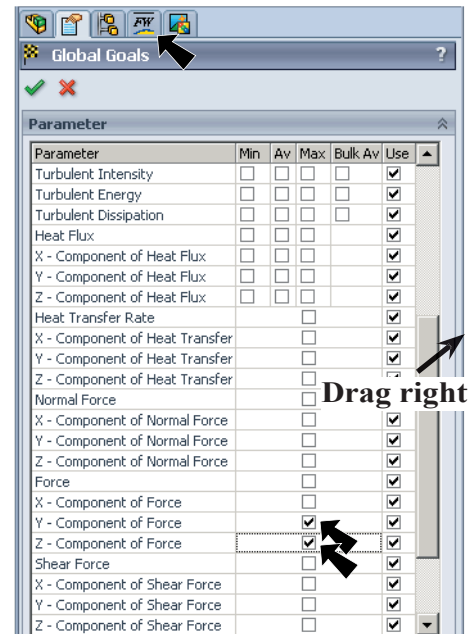


Fig. 14

- Step 8. Save. Use **Ctrl-S**.

E. Run Analysis.

- Step 1. Click **Run**  on the COSMOSFloWorks toolbar.
- Step 2. Click **Run** in the Run dialog box, **Fig. 16**.

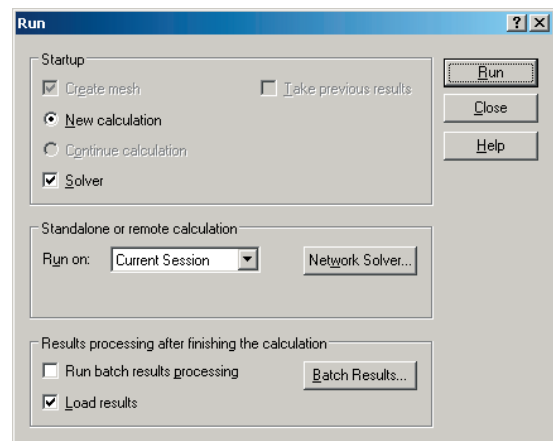


Fig. 16

F. Solver.

Step 1. In the Solver dialog box you can view Calculation time left, **Fig. 17**. The CPU time runs around 6-8 minutes depending on the car design and the computer.

Step 2. When the calculation is done check the drag. To check drag in the Solver, click Insert Menu > Goal Table, **Fig. 18**. Our drag was **-6.17**

Step 3. Close the Solver dialog box, click File > Close.

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

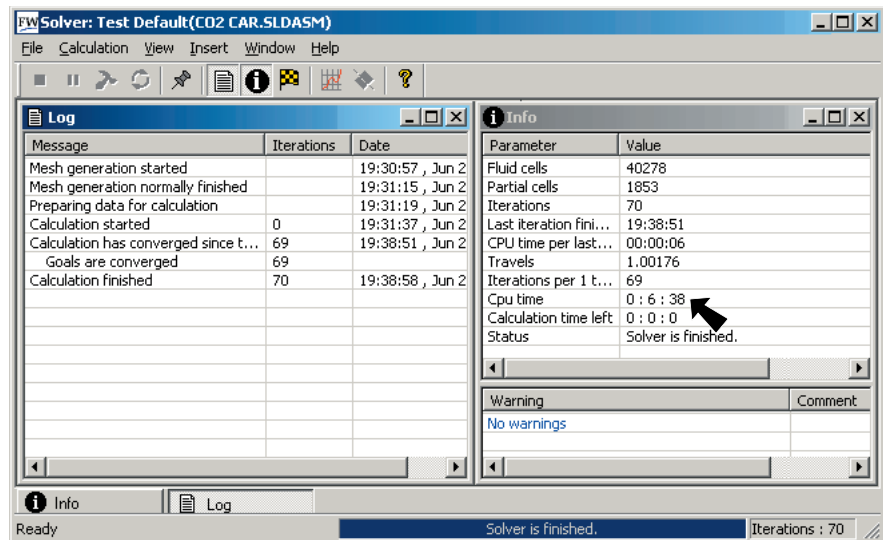


Fig. 17

Goal Name	Current Va...	Averaged ...	Minimum V...	Maximum ...	Progress	Delta	
Drag	-5.98817 p	-6.15675 p	-6.55661 p	-5.98817 p	Achieved	0.568432 p	1.0
Lift	3.47248 p	3.52126 p	3.46119 p	3.74181 p	Achieved	0.280616 p	0.2

Fig. 18

G. Set Pressure.

Step 1. Right click **Computational Domain** in FloWorks tree and click **Hide**, **Fig. 19**.

Step 2. Click **View Settings**  on the COSMOSFloWorks toolbar.

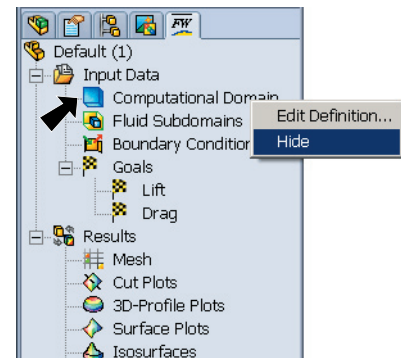


Fig. 19

Step 3. In the View Setting dialog under Parameter: Pressure, key-in:

100930 for Min. pressure

101575 for Max. pressure,

Fig. 20.

click **Apply** and **OK**.

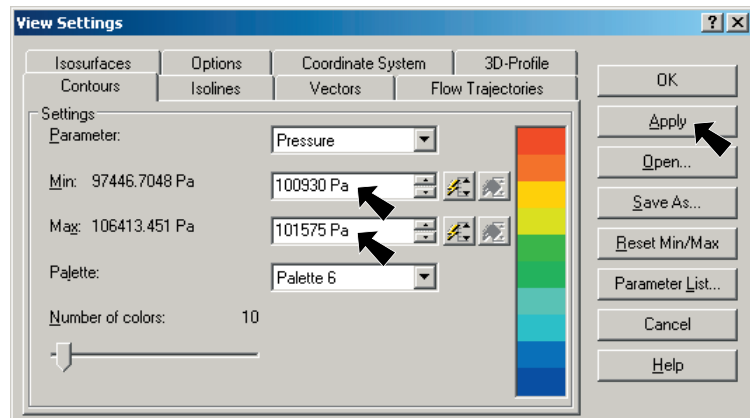


Fig. 20

H. Surface Plots.

- Step 1. Click **Surface Plot**  on the COSMOSFloWorks toolbar.
- Step 2. In the Property Manager, set:
check **Use all faces**, **Fig. 21**
Contours (button depressed)
click OK  and **Fig. 22**
- Step 3. After viewing the surface plot, **right click Surface Plots 1** in FloWorks tree and click **Hide**, **Fig. 23**.

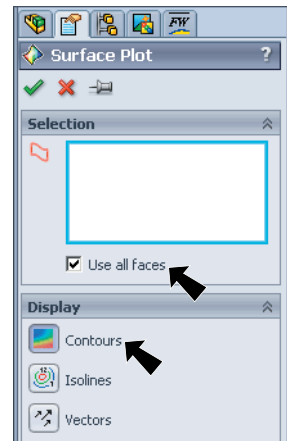


Fig. 21

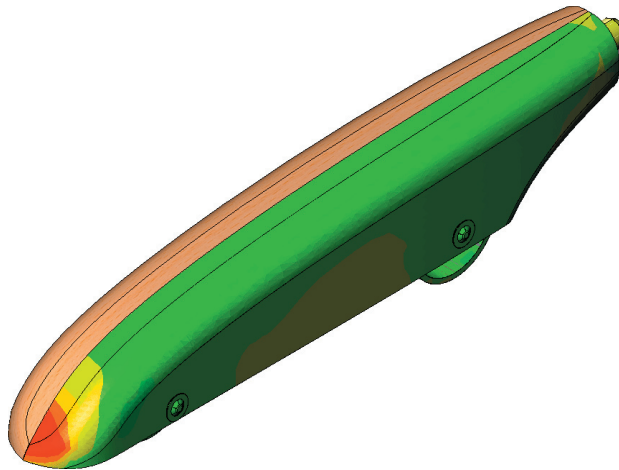


Fig. 22

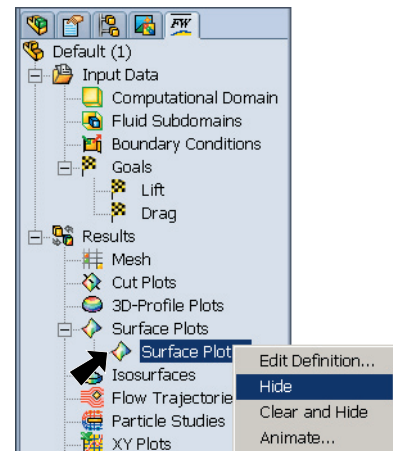


Fig. 23

I. Flow Trajectories.

Step 1. Click **Flow Trajectories**  on the COSMOSFloWorks toolbar.

Step 2. In the Flow Trajectories dialog box set:

under **Reference**:, **Fig. 24**

Ctrl click all the faces of the car body on the left side, **Fig 25**. Use the left arrow on the keyboard to rotate view as shown in **Fig. 26** to select the under side of cartridge.

set **Number of trajectories** to **50**, **Fig. 24**

click **Setting** tab at top

set **Draw trajectories** to **Line with Arrow**
click **OK**, **Fig. 32**.

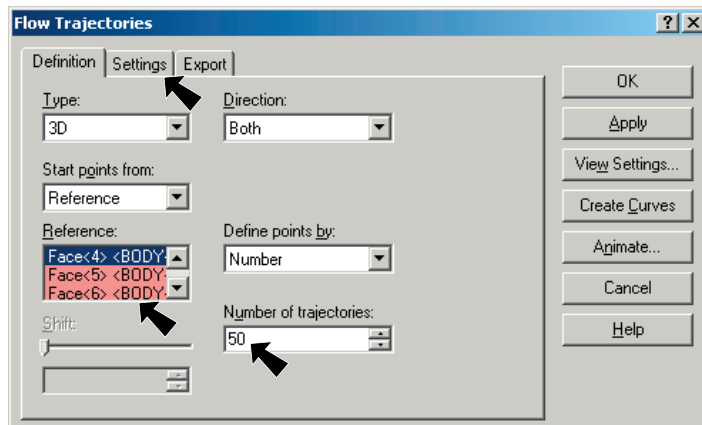


Fig. 24

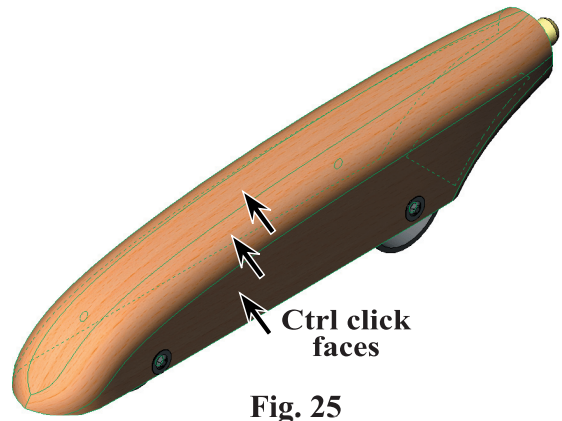


Fig. 25

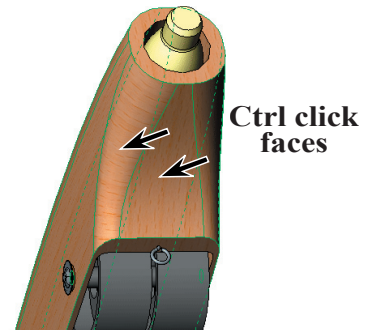


Fig. 26

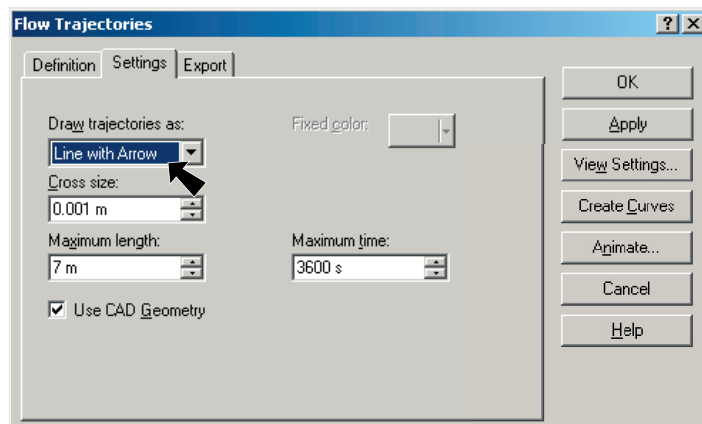


Fig. 27

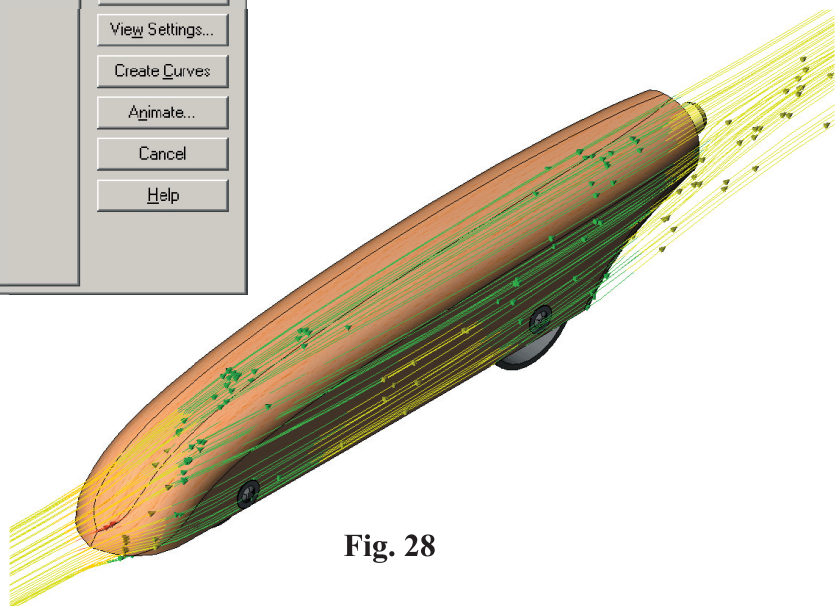


Fig. 28

Step 3. After viewing the flow trajectories, **right click Flow Trajectories 1** in FloWorks tree and click **Hide**, Fig. 29.

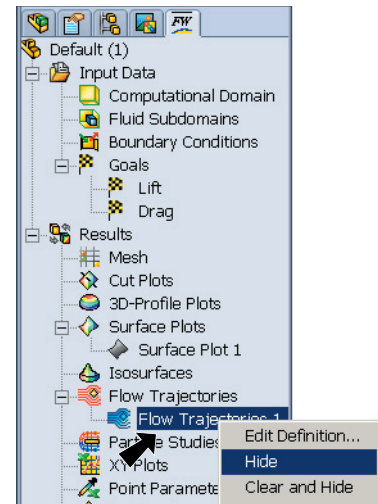


Fig. 29

J. Goals Plot.

Step 1. Click **Goals**  on the COSMOSFloWorks toolbar.

Step 2. Click **Add All** and OK, Fig. 30.

Step 3. An Excel file is opened. Check out the Drag, Fig. 31.

Step 4. Close the Excel file.

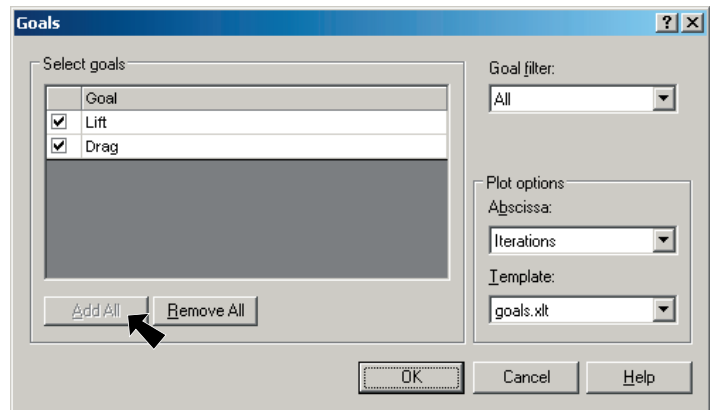


Fig. 30

Microsoft Excel - goals1

Goal Name				
CO2 CAR.SLDASM [Default (1)]				
	Goal Name	Unit	Value	Averaged Value
4	Lift	[p]	3.472479058	3.52126
5	Drag	[p]	-5.988174985	-6.15675
9	Iterations: 70			
10	Analysis interval: 35			

Fig. 31

K. Animate Flow Trajectories.

Step 1. **Right click Flow Trajectories 1** in FloWorks tree and click **Animate**, Fig. 32.

Step 2. At the bottom of the display in the animation control panel, click **More**  to expand the panel, Fig. 33.

Step 3. Click **Play**  in animation control panel, Fig. 33.

Step 4. **Right click Flow Trajectories 1** in the Animation tree and click **Edit Definition**, Fig. 33.

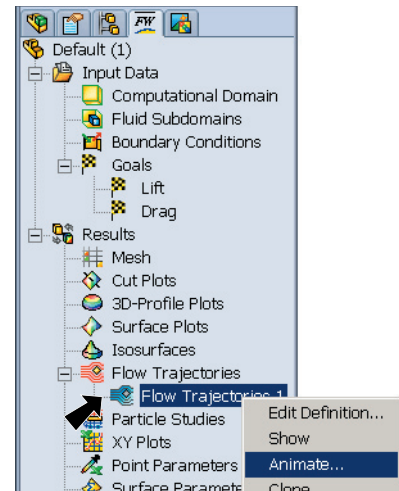


Fig. 32

Step 5. In the Flow Trajectories dialog box set:

click **Setting** tab at top, Fig. 34

set **Draw trajectories to Spheres**
set **Cross size** to **.003**

click OK

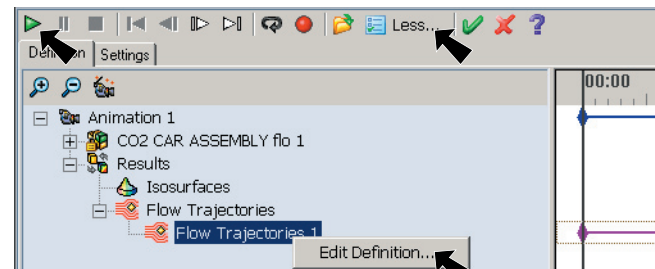


Fig. 33

Step 6. Click **Loop**  and **Play**  in animation control panel, Fig. 33.

Click **Stop** .

Step 7. Click **Dimetric**  on the Views toolbar and **Play** .

Step 8. Experiment with other Flow Trajectories setting. To change setting, **right click Flow Trajectories 1** and click **Edit Definition**, Fig. 33.

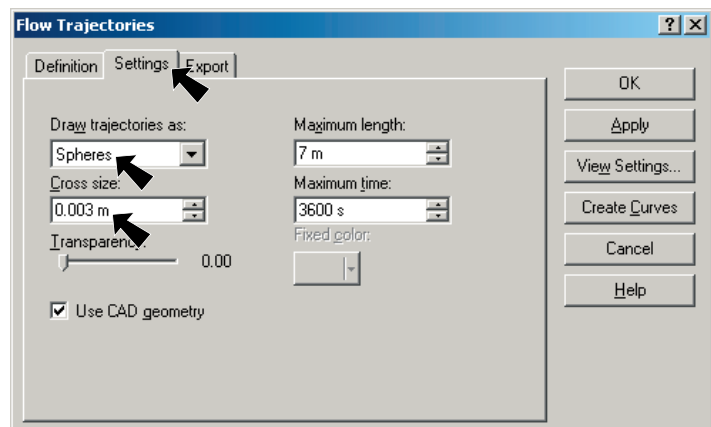


Fig. 34

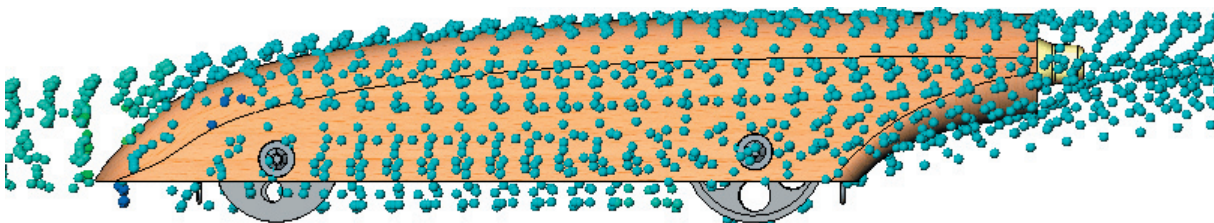


Fig. 35

L. Create Animation Movie.

Step 1. To save animation as a movie file (AVI), click the **Setting** tab in animation control panel, **Fig. 36**.

Step 2. In Setting you can set file name. Also, the frames per second can be controlled. The more frames the larger the file size.

Step 3. Click the **Definition** tab in animation control panel to switch back, **Fig. 37**.

Step 4. Click **Record** . View the movie file in MyDoc\1 folder.

Step 5. To exit, click **OK**  in animation control panel, **Fig. 37**.

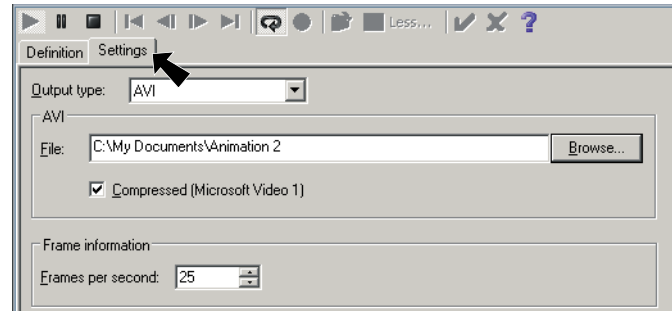


Fig. 36

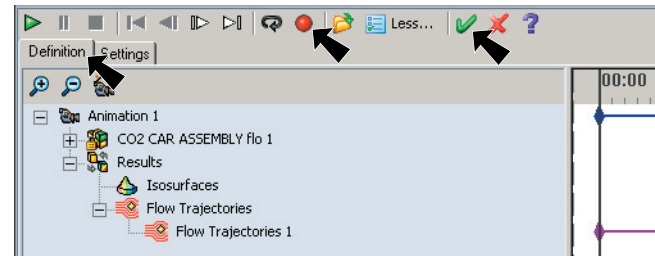


Fig. 37

