

### CarSim Problems Aerodynamics

A car drives along at the conditions shown below:

Front axle weight = 1051 kg	Aero drag coefficient = 0.3431
Rear axle weight = 654 kg	Lift coefficient = 0.166
Wheelbase = 2.69 m	Pitch moment coefficient = 0.10545
Frontal area = 1.8 m <sup>2</sup>	Air density = 1.206 kg/m <sup>3</sup>

- a) What is the aerodynamic drag at a speed of 120 km/h?
- b) What is the drag under the conditions above with a 40 km/h headwind? A 40 km/h tailwind?
- c) What are the front and rear axle loads (in Newtons) when the vehicle is traveling into the 40 km/h headwind?
- d) Determine the three aerodynamic forces (drag, side force and lift) when the vehicle experiences a 40 km/h crosswind (90 degree wind direction). *For this part of the problem, determine the relative wind angle and then go to the aerodynamic tables in CarSim to determine the value of the various coefficients needed to solve this problem.*
- e) Duplicate these conditions in CarSim and show your results by filling in the table below. (Also show a print screen of the plots)

	Calculated	Simulated	Error
a) Drag at 120 km/h	_____	_____	_____
b) Drag in headwind	_____	_____	_____
Drag in tailwind	_____	_____	_____
c) Front axle load (in headwind)	_____	_____	_____
Rear axle load (in headwind)	_____	_____	_____
d) Drag	_____	_____	_____
Side force	_____	_____	_____
Lift	_____	_____	_____

**CarSim Exercise #4****CarSim #4 – Finding aerodynamic forces**

1) The data given in the problem matches that for the Big Car in CarSim. Go to the *Aero Effects* category of runs and select *W/Steer: Crosswind*. This is close to the condition you want to duplicate, select *NEW* and put your name in the Category box. Now just turn off the crosswind and set the speed to 120 km/h and you are in business. Under the plots, delete *Steer SW – Steering wheel* and replace it with *Fz – vertical forces (Car) (All)*.

2) Simulate the problem in Parts a thru c. Note that you can duplicate a tailwind by selecting the 40 km/h crosswind and setting the wind angle to zero. A headwind is obtained by making up a table for a wind heading of 180 degrees.

3) To solve Part d, set the crosswind angle to 90 degrees.

3) Evaluate the plots to obtain the data needed to fill out the table and print the plot screens for submission with the homework.