

Ansys-CFX Analysis On A Sedan Car With Wheels And Without Wheels

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Abstract: The Computational Analysis has been performed on the Sedan Car with wheels and without wheels at a speed of 60 kmph. Catia, 3D Modeling Software was used to model the sedan car. Ansys-CFX was used to perform the Computation. The Aerodynamic Analysis was performed to study the flow behavior of the air over the sedan car. The Analysis includes the study of Contours, Vector Plots, Streamline Flows, Momentum and Mass Graphs, Turbulence Graphs and an evaluation of Drag Coefficient.

Keywords: Computational Analysis, Ansys-CFX, Catia Modeling, Contours, Vector Plots, Drag Coefficient.

Introduction: A variety of studies of the aerodynamic influence of vehicle Front End and Rear End shapes have been researched including the study of critical geometry found by plenty of researchers and well known issue is the rear end shape of car impacts the drag coefficient. Aerodynamically superior cars gives the benefit of drag reduction which leads increase in top speed of vehicle, increasing fuel efficiency, perfect handling performance, aesthetically attractive.

The main aim of this paper is to investigate aerodynamic of Sedan Car with wheels and without wheels.

Catia Modeling: The part modeling of sedan car with wheels and without wheels is given below:

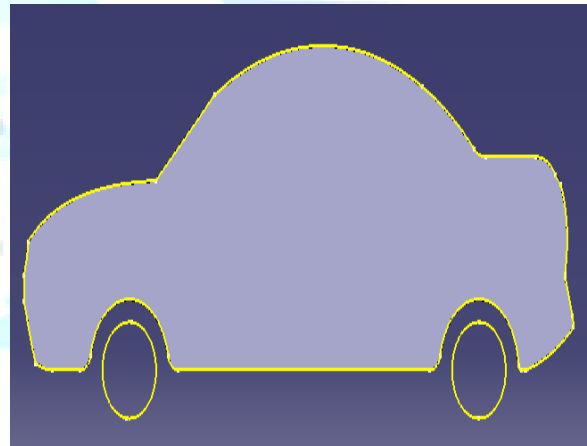


Fig-1: Sedan Car with wheels.

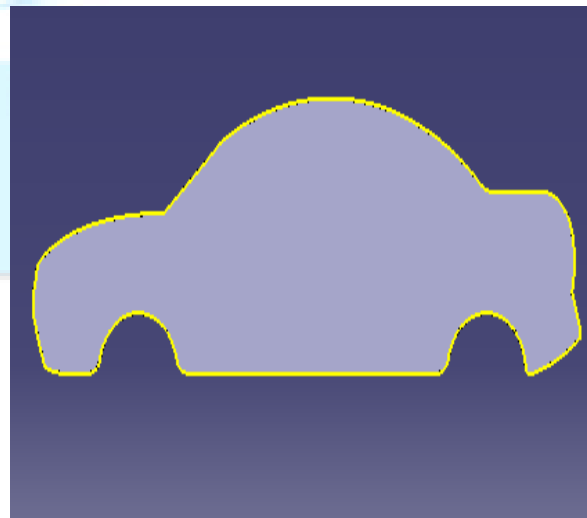


Fig-2: Sedan Car without wheels.

Geometrical Dimensions:

Length, mm	4175.62
Width, mm	1500.00
Height, mm	1368.87
Wheel Base, mm	2650.99
Ground Clearance, mm	203.20
Slant Angle, degrees	50

Table-1.

Ansys-CFX Analysis: Ansys-CFX 15.0 is a high end computer program for modeling fluid flow over the body in complex geometry. The Aerodynamic Analysis Contours, Vectors Plots, Streamlines was studied and drag coefficient was calculated.

The boundary condition for the flow is also an important factor. Boundary conditions used for this analysis are given as follows:

Velocity Inlet	16.67 m/s
Sides and Top	Symmetric Walls
Road	Wall

Table-2.

The Results and Discussions are as follows:

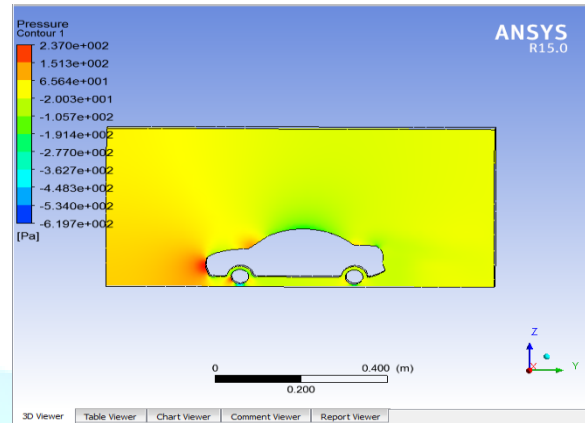


Fig-3: Pressure Contours of Sedan Car with wheels.

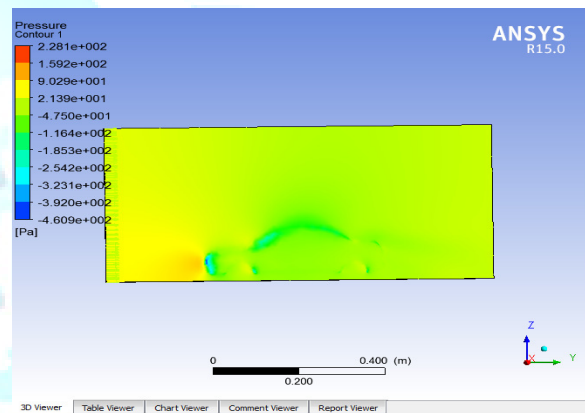


Fig-4: Pressure Contours of Sedan Car without wheels.

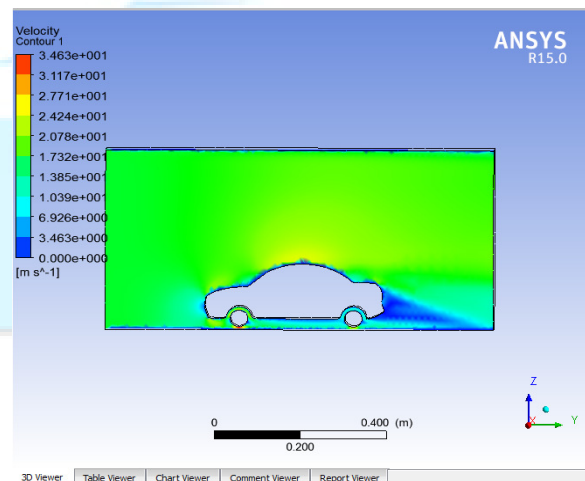


Fig-5: Velocity Contours of Sedan Car with wheels.

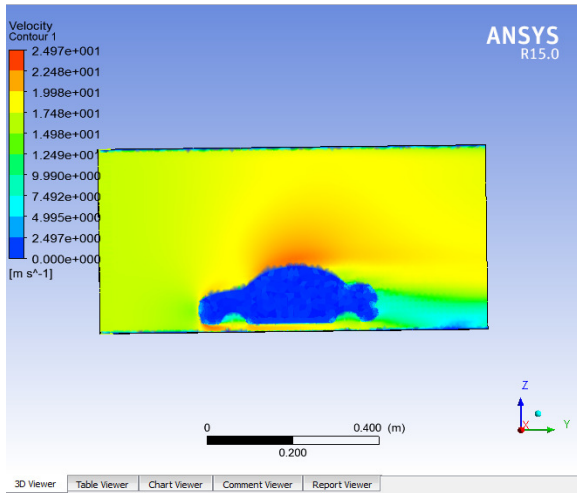


Fig-6: Velocity Contours of Sedan Car without wheels.

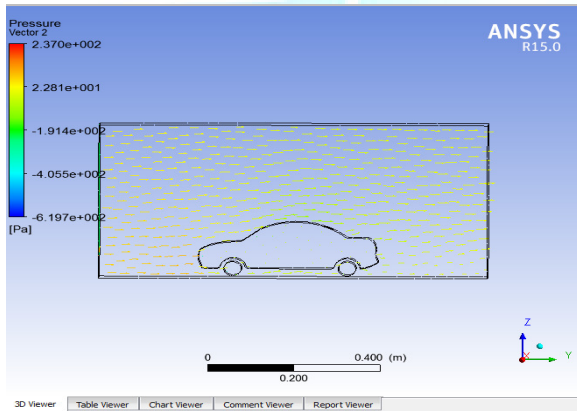


Fig-7: Pressure Vector Plots of Sedan Car with Wheels.

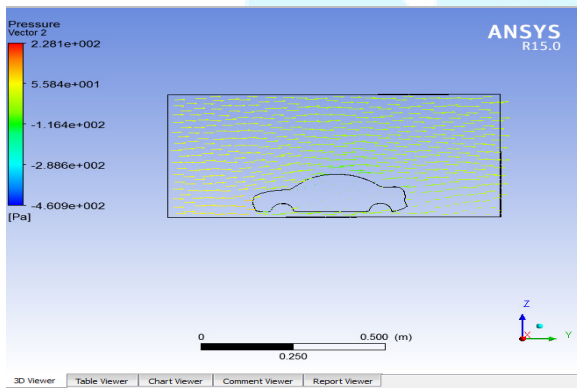


Fig-8: Pressure Vector Plots of Sedan Car without wheels.

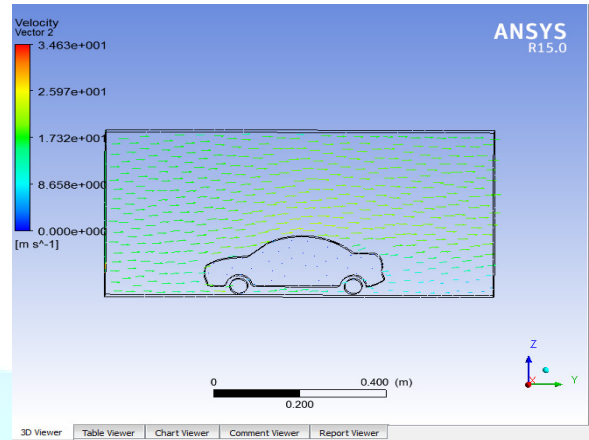


Fig-9: Velocity Vector Plots of Sedan Car with wheels.

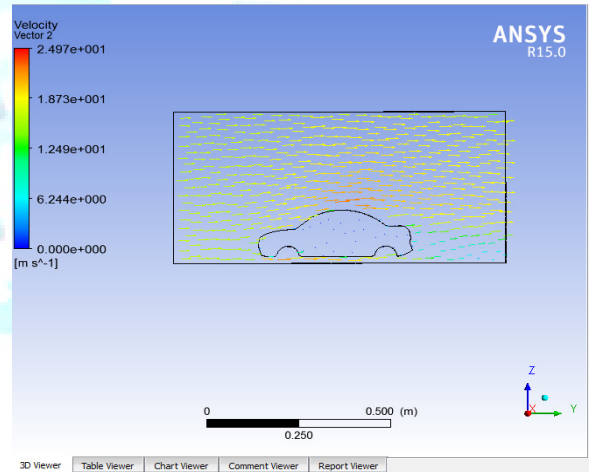


Fig-10: Velocity Vector Plots of Sedan Car without wheels.

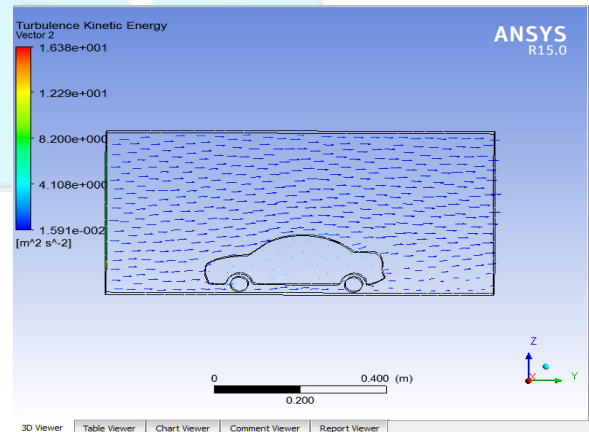


Fig-11: Turbulence (KE) of Sedan Car with wheels.

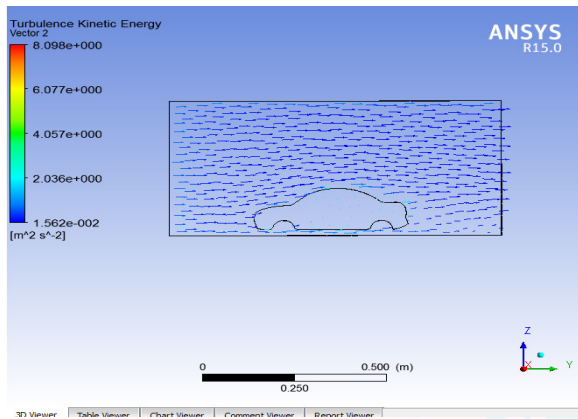
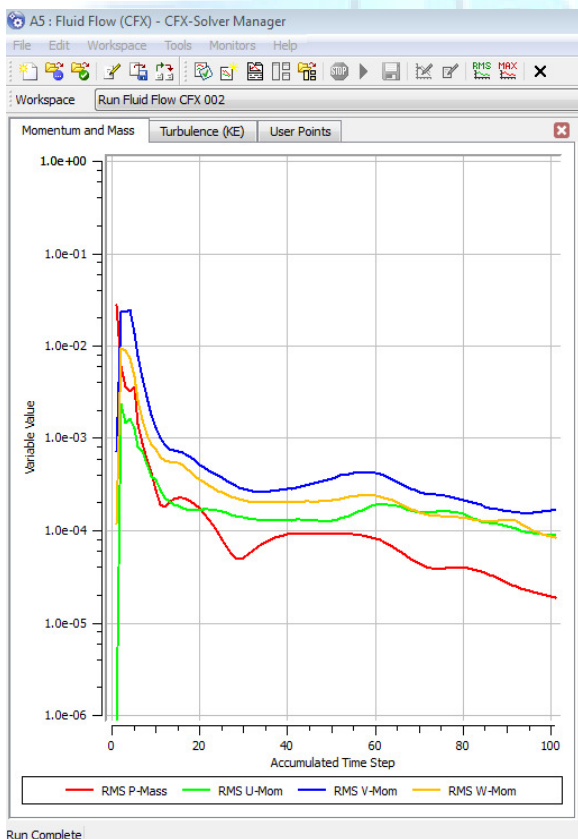
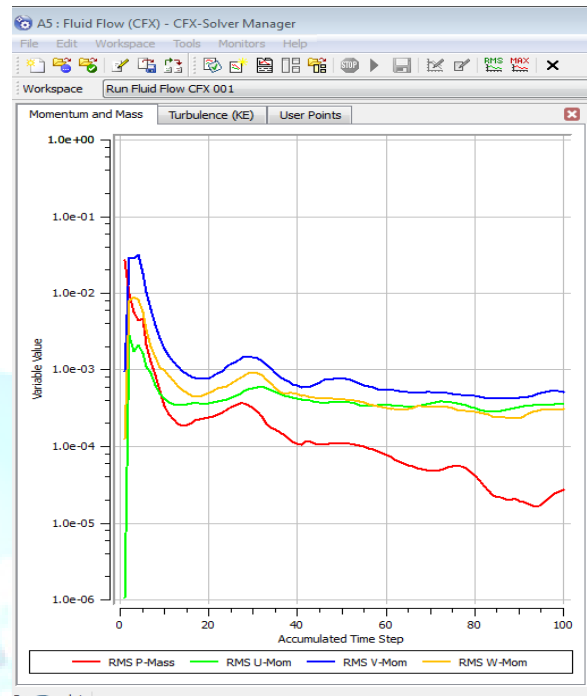


Fig-12: Turbulence (KE) of Sedan Car without wheels.

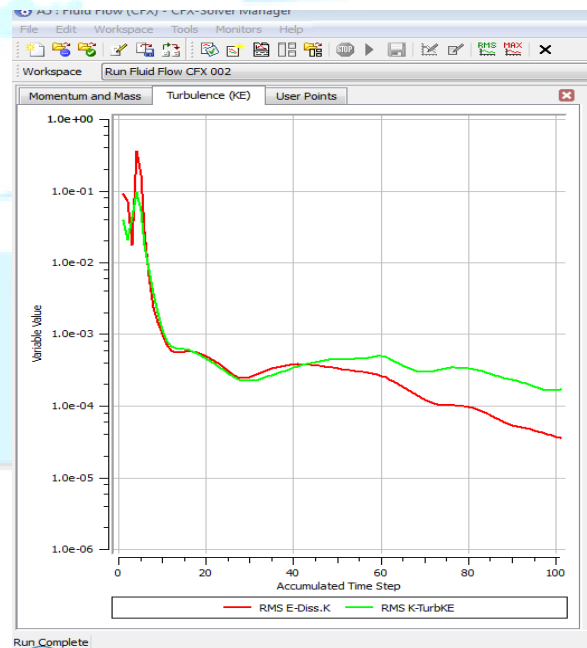
The graphs associated with this Analysis are as follows:



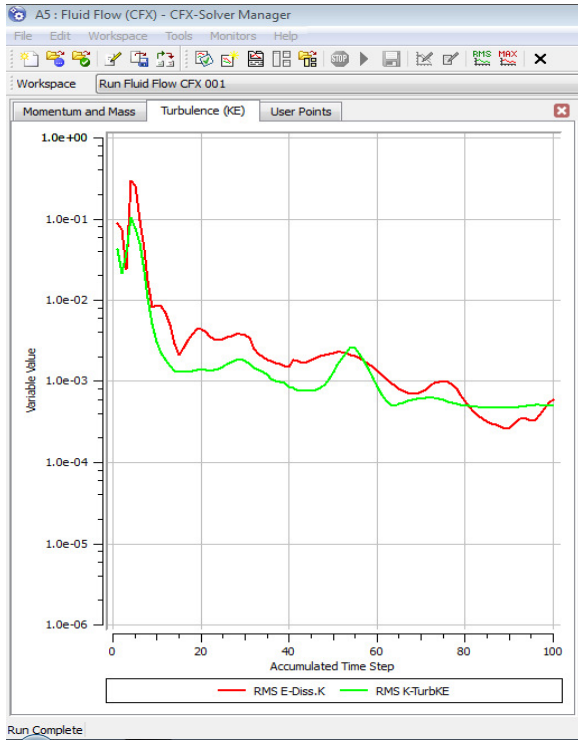
Graph-1: Momentum and Mass graph of Sedan Car with wheels.



Graph-2: Momentum and Mass graph of Sedan Car without wheels.



Graph-3: Turbulence (KE) graph of Sedan Car with wheels.



Graph-4: Turbulence (KE) graph of Sedan Car without wheels.

The Velocity Streamlines of Sedan Car with and without wheels is as follows:

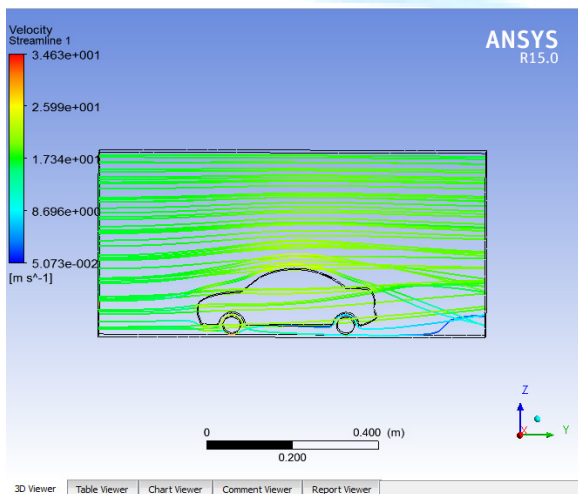


Fig-13: Velocity Streamlines of Sedan Car with wheels.

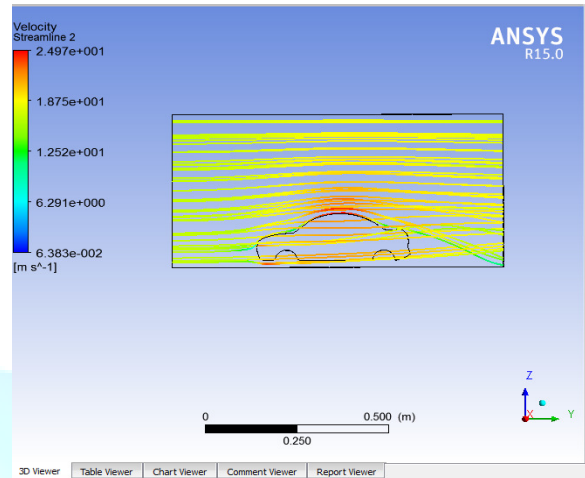
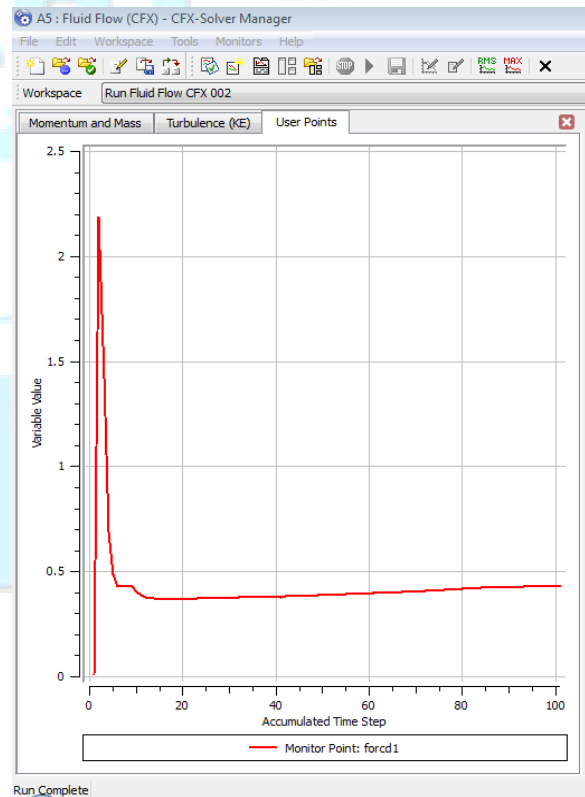
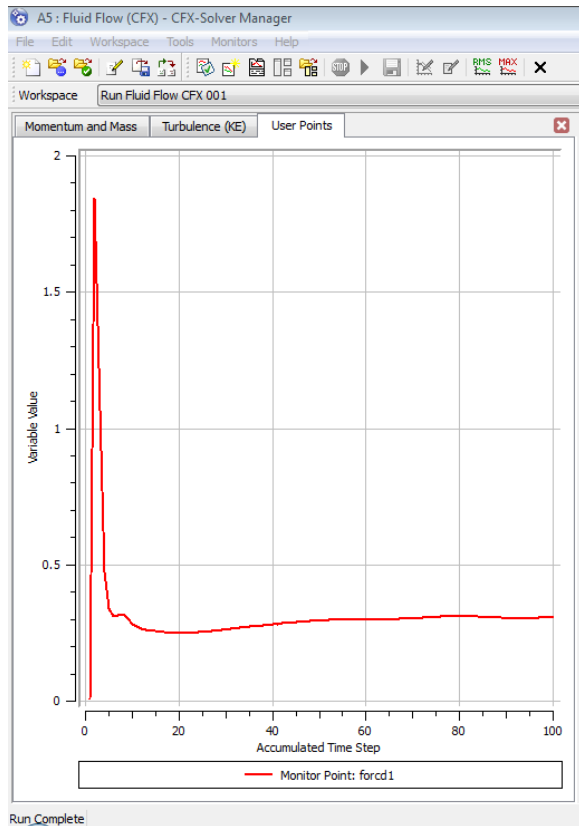


Fig-14: Velocity Streamlines of Sedan Car without wheels.

The drag coefficient found for this model through Ansys-CFX analysis is as follows:



Graph-5: Drag Coefficient of Sedan Car with wheels.



Graph-6: Drag Coefficient of Sedan Car without wheels.

Car Model	Drag Coefficient
Sedan Car with wheels	0.429227
Sedan Cars without wheels.	0.308154

Table-3.

Drag Coefficient of the vehicle is impacted on shape. And drag force increases with increase in speed of the vehicle. Sedan car without wheels has low drag when compared with Sedan car with wheels from CFX analysis.

Conclusion: Aerodynamic Styling plays a crucial role in passenger car’s fuel economy, performance, emissions, handling and stability. This paper gave us an experience in understanding the variations between sedan car with wheels and without wheels. The wake formations of sedan car without wheels are low when compared with sedan car with wheels and also the Drag Coefficient of Sedan Car without wheels has lowest drag when compared with Sedan Car with wheels.

Further Work: The Aerodynamic Design must be improved for the Sedan car with wheels as it has highest drag coefficient when compared with Sedan Car without wheels. But in reality the vehicle moves with wheels only. So for better results, the Sedan with wheels must be redesign once again for obtaining lowest drag coefficient.

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