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Design a Winning Car with FloEFD for Solid Edge

Greenpower International Final 2018

Aerodynamic Design

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AERODYNAMIC DESIGN OF A GREENPOWER CAR

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The single biggest performance limiting factor for a Greenpower car is aerodynamic drag, and it is often overlooked where it should perhaps be incorporated during the earliest stages of design.

It is often assumed that rolling resistance is a greater enemy, but even the most aerodynamic cars will spend approximately double the amount of energy fighting aerodynamic drag at 25mph when compared to what is being spent on rolling resistance.

the cars on the very last row of the grid.

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Important Aerodynamic Parameters

be very small, feature very few exposed components and, most interestingly, will be no more elaborate either electronically or mechanically than the cars on the very last row of the grid.

Aero 101

So what is aerodynamic drag? And how does it influence a Greenpower car?

Put simply, aerodynamic drag is the force that an object travelling through air will experience acting against it and is a result of air speed, pressure and the surface finish of your bodywork.

When designing your vehicle, there are two elements that you should keep in your mind

Frontal Area (Fa) – Sometimes referred to as cross-sectional area, Frontal Area is effectively a measurement of the silhouette of the object that is presented to the air it is passing through.

Coefficient of Drag (Cd) – The coefficient of drag is a scaleless measurement that is used to identify the drag generated by the shape of the vehicle regardless of its size.

A vehicle's Cd can be difficult to measure accurately but as a rule the more angular and bluff the shape of the vehicle is, the higher the Cd will be.

Coefficient of Drag (c_d)

Wikipedia: Drag coefficient

In fluid dynamics, the **drag coefficient** is a dimensionless quantity that is used to quantify the drag or **resistance** of an object in a fluid environment, such as air or water. It is used in the **drag equation** in which a lower drag coefficient indicates the object will have less aerodynamic or hydrodynamic drag. The drag coefficient is always associated with a particular surface area.

$$c_d = \frac{2F_d}{\rho u^2 A}$$

$$F_d = \frac{1}{2}\rho u^2 c_d A$$

$c_d * A$ = Drag Area

F_d	Drag force (the force component in the direction of the flow velocity)
ρ	Mass density of the fluid
u	Flow speed of the object relative to the fluid
A	Reference area (orthographic projection of the object on a plane perpendicular to the direction of motion)

Shape	Drag Coefficient
Sphere	0.47
Half-sphere	0.42
Cone	0.50
Cube	1.05
Angled Cube	0.80
Long Cylinder	0.82
Short Cylinder	1.15
Streamlined Body	0.04
Streamlined Half-body	0.09

Measured Drag Coefficients

https://en.wikipedia.org/wiki/Automobile_drag_coefficient

en.wikipedia.org/wiki/Drag_coefficient

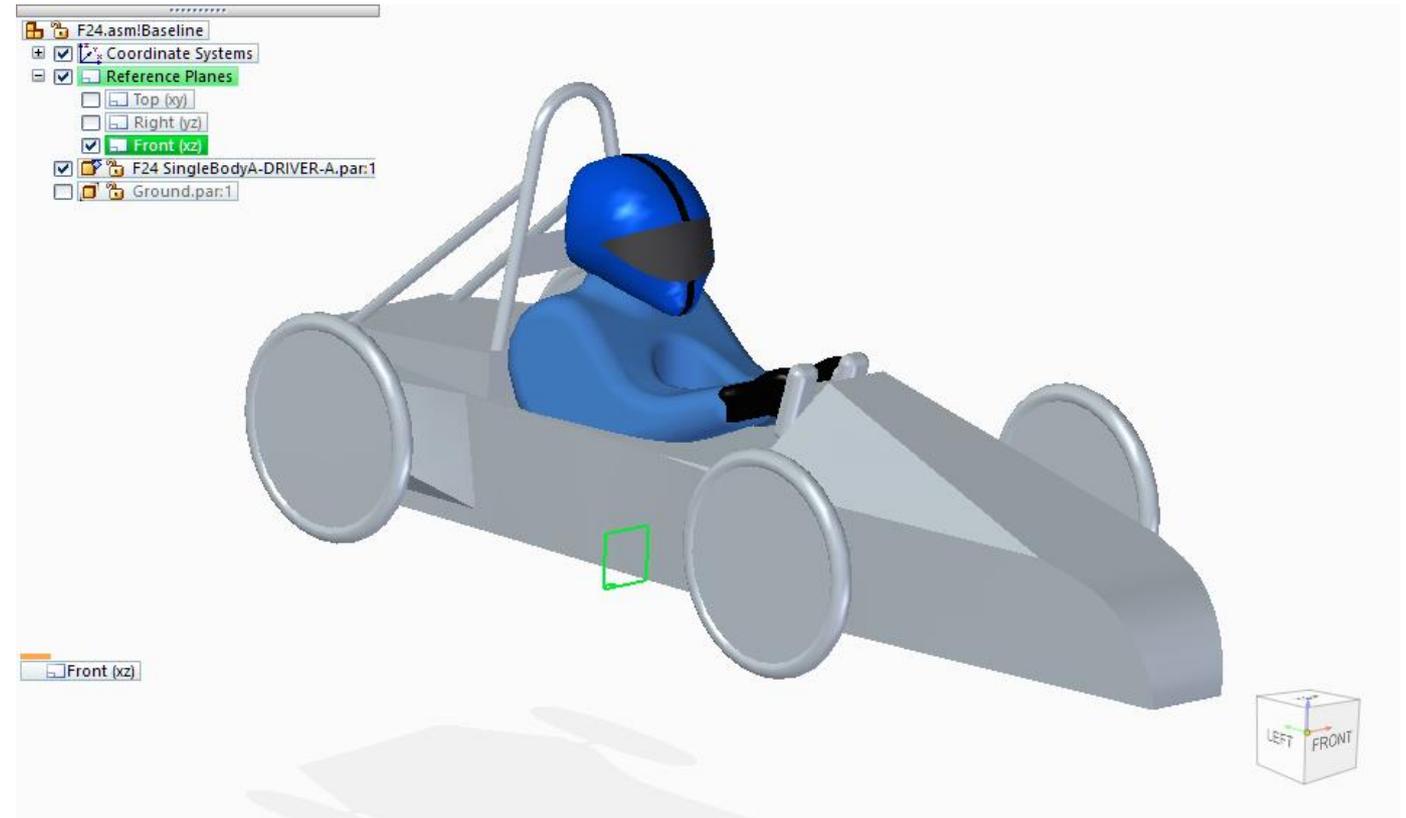# Frontal Area (Fa)

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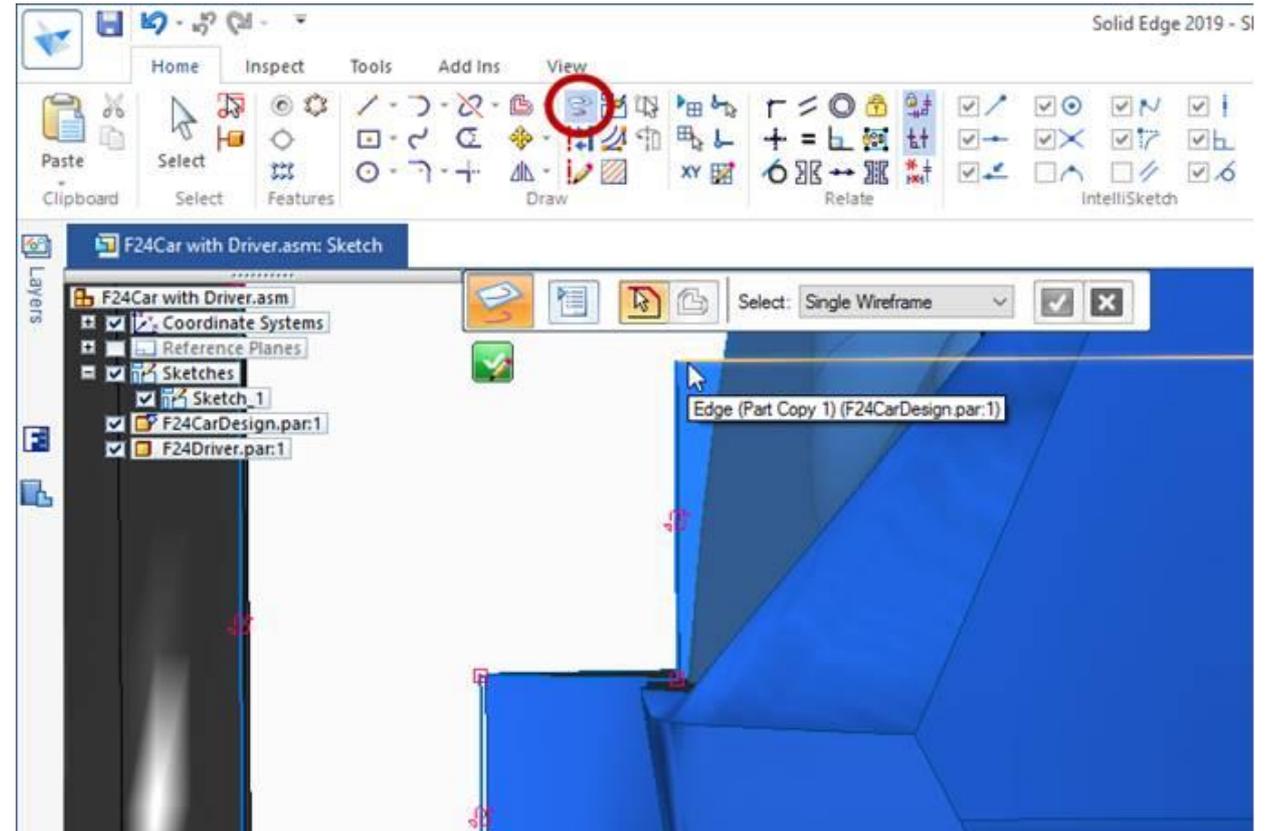
www.greenpower.co.uk/node/398

Frontal Area (Fa)

- In the assembly, create an **Assembly Sketch** on the Front Plane.
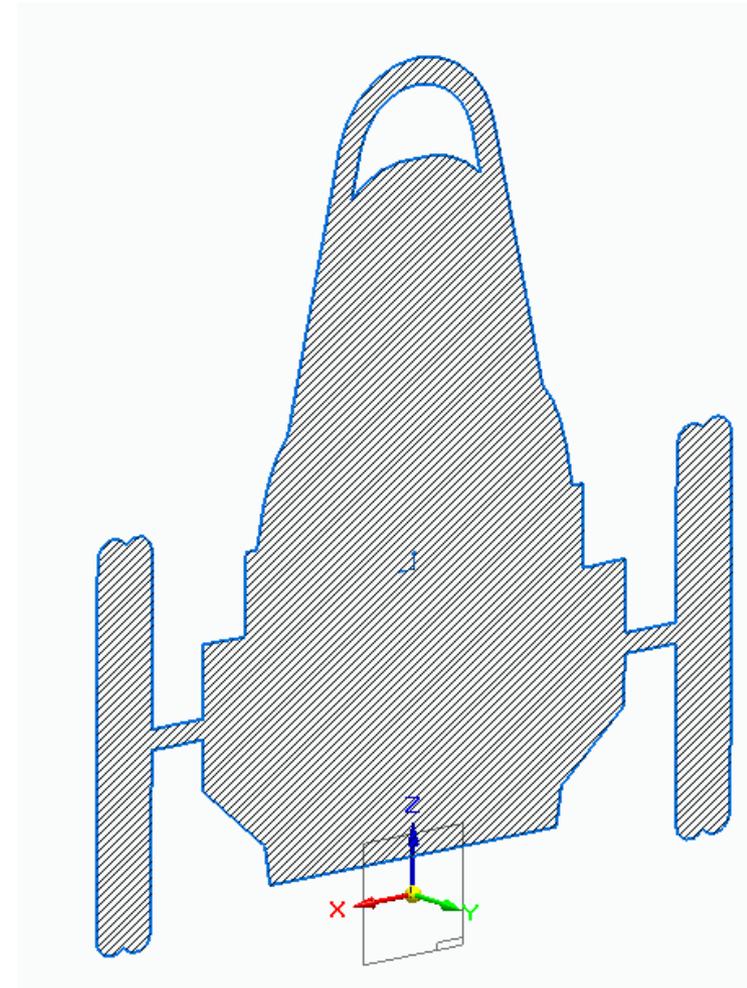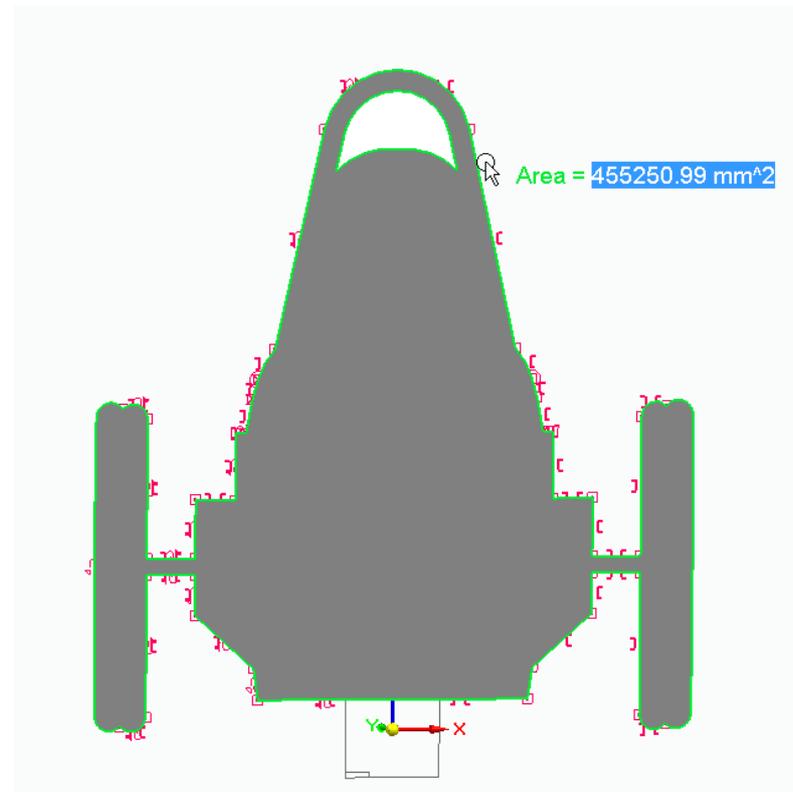
Frontal Area (Fa)

- In the assembly, create an **Assembly Sketch** on the Front Plane.

- Use the **Project to Sketch** command to select the edge chains and silhouette edges of the axles and wheels.

Siemens PLM Software

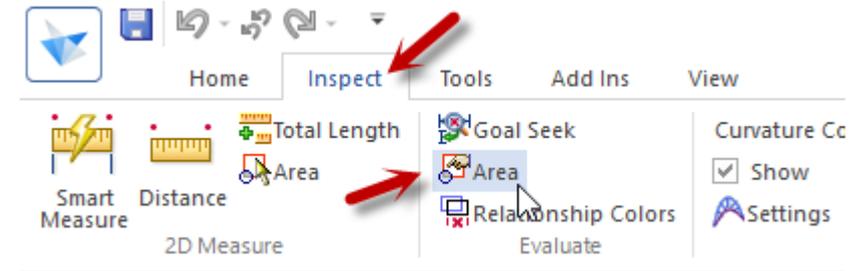# Frontal Area (Fa)

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- In the assembly, create an **Assembly Sketch** on the Front Plane.

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- Trim everything together to get a completely closed loop.

  For experts: Do only ½, then mirror the sketch elements.
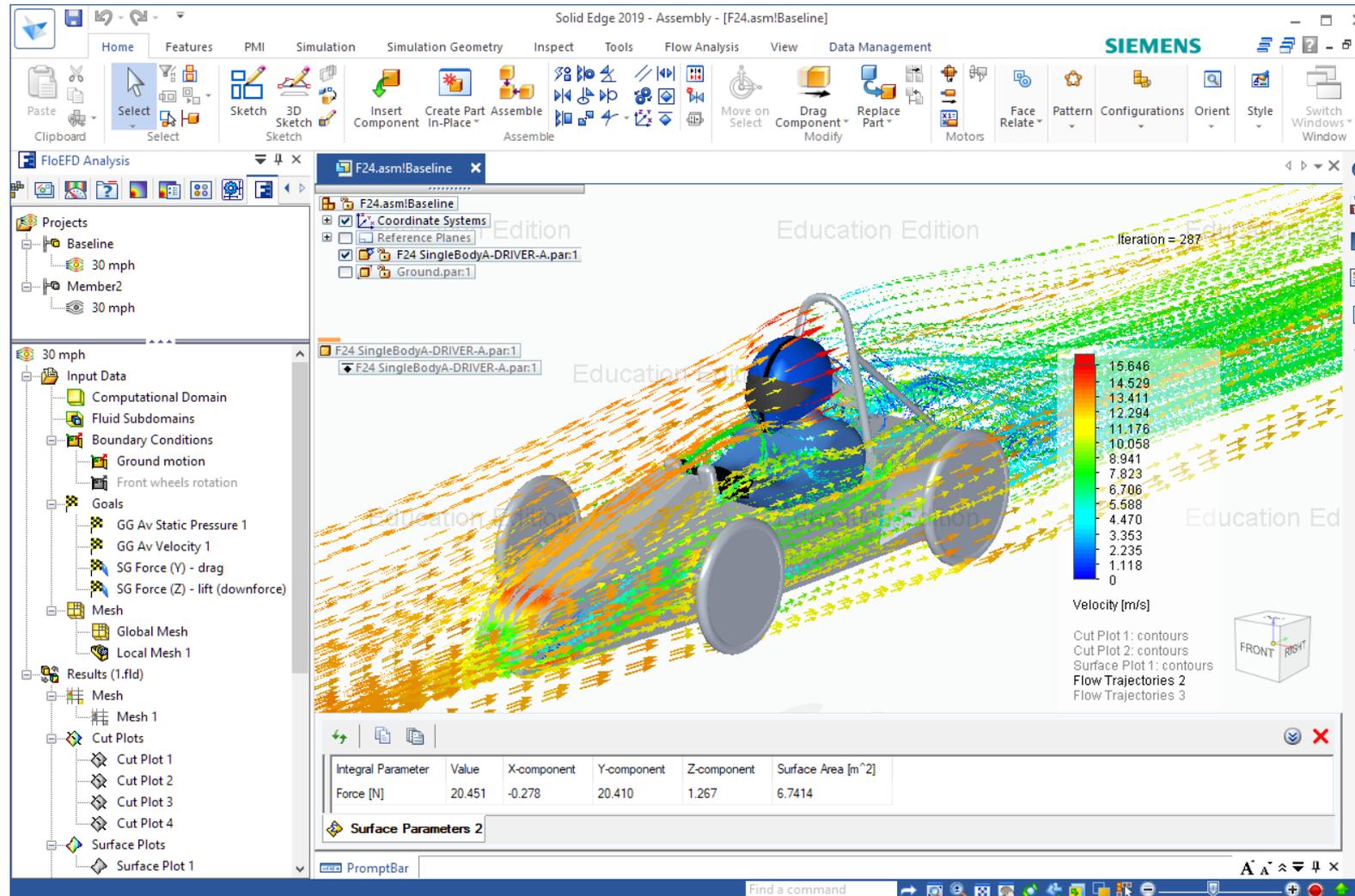
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- On the **Inspect** tab, run the **Area** command and click inside the closed sketch to get the area.

Area = 455250.99 mm^2

Siemens PLM Software

Solution – A Digital Twin

Solution – A Digital Twin

- **Create a 3D Digital Twin** of your car and test the aerodynamic performance virtually on your computer during the earliest stages of design

  Wikipedia: Digital Twin refers to a digital replica of physical assets (…).

- **Build a 3D CAD model** in Solid Edge

- Use the add-in FloEFD to **simulate the aerodynamic efficiency** of your design ideas

- **Learn** from the simulation results, **improve** your design, and **test** through simulation again
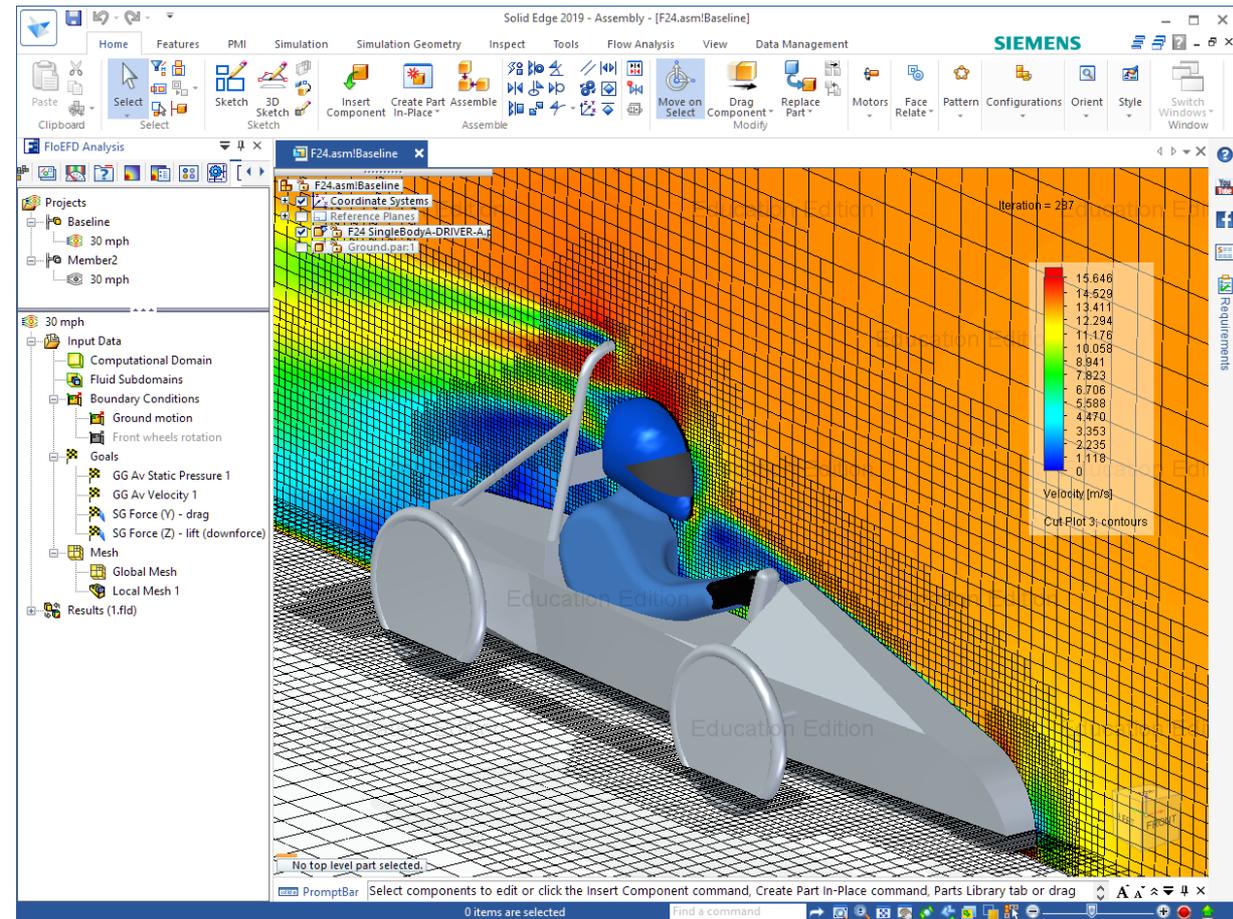
en.wikipedia.org/wiki/Digital_twin

Getting Ready … Solid Edge & FloEFD

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- Install a copy of **Solid Edge** 3D CAD from Siemens
  - At your school
  - Download from the **Solid Edge Student Edition website**

- Download the free add-in **FloEFD for Solid Edge Student Edition** from Mentor, and install it on the same PC

- Build a **3D CAD model** of your car

- Setup and run **FloEFD projects** for simulation of aerodynamics around your car model

- **Visualize** the simulation results, **understand** the fluid flow patterns, **learn** from it, and **improve** your design

- **Run** the FloEFD projects **again** and **compare** the performance with your previous designs

https://www.plm.automation.siemens.com/plmapp/education/solid-edge/en_us/free-software/student

https://www.mentor.com/company/higher_ed/floefd-solid-edge-student-edition

FOR STUDENTS

Solid Edge Student Edition

Free professional 3D CAD software for students

Engineering is an exciting, challenging and rewarding discipline that offers opportunities in a diverse range of careers. You can build the skills you need with Solid Edge Student Edition software —a free version of the same easy-to-use software suite used by professionals. Learning Solid Edge as part of your education prepares you to enter the workforce and helps you stand out in today's highly competitive economy.

This free download:

- Is available to any active student
- Is intended for academic course work
- Has a license that will not expire

Note: Files
drawings a

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Free FloEFD for Solid Edge Student Edition
Fully Embedded Computational Fluid Dynamics

FloEFD for Solid Edge is a general purpose Computational Fluid Dynamics (CFD) software that is fully embedded in Solid Edge and it is available FREE to students. Create designs with Solid Edge and immediately test them for fluid flow and heat transfer. It offers all the functionality as its commercial counterpart so you can conduct realistic tests on your designs and be fully prepared to enter the workforce. Fast. Accurate. Intuitive to use.

Download and work with FloEFD for Solid Edge today: http://bit.ly/FloEFD4SE

Thank you!

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