Voxdale and Flanders' Bike Valley build a Wind Tunnel using FloEFD™

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In April 2016, the Flanders' Bike Valley wind tunnel in Beringen, Belgium was unveiled. The eye-catching structure attracted more than 400 spectators to the opening event. The wind tunnel, with a surface area of around 600 square meters, is the latest project co-created by Voxdale BVBA, and Flanders' Bike Valley. The purpose of the wind tunnel is to provide cyclists, the growing cycling industry and its manufacturers, product developers and athletes with accurate test data to improve product and athlete performance. The tunnel will also be used for additional low speed aerodynamic testing like sports equipment, clothing, drones etc.

The open circuit wind tunnel, also known as an "Eiffel" or NPL Tunnel, is constructed in such a way that air is sucked from the ambient into the test section. The Flanders' Bike Valley wind tunnel is housed in a purpose built hanger measuring 50m x 16m x 10m. The tunnel itself has a length of approximately 50m.

The tunnel comprises several sections: the contraction section, the test section, and the diffusor section. The test section is 2.5m x 2.5m x 6.5m and the maximum wind speed is 108 km/h. The wind tunnel design enables a high level of laminar flow, which leads to very accurate and repeatable results. The test section is equipped with a balance measuring system to determine weight and drag forces and a PIV (Particle Image Velocimetry) system to visualize velocity and the direction of the air.

Marc Hufkens, Chairman Board of Directors of Bike Valley Innovation Center said, "The first idea for a common wind tunnel facility came in Spring of 2012 and we took a few years of preparation to find the right partners, Voxdale is one of them. We started with the construction of the infrastructure in April 2015 and were happy to celebrate the inauguration in April 2016. The wind tunnel is unique, because we have a very exact measurement system. This is unique for cyclist and also for ski and alpine sports applications to determine the exact gain in cm or seconds with the optimized aerodynamics"

Koen Beyers, CEO of Voxdale said, "One of the main challenges we have in our work is the validation of our results and that is the reason why we participated in the Flanders'

Figure 1. Test Section

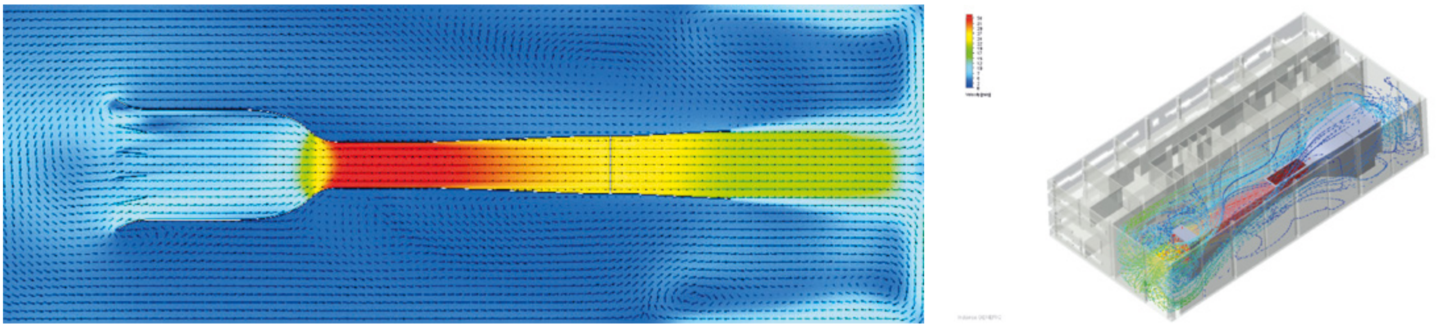

Figure 2 a+b. Wind tunnel simulation set up inside the building

Bike Valley Wind Tunnel project”. Additional founding companies include BioRacer, Flanders Make, Lazer Helmets and Ridley with the support of Agentschap Ondernemen, Province Limburg and the European Regional Development Fund.

Voxdale built a very early mockup of the Flanders’ Bike Valley Wind Tunnel and building. Many aspects have to be considered during the conceptual phase, for example, the type and size of wind tunnel, performance, velocity and naturally the budget. Voxdale was involved from the beginning in the conceptual design of the wind tunnel as well as in the aerodynamics. Mentor Graphics’ FloEFD 3D Simulation Tool was used in the very early design phase. The contraction section, the test section and the diffusor section were modeled, simulated and designed directly in PTC Creo embedded FloEFD. Furthermore the entire hall around the wind tunnel was simulated because it is an open return wind tunnel.

One of the main challenges was the positioning of the wind tunnel inside the brand new building. The flow back from the fans to the contraction section was simulated and visualized. At the same time the laminar flow in the test section and the wind tunnel design were simulated.

Patrick Vlieger, Engineer at Voxdale commented, “At first we did a concept design of the Flanders’ Bike Valley wind tunnel. We simulated inside the building to analyze the backflow inside the building and then we could also see the laminar flow in the test section. So we positioned the wind tunnel a little bit higher, a little bit more to the back or to the front of the building. We checked how this influences the laminar flow inside the test section and inside the building itself”.

The height and the distances to the walls were optimized taking into consideration the effect on the flow conditions inside the wind tunnel. Hence, the FloEFD simulations ensured a good detailed engineering of the wind tunnel as well as a reliable and efficient design of the hall because an overdesign would lead to unnecessary expenses for the building.

The next stage is to create a digital replica of the test section in FloEFD to prepare the tests virtually. “With that we will be able to facilitate the preparation of the wind tunnel use. We can decide how many runs and which configuration we will do”, says Koen Beyers. The correlated results can then be used also for further development in FloEFD. By doing this the time spent in the wind tunnel can be reduced noticeably.

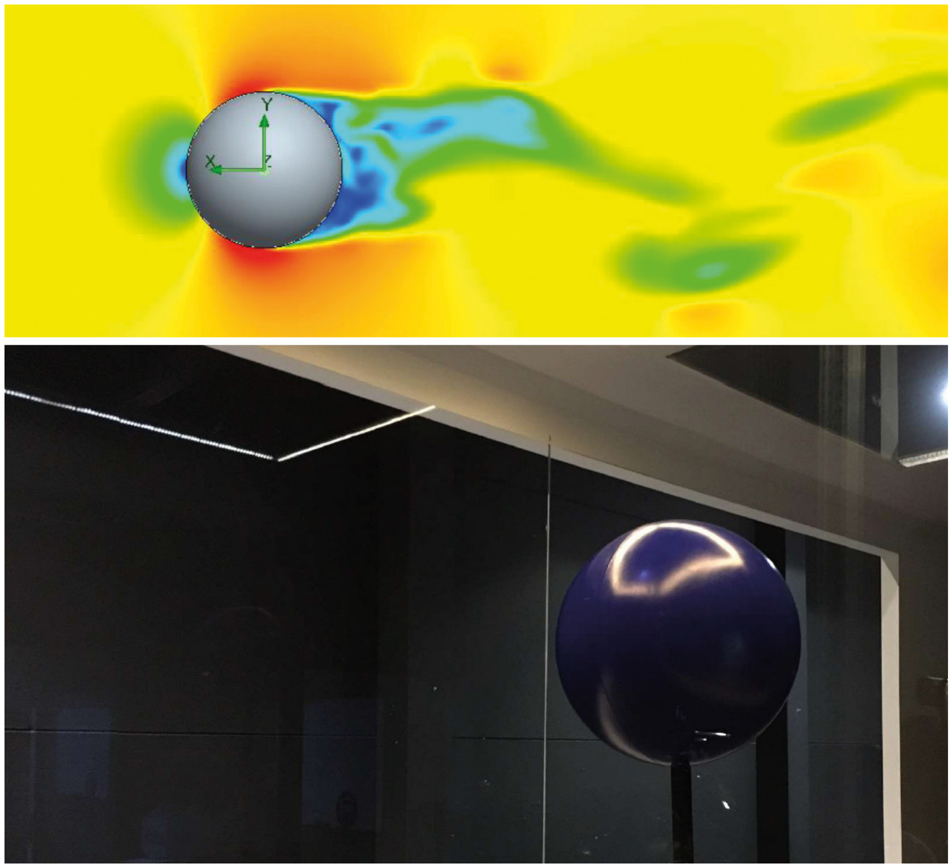

Figure 3. Sphere calibration picture and corresponding FloEFD simulation

Figure 4. The “Aerobar”

Besides all the strictly technically focused solutions the engineers elaborated an additional idea, they found a way to install a bar bellow the wind tunnel contraction section, which is called the “Aerobar”.

Koen Beyers sums up, “You have to imagine, this is a multi-million Euro project. You have to come up with the design and then you have to step-by-step really build it. And that might be a risk, imagine that it does not perform as expected or it does not work very well. That’s why we stepped in with FloEFD. That gave us enough confidence to validate the design of the tunnel itself and to have the correct dimensions of the hall. We are really proud of this project and it’s almost unbelievable what we have materialized in this short period of time to end up with this F1-like facility”.

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