SHAVE

White Paper

02/2026

Standards? Break away.

Many ideas, countless simulations and a clearly defined requirement: creating a platform that sets new standards and breaks with familiar patterns in the world of cycling. The result is two frame concepts that combine everything you need to have fun on the road – and to win races.

The Shave combines ergonomics with aerodynamics and pushes you to ride faster for longer. Aero or endurance? No more compromise thanks to the AergoConcept.
The Shave FF was designed for racing: The aero form follows the function and the function follows your ambitions: Being faster than everyone else. Pushing the limits of weight, it sets the new benchmark for all-in-one bikes in the wind tunnel.

How did we manage that? Let's go!

Introduction

Performance road bikes are made for competition – their development is characterised by bringing race-relevant factors into the best possible balance. The biggest challenge: the fragile triangular relationship between aerodynamics, stiffness and weight. This is because optimising one parameter usually leads to losses in another.

The Shave has therefore been developed with a holistic approach based on strictly scientific methods. Aerodynamic effects were analysed in the virtual wind tunnel, decisions regarding stiffness were made on a virtual test rig – with the aim of creating a road bike that sets new standards.

The result is two highly specialised frame concepts that are technologically based on the same foundation:

- The Shave is an absolute novelty: The AergoConcept is the first to combine the aero performance of a specialised competition bike with the ergonomic advantages of endurance geometry. Ambitious riders benefit from aerodynamic advantages even over longer distances – without having to compromise on comfort.
- The Shave FF and FFX represent the uncompromising race geometry for maximum speed and efficiency in competition. It stands for the optimum balance of minimum drag and weight as well as maximum stiffness – the benchmark in the performance road bike segment.

At the same time, a new wheelset was developed. While the progressive frame geometry forms the basis for efficiency, acceleration and control, the new RC55 wheels combine high riding stability with minimal drag and weight.

The following pages explain the methods and assumptions used in the development of the bike. Unless explicitly stated, the term “Shave” is used as a generic term for both platforms.

Figure 1: On the left the Shave, on the right the Shave FFX

Objective

During the development of the Shave, aerodynamics took centre stage. Aerodynamic frames and wheels have characterised modern road cycling for years and have long since developed into a key success factor even outside of time trials.

Already below 20 km/h, air drag is the dominant riding resistance on the flat. The power required to overcome it rises disproportionately. For example, an increase in speed from 30 to 35 km/h requires more than 50 % more power solely to overcome aerodynamic drag. With increasing average speeds in professional road cycling, this correlation is therefore gaining enormously in importance.

Designing an aerodynamic road bike is only one aspect of the challenge. It is crucial to harmonise aerodynamics, weight and rigidity – factors that influence each other and have an impact on energy efficiency as well as riding behaviour and comfort. Beyond the additional requirements, such as tyre clearance or geometry, clear development goals were set for the Shave, which are summarised in the following objective matrix.

	Frame	Fork	Cockpit	Seat Post	Wheelset
Aerodynamic drag	-	-	-	-	=
Weight	-	=	-	-	-
Stiffness	+	=	/	/	=
Steering torque	/	/	/	/	-

* + indicates an increase in value, - indicates a decrease in value, = indicates no change in value, / indicates an undefined value

As early as the concept phase, it became clear that, in terms of a holistic development approach, purely analytical methods were not sufficient to fulfil the defined objectives. For this reason, numerical analyses based on computer simulations were used. They enable a quantitative evaluation of the development goals, the direct comparison of different geometry variants and the optimisation of the overall system consisting of frame, fork, cockpit and wheels as a functional unit.

Aerodynamic development

The CFD simulations (Computational Fluid Dynamics) used for development are software-based analysis methods that simulate the air flow around the road bike in a "virtual wind tunnel". Compared to testing prototypes in a real wind tunnel, CFD simulations allow more geometry variants to be analysed in less time. The method, which is also used for Formula 1 cars and aeroplanes, was a key tool in the development of the Shave.

Contrary to the industry trend, flow analyses were deliberately not outsourced. Instead, the necessary aerodynamics and CFD expertise was built up in-house, resulting in the following advantages in particular:

- optimised development approach through control of methodology, accuracy, and boundary conditions
- short development intervals thanks to close coordination between the design and simulation teams
- sustainable knowledge building for follow-up projects and to strengthen brand perception

Structure of the CFD setup

CFD analyses make it possible to simulate the flow around the road bike using predefined computational models and to present the results in numerical and graphical form. This means that the design of the bike can be refined at will, even before a prototype has been built.

Firstly, a digital image of the road bike geometry is created and this model is then converted into a three-dimensional grid – consisting of millions of cells, which, as individual computational elements, enable the flow to be captured with pinpoint accuracy (Fig. 2).

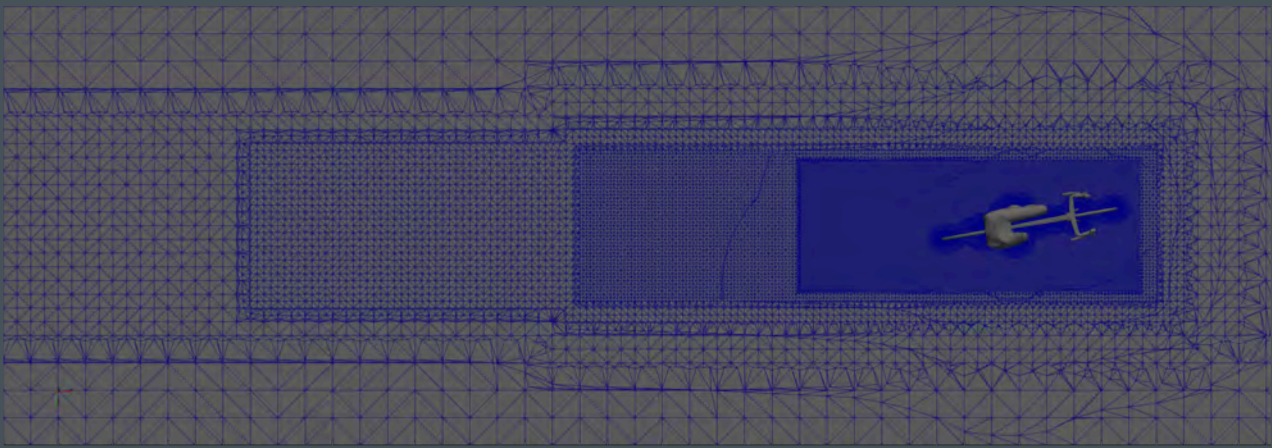


Figure 2: Top view of the virtual wind tunnel in crosswind conditions

At the same time, physical models were selected that describe the flow behaviour as realistically as possible, for example for turbulence or crosswinds. In addition to the headwind, there is almost always wind in nature – from changing directions and at speeds similar to those in cycling.

The influence of the angle of attack is significant. Crosswinds influence the pressure distribution on the frame in such a way that the air resistance of the frame decreases at certain angles and with suitable tube profiles – a behaviour that is also known as the sailing effect. The aim of any aerodynamic design process is to harness this desired effect even at low angles of attack while minimising frontal drag.

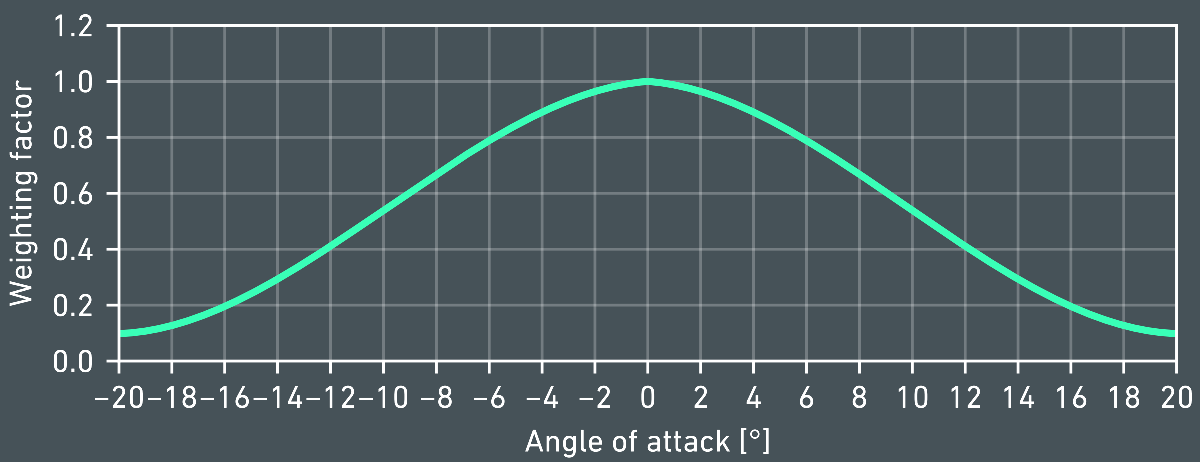


Figure 3: Weighting factor distribution for riding speed of 40.23 km/h and wind speed of 11.27 km/h; source: Barry N, 2018, A new method for analysing the effect of environmental wind on real world aerodynamic performance in cycling

Based on scientific findings (see Barry, 2018), an evaluation method was developed that takes into account angles of attack between 0° and 20° and combines them into an overall result with different weightings (Fig. 3). This made it possible to determine not only wind resistance and sailing effects, but also the steering torques under crosswind conditions.

The complex mathematical equations are solved in thousands of iterations until stable results are finally obtained. Graphically processed, they make the otherwise invisible flow around the bike visible (Fig. 4). The consistent use of scientific methods and a high degree of automation of the calculations make the Rose CFD tool the basis for the aerodynamic design of the Shave. Following successful implementation, it was now possible to enter the development phase.

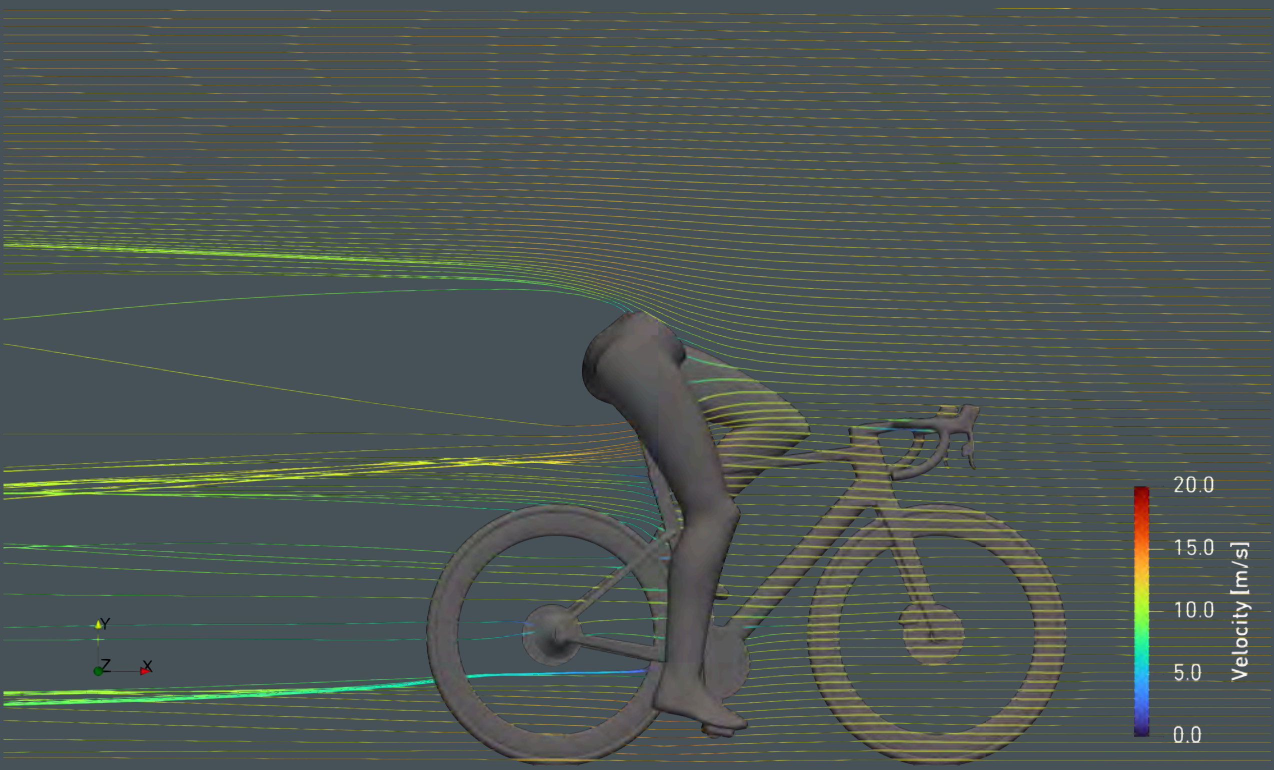


Figure 4: Streamlines around the bike and the dummy

Development of a new bike frame

Already the predecessor of the Shave, the Xlite, was designed with the "golden ratio" in mind. The focus is on a balanced ratio of dynamic riding characteristics with controlled handling, aerodynamic design with low weight, as well as high stiffness and comfort without compromising performance. The successful concept should also be transferred to the Shave and further refined. The first step was therefore to carry out a detailed analysis of the Xlite in order to examine all parts of the frame for aerodynamic optimisation potential.

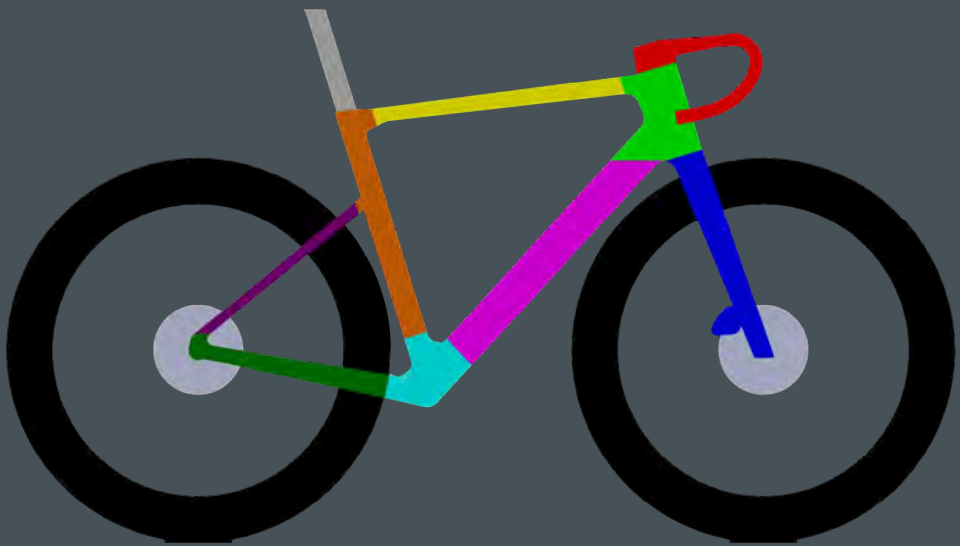


Figure 5: Division of the overall bike model into sections

Suitable airfoil families were used for the first redesign of the frame, including those from aerospace applications. Then, using the CFD process chain, each individual section of the frame (head tube, down tube, cockpit, seat tube, seat post and seat junction) was considered separately and optimised aerodynamically (Fig. 5). Thanks to the close integration of design and simulation within the development department, a large number of geometry variants could be calculated in a short time.

This process took place over several months and in many development loops. Based on the CFD results, the sections were repeatedly adjusted and re-evaluated. Figure 6 provides an insight into the iterative process and the development of the percentage power savings. The optimised sections were then combined to form a final configuration – the subsequent physical prototype, which was tested in a real wind tunnel.

Figure 6: Extract from the progression of the bicycle's drag over several development loops compared to the Xlite 06

Test Results

Even with high processor performance and complex software, CFD simulations always remain just a modelling of physical reality. There are always discrepancies between modelling and reality, so that tests of real prototypes in the wind tunnel remain indispensable in order to validate the simulation results. The results of a wind tunnel test are presented below, comparing real test values of the Shave FFX in size ML with those of its predecessor, the Xlite 06 in size 57.

Figure 7: Test setup of the Shave prototype in the GST wind tunnel © Robert Kühnen

Aero performance in the wind tunnel

To enable meaningful comparative tests in the wind tunnel, TOUR magazine has established a reproducible test protocol that takes all relevant parameters into account (Fig. 7). These include crosswind conditions from -20° to +20°, the rotation of the wheels and the legs of a dummy rider moving at a fixed cadence. The wind tunnel test in the GST wind tunnel (Immenstadt im Allgäu, Germany) was carried out at incoming flow velocities of 45 km/h.

This showed significant reduction of 4.7 % in the total drag of the Shave compared to the Xlite 06, which corresponds to a total saving of 10 W. Figure 8 shows that the savings were constant across all angles.

	Xlite 06*	**Shave FFX (ML)**	Change
TOUR method (wind tunnel)	215 W	205 W	-4.7 %

*TOUR-Magazine 04/23

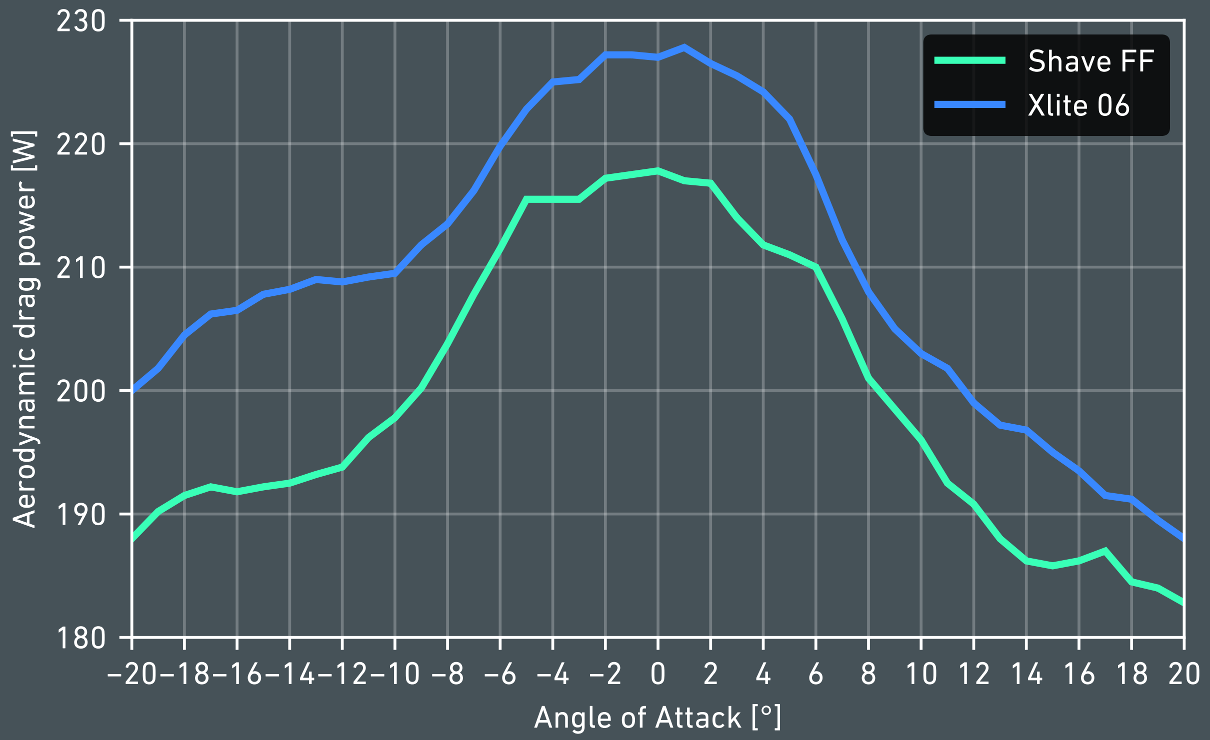


Figure 8: Aerodynamic drag power of the Shave FF and Xlite 06 for angles of attack from -20° to +20°, tested by TOUR magazine in the GST wind tunnel

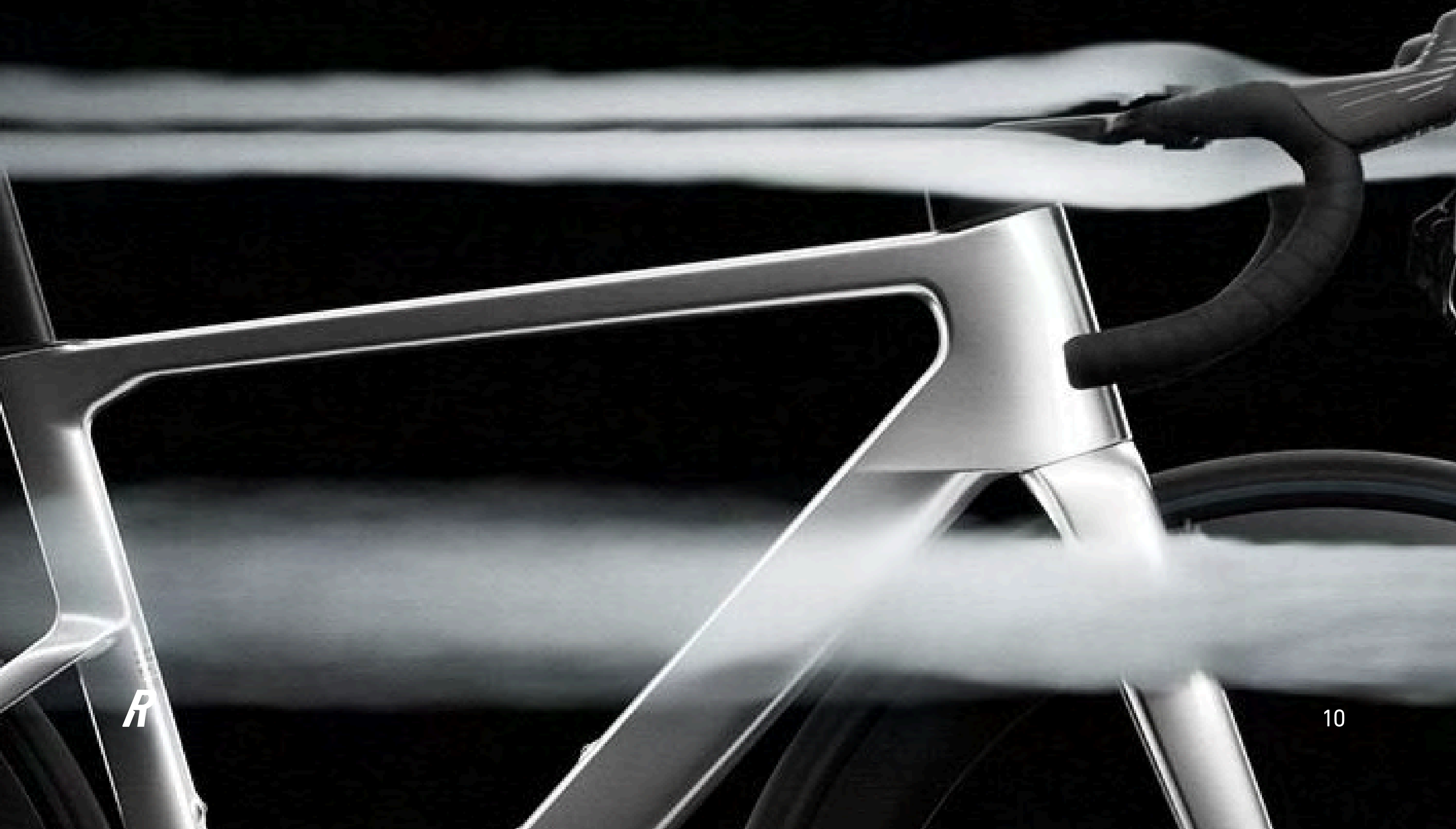
The results from the wind tunnel test also served as a basis for evaluating the accuracy of the Rose CFD tool. With a similar setup – the simulated rider's legs were tested statically in two positions – and the same boundary conditions, a deviation of only 0.5 % compared to the wind tunnel test was found. The difference can be explained by different configurations between the wind tunnel and CFD simulation, e.g. with regard to tyre width, position of the brake levers or geometric simplifications.

Change wind tunnel compared to Xlite 06	Change CFD compared to Xlite 06
-4.7 %	-4.2 %*

*Refers to the total drag including rider's legs and drivetrain components

The comparison thus shows that the internally set up CFD process generates reliable data and can be used for further developments and analyses – such as detailed evaluations of individual components, which a wind tunnel test cannot provide:

Components	Change CFD with rider's legs compared to Xlite 06
Cockpit	-28.1 %
Fork	-9.7 %
Seat Post	-36.7 %
Seat Tube	-7.5 %
Seat Stays	-16.7 %
Head Tube	-55.6 %
Down Tube	-49.3 %



Stiffness on the test rig

The stiffness of the frame and fork has a significant influence on aspects such as power efficiency, riding dynamics, stability and comfort. Relevant stiffness parameters and targets are defined early on and checked in the course of development using various test series. For the Shave, the aim was to keep the stiffness values largely constant compared to its predecessor, as these were already at a high level with the Xlite 06. During the development phase, a separate FEM setup (finite element method) was set up to analyse strength-critical components.

This computer-based analysis method can be used to simulate the structural mechanics of the frame in terms of strength and deformation under defined loads. Development approaches were therefore only pursued if they could fulfil all safety and stiffness requirements. Subsequent prototype tests on the test rig should successfully confirm the objectives.

Characteristic value	Xlite 06 (57)	Shave FFX (ML)	Change
Head tube stiffness	96 Nm/°	98 Nm/°	+2.1 %
Bottom bracket stiffness	61 N/mm	59 N/mm	-3.3 %
Fork lateral stiffness	51 N/mm	50 N/mm	-2.0 %
Fork brake stiffness	90 N/mm	92 N/mm	+2.2 %
Stiffness wheel	38 N/mm	40 N/mm	+6.1 %

Weight comparison with the Xlite 06

The weights of the individual components cannot usually be reliably predicted during the development process, as they can still change as a result of adjustments to stiffness or safety parameters. Despite these methodological limitations, a total weight saving of over 450 g was achieved in the frameset including wheelset and small attachments.

The decision to use highly stiff M40X carbon fibres for the Shave FFX model was a key factor in this. By using ultra-high modulus fibres from the manufacturer Toray, the frame weight was even able to fall below the 750 g[1] mark.

Components	Xlite 06 (57)	Shave FFX (ML)	Change
Frame (RTP*)	795 g	740 g	-6.9 %
Fork (RTP*)	330 g	370 g	+12.1 %
Cockpit	395 g	370 g	-6.3 %
Wheelset	1635 g	1280 g	-21.7 %
Seat Post	115 g	117 g	+1.7 %
Bottle cages	90 g (45 g+45 g)	60 g (37 g+23 g)	-33.3 %
Parts	382 g	342 g	-10.5 %
Total**	3749 g	3279 g	-12.5 %

*RTP (ready to paint) refers to a frame or fork that has already been primed but not yet painted, and is therefore ready for the final coat of paint.
**without groupset, tyres, saddle, handlebar tape

[1] Shave FFX RTP in size ML

Overall rating

Results count for a competition bike – and the Shave delivered. The figures speak for themselves: All development goals were realised and in some cases even exceeded. In the conflicting objectives of aerodynamics, stiffness and weight, it has taken the lead in every aspect: 4.7 % better aerodynamics. 6.9 % less weight. 3.1 % more stiffness. And the new aerodynamic benchmark for all-in-one bikes.

Time to show that on the streets of this world. Together with the Unibet Rose Rockets in professional racing.

Characteristic value	Xlite 06 (57)	Shave FFX (ML)	Change
Aerodynamics	215 W	205 W	-4.7 %
Weight of complete bike*	7.2 kg	6.7 kg	-6.9 %
Stiffness	96 Nm/° 61 N/mm 51 N/mm 90 N/mm 38 N/mm	98 Nm/° 59 N/mm 50 N/mm 92 N/mm 40 N/mm	+3.1 %

*SRAM RED AXS without pedals

** For the specific assignment of the stiffness values, see p. 11

Development of the RC55 – Deep Dive

The guiding philosophy of a road bike that sets aerodynamic standards also included its own wheelset in the development concept from the very beginning – the RC55. From a aerodynamic perspective, the wheels are the most complex component of the whole system. The development of the RC60 (Xlite 06) and GC50 (Backroad FF) has already provided important insights into this.

In the following, the development of the RC55 wheels will therefore be presented in a deep dive to give interested parties a deeper understanding of the aerodynamic relationships and design challenges of the component wheel. The part on development provides further insights into CFD engineering, which can also be applied to the development of frames.

Steering torque and influencing factors

While the frame is essentially optimised to minimise aerodynamic drag, another target variable comes into play for wheels: the aerodynamic steering torque. A characteristic value that has a noticeable influence on the riding stability of the bike in crosswinds. It is caused by uneven pressure distribution, which applies to all rotating bike components.

The wheel clearly plays a dominant role, on the one hand due to its large surface area exposed to the wind, and on the other hand due to the wide lever arm to the steering axis. The effect is strongly dependent on the angle of attack of the crosswind. As the angle increases, the air is initially deflected more strongly on the outside of the wheel and thus accelerated. However, if the angle is too large, the flow can no longer follow this deflection and detaches – the steering torque causes the wheel to move sideways and requires the rider to actively counter-steer.

The effect is particularly noticeable when the wind direction changes abruptly or when the airflow changes due to large steering angles in corners. Especially at high speeds, a wheel with unfavourable pressure distribution feels unstable and wobbly.

When designing the wheel, it is therefore important to harmonise drag and steering torque – especially as they tend to work in opposite directions. A wheel with low drag is therefore usually susceptible to crosswinds.

Geometry of the wheel

The rim profile or geometry of the wheel also plays an important role. Its rotational symmetry results in front and rear airflow over the profile cross-section, as well as a distortion that increases with height (Fig. 9, sections C-C and B-B). The profile cross-section therefore changes over the course of the height until the front and back meet and merge to form a profile (Fig. 9, section A-A). A profile that is streamlined at the front can therefore perform significantly worse with a rear or lateral flow.

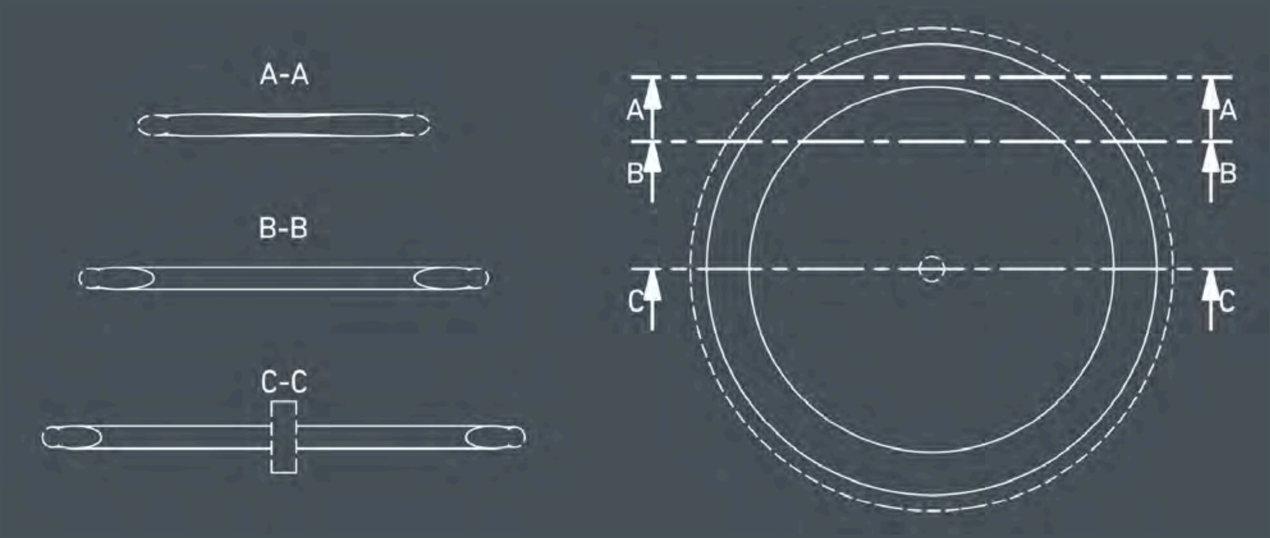


Figure 9: Sectional views of a wheel at different heights

Finally, the tyre must also be taken into account, as its contour is predetermined and must be optimally fitted to the wheel in the sense of a closed surface contact – a design challenge, especially in the rear area, which is becoming even more difficult with increasing tyre widths in road cycling.

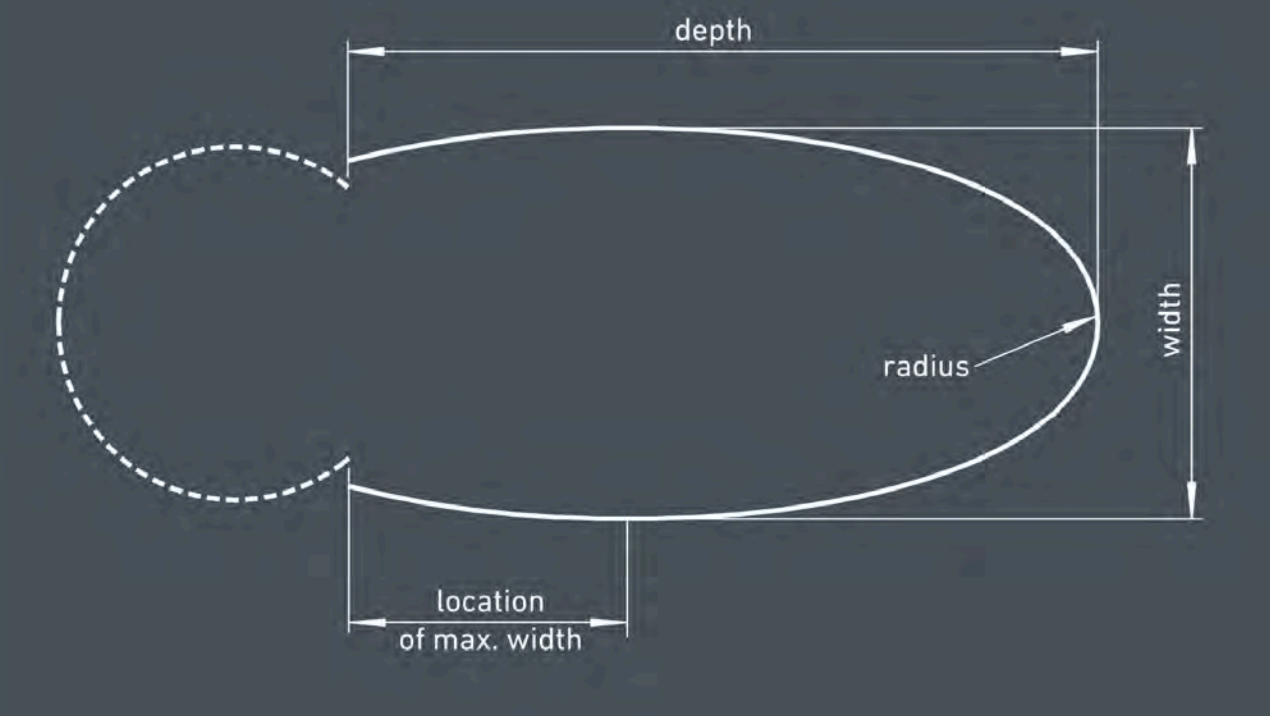


Figure 10: Parameters of the digital wheel model

Development and test results

In order to fully map the complex interrelationships, an independent process was developed, starting with the creation of a digital wheel model that can flexibly adapt parameters such as rim depth or width (Fig. 10). The existing CFD setup was then expanded and adapted to the front wheel – initially, however, with a reduced model complexity in order to realise the simulation of a large number of variants in the shortest possible time.

The resulting insights and trends enabled an initial preselection to be made, especially with regard to rim depth. Figure 11 illustrates the clear trends with higher rim profiles:

- the aerodynamic drag decreases with frontal flow
- the sailing effect starts with a smaller angle of attack and increases more strongly
- the steering torque starts with a smaller angle of attack and increases more strongly
- the steering torque increases more linearly – it starts less abruptly

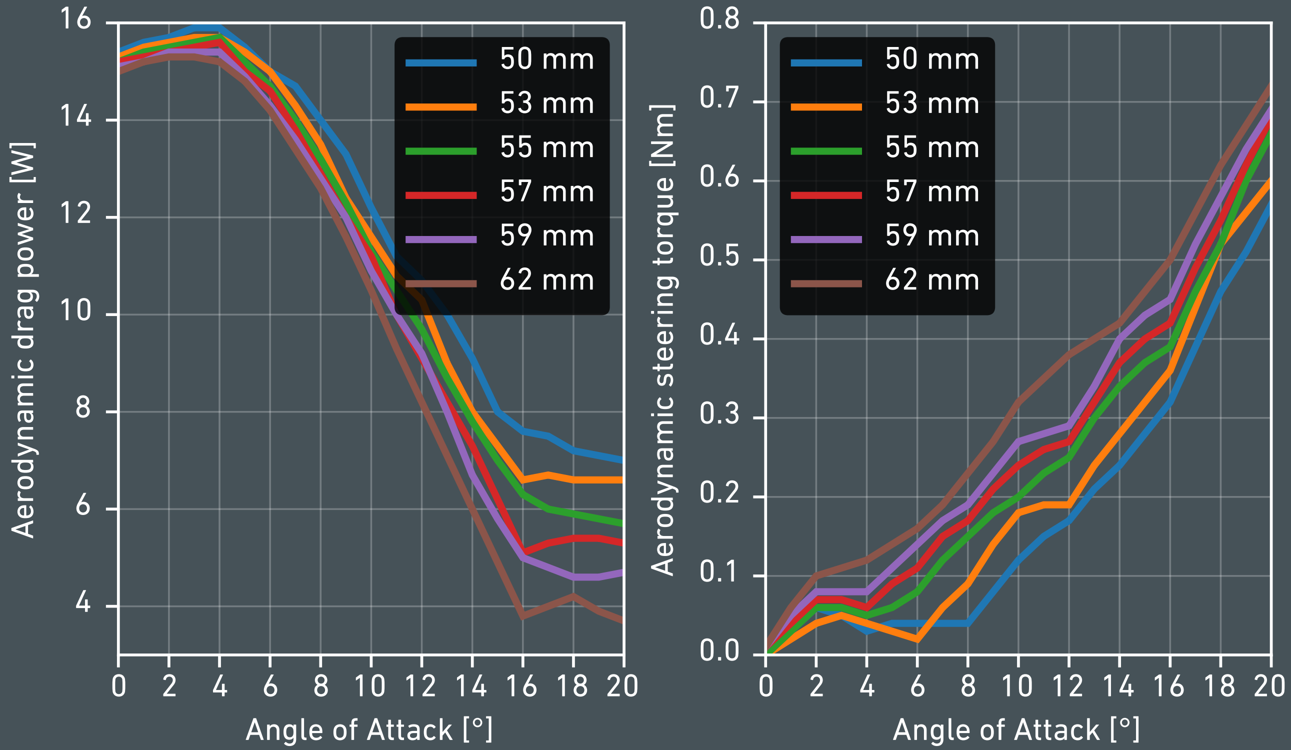


Figure 11: Progression of the aerodynamic drag power and the aerodynamic steering torque of the front wheel over the angle of attack for different rim depths

Based on the results of the first development stage, optimised wheel profiles were derived and integrated into the overall model. The next stage involved systematic geometry variations, this time with maximum accuracy. This made it possible to determine a wheel geometry that delivers the greatest possible aerodynamic advantage in the overall system while simultaneously optimising the steering torque.

The comparison with the RC60 shows that the drag performance has increased slightly, partly due to the lower rim depth. The aerodynamic steering torque, on the other hand, was reduced by 50% (Fig. 12).

The results were also confirmed in the TOUR wind tunnel test. For better comparability, TOUR magazine carries out standard tests with Zipp 404 wheels (58 mm profile, with 25 mm Continental GP5000), followed by tests with the production wheelset (RC55, 55 mm profile, with 28 mm Schwalbe Pro One Aero). Despite the shorter profile and wider tyres, the RC55 showed 205 W in the overall system, which was only one watt behind the Zipp 404 with 204 W. A result that can be seen as a clear success.

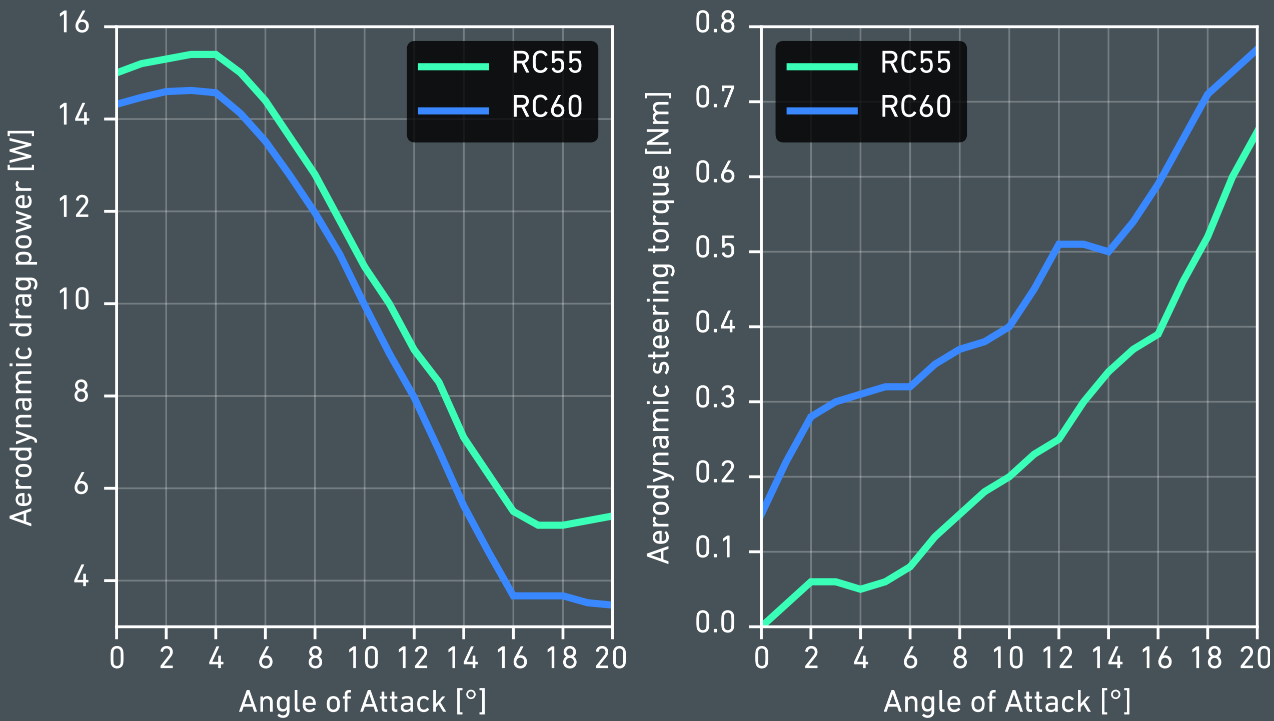


Figure 12: Progression of the aerodynamic drag power and the aerodynamic steering torque of the front wheel over the angle of attack for the RC60 and RC55

Safety

When developing a bike frame, the conflicting objectives of aerodynamics, weight and stiffness are supplemented by a fourth aspect: Safety. In contrast to the other target variables, clear specifications apply to the safety of the overall system (and therefore also the riders), which have the highest priority in development decisions and approval processes.

The ISO 4210 series of standards, which defines specific requirements and test procedures for bicycles, served as the basis for the safety verification. It includes both static and dynamic tests. Dynamic tests are particularly important for evaluating structural integrity, as they provide information on the fatigue and impact behaviour of the frame and fork under repeated cyclic loading.

In addition to the standardised requirements, additional safety tests were carried out by an independent German testing institute. During this process, even higher loads and/or extended load cycle numbers were used in order to map the real material stress even in conservatively set boundary cases (see table). Although these tests can reduce the design freedom with regard to lightweight construction and aero shaping, this was expressly accepted in order to prioritise additional safety reserves.

	ISO 4210	Rose Requirements
Dynamic testing with pedalling forces	1 100 N / 100 000	up to a factor of 1.55 higher load
Dynamic testing with vertical force	1 200 N / 50 000	up to a factor of 1.4 higher load
Dynamic testing with horizontal force	(+)600 N, (-)600 N / 100 000	up to a factor of 1.5 higher load
Impact test (falling mass)	22.5 kg / 212 mm	3 times the drop height
Handlebar/stem unit dynamic (out of phase)	(+-)280 N / 100 000	over a factor of 2 in peak load
Handlebar/stem unit dynamic (in phase)	(+-)400 N / 100 000	over a factor of 2 in peak load

Geometry

SHAVE

Frame Size	XS	S	M	ML	L	XL
Seat tube length (mm)	435	470	492	512	537	575
Top tube length horizontal (mm)	505	525	545	566	582	602
Head tube length (mm)	123	138	157	175	196	223
Head angle (°)	71.00	72.00	73.00	73.25	73.25	73.25
Seat tube angle (°)	75.00	74.50	74.00	73.50	73.50	73.50
Bottom bracket offset (mm)	73	73	73	73	73	73
Chainstay length (mm)	412	412	412	412	412	412
Wheelbase (mm)	975	982	989	1002	1020	1039
Reach (mm)	360	370	378	388	398	410
Stack (mm)	544	562	584	602	622	648
Reach+ (mm)	534	544	562	572	593	604
Stack+ (mm)	608	626	638	666	686	712
Protrusion height (100 mm in Front of BB)	748	774	796	815	837	867
Stack to reach ratio	1.51	1.52	1.54	1.55	1.56	1.58
Stack to reach ratio+	1.14	1.15	1.14	1.16	1.16	1.18
Fork rake ((Offset) mm)	45	45	45	45	45	45
Wheel size	700C	700C	700C	700C	700C	700C
Max. tyre width (mm)	36	36	36	36	36	36
Stem-length (mm)	90	90	100	100	110	110
Size recommendation (cm)	155-166	163-173	171-179	177-184	181-191	189-200
Permissible total weight (kg)	120	120	120	120	120	120

SHAVE FF   SHAVE FFX

Frame Size	XS	S	M	ML	L	XL
Seat tube length (mm)	435	470	492	512	537	575
Top tube length horizontal (mm)	508	527	544	562	584	612
Head tube length (mm)	110	120	135	155	180	205
Head angle (°)	71.50	73.00	73.25	73.25	73.50	73.75
Seat tube angle (°)	75.50	75.00	74.50	74.00	73.75	73.50
Bottom bracket offset (mm)	72	72	72	72	72	72
Chainstay length (mm)	410	410	410	410	410	410
Wheelbase (mm)	969	975	985	998	1015	1038
Reach (mm)	375	385	392	400	412	430
Stack (mm)	515	532	547	567	591	616
Reach+ (mm)	550	570	587	595	617	635
Stack+ (mm)	578	595	610	630	653	678
Protrusion height (100 mm in Front of BB)	735	762	780	799	823	854
Stack to reach ratio	1.37	1.38	1.40	1.42	1.43	1.43
Stack to reach ratio+	1.05	1.04	1.04	1.06	1.06	1.07
Fork rake ((Offset) mm)	44	44	44	44	44	44
Wheel size	700C	700C	700C	700C	700C	700C
Max. tyre width (mm)	35	35	35	35	35	35
Stem-length (mm)	100	100	110	110	120	120
Size recommendation (cm)	155-166	165-175	174-181	179-186	183-193	191-200
Permissible total weight (kg)	110	110	110	110	110	110

Cockpit

Stem/width	350 mm	370 mm	390 mm	410 mm
90 mm		Shave XS, S		
100 mm	Shave FF XS, S		Shave M, ML	
110 mm		Shave FF M, ML		Shave L, XL
120 mm			Shave FF L, XL	

Stem angle: -6° Reach: 78 mm Drop: 125 mm Flare: 13° Weight: 370 g (370 mm / 110 mm)

Seatpost

Length/Offset	0 mm	14 mm
320 mm	Shave FF XS-S	Shave XS-S
380 mm	Shave FF M-XL	Shave M-XL

Wheelset

Rim depth	55 mm
Inner rim width	23 mm
Max. width	33.5 mm front / 30.5 mm rear
Spokes	24 v/h RC55 (Stahl) / 21 v/h RC55CS (Carbon)
Weight	RC55 1360 g / RC55CS 1280 g