PRINCE

INDEX

CICLI PINARELLO S.R.L. | Viale della Repubblica, 12 - 31020 Villorba (TV) - Italia
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1. INTRODUCTION

Cicli Pinarello SpA is one of the most famous and winning bike manufacturer in the world. Founded in Treviso (Italy) in 1952 by Giovanni (Nani) Pinarello, it produces high end racing bikes. This name, Pinarello, recalls legendary victories of the greatest cyclists of all times: since 1975, the first victory in **Giro d'Italia** with **Fausto Bertoglio**, Pinarello has won all the most important races in the world, including **Olympics**, **World Championship**s and **Tour de France**.
All the bikes produced for the best riders in the world are also available for the amateurs, to allow everyone to perform the best possible. The collaboration with the pro riders allow us to develop cutting edge technologies in order to win the races…. those technologies are then applied on the bikes that everyone could buy and use.

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2. PURPOSES OF PINARELLO PRINCE PROJECT

Identify the project's purposes it is essential when designing a new bike, especially if it must be an all-around bike. Follow them along the development and, at the end, verify that the new project satisfy the initial requests.
Prince project start with the idea to provide to all cyclist the pleasure of having a Pinarello bike with its well know riding feeling and unbeatable handling.

Starting from the experiences we had developing the F8 and F10 the main purposes we follow for the Prince project were:

- Reduce air drag, to eliminate any waste of energy due to air resistance.
- Guarantee the Pinarello performances and stability.
- Provide the best riding feeling and handling for every rider
- Rise up the bar in terms of performances for the mid-segment bike

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3. AERODYNAMIC DESIGN

All the aerodynamic improvements design for the new Prince project were focused to reduce the overall drag of the system composed by bike and rider. The huge amount of data and the analytic experiences we did developing Bolide HR, Bolide TT and F10 was the starting base to improve the aero performances of the new Prince bike.

We approach the problem developing dedicated shapes for each single part of the bike but always keep in consideration the overall system, because it is the airflow interaction between all the components that makes the difference in terms of drag reduction.
The main areas of improvements are:

a. Downtube
- **Concave Downtube**
- **Wheel Shaped Downtube**
- **E-link**

b. Fork Flap

c. 3X Air

d. Airflow Hidden Rim Brake

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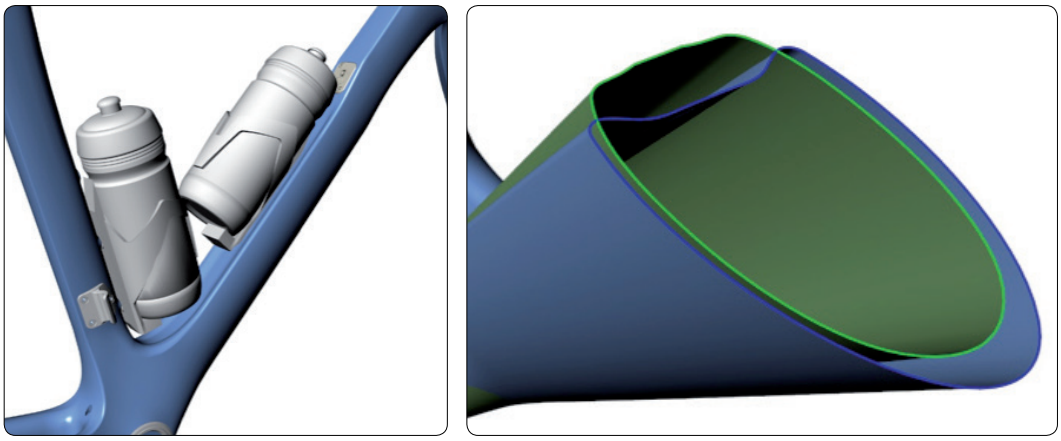
3a. DOWNTUBE - CONCAVE DOWNTUBE

Downtube is one of part of the frame which has a significant influence on the aero performances. Due to its dimension (is the wider tube of the frame) and due to its position just behind the front wheel, it generates a big portion of the overall drag of the frame. Therefore, optimizing the downtube shape and the air flow around, it would generate a significant improvement on the bike drag.

CONCAVE DOWNTUBE
One of the greatest aerodynamic study done on the Bolide TT and F10 was then applied to the new Prince.



We developed several possible cross sections for the down tube in order to find the perfect compromise that optimize the airflow around the tube shape and the protection of the bottles and the seat tube. Thanks to the CFD calculation we define a downtube shape that allowed to reduce the bottles' drag and the tube itself. In comparison to the old GAN frame, the drag reduction is more than 10% (data derived from F10 analysis).

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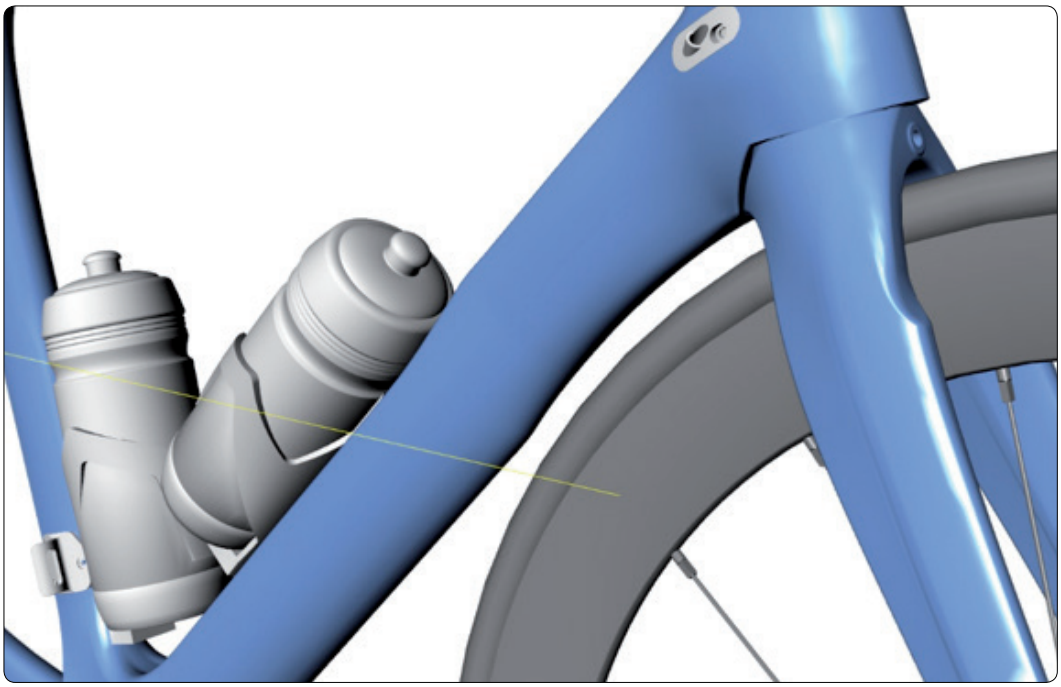
3a. DOWNTUBE - WHEEL SHAPED DOWNTUBE

WHEEL SHAPED DOWNTUBE

Keeping under control the aerodynamic interaction between the front wheel and downtube was a must in the Prince project. This area is particularly sensitive because the turbulences generated between the rim and the tube shape will then effect the general air flow around the bike and around the rider.

Thanks to the CFD analysis we discover that if the downtube shape is close to the front wheel , the airflow goes more harmonically along the tube shape. A more harmonic stream means and airflow with higher energy and so with much less drag.



The picture above shows the difference between the Gan frame vs the new Prince frame. It is well visible that the downtube shape is bigger and closer to the front wheel. In order to optimize the effect but keeping the frame always in the UCI rules, the downtube has a particular shape that follow as close as possible the round shape from the rim. The distance between tyre and downtube is reduced by 40% if compared with the Gan frame.

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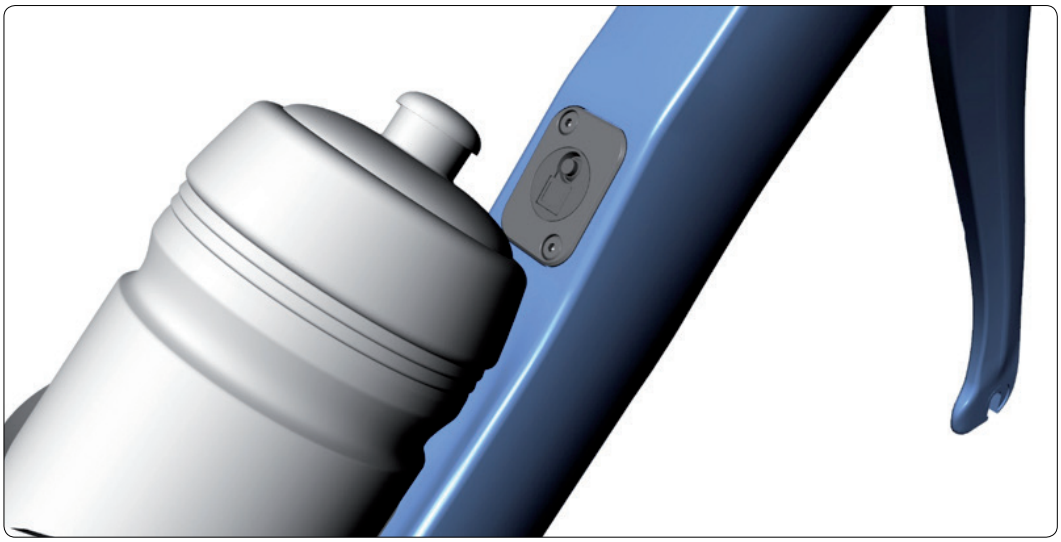
3a. DOWNTUBE - E-LINK

E-LINK

The junction of the Shimano DuraAce Di2 and the new Shimano Ultegra Di2 is integrated into the down tube. This provide an unquestionable aerodynamic improvement and also a more ergonomic access for adjustment and recharge.



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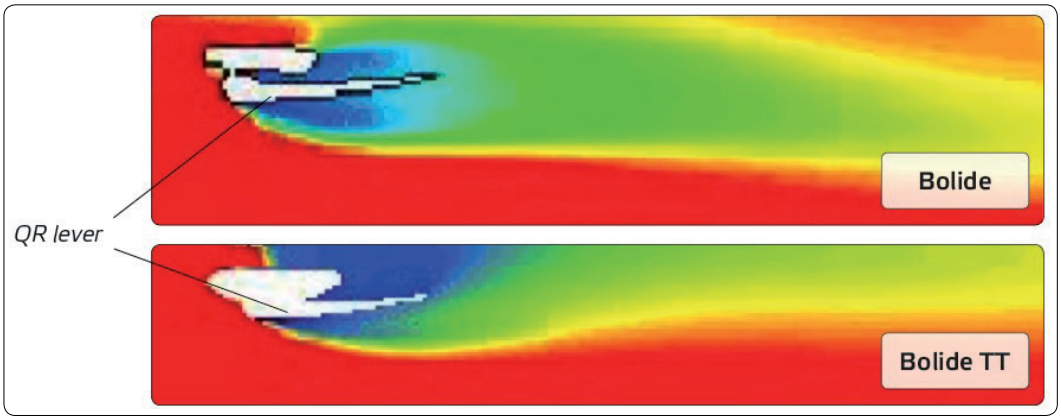
3b. FORK FLAP

In terms of aerodynamics, the front of the bike is the most important part because it is the first surface that runs into the airflow and influence the stream behind. So even something little like the Fork Flap, introduced the first time on our record bike Bolide HR, can generate a big improvement in aerodynamic.
The concept behind the Fork Flap is to reduce the slipstream that is generated by the air going around the fork and the Quick Release. On a traditional fork the QR lever generates a big slipstream behind the dropout, with the consequence of increasing the drag. Adding material behind the dropouts, where the slipstream is high, we were able to reduce it. Analysis derived by the Bolide TT fork and repeat on F10 shows a drag reduction up to 10%.



As visible on the picture above, the design of the dropout encloses part of the QR lever generating a narrower slipstream that tends to move towards the frame.
Finally, as done on F10, the final Fork Flap shape is designed to get the best compromise between aerodynamic and lowest weight.

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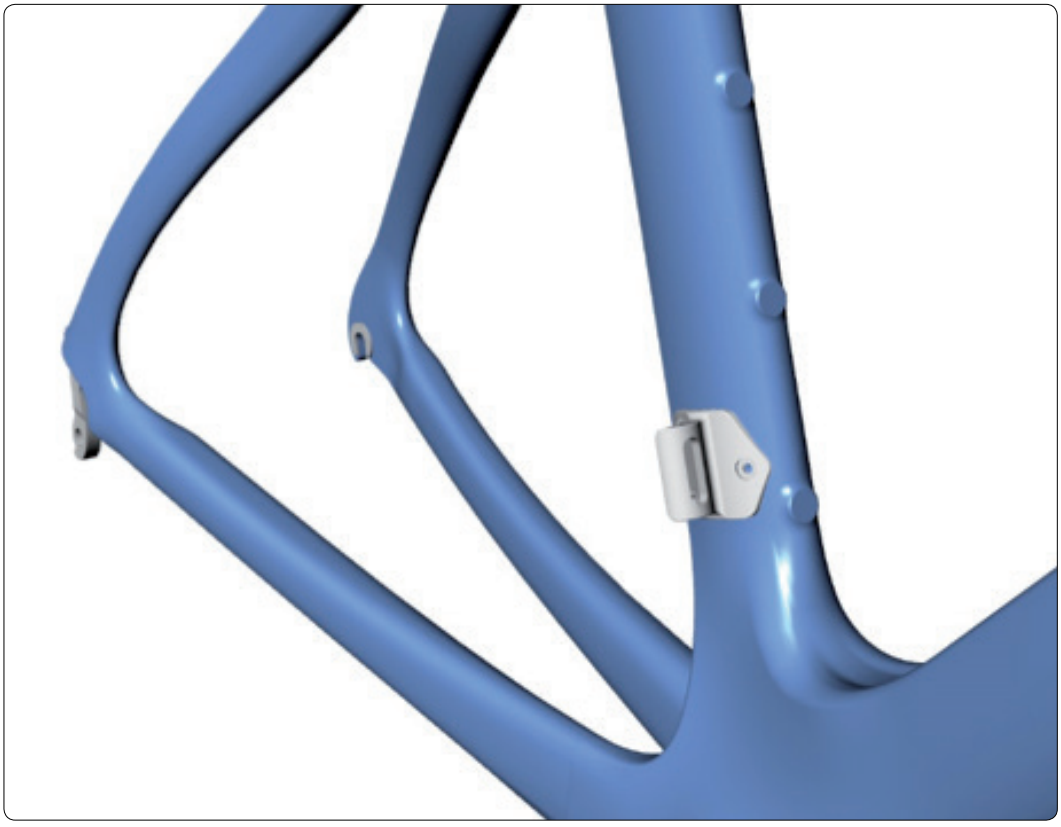
3c. 3X AIR

As we have done on F8 and F10, now also on Prince is available the 3X Air concept. Thanks to the 3rd rivet on the seat tube, the bottle cages has now 2 positions. The lower one improves aerodynamics because the bottles is even more protected by the down tube , the higher one improves accessibility and comfort.



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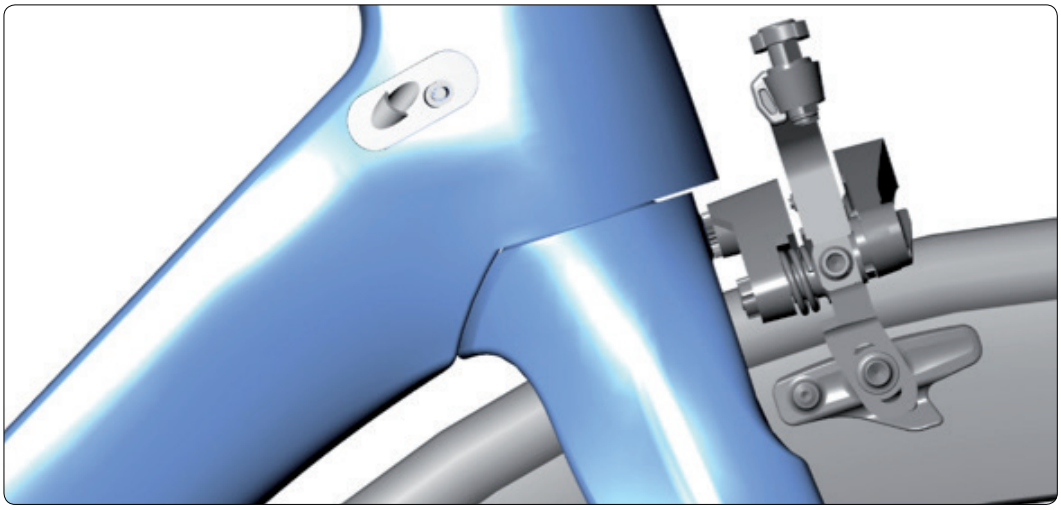
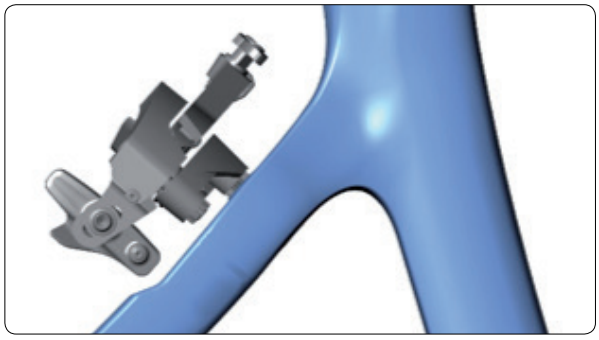
3d. AIRFLOW HIDDEN RIM BRAKE

As explained before on Fork Flap, the front surface area of bike is one of the most crucial part in terms of aerodynamic. In order to further develop the airflow around those surfaces with the clear target to reduce the turbulences, we put analytic efforts to optimize the front and rear brake area.
On the new Prince the head tube is moved forward to allow a more aerodynamic shape. In addition to that the fork is design with a specific recess. In this way the front brake is positioned close as possible to the head tube and it is better integrate with the fork profile. The airflow moving around the fork can be better guided and steer away from the down tube shape.



At the same time the rear brake is hidden from the airflow thanks to the seat stays shape. Since the brake is asymmetric, thus the seat stays are asymmetric. As done on the fork, the seat stays profile has a recess to integrate in the best way the brake.



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4. STRUCTURAL DESIGN

a. Asymmetrical Design
b. Material's choice
c. Disk Version

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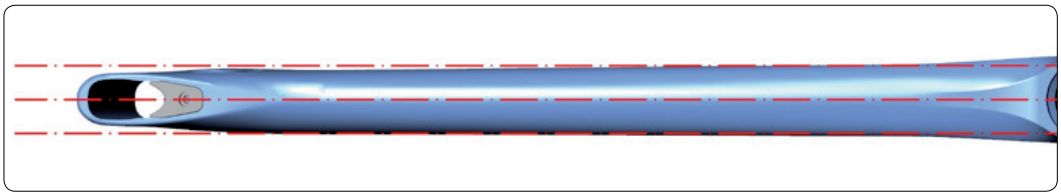
4a. ASYMMETRICAL DESIGN

Since Pinarello introduces the FEM analysis for developing the frame shape, was immediately clear that the final tube design is the optimal compromise between an aero shape and a stiff shape. So define the proper tubes cross section in order to assure rigidity and drag reduction is a topic in every Pinarello frame.

The Asymmetric design of Pinarello frames is the perfect answer to that. The right side of the frame is larger than the left side, this counteracts the asymmetric forces coming from the combined action of rider and chain, provides a stiffer and more balanced bike and let more freedom to optimize aerodynamically the tube shape.

The new Prince frame was developed following the Asymmetric principles. The top tube section was moved to the right side, as clearly visible on the picture below.



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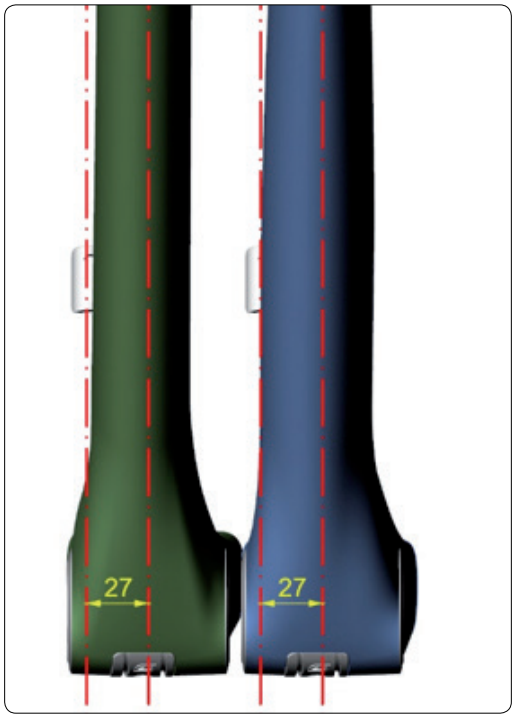
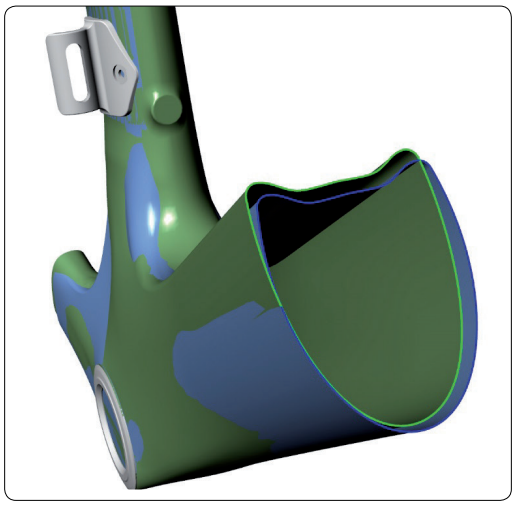
At the same time the down tube was not only enlarged, but moved even more to the right side of the frame. The picture below shows the comparison between the Gan frame and the new Prince. Moving the down tube on the right side the Prince frame becomes stiffer and increase the overall balance of the bike.





Prince is a bike designed for a very large target user, so in order to make it more comfortable if compared with the F10, the downtube cross section is a bit less asymmetric and a bit more round. The overall cross section is slightly bigger as F10 to compensate the different material used. This assure a perfect level of stiffness for the target user and guarantees smoother and more pleasant riding feeling.

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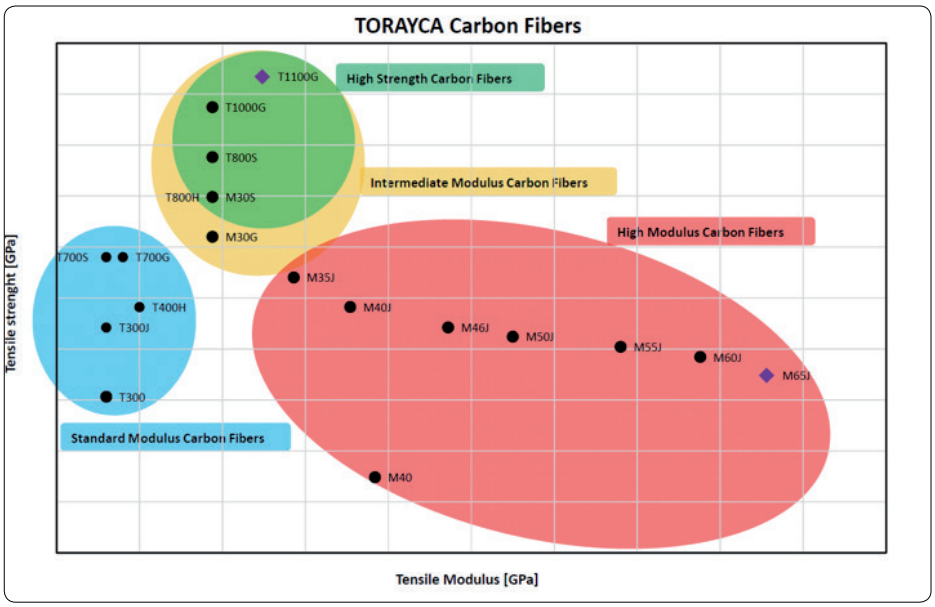
4b. MATERIAL'S CHOICE

The proper choice of material deeply influences the frame performances. The use of Carbon Reinforced Polymer (CFRP), can be optimized for every single area of the frame to achieve the desired stiffness and lightness values. For example in areas where the stiffness must be favorite, a high modulus fiber (HM) could be used, while where the strength is primary, a high strength fiber (HT) should be preferred. This variation of material could be done locally, into the same frame, while metallic material would entail constant properties in the entire frame.



On Prince frames we used high tensile strength fibers (HT) like T900 and T700. This choice contributes to increase the impact strength and to prevent breakages.

The modularity of CRFP allowed the designer to control and define the stiffness and lightness of the same frame just changing the material used. So, the right choice of fiber properties, type of resin and lay-up method will influence the behavior of the bike allowed to optimize the same frame for different target user. Prince is designed for a very wide range of user, for that reason we decide to produce 2 different type of frame based on the same shape: Prince FX and Prince. Those frames will adopt different tensile strength fibers (T900 and T700) and different grade of carbon 3K and 12K. This choice provides different response of the frame and different weight, but at the same time, allows to have cheaper version based on the characteristic of every rider.

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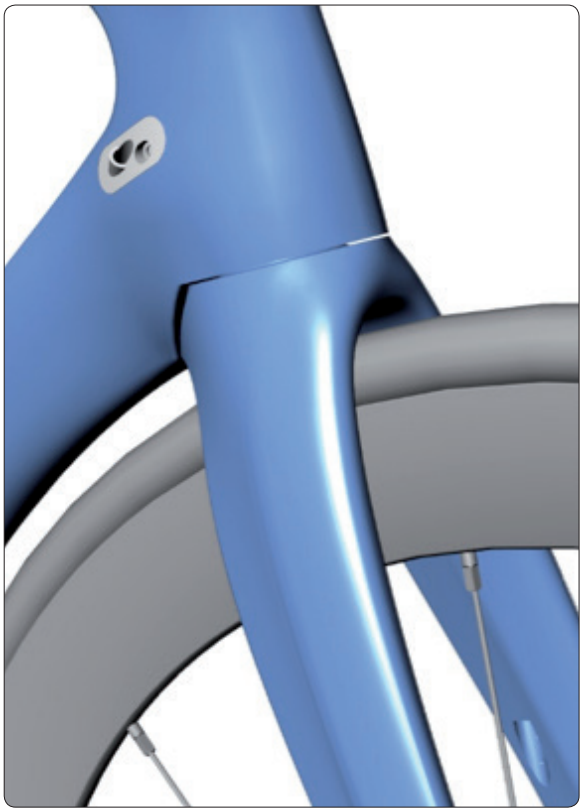
4c. DISK VERSION

Prince will be available also as Disk version. It will combine all the qualities and features of the rim brake version with the strength and reliability of a disk brake system.
The fork has been designed in order to integrate the thru axles (100x12mm), for better stiffness of the front wheel and to increase the precision at the beginning of the turn.
To improve the aerodynamic and the integration, the fork head was designed with a unique shape that integrate the front surface with the head tube surface.



The chain stays are designed with 142x12mm thru axle for the best responsiveness and stability during the braking phase.
Both, front and rear Caliper are Flat Mount and allowed 160mm disk.
The disk brake integration contributes to elevate further the cutting edge design of the Prince, letting the fork crown and the rear stays perfectly clean.

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5. PRODUCTION

a. RP Sample
b. Engineering Sample

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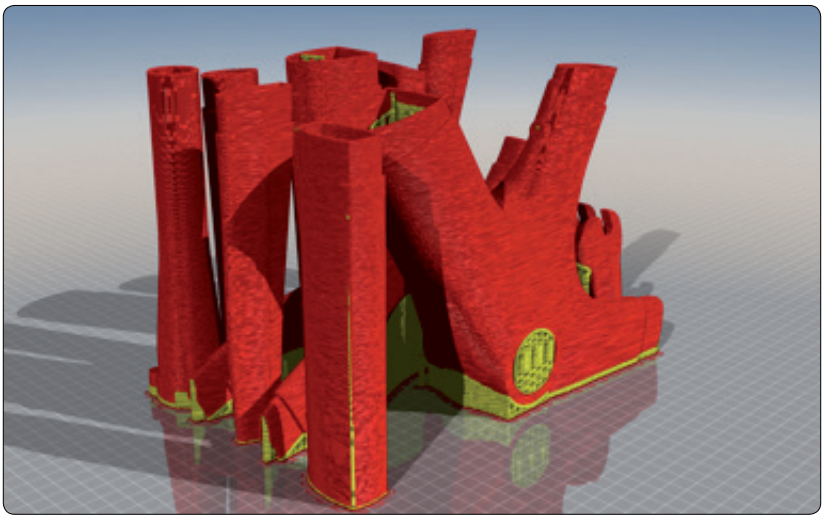
5a. RP SAMPLE

Since 2015, the development of the bike largely use the 3D printing technology to have a continue control of real samples. In 2017 Pinarello invests in a new 3D printing machine that allowed the engineers to realize faster and more precise frame parts.

Prince was completely developed used 3D printing technology. For example, several shapes of the down tube were printed to check the matching with the other bike parts from a functional and aesthetic point of view.



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5. **PRODUCTION**
a. RP SAMPLE

At the end the complete frame was printed before obtaining final aesthetic approval and before making molds.

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5b. ENGINEERING SAMPLE

After the main development phase, we proceed with the production of the first sample in carbon fiber materials, called ES (engineering sample).

These sample were used to verify the assembly of the bike and mostly the performances of the frame. Static and dynamic test where conduct to measure the stiffness of the bike and to compare the values with the initial target of the project. The laboratory test where obviously compared with the road tests to assure the correct behavior on field.

Once the results are obtained and before to give the green light for production, the Engineering Sample had to pass all the normative test to get the ISO 4210 approval.

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6. TECHNICAL SPECIFICATION

a. Main Features
b. Geometries

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6a. MAIN FEATURES

Prince frames are the latest evolution of the all round bike from Pinarello for a wide range of users. Prince comes from experience and technologies developed for top range models but adapted for a less-extreme use, maintaining the unmistakable riding style of the most successful company in Tour de France.

Prince is available in 3 different options:

- **Prince FX**: very performing, reactive and precise frame. Ready to race.
- **Prince**: more docile frame, intended for those who want to perform without excess.
- **Prince Disk**: disk brake version to emphasize safety and riding precision.

In details all the specification that makes Prince the new standard in terms of performances for mid-range road bikes

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PRINCE FX

- Carbon Torayca T900 3K
- Asymmetric frame
- Italian thread BB
- Drop In bearing system with tapered headset (1" 1/8 up; 1" ½ down)
- Think 2, to fit electronical or mechanical groupsets on the same frame
- Internal cable routing
- FSC Frontal seatclamp, integrated and aerodynamic
- Flatback profiles
- Concave Downtube
- Wheel shaped Downtube
- E-link
- 3X Air
- Fork Flap
- Max Tyre 700x25mm
- 940g for raw frame size 530
- UCI approved

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6. TECHNICAL SPECIFICATION
a. MAIN FEATURES

PRINCE

- Carbon Torayca T700 12K
- Asymmetric frame
- Italian thread BB
- Drop In bearing system with tapered headset (1" 1/8 up; 1" ½ down)
- Think 2, to fit electronical or mechanical groupsets on the same frame
- Internal cable routing
- FSC Frontal seatclamp, integrated and aerodynamic
- Flatback profiles
- Concave Downtube
- Wheel shaped Downtube
- E-link
- 3X Air
- Fork Flap
- Max Tyre 700x25mm
- 960g for raw frame size 530
- UCI approved

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PRINCE Disk

- Carbon Torayca T700 12K
- Asymmetric frame
- Italian thread BB
- Drop In bearing system with tapered headset (1" 1/8 up; 1" ½ down)
- Think 2, to fit electronical or mechanical groupsets on the same frame
- Internal cable routing
- FSC Frontal seatclamp, integrated and aerodynamic
- Flatback profiles
- Concave Downtube
- Wheel shaped Downtube
- E-link
- 3X Air
- 25mm tires fitting
- RAD SYSTEM Disk brake
- Front Axle 100x12mm Shimano®
- Rear Axle 142x12mm Shimano®
- Disk Flat Mount max 160mm
- Max Tyre 700x25mm
- 980g for raw frame size 530
- UCI approved

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6b. GEOMETRIES

Pinarello is used to offer every single rider the best bike. The well know "Made4you" concept was applied during development of the Prince. The result is 10 sizes available as unisex (included size 620) and 4 sizes Easy Fit dedicated for women.
Every single size of the frame is design on its own, for example the bigger sizes are shaped in order to absorb bigger stresses while smaller sizes can by lighter saving material. The main purpose is that every rider can ride his Pinarello with the same feeling and performance.

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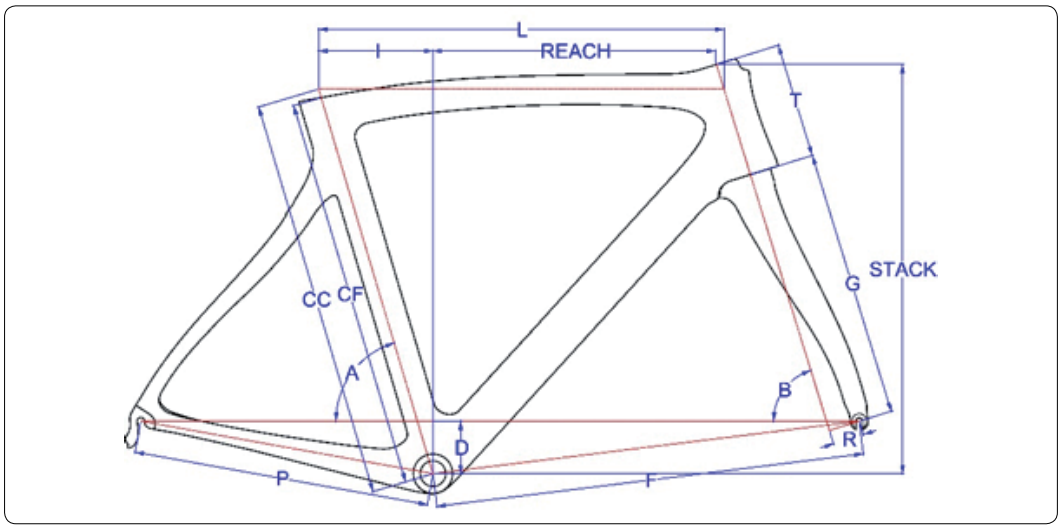
6. TECHNICAL SPECIFICATION
b. GEOMETRIES

Here in detail the Prince geometries



CF	CC	L	I	A [*]	B [*]	F	P	T	D	R	G	REACH	STACK
435	440	503	118	74,40	70,00	565	408	115	67	43	367	354	506
460	465	515	124	74,40	70,50	575	408	120	67	43	367	367	513
495	500	525	138	74,00	71,40	575	408	125	72	43	367	372	525
510	515	535	145	73,70	72,00	577,5	408	130	72	43	367	378	532
525	530	545	149	73,70	72,50	583	408	139	72	43	367	386	543
535	540	550	154	73,40	72,80	583	408	152	72	43	367	384	556
545	550	557	157	73,40	72,80	590	408	163	72	43	367	387	567
555	560	565	163	73,00	73,20	591	410	170	72	43	367	390	575
570	575	575	168	73,00	73,70	596	410	184	72	43	367	395	590
590	595	587	180	72,40	73,40	605	410	210	67	43	367	395	609
615	620	620	192	72,00	73,40	633	411	255	67	43	367	410	651

EASY FIT geometries

CF	CC	L	I	A [*]	B [*]	F	P	T	D	R	G	REACH	STACK
440	425	500	117	74,00	70,00	563	408	115	67	50	367	348	504
475	460	512	127	74,00	71,00	570	408	130	67	50	367	358	522
505	490	528	139	73,50	72,00	575	408	145	72	50	367	365	544
525	510	545	149	73,00	72,00	588	408	155	72	50	367	374	544

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