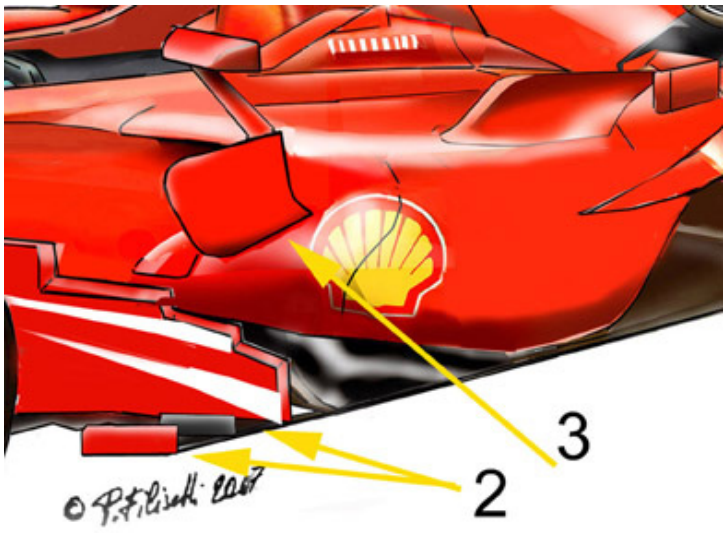
Giorgio Piola

Formula 1

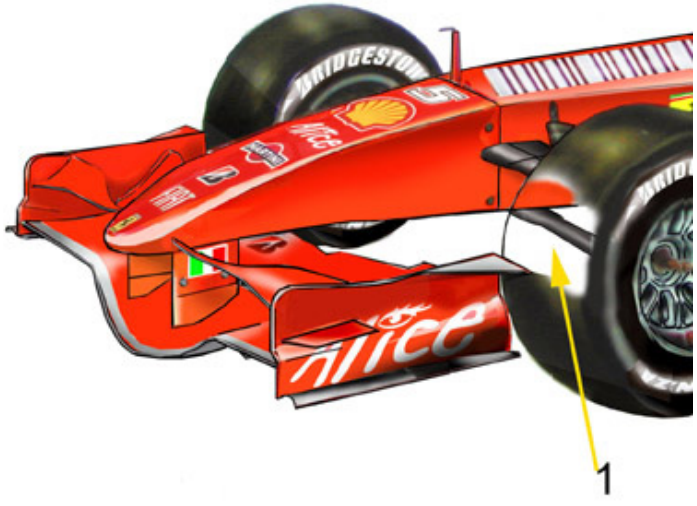
technical analysis
2007-08

ΑΗΔΡΕΑΣ



Ferrari F2007 - Barge boards, winglets and sidepods (29 January)

Although the F2007's sidepods feature larger radiators, the slightly smaller air inlets and the steeper angle of the radiators have reduced the width of the car's cross-section. The barge boards (2) have also been heavily refined and now sport a more sculpted, serrated profile. Two small vertical fins have been added at the front to divert and adjust the airflow around the lower section of the sidepods. The winglets (3) in front of the sidepods have been narrowed at the top and feature wider vertical shields. This development is designed to work in conjunction with the winglets behind the cooling chimneys (top right). The rear end of the F2007 is visibly narrower and lower than its predecessor, improving the efficiency of the rear wing.

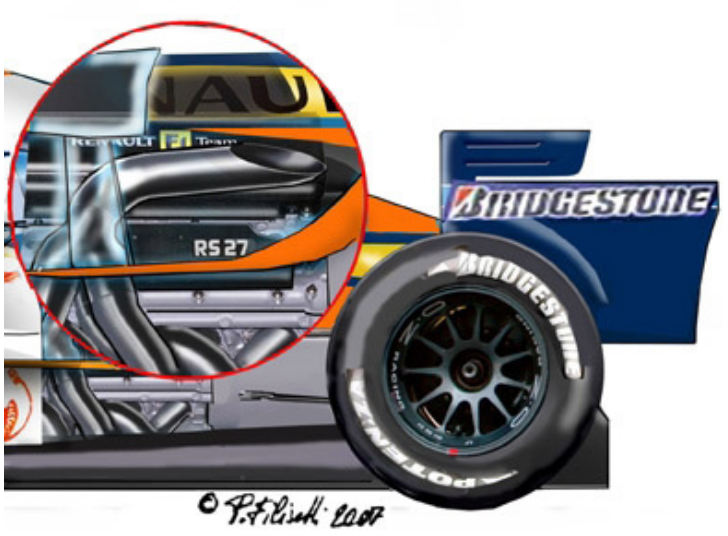


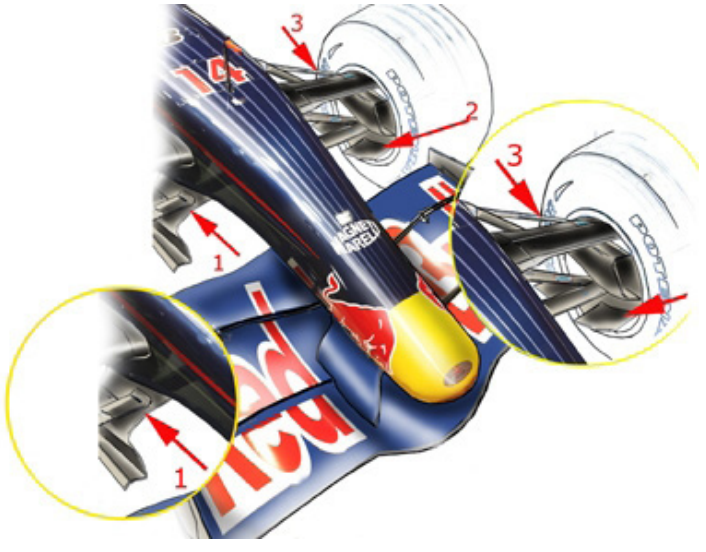
Ferrari F2007 - zero keel concept (29 January)

One of the most noticeable changes to the new Ferrari has taken place to the mounting of its front suspension. Rather than the traditional single keel, which appeared on 2006's 248 F1, the F2007 sports a 'zero keel' arrangement - a first for Ferrari. Gone is last year's bulb-shaped keel. Instead the car's lower wishbones are attached directly to the lowest corners of the chassis (1). This modification should dramatically improve the efficiency of the bottom of the car by improving the quantity and quality of the airflow passing underneath.

Renault R27 - sidepod development (30 January)

The R27 is mostly an evolution of the title-winning R26. The area around the sidepods, however, has undergone some more radical changes. Vertical winglets (left arrow) have been added in front of the sidepod inlets, also acting as pillars for the car's rear view mirrors, which are now positioned Ferrari-style on the external edges of the sidepods. The bottom edge of the winglets now extends along the length of the sidepods (right arrow), eventually connecting with the flip-ups in front of the rear wheels. The aim is to prevent any interruption of the airflow towards the car's rear end.





Renault R27 - quick-shift gearbox (30 January)

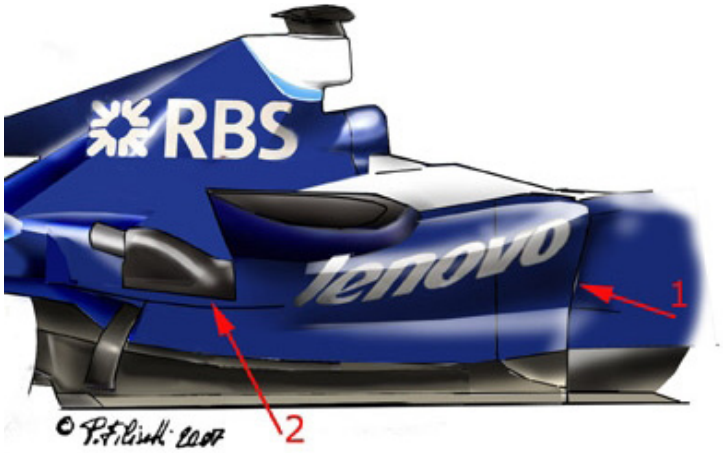
Renault's new car, the R27, boasts a completely revised gearbox, featuring the 'quick shift' system already adopted by some teams, designed to cut shift times to practically zero. The gearbox is coupled with the RS27 engine, a refined version of last year's V8, featuring new pistons, cams, valves, conrods, and redesigned combustion chambers.

McLaren MP4-22 - nose pillars (02 February)

The MP4-22 sports a very different nose pillar arrangement to its predecessor. Rather than being connected to the wing's main profile as before, the curved pillars are now attached to the lower of the wing's two flaps (yellow arrows), leaving the main wing profile completely free. The result is that when airflow impacts the main profile - the foremost part of the car - it is not disrupted by turbulence from the pillars. This should make the front wing more efficient and also improve the quality of the airflow passing underneath the car. Increased downforce and better stability are the results.

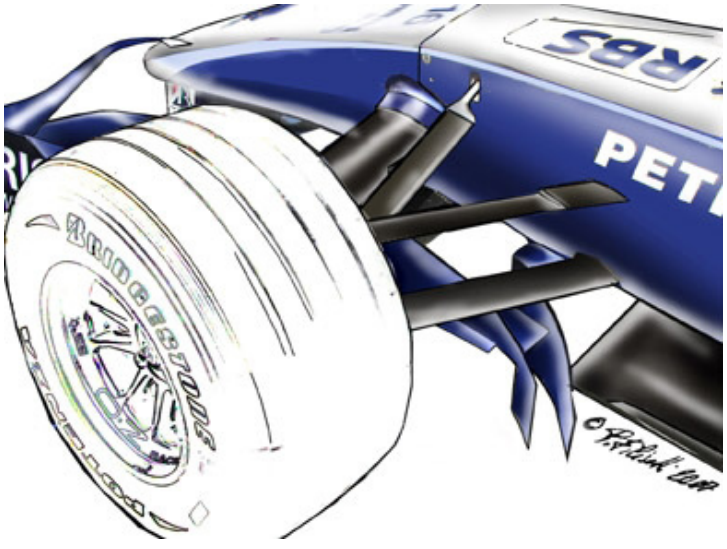
Red Bull RB3 - front suspension (02 February)

What is most striking about the Adrian Newey-designed RB3 is not just its resemblance to previous McLarens, but its front-end detailing. One obvious changes is the adoption of a twin keel (1). Although most teams have gone to a zero-keel arrangement, Newey's design does not represent a step back. There is very little difference in terms of overall efficiency between the two and a twin keel integrates more easily with the rest of Newey's front-end aero package. The actual arrangement of the suspension (2) and how it will manage airflow to the wheels is far more interesting. The wishbones are heavily sculpted and wing profiled in an effort to reduce turbulence generated by their presence. The area close to the brake cooling ducts features an array of small winglets and fins (3), which will divert airflow to minimise disruption generated by the rotation of the wheels. These seemingly small details have a huge effect on cooling efficiency - crucial given this car's small radiators.



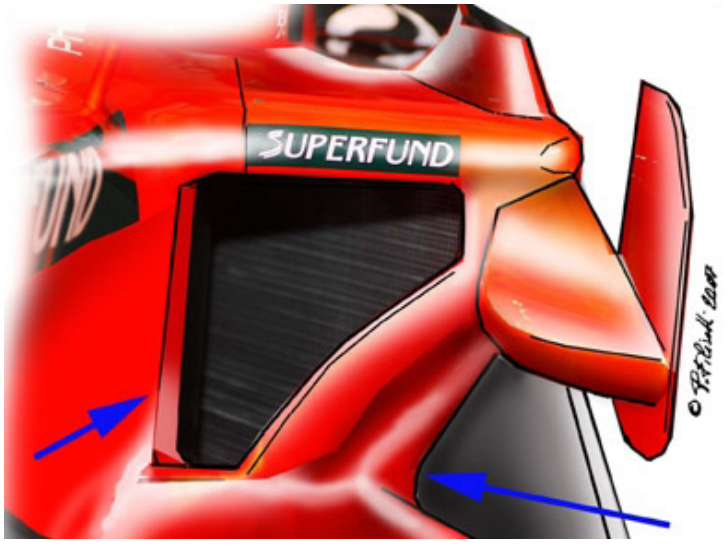
Williams FW29 - sidepod developments (19 February)

The sidepods of the new Williams FW29 (1) have become noticeably narrower towards the bottom. This is to improve aerodynamic efficiency in this area, reduce drag and hence make the rear wing mor effective. As a result, the radiator inlets have been reduced in size and the radiators themselves, though larger than before, have been inclined at a different angle to take up less space. In comparison to last year's car, the rear end is also much more tightly packed and lower, while the engine exhaust chimneys (2) - now far more visible - have been increased in volume in an effort to improve the extraction of hot air from the sidepods.



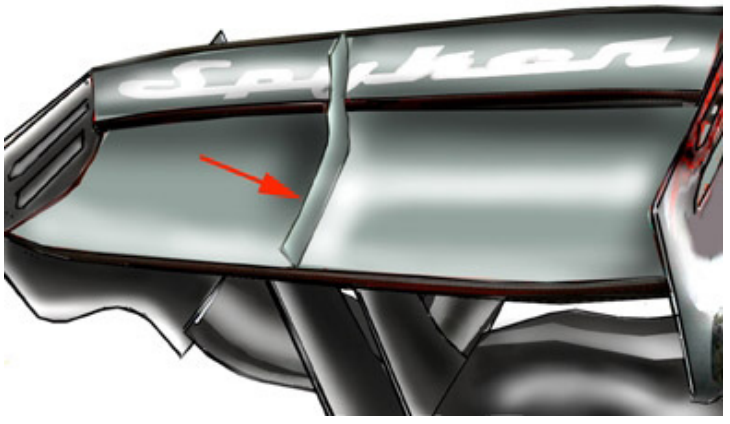
Williams FW29 - front-end aero (19 February)

Williams constantly developed this area last year and the results are seen here. It is crucial to correctly manage airflow at the front of the car. It is where you begin controlling the air that passes to the rear of the car, feeding the rear wing and the under-body diffuser, and the air entering the sidepods for engine cooling. On the FW29, Williams have kept the same configuration seen during the last races of 2006. The front wing features a long sinuous upper profile, while an array of vertical shields at front-suspension level help to deflect the turbulence generated by the front wheels.



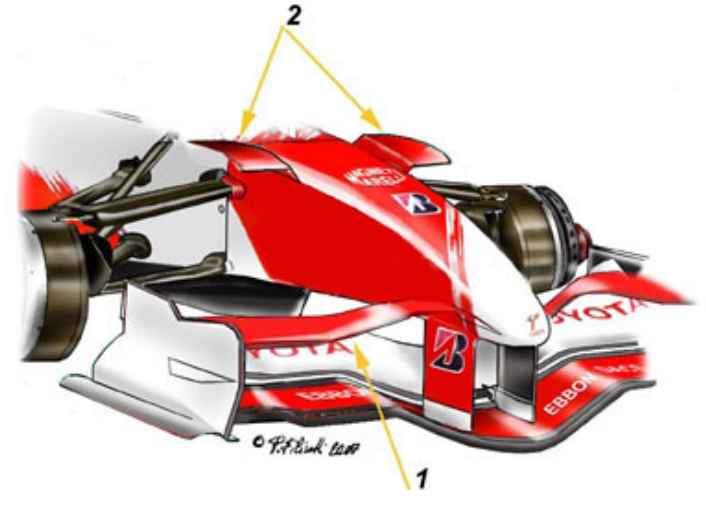
Spyker F8-VII - tapered sidepods (21 February)

These represent the most noticeable change on the new Spyker over its predecessor. Like most other teams, Spyker have opted to taper the sidepods at the bottom, in an effort to improve overall aerodynamic efficiency by reducing drag and by increasing the quality and quantity of airflow directed towards the bottom and rear of the car. The change can be seen most clearly in profile, the bottom edge of the sidepod (right arrow) markedly narrower than the top. As a result, the radiator inlets sport vertical sections (left arrow), feeding air to radiators inclined on their vertical axis.



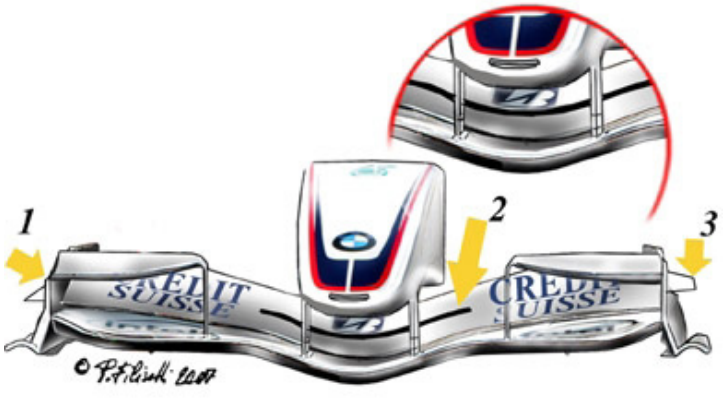
Spyker F8-VII - rear-wing fin (21 February)

Though it won't necessarily be fitted for March's Australian Grand Prix, there's currently an interesting addition to the F8-VII's rear wing - a vertical fin (arrow) in the middle of the main profile and flap. This has a double purpose. Firstly, it keeps the main profile and the flap rigid. Secondly - and arguably more importantly - it acts as a sort of turning vane, splitting the airflow that hits the main profile and flap in two, reducing the drag generated by these elements. It also creates a depression of negative pressure, which in turn will increase the speed of the airflow exiting the rear wing and improve the extraction of air from the rear diffuser.



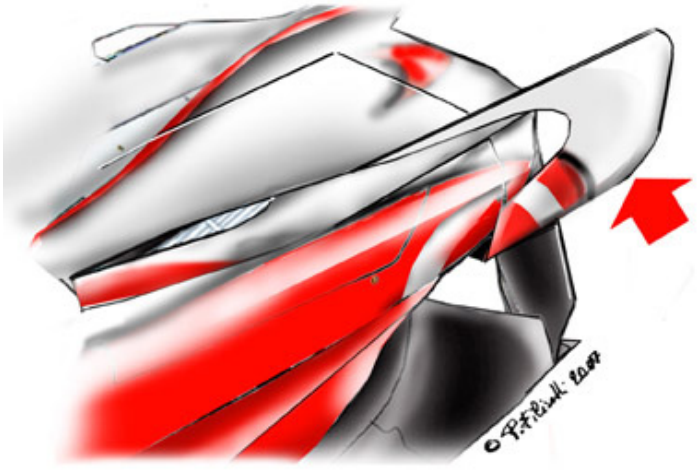
Toyota TF107 - front-end aero (27 February)

This dramatically-revised front wing appeared at last week's Bahrain test. Its sinuous upper profiles (1) now extend from the endplate and - unusually - connect directly to the nosecone, in a bid to generate more downforce. In addition, two large horizontal 'ears' (2) have been added to the side of the nose cone. These are an evolution of the winglets introduced last year, but in a slightly lower position over the push-rod link. The new 'ears' reduce both drag and turbulence generated by the front suspension elements. They also split the airflow in two, the lower part directed into the sidepod inlets and the upper part towards the rear wing.



BMW Sauber F1.07 - front-wing development (28 February)

At first sight the F1.07 hasn't altered much since launch, but looking at the front wing, there's a variety of small changes. The endplates (1) have lower entry edges, which curve inwards and connect to an additional upper profile. This reduces turbulence generated when the airflow hits the edge of the endplates. In addition, new small horizontal profiles (3) act as airflow splitters ahead of the front wheels, lessening turbulence from air impacting the wheels. Another interesting new feature is a slit (2) in the wing's main profile. This divides the flap in two, acting like a double flap to increase downforce, but - because the wing isn't split over its entire length - with less drag.

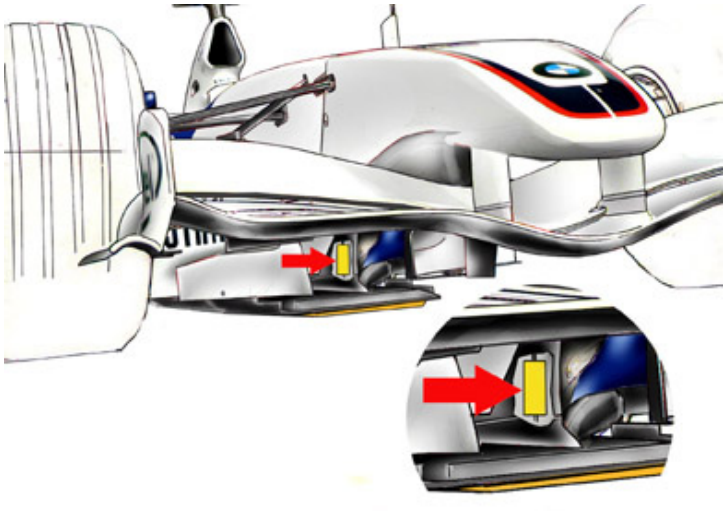


McLaren MP4-22 - sidepod front winglets (01 March)

Until recently McLaren were one of the few teams not sporting large vertical winglets, or shields, in front of the sidepods. They finally introduced their interpretation of these elements (red arrow) at the recent Bahrain test. With a less rounded leading edge than many rivals' equivalents, they are also unusual in that they connect to the foremost edge of the elongated cooling chimneys, which also act as a kind of turning vane atop the sidepods. The new shields help manage airflow in the critical area in front of the radiator inlets, hence improving cooling whilst raising aero efficiency through reduced turbulence and increased downforce.

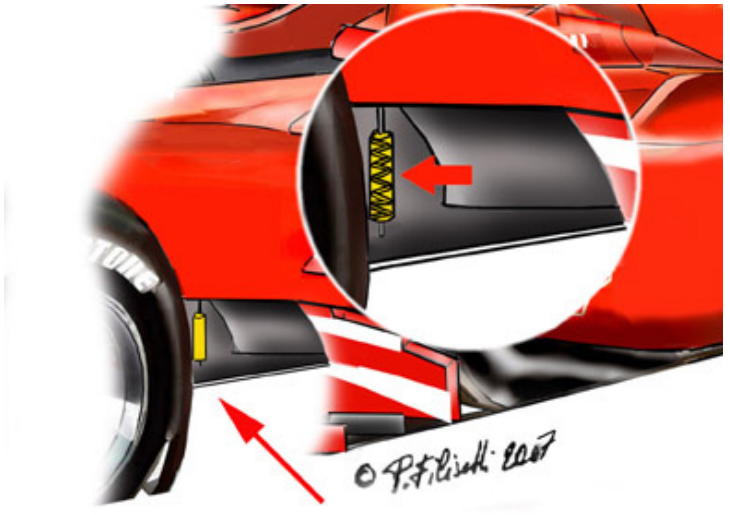
Renault R27 - nosecone winglets (02 March)

It is not the first time the R27 has sported 'ears' (arrow) on its nosecone, but it seems likely, after the new additions appeared once again in Bahrain, they have become a permanent fixture. Designed to improve airflow management around the cockpit and reduce turbulence, these horn-like winglets are positioned halfway between the front axle and the cockpit and bend upwards, extending outwards by 25 centimetres. They are designed to split the airflow into two parts, with the lower flow directed to the sidepod inlets and the upper flow towards the rear wing.



BMW Sauber F1.07 - bib stay (04 April)

The system adopted by BMW is similar in its basic concept to the one used by Ferrari. The supporting device (red arrow) between the bib (the front section of floor under the splitter) and the splitter endows the portion of floor closer to the ground with a certain degree of movement - enough to prevent damage to the floor over kerbs, but not enough to fail the mandatory floor deflection test. The question being asked in Melbourne was could such devices be used to circumvent the regulations and allow greater movement at speed. From round two in Malaysia such devices must be removed before the car undergoes the floor deflection test.

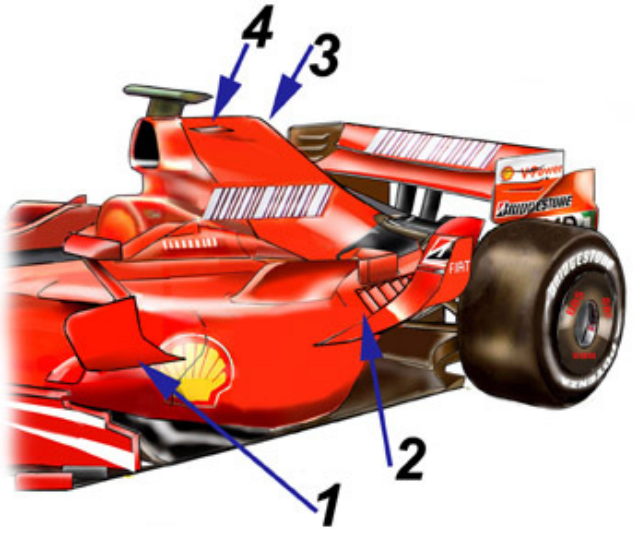


Ferrari F2007 - bib stay (04 April)

The sprung supporting element on the F2007's bib stay (the front section of floor under the splitter) was the subject of much media attention in Melbourne. Had Ferrari and/or other teams found a way to pass the floor deflection test, but then allow greater upward movement at speed to gain an aerodynamic advantage? The predetermined rate and preload of such a sprung device could make this possible. However, all cars passed scrutineering and Ferrari maintain the device simply allows limited - and legal - movement to avoid damage to the floor as the car rides over kerbs.

McLaren MP4-22 - new front wing (09 May)

Tested extensively in Barcelona last week, this is a development of the concept first introduced by Renault two years ago and evolved by many teams since. Previously, two additional, upper profiles were attached to the wing's endplate at one end and the car's nose at the other. The McLaren design features instead a single profile, going directly from one endplate to the other, passing over the top of the nose, with a significant gap (yellow arrow) inbetween. The MP4-22's particularly low nose eases the application of this solution. The extra width means more downforce, while the gap between the upper and main profiles helps keep added drag to a minimum (blue arrow). The result is improved front-end sharpness to the car's handling in both fast and slow corners, so a debut at the Spanish Grand Prix is quite possible. At the following round in Monaco, where front-end sharpness is paramount, it could provide even greater gains.

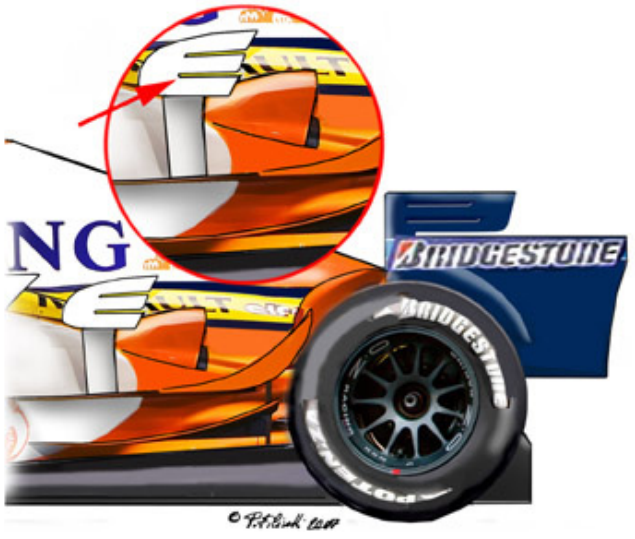


Ferrari F2007 - revised aero package (10 May)

Ferrari's new aerodynamic developments, tested in Barcelona last week, are designed to enhance its cooling capability, reduce drag and increase the car's rear-end efficiency. The front sections of both sidepods have been visibly shortened and narrowed, while wider winglets (1) have been added to increase the quality and quantity of the airflow directed into the inlets to compensate for the slight reduction in the radiator's surface area. The number of venting gills (2) has been almost doubled (to 15 each side) to further enhance the effectiveness of the car's cooling. The engine cover now sports an elongated fin (3), similar in profile to that on BMW Sauber's F1.07, to better direct the airflow to the rear wing. The revised mid-wing (4) is now triangular, with a upward-sloping tip, and will improve aerodynamic balance and reduce drag in this area.

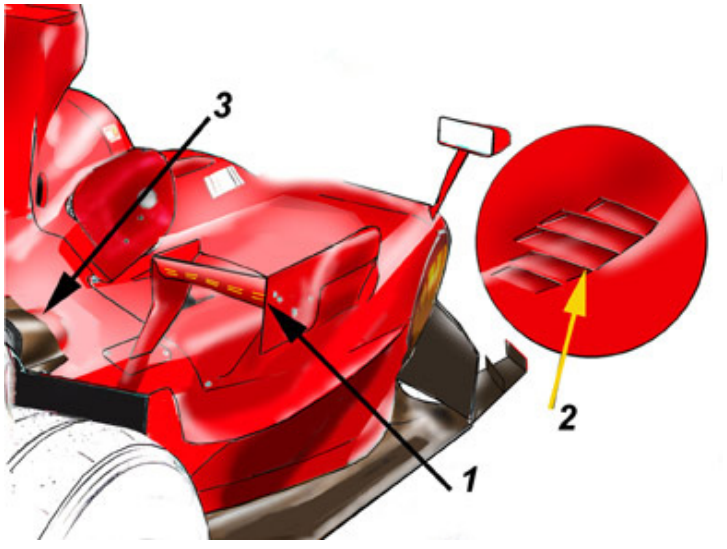
Ferrari F2007 - rear wing & engine cover

This latest rear wing sports a double-sculpted main profile (lower arrow), with a much smaller flap that decreases in section at its extremities (upper arrow). The effect is raised rear downforce, without a noticeable increase in drag. This improves the car's overall aero balance, providing better handling, especially in the transition from fast to twisty sections of track. The engine cover is also slightly revised, its narrow 'shark fin' profile enhanced still further by a narrowing of the cover's base.



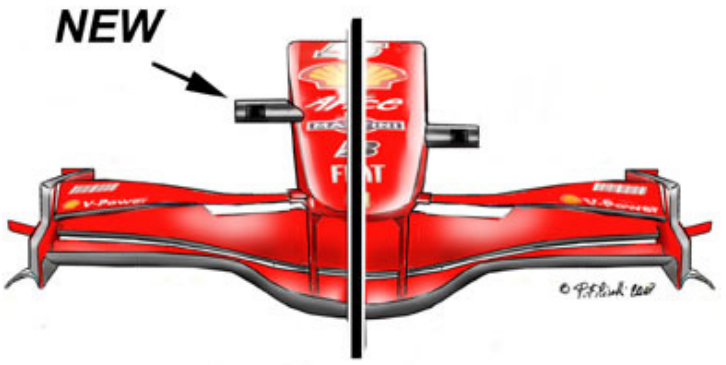
Renault R27 - revised sidepod winglets

Not a revolutionary change, recalling a similar solution adopted last season, but interesting in that now both the side of the vertical shield and the winglet elements feature two open slits, which help raise the air pressure in this area. They also assist in diverting airflow towards the outer edges of the car, reducing the turbulence generated by the rotation of the rear wheels.



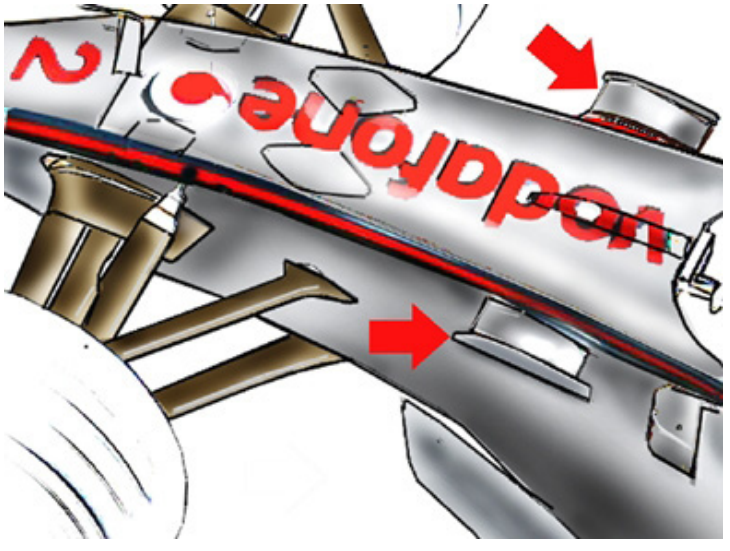
Ferrari F2007 - revised sidepods

This series of changes is part of the aero package introduced at the recent Bahrain tests. They were developed to up aero efficiency while also assuring adequate engine cooling. The winglets (1) behind and connected to the chimneys now sport a single, rather than a double element, reducing drag. The cooling slits (2) are now asymmetrical in their layout, with the right sidepod featuring one less slit than the left. This will, of course, vary from race to race. Also asymmetrical is the positioning of the exhausts (3), with the one on the right slightly further forward than that on the left.



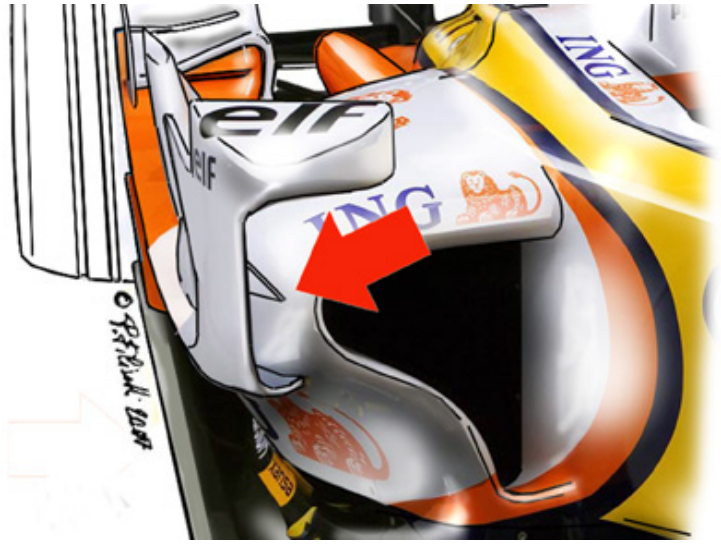
Nose-cone camera position

This is a small but important change for 2007. The camera housing is now placed on the top corner of the nose cone, where it acts as a proper winglet, diverting airflow around the front suspension's upper wishbone. Previously it was in the middle of the vertical side of the nose cone, where its position reduced the aero efficiency of the car's front end by affecting the airflow exiting off the front wing.



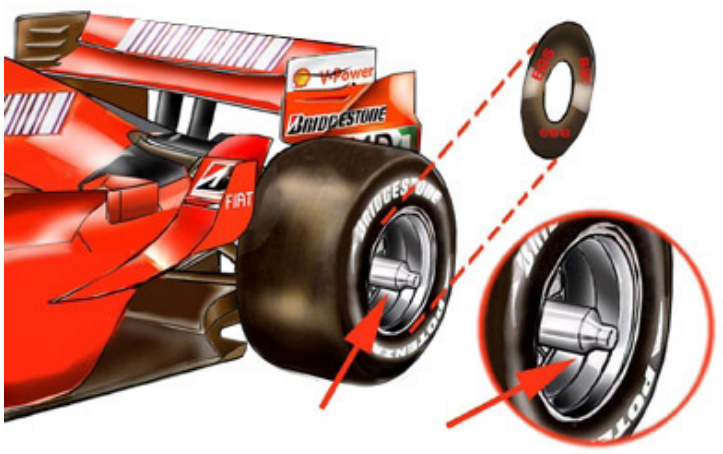
McLaren MP4-22 - front cockpit 'ears'

Since the last Bahrain test session, two winglets have been added to the side of the front section of the chassis. Last season similar additions were used by Renault in a few races. These elements don't noticeably increase the downforce, instead they act as turning vanes, splitting the airflow directed towards the cockpit. They work in conjunction with the horn wings placed behind the cockpit and raise the quality of the airflow directed to the rear end of the car, hence improving overall aero efficiency.



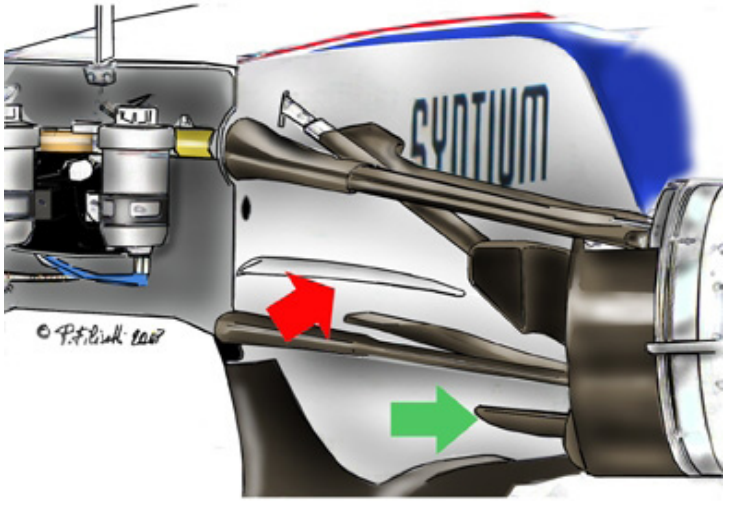
Renault R27 - rear view mirror pillars

The rear view mirrors on this car are housed in the uppermost section of the front sidepod winglets. During winter testing, rival teams trialling similar solutions complained about the mirror flexing too much when the car was in motion. Hence before Australia, Renault decided to adopt an additional pillar on each side (red arrow) to increase the stiffness of the assembly and hence reduce flexing under load.



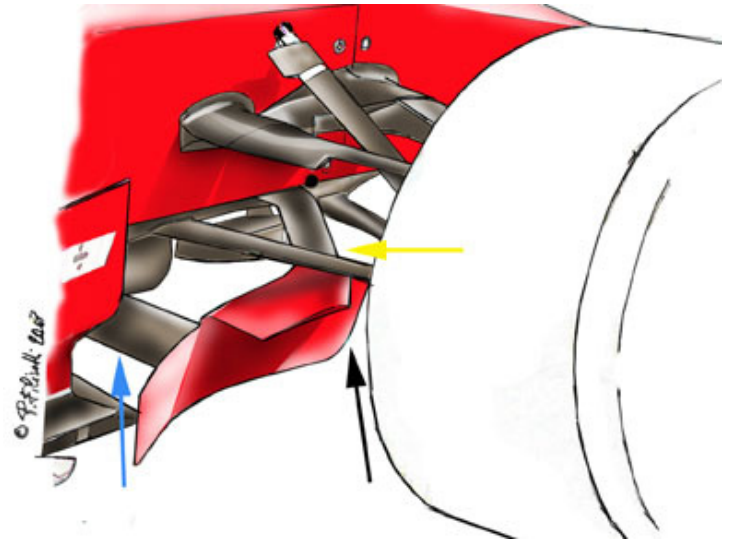
Ferrari F2007 - rear wheelnut extension

Last season, Ferrari adopted shields to cover the rear wheel rims. These additions meant the mechanics could only access the wheels with their wheel guns through a small central hole. To improve the timing and precision of this operation, the F2007 has been fitted with a wheel nut extension, which enables the mechanics to fit the wheel gun onto the nut more easily. This modification has already improved the timings of the team's pit stops.



BMW Sauber F1.07 - chassis & wing fins

Two horizontal fins (red arrow) have been added in Melbourne, midway up the side of the chassis. Shaped almost like an Arabian sword, the fins split the airflow coming out from the front wing, diverting it towards the sidepods inlets and, to an extent, the bargeboards. More fins (green arrow) have been placed inside the inner shields of the front wheel beneath the brake cooling ducts. Slightly curved, these help to reduce the turbulence generated in this area by the wheels' rotation, providing more aerodynamic stability.

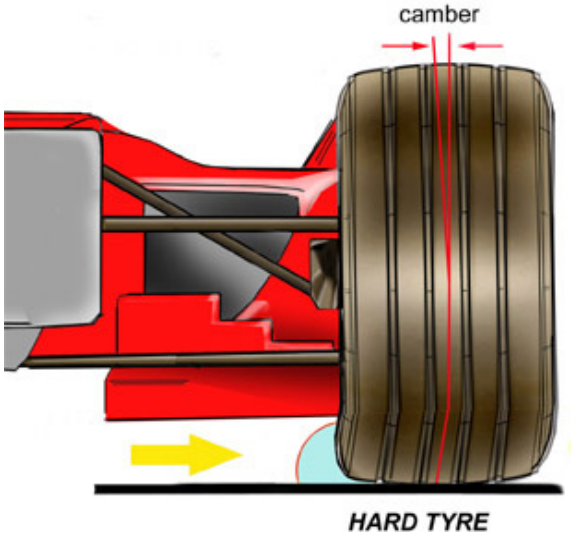


Ferrari F2007 - front barge boards & suspension

This latest barge-board evolution was spotted on the Melbourne grid. The front edge bends noticeably outwards (black arrow), while the bottom edge is neatly rounded. The increased angles of the pillars connecting the board to the chassis (blue and yellow arrows) highlight the board's new, more curved shape. These changes are designed to divert more airflow away from this area and hence keep the bottom of the car free from turbulence. As on the launch version of the F2007, the barge boards retain a wing-like element on their top edge, designed to help raise the pressure of air passing towards the bottom of the car.

Spyker F8-VII - revised sidepod winglets

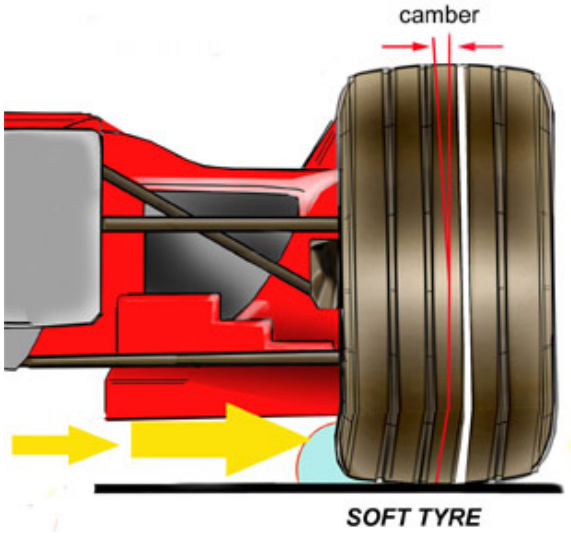
Spyker introduced a major aero upgrade in Malaysia. There are several radical changes, many to the rear of the sidepod profile, but also some at the front, where the winglets (red arrow) are now longer than before, with their lower profile curving inwards to connect to the sidepod itself. This allows them to better split the airflow in this area close to the sidepod air inlets. This is turn improves cooling capabilities, which is paramount to engine reliability, especially in the intense heat at Sepang.



HARD TYRE

Ferrari F2007 - harder Bridgestone tyres

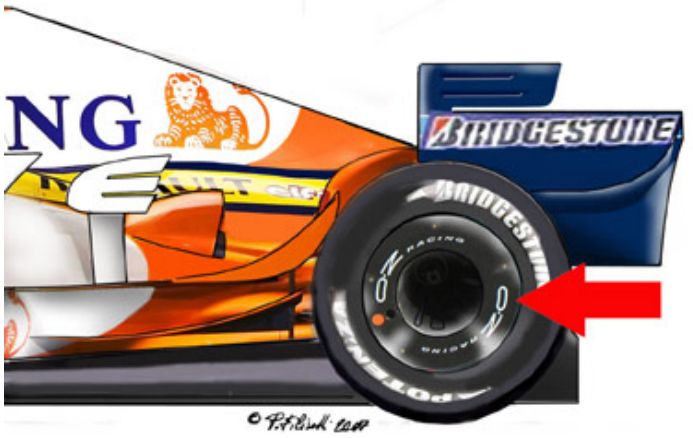
At Sepang on Friday, the harder tyre was also sliding in corners, though not nearly as much as the softer compound (hence single, rather than double, yellow arrow), but provided less traction on the straights - and hence a lower final top speed. This meant using the harder, more cautious option didn't pay off. Ferrari was one of the few teams able to maintain a strong pace on this tyre - something that could be key in Sunday's race when the use of both compounds is compulsory for all drivers.



SOFT TYRE

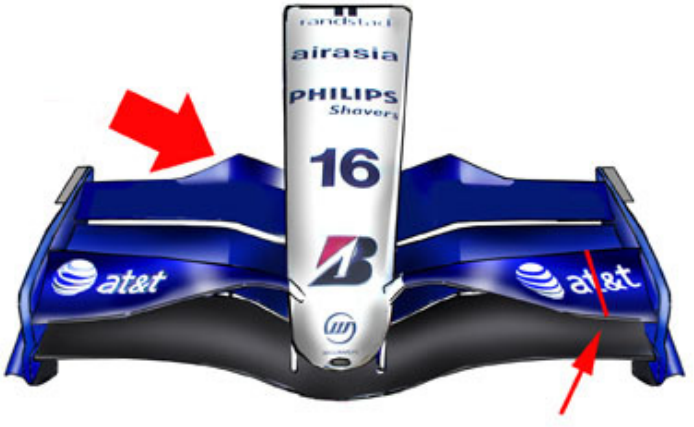
Ferrari F2007 - softer Bridgestone tyres

In Friday practice at Sepang, the softer of the two Bridgestone tyre compounds (recognisable from the white groove) unusually provided better overall performance than the prime tyre. One problem all teams did have with it, however, was its tendency to slide more in corners - due to its lower resistance to sideways forces (symbolised by double yellow arrow). Only Ferrari seemed able to fully exploit both Bridgestone compounds, perhaps due to the specifics of their camber angles. Ferrari too experienced sliding with the soft tyre, but it didn't seem to compromise their lap times thanks to its better traction on the straights.



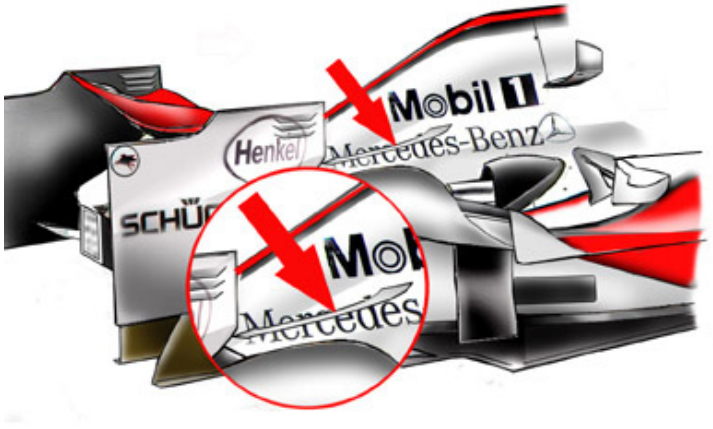
Renault R27 - rear rim shields

These were in use in Australia, but their role is far more relevant in Malaysia due to the severe temperatures. Heat generated under braking by friction between the brake disc and brake pads is dissipated through the small central hole. To avoid problems with brake fading, it is paramount that the working temperature of the discs does not exceed the optimum range. It is very difficult to cool them here due to the track's close sequence of braking points - and the high ambient temperatures. Any solution that can effectively cool the discs will help give the car a well-balanced and efficient braking capability.



Williams FW29 - front wing update

Sepang's long straights and medium to low-speed corners makes finding a compromise between straight-line speed and downforce difficult. Cars are prone to slide sideways here and you need enough downforce to keep the car on the track. Williams have adopted a high downforce configuration for their front wing. The rearmost flap of the FW29's dual-flap assembly sports a pointy extension to its central section either side of the nose cone (large red arrow). In another change, the additional curved profile, adopted since China last year (small red arrow), now features wider elements (thin red line) to increase the downforce generated.

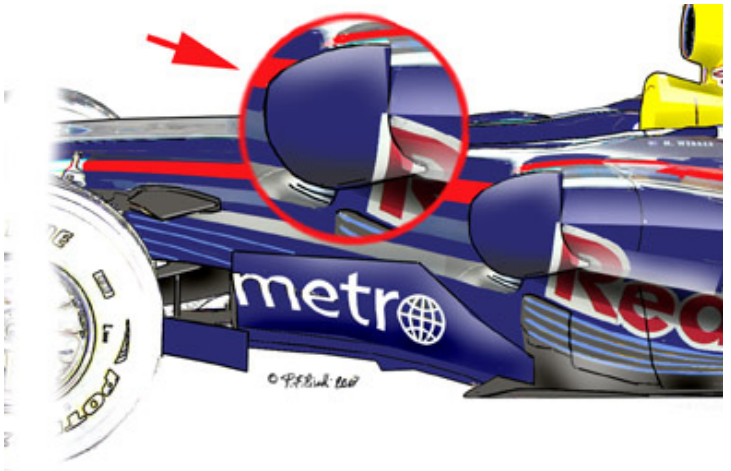


McLaren MP4-22 - engine cover detail

The MP4-22's engine cover is particularly narrow, and in Malaysia it sported elements resembling an ice skating blade applied to either side of its rear section (red arrows show location and detail). Their function is to reduce drag by detaching the boundary layer of airflow from the very rear of the cover. At the same time they improve the quality of airflow directed to the rear wing, increasing downforce. It is also important to note how the lower section of the cover is very low and flat close to the suspension pick-up points, cleaning up airflow and reducing turbulence in the whole rear area.

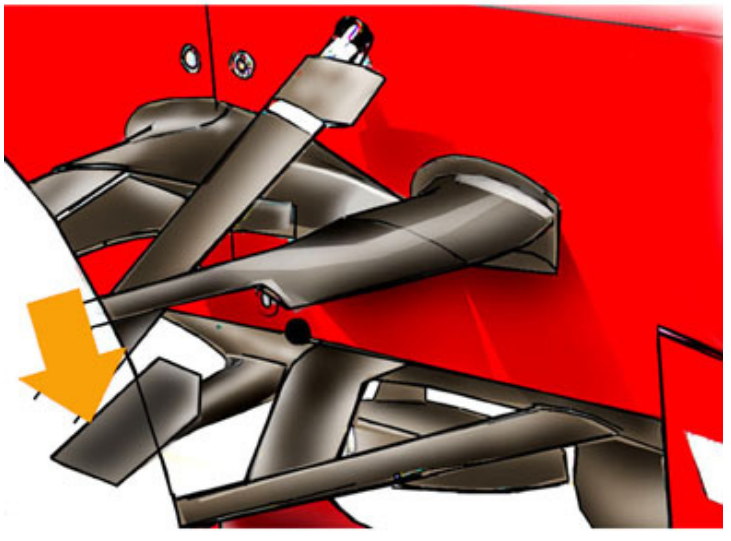
BMW Sauber F1.07 - rear wing update

The F1.07's rear wing sported a new main profile in Malaysia, with its entry edge raised in its central section (red arrow) and its outer extremities bending slightly downwards. This configuration mainly suits the requirements of medium to high downforce tracks like Sepang. It is likely the wing will be retained for next weekend's race in Bahrain, a circuit with similar characteristics. The overall balance of the FW.07 looked very good in Malaysia, especially in the race, helping Nick Heidfeld to fourth place.



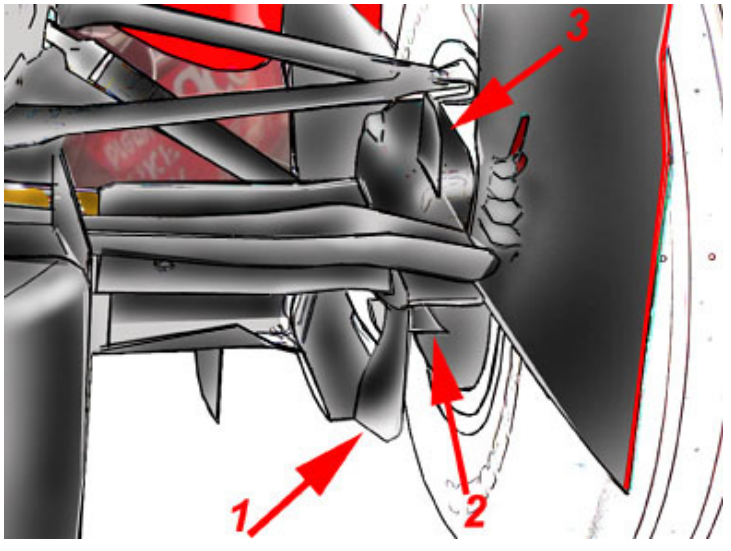
Red Bull RB3 - sidepod winglets

Introduced in Malaysia last weekend and again present in Bahrain, these elements are similar to those adopted by many other teams, but are notable in how close they are to the front edge of the sidepod. There is a certain resemblance to the winglets on Ferrari's F2007. The whole side profile of the winglet is tilted downwards, helping to divert airflow towards the lower area of the sidepod where the bodywork shrinks inwards, thus reducing turbulence. The upper portion of the airflow is directed towards the rear of the sidepod and works in conjunction with the rear winglets (unseen here) placed behind the car's small cooling chimneys.



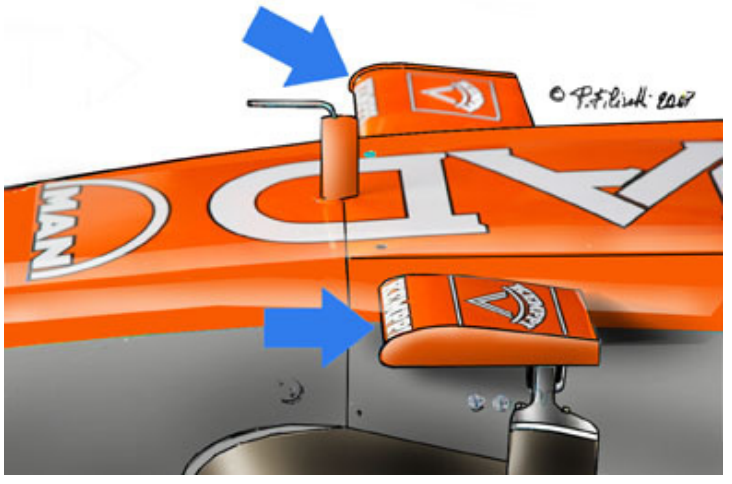
Ferrari F2007 - front wheel inner fins

This is an element of the Ferrari you'd only ever notice if you were up close to it when stationary. It is an inclined, partially curved fin (yellow arrow) near the inner front wheel. It helps improve the quality of airflow passing through the front suspension elements, as well as generating a small increase in downforce. Most importantly, however, it raises the efficiency of the bargeboards by reducing the vortices generated by the suspension's pushrod link and upper wishbone close to the front wheel. A small detail perhaps, but one that helps optimise the overall efficiency of the car.



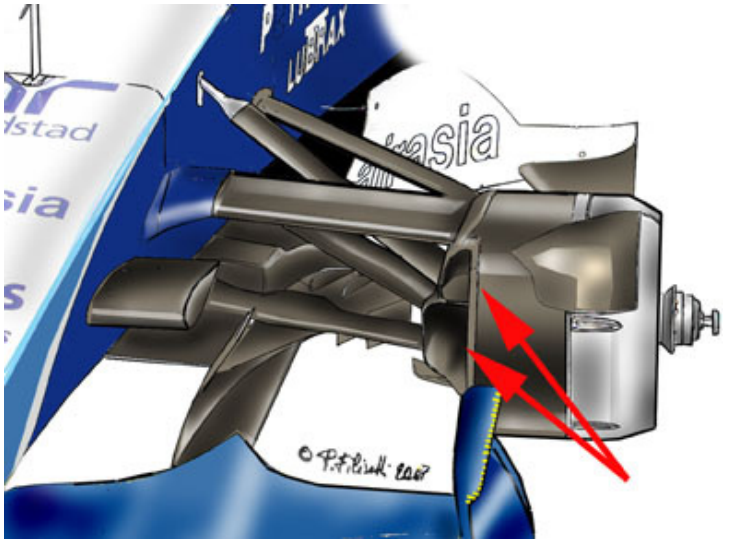
Ferrari F2007 - rear brake cooling inlets

This illustration shows just how complex the detailing is close to the Ferrari's rear wheels. In particular, the braking cooling inlets have a highly intricate design, which allows them to be small yet efficient, reducing the disruptive aero effect that bigger inlets would have. A sculpted vertical fin (1) creates a channel which increases airflow used to cool the rear section of the brake discs. A horizontal fin (2) helps minimise disruption to airflow passing through the rear suspension and inlet components. This in turn means improved extraction of that airflow by the car's rear diffuser. Another vertical fin (3) on top of the cooling inlet cover helps divert some airflow towards the rear wing's lower profile, also feeding the small slits in the lower section of the rear wing endplates.



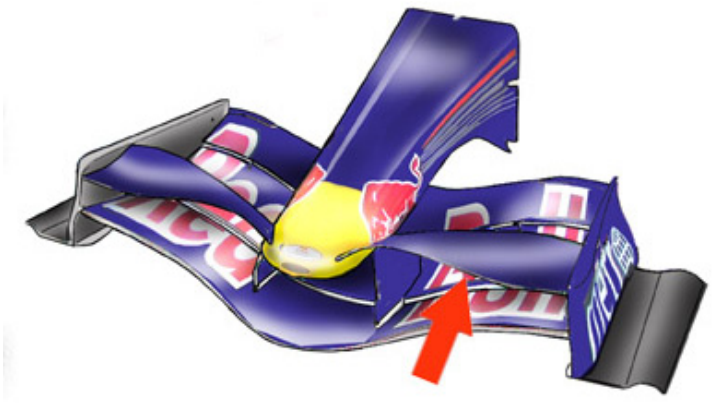
Spyker F8-VII - front chassis winglets

Spyker have the tough job of making a competitive car without the huge financial resources of many of their rivals. They thus have to take minimal gains wherever they can. These winglets (blue arrows), as seen in Bahrain, are one such example, working with the new aero package introduced last weekend in Malaysia. Placed on the front edge of the chassis, the winglets follow the concept of similar devices used last season and adopted by many teams since. They increase front downforce slightly, but their primary function is to clean up the airflow directed towards the cockpit, improving the aero efficiency of the car's central section and the rear wing.



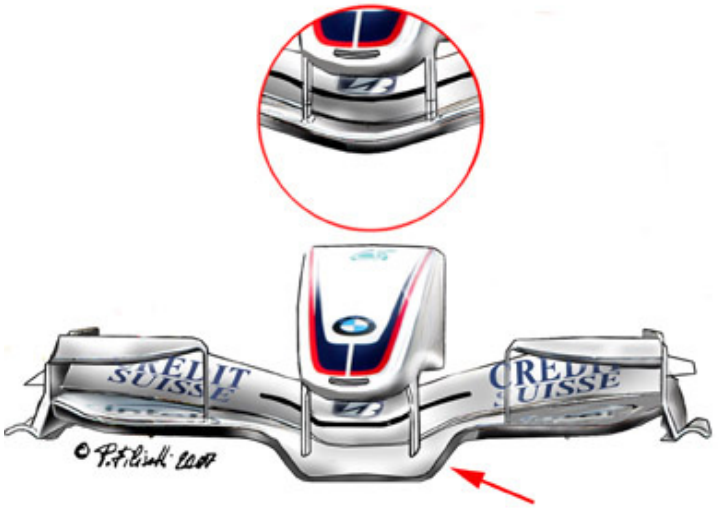
Williams FW29 - front brake cooling inlets

At hot races such as Bahrain and Malaysia, one main challenge is to avoid a progressive increase in brake disc temperature. To make it harder, these tracks have multiple, heavy braking points, with little time to cool the brakes inbetween. To ensure efficient cooling Williams have adopted a sophisticated twin inlet design for their front brakes, each inlet directing airflow to separate sections of the disc and calliper. The smaller, upper inlet feeds air mainly to the calliper. The larger, lower inlet directs air to the inner surface of the disc, generating a 'twister' effect in the centre, which helps extract heat via the disc's radial holes.



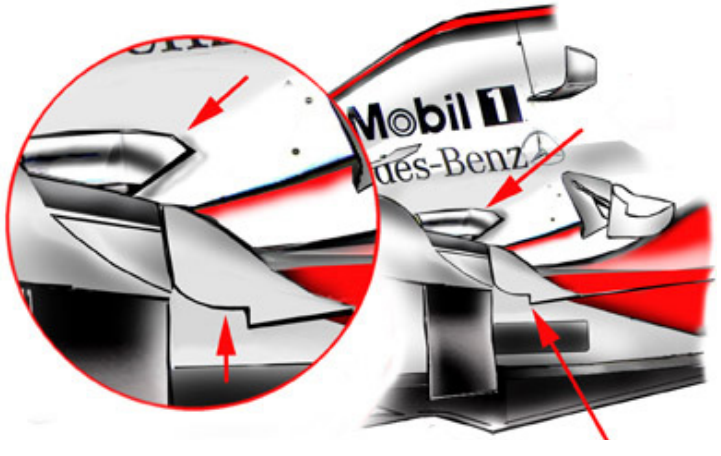
Red Bull RB3 - front wing development

Barcelona is very demanding aerodynamically, hence the teams test a lot here and Red Bull, like many others, are debuting major aero modifications. Changes to the RB3 are extensive, with sidepod revisions and this new front wing, which for the first time sports an additional upper profile (red arrow) on each side, a feature seen on many other cars. The new profiles are highly curved, not dissimilar to those on the Williams and Renault. The change provides a significant increase in front downforce, without noticeably raising drag.



BMW Sauber F1.07 - new front wing

The BMW sports extensive changes to both front and rear wings in Barcelona. The front has a completely new main profile - highly curved with a squared spoon shape in the centre (red arrow - previous design in red circle) and a front lip that protrudes slightly upwards. The new design dramatically increases the quantity of airflow passing over the main profile and between the two flaps.And the taller mounting pillars mean the distance between the nose and the wing is now greater, reducing disruption to the airflow. The changes not only raise downforce, but also make for sharper front-end handling, and increase the car's sensitivity to set-up variations - just small changes to the flap angle will now dramatically alter the front-end's behaviour.

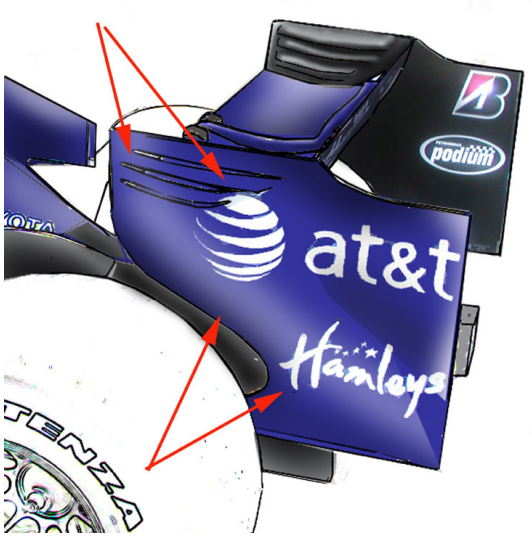


McLaren MP4-22 - rear-end bodywork development

In addition to their new front wing, McLaren also introduced some interesting rear-end changes in Spain. The bodywork close to the clearly-visible exhaust pipes (upper arrows) now looks slightly lower and the flip-ups in front of the rear wheels now feature a different vertical endplate with a sculpted lower edge (lower arrows). The changes reduce the negative influence of the turbulence generated in this area by the rear wheels' rotation. The flip-ups can now generate slightly more downforce aswell as reducing drag.

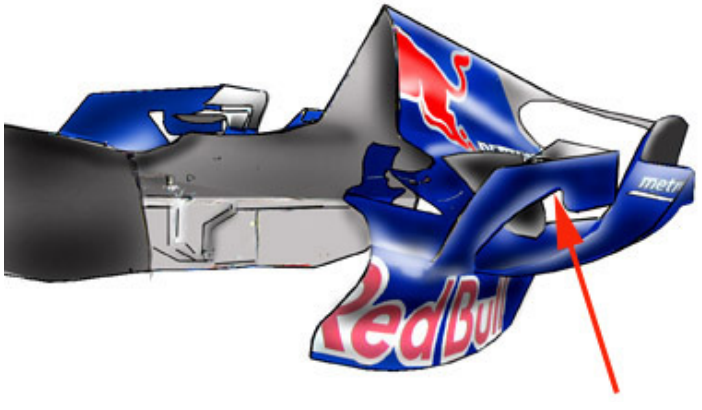
Ferrari F2007 - new front wing

In addition to their rear bodywork and sidepod updates, Ferrari also introduced a new front wing in Spain. Its main profile now features a dual curve (blue arrows) towards its outer extremities, in contrast to the previous flat version. The change helps increase the quantity of air passing under and close to the endplates, and hence raises the amount of pressure generated in this area. The upper profiles have also been revised, with small vertical fins (yellow arrows) added, to increase pressure in the profiles' outermost sections. They also help to better direct airflow towards the barge boards and sidepod inlets.



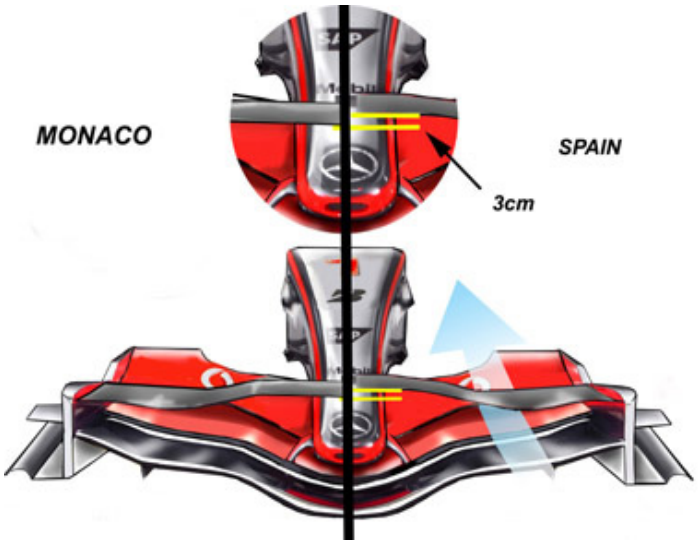
Williams FW29 - rear wing endplates

Like their rivals, Williams introduced a seriously revised aero package in Spain, including a new endplate design on the rear wing. These now look pretty similar to those on the McLaren in terms of profile and assembly. The curved front-lower edge (two lower arrows) is able to free the airflow passing close to the rear suspension's upper wishbones, hence reducing the turbulence and resulting drag in this area. At the top of the endplate, the three horizontal slits are still present, but are now more closely profiled, again similar to the MP4-22. The changes have helped to improve the FW29's already excellent aero efficiency and balance.



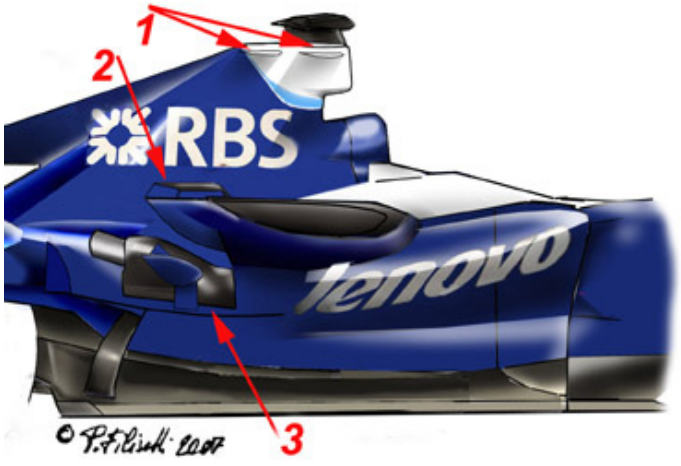
Red Bull RB3 - sidepod development

In addition to their heavily revised front wing, Red Bull's new aero package for Spain included extensive development of the sidepod area. The placement of the water and oil radiators has been revised slightly, and both have been reduced in size somewhat. Moreover, there is a completely new chimney assembly, connected as a single piece with the winglets (red arrow) on top of the sidepods. This assembly recalls the solution adopted by Ferrari since the start of the season, though the chimney profile more closely resembles that on Renault's R27 - no surprise given the RB3 uses the same engine. The new assembly provides better management of the airflow passing over the sidepods, directing more air towards the chimneys, helping to extract hot air more efficiently.



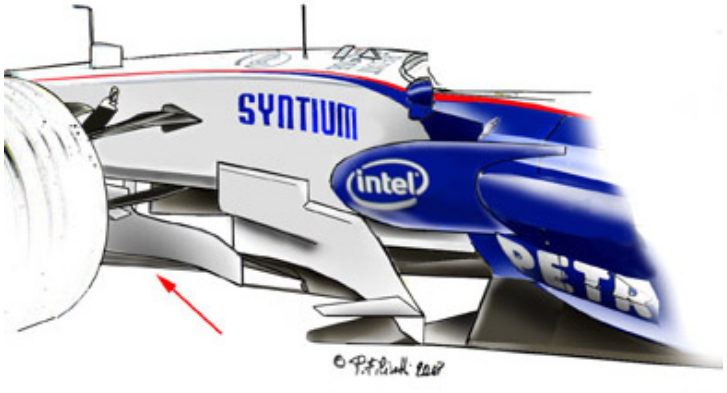
McLaren MP4-22 - front wing development

McLaren introduced their innovative 'bridge' wing, with its upper profile spanning across the car's low nose, at the last round in Spain. For Monaco it has been modified. The central section of that upper profile is now flatter and about 3cm lower than before. This increases air pressure and raises downforce in this area, helping the front end of the car to handle more sharply. This is crucial in the tight confines of Monte Carlo, where any solution that improves downforce is justified, even with some additional drag, which has a negligible effect given the low top speeds here.



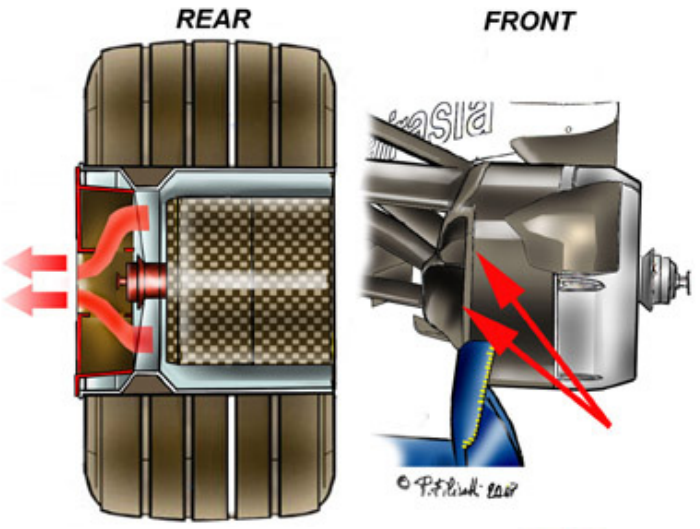
Williams FW29 - Monaco aero package

Williams (like all the teams) have adopted specific aerodynamic devices to cope with Monaco's twists and turns. A double mid-wing (1) has been placed near the base of the onboard camera to improve aero balance and increase the efficiency of the rear wing. The winglet assemblies (2) connected to the sidepod chimneys have been seen before, but are now coupled with additional winglets (3) featuring rounded endplates. These increase downforce slightly and help manage airflow in this area where hot air exits the radiator vents. Small changes, but such details matter more at Monaco than at any other track.



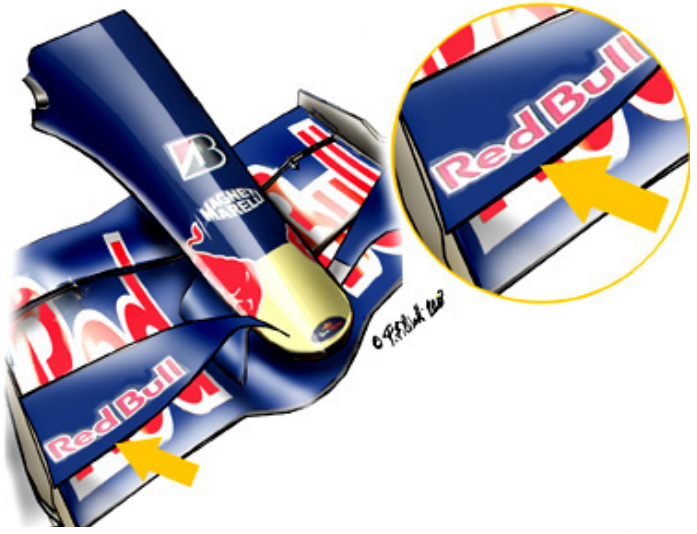
BMW Sauber - F1.07 barge board development

The F1.07's Monaco aero package is one of the most highly developed in the paddock, even if much of it is carried over from the last round in Spain. A key part of its development here is the barge boards placed at front-axle level. These now sport a clearly visible horizontal knife-edge profile (arrow) at their base. This improves their efficiency, slightly increasing front-end downforce. This in turn improves the car's front-end sharpness, something that is of paramount importance within the tight confines of Monte Carlo's street circuit.



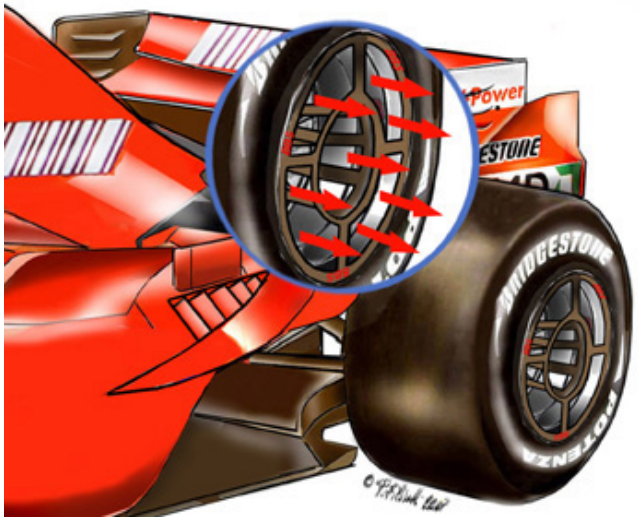
Monaco - brake fading problems

In Thursday's practice sessions in Monaco (and even to some degree in Saturday's cooler, wet session), many cars suffered significant brake fade - in some cases it contributed to them running into the barriers. The problem, according to engineers from brake manufacturers Brembo, is the fact that this year's harder tyres provide less grip. This forces engineers to switch the car's brake bias towards the rear - and cooling rear brakes is harder than cooling front brakes. Cooling the rears relies largely on efficient extraction of heat (red arrows), whereas the fronts have far more efficient ventilation to prevent heat build-up (as shown with the multiple inlets on the Williams here). Monaco is not 'hard' on brakes in the traditional sense, but the short intervals between braking points gives the discs little time to cool. According to Brembo, this means drivers have to apply as much as 105 kilograms of pressure to the brake pedal - quite a physical strain over 78 race laps.



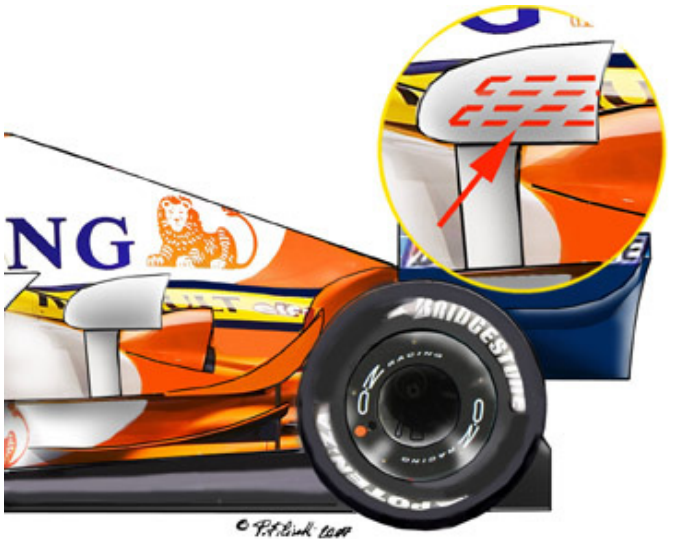
Toro Rosso STR2 - front wing

Toro Rosso debuted a new front wing in Monaco, sporting for the first time an additional upper profile on each side - as introduced by sister team Red Bull at the last round in Spain. The extra profiles generate additional front-end downforce - very useful in Monte Carlo - without creating too much additional drag.



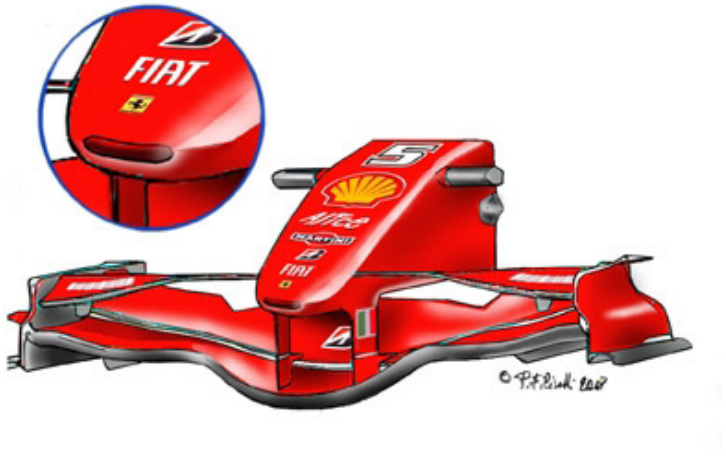
Ferrari F2007 - modified rim shields

As discussed previously, brake fade is a problem in Monaco. Less grip from the 2007 tyres forces brake bias rearwards, and cooling the rear brakes is difficult. To avoid problems in the 78-lap race, Ferrari modified their rear wheels' rim shields, giving them wide vents to allow the heat generated under braking to dissipate more efficiently. The vents lessen aerodynamic efficiency by adding drag, but this is of little consequence on the slow-speed Monte Carlo circuit.



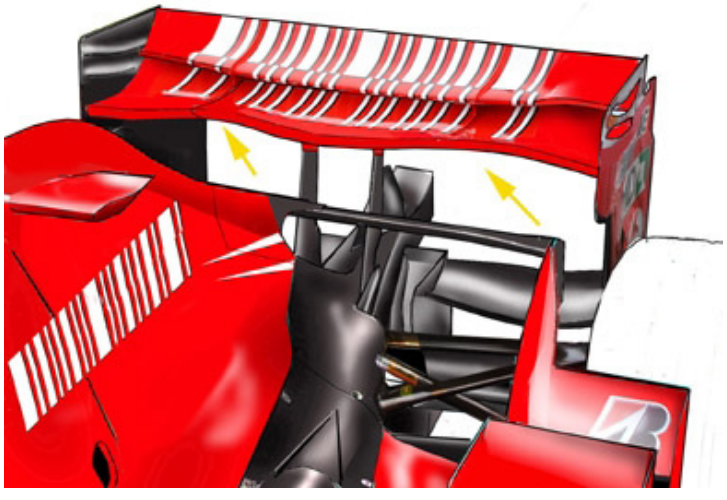
Renault R27 - sidepod winglet development

The Montreal circuit requires a medium to low-downforce set-up, thus most teams will adopt new aero packages in Canada. Since even small details can help improve a car's overall balance, Renault have modified the R27's sidepod winglets for the race. From the very start of the season these winglets have featured two horizontal slits (see inset) to help increase the downforce in this area. With less downforce needed at this track, the slits have been removed and the winglet is now a single, complete, element. Renault are expected to run the revised winglets at next weekend's United States Grand Prix.



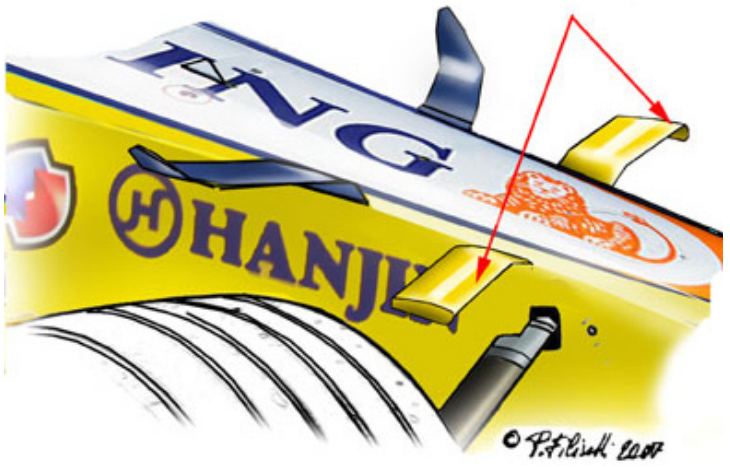
Ferrari F2007 - new nose cone

Having revealed a revised front wing at the Spanish Grand Prix in May, Ferrari complete their alterations to the F2007's front profile with the introduction of a new nosecone in Canada. It now features a small horizontal slit on its tip (see inset), similar to that on the BMW Sauber. The profile of the nose has also changed slightly in its lower section. This development not only provides cooling to the car's power-steering hydraulics, but also manages the airflow in the area close to the nosecone's tip, reducing disruption as it passes through the front suspension.



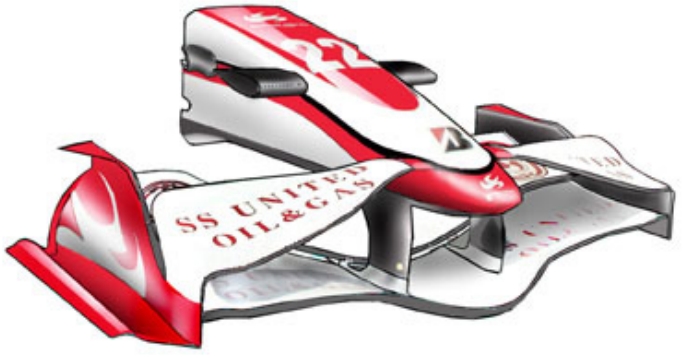
Ferrari F2007 - new rear wing

As well a new front wing assembly, Ferrari have introduced a modified rear wing in Canada to suit the medium to low downforce demands of the circuit. The profile and flap have been completely revised. The profile now features a double curve, with its central section lower in the middle and tapering up towards its extremities (yellow arrows) - the opposite to the previous design, which was higher in the centre. The transition from each section of the profile to the next is now much smoother, improving the management of airflow passing over and under it, hence making the rear wing more efficient and generating less drag.



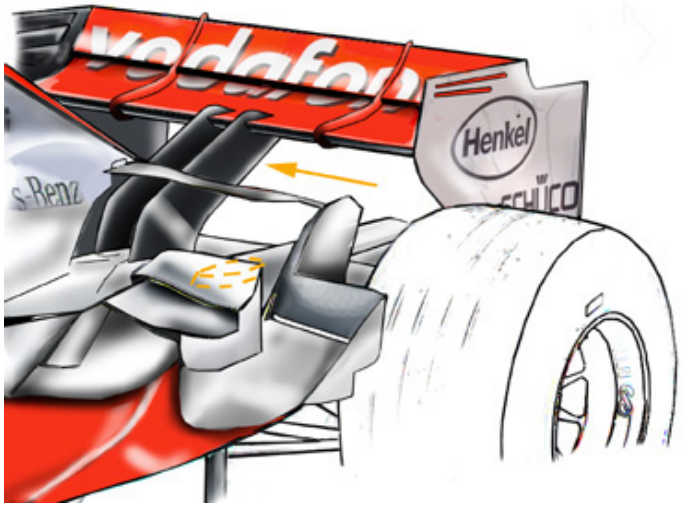
Renault R27 - front ears

Renault introduced horn winglets halfway between the front axle and the cockpit during pre-season testing in Bahrain. These were designed to improve airflow management around the cockpit and reduce turbulence. Now, in Canada, a couple of nose winglets (red arrows) have been added to increase their effect. These improve airflow management immediately in front of, and over, the upper suspension wishbones, cleaning up the airflow directed into the sidepods and towards the rear of the car. This helps overall aero efficiency by reducing drag and turbulence. As a result, the front end of the R27 looks to be sharper than before, with improvement to the car's driveability and overall dynamic balance.



Super Aguri SA07 - double-decker front wing

Super Aguri introduced this completely new front wing in Montreal. It features additional upper profiles, extending from the endplates to the nose. It's a solution now common to most of the cars and is known to provide additional downforce without increasing drag too much. It is particularly useful on tracks where a successful set-up compromise for both slow and fast sections is paramount. The Circuit Gilles-Villeneuve is one such circuit, and Indianapolis next weekend will be another.

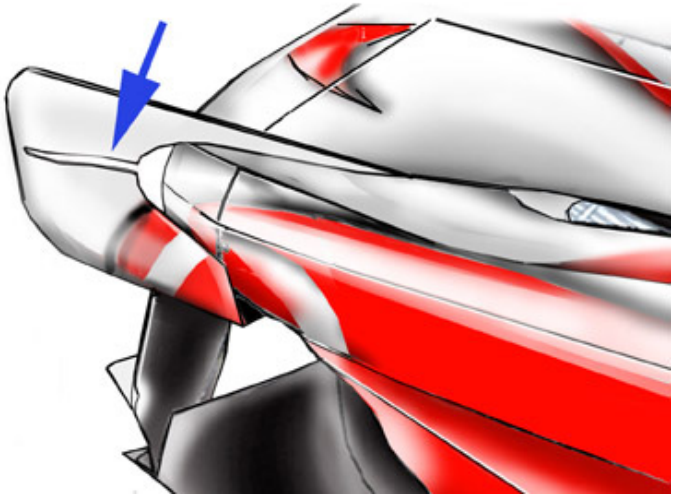


McLaren MP4-22 - new rear wing

McLaren debuted this in Canada as part of the ongoing development of the MP4-22's aero package. The new wing features a completely flat main profile, designed for low to medium-downforce circuits, and the base of the central mounting pillars (yellow arrow) has been brought forward, the pillars now inclining at a greater rearward angle as a result. This has two benefits - firstly, it helps to stop turbulence upsetting the airflow directed towards the rear wing; secondly, it provides a greater degree of stiffness, preventing the wing flexing rearwards under heavier loads at high speed.

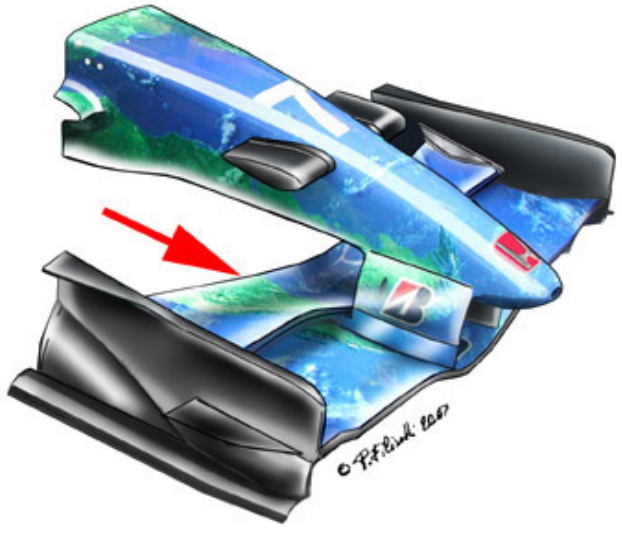
BMW Sauber F1.07 - rear wing development

Introduced last weekend in Canada and retained for Indianapolis, this design features a new main profile, with its leading edge noticeably raised in its central section (yellow arrow) and its outer extremities bending downwards slightly. This assembly has been designed specifically for low to medium downforce tracks, and provides a perfect compromise for the two distinct sections of the Indianapolis track - the fast one, including the long straight, and the slow one, the twisting infield, where traction rather than top speed is paramount.



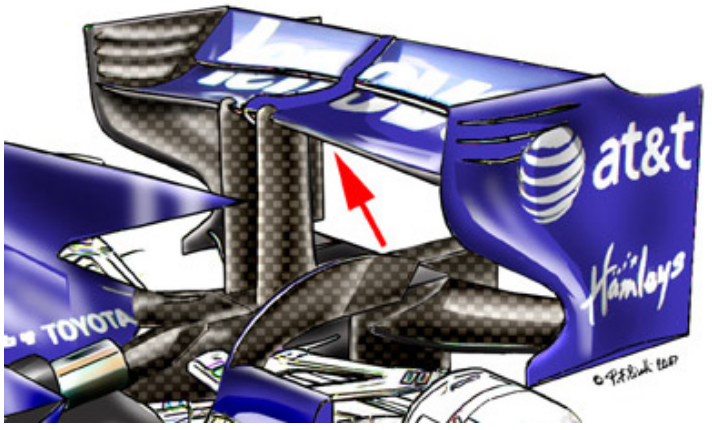
McLaren MP4-22 - sidepod winglet slits

Introduced in Canada and retained at Indy, this looks set to become a definitive change. The long, curved slit (blue arrow) cuts through almost the entire length of the large vertical winglet shield at the front of the sidepod. The function is to better divert airflow away from the side of the car as it impacts the outer edge of the sidepod. The slits also reduce the turbulence generated by the shields and hence improve the quantity and quality of airflow entering the sidepod radiator inlets. At the same time they aid the efficiency of the chimneys just behind, the diverted air pressure helping to improve the level of hot-air extraction.



Honda RA107 - front wing

Like a lot of teams, Honda have biased their Indianapolis set-up in favour of the fast section of the track, focussing on high top speed down the long straight with the result that the drivers must make do with a less-than-ideal low-downforce set-up through the tight infield section. This front wing, with a very small flap (blue arrow) featuring a much-reduced chord, is part of that set-up. The speed advantages are clear, but the car did indeed seem nervous in the infield, struggling for traction out of slow corners. The team hope to gain competitiveness with a heavily-revised RA107, expected to debut in the forthcoming European races.

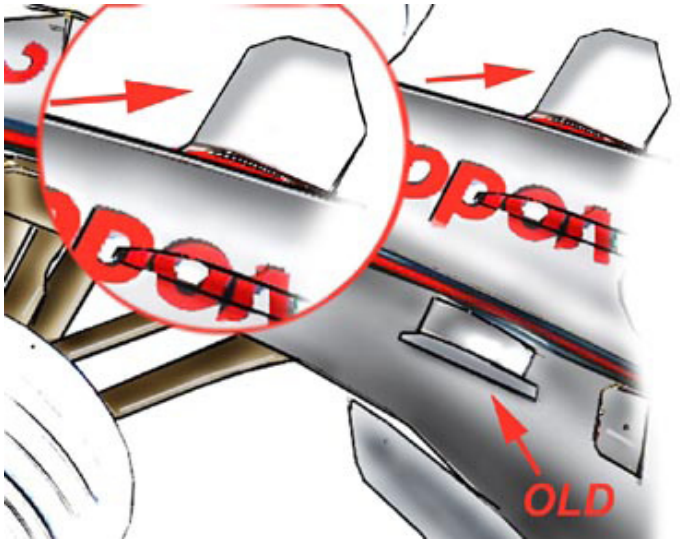


Williams FW29 - rear wing

Williams, like most teams, went for a low to medium-downforce set-up at Indy, focussing on performance in the high-speed section of the track. To this end they adopted a new rear wing, with its main profile raised slightly and curved upwards in the middle (blue arrow) relative to the previous version. The team actually carried out a back-to-back comparison of the two configurations in Friday practice and this one won out. It reduced drag and turbulence significantly, providing more rear-end stability, especially through the banking where a driver's confidence in the car is crucial.

Renault R27 - front wing

At Indy the R27 sported a new front wing, especially conceived for the low-downforce configuration needed at this circuit. Gone are the additional curved upper profiles (see detail circle) used as part of the medium to high-downforce set-up seen at previous races this year. This design obviously favours the high-speed section of the track and the tradeoff is reduced sharpness and front-end grip in slow corners. It seemed to work, as seen from Renault's improved performance in the US.

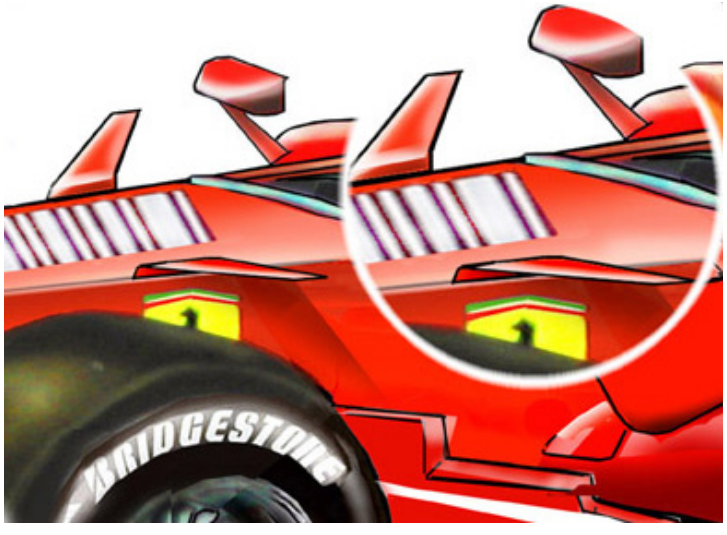


McLaren MP4-22 - front cockpit 'ears'

In Australia McLaren introduced two thin, small winglets to the side of the front section of the chassis. While these elements don't noticeably increase downforce, they do act as turning vanes, splitting the airflow directed towards the cockpit. In Montreal and in Indianapolis, these elements were much bigger (inset) and featured a modified rounded, knife-edge profile. These revised winglets are designed to work closely with the new front wing, which was introduced in Spain, to improve the aero balance of the car.

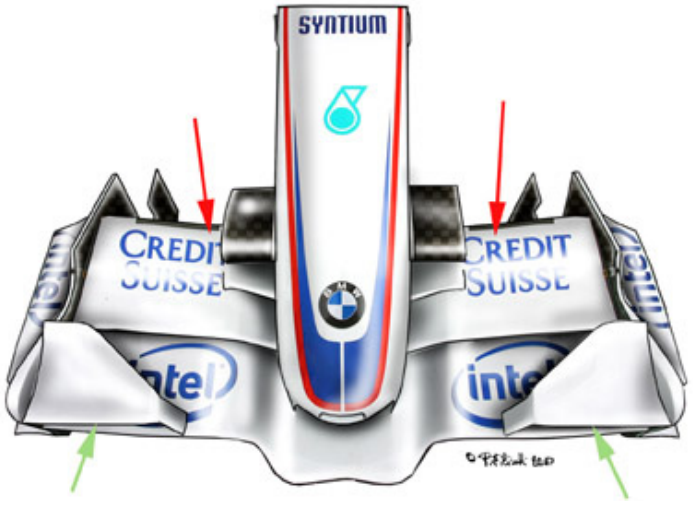
Williams FW29 - front wing

After intensive testing at Silverstone last week, Williams have introduced a revised front wing at Magny-Cours. The new wing (left) features steeper, less curved upper profiles than the older version (right). They are connected to the nosecone by an almost horizontal link (left arrow) that is bent slightly backwards (right arrow). This makes the front wing assembly more efficient and reduces turbulence around the nosecone tip. Optimising the front-end aero balance like this helps with overall aero efficiency around the middle of the car.



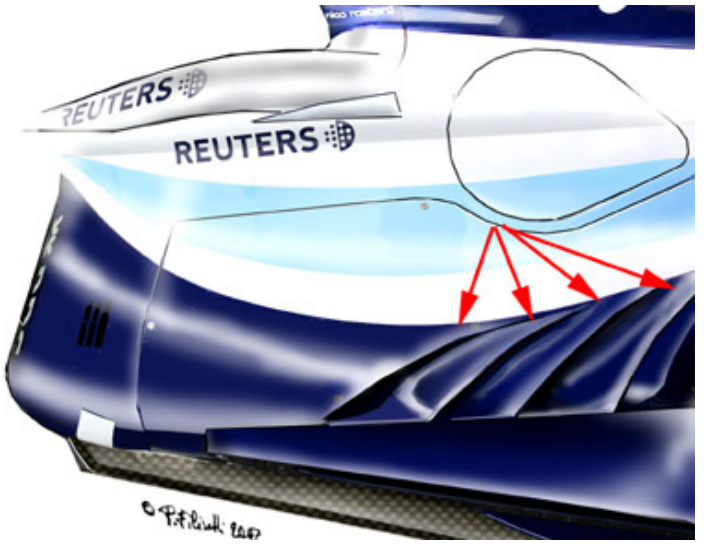
Ferrari F2007 - cockpit winglets

During last week's Silverstone test Ferrari introduced new winglets in front of the F2007's cockpit, placed either side of the chassis. Resembling similar winglets on the Renault and McLaren, these small additions better divert airflow around the cockpit and, more importantly, improve the quality of airflow directed towards the sidepod inlets, thus aiding cooling. They also allow the team to run more radical front wing angles, which without the new winglets would cause too much disruption to the airflow to the sidepods.



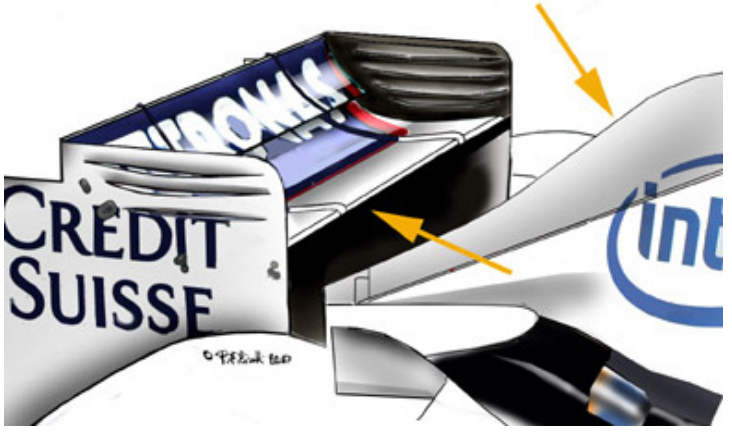
BMW Sauber F1.07 - front wing development

BMW introduced this revised wing in France following last week's Silverstone test (it will probably be retained for the British Grand Prix, as both venues require similar aero configurations). The new design retains the squared central spoon profile, but has a completely new flap (red arrows), which is now much deeper to provide adequate front downforce for this circuit. The resulting increase in drag is offset by the additional upper profiles (green arrows), now shortened to reduce the drag they create.



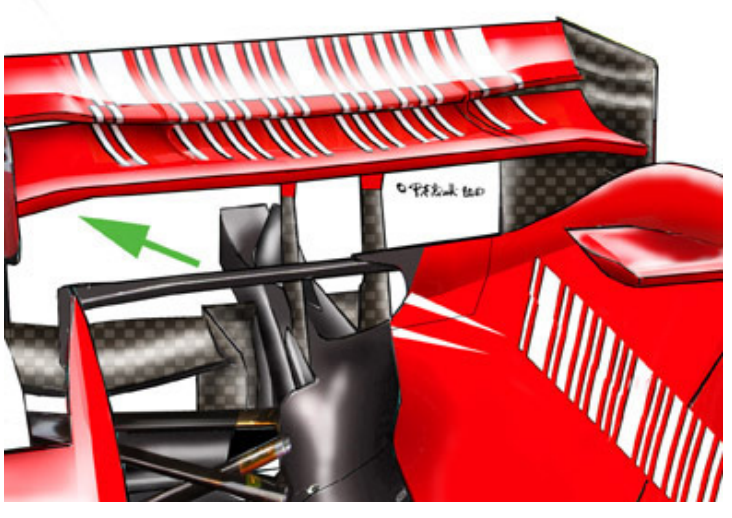
Williams FW29 - sidepod slits

For France, a series of curved slits has been added to the FW29's sidepods, just inside the radiator chimneys. However, the change is not primarily cooling-related as you might expect, but aerodynamic. The hot air exiting the slits lowers the air pressure in this area and hence increases the speed of airflow. This helps to better direct it towards the winglets in front of the rear wheels and to free up the portion of airflow nearer the centre of the car so as to maximise the efficiency of the rear wing. In essence, another small detail that helps to perfect the car's overall aero balance.



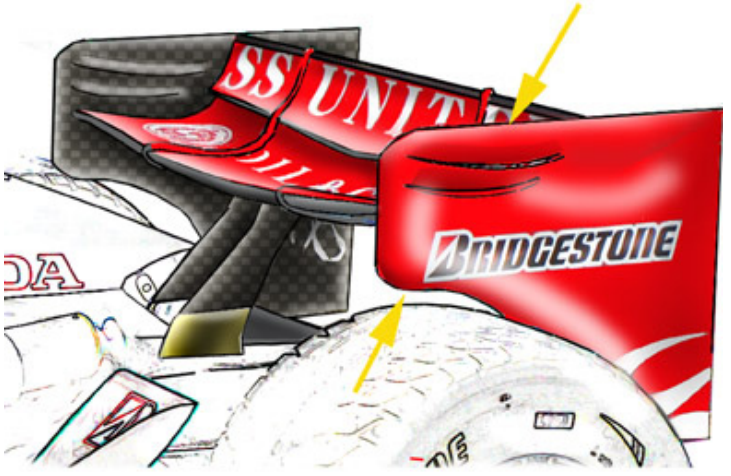
BMW Sauber F1.07 - rear wing, engine cover fin

Another team to introduce a revised rear wing for France, BMW Sauber's features a main profile that is completely flat across its entire width (left arrow). Its aim is to provide a good level of downforce without losing too much top speed on the straights. It works in conjuction with the modified engine cover (debuted a couple of races back), with its pronounced fin (right arrow) helping to direct a clean airflow to the rear wing, maximising the efficiency of the wing's main profile and flap.



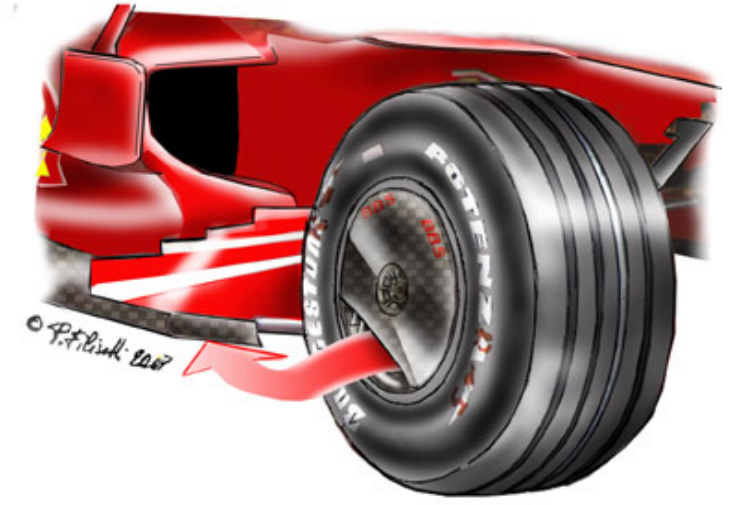
Ferrari F2007 - revised rear wing

Introduced as part of a new aero package at the recent Silverstone test, this wing, sporting a completely revised main profile, was used in France. The profile has lost the relatively dramatic curves of its predecessor and is now largely flat across its width, with just its extremities bending downwards slightly (green arrow) at their leading edge. This configuration looks to have been designed specifically for medium-downforce tracks like Magny-Cours and Silverstone, providing adequate downforce (and hence rear grip), without too much of a penalty in terms of drag.



Super Aguri SA07 - rear-wing development

This design was tested at the Silverstone test prior to the British Grand Prix. It sports completely revised endplates, which feature a totally flat top edge (upper arrow) and a narrow upper section at the front, the lower edge of which is clearly visible above the top of the wheel (lower arrow). The design might look old-fashioned, but actually cuts drag thanks to the smaller front section and better management of the airflow exiting the upper wing profile and flap. This configuration is particularly efficient on medium-to-fast tracks such as Silverstone and improves the rear stability and overall balance of the car.



Ferrari F2007 - front rim shields

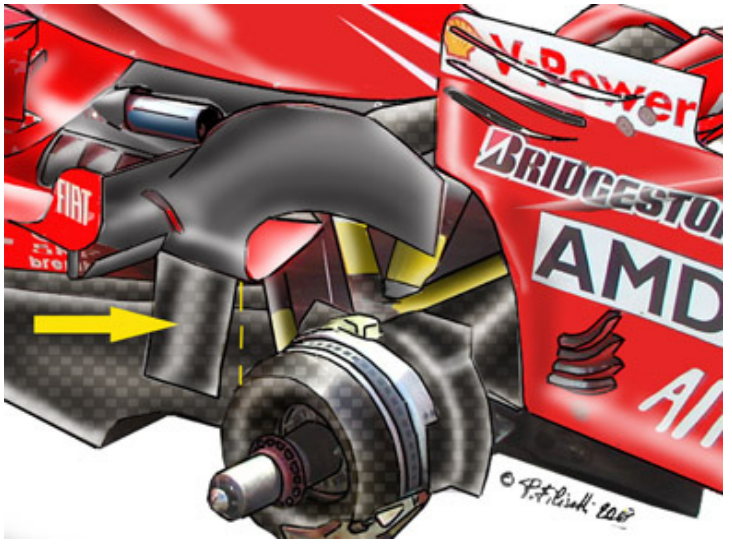
Although they've been tested at Barcelona and Paul Ricard, Silverstone marks the race debut for these items. Their purpose is to direct the hot airflow generated under braking away from the wheels and underneath the car (red arrow). The slit in the rim shield has a specific 27-degree angle to achieve this. The hot air accelerates the airflow underneath the car, hence helping with the extraction of air via the diffuser. This provides additional downforce, better stability and an improved aero balance. As you can see, the function of the front shields is completely different to the rears, which simply aid brake cooling and reduce turbulence.

BMW Sauber F1.07 - engine cover

At Magny-Cours we mentioned how this new engine cover works in conjunction with the rear wing. At Silverstone, we look more deeply at the cover, which sports a dramatically elongated shark-fin profile on its top edge (red arrow). This helps to clean up the airflow directed towards the rear wing, though it is not this element alone that works to achieve this - so do the sculpted winglets placed behind the venting chimneys. These help specifically in optimising airflow over the lower profile of the wing, aided by the extremely low section of the rear of the sidepods immediately in front of the rear axle.

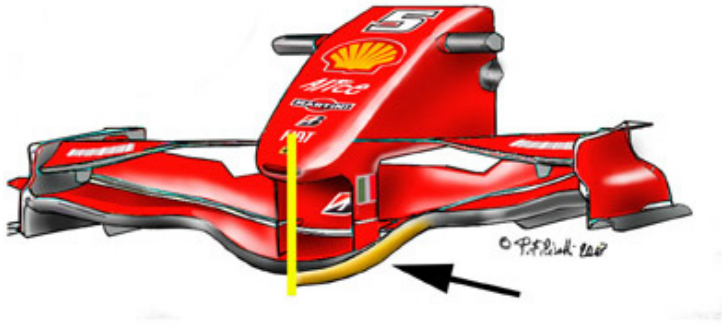
Honda RA107 - revised front wing

Honda adopted this revised wing for Silverstone, featuring a completely new flap, which is much deeper than the previous version and sports a flat top edge with a small Gurney tab (red arrow) to increase downforce. This helps raise the car's front-end sharpness, especially in the area of the circuit around Becketts, with its several fast direction changes. After positive feedback, this configuration is likely to also be used at the next round at the Nurburgring, with just some minor adjustments.



Ferrari F2007 - rear fin / airflow splitter

The rear end of the F2007 has been heavily developed in the last couple of races and is now dramatically lower than before. The aerodynamic design of this area has been refined in every detail to provide an efficient and clean airflow to the diffuser, to help increase downforce and maintain the car's rear-end stability. At Silverstone, a sort of slightly curved splitter (yellow arrow) was adopted in front of the rear wheels, replacing the previous vertical one. The curvature of this new element makes for a wider channel in the airflow, broadening and increasing the airflow to the diffuser.

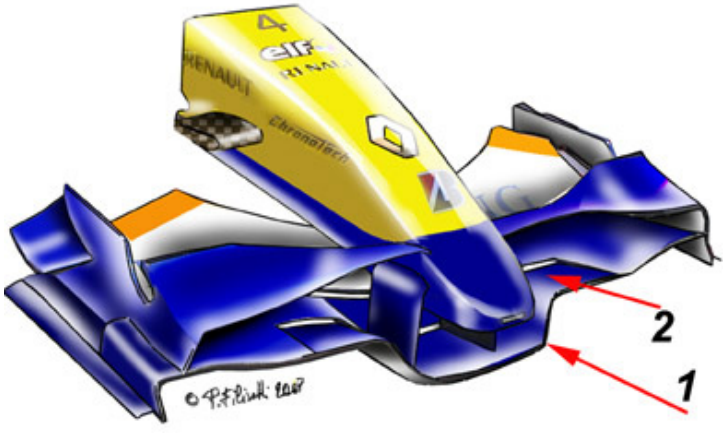


Ferrari F2007 - front wing development

This wing made its debut back in Canada, but has been continuously developed since then in terms of new flaps and the main profile. The change here at the Nurburgring is the much lower and deeper central spoon profile (yellow detail), which has a very specific effect - it helps the front wing to stall more easily on the circuit's straights, dramatically reducing drag, hence increasing top speed. Furthermore, it also aids the stalling of the diffuser by depriving the diffuser's central section of a large quantity of air.

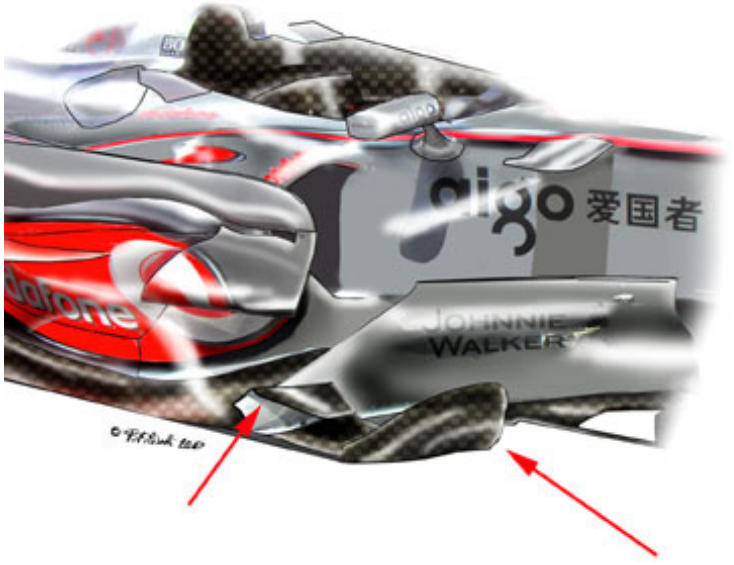
McLaren MP4-22 - revised rear wing

This change, introduced at the Nurburgring, sees the extremities of the wing clearly bent upwards (red arrow), creating a curved entry profile to the wing's upper element. This configuarion provides better management of the airflow impacting the central section of the wing and reduces the turbulence generated by the endplates. It is a layout specifically for medium- to high-downforce tracks, hence with some refinements it is likely to also be used at the next round in Hungary.



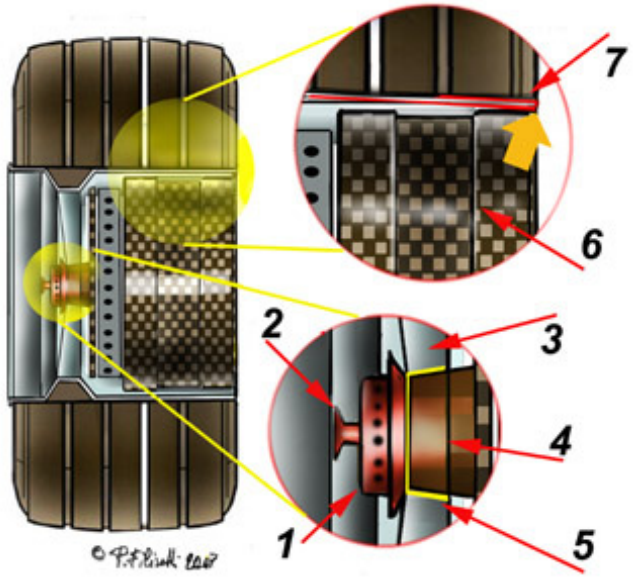
Renault R27 - new front wing

Introduced at the Nurburgring, this design closely recalls that on the latest BMW Sauber. The differences compared to its predecessor are a squared-off, flatter central spoon section (1), and a deep, 60cm-wide slit (2) in the centre of the main profile. The slit helps to increase the pressure of the airflow passing under the main profile and exiting the flap. The BMW sports a similar slit, but in the flap rather than the main profile. Both solutions tend to provide the same kind of improvements.



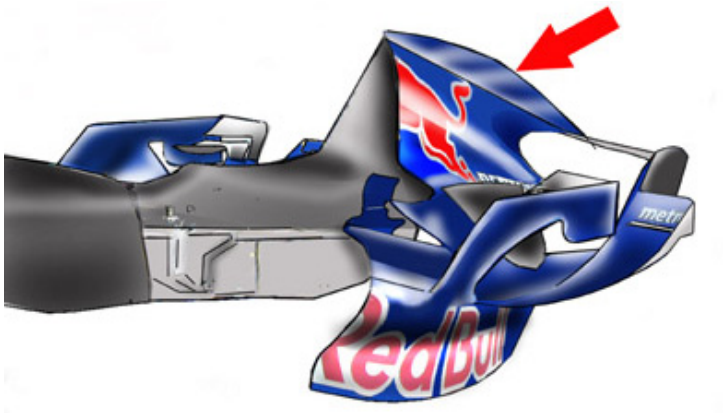
McLaren MP4-22 - barge board development

Though not new, recent refinements to the lower section of the McLaren's barge boards (right arrow) are particularly significant here, given the nature of the Nurburgring's layout - neither slow nor fast, instead featuring a continuous series of short straights and smoothly linked corners. This requires a perfectly balanced aero package, especially in terms of the car's underbody aero efficiency, and this is what the barge board revisions are aimed at - improving the quality of the airflow passing under the car. Working in conjunction with these refinements, the top-edge winglets (left arrow) condition the upper section of airflow impacting the sidepod ducts. They help reduce the lift effect generated by airflow exiting the front wing, and improve not only the quality of airflow directed to the rear of the car, but also cooling efficiency.



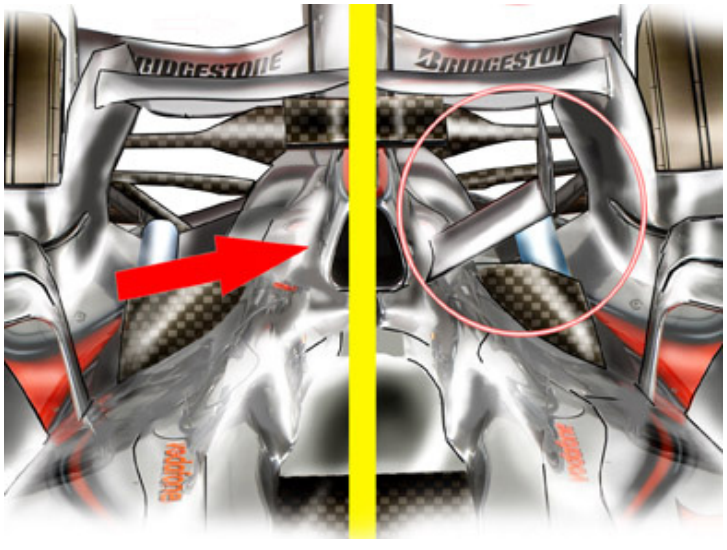
Hamilton's qualifying accident explained

A failure on the wheelgun, or at least the wrong pneumatic air pressure applied to it, was at the root of Lewis Hamilton's qualifying accident at the Nurburgring. To summarise, the fault meant it was not possible for the mechanic changing the right-front wheel to completely fasten the wheel nut (1), although it did allow the safety pin (2) to be pulled into its required position, preventing the wheel nut loosening completely and hence the wheel falling off. The result of the fault was a small gap (5 - in yellow) between the central mounting of the wheel (3) and the brake disc holder (4). This allowed the wheel an abnormal degree of freedom in relation to the aforementioned assembly and the inner edge of the rim started touching and scratching against the edge of the carbon fibre brake drum (6), damaging the rim (7) and causing the sudden deflation of the tyre.



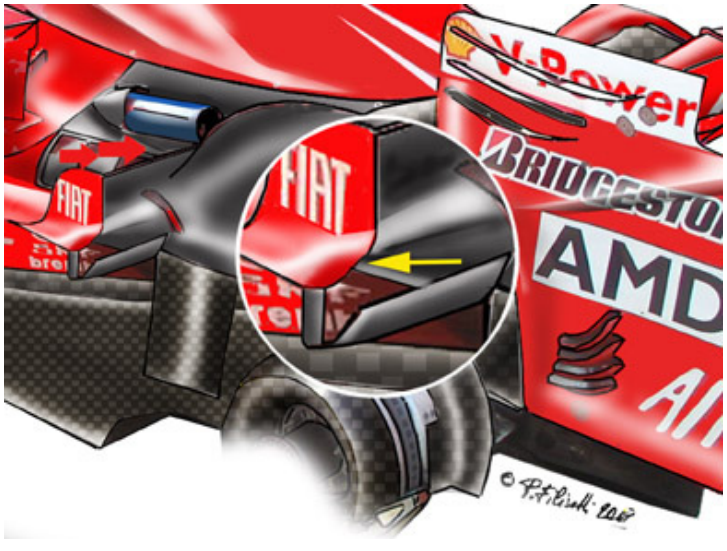
Red Bull RB3 - engine cover fin

In Hungary we are reaching the point in the season where common trends are emerging in the development of cars. Solutions that have proved efficient in the hands of the frontrunners are being adopted by teams further down the grid - and this long, high, narrow engine cover is one example. Here, Red Bull are following the path already trodden by McLaren, BMW Sauber and Ferrari, with the cover now sporting a generous vertical fin (red arrow) protruding towards the rear. As explained previously, this improves the quality of airflow to the rear wing, hence increasing the downforce the wing generates.



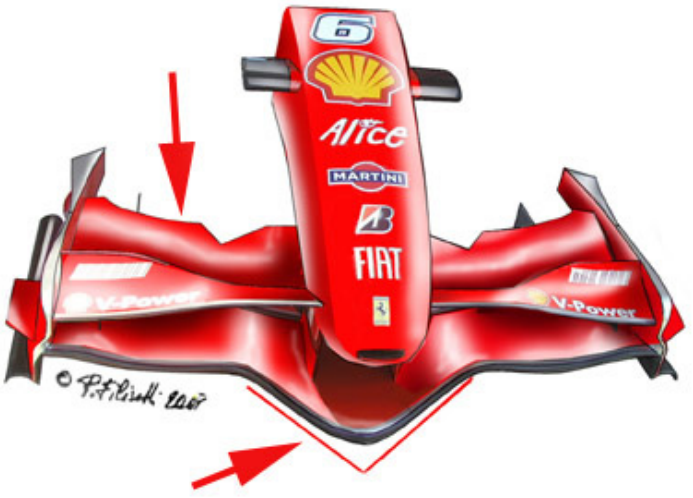
McLaren MP4-22 - horn winglets removed

The famous horns were gone at the last round at the Nurburgring and remain absent in Hungary, though it is too early to say whether the change is definitive. What is clear is that the new 'cleaner' configuration of the engine cover works in partnership with the heavily-revised rear wing adopted at the last race. Since their introduction around two years ago, the horn winglets' prime function was never one of downforce, but rather as airflow conditioners, aiding the efficiency of the rear wing. It seems McLaren's latest rear wing doesn't need that help, and removing the horns also gets rid of the small additional drag they generated.



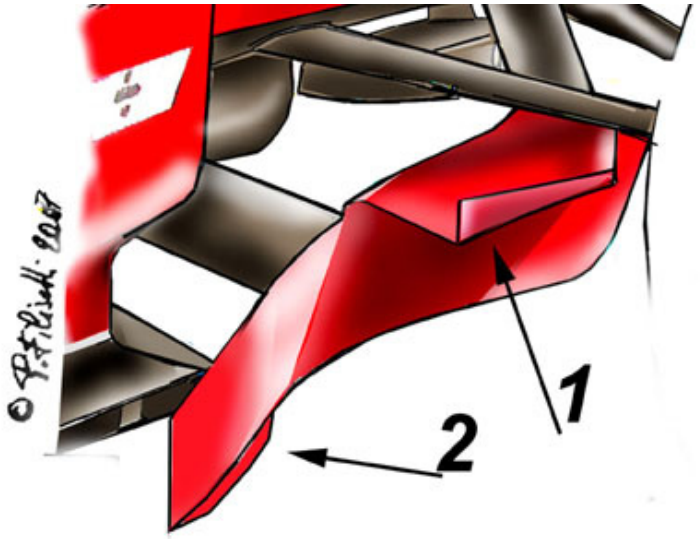
Ferrari F2007 - rear winglet development

Even the slightest detail counts in the continual development of the aero package. In Hungary, the winglets in front of the rear wheels have been altered with revisions to their endplates, which are now slightly shorter and bent inwards so as to eliminate turbulence generated by the airflow passing over the small profile attached beneath. As a result the winglets are also more efficient in diverting airflow near the rear wheels, reducing the drag generated by the wheels' rotation.



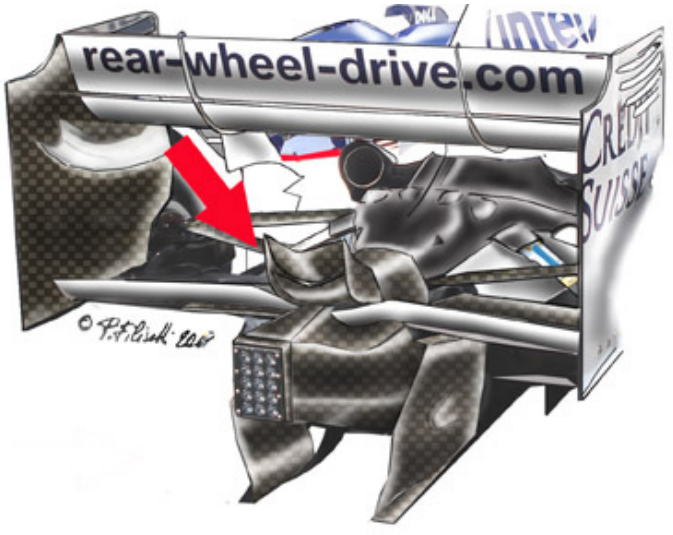
Ferrari F2007 - revised front wing

The revised wing introduced at the Nurburgring has been further developed for Hungary. The main profile sports a deeper central spoon section, featuring straight sides (see lower arrow) rather than the previous arch shape. The flap now has an increased chord, especially at the extremities, and features a slightly curved upward exit profile, equipped with a small Gurney tab (upper arrow).This configuration is specific to this track, which requires high downforce due to its twisty layout. Rhythm is paramount for a good lap time, hence sharper front-end handling - which this wing helps provide - is vital for strong race pace.



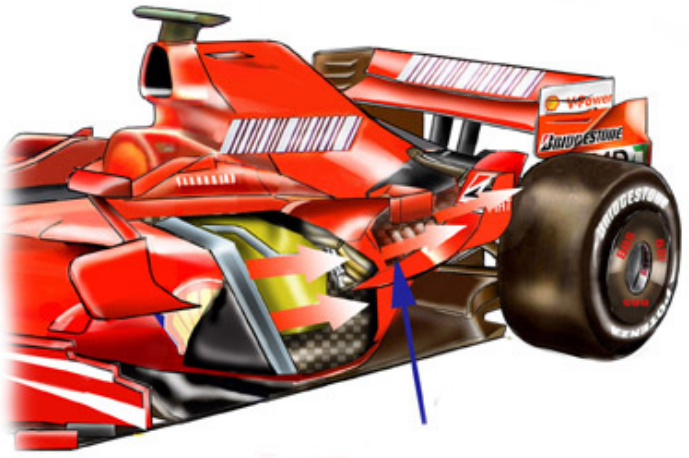
Ferrari F2007 - front barge board development

The latest version in Hungary sports two changes. Firstly, the boards now feature a generous vertical fin (1) on the edge of the horizontal upper profile at the front. This provides a channel for the airflow coming from underneath the front wing. Secondly, a small horizontal lip (2) has been applied to the slightly elongated rear portion of the board. The lip helps detach the boundary layer of the airflow that could otherwise create vortices - and turbulence - in this crucial area in front of the main barge boards, reducing their efficency.



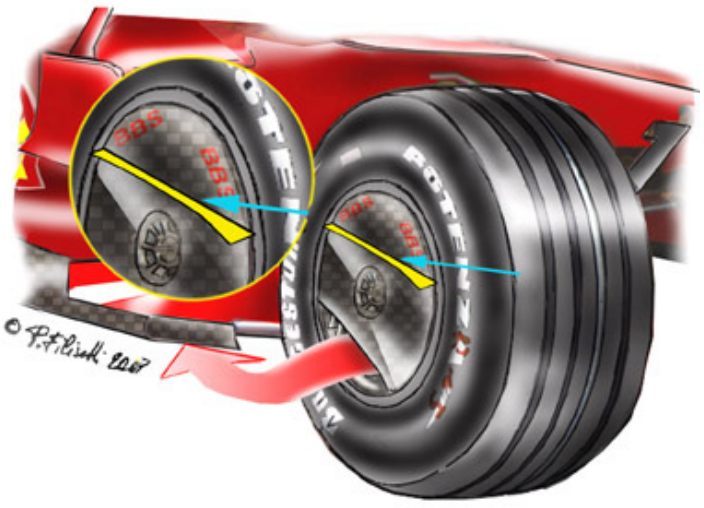
BMW Sauber F1.07 - double tail winglet

Overall downforce loads are even greater at the Hungaroring than in Monaco. Every possible piece of bodywork is finalised with this in mind and every year teams try to reduce the additional drag the changes create. On the F1.07 the usual single tail winglet on the rear crushable structure has been doubled up, with two curved and steeply angled profiles (red arrow). These help to keep the rear of the car stable on a twisty circuit by opening up the airflow and aiding air extraction via the central section of the rear diffuser.



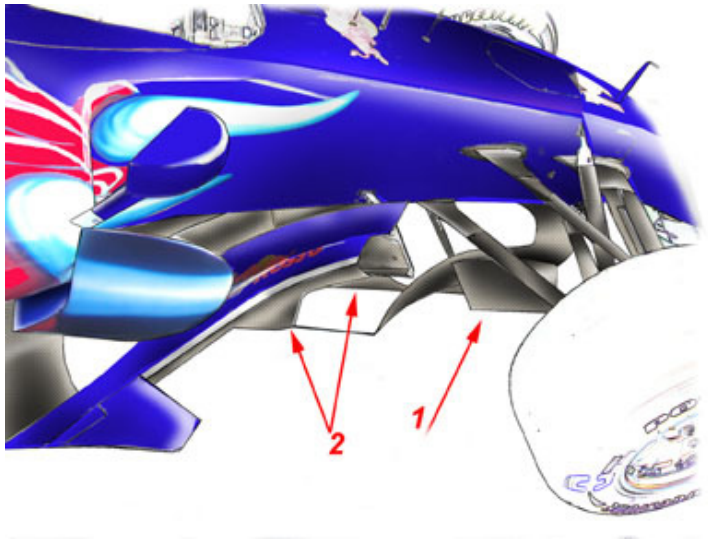
Ferrari F2007 - cooling detail

Istanbul is well known for its high temperatures and many teams increase the cooling capabilities of their cars here to prevent reliability issues. This is not the case on the Ferrari, as the multiple cooling gill system introduced earlier in the season is already more than efficient enough to cope. This is because the system's clean design means the hot air from the angled radiators in the sidepods does not face any obstructions as it exits the bodywork (blue arrow) via the 15 gills (per side) and flows freely towards the rear of the car.



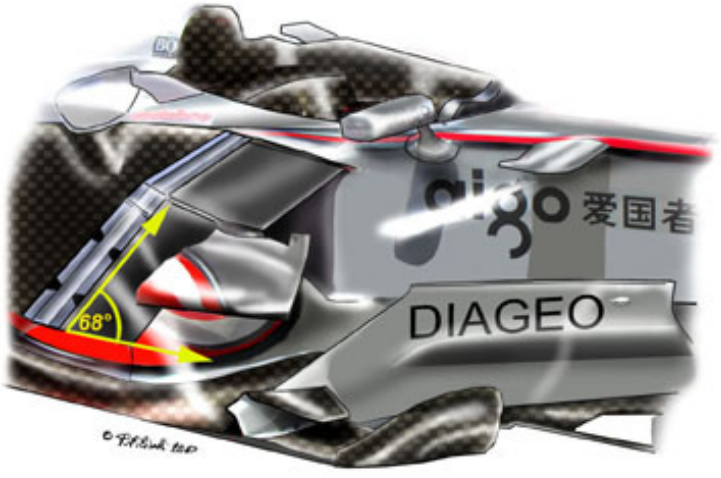
Ferrari F2007 - front rim shield Gurney tab

Introduced in Hungary and retained for Turkey, a thin Gurney tab (blue arrows) has been applied to the top half of the shields. The tab has a slightly curved side profile, wider at the extremities and narrower at the centre, so as to split the airflow in this area in two. This reduces the turbulence generated by the inner portion of the shields and helps with hot-air extraction via the diagonal vent in the lower section (red arrow).



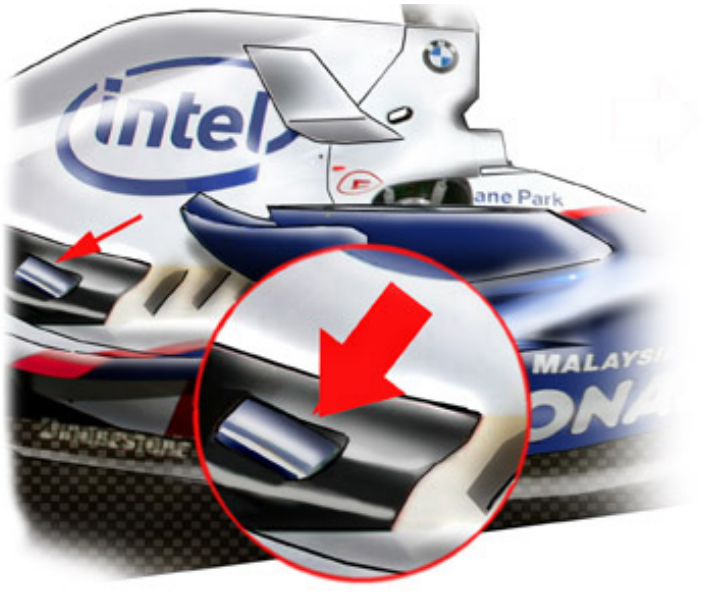
Toro Rosso STR02 - barge board development

The barge boards continue to evolve. In Turkey the front ones now feature a larger horizontal fin (1). The lower edges of the main boards have also been refined to work in conjunction with the front boards. A small vertical fence (2 - right) has been placed beside the splitter's horizontal section (or bib), creating a channel of sorts to better divert airflow under the car. And the knife-edge profile of the barge boards has gained a curved lip (2 - left) to improve the way the boundary layer of the airflow passing close to the shields is detached, thus cutting drag.



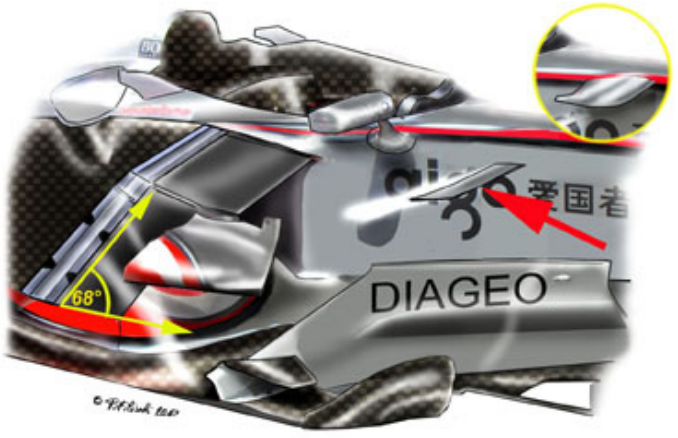
McLaren MP4-22 - radiator layout

In contrast to its Ferrari rival, which sports multiple cooling gills, the McLaren features totally enclosed sidepods, despite the high Turkish temperatures. The MP4-22's radiator layout, however, does not differ greatly from that of the F2007. The radiator pack sports a single incline of around 68 degrees, allowing for tight packaging within the sidepod, whilst also providing highly efficient cooling. The solution appeared to work well at Istanbul Park, even if the McLarens weren't quite as quick as the Ferraris.



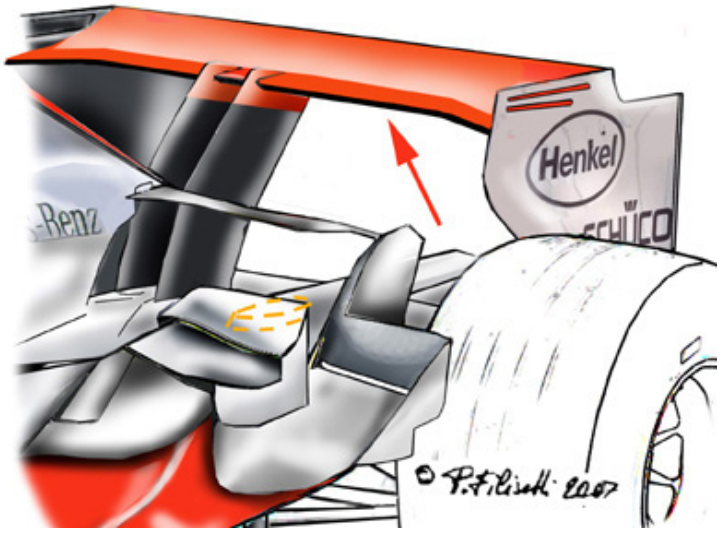
BMW Sauber F1.07 - engine cover detail

At the last round in Hungary we looked at BMW updates behind the rear axle. In Turkey we look at those just in front of it. The bodywork has been lowered in the area around the engine exhausts - by about 2.5 cm - meaning the exhausts now protrude more clearly (see magnified detail). This change allows for an increased and less disturbed airflow to the lower profile of the rear wing (making the wing more effective) and also helps with extraction from the diffuser, hence producing more downforce.



McLaren MP4-22 - cooling fin detail

The removal of the front-wing's upper profile at Monza has meant a small change for the cooling fins placed in front of the cockpit on either side of the McLaren chassis (red arrow). They are now at a lower point (inset circle shows previous placing) and a few centimetres back from their original position, hence closer to the sidepod inlets. They are also curved slightly backwards to improve the quality of the airflow to the radiator inlets, thereby compensating for the absence of the front wing's upper profile.



McLaren MP4-22 - revised rear wing

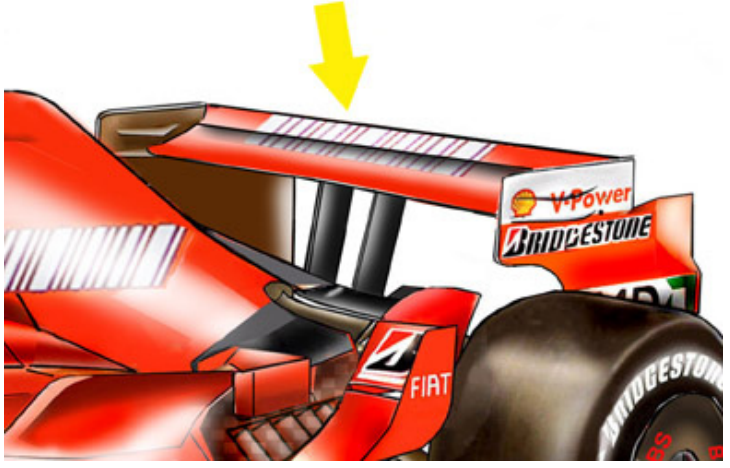
At the rear of the McLaren, instead of its standard double profile, the Monza set-up features a single, almost flat, profile (see red arrow) with a slight upward curve in the middle. This configuration matches the low-drag set-up adopted at the front and will help make the rear diffuser become rigid at high speeds on the straights. Although this will mean a slight loss of grip in the corners, the car's overall pace will improve.

McLaren MP4-22 - revised front wing

Monza is the fastest circuit on the calendar, with long straights interrupted by tight chicanes, and teams must therefore use a low-drag configuration to maximise performance. The McLaren is sporting a heavily-revised front wing here. The upper profile, which had been used to optimise airflow to the radiator inlets, is no longer present (detail circle). Instead there are two smaller flaps (yellow arrows), which provide just enough front-end downforce and grip down the straights and in the crucial early stages of braking into turns.

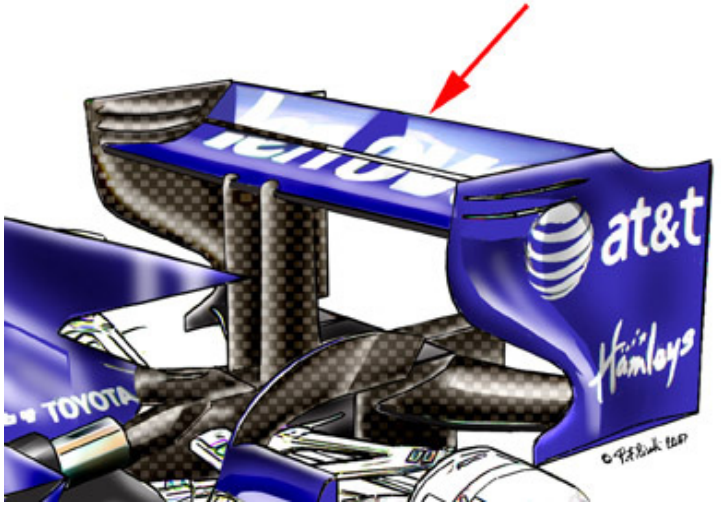
Williams FW29 - front wing development

Williams introduced a revised front wing at last week's Monza test. The wing, which mirrors the one adopted by McLaren at the Spanish race, will probably be retained for the rest of the season. Although this doesn't add much to the car in terms of downforce - not useful at Monza anyway - it does improve the FW29's cooling capacity by splitting the airflow impacting the profile's central curved section (red arrows) in two. A second, indirect benefit is that the car can run with smaller air vents on top of its sidepods, a change which improves its aerodynamic efficiency at this ultra-fast track.



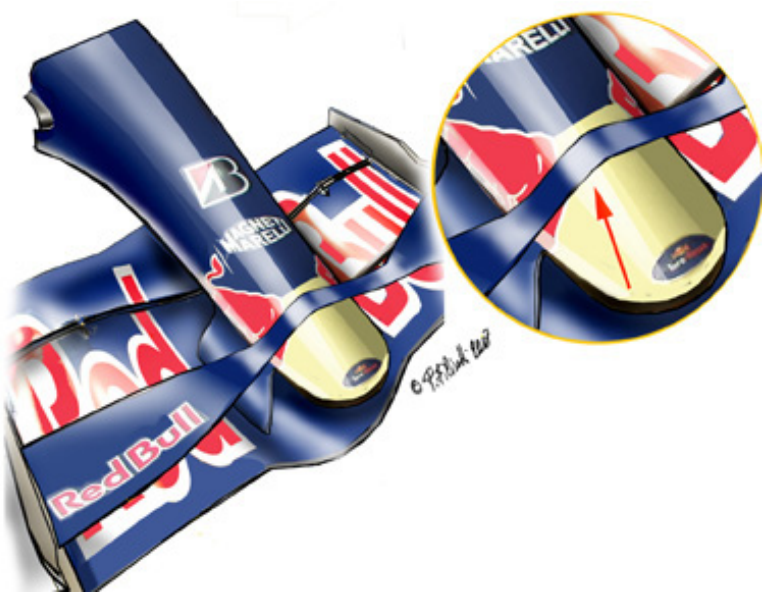
Ferrari F2007 - revised rear wing

The F2007's Monza-specific aero package includes an updated rear wing. This still has a double profile, but the upper flap (yellow arrow) has been narrowed and has a very low incidence angle. This reduces drag by approximately 16 percent, dramatically improving the car's top speed. The small loss of grip into corners is offset by the F2007's increased pace in 80 percent of the Monza lap.



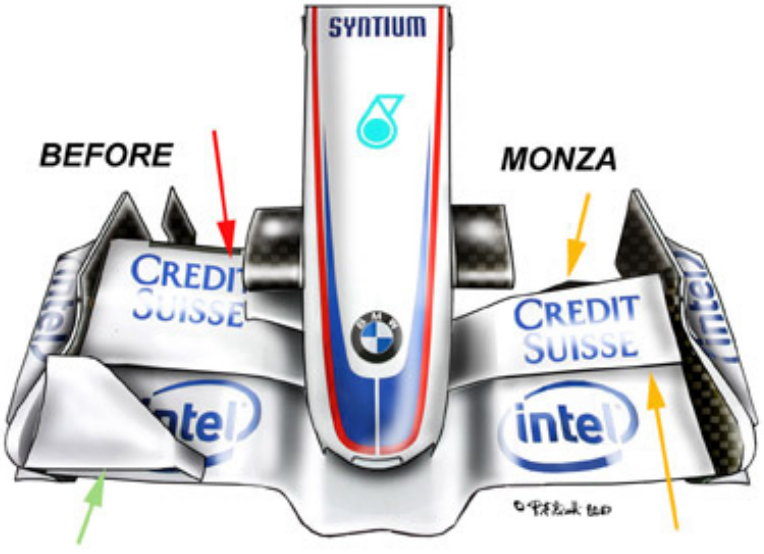
Williams FW29 - revised rear wing

As well as changes to its front wing, the Williams' also has heavily revised rear wing at Monza. It now features a completely flat double profile (red arrow) with a much narrower flap, which has been positioned with a very low incidence angle. This set-up will complement the low-drag configuration adopted at the front and will help the car's diffuser to stall at high speed, thereby reducing the overall amount of drag.



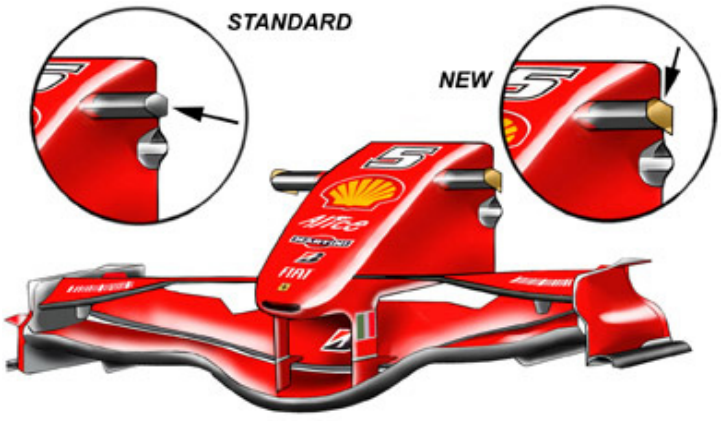
Toro Rosso STR02 - updated front wing

Mirroring changes seen on the Williams and the McLaren, Toro Rosso have introduced a revised front wing to the STR02 in Monza. It features an additional profile, which passes over the tip of the car's nose (see inset). Rather than increasing downforce at the front, the revisions will primarily assist the cooling system's efficiency, which will allow team to use either closed chimneys or closed bodywork on top of the sidepods to reduce drag on the straights and improve the rear wing's efficiency.



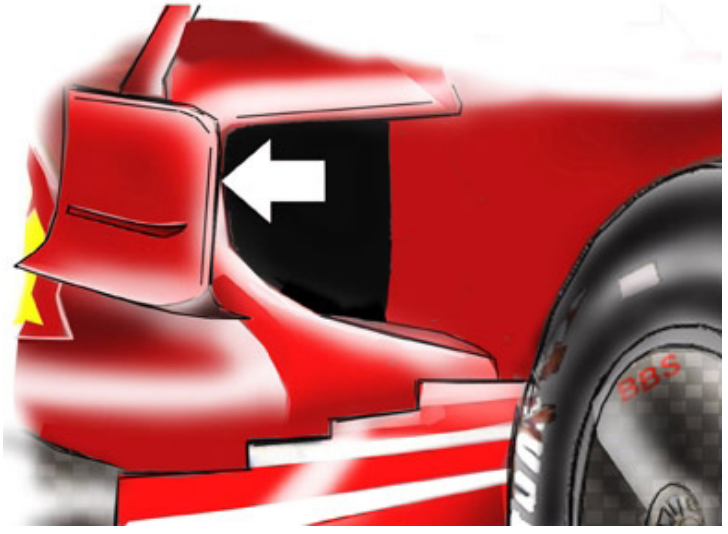
BMW Sauber F1.07 - front wing configuration

BMW Sauber's series of strong performances continued at Monza, the team finishing fourth and fifth. As expected, the main changes to the car were to adapt its aero package to the high-speed Italian circuit. Both front and rear wings were heavily revised, the front one sporting a single flap (lower yellow arrow), much narrower than the usual version (red arrow), and with the additional upper profiles (green arrow) removed. Interestingly, a triangular-shaped Gurney tab was adopted on the exit edge of the flap (upper yellow arrow), contrasting with the usual rectangular version. This front wing configuration produces dramatically less drag than the standard version, but was still able to keep the car's front end stable and sharp in the corners.



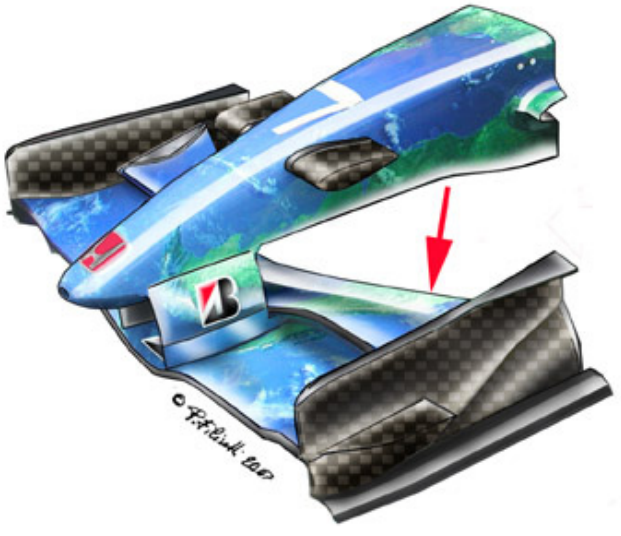
Ferrari F2007 - onboard camera endplates

A subtle development to the Ferrari's front-end aerodynamics at Spa. The onboard camera housings on the sides of the nose cone have minimal influence on overall aero balance, but their wing-shaped profile can be used to direct the airflow impacting against them. Ferrari have added small endplates, with a curved top edge and a triangular point on the lower rear edge, to better divert airflow to the sidepods.



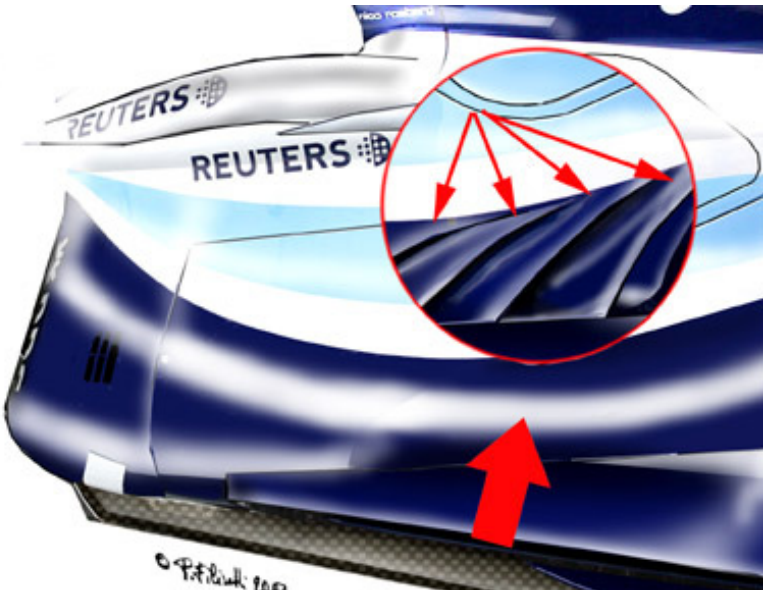
Ferrari F2007 - sidepod winglet slits

Ferrari's T-car at Spa is sporting wider winglets in front of its sidepods, with a horizontal slit running almost their entire length, curving slightly upwards at the front. The Italian team trialled these at July's test here to reduce airflow disruption near the sidepod inlets, hence improving cooling efficiency and reducing drag.



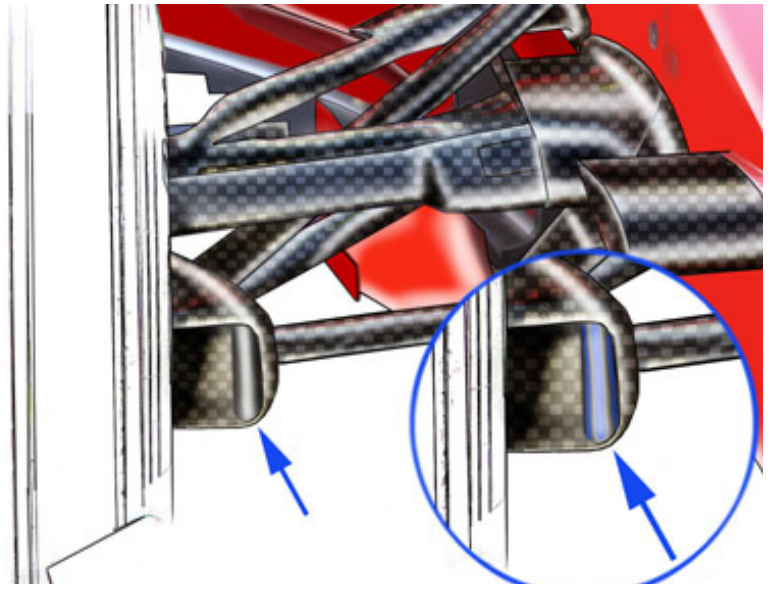
Honda RA107 - modified front wing

Although the aero package required at Spa is a lot less extreme than the one used by Honda at the last race in Monza, there is one interesting change. A very narrow flap (see red arrow) has been adopted to work in conjunction with the standard main profile and connecting pillars. This configuration is a compromise between the fast and slower sections of the circuit. It will reduce drag on the straights but should also provide enough grip in the turns especially the tricky Eau Rouge corner.



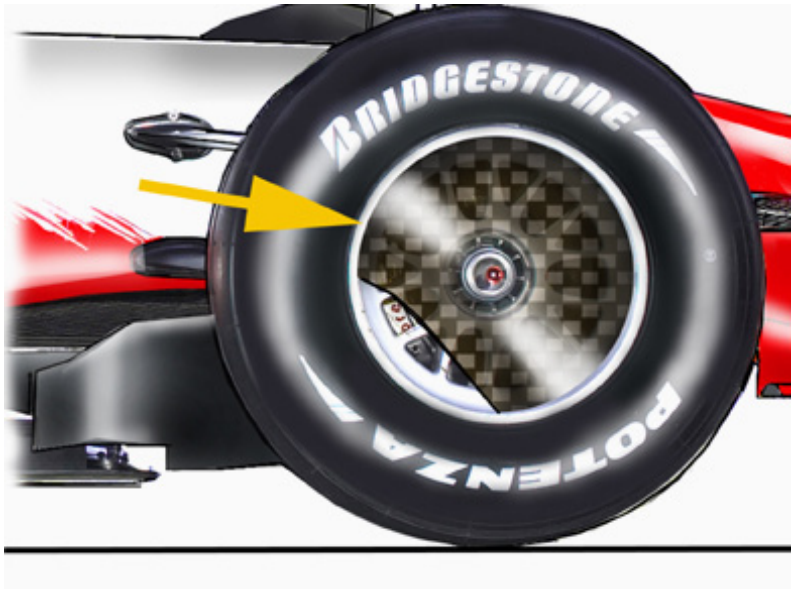
Williams FW29 - removal of cooling gills

Low ambient temperatures at Spa allowed teams to reduce the standard sidepad cooling vents in order to improve aero efficiency. Williams removed the gills (inset detail) normally located on the FW29s left sidepod, close to the inner face of the venting chimney. This solution improved airflow management towards the rear of the car, as the airflow was not disrupted by the turbulent, hot air that normally emerges from the gills.



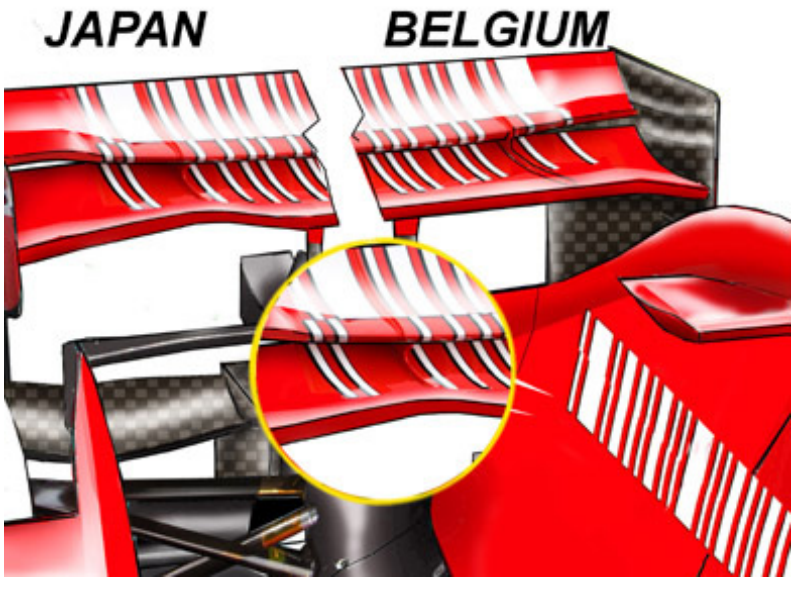
Ferrari F2007 - brake duct blanking

A subtle but interesting change at Spa was the F2007's partially blanked-off front brake ducts. Rather than using the usual sealing tape to achieve this, an actual lip (inset - in blue) has been added to the internal vertical edge of the duct, so as to better manage airflow through the reduced duct entrance. The smaller entrance is made possible by the relatively low air temperatures in Belgium. So why not simply use smaller ducts? Because this solution is better at moderating the airflow in relation to the car's speed, which varies greatly between the fastest and slowest parts of the Spa-Francorchamps lap.



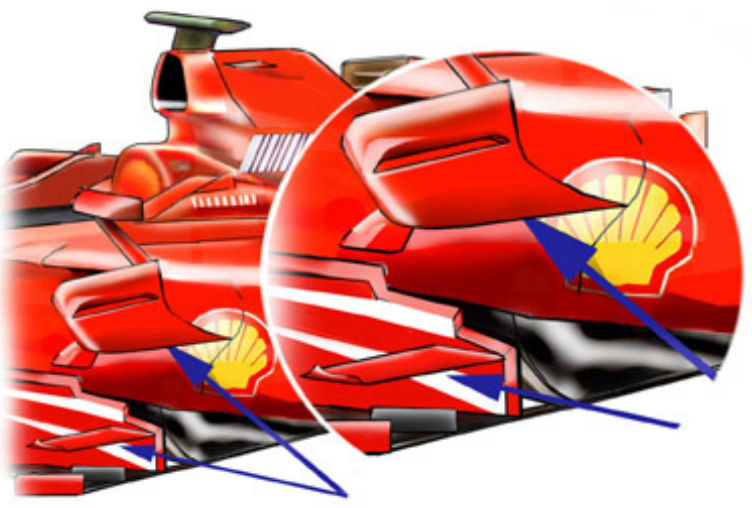
Toyota TF107 - front rim shields

Toyota have introduced front rim shields (yellow arrow) in Japan to improve the TF107's aero efficiency. Similar to those introduced by Ferrari at the British Grand Prix, their purpose is to extract the hot air generated by the brakes and divert it so as to accelerate the airflow passing underneath the car. The shields also reduce turbulence in the area close to the car's sidepod turning vanes.



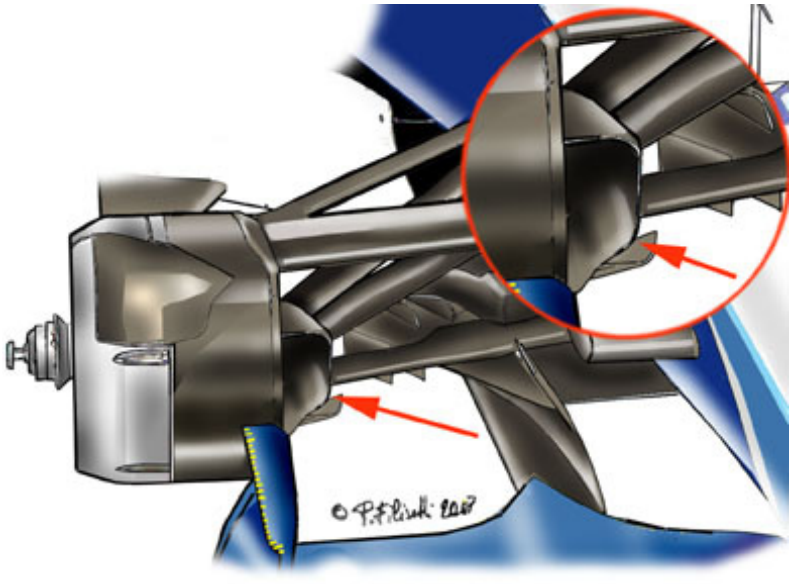
Ferrari F2007 - modified rear wing

In Japan, Ferrari have introduced a heavily revised aero package. This was seen, but not used, at the previous round in Belgium and was subsequently tested in Jerez last week. Instead of the rear wing eventually used at Spa, which was flat at the centre but bent downwards at its outer edges, the new wing has two curves towards its extremities (see inset). This modified configuration is a compromise between the low drag needed along the Fuji Speedway's long start-finish straight and the better grip required on the twisty sections.



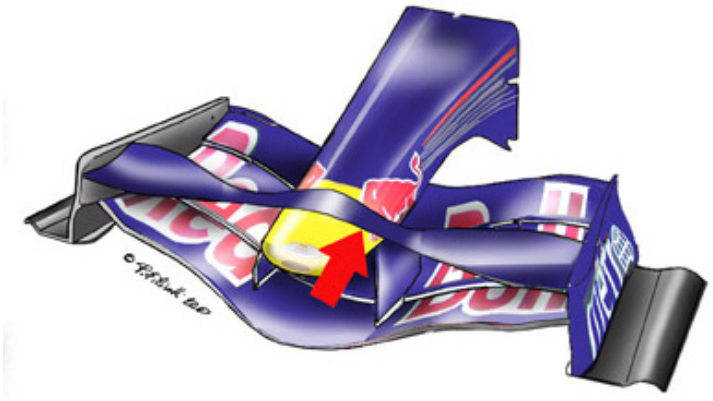
Ferrari F2007 - winglets and barge-board fins

At the last round in Belgium we featured the Ferrari T-car's sidepod winglet slits. A revised solution was adopted on all three cars in Japan. The dimensions of the winglet shields have been revised and the shields are now elongated at the front. This helps to reduce turbulence close to the radiator inlets and to clean up the airflow directed towards the rear of the car. This change has been coupled with another subtle one to the barge boards, which have gained an almost triangular fin with an upward-sloping outer lip. Its function is to reduce vortices in this area and improve airflow around the lower section of the sidepods.



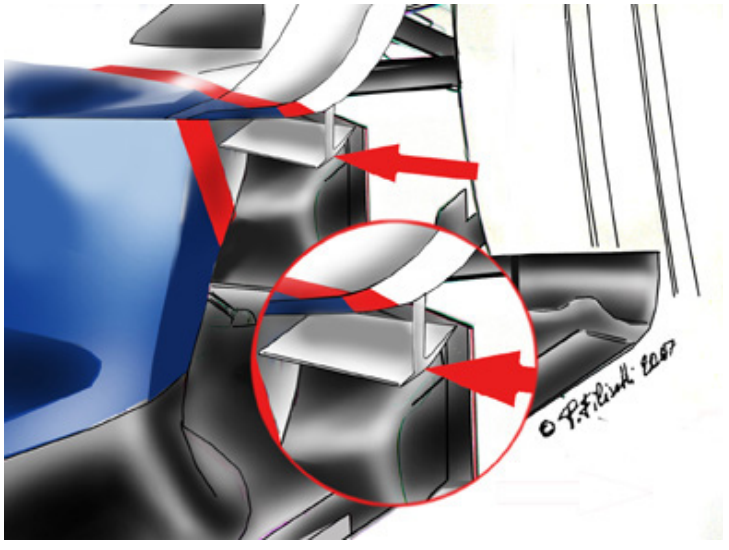
Williams FW29 - brake ducts

The unexpectedly cool weather conditions at Fuji did the teams no favours in terms of managing brake temperatures. Most were expecting to use relatively large brake cooling ducts, designed for dry-weather running in warmer temperatures. Sunday's rain and cooler temperatures, however, forced them to either blank off part of the duct opening, or - as Williams did - switch to a smaller duct. Williams also removed the small additional calliper-cooling duct that normally appears on top of the main duct. A similar solution was used at Monza - in that case for drag-reduction purposes.



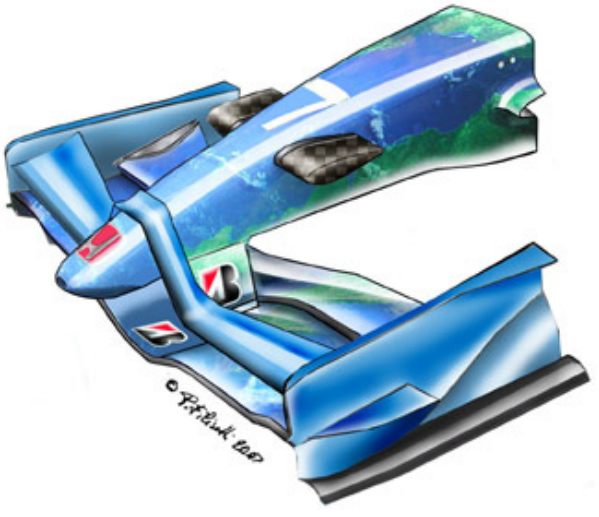
Red Bull RB3 - front wing revisions

An interesting aero change for Red Bull in China. The front wing's two additional upper profiles introduced back in Spain have been replaced by a single continuous element (red arrow). Sister team Toro Rosso introduced a similar solution in Belgium, following the trend set by McLaren this season. It helps in terms of cleaning up the airflow towards the sidepods, reducing drag and turbulence, and aids cooling efficiency. The last benefit could be of particular advantage at the last round in Brazil.



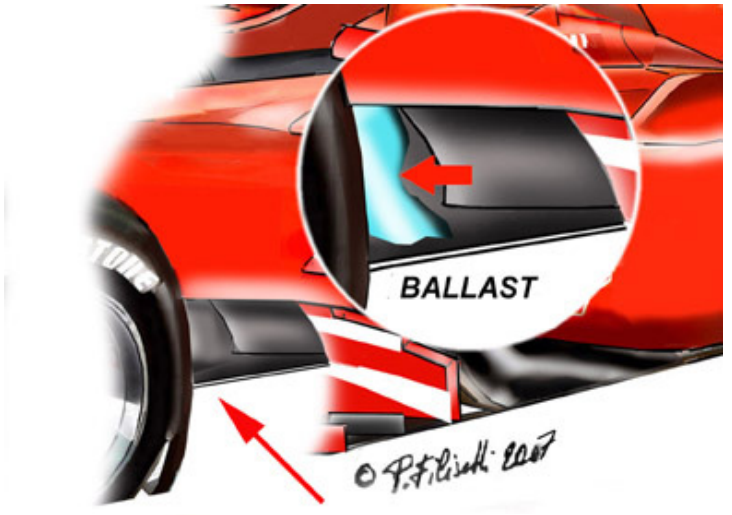
BMW F1.07 - additional rear winglet

In China BMW have added a small winglet suspended under the main curved flip-ups in front of the rear wheels, following the fashion introduced by Ferrari few races ago. These elements help in terms of reducing turbulence around the inner edge of the wheels and the rear bodywork close to them. This in turn noticeably aids the efficiency of the side sections of the rear diffuser, their air extraction being increased as a result.



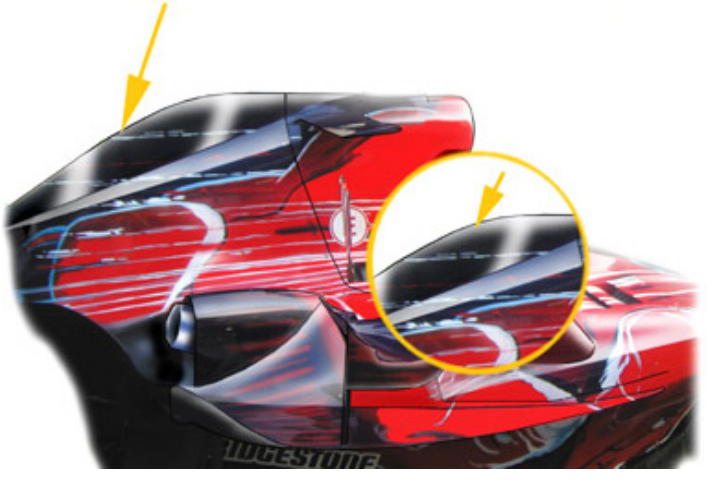
Honda RA107 - front wing revisions

Having already tested it at Jerez before last week's Japanese Grand Prix, Honda have introduced a heavily-revised front wing in China. It not only features an additional, curved upper profile - similar to the one already introduced by McLaren - but its connecting pillars are now attached to the middle flap rather than the main profile. This reduces the drag and turbulence generated by the airflow impacting the front of the pillars.



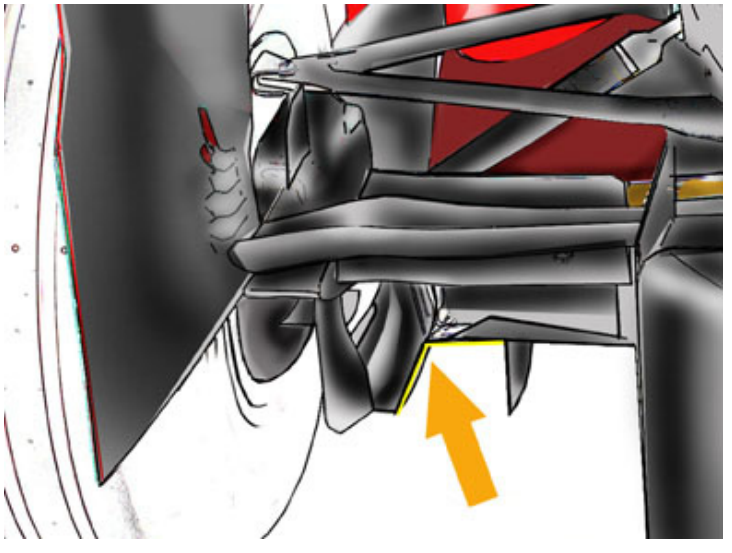
Ferrari F2007 - ballast changes

At the last couple of races, Ferrari are understood to have added more ballast to the front of the F2007. Hidden in the splitter section at the bottom (see red arrow), the extra ballast has changed the car's weight distribution slightly to increase its sharpness at the front, perfect for the twistier circuit layouts at the last three Grands Prix of the season.



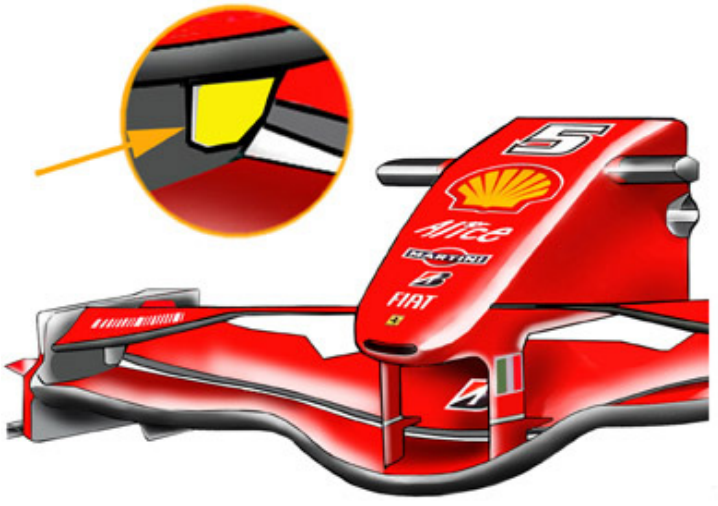
Toro Rosso STR02 - engine cover

This change appeared a few races back, but almost certainly contributed to the car's strong pace in China. The engine cover sports a rounded dorsal fin, similar to that on sister team Red Bull's car, and that on the BMW Sauber and Ferrari. It improves the aero effiency of the rear wing, and aero balance in general, aiding driveability and allowing the car to make better use of its tyres.



Ferrari F2007 - rear diffuser development

The rear diffuser is being constantly developed on all the cars, but due to their positioning and complexity, changes are often difficult to spot. One you could see in China was to the outer side section on the Ferrari. Specifically, the outermost fence (arrow) close to the wheel is sloped rather than vertical, so as to create a sort of trapezoidal section to the channel (yellow highlight). This improves airflow extraction from beneath the car, hence increasing downforce.



Ferrari F2007 - front wing development

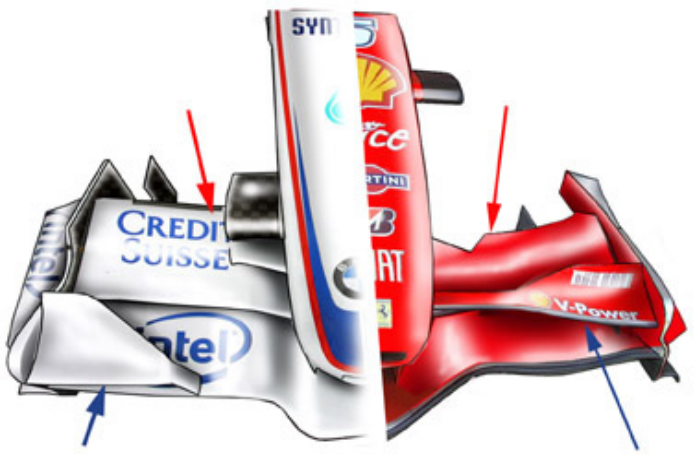
At Interlagos the challenge is to balance straightline performance with driveability on the twistier sections. The circuit's high altitude means lower air density, hence higher wing angles are needed to obtain adequate downforce levels. Alternatively, air pressure can be raised by better airflow diversion in certain areas of the car, as with Ferrari, who have increased the cross-sectional area of the small winglets placed under the wing's upper profile near the endplates. This change raises the pressure of the airflow passing underneath, slightly increasing downforce, but without having to dramatically alter the wing angle, hence keeping drag as low as possible.

BMW Sauber F1.07 - rear wing revisions

For Brazil, BMW have adopted a rear wing profile with a double curve, bending upward at the extremities. This solution raises dowforce at the rear without a significant increase in drag, hence leaving the car's top speed unaffected on the long uphill straights of Interlagos.

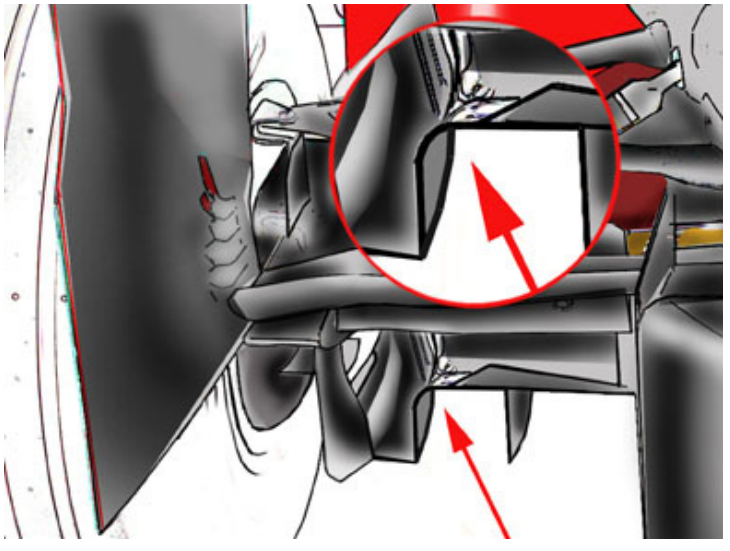
McLaren MP4-22 - rear wing development

This solution, as with the Ferrari front wing shown previously, is designed to compensate for the low air density at the high-altititude Interlagos circuit. Air pressure is increased in the rear wing area by a greater angle to the extremities of the main profile, its boundaries limited at one end by the endplates and at the other by flap separators (see detail circle). The 'channel' created between endplate and separator helps accelerate airflow both above and below the main profile, providing performance gains not just at high speeds on the straights, but also in the slower sections of the track where rear-end grip is improved.



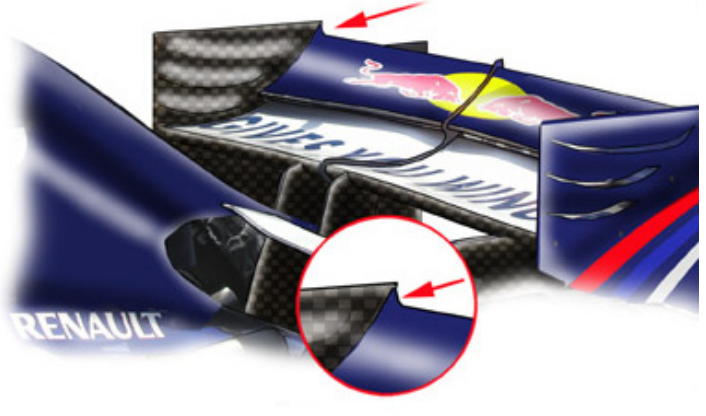
BMW Sauber F1.07 v Ferrari F2007 - front wing comparison

These two designs look visually quite different, but actually follow very similar concepts. The flaps sport a completely different profile on their rear edge (red arrows) but both have a vertical fin underneath (visible protruding from the rear of the flap) to divert airflow towards the sides. The additional upper profiles also have similar functions. The BMW's are noticeably shorter than the Ferrari's, but their more curved and sculpted shape manages airflow in the same way. And finally, the central spoon profiles again appear different, but serve the same purpose. That on the F1.07 sports a sort of squared lip, whilst that on the F2007 has a steeper, sharper profile. Both manage airflow in this area, feeding the front barge boards at front-axle level.



Ferrari F2007 - rear diffuser development

At the last round in China Ferrari tweaked their diffuser, inclining its outermost fence outwards so as to create a trapezoidal shape to the channel. In Brazil the team have reverted to the previous version, with the usual vertical outer fence attached to the diffuser via a rounded connecting profile (red arrows). This design was considered advantageous at Interlagos due to its reduced sensitivity to the ride height variations caused by the bumpy track surface (though the bumps have been reduced this year through resurfacing).



Red Bull RB3 - rear wing revisions

For the last round in Brazil the Red Bull sported a heavily revised rear wing, with a completely flat main profile and an interesting flap design, its exit edge actually slightly lower than the top edge of the endplates (red arrows). The flap and endplate are connected by a rounded profile that helps to increase air density close to the flap's extremities, providing a small but useful amount of additional rear downforce.