FIRST PRINCIPLES

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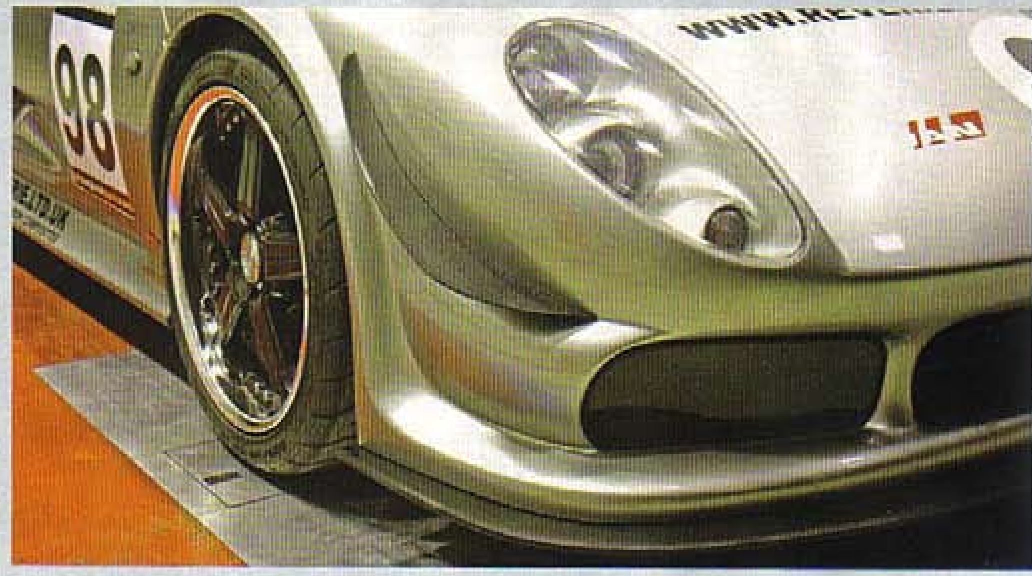
Fencing lessons

Some simple, low-cost improvements to the front of a GT racer



All photos: Simon McBeath

The Britcar M400 Noble's front air dam and splitter arrangement as it arrived in the MIRA full-scale wind tunnel

The front airdam/splitter combination is well known and understood for the benefits to front-end downforce (and sometimes to drag) that it can bring to closed-wheel racecars. The most frequently seen manifestation is an essentially vertical apron forming the airdam around the front of the racecar, with a horizontal extension – the splitter – protruding from its bottom edge. Hopefully, the splitter also extends back under the front of the car (if permitted), forming the entry to a smooth, uninterrupted underbody.

In V16N7 we saw how BTCC entrant Team Dynamics inherited an airdam design on its Honda Touring Cars that narrowed in front of the front tyres, leaving the lower part of the tyres exposed when viewed from the front. This trend, which persisted for a while on other BTCC cars, seemingly arose from track-based downforce measurements that did not take wheel-generated aerodynamic forces into account. In the MIRA full-scale wind tunnel, albeit it with stationary wheels and floor, wheel forces are included as part of the whole car's aerodynamic forces. And in the wind tunnel it was found to be far better to blank off the front wheels with vertical fences (see below). This prevented the airflow hitting the wheel at an angle destined to generate a lift increment, while simultaneously slowing the airflow down here, increasing the static pressure on the top of the outer portions of the splitter.

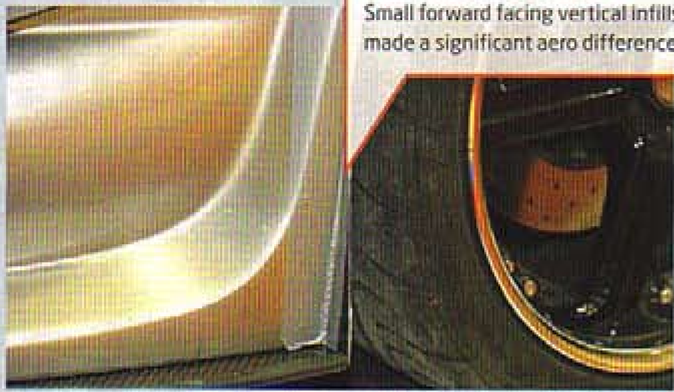
So when the Britcar Noble M400 of Paul Cundy was brought to the MIRA full-scale wind tunnel with a splitter that extended horizontally beyond the outer ends of the airdam (see photo above), the opportunity to try a similar idea was not to be missed.

As step 1 overleaf shows, the airflow above and below the splitter is aligned more or less fore and aft so there will be little if any velocity differential (and hence little pressure differential) above and below this portion of the splitter. However, adding small vertical fences to join the rear edges of the splitter to the wheelarches, as seen in step 2, made a significant difference, as table 1 shows.

So, as with the Honda, although drag slightly increased (by 1.2 per cent), the gain in front (and overall) downforce has to be regarded as pretty efficient. Combined with the small loss of rear downforce, this simple, cheap modification made a very

The airdam/splitter configuration seen on the BTCC Honda Touring Car that inspired this month's wind tunnel trials

1 ORIGINAL SPLITTER
Smoke plume shows little velocity difference above and below splitter



2 VERTICAL FENCES
Small forward facing vertical infills made a significant aero difference

3 SIDE FENCES
Small rectangular end fences added further aerodynamic benefit

4 REDUCED SIDE FENCES
Smaller, triangular-shaped end fences reduced the aerodynamic benefit

worthwhile contribution to shifting the balance more to the front, a primary aim on this car, which previously had a 40 per cent front / 60 per cent rear static weight distribution.

It is interesting to note that this small modification actually mirrors the design of the car's original moulded airdam, although that was shaped more to allow the air to roll off to the sides instead of slowing it down to tap the ensuing increase in local pressure. Clearly, if the idea here is to slow the airflow down to increase the local static pressure on the splitter top, then some form of end fence might enhance the effect. This was the basis for the next iteration that was tried (see step 3 above).

Sections of 30mm aluminium angle were taped onto the splitter top faces on either side so they butted up and joined the vertical forward facing fences to form small end fences, as shown above. The effects were again pretty significant, as table 2 shows.

So the changes were not as great as were derived from fitting the forward facing fences. But, by virtue of a further front downforce increment, plus a further loss of rear downforce, the balance was shifted more to the front and closer still to the target of 35 per cent to 38 per cent front downforce by adding these side fences. Logically, had time permitted it would have been worth trying larger side fences, perhaps triangular in side view shape, connecting the top of the forward facing fence to the front of the side fences tested. As it was, a reduced size triangular version was tried instead (see step 4) and this saw a drop of one count of drag and 12 counts of total downforce, split fairly evenly front and rear, suggesting the logic for trying larger side fences has validity.

Another comparison, done at an earlier point in the session, evaluated the benefit of the side fences alone, and the results in table 3 further reinforce the conclusion that the forward facing fences were an essential element of these splitter improvements.

The changes from the side fences alone were beneficial but modest, and clearly these devices needed integrating with the forward facing fences to make a significant improvement.

Thanks to Simon Farren at Reverie, Paul Cundy, Richard Gould, Phil Brett and Adrian Winch.

TABLE 1

The effects of adding forward facing vertical fences to the outer ends of the splitter

	CD	-CL	-CLfront	-CLrear	%front	-L/D
Without vertical fences	0.504	0.530	0.151	0.379	28.49%	1.052
With vertical fences	0.510	0.549	0.177	0.373	32.24%	1.076
Change, counts	+6	+19	+26	-6	+3.75%	+24

TABLE 2

The effects of adding small end fences to the forward facing vertical fences on the outer ends of the splitter

	CD	-CL	-CLfront	-CLrear	%front	-L/D
Without side fences	0.510	0.549	0.177	0.373	32.24%	1.076
With side fences	0.511	0.554	0.188	0.365	33.94%	1.084
Change, counts	+1	+5	+11	-8	+1.70%	+8

TABLE 3

The effects of side fences alone on the outer ends of the splitter

	CD	-CL	-CLfront	-CLrear	%front	-L/D
Without side fences	0.502	0.504	0.109	0.384	21.63%	1.004
With 15mm side fences	0.502	0.507	0.114	0.392	22.49%	1.010
With 30mm side fences	0.503	0.509	0.115	0.393	22.59%	1.012