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Mallock Racing

Formula 3 Performance for Clubmans The Mk 25/26/27 concept

Following F.3. cars in testing, straight line performance and steady state cornering are much the same. Traction from the Mallock on corner exit is definately superior, so where are we loosing out? The answer is in braking and dynamic cornering stability i.e. The F.3. car is quicker and more consistant on corner entry. Why?

The first visible clue is that the F.3. car rolls less. On the Mk 25 then, apart from an improved front suspension, and dampers, the main theme was to "Get the roll bars to work".

With chassis roll rates in excess of $\frac{1}{2}^{o}$ per G, designers soon discover that the chassis is twisting as much as the suspension.

The Mk 24b at 2200 lb ft/^{o} was already the stiffest space frame in production and only a modest improvement to 2350 was reasonably practical between suspension mounts. However, roll bars are always several times stiffer than springs, so that by mounting the rear bar some 2ft further forward the effective chassis rigidity has been improved about 50%, well into 'State of the art' F.3.

The next improvement in the Mk 25 was to make the roll bars themselves more 'Technical'.

At 1^{o} roll, the arm ends move only $\frac{1}{4}$", so we made certain this movement really was twisting the torsion bar and not being absorbed in free play, or bending arms.

The programme has been 100% successful. Roll angles are visibly less, using half the theoretical torsion bar rates and adjustments have an immediate effect.

The most obvious difference to F.3. was a foot longer wheelbase and lower polar moment (All weight concentrated rear of C of G), so this was the theme for the Mk 26.

The 8" longer wheelbase was certainly a step forward. Attitude change at corner entry and exit is visibly improved and there are several secondary advantages, such as being able easily to vary weight distribution and fit an extra bulkhead for improved chassis rigidity.

On the polar moment front, it seems development has not yet reached the point where we can go to extremes.

All through 1983 we had been evaluating a special rear wheel bearing by using this on one side only.

On the Mk 26 we first noticed a nasty twitch on turn in. This was eventually cured by fitting a 'Superbearing' to the other side. It seems then that a low polar moment will highlight any "twitch" tendancy. In this case, however, it has concentrated our mind on what could well be the most important discovery of the decade. With a beam welded to a dummy wheel, we tested the rear axle toe control. Ray's comment was that if it were four times better, it would still be enough to destroy the handling of an RT 4 and this was with 'Superbearings' which have at least three times less wobble than the standard units.

We are currently running a programme to quantify 'Toe Control' and a pattern is now crystal clear.

I can think of at least eight clues, when test or performance results indicate that poor toe control is rubbish and reasonable control can show a dramatic improvement. Just one example will serve.

Jim Robinson runs a Mk 21 on the Hills using a 2.2 litre Hart. Without being unkind, the handling this year could fairly be described as visibly horrible.

At a recent Mallory test, a change of wheel bearings transformed it, possibly 2 seconds per lap.

Many of the clues come from the users of twin bearing axles (Creighton Brown and John Fyda). These were tried two years ago, but their very success in controlling wobble was their downfall. Unless the axle is 100% straight, bending loads play havoc with half shafts and star wheels and at that time we abandoned them to allow the single bearings to take up mis-alignment.

We have come a long way since then and once more development goes round in full circle. First we developed a very sophisticated method of checking straightness. Then, a new jigging system for building axles straighter and quite recently a new straightening jig which allows us to straighten full Ford casings. These are larger in diameter but thinner, so they are stiffer but no heavier. They need about 8 tones to straighten and are easily kinked. The new jig has cracked the problem.

By abandoning super low polar moment, we have also been able to loose the side mounted radiator, which was certainly loosing out on side pod down-force.

We have had two good test days with important lessons learnt. For example, a short tail costs close to a second a lap.

A lesson learnt on the Nimrod does not apply to the Mallock. On a Group C car, it is difficult to generate front down-force without excessive drag so that popular to usual practice a low mounted wing is used for high down force which does not see-saw the front up. For lowest drag, a high mounted wing is used.

Evaluation of three Mallock noses showed no detectable drag difference in themselves, but the extea wing needed to balance the high downforce nose lost some 300 RPM. Clearly a high mounted wing would be more efficient.

The WOB link rear axle location gives a roll centre as low as 3 3/8" and was quite a breakthrough in itself, as proved by many successful up dates.

The stress levels in the off side axle mount is unpleasantly high and although steady development has reduced the problem to manageable proportions , it still needs to be carefully watched. Not quite as idiot proof as I would like in the hands of the inexperienced or casual.

For this, and other reasons, we are taking a close look at a new system invented by Michael Mumford and used with dramatic success in 1300 F by Richard Gilmour and Godfrey Faux.

Remember the Bulldog link used on the Mk 23?. The stess levels were a quarter of those in the WOB. Also cornering loads on right hand corners are not transfered through the axle and thus relieve it of much bending. It's down fall on the Mk 23 in Mk 1 form was the very high roll centre (about 9½") giving rise to the notorious Stage Coach effect, which in lay terms means that when one wheel hits a 1" bump, the whole axle moves sideways at least 1/5". The effect is directly proportional to the R.C. height so the WOB is almost three times as good, but still poor by I.R.S. standards.

On the Mk 2 version of the Bulldog we inclined the rods downward to the centre which dropped the R.C. to 7" with a significant improvement.

I did not like to persue this path much further as I supposed that heavy inclination would give ride to unwanted vertical forces and the R.C. was starting to move about.

Michael Mumford, however, has pointed out that due to the pure symetry, vertical leads are cancelled out which few other systems achieve. This could well be a subtle advantage in itself and moreover by carefully proportioning the bell crank and links the roll centre car be very exactly controlled.

The roll centre height is where the rod projections intersect so can be anywhere the designer chooses. The 1300 F cars use ½" clearly well below the 4" ground clearance and low enough to make the stage coach effect negligible.

A secondary advantage is that the axle itself has fewer brackets and stays, which makes it easier to straighten and reinforce.

The Mk 25 front suspension geometry was close to perfection when used with special fabricated uprights and small radius tyres such as Yokos or M and H, but became progressively worse with Vitesse uprights and Avon or Dunlop tyres.

This has been corrected on the Mk 27.

To summerise then, the Mk 27 will feature:

1/ Improved front suspension geometry.

2/ Improved damping using reasonably priced Koni 'Supersport' dampers with our optimised settings.

3/ 8" longer wheelbase (as described).

4/ Straight taper chassis for better weight/rigidity/drag/appearance ratio.

5/ New narrower side pods and bonnet for lower drag and improved appearance.

6/ A target of at least 400% improvement in rear axle toe control.

7/ Optomised tail length and wing height.

8/ Roughly 50% improvement in effective chassis rigidity and much more effective roll bars.

9/ Probably Mumford axle sideways location system.

10/ Improved seating.

11/ Needless to say, weight reduction is something we keep looking at all the time. The Mk 26 is some 100 lbs lighter than the Mk 24. Approx 945 lbs with iron diff and fuel.

With ground effect banned, 1985 should be the year of F.3. times for Clubmans.

You will need a Mk 27 to remain competative.

Arthur Mallock

The Mumford System