

Design De-Brief 2007

To all those who made it to Formula Student 2007, held for the first time ever at Silverstone, "Well Done".

Regardless of your finishing position we are all aware of just how much hard work, time and pride have gone into your entries. However please also remember that all of the Judges and Officials and organisers have also given up a lot of their time in order that the competition could be run.

I think 2007 Silverstone could be viewed as the coming of age of the single cylinder car: the feat of RMIT in winning the Endurance event whilst simultaneously using the least fuel proves a combined level of reliable performance and economy can be made possible by an integrated and tested light weight design.

Apologies to those teams that asked me to come around to see them in their garages: I either came at a time when you were out (successfully) running or I ran out of time simply due to the difficulties of trying to compile the results.

Some time ago we published a guide as to how the judging process worked. One of the basic facts is that there are several judging teams and it is unlikely that they all share common views and thus they may score slightly differently. As a result we try to moderate or normalise their individual views and scores to balance the results fairly overall. It is a very difficult and nearly impossible task to do correctly: it is fair to say that I think there has only been one year at which I personally felt this was done to perfection.

The fundamental outcome of this process is that the individual score allocated to you at your judging session and as recorded on your individual Design Score Sheet does not necessarily relate directly to your Final (moderated) Score. There are a few key things that are noted instantly: cars that are unfinished or incomplete or don't turn up are marked down and cars that feature comments such as "unsafe or dangerous" are also marked down. This year a number of cars were discovered, by the Scrutineers, to have features that were not quite in compliance with the rules. Where these could not be rectified we, as Design Judges, were asked to penalise these offenders accordingly. The main transgressions were either an inability to adequately accommodate the 95th percentile "Percy" or tube sizes/wall thickness that failed to offer equivalent strength. Each "offence" was penalised at 10 points in the allocated Final (moderated) Score as shown on the Results sheet. Teams that suffered this indicate a "Rules non compliance penalty" in the summary.

Now for the highlights:

1. It is said every year and repeated again, "Read the Rules". It is a sad statistic that only 7 teams actually made a good impression prior to the event by submitting the correct paperwork, in the correct format by the deadline. Most of these rules, albeit perhaps slightly different to the Stateside event, have been around for a while and are published well in advance and are on the website. There is therefore absolutely no excuse to have any penalties at all. It seems absurd to leave it until the last possible day to send these submissions as a small server error and yours arrives late etc. We do

understand that you often feel aggrieved by these penalties and in order that they be explained 100% fairly we will be publishing a revised guide to their application although these are already explained on the website. A number of teams claimed that they were not aware of these; it is your responsibility to be aware of them! There are reasons for the penalties, even if in some cases it is only to make things easier for the Judges who may have to look through all of them. Avoiding these penalties is the easiest, cheapest and quickest points gain that most of you can make!

2. I was surprised by the tiny number of teams that failed to mention in their Reports the accommodation of the bigger occupants; given that the new regulations regarding the 95th percentile "dummy" (Percy) were highlighted along with the necessary information for you to make him and therefore check for yourself. Incorporation of new rules into your design should have been a high priority.
3. A major flaw across many Reports was the lack of any balanced reasoning or discussion. You were all quick to note the benefits of your chosen option but often failed to outline what other choices were available, let alone discuss why they were less suitable. I questioned a hopeful team at the event as to their way forward for next year, in this case I was asking about engine choice. They were completely set to keep the same engine as this year. It took a while to convince them that in starting from scratch they actually had a choice of engine options and that they should sit down for a short while and list the pros and cons to each. For example choosing an air cooled engine to save the weight of the cooling system and fluids is a flawed decision if the base engine is heavy or bulky or has a high CG or unsuitable gearbox or poor packaging or expensive etc.
4. It is good to see a lot of teams actually thinking from the outset as to how their product will be manufactured. This is a key skill that is learnt primarily by experience and it is often the case that if the component is simple to actually draw, model and dimension then it will be cheap to make. Material choice often dictates a manufacturing method and often the part cost too. It is possible to model a part on the computer that cannot be made at all, let alone economically!
5. The use of a motorcycle engine in a car, sometimes in a different orientation means that the forces experienced by the engine and ancillaries are quite different. The obvious ones here are the oil sump and the engine mounting arrangement. Oil surge in the car application is quite likely compared to the motorcycle and the loads transmitted through a "stressed engine" are again unlikely to be the same as in the original motorcycle frame. As some teams also realise, the vibration issues of a solidly mounted engine can be influential, especially on reliability.
6. The Formula Student dynamic events are very much transient in nature. Outright engine power is less important than driveability and torque. Unfortunately they rarely make headlines! The same can be said of the dampers: it is very difficult indeed to make consistent tests on the dampers and their effects on both the handling of the car and the driver's perception of

the same. One thing is certain however; any excess friction or free play between the tyre and the damper will provide untold inconsistency and grief. Teams that have extended small mountain bike dampers to span the lower wishbone to chassis mounting almost universally failed to appreciate the drawbacks of so doing.

7. The finesse, feel and "gearing" of the controls are very important. Free play or excessive friction in any of these is simply off putting at best and dangerous at worst. It makes a negative initial impression on Judges and gives your car a cheap feel to it immediately. The operating effort of pedals, gear shift mechanisms and the ratio of throttle linkages are all vital "feel good" factors for the driver and prospective purchasers.
8. The installed stiffness of various assemblies, e.g. rear uprights (toe control etc.), the pedal box and the steering column are other things to consider carefully, both during the design and the build stage. They should be checked after final assembly to ensure that the torqued up bolt is clamping the parts together and that the energy has not simply been wasted in bottoming the nut on the run out of the thread whilst leaving the parts touching but not tightly joined. Any trick (or maybe not so trick) adjustment mechanisms should maintain the location without any play.
9. It is still my view that you need very good reason(s) to design and manufacture your own components that could logically be better off purchased. In particular I am thinking of safety critical parts like brake calipers. The commercial quality controls, fatigue testing etc. of these items is unlikely to be something that you can equal. Some of you may have very good reasons. If your overall design package requires you to do so then please ensure, as a few teams did, that you research both the design and manufacture thoroughly and that you test the finished items prior to installing on the car. Designing and making the component/assembly just because you want to, you are working at a particular company or your tutor thinks it is a good idea are not valid reasons as part of the holistic whole car design philosophy.
10. The Formula Student/Formula SAE event is very specialised. Regardless of what marketing people or your tutors may tell you there is NO point in attempting to design a car that also serves another purpose. SVA compliance is pretty difficult to achieve for any form of race style car and who on earth would want a road car with only a 600cc engine! By the time the additions required for SVA compliance are designed in the weight alone would render the vehicle obsolete for both road and track. An SVA design study is a separate project; it is not a part of Formula Student.
11. A number of teams chose the E85 fuel route and most did so with sound reasoning and understanding. For forced induction engines the chance to lose the intercooler made a good case for this bio fuel. It is this sort of thinking, along with endurance winners using the least fuel overall, that will help Universities and Governments appreciate the benefits offered to students and industry by the Formula Student/Formula SAE competitions.

12. Finally it must be noted that in a small number of cases there is a basic lack of fundamental engineering principles, let alone those specialist automotive or motorsport skills. It is not possible to run a marathon before you have learnt to crawl! In every area of life you must prove yourself capable of the basics first. In a way this relates back to point 9 above.

Formula Student is one of those very rare things, a "win-win" situation for everyone involved. Universities get better applicants if they provide a good Formula Student experience, students learn far more of the real world practicalities, financial and temporal use of resources etc., prospective employers get better quality new graduate recruits and even the Judges usually learn something!

Thanks again for your enthusiasm and effort, keep an eye out for any Rules changes and hope to see you again.

Neill Anderson

Chief Design Judge 2003-2007