

Vehicle Balancing Assignment

by Danielle Haynes

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Vehicle Balancing and Braking Report

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Introduction

This assignment will be looking into the vehicle chassis and the suspension design features on different types of vehicles to see what specific behavioural characteristics will influence the overall performance. This will be split into three separate sections, these are;

- A technical report
- A technical Excel spreadsheet
- An analysis

In the technical report research will be complete about the comfort and handling of car designs and how they differ on three different types of vehicles, these are a standard road car, a supercar and a race car. For each of these vehicles they all require different levels of comfort and handling as they are designed for different tasks.

In the second section an Excel spreadsheet shall be created to show the calculated longitudinal and lateral weight transfer with a number of calculations from data that has been collected. These figures shall be increased to show the vehicles reactions to different driving and roads conditions.

The final part of this assignment will be the analysis side, this will include the results that will be recorded in the Excel spreadsheet explaining why certain figures are increasing or decreasing and what different aspects of the vehicle could be influencing them. How forces on the vehicle such as aerodynamic load affect the acceleration and cornering of a vehicle and how the vehicle characteristics are affected by the chassis and the suspension.



Research

With vehicles an extremely important part of their design is that of the handling and comfort. There must be several different options of vehicle for different tasks, on a passenger vehicle it is desirable to be comfortable, otherwise the customers are not likely to purchase the product. The older generation or a family type car would have a softer suspension as opposed to that of a sport performance-based model which may be lower and have stiffer. This is also important for racing vehicles or super cars.

A racing vehicle will be adapted for whichever race it will be participating in, for example an off road racing situation the vehicle will be adapted with suspension characteristics that would allow better articulation in terms of angle on axles, this is imperative for 4x4 vehicles when negotiating extremely rough terrain. As opposed to Formula race-based vehicles where camber and castor angles have a high priority as they affect the contact patch on tyre to track which influences handling and performance.

Supercars suspension need to strike a balance between performance handling and comfort whilst also being able to be used on normal driving roads.  2

Suspension

A standard road vehicles suspension is soft so that it can withstand the conditions of different surfaces of road whilst still maintaining a comfortable ride. The cost of suspension components must be affordable and readily available especially in popular models.

Supercars suspension are considerably more expensive and are generally only available from main or specialist dealers, the reason for this is that the setting for suspension is of a higher quality that requires specialist training to fit.

Race cars suspension is different to road cars because the faster the vehicle goes the more down force is created so there are large amounts of weight being pushed onto this vehicle in which the suspension must compensate for.

(Unknown, 2019)

Tyres

Road vehicles usually use cheaper tyres which in most cases are much smaller with a smaller contact patch. They have a low noise output and have a larger tread pattern which is to lower the likelihood of aquaplaning.

Super vehicles have much wider tyres, this achieves more grip as the contact patch is greater which will help with acceleration and braking. However the vehicles drive is not as comfortable as the lower profile tyre as it cannot absorb as much movement as the road vehicle as there is not as much area in the tyre to compensate. "Wide tyres can grip and accelerate on dry surfaces much better than narrow ones".  3

(Seward, 2014)

Race vehicles continuously change their tyres depending on the race they are participating in, for example on a dry day on tarmac, softer tyres with less tread are used so that a higher amount of grip can be achieved, as opposed to a rally vehicle on a rough track on a wet day would use thicker tyres with, much more tread for the use of water displacement and grip.

Roll centre/ Centre of Gravity

Road vehicles tend to have a higher roll centre, this is because they are limited by road traffic laws, this can mean limitation of speed in general and on cornering.

Supercars have a lower roll centre as they can achieve higher speeds which requires more stability.

Race cars have a very low roll centre, this is to increase performance, handling and tractive effort, also they are used on dedicated made tracks.

Aerodynamics

In road vehicles the aerodynamic design is quite important, most people think of cars and aerodynamics are only for race or sports cars but if it was not thought of during the design process of a standard road vehicle then there would be many problems. The fuel economy of a road vehicle is a large contributing factor of customers when purchasing a vehicle as most would like to get as far as they can with as little money, and if the vehicle had poor aerodynamics then as the wind hits the vehicle it would drag and push the vehicle instead of it cleanly slicing through the air. In some cases when a car is damaged and a customer is driving it they can often here a whistling sound as the air catches the damaged part, this shows that if the car was not damaged then the air would not catch and the noise would not be created and customers would not purchase this product as it can be very irritating.

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(Schuetz, 2016)

Super cars have the same problem but as they are able to travel at a much higher velocity the wind speed is more likely to cause the whistling noise which people do not want to hear in an expensive vehicle. The drag of the car as it is going at high speed must be reduced as much as possible so that it could attain a higher speed, this is why most super cars are very low to the ground. This can often be amended by spoilers to help stabilise the vehicle at high speed, one example of this is the Bugatti Veyron.

Race vehicles do not take much notice of the noise that the air creates around the vehicle as the highest priority of this vehicle is to finish the race it is participating in, in the fastest time possible, this means that by using a spoiler the vehicle is pushed down and the wheels can achieve more grip on the road.

5

Results

Analysis



Conclusion



Bibliography



Schuetz, T. (2016). *Aerodynamics of Road Vehicles (Fifth Edition)* p.g.XV. SAE International.

Seward, D. (2014). *Race Car Design* - p.g.4.



Unknown. (2019, January 24). *The Suspension of a Formula One Car*. Retrieved from AMG Petronas - Formula One Team: <https://www.mercedesamgf1.com/en/news/2019/06/the-suspension-of-a-formula-one-car/>

Vehicle Balancing Assignment

GRADEMARK REPORT

FINAL GRADE

43/70

GENERAL COMMENTS

Instructor

Even though only three sources were used for your report, they are well embedded in the research and referencing has been done correctly.

It is clear you have had issues with the excel spreadsheet. However the rest of the report is to a very good level.

The level of knowledge shown about what effects handling characteristics is very good and it is clear that you have a good understanding of this topic.

The report is written to a high technical level and the terminology / language used is very good. The report layout is excellent. A conclusion would have helped to have just finish the report off, even though you had not managed to do the analysis part of the coursework.

PAGE 1

PAGE 2

PAGE 3



Comment 1 |  K & U Subject

Very good introduction, shows that you understand what you were being asked to do.



Comment 2 | [K & U Subject](#)

Very good analysis of the different vehicle applications.



Comment 3 | [K & U Subject](#)

Good points.



Comment 4 | [K & U Subject](#)

Not sure this last section is needed to make your point.



Comment 5 | [K & U Subject](#)

Really good section on Aerodynamics.



Comment 6 | [C&I Skills](#)

If you have this issue in the future that you haven't been able to get any results. Remember you can always put what you would have expected to see.



Comment 7 | [Prof Prac](#)

Even though you didn't manage any analysis, a short conclusion would still have been possible.



Comment 8 | [Literature](#)

Good references included, would have been good to see a few more included in a report of this length.



Comment 9 | [Literature](#)

The author would be Mercedes AMG F1

LITERATURE

Good 50-59%

(including reading, referencing, academic conventions and academic honesty)

OUTRIGHT FAIL 0-29%	Little or no evidence of reading and/or reliance on inappropriate sources. Views and findings mostly unsupported and non-authoritative. Referencing conventions used incoherently or largely absent.
UNSATISFACTORY 30-39%	Poor engagement with essential reading. No evidence of wider reading. Reliance on inappropriate sources, and/or indiscriminate use of sources. Heavily reliant on information gained through class contact. Inconsistent and weak use of referencing.
SATISFACTORY 40-49%	Engagement with a limited range of mostly relevant and credible sources but with some reliance on information gained through class contact. Some omissions and minor errors. Referencing conventions evident though not always applied accurately or consistently.
GOOD 50-59%	Engagement with an appropriate range of literature, including sources retrieved independently. Some over-reliance on texts rather than other sources. Referencing may show minor inaccuracies or inconsistencies.
VERY GOOD 60-69%	Engagement with a wide range of literature, including sources retrieved independently. Selection of relevant and credible sources. Generally sound referencing, with no/very few inaccuracies or inconsistencies.
EXCELLENT 70-84%	Engagement with an extensive range of relevant and credible literature. Consistently accurate application of referencing.
EXCEPTIONAL 85-100%	Exceptional engagement with an extensive range of relevant and credible literature. High-level referencing skills consistently applied.

K & U SUBJECT

Excellent 70-84%

Knowledge and Understanding of Subject. Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.

OUTRIGHT FAIL 0-29%	Major gaps in knowledge and understanding of the basic underlying concepts and principles of the subject matter. Inclusion of irrelevant material. Substantial inaccuracies
UNSATISFACTORY 30-39%	Gaps in knowledge of the basic underlying concepts and principles, with flawed or superficial understanding. Some significant inaccuracies and/or irrelevant material.
SATISFACTORY 40-49%	Limited knowledge and understanding of the basic underlying concepts and principles within the subject area. Some elements may be missing
GOOD 50-59%	Knowledge of the basic underlying concepts and principles is accurate with a good understanding of the field of study but lacks depth and/or breadth.
VERY GOOD 60-69%	Competent knowledge of the basic underlying concepts and principles. Exhibits very good understanding

EXCELLENT 70-84%	Excellent knowledge and understanding of the basic underlying concepts and principles of the subject.
EXCEPTIONAL 85-100%	Exceptional, detailed knowledge and understanding of the basic underlying concepts and principles

C&I SKILLS

(Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.)

OUTRIGHT FAIL 0-29%	Wholly or almost wholly descriptive work. Little or no evaluation of the underlying concepts and principles. Failure to develop arguments, leading to illogical or invalid judgements. Minimal or no use of evidence to back up views.
UNSATISFACTORY 30-39%	Largely descriptive work, with superficial evaluation of the underlying concepts and principles. Weak interpretation of data, flawed development of arguments and judgements. Information accepted uncritically, uses generalised statements made with scant evidence and unsubstantiated opinions. Ideas sometimes illogical and contradictory
SATISFACTORY 40-49%	Limited attempt at evaluation of the underlying concepts and principles, tending towards description. Can interpret qualitative and quantitative data but with some errors. Some evidence to support emerging arguments and judgements but these may be underdeveloped or with a little inconsistency / mis-interpretation.
GOOD 50-59%	Good evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data, with minor errors. An emerging ability to use evidence to support the argument. Mostly valid arguments and logical judgements.
VERY GOOD 60-69%	Sound evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately. Ability to devise arguments using evidence to make mostly appropriate and valid judgements.
EXCELLENT 70-84%	Excellent evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately and with some insight. Excellent ability to devise arguments using evidence and make appropriate and valid judgements
EXCEPTIONAL 85-100%	Exceptional evaluation of the underlying concepts and principles based evidence. Outstanding interpretation of qualitative and quantitative data. Exceptional ability to devise arguments using evidence and make wholly appropriate and valid judgements

PROF PRAC

Excellent 70-84%

(Communicate the results of their study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.)

OUTRIGHT FAIL 0-29%	Work is poorly structured, disorganised, inaccurate and/or confusingly expressed. Very weak use of language and/or very inappropriate style. Failure to work effectively individual or as part of a group. Little or no evidence of the skills for employment requiring the exercise of some personal responsibility.
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UNSATISFACTORY 30-39%	Work is poorly presented in a disjointed manner. It is loosely, and at times incoherently, structured, with information and ideas often poorly expressed. Weak use of language and/or inappropriate style. Flawed approach to individual or group work, meeting only partial obligations to others. Limited evidence of the skills for employment requiring the exercise of some personal responsibility.
SATISFACTORY 40-49%	Mostly ordered presentation and structure in which relevant ideas / concepts are reasonably expressed. Work may lack coherence and/or accuracy in places. Can work as part of a group, meeting most obligations to others but perhaps with limited involvement in group activities. Demonstrates the basic skills for employment requiring the exercise of some personal responsibility, with some areas of minor weakness.
GOOD 50-59%	Mostly coherent, organised and accurate work, in a suitable structure and is for the most part clearly expressed. Can work effectively independently and/or as part of a team, with clear contribution to group activities. Demonstrates the skills for employment requiring the exercise of some personal responsibility, with some areas of strength and some of minor weakness.
VERY GOOD 60-69%	Work is accurate, coherent, fluent, well-structured and organised. Can work effectively independently and/or as part of a team, with very good contribution to group activities. Demonstrates very good skills for employment requiring the exercise of some personal responsibility, with just occasional minor weakness.
EXCELLENT 70-84%	Work is coherent, very fluent and is presented professionally. Can work effectively independently and/or as part of a team, with an excellent contribution to group activities. Demonstrates excellent skills for employment requiring the exercise of some personal responsibility with an appetite for further development.
EXCEPTIONAL 85-100%	Work is accurate, exceptionally coherent, very fluent and presented well. Can work effectively independently and/or as part of a team, with an exceptional contribution to group activities. Demonstrates exceptional skills for employment requiring the exercise of some personal responsibility with an appetite for further development