



Programme:	BEng Motorsport Engineering and Design BEng Automotive Engineering		
Module/Unit:	Vehicle Dynamics		
Assignment No:	1	Lecturer: R Dowden	Internal Verifier: M Sandford
Assignment Title:	Longitudinal acceleration investigation V2		

Hand Out Date:	Tuesday 10 th October 2011	Return Date:	22 nd November for Groups W & X 28 th November for Groups Y & Z	Contribution to Overall Module/Unit Assessment (%):	25%
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Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, Fail.

Aims
1 To determine the value of the road tyre coefficient of friction μ_t by undertaking a brake test on the university test surface at Pembrey Circuit.
Outcomes being Assessed (from Module Syllabus):
Upon successful completion of this module, the student will be able to demonstrate: The ability to analyse the kinematic and load transfer characteristics of a car under steady state longitudinal accelerations and to use this to determine road tyre coefficient of friction.
Procedure
Brief 1. You have been divided into working groups, each group will need to design the detailed test procedure and calculations required to achieve the aims of the assignment. 2. Two working groups will attend each morning or afternoon session Each working group will work independently of the other group having approximately 1.5 hrs to undertake their test.

Tasks

1. Determine the maximum rate of deceleration achievable by the car with four wheel braking and hence determine a mean value for μ for the car.
2. Determine μ for the pair of tyres fitted to the axle being investigated by your group.
3. Undertake an auxiliary test which will be allocated to your group from the following list.
 - i. investigating the effect of tyre pressure on μ
 - ii. Investigating the effect of damper setting on μ
4. Compare the calculated weight transfer due to sprung mass with the weight transfer determined from wheel deflection and wheel rate and so demonstrate the validity of using wheel deflection for load measurement.

Considerations

1. The test car will be fitted with brake locks to enable front or rear brakes to be locked out of operation
2. The cg position for and aft should be determined for the car in its test condition. Assume the CG height remains constant at value given in the data table at the end of this brief.
3. As most testing will be carried out on the steering pad, speeds will be relatively low and braking distances relatively short.
4. It is important that you consider the limitations of this test and factors that will affect the accuracy of the results obtained..
5. The test will be undertaken on Thursday 27th October for half the class (in two groups – W in the morning and X in the afternoon) and 3rd November for the other half again in two groups Y in the morning and Z in the afternoon) at Pembrey. You will be given instructions, concerning the time of leaving the University etc. closer to the day. On arrival you will be responsible for the work that is to be undertaken.
6. Each group has sub-groups 1 and 2 . Sub-group 1 will look at front tyre behaviour and sub-group 2 will look at rear tyre behaviour.
7. Once the test has been undertaken and the results obtained you, **as an individual**, need to decide on the best way of demonstrating the results, analysis and evaluation.

Your report should contain:

Introduction – What the aim of the assignment is

Methodology – The test procedure used and how the measurements were taken and any changes to the procedure introduced on the day. Details of the auxiliary test undertaken.

Analysis – In this section you should include the results obtained and your analysis of each of the four tasks

Evaluation – Estimation of the validity and implications of the outcomes of each of the four tasks, how the assignment could be improved next time, further investigations possible and finally how you performed during the testing.

Marking Scheme

	No	Proportion of overall grade of this element
Quality of experimental test work and collection of data This includes the group's ability to overcome limitations imposed by environmental conditions or resources, the group's determination to obtain accurate and consistent results, the group's use of measures to minimise the effect of uncontrolled variables and the quality of team working (Group mark)	1	30%
Analysis of data and presentation of analysis (Individual mark)	2	50%
Production of well structured report containing the required elements described above (Individual mark)	3	20%

Long accel data	
CG height for sprung mass above ground.	0.299m
Wheelbase	2.351m
Left front unsprung mass [kg]	38kg
Right front total unsprung mass [kg]	38kg
Left rear unsprung mass [kg]	44kg
Right rear unsprung mass [kg]	44kg
Rolling radius	0.275 m
Sprung mass and mass distribution	Measured on the day
Velocity ratio (wheel travel to pot travel)	1.622
Suspension Leverage (wheel travel to spring travel)	1.83

Test procedure at Pembrey

1. Top up fuel tank outside workshop
2. Measure car in workshop including
 - ride height,
 - individual wheel loads,
 - tyre pressures
 - air and track temperature
 - fuel level
3. Set up data logging laptop-and ensure download path is correct in Pi Delta.software.
4. Send car out for first test run with all four wheels braking
5. At end of test run and (on track if possible) download data, measure tyre temps. Send car out again to repeat the test
6. Make sure the correct brake circuit is operational for your group's test
7. Send the car out to undertake test braking with two wheel braking , download data and then repeat test
8. Make changes for auxiliary tests , start logging and send car out again, download data and then repeat test
9. For the auxiliary test you need to decide on the range of the parameter being investigated . This will depend mainly on the time available but for example if tyre pressure is being investigated then a high pressure (30 psi) and a low pressure (10 psi) setting would be worth looking at Similarly for damping very soft (20 clicks) and very hard (2 clicks) would be suitable.
10. You need to ensure the reliability and repeatability of the results obtained and the choice you have includes doing two runs on each parameter setting or to do single runs and repeat the whole process. Each will have advantages and disadvantages.



School of Automotive Engineering

Student Name:	Group ____
Assessor :	Roger Dowden
Assignment Title:	Vehicle Track Testing
Programme:	BEng Motorsport Engineering and Design BEng Automotive Engineering
Module:	Vehicle Dynamics
Submission Date:	
Grade Awarded:	
Quality of experimental test work and collection of data (<i>Group</i>) Including group's ability to overcome limitations imposed by environmental conditions or resources , group's determination to obtain accurate and consistent results, group's use of measures to minimise the effect of uncontrolled variables and the quality of team working (30%) Group	
Analysis of data (50%) (<i>Individual</i>)	
Production of well structured report (20%) (<i>Individual</i>)	

The mark awarded for this work is provisional. It will not be used for determining the final mark for the module until it has been agreed by the Examinations Board in June 2011.