Gaydon technology partnership centre

On the 22nd of February we visited the Landrover site in Gaydon also known as the Technology Partnership Centre. The guide spoke to us about what the establishment does and how it works in the context of Physics. Its main purpose is as a Design and test centre which incorporates a variety of areas:-
Concept Design

-CAD and Modelling

-Prototyping

-Component Testing

-Whole Vehicle Testing(static or on a test track)

-Design Modification and improvement

During the visit we looked at several areas in detail and how their work relates to physics these were the semi-anechoic chamber where sound is tested, the safety test area and in particular the crash sled and pendulum rig, and the rapid prototyping area where CAD and lasers are used to make accurate prototypes of the finished components without having to use tools.

Purpose of Physics

Here I will look in more detail at two specific areas at the purpose of the testing and how and why the physics is applied, these are the semi-anechoic chamber and the crash sled in the safety test area.

1. SEMI-ANECHOIC CHAMBER is the area where the car is tested for the noise level its engine and other parts of the car vibrating at specific frequencies

produce. This vibration has to be stopped or cut to a minimum by either increasing stiffness or absorbing them. The legal level of noise from a car is 74 dB as above this it would be deemed as noise pollution and also the more noise it makes the less economical the car is as energy is being wasted in vibrations creating the sound waves. This used to have to be tested outdoors but this created a problem as it could only take place on a clear windless day. The ï¿½2. 7mill chamber is built to replicate a day like this and to simulate an open road or field. This is done by only being semi as noise is still allowed to reflect off the floor, but on all other walls the reflection is cut to a minimum by having a sees of wedges placed on the walls and ceiling they are made of aircraft seat foam which is very good at absorbing sound also the shape makes any sound waves which are reflected scatter so this reduces echo or reverberation further. This allows the acoustics to be measured accurately. The same technique is used in concert halls. The sound is measured using 24 microphones placed in two rows 7. 5m from the car and the noise level is measured by transmitting this data to computers.

SAFETY TEST CRASH SLED

The crash sled or deceleration rig is used to test various internal components of cars such as seats and mountings. It simulates collisions that the car may have and can be altered to replicate different situations including different speeds, force or deceleration. The law states that seat anchorage’s are required to withstand a force of 20g for a speed of 30m/s but to increase safety standards for their drivers landrover test to a standard of 30g for a speed of 30m/s. The crash sled consists of a seat or the component being tested on a rails connected to 10 bungy straps which are pulled to different

tensions to control the force of the crash this coupled with the mass of the component determines the speed at which it collides. A magnetic solenoid release mechanism is used to release the sled by having a switch which breaks the circuit. To simulate the object which the car collides with specialised aluminium decelerating cans are used they collapse on impact. Each one gives a constant force of 24, 500N and so they change the amount of tubes to change the rate of deceleration. These aspects of the test are measured and recorded before hand but a video is set up to record what effect these have on the component being tested.

Physics Principals in Detail

We can see that the bungy system works by the transfer of energy from one type to another and the conservation of energy. Here as the bungy is stretched elastic potential energy is stored as seen in the equation E= force x distance this shows that depending on the distance it is puled back different amounts of energy are stored creating a different force. This energy when released is then transferred to kinetic energy shown in the formula E= 1 2 from this I can see that the mass of the 2 mV

component will also effect the speed at which the sled collides with the tubes and the greater the energy transferred the greater the speed and therefore the greater the force the greater the speed and also the greater the mass the slower the speed at which it collides. From this we can also determine the acceleration of the sled using F= ma showing the greater the force the greater the acceleration and the the greater the mass the slower the acceleration. The same formula can be used to calculate the force needed to

decelerate a component of specific mass by 30gx9. 81m. s-2. This force corresponds to the amount of force needed from the tubes. The greater the mass the larger the force needed to stop it.

e. g. mass of test items+sled= 600kg

deceleration required= 30gx9. 81m. s-2 Force required= 600x30x9. 81= 176580N

Therefore to calculate the amount of tubes needed I divide this by the force of each tube: 176580/24500= 7. 2 so use 8

We can then use this to find the total mass needed to give a deceleration of 30g with this force

m= F/a m= 8×24500/30×9. 81= 666kg

Therefore the component will need extra weights of 66kg added

Another area to do with physics on this rig is the solenoid release mechanism. This consists of an electric circuit where the wire is in a coil which creates an electromagnetic effect holding the sled back this also incorporates a switch which is released and disconnects the circuit stopping the magnetic field releasing the sled.

In this piece of equipment physics is being used very effectively by measuring and using the calculations it is possible to know before hand what is likely to happen and each test can be set to its own specification. The solenoid release mechanism is also effective as it can be released at an exact moment and always works the same for each test. But by using the

decelerating tubes we have to readjust the mass of the object being tested to create the appropriate conditions this means adding weight to the test object this may make it act differently to the impact. It is also not possible to test the parts on this equipment for anything other than a simple crash or impact other variables are not taken into account.

These same formulas can be used in Forensic investigations into collisions they can work out the speed and deceleration of the car(s) on impact thus finding the culprit of the accident. The use of electromagnetic circuits similar to the solenoid release mechanism can be seen in doorbells where a relay system is used where the electric circuit is continuously switched on and off attracting and releasing the hammer which hits a bell this creates the ringing sound.

In the future all of this information may be fed into a computer which will automatically create this specified situation on the machine this will stop any human errors. Eventually the whole test may be simulated on the computer using calculations. Also the use of hydraulics instead of the metal tubes which can be set to decelerate the sled at different forces could be used. This would mean that the expensive metal tubes would not have to be changed or replaced after each test.

Conclusion

From the visit I saw how physics can be adapted for use in the working environment. It showed me that there many uses for different types of physics in every day life and that many things couldn’t function without it. Especially, in this case, in the field of cars testing and design.

Bibliography

A lot of my work came directly from notes taken from the visit but I also used other sources to extend these notes in more detail these were: AS PHYSICS- salters horners