Evaluating Effects of Height on Different Speed Bump Profiles Project Proposal

Group 4
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June 1, 2020

1 Context

2 Aim

We would like to investigate the effectiveness of different speed bumps profiles (parabolic, trapezoidal and sinusoidal) and for each profile, we will investigate the optimal height with respect to the size of the vehicle/wheel. We will quantitatively evaluate their effectiveness by measuring our dependent variable, ratio of "velocity loss" to "Peak vertical acceleration", which we would want to maximise as in our model, we would want a speed bump which can slow down a speeding car as much as possible, while minimising the discomfort felt by passengers caused by the increase in vertical acceleration.

3 Procedure

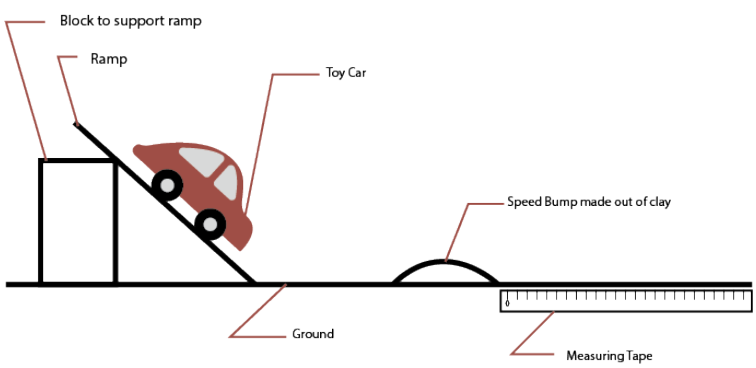

Figure 1: Experimental Set-up

3.0.1 Model

Our experiment will seek to simulate a speeding car arriving at a speed bump and consequently slowing down. A toy car will be released and its gravitational potential energy will convert to kinetic energy (and heat, sound etc.) as it rolls down. It will then collide with the speed bump and possibly make it over the speed bump and continue moving to the right in the diagram until it slows down and stops due to the work done against the car by friction. The speed bump will be constructed out of clay and its curvature will be modelled after the speed bump profile being investigated.

The experiment will be recorded by a phone camera and the velocity and acceleration of the of the vehicle will be interpreted by Tracker and analysed with Vernier's Logger application. Using this we will be able measure each speed bump profile and its optimal height using the aforementioned velocity loss to peak vertical acceleration ratio.

Our experiment will investigate parabolic, sinusoidal, and trapezoidal speed bumps (or humps), characterised by $p(x) = ax^2$, $s(x) = a\sin(x)$ and $c(x) = (x-h)^2 + (y-a)^2 = r^2$, where h, r are constants and a is changed to vary the height of the speed bump. The speed bump is expressed in terms functions for greater convenience in differentiating to find the gradient at each point and calculating the normal force of the speed bump on the wheel.

The height of the speed bump will be adjusted in increments of 10% of the vehicle's wheel's radius from 0% to 110%.

3.0.2 Apparatus

- Phone Camera
- Toy Car
- Moulding Clay
- Measuring Tape
- Rulers (for use in constructing the speed bump)
- Ramp and Block

3.1 Safety Precautions and Limitations of Model

In order to avoid shearing the soft clay speed bump as the vehicle passes and for the personal safety of us and those around us, the vehicle will be reasonably lightweight and the height of the ramp will not pass 1.5m.