

Week 2

Longitudinal Acceleration Braking

Continuing Example 1 from Week 1

Longitudinal force F_x

The car is decelerating at 1.4 g
ie 13.734 m/s²

The friction force required to achieve this rate of deceleration is found from:

$$F_x = m a_x$$

So

$$\begin{aligned} F_x &= 800 \times 13.734 \text{ N} \\ &= 10987 \text{ N} \end{aligned}$$

Example 1 Finding μ

If all four wheels are braking then the average value of μ for the four tyres of car will be:

$$\frac{F_x}{W_{fb} + W_{rb}}$$

$$\begin{aligned}\text{So } \mu &= \frac{10987}{5189.1 + 2659.08} \\ &= 1.4\end{aligned}$$

Finding μ

This can be simplified by saying that the combined value of μ for the tyres of a car is the maximum rate of deceleration that can be achieved divided by g .

Or to put it another way , the maximum rate of deceleration that can be achieved is μg

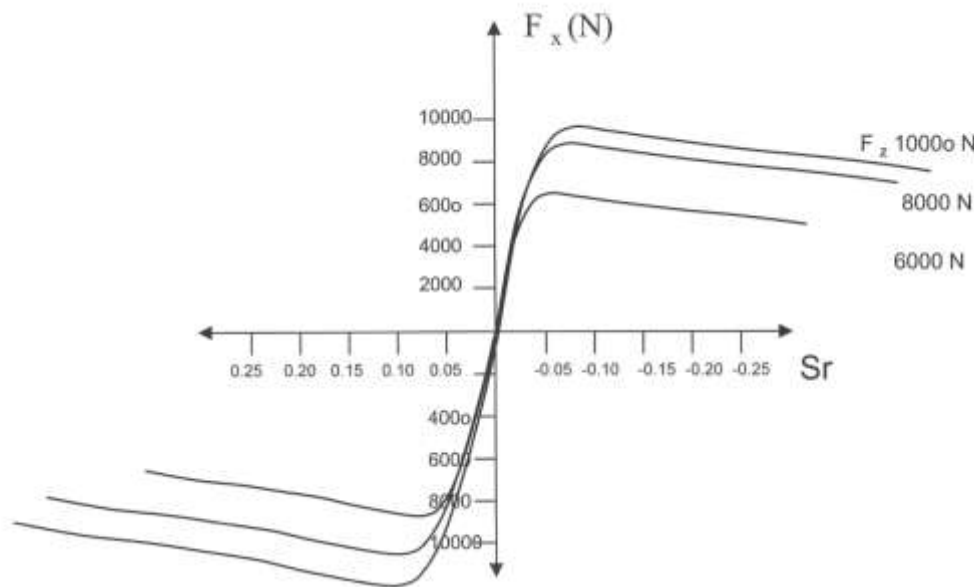
Refining the value of μ

We can determine the value of μ for a pair of front or rear tyres rather than all four tyres by only braking the wheels of one axle at a time

We will then be able to determine the value of μ for the tyres on that axle alone.

Finding μ for front or rear tyres

It has been demonstrated already that μ varies with vertical load.



Two wheels braking

$$\mu = \frac{F_x}{W_{fb}}$$

If the car had still been able to decelerate at 1.4 g using just the front brakes

$$\begin{aligned}\mu &= 10987/5189.1 \\ &= 2.117 !\end{aligned}$$

Two wheel braking

More realistically the value of μ will be slightly lower at the front than the rear due to the increased vertical load.

Assume that the rate of deceleration with just two wheels braking is now just **0.8g**

giving a decelerating force of **6278.4 N** from the two front tyres.

Two wheel braking

$$W_{fb} = F_{zfs} + WT$$

$$F_{zfs} = \frac{800 \times 1.156 \times 9.81}{2.5}$$
$$= 3628.9 \text{ N}$$

$$WT = \frac{800 \times 9.81 \times 0.8 \times 0.355}{2.5}$$

$$WT = 891.53 \text{ N}$$

$$W_{fb} = 3628.9 + 891.53 \text{ N}$$
$$= 4520.43 \text{ N}$$

Two wheel braking

So for the two front tyres:

$$\mu = \frac{F_x}{W_{fb}}$$

$$= \frac{6278.4}{4520.43}$$

Giving $\mu = 1.389$

Summary

- The value of μ averaged for all tyres of a car can be found by dividing the maximum rate of deceleration [in m/s^2] by g .
- The maximum rate of deceleration achievable by a vehicle with four wheels braking is μg (*where μ is the averaged value described above*)
- The individual value of μ for front or rear tyres can be found by only braking the wheels on that axle and calculating vertical load on the tyres and the braking force created by those tyres