

### 1. Tire size codes

Explain the meaning of the following tire size codes:

- A. A. P 205/75R14 80T
- B. B. P 16/205/55 78S
- C. P 215/65R15 96H
- D. 480/80R46 78P M+S

### 2. Tire of Chevrolet Corvette Z06

A model of Chevrolet Corvette Z06T M uses the following tires.

Front tire 275/35ZR18      Rear tire 325/30ZR19

- A. What is the speed of this car if its rear tires are turning at  $\omega = 2000$  rpm?
- B. At that speed, what would be the angular velocity of the front tires?

### 3. Axle load

Consider a car with the following specifications that is parked on a level road. Find the load on the front and rear axles.

$$m = 1765 \text{ kg} \quad l = 2.84\text{m} \quad a_1 = 1.22\text{m} \quad a_2 = 1.62\text{m}$$

### 4. Mass center height

McLaren SLR 722 has the following specifications:

$$\text{Front tire } 255/35\text{ZR}19 \quad \text{Rear tire } 295/30\text{ZR}19 \quad m = 1649 \text{ kg} \quad l = 2700\text{mm}$$

When the front axle is lifted  $H = 540\text{mm}$ , assume that

$$a_1 = a_2 \quad F_{z2} = 0.68mg.$$

What is the height  $h$  of the mass center?

### 5. Maximum acceleration.

Honda CR-VT M is a midsize SUV car with the following specifications.

$$m = 1550 \text{ kg} \quad l = 2620\text{mm} \quad a_1 = a_2 \quad h = 720\text{mm} \quad \mu_x = 0.8$$

And determine the maximum acceleration of the car if

- (a) The car is rear-wheel drive
- (b) The car is front-wheel drive
- (c) The car is four-wheel drive.

**6. A car with a trailer**

Volkswagen Touareg TM is an all-wheel drive car with:

$$m = 2268 \text{ kg} \quad l = 2855 \text{ mm.}$$

Assume  $a_1 = a_2$  and the car is pulling a trailer with:

$$m_t = 600 \text{ kg} \quad b_1 = 855 \text{ mm} \quad b_2 = 1350 \text{ mm} \quad b_3 = 150 \text{ mm} \quad h_1 = h_2.$$

If the car is accelerating on a level road with acceleration  $a = 2 \text{ m/s}^2$ , what would be the forces at the hinge?

**7. A parked car on a banked road.**

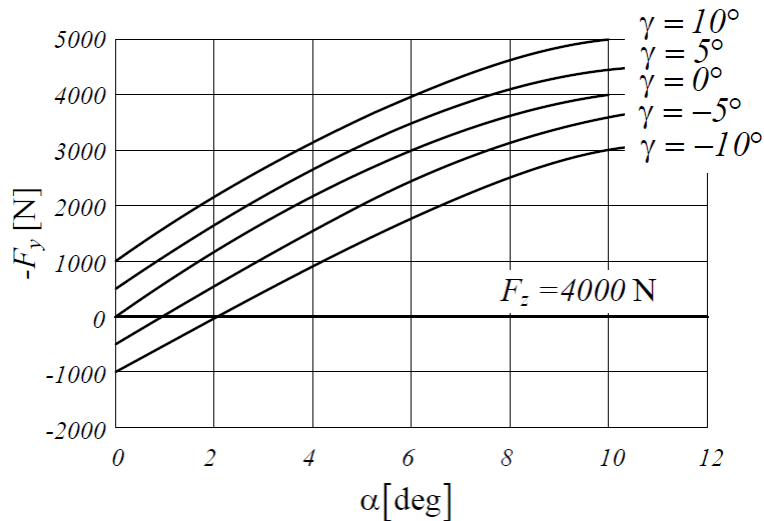
Cadillac Escalade is a SUV car with

$$m = 2569.6 \text{ kg} \quad l = 2946.4 \text{ mm} \quad w_f = 1732.3 \text{ mm} \quad w_r = 1701.8 \text{ mm.}$$

Assume  $b_1 = b_2$ ,  $h = 940 \text{ mm}$ , and use an average track to determine the wheels load when the car is parked on a banked road with  $\phi = 12 \text{ deg}$ .

**8. Required camber angle.**

Consider the tire for which we have estimated the behavior shown in Figure below. Assume  $F_z = 4000 \text{ N}$  and we need a lateral force  $F_y = -3000 \text{ N}$ . If  $\alpha = 4 \text{ deg}$ , what would be the required camber angle  $\gamma$ ? Estimate the coefficients  $C_\alpha$  and  $C_\gamma$ .



**9. Radius of rotation.**

Consider a two-axle truck that is offered in three different wheelbases.

$$l = 109 \text{ in} \quad l = 132.5 \text{ in} \quad l = 150.0 \text{ in}$$

If the front track of the vehicles is  $w = 70 \text{ in}$  and  $a_1 = a_2$ , calculate the radius of rotations if  $\delta = 30 \text{ deg}$ .

### 10.A three-axle truck.

Consider a three-axle truck that has only one steerable axle in front.

The dimensions of the truck are

$$a_1 = 5300\text{mm} \quad a_2 = 300\text{mm} \quad a_3 = 1500\text{mm} \quad w = 1800\text{mm}.$$

Determine maximum steer angles of the front wheels if the truck is supposed to be able to turn with  $R = 11\text{m}$ .

### 11.A vehicle with a one-axle trailer.

Determine the angle between the trailer and vehicle with the following dimensions.

$$a_1 = 1000\text{mm} \quad a_2 = 1300\text{mm} \quad w_v = 1500\text{mm} \quad b_1 = 1200\text{mm} \quad b_2 = 1800\text{mm}$$

$$w_t = 1100\text{mm} \quad g = 800\text{mm} \quad \delta_i = 12\text{deg}.$$

What is the rotation radius of the trailer  $R_t$ , and the vehicle  $R$ ?

Determine minimum radius  $R_{\min}$ , maximum  $R_{\max}$ , and difference radius  $\Delta R$ ?

### 12.Different front and rear tracks.

Lotus 2-Eleven is a RWD sports car with the following specifications.

$$l = 2300\text{mm} \quad w_f = 1457\text{mm} \quad w_r = 1607\text{mm} \quad \text{Front tire} = 195/50R16$$

$$\text{Rear tire} = 225/45R17 \quad F_{z1}/F_{z2} = 38/62$$

Determine the angular velocity ratio of  $\omega_o/\omega_i$ ,  $R$ ,  $\delta_i$ , and  $\delta_o$  for  $\delta = 5\text{deg}$ .

### 13.Turning radius of a 4WS vehicle.

Consider a FWS (Front wheel steering) vehicle with the following dimensions.

$$l = 2300\text{mm} \quad w_f = 1457\text{mm} \quad w_r = 1607\text{mm} \quad a_1/a_2 = 38/62$$

Determine the turning radius of the vehicle for  $\delta_{f1} = 5\text{deg}$ . What should be the steer angles of the front and rear wheels to decrease 10% of the turning radius, if we make the vehicle 4WS?

### 14.Coordinates of the turning center.

Determine the coordinates of the turning center for the vehicle in

Exercise 9 if  $\delta_{f1} = 5\text{deg}$  and  $c_1 = 1300\text{mm}$ .

### 15.A three-axle truck.

Consider a three-axle truck that has only one steerable axle in front. The dimensions of the truck are

$$a_1 = 5300\text{mm} \quad a_2 = 300\text{mm} \quad a_3 = 1500\text{mm} \quad w = 1800\text{mm}.$$

Determine maximum steer angles of the front wheels if the truck is supposed to be able to turn with  $R = 11\text{m}$ .