Transverse Double Wishbone Suspension

M. Gobbi 5/2016 rev. 3.3

Roll centres The roll centre of a suspension system refers to that centre relative to the ground about which the body will instantaneously rotate. The actual position of the roll centre varies with the geometry of the suspension and the angle of roll.

Roll axis The roll axis is the line joining the roll centres of the front and the rear suspension. Roll centre height for the front and rear suspension will be quite different; usually the front suspension has a lower roll centre than that at the rear, causing the roll axis to slope down towards the front of the vehicle. The factors which determine the inclination of the roll axis will depend mainly on the centre of gravity height and weight distribution between front and rear axles of the vehicle.

Determination of roll centre height

A vehicle's suspension system involves three principal items; the suspended body B, the supporting wheels W and the ground G which provides the reaction to the downward load of the vehicle.

If a body which is suspended between two pairs of wheels is to be capable of rolling relative to the ground, then there must be three instantaneous centres as follows:

1 I_{BG} the instantaneous centre of the body relative to the ground which is more commonly known as the body roll centre,
2 I_{WB} the instantaneous centre of the wheel relative to the body which is the swing arm point of pivot,
3 I_{WG} the instantaneous centre of the wheel relative to the ground which is the contact centre between the tyre and ground. It therefore forms a pivot permitting the top of the wheel to tilt laterally inwards or outwards.

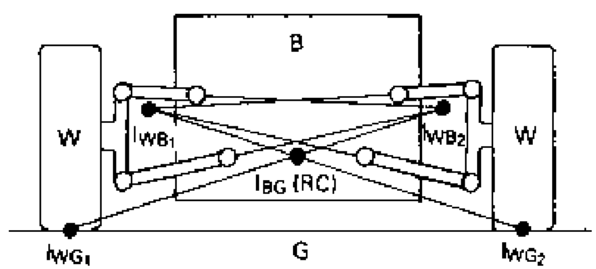
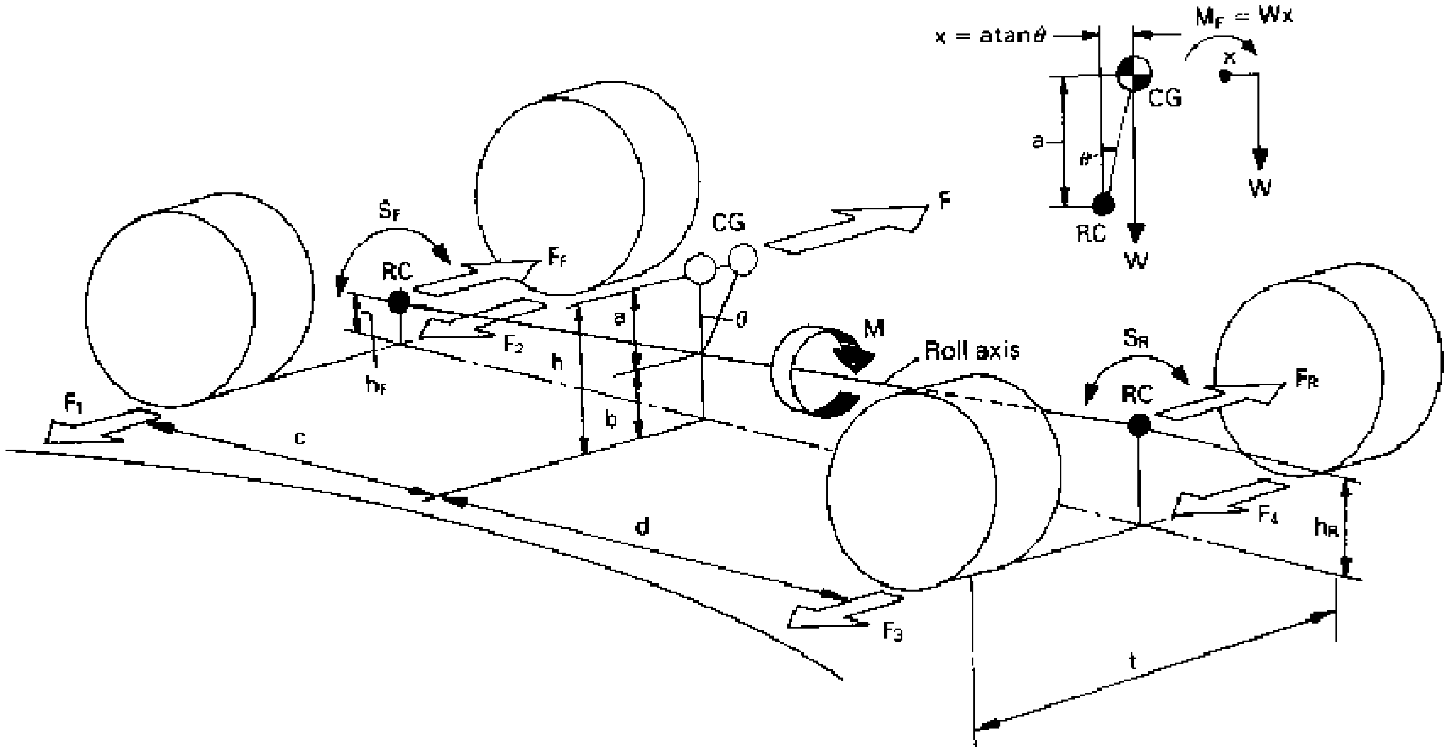


Fig. 10.20 Inward converging transverse double wishbone



Centrifugal moment about the roll centre = Fa (Nm)

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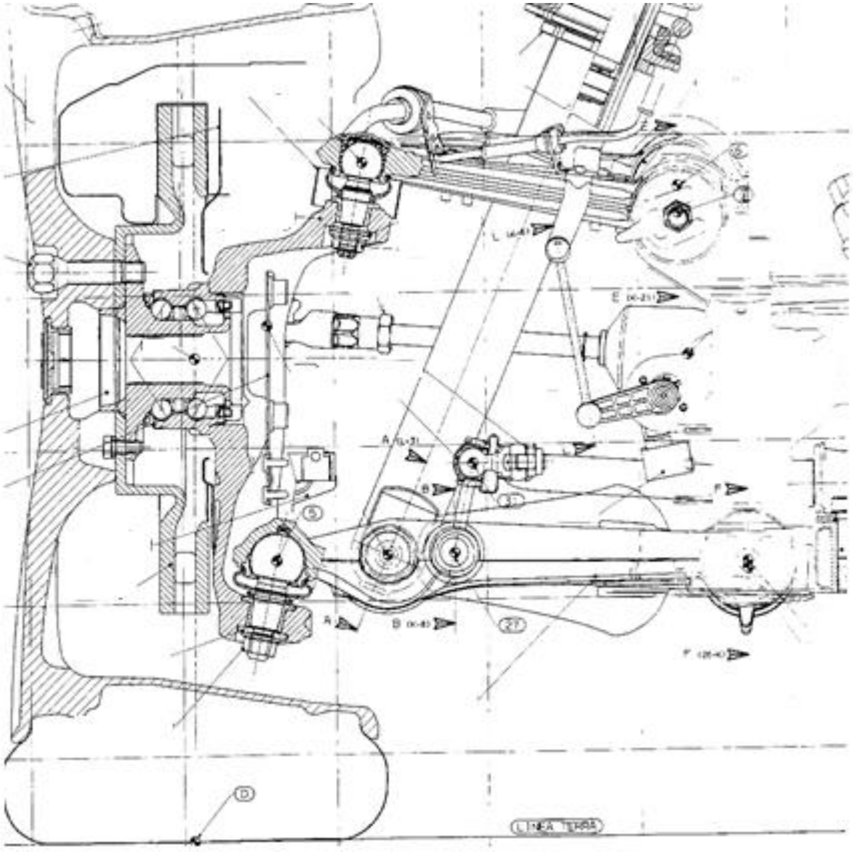

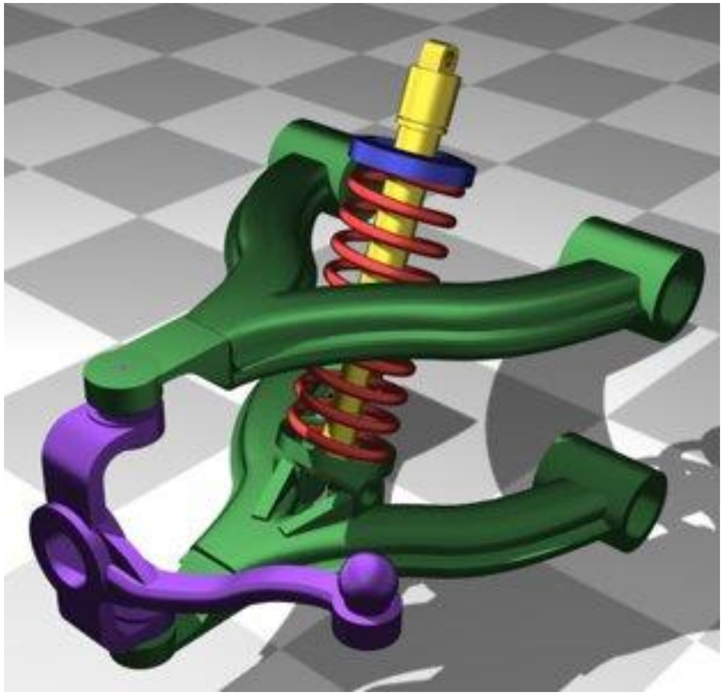

Objective functions

- Camber Change (wheel $\perp$ ground in turning)
  (lwb-lwg length)

- RC height (centrifugal moment, jacking, …)
  (lwb-lwg length and height)

- Tire scrub (straigth motion: lateral disturbance)
  (lwb rel. Distance from ground,….)

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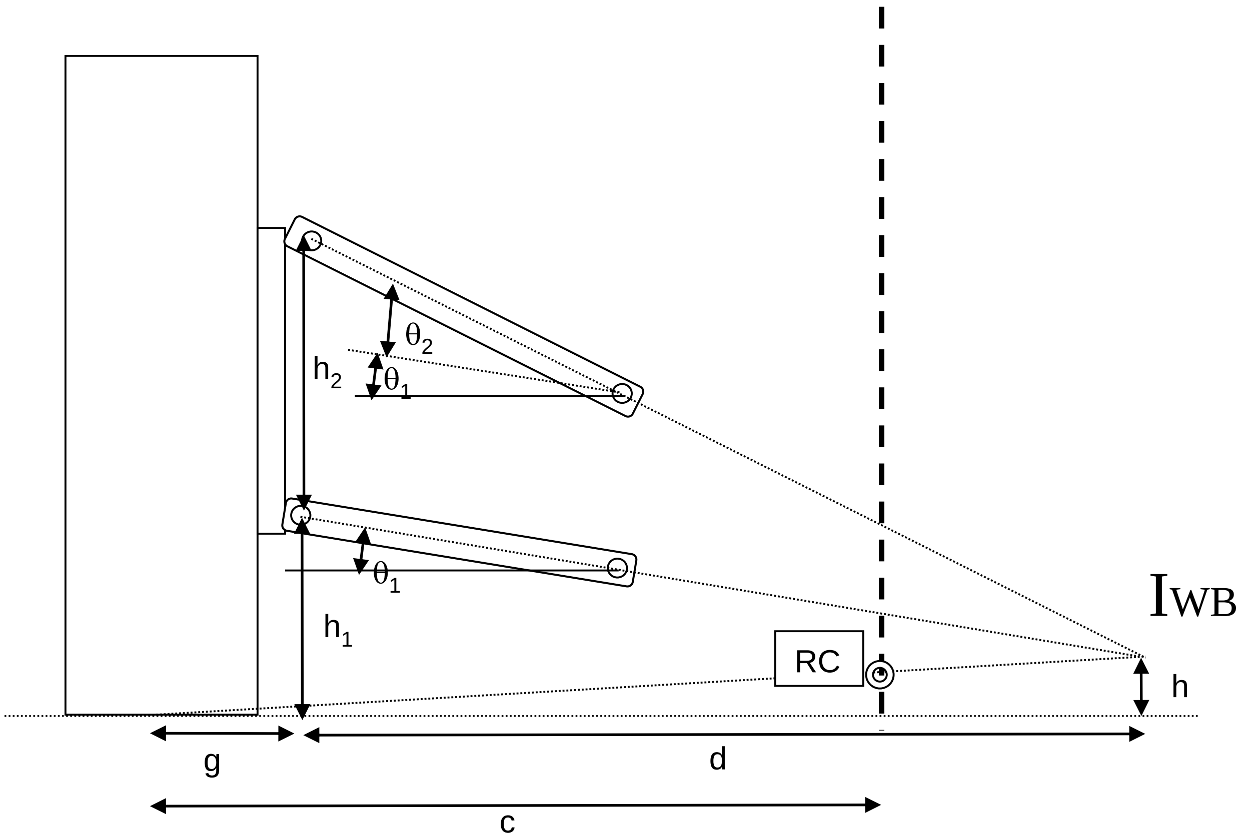
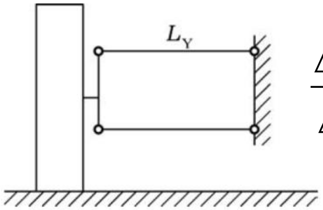
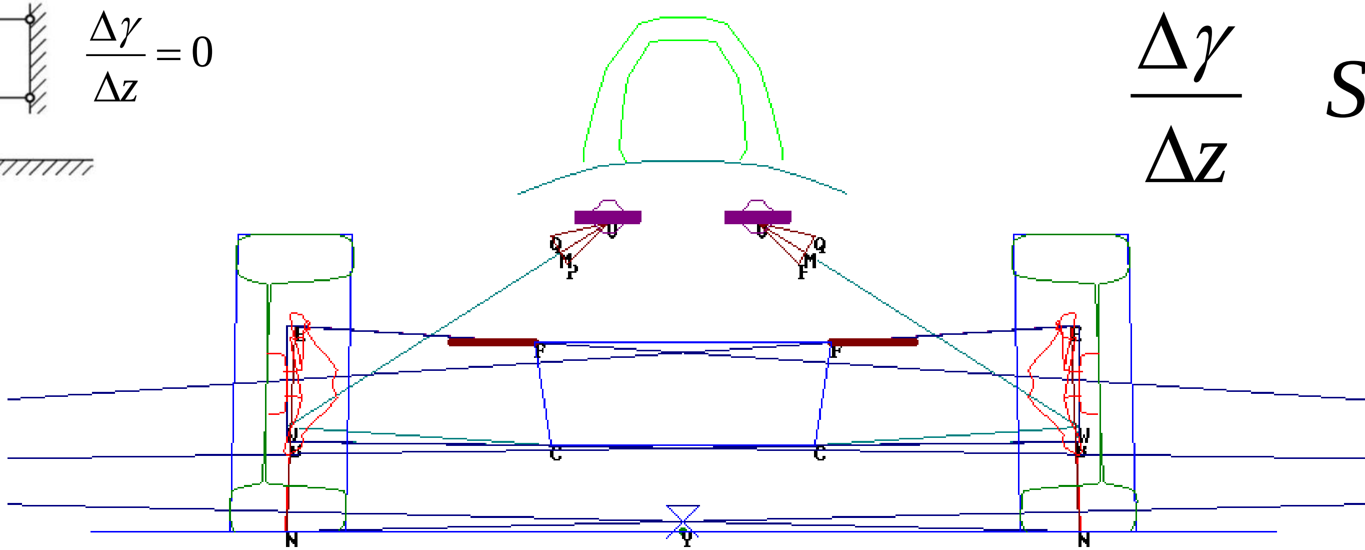
- Camber Change (wheel ⊥ ground in turning) (Iwb-Iwg length)



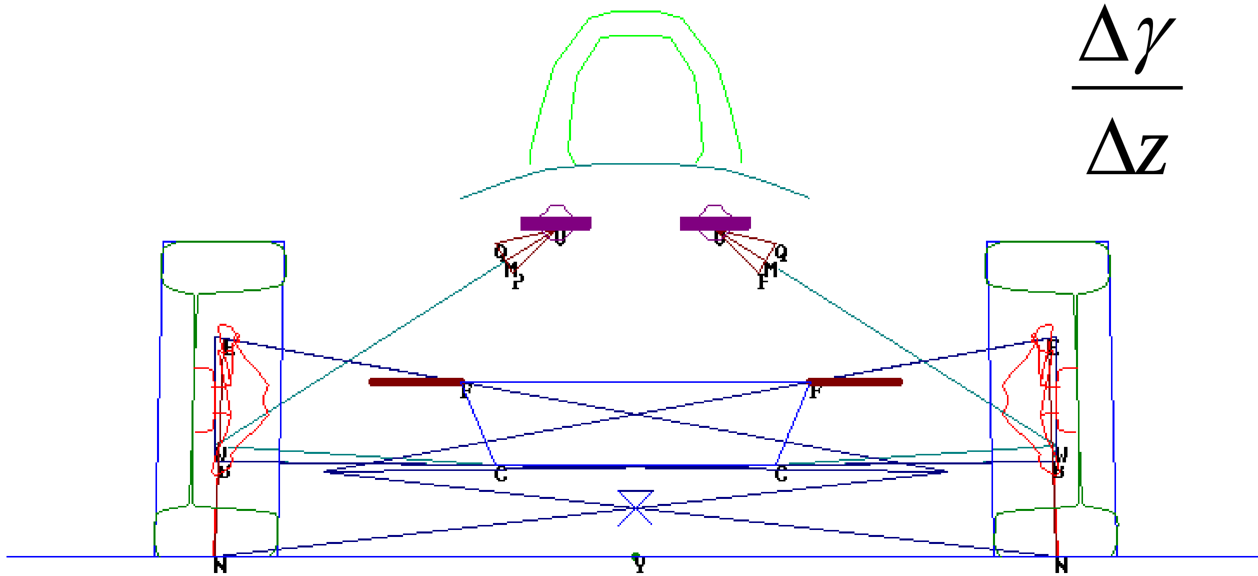
$$\frac{\Delta\gamma}{\Delta z} = \frac{1}{d+g}$$



$$\frac{\Delta\gamma}{\Delta z} = 0$$

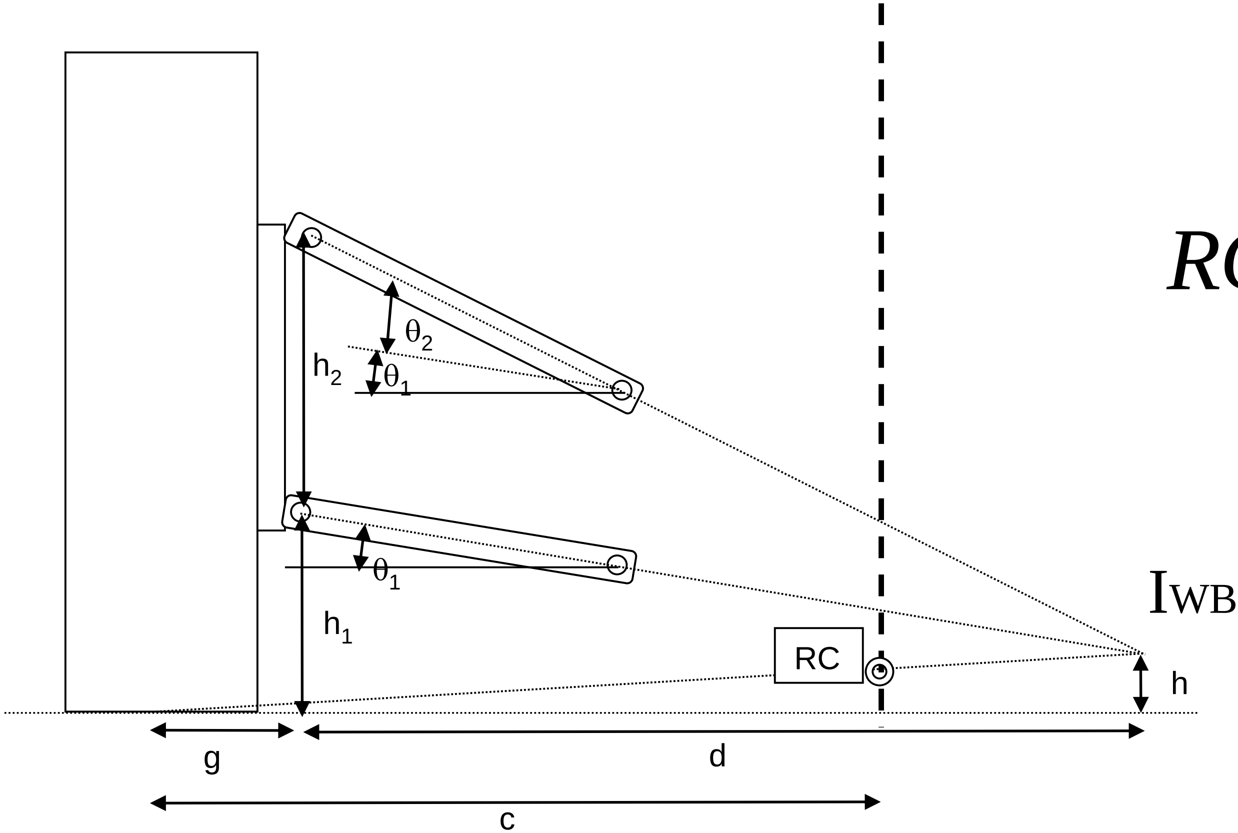


$$\frac{\Delta\gamma}{\Delta z}$$ *SMALL*



$$\frac{\Delta\gamma}{\Delta z}$$ LARGE

- RC height (centrifugal moment, jacking, …)
  (Iwb-Iwg length and height)



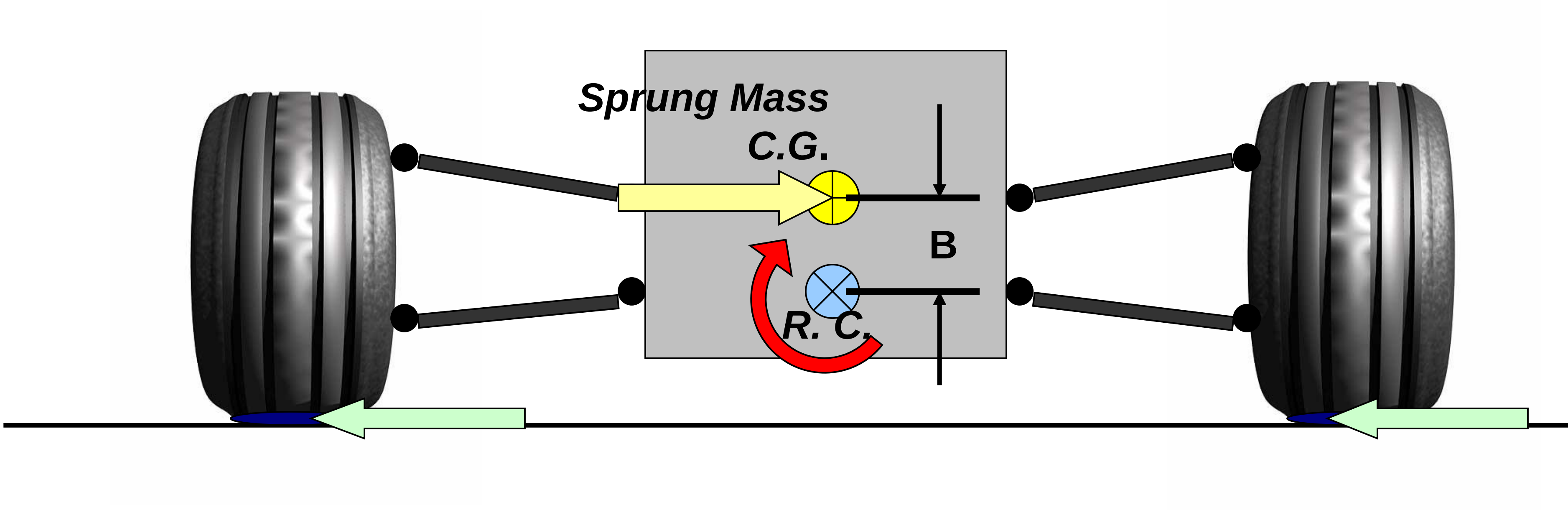
$$RCH = \frac{h}{d+g}c$$

Centrifugal Moment

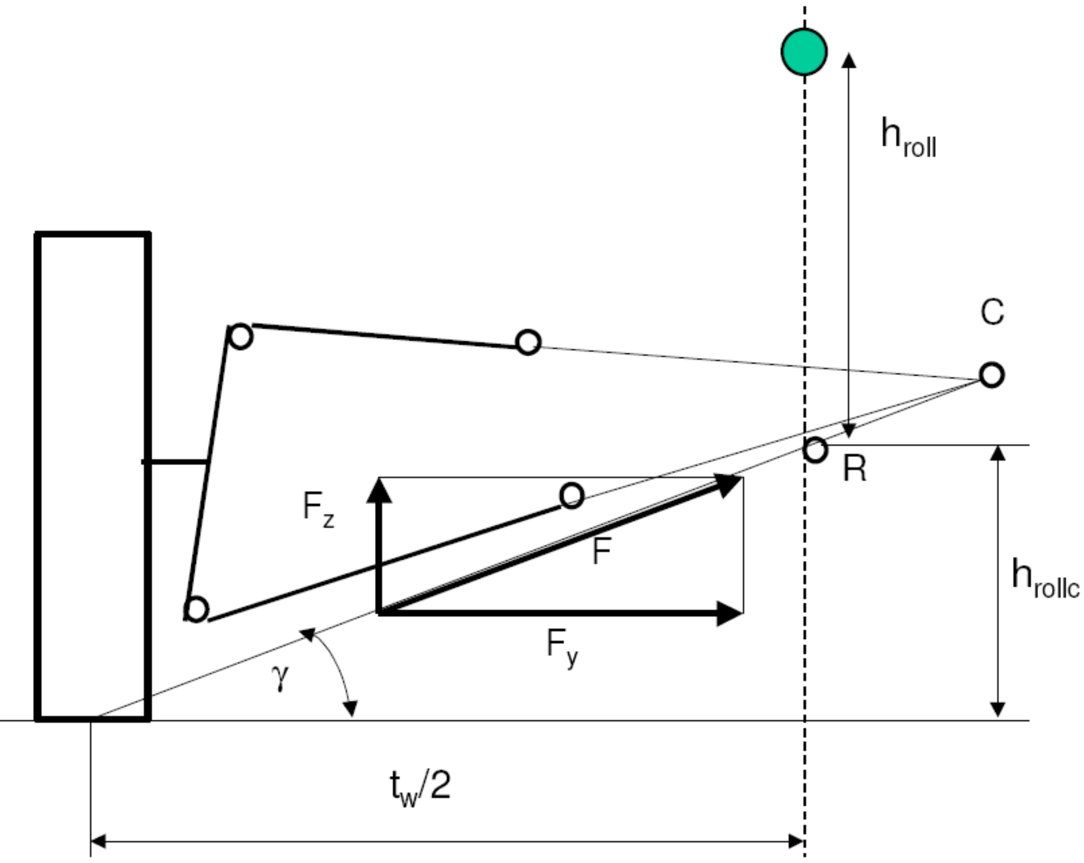
- Present during lateral acceleration *(cause of body roll)*

  – ***Moment Arm:***
  B = *Sprung mass C.G. height – Roll center height*

  – ***Force:***
  F = *(Sprung Mass) x (Lateral Acceleration)*



Jacking forces



Lateral forces during cornering maneuvers are transmitted between the body and the wheels through suspension links. In general, these members are not parallel to the ground; therefore the reaction forces in these elements have vertical components, which pushes the body up.

The forces transmitted between the vehicle body and a wheel through lateral arms are equivalent to a single force, which reacts along the line from the tire contact patch to the roll center of the suspension.

If the tire lateral force is *Fy*, then the jacking force, *Fz*, is

$Fz = Fy \tan \gamma$

where γ is the inclination angle of the line connecting tire contact patch with the roll center.

- Tire scrub (straigth motion: lateral disturbance) (Iwb rel. Distance from ground,…)