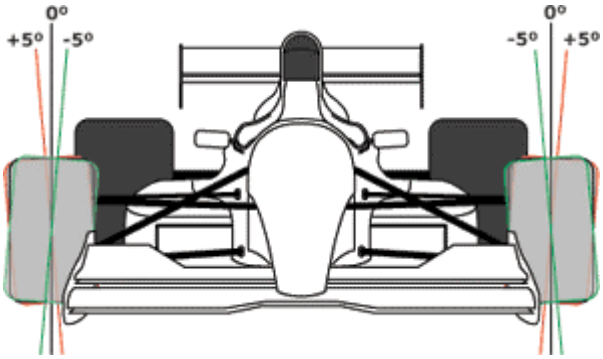
Alignment Angle Effects

Angle	If	Result
Camber	**Just right**	***Good tire wear, ride quality, and directional stability.***
	Too positive	***Tire wear at outer tread; reduced cornering ability.***
	Too negative	***Tire wear at inner tread; excessive road shock; reduced ride quality; improved cornering ability.***
	Unequal	***Pull toward most positive side.***
Rear Camber	**Just right**	***Good tire wear.***
	Too positive	***Wear at outer tread.***
	Too negative	***Wear at inner tread; improved cornering ability.***
Caster	**Just right**	***Good directional stability and returnability.***
	Too posititve	***possible shimmy; possible camber wear on turns.***
	Too negative	***Wander; unstable steering.***
	Unequal	***Pull toward least positive side.***
Toe	**Just right**	***Good tire wear.***
	Too positive (in)	***Scuffing and wear at outside shoulder.***
	Too negative (out)	***Scuffing and wear at outside shoulder; possible wander.***
Rear Toe		***Same as front settings.***

Camber

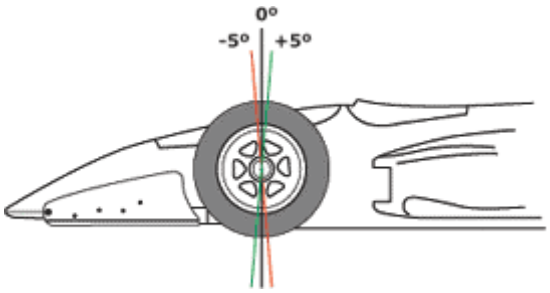


Positive Camber: If the top of the tire leans outward, away from the car's center, the tire has a positive camber angle.

Negative Camber: If the top of the tire leans inward, toward the car's center, the tire has negative camber angle.

Negative camber is necessary because when a car turns into a corner, it experiences chassis roll, which increases the tires' camber angle. Also, because most rubber tires are quite flexible, they get a little deformed in the direction of the center of the corner. If the car doesn't have any negative camber, only the tires' outer edge and sidewall would touch the ground, which isn't beneficial for traction. A tire's coefficient of traction (grip) increases as it's contact surface increases, so the ideal situation would be that the tire would stay perpendicular to the ground at all times, and that it wouldn't deform under heavy side load. Unfortunately, this isn't the case; most of the time you have to find the best compromise. The problem is that if you want maximum forward traction, you have to set the camber to 0°, and if you want maximum cornering action you have to set it to a few degrees negative, depending on the softness of the suspension and tire carcass. So you can't have both, but you can try to make the best possible compromise. The easiest way is to set camber so the tires wear evenly across their surface, that way you can be sure every part of the surface is used to the maximum of it's potential. Keep in mind that a car with very soft suspension settings and very little camber change will need more negative camber than a car with a very stiff suspension.

Caster



Caster is a directional control angle that helps the driver keep the front tires straight down the road and return the steering straight ahead after turning a corner.

Zero caster: The steering axis is vertical.

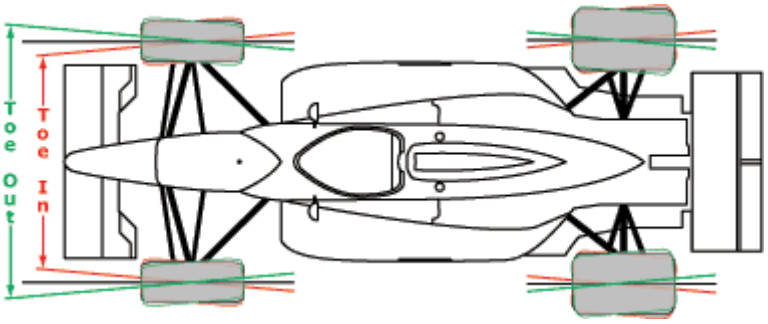
Positive caster: Steering axis is inclined toward the rear of the vehicle.

Negative caster: Steering axis is inclined toward the front of the vehicle.

Positive caster angles are more common because they are much more stable than negative caster settings. Positive caster places the ground level point of the steering axis toward the front of the road-contact patch of the tire.

Caster roll: caster causes the tire's camber angle to change as the tires are turned to the right or left. This is called **caster roll**. A right turn causes the camber on the right tire to become more positive and the left tire more negative. This is the apparent "leaning" of the tires into the turn. As the vehicle's momentum directs the car toward the outside of the turn, the caster induced camber change maximizes the road-contact patch area making it possible to turn in more aggressively while maintaining control. The increased road-contact patch area can handle a larger load and increased speed through the turn could be possible if proper tuning is performed.

Toe



Toe in is a comparison of the distance between the front of the tires and the rear of the tires. If the two tires are parallel, the two distances are the same; toe is zero. If the distance is smaller in the front of the tires than the rear, the difference is equal to the amount of toe-in. If the distance is larger in the front of the tires than the rear, the difference is equal to the toe-out.

A small amount of toe-out is sometimes used in front, as long as the car has sufficient caster, instability on the straights won't be a problem. The 'unstable effect' will be noticeable while turning into corners. Turning in will feel more immediate and more aggressive. Toe out will have the effect of the tires pulling away from the car's centerline. This could induce a side-to-side motion on straights if the toe-out is excessive. Adjust caster accordingly or fine-tune the amount of toe-out to facilitate turning without compromising stability.

The rear tires should always be set to have toe in. The two tires will create resultant forces that meet at the centerline of the car. These forces will stress the chassis but will balance each other on straights.

Bibliography

Birch, Thomas W. Automotive Chassis Systems, Delmar Thomson Learning

Ditmer, Professor Farmingdale University NY

Heremans, Elvo Quick Setup Guide

Many thanks to Keith Parsons for hosting this file.