

Kshatij 2014

RACE PULSE

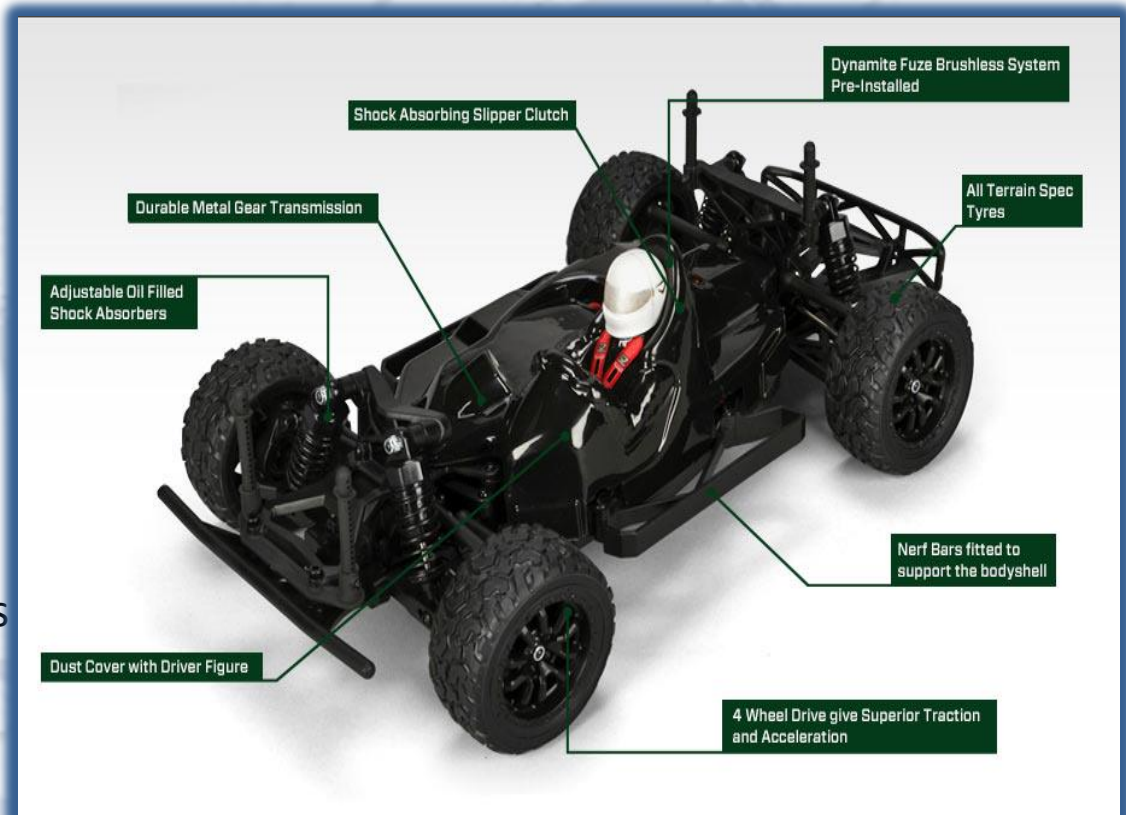


TUTORIAL

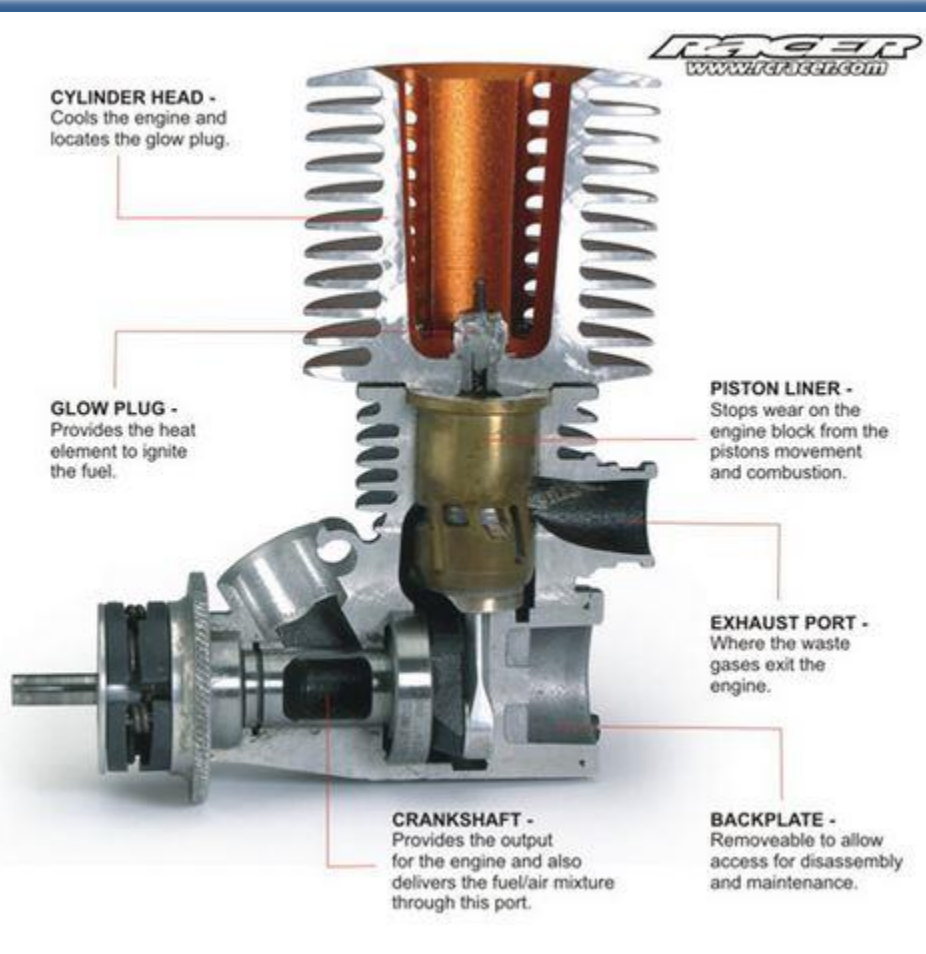
BASIC COMPONENTS OF A RC IC ENGINE.

- STEERING MECHANISM
- SUSPENSION and CHASSIS
- ENGINE TRANSMISSION
- BRAKE SYSTEM
- ELECTRONICS

We'll be discussing these in details in the upcoming slides.



ENGINE AND TRANSMISSION



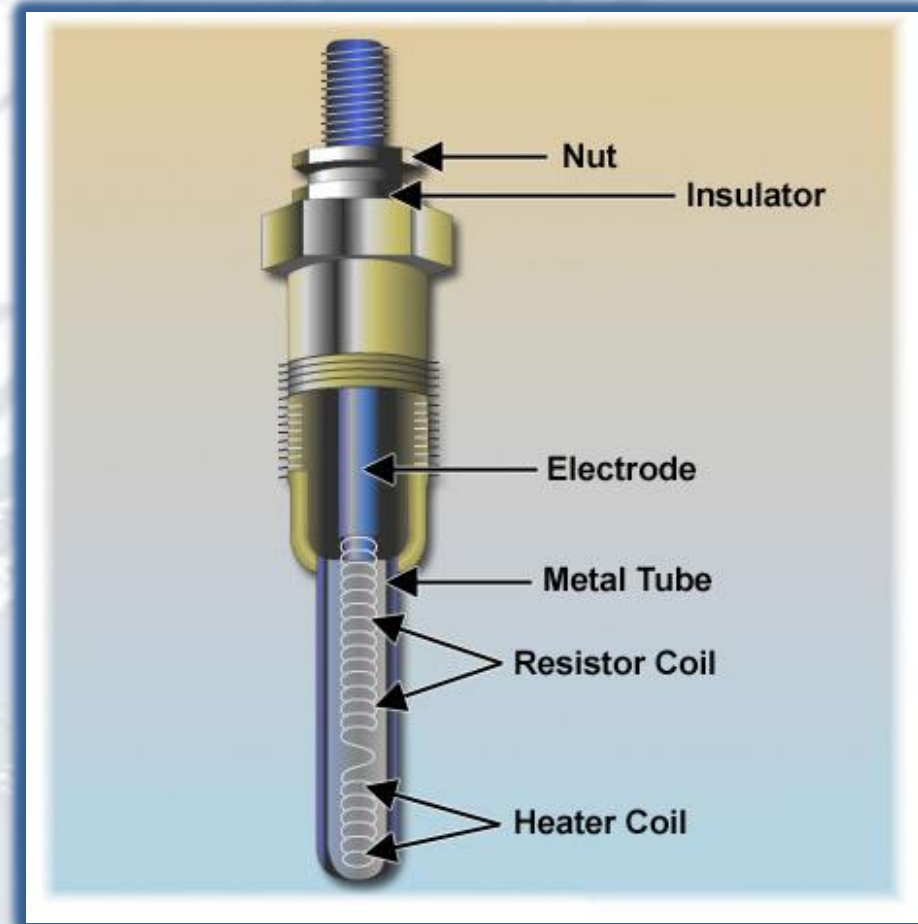
Components needed for engine.

1. **Carburetor** –responsible to regulate the flow of air and gasoline into the engine cylinders. (3cc single cylinder)
2. **Glow plug** -a heating device used to aid starting diesel engines (needs to be rechargeable and glow plug starter.
3. **I.C. Engine** -
4. **Crankshaft** – mostly comes with engine.

GLOW PLUG

- To start a glow plug engine, a small direct current (around 1.5 volts) is applied to the glow plug, using the glow plug starter, initially heating the filament.
- The engine is then spun from the outside to introduce fuel to the chamber.
- When fuel enters the combustion chamber, it is ignited by the heated glow plug and with that, the engine springs to life, instantly gaining the momentum to continue running after all the starter accessories are removed.
- The engine's **Carburetor** supplies the fuel and air needed for combustion.
- It has several other adjustments.

Most glow plug failure is due to breaking of resistor coil. So perform a continuity check for coil.



ENGINE TUNING

- Adjust the Fuel/air Ratio.
- Low Speed Needle (screw).
- High Speed Needle (screw).
- Idle Screw.
- Turn to Adjust Them (similar to kitchen taps).

Some tips on engine tuning.

1. Replace the car's fuel filter.
2. Replace the car's spark plug.
3. You should also use the best spark plug as replacement.
4. Replace the vehicle's condenser and points.
5. Make sure that the valves are properly adjusted.

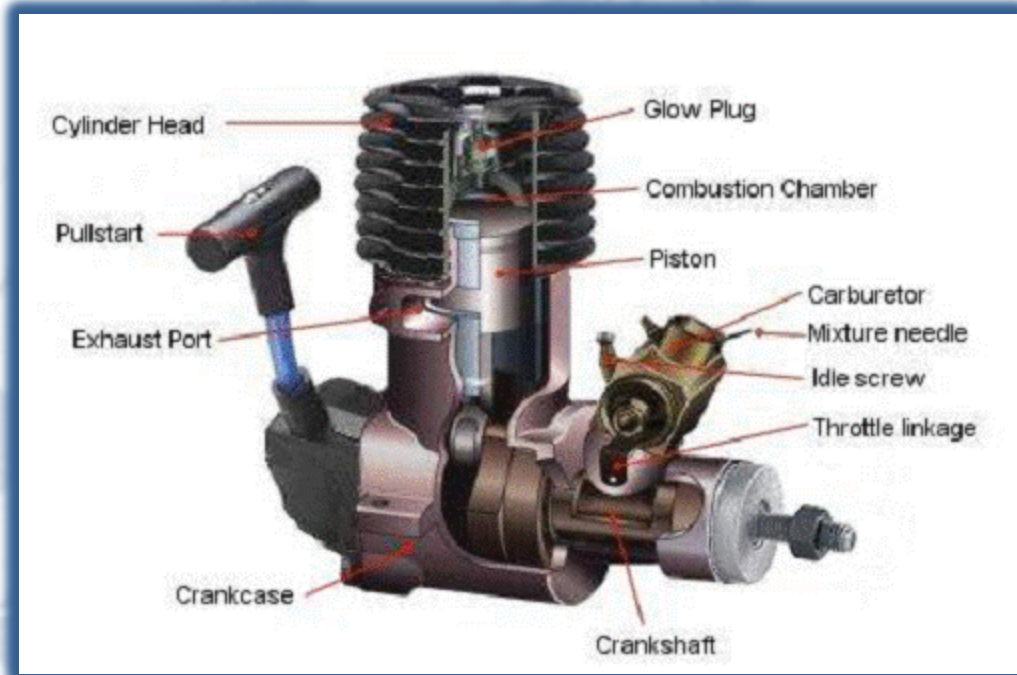


Fuel

- Mixture of methanol (75-80%), nitro methane (15-20%), castor oil (5-10%) called hobby fuel/ nitro fuel.
- Always keep the fuel in air tight container.
- Nitro methane is an explosive so handle carefully.

How to Stop the Engine

- Block the air cleaner with your fingers.
- Squeeze the fuel line.
- Either method will stop the engine.
- Squeezing the fuel line will rev up the engine first and then stop as the engine leans out.



A complete overview of the different components of an IC Engine.

TRANSMISSION

Transmission refers to the whole drive train, including clutch, gearbox, prop shaft (for rear-wheel drive), differential, and final drive shafts. It is a type of gearbox that can be "shifted" to dynamically change the speed-torque ratio such as in a vehicle. It adapts the output of the internal combustion engine to the drive wheels.

To sum up it includes:

- Differential with Casing.
- Dogbone Shaft (Drive Shaft).
- Clutch.
- Gear Box (Nylon Gears).

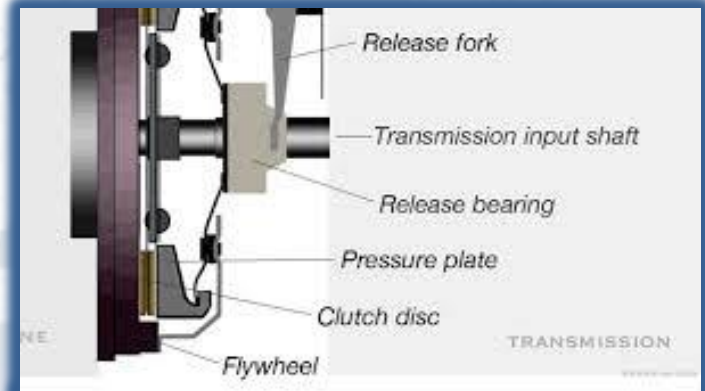


Transmission

CLUTCH AND GEAR BOX

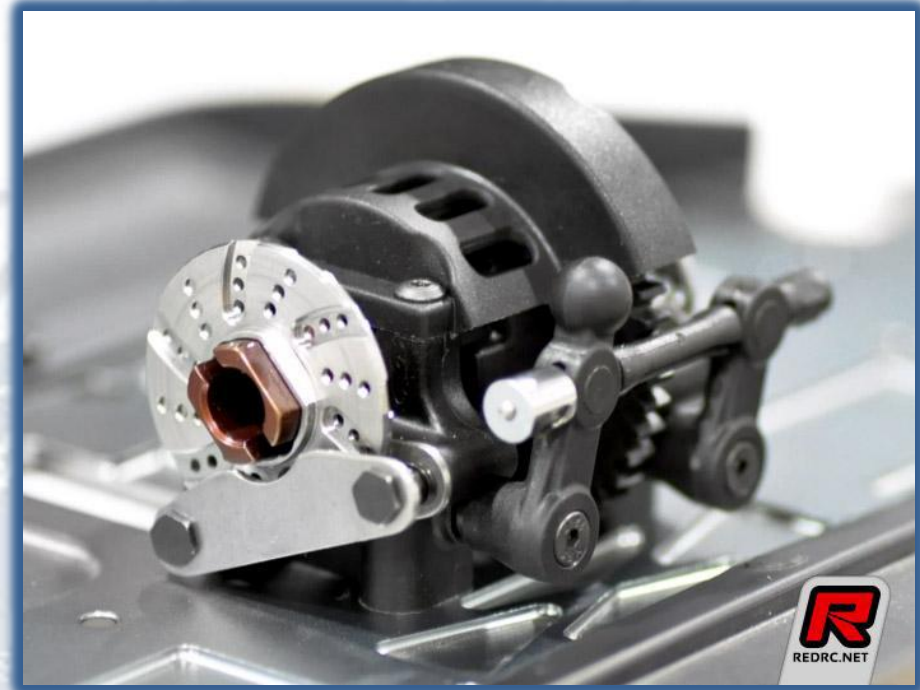
A **clutch** is a mechanical device that provides for the transmission of power (and therefore usually motion) from one component (the driving member) to another (the driven member) when engaged

It is used to change the direction of motion to a desired direction.



BRAKING SYSTEM

- An RC car uses a combination of Disc brakes but Cam is used for actuation instead of hydraulic pressure.
- When servo is rotated in opposite direction, the carburettor is in closed state, thus throttle gets cut off. At this position Brake cam bushing pushes brake pad on its side against rotor.
- As result rotor gets pressed against brake pads and thus RC Car stops.



Parts Required

The following parts are required for manufacture of basic brake system:

- Brake pad/disc (Each rotor needs 2 brake pad).
- Brake calipers (If you use hydraulic brake system. 1 on each brake rotor).
- Master Cylinder & Spring (For hydraulic brake system)
- Brake rotors.
- Brake cam.
- Brake cam linkage.
- Brake cam bushings.

Parts common to transmission and brakes are:

- Drive shaft cups.
- Transmission box onto which driveshaft are attached.
- Servo motor to regulate Throttle opening position in carburetor.

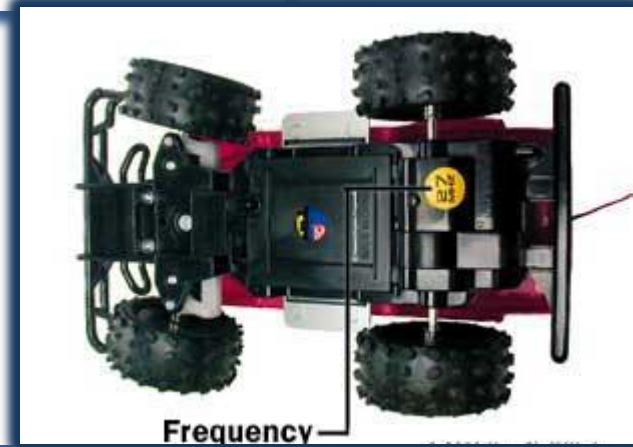


ELECTRONIC COMPONENTS OF RC IC ENGINE CAR

The electrical and electronic components basically aids in the control of the steering and the throttle. The electronic components in the RC car are,

1. Crystal Transmitter
2. Battery pack
3. Servo motors
4. 2 channel RC controller

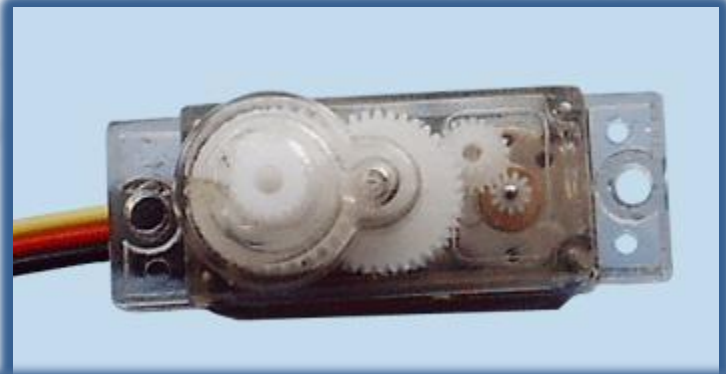
The servo reads pulses from the receiver and moves the servo output arm to a certain position. This is how it works.



SERVO MOTORS

A **servomotor** is a rotary actuator that allows for precise control of angular position, velocity and acceleration.

- For the car we need 2 servo motors .
- It is precisely used to control throttle, brakes and steering.
- Contains three wires coming out of it, two of them give power and the third controls the rotation.



ASSEMBLY

Servo Motor 1

- Controls both throttle and braking.
- Set the servo motor mean position at some angle in between its total angle of revolution.
- Deviation of the servo motor in one direction will increase the air intake of the IC engine, enabling throttle (functions as the accelerator pedal of a car).
- Deviation of servo motor in opposite direction actuates the brakes (works as the brake pedal in a car).

Servo Motor 2

- Steers the car using the same rotational principal explained above

CHASSIS

- This is the support structure to place the engine, transmission and other essential components of the body.
- The chassis is typically made of a heavy, rigid plastic or aluminium.
- It provides good stability to the vehicle.
- It is less fragile in case of crashes.
- Hence, this should be chosen wisely.



SUSPENSION SYSTEM

The suspension system of the RC car is a wish bone type of suspensions with all the upper and lower arms made of plastic. The suspension is again an individual suspension.

Suspension components :

- **Spring type oil damped**
- **Spring material: carbon steel**
- **Free length: 35mm**
- **Pitch: 5mm**
- **No of turns: 7**

Damping is provided using the suspension oil. It is needed to absorb the energy associated with suspension travel. In terms of energy, damping absorbs most of the energy the car receives as it moves, unlike springs stores the energy, and release it again



Suspension-Basic terms

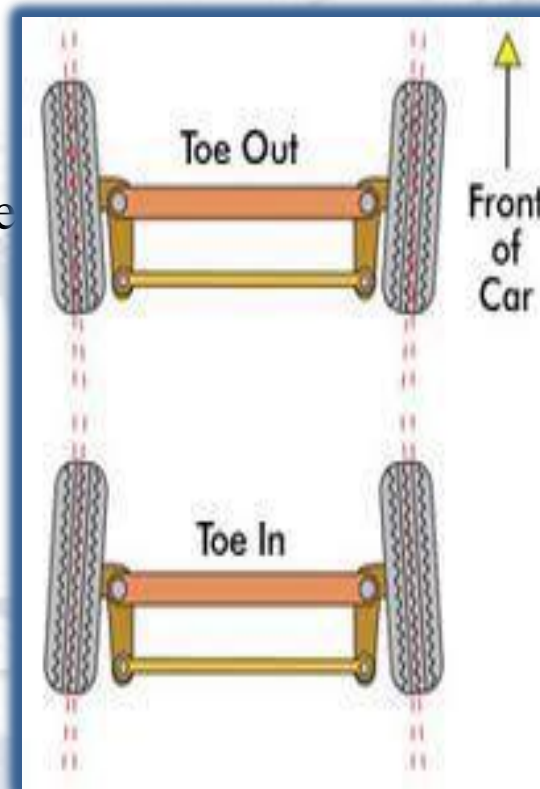
•Toe in/out :

Toe-in means the tires point inwards, and toe-out means the tires point outwards.

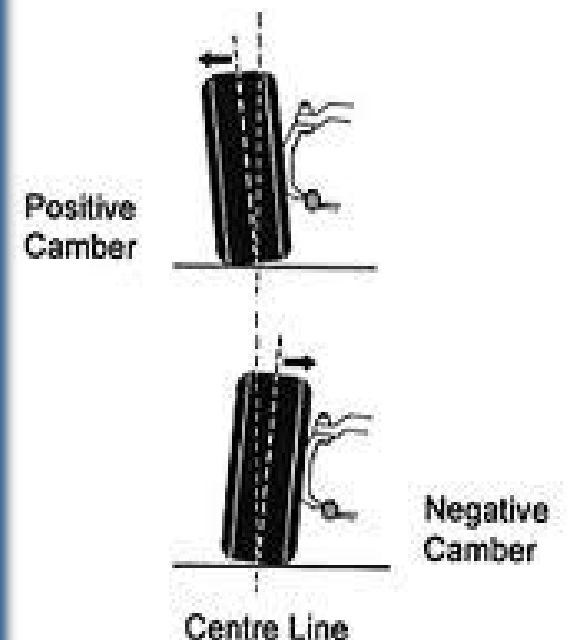
•Camber :

Angle between the tire's centreline and the vertical plane (usually negative).

Top View



Camber Front view



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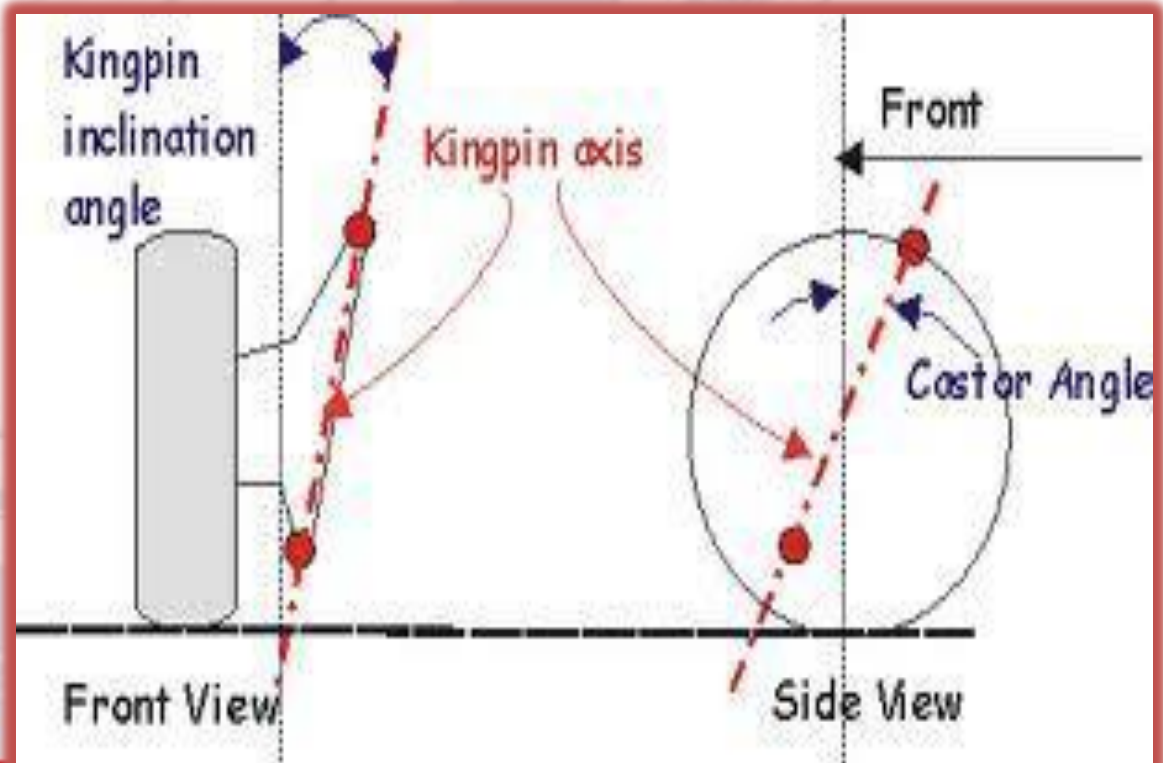
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- **Kingpin axis :**

The axis about which the wheel rotates.

- **Castor :**

Castor describes the angle between the kingpin and the vertical plane (usually positive).



COMPONENTS

- **A-arms/ Wishbones :**

A-arms are usually made up of plastic or metal parts that connect to the chassis and to a smaller part (hub carrier or caster block) that ultimately holds the wheel. The A-arm is hinged at either end to allow up & down movement.

- **Shocks and Springs :**

Springs compensate for irregularities in the road surface, maintain the suspension system at a predetermined height and support added weight without excessive sagging.

- **Shock tower :**

Built for multiple size coil overs. These come complete in pairs with grade 8 nuts and bolts.

- **Camber link:**

Used to adjust camber.



- **Steering link :**

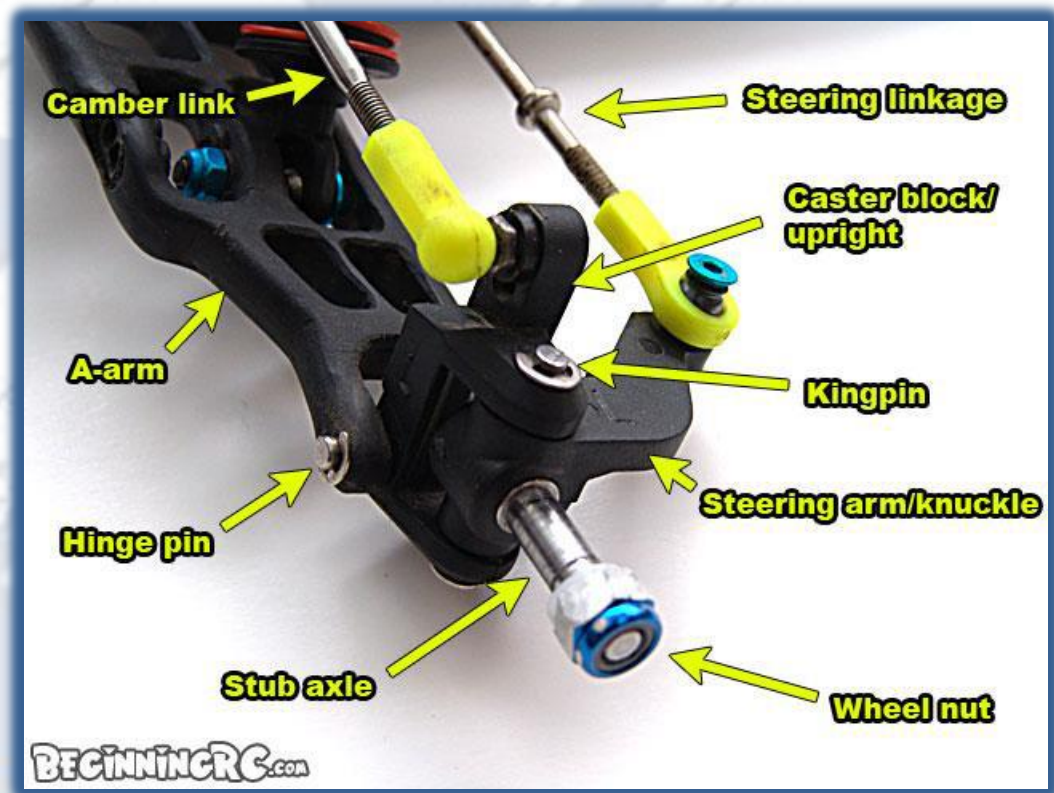
A steering link is the part of an automotive steering system that connects to the front wheels. It translates the movement to the front wheels.

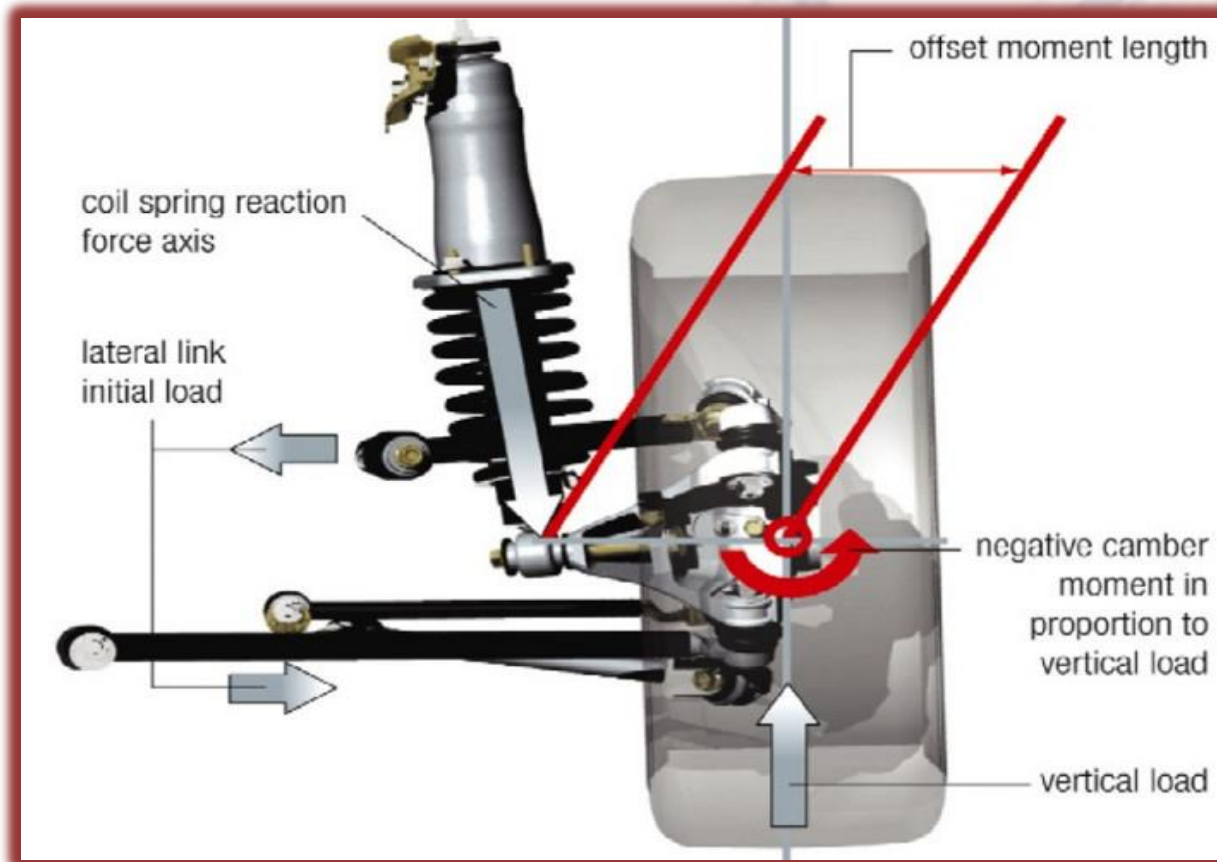
- **Caster block:**

Caster is the angle of the steering block kingpin as it leans toward the rear of the car.

- **Hub carrier**

- **Steering knuckle**

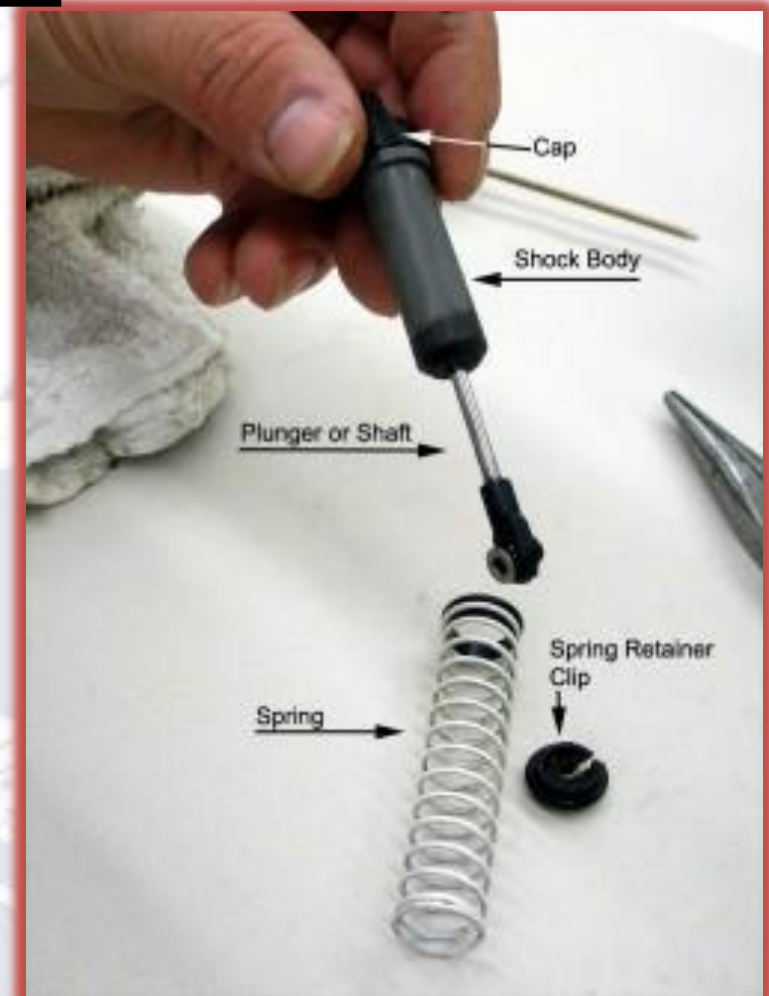




A DETAILED DESCRIPTION OF THE SUSPENSION MECHANISM

OIL AND SPRING

- Oil-filled shocks give RC vehicles more stability over rough terrain. Without the oil the shocks compress and rebound too quickly and fail to absorb or dampen the bumps in the road. When you feel that your shock absorbers aren't performing properly you can check the fluid level and add more oil to the shocks.
- Shock oil comes in different weights such as 40, 70, or 100; more is the weight thicker is the oil.
- Springs that are too hard or too soft cause the suspension to become ineffective because they fail to properly isolate the vehicle from the road. The spring rate (or suspension rate) is a component in setting the vehicle's ride height or its location in the suspension stroke.



Wheels and Tires

- Tires are stuffed with fitted foam inserts that give them a level of stiffness and make them bounce back when compressed.

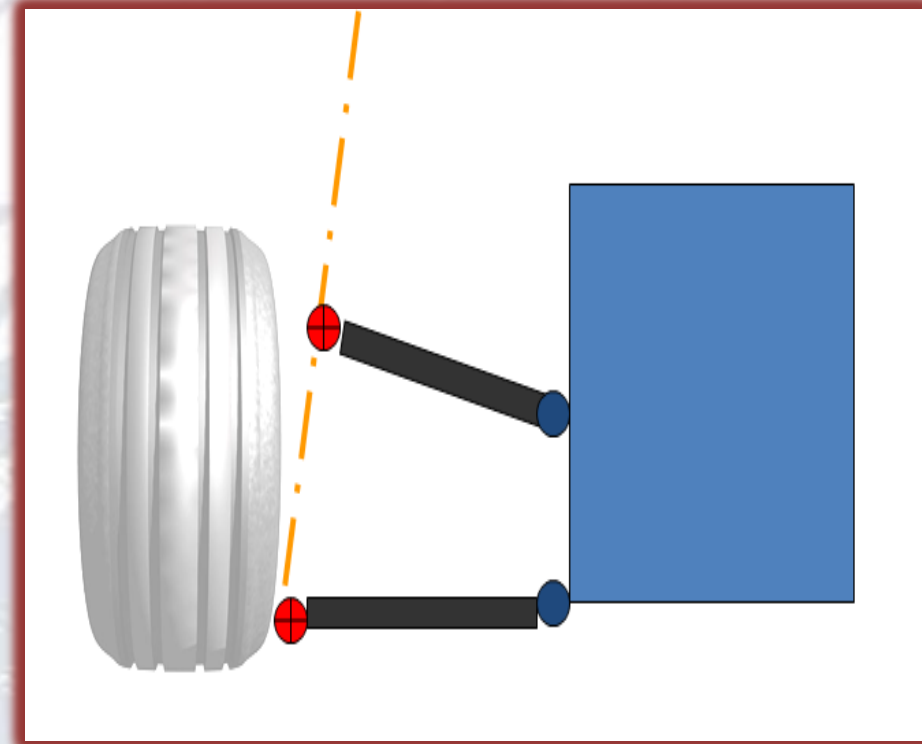


Steering

- To design the steering system we must consider the 3-Dimensional geometry of the system and aspects like
 - Caster
 - Steering axes
 - Scrub Radius and many others

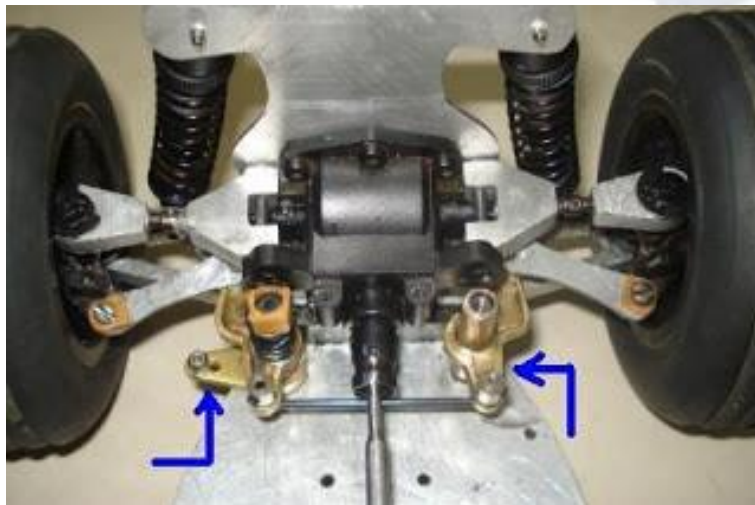
Steering Axis:

- Imaginary line from the upper and lower outboard A-Arm pivots.



Steering Mechanism

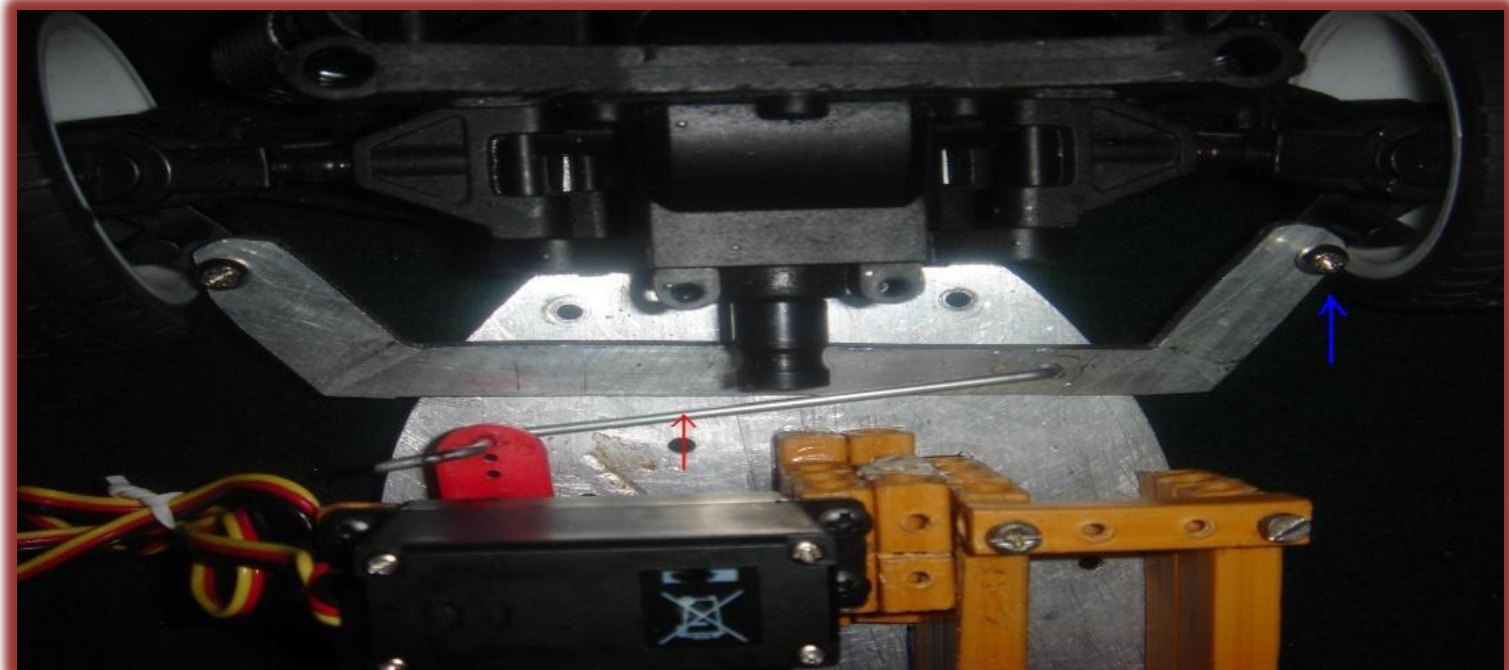
- The steering mechanism is used to turn the car around the bends in the track.
- An ideal steering must show following properties for RC cars.
It must be moderately smooth; otherwise you cannot control it in proper way.
- The servo motor is used to control steering system, so you must properly insure front wheels otherwise it may destroy motor in case of bumps or crashes. Or steering system must have a mechanism known as servo saver.



Blue Arrows indicate
steering mechanism

Pitman Arm:

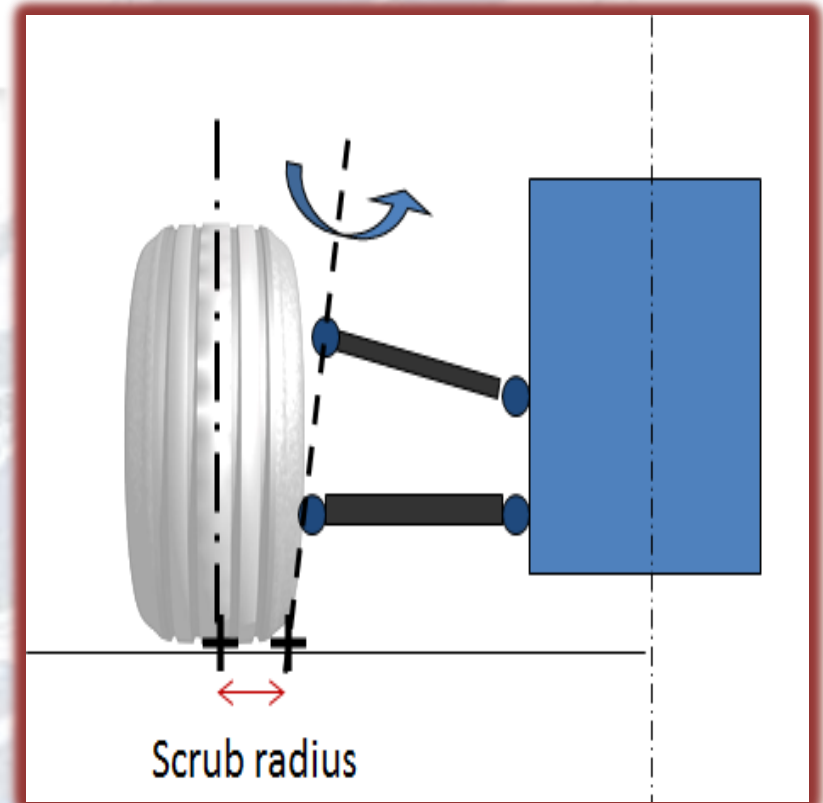
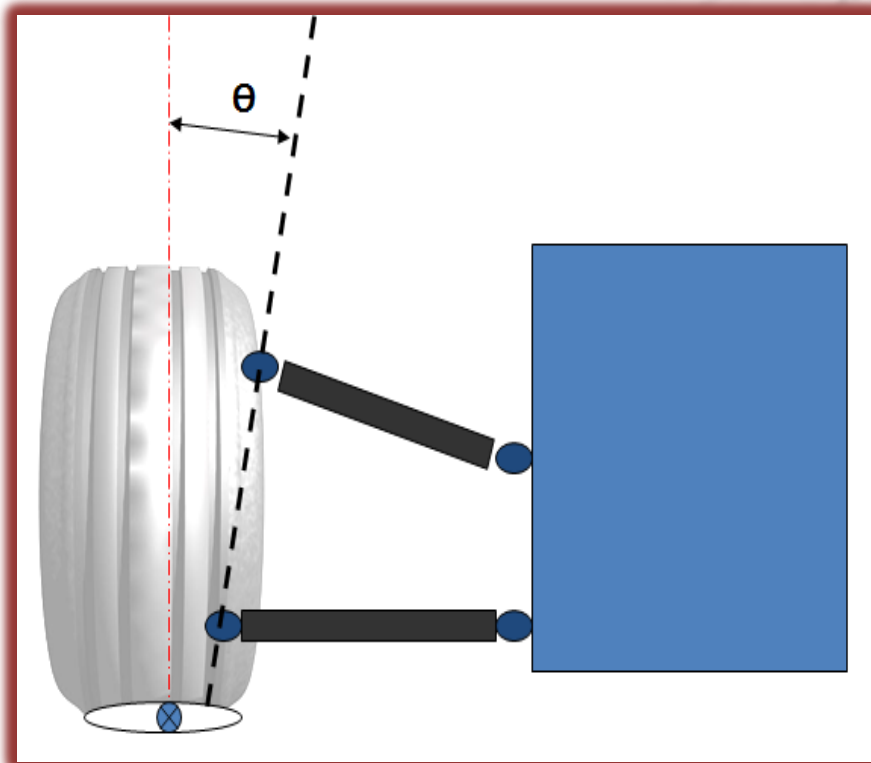
The Pitman arm is used to connect the steering column to the tie rods. The arm changes the rotational (turning) movement of the steering column to a sideways motion in the tie rods. The tie rods are connected to the steering arms, which then change the sideways motion back into a rotational movement, which turns the wheels.



Kingpin Angle

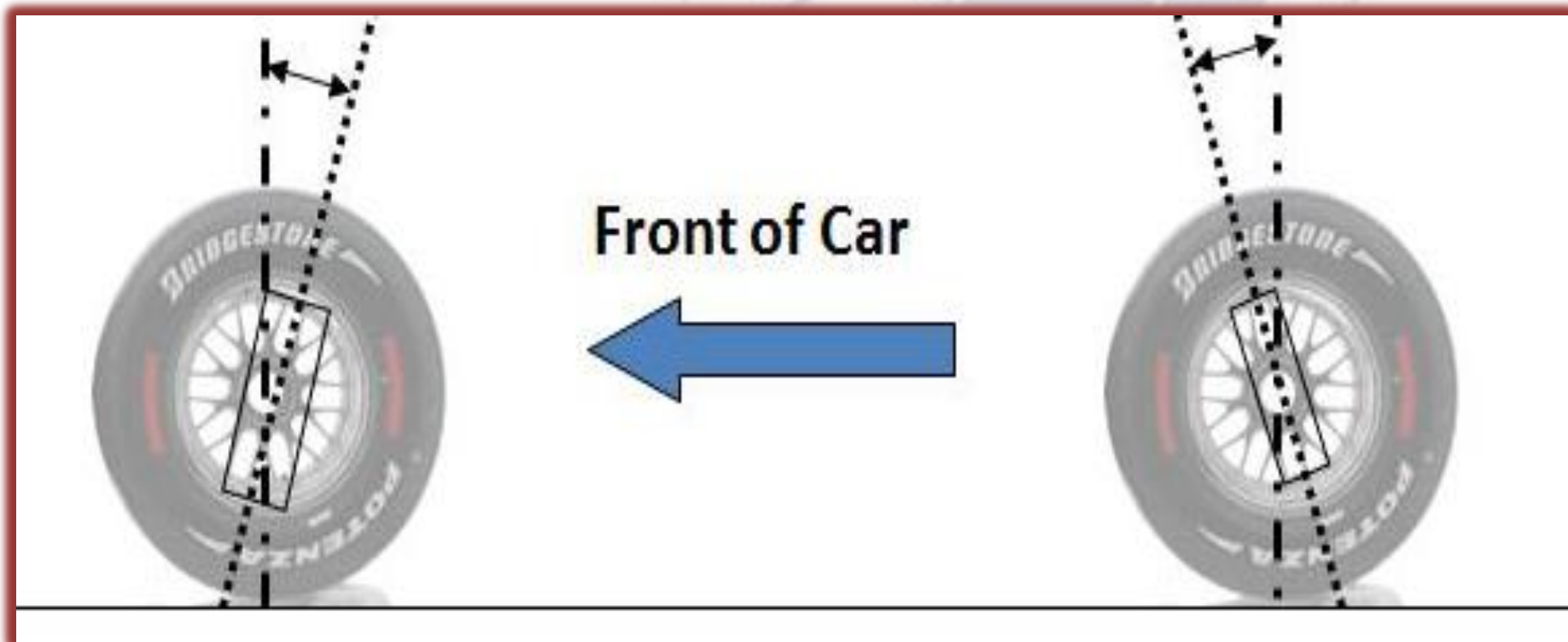
Θ = steering axis angle

Effect of Kingpin Angle



Caster

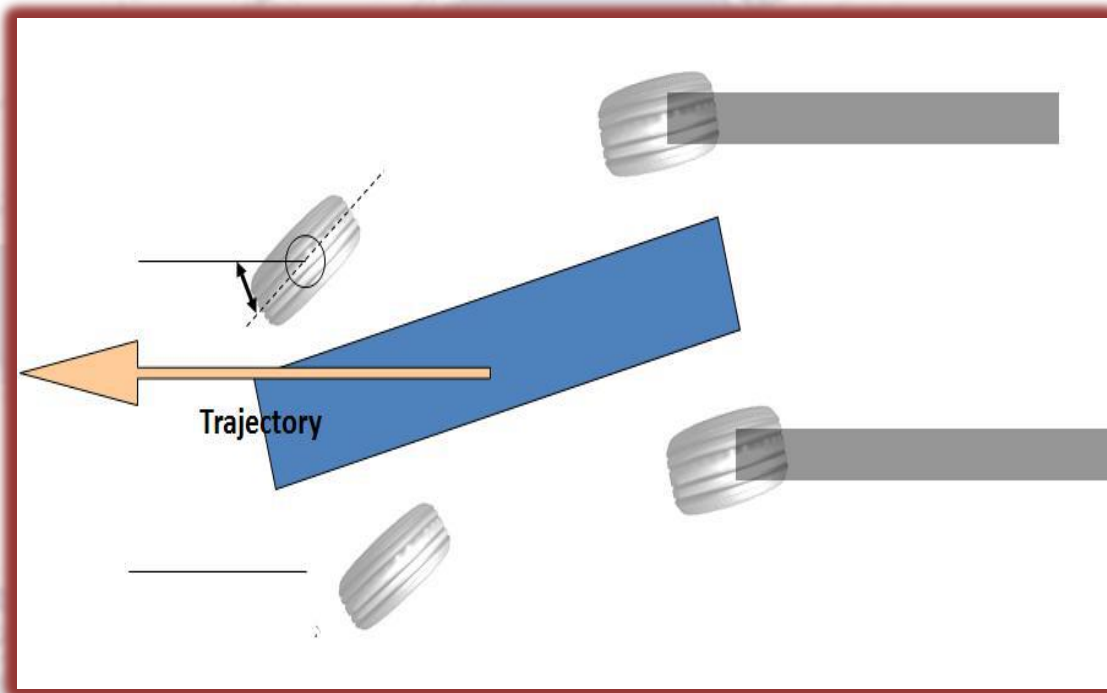
- The angle of the steering axis as viewed from a side view :



POSITIVE

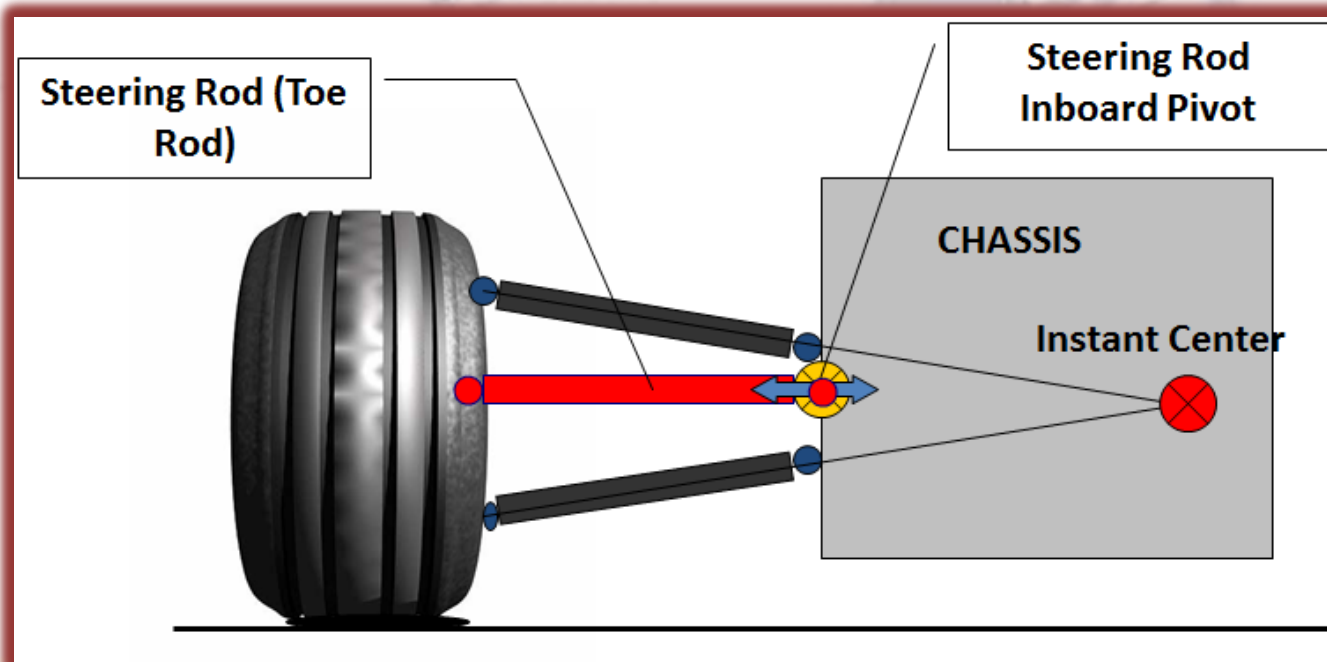
NEGATIVE

- The torque created by caster is a large factor in providing feedback for a driver.
- These aligning torques are responsible for allowing a driver to recover from a spin.
- These forces are present any time the wheel is turned at an angle to the vehicle trajectory.



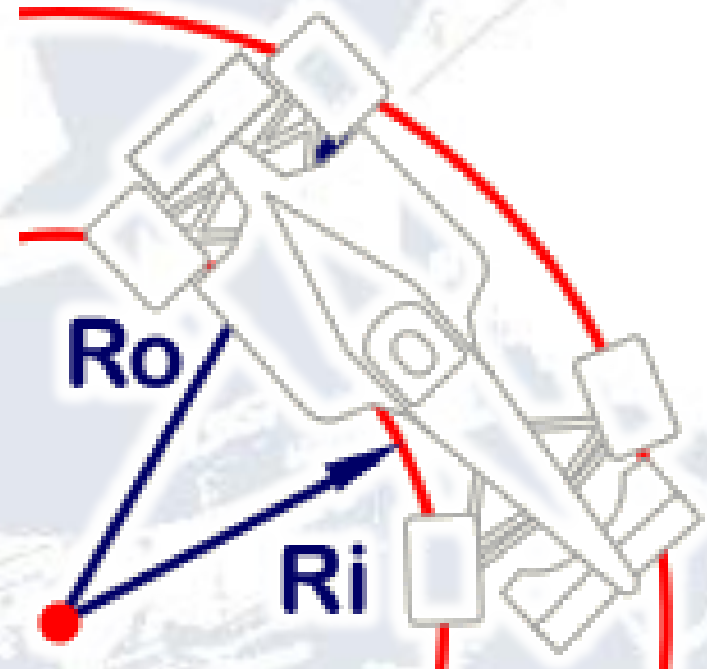
Bump Steer

- Steer angle generated any time the suspension travels up or down.
- Created any time the steering rod inboard pivot is not located on the instant center.
- Causes tires to toe in or out with steer angle.



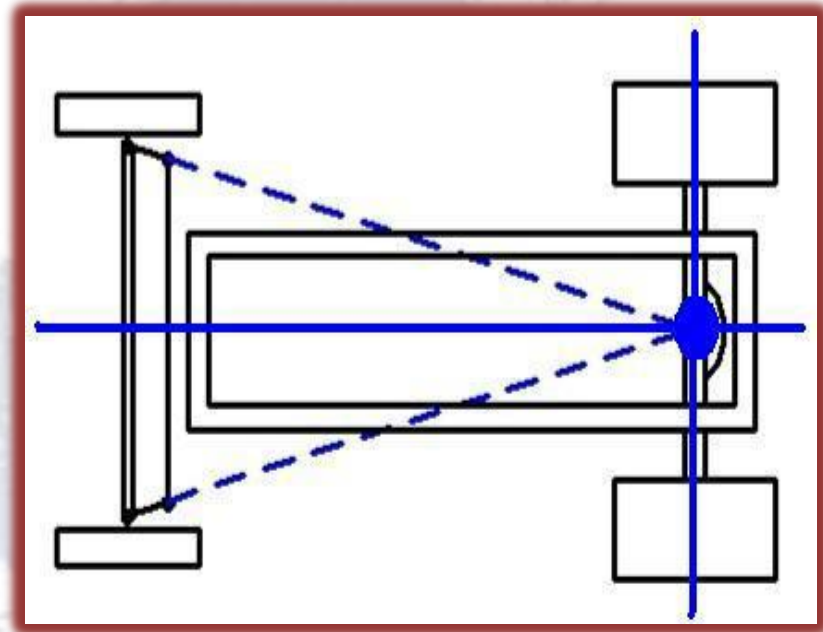
Corner Conditions

The red lines represent the path that the wheels follow. If both the wheels were turned by the same amount, the inside wheel would scrub (effectively sliding sideways) and lessen the effectiveness of the steering. This tyre scrubbing, which also creates unwanted heat and wear in the tyre, can be eliminated by turning the inside wheel at a greater angle than the outside one.



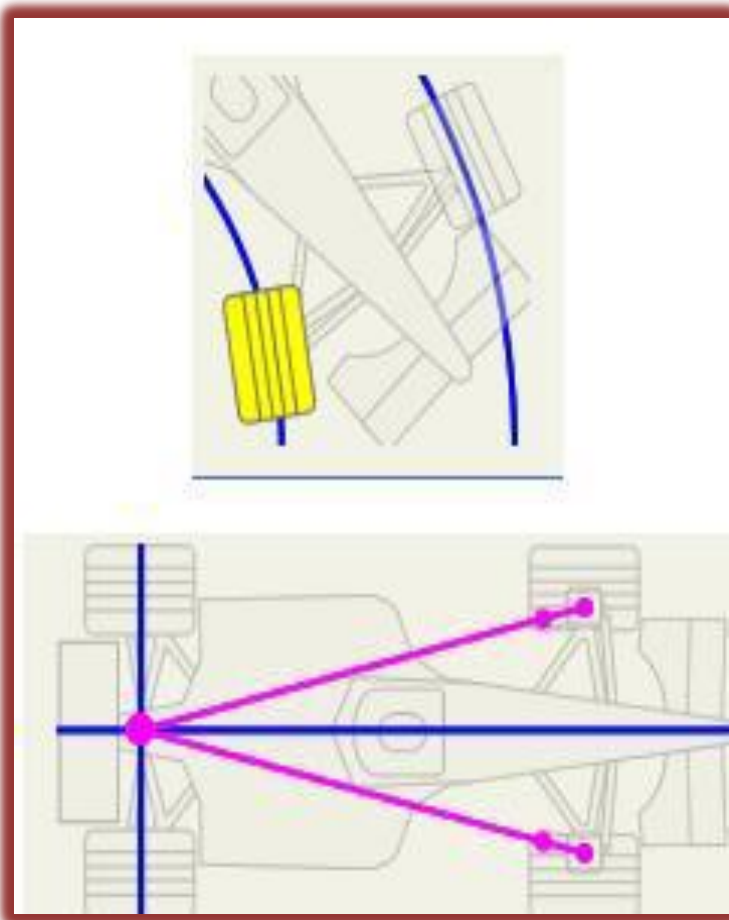
Drawing out Ackerman

- To visualize Ackerman steering geometry you can draw it out on the vehicle lay out
 - First draw a vehicle center line.
 - Draw a line down the center of the rear axle.
 - Then draw a line intersecting the outer steering point and the kingpin axis.
- The intersection of the two dotted lines defines the Ackerman characteristics of the vehicle.

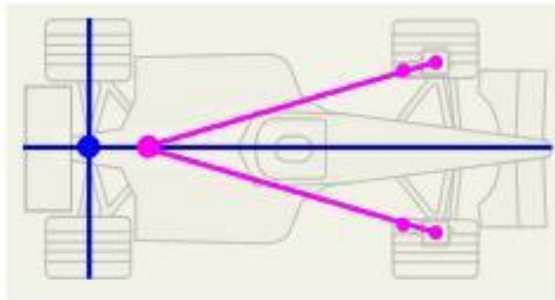
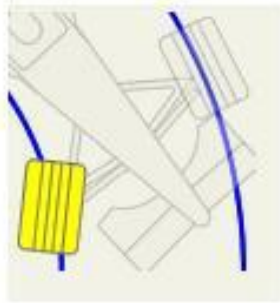


True Ackerman

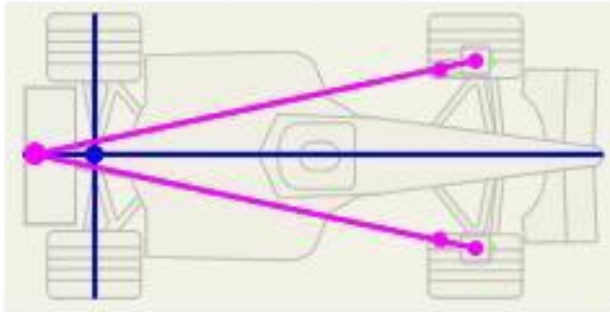
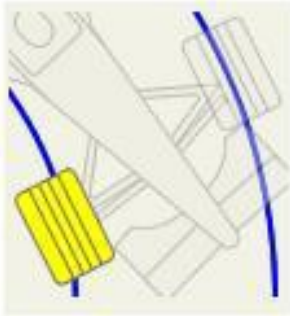
- For a vehicle to have true Ackerman all of the wheels must pivot around the same point.
- This ensures that no tire is unnecessarily scrubbing, so this means that both tires are traveling tangent to the circle the vehicle is traveling on.
- When the outer steering attachment falls anywhere on the pink line the vehicle will have the same true Ackerman



Over True Ackerman



- Over Ackerman refers to the inside tire turning more than the amount required to travel the desired arc.
- In most cases this is done for low speed cars that require nimble quick turning, the vehicle will have increased steering response at low speeds.

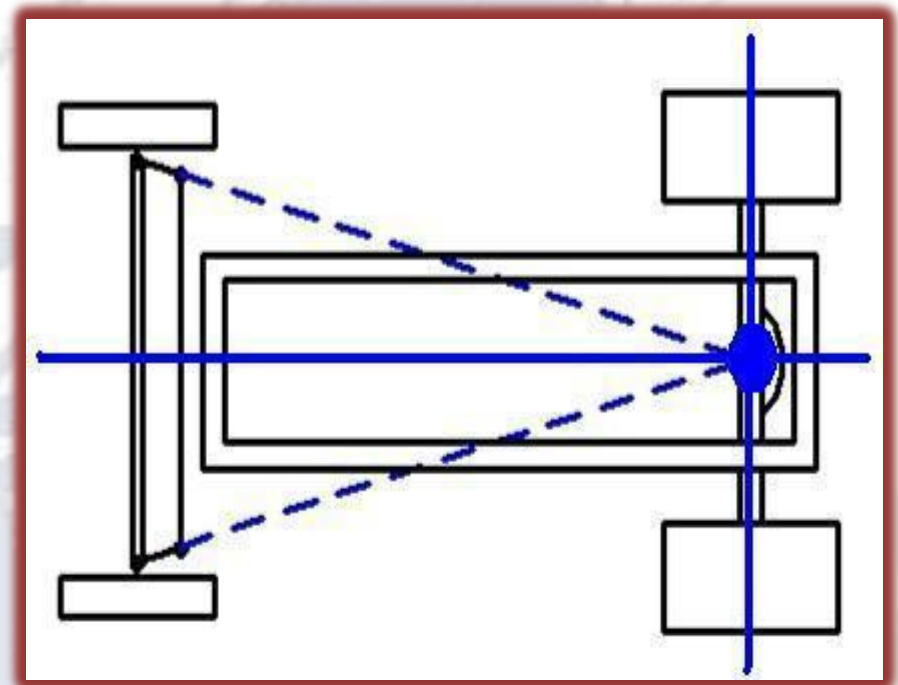


Under True Ackerman

- In this setup the intersection point falls behind the axle center.
- This causes the steering response of the vehicle to decrease slightly.
- So it could be described as have toe in in relation to the turning circle.

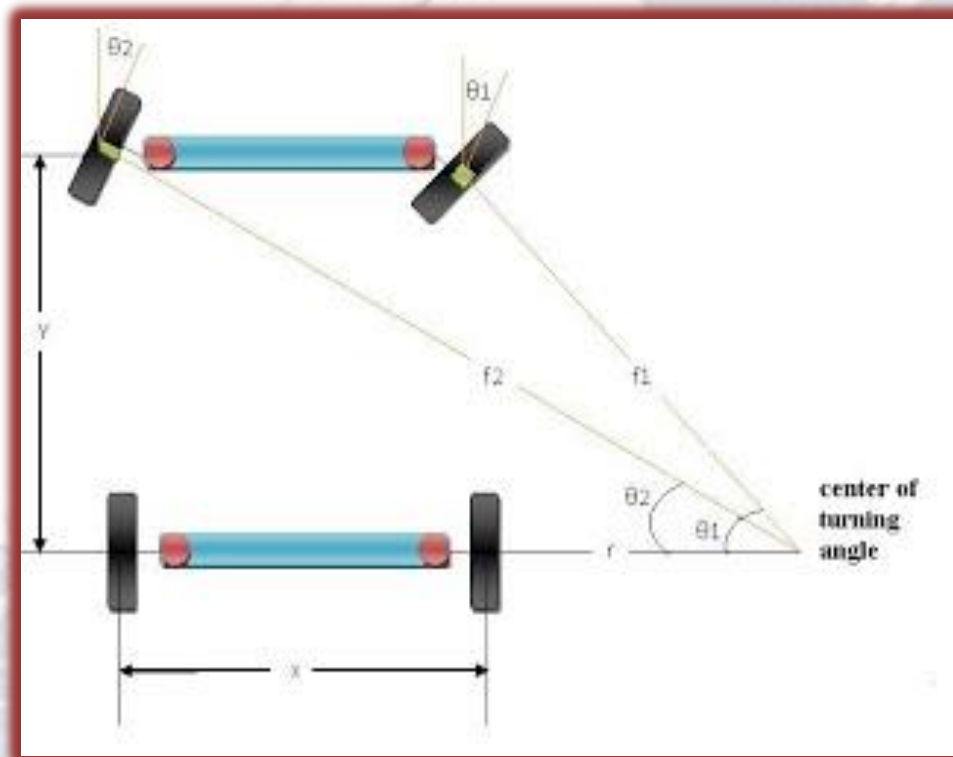
Steering Ratio

- The steering ratio can be adjusted by moving the outer steering pickup point along the Ackerman Axis (dotted line), and still maintain the Ackerman geometry.
- This action will decrease the steering effort required, but it will also slow the steering.



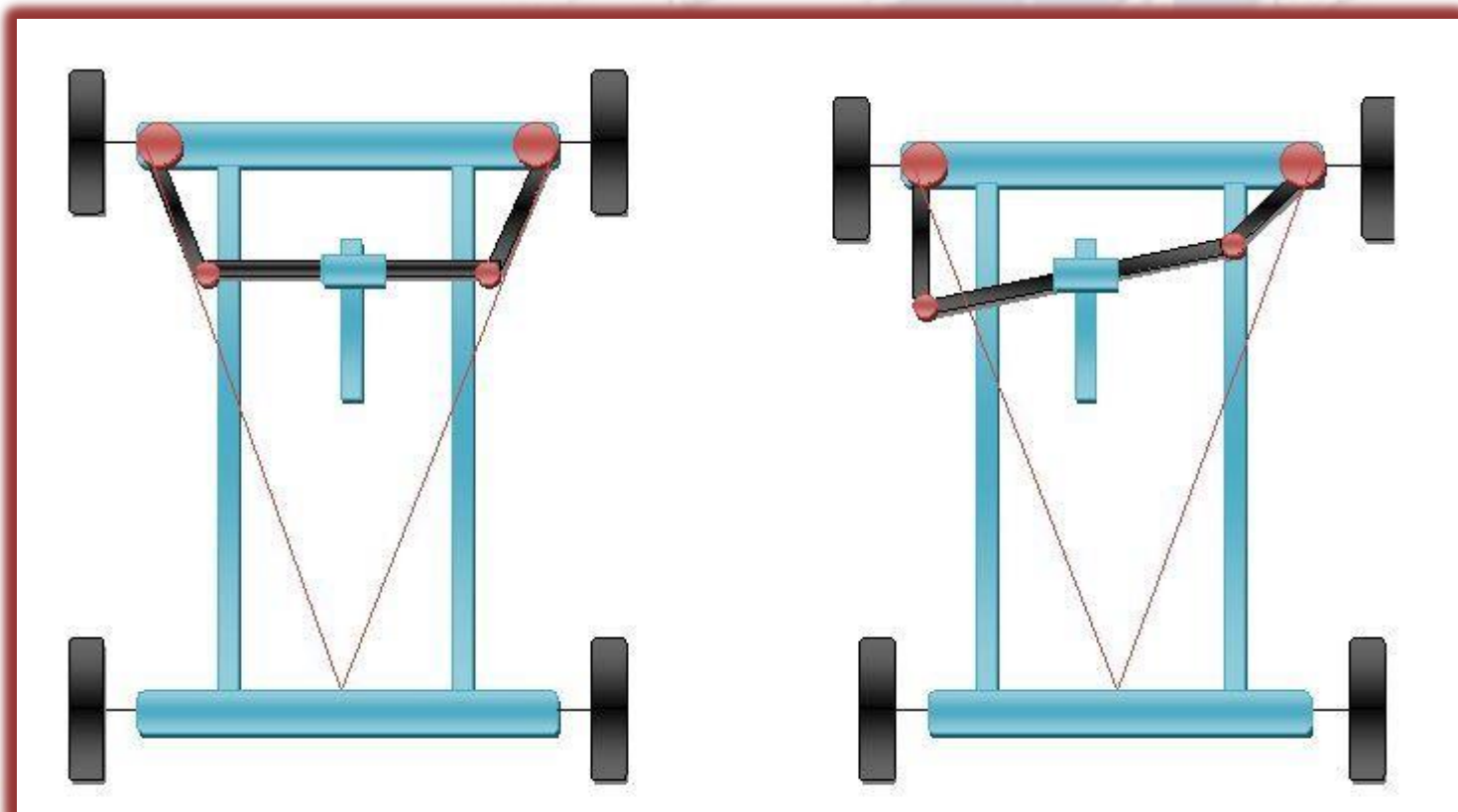
Turning Angle:

The inner wheel always turns more than the outer wheel; the difference between these two angles (Θ_1 minus Θ_2) is called the 'toe-in' of the wheels.



Steering Arms:

Calculating of the exact angle of each steering arm is complicated but angling the steering arms so that a line drawn from the centre of each arm meets at the centre of the rear axle gives a good result.



The Application:

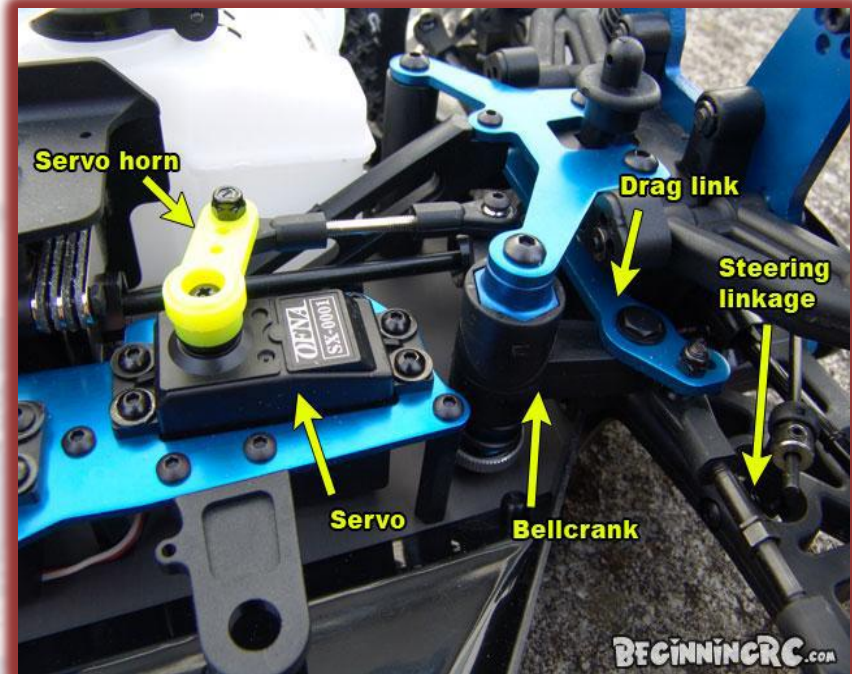
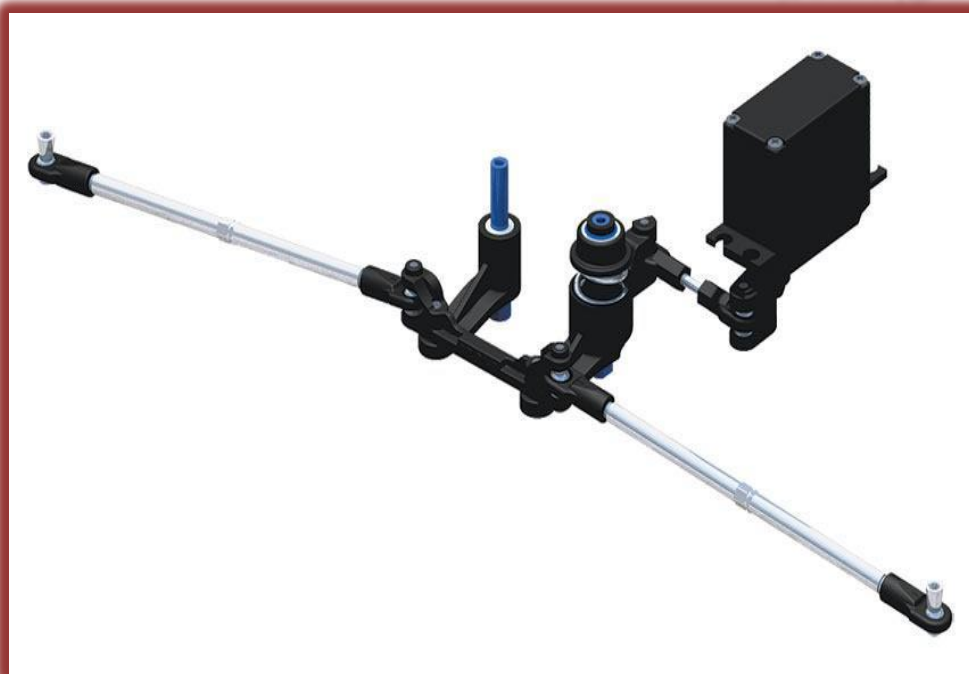


TURN RIGHT



TURN LEFT

Steering Assembly



Some Useful Links

<http://robokits.co.in/shop/>

<http://www.meadinfo.org/2009/07/design-and-fabrication-of-ic-engine.html>

<http://electronics.howstuffworks.com/rc-toy.htm> Contacts

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