Teach Me Suspension (Part 1): Basic Components & Functions

To get started, in this first part I'm going to give you an overview of the core aspects of your suspension system.

While the suspension components of today are intricate and complex pieces of equipment, in terms of the functions they have, they can be broken into two key parts.

The springs, and the dampers.

Both work together to give you one singular result – to keep the tyre in good contact with the road and give you good traction – but they each have very different jobs.

To get started, let's look at the job of the springs

Springs

On a motorcycle, the spring's job (both front and rear) is to support the bike's weight and allow the wheels to continue tracking the road's surface as it changes, while the bike remains in the same position relative to the road as a whole.

When you ride over a bump, for example, the spring will compress, absorb the force and allow the wheel to move vertically. On the downslope of the bump the spring will extend back out and release the energy.

The perfect scenario for the bike would be for the spring to compress and extend at the precise rate over the bump so the wheel never leaves the ground and the rider barely feels it.

Spring Rate
As you can see the main facet of a spring is pretty simple. The spring will compress and extend a given amount based on the force that is applied to it.

However, as you well know not every rider is the same, and the 'rate' at which the spring compresses will need to be different for different riders.

If two motorcycles with springs of the same rate travel over a bump at the same speed, the results will be very different if there is a large difference between the weight of the riders themselves.

When we talk about spring rate, this refers to the force that is exerted when the spring is compressed by a given amount.

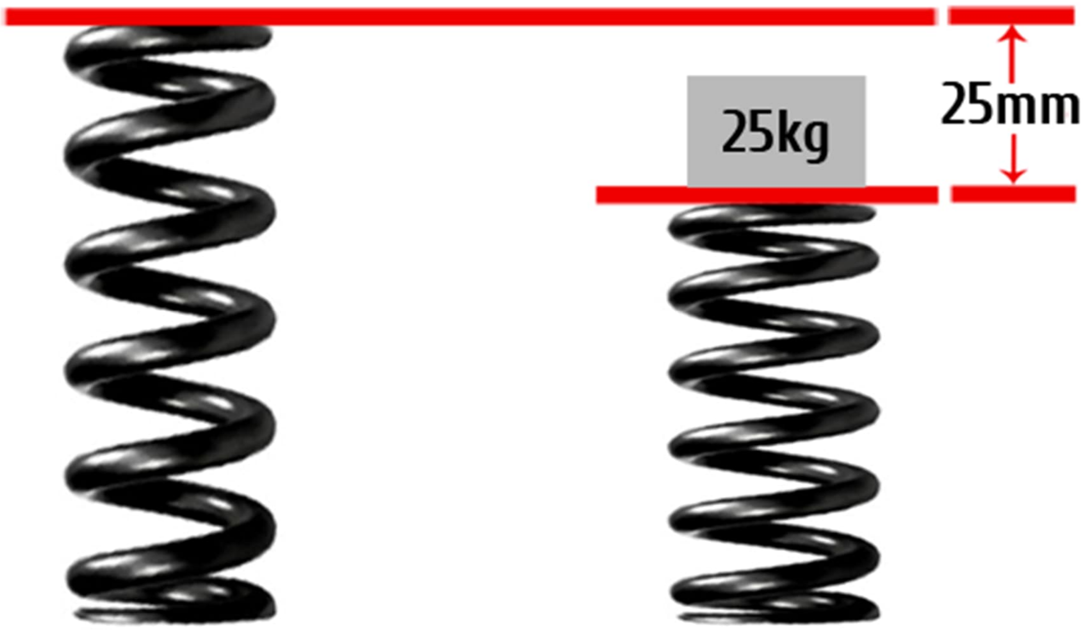
For example, let's say that the rate for your front fork spring is 1kg/mm.

What this means is that if you push down on top of the fork spring and compress it by 1mm, the spring will exert a force of 1kg back up at the object applying the force (your hand).

Or to say it another way, if you apply 1kg of force to the top of the spring, it will compress by 1mm.

For the majority of springs, this force to compression relationship is linear no matter how much you compress the spring.

So if you applied 25kg of force to the same spring, it would compress 25mm.



The only point at which this relationship changes is once the coils touch one another and you achieve what is known as coil bind.

However, while it is more common for this relationship to be linear, there are in fact springs that have a progressive rate the more they're compressed. They do this by altering the distance between the coils across the spring's length.

They Can't Handle it All
By its nature a spring on its own is not very good at dissipating the energy that it has stored up, and once it extends back out to release the momentarily stored energy it will continue to compress and extend at a given frequency until the energy is fully dissipated.

The spring needs a helping hand in order to tame that oscillating effect, which it gets from the dampers.

Damping

This is the second part to the suspension equation.

Where the spring is responsible for controlling the distance at which the wheel moves up and down, the dampers are responsible for controlling the speed at which they move up and down.
It does this by stopping the spring from compressing or extending too quickly.

Dampers are also able to separately handle both the compression and extension of the spring in different ways. There are two different types of damping that allow them to do this. They are:

Compression Damping – How quickly/slowly the spring is allowed to compress.
Rebound Damping – How quickly/slowly the spring is allowed to extend back to its original position.
Further to this, many bikes now offer both high and low speed damping. This allows you to change how the damping works at two different ends of the compression speed scale.

High-speed damping refers to very quick suspension compression, such a going over a pronounced bump at high speed.

Low-speed damping on the other hand refers to slower suspension compression, such as progressive power application, or when applying the brakes.

I will go into more detail about these variations in damping, how they manage to do it, and how to adjust them to find a setting in future parts.

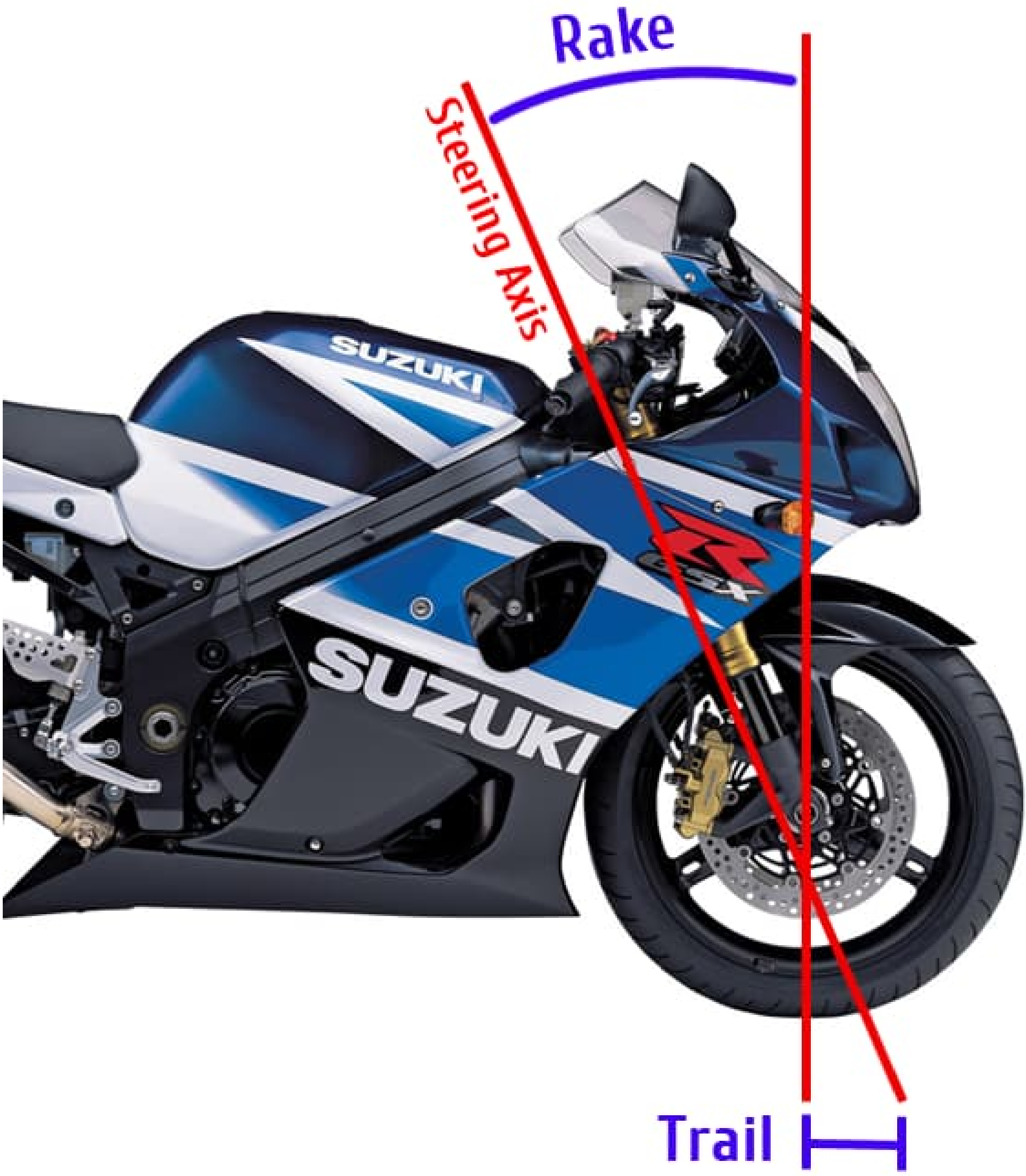
Geometry

Perhaps regarded as even more of a dark art than suspension component adjustment is geometry.

However, while the term 'geometry changes' may bring about the feeling of complete vagueness and fright, it's not quite as complex as you might think.

The handling performance and nature of a bike's steering predominantly comes from the rake and trail.

Rake and trail are two very important dimensions of the front end.



The picture above should tell most of the story, but the two are defined as:

Rake – The angle of the steering head relative to a line running vertically up from the ground. Typically sports bikes will be around 23-24 degrees as standard.
Trail – A measurement from the centre of the front tyres contact patch, to the point at which the steering axis meets the ground. Modern sports bikes tend to be around the 90-100mm range.
These two dimensions cannot be changed independently of one another. If you change one, the other will change too.

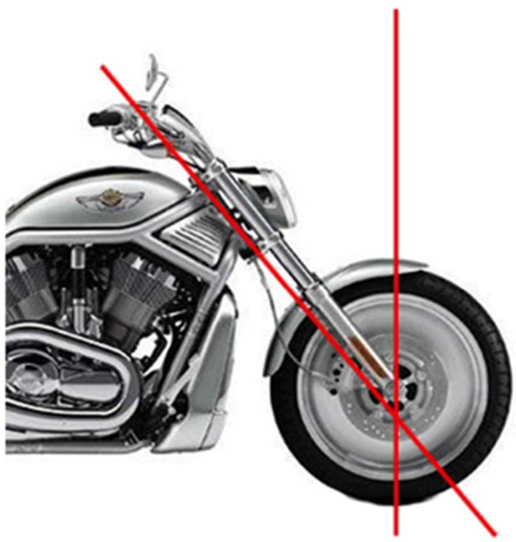
While we cannot change the rake and trail by altering the bikes components directly (on most bikes the steering head is fixed) what we can do is change the height of either end of the bike.

These height adjustments change the angle of the forks relative to the ground and therefore change the rake and trail of the front end. This is often what takes place when people talk about making geometry changes.

Trail is a very important thing to have for a bike because it is what gives the motorcycle its stability with the self-centering force it provides for the front wheel.

Sports bikes tend to have steeper rake and less trail. This means that while they are agile and quick to turn, they have less stability and can be considered twitchier.

Cruisers on the other hand have much shallower rake and more trail, offering a lot of stability in a straight line, but as a result it gives them slower steering.



Another aspect of geometry often talked about is the angle of the swingarm relative to the ground and the bike's frame, and how that affects the handling.

The squat you would naturally get as the weight moves to the back under acceleration can be offset by the force exerted through the chain, *preventing* this squat. This is known as anti-squat.