REAR SUSPENSION DESIGN
SOFTWARE SUSPENSION DESIGN

The software Suspension Design, in addition to being used to analyze and optimize the behavior of the suspension and the balance of the motorcycle in the different conditions, can be a very useful tool in the design and development of the rear suspension.

Nowadays most of the rear suspensions do not have a simple direct control of the shock absorber via the swingarm, but have a linkage system that connects the two elements.

Thanks to this linkage system it is possible to obtain a progressive behavior of the suspension.

The different features of the system affect:

- height of the motorbike rear part;
- suspension progressivity;
- behavior of the motorbike during acceleration due to chain force.

The software Suspension Design allows you to analyze all these aspects in the detail.

HEIGHT OF THE MOTORBIKE REAR PART

Once the linkage geometry and shock absorber length have been entered, the software calculates how the center of the wheel is positioned with respect to the swingarm pivot.

|		
wheel center position	x [mm]	**-537.2**
	y [mm]	**-168.5**
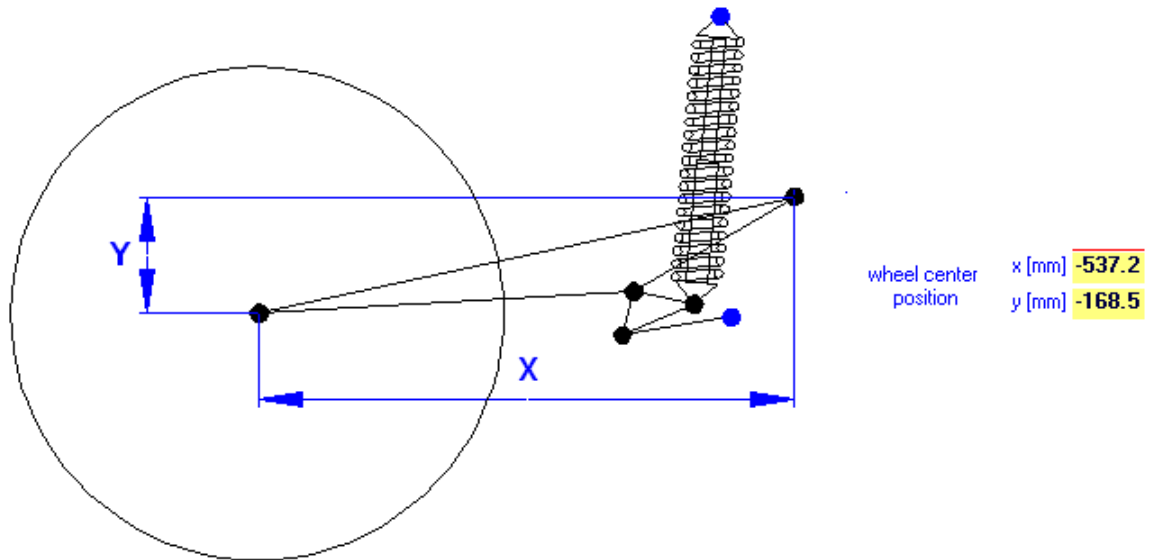
SUSPENSION PROGRESSIVITY

The software calculates how the leverage ratio changes as the rotation of the swingarm and therefore with the movement of the wheel.
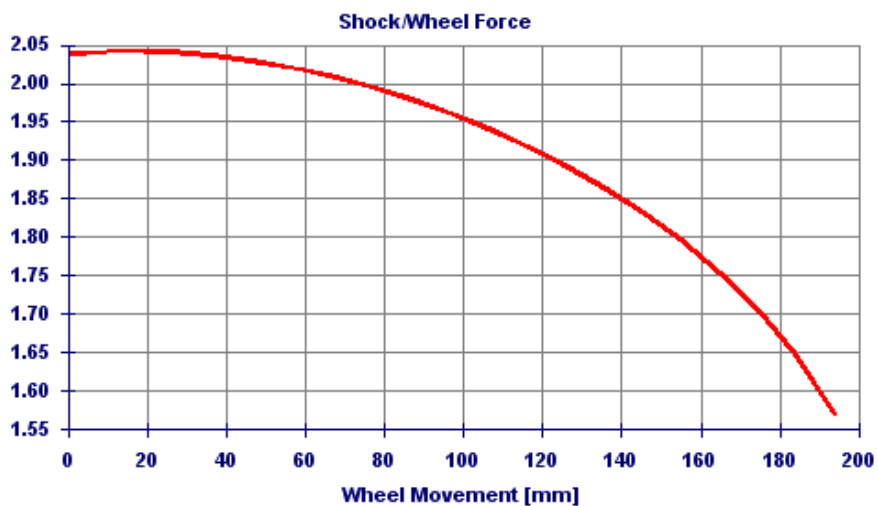
In this example we see that initially the force acting on the shock absorber is approximately double that which acts on the wheel, and then it decreases. So initially the shock absorber compresses itself more easily and after becomes stiffer.

Entering then the features of the shock absorber spring, the software calculates the vertical force necessary to determine the vertical movement of the wheel.

Wheel Movement

Y-axis: [mm] (0 to 200)
X-axis: Wheel Force [N] (0 to 8000)
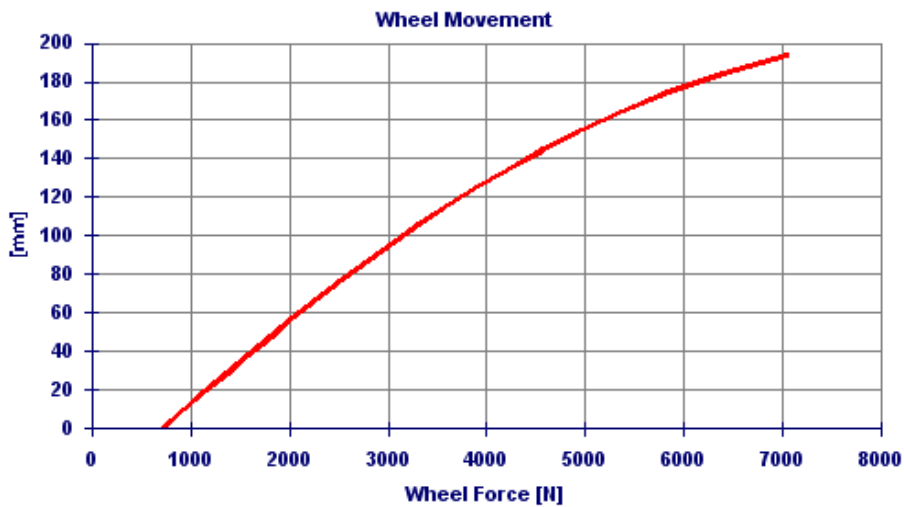
In this example you can see the effect of the preload, and the effect of the progressivity analyzed in the previous graph.

BEHAVIOR OF THE MOTORBIKE DURING ACCELERATION DUE TO CHAIN FORCE

Entering the position of the front sprocket, and the transmission data, the software calculates the behavior of the suspension in the acceleration phase for the effect of the chain force. The software hypothesizes to apply an increasing traction force defined as a fraction of the grip used Ftraction/Fvertical.

Wheel Movement

Y-axis: [mm] (0 to 35)
X-axis: Traction Grip [-] (0.0 to 2.0)
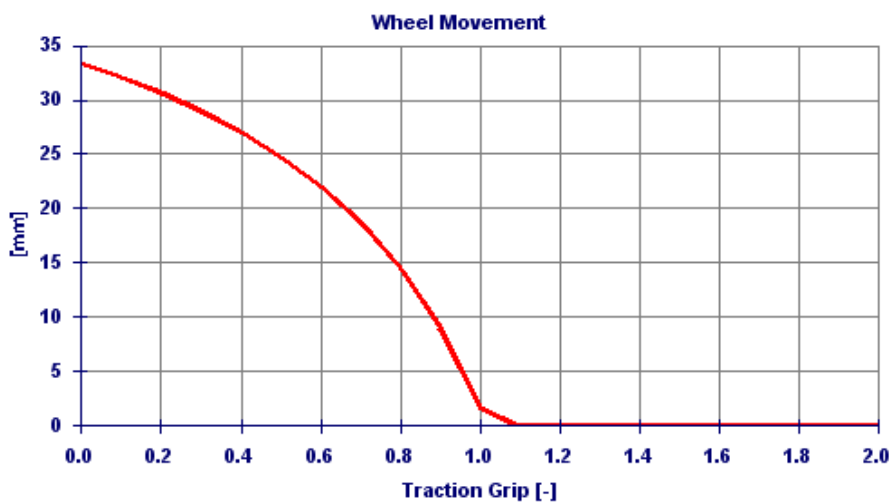
In this example we see that as the applied traction force increases, the suspension tends to open (the vertical displacement of the wheel decreases). It means that the suspension under consideration has an anti-squat effect.

Once the features of the suspension have been analyzed, thanks to the software Suspension Design it is possible to identify the most appropriate modifications to optimize the operation of the suspension in the desired direction. Below we show some examples.

MODIFICATION HEIGHT OF THE MOTORBIKE REAR PART
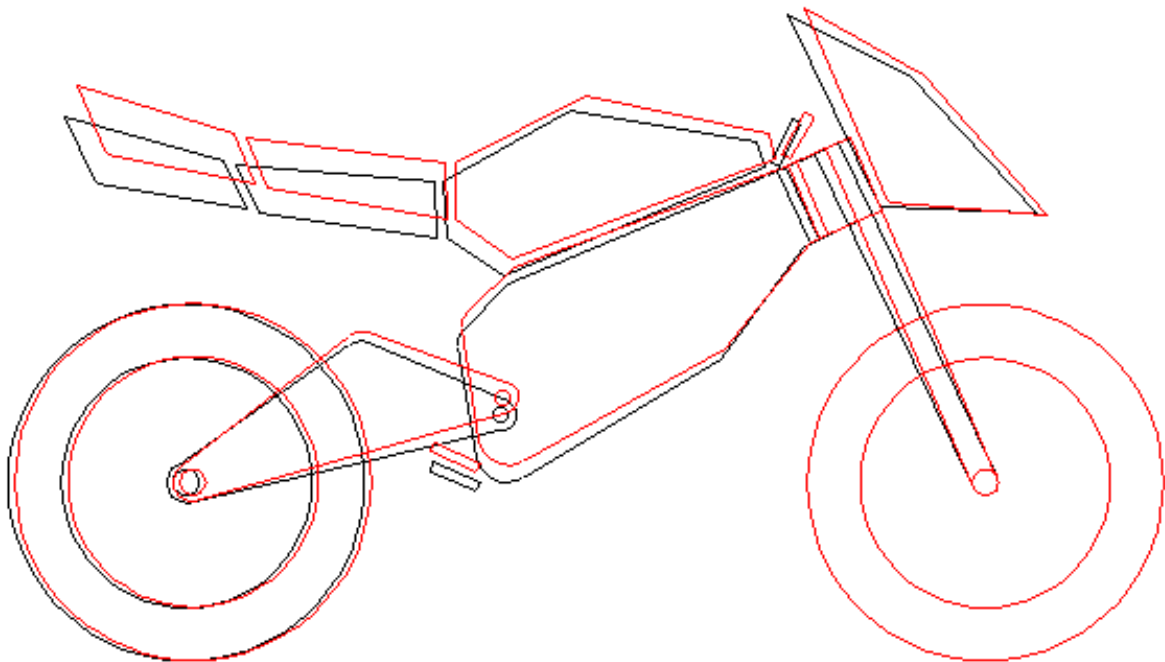
Thanks to the software it is possible to see how the height of the rear part of the motorbike changes, for example by intervening on the length of the shock absorber.

| wheel center position | x [mm] | -528.2 | -537.2 |
| | y [mm] | -194.8 | -168.5 |

In this example the modification causes the motorbike to be raised by approximately 26 mm, but in addition to this, thanks to the software it is possible to see how the modification affects the operation of the suspension.

Comparing the new solution (in red) with the initial one (in blue) you can see that with the modification, the suspension becomes less progressive, and the anti-squat effect is accentuated, raising the rear more quickly during acceleration.

Shock/Wheel Force

Wheel Movement
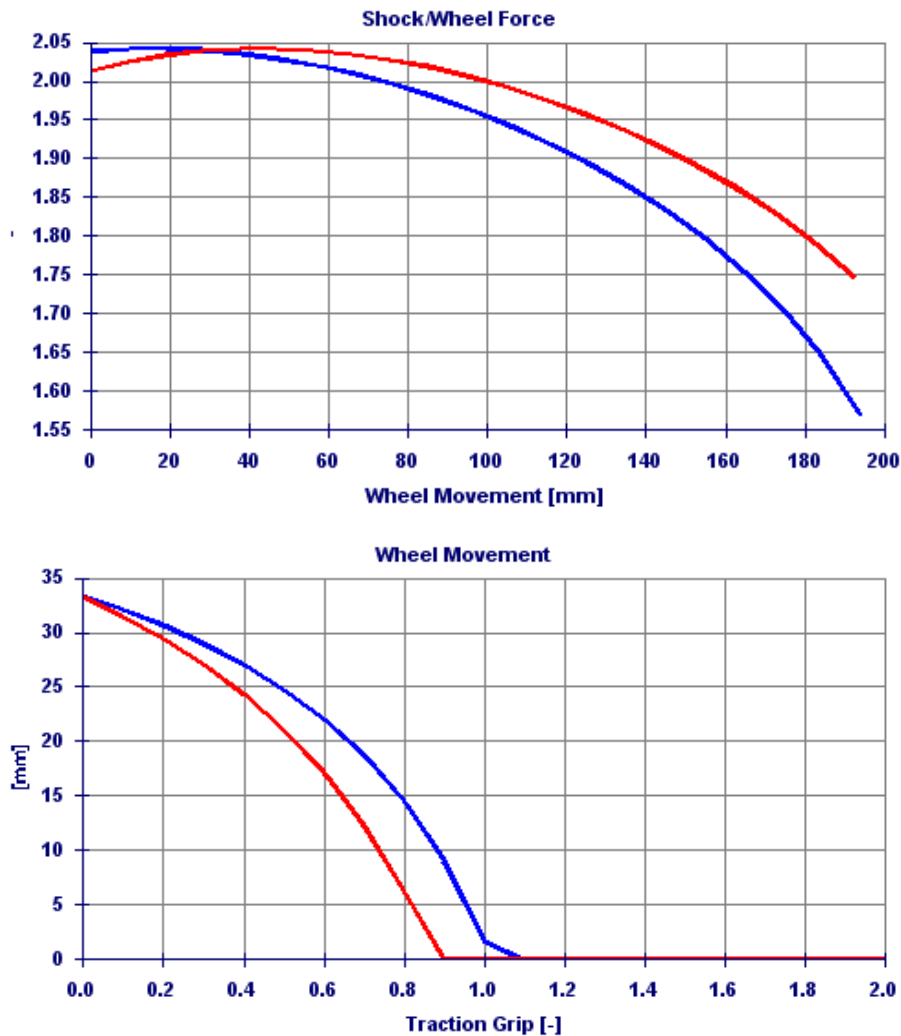
If the solution identified by modifying the length of the shock absorber is not satisfactory, or you want to modify the height of the rear part of the motorcycle without changing the shock absorber, thanks to the software it is possible to study modifications to the linkage to achieve the desired purpose.

In this example, the length of a connecting rod of the system is modified to obtain the same height variation of the rear:

| wheel center position | x [mm] | -528.2 | -537.2 |
| | y [mm] | -194.8 | -168.5 |

A completely different change in the behavior of the suspension is obtained, in fact in this case the progressivity of the suspension increases, and the anti-squat effect is more similar to the initial situation.

**Shock/Wheel Force**

Wheel Movement
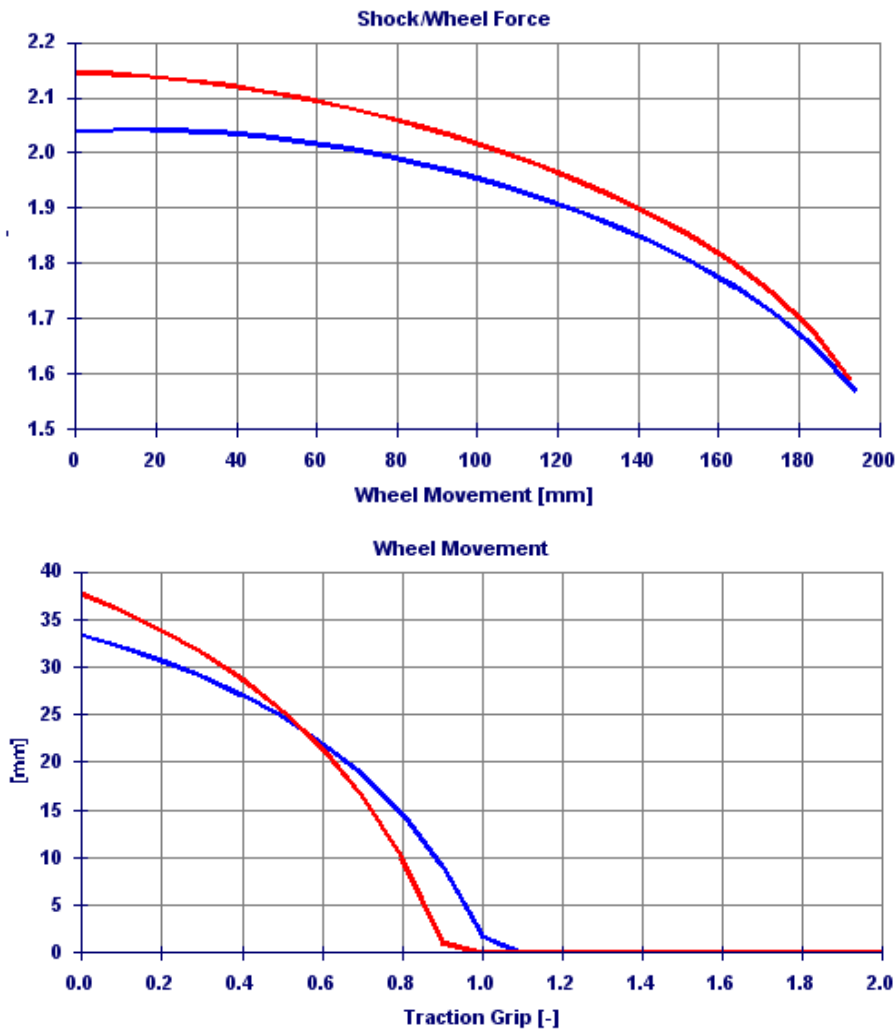
As you can see in this example, thanks to the Suspension Design software, modifying the suspension to obtain the best solution for your needs is very easy, as it is possible to quickly compare all the key aspects of operation.

MODIFICA SUSPENSION PROGRESSIVITY

In the previous example we saw how trying to change the height of the rear part of the motorbike also changes the progressivity of the suspension. Thanks to the software it is possible to identify solutions that allow changing the progressivity without changing the height.

In this example, in fact, the dimensions of two elements of the linkage have been modified to obtain the same height of the rear, but to increase the progressivity.

| wheel center position	x [mm]	-537.2	-537.2
	y [mm]	-168.4	-168.5
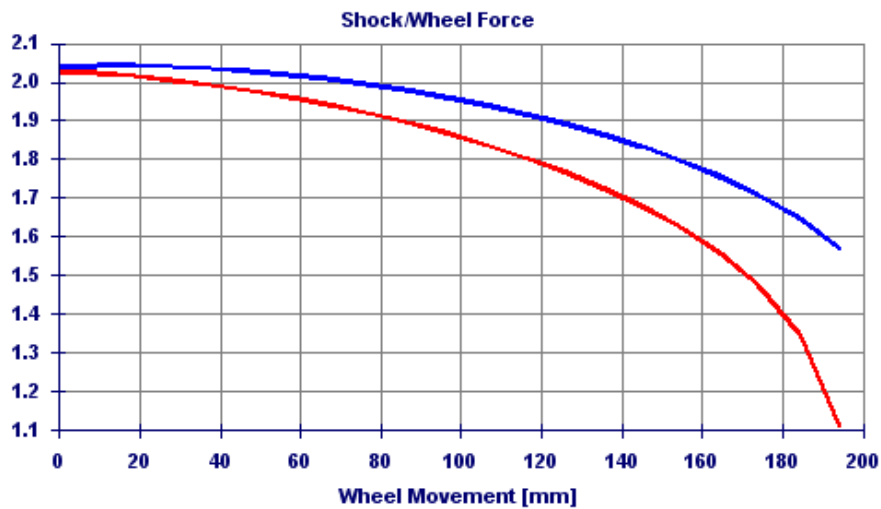
MODIFICATION BEHAVIOR OF THE MOTORBIKE DURING ACCELERATION

Another very important aspect where often come tried interventions to optimize the operation of the suspension is the behavior during acceleration.

Infact the suspension can have an ANTI-SQUAT effect that opposes the natural compression of the rear on acceleration, or a PRO-SQUAT effect that increases the compression.
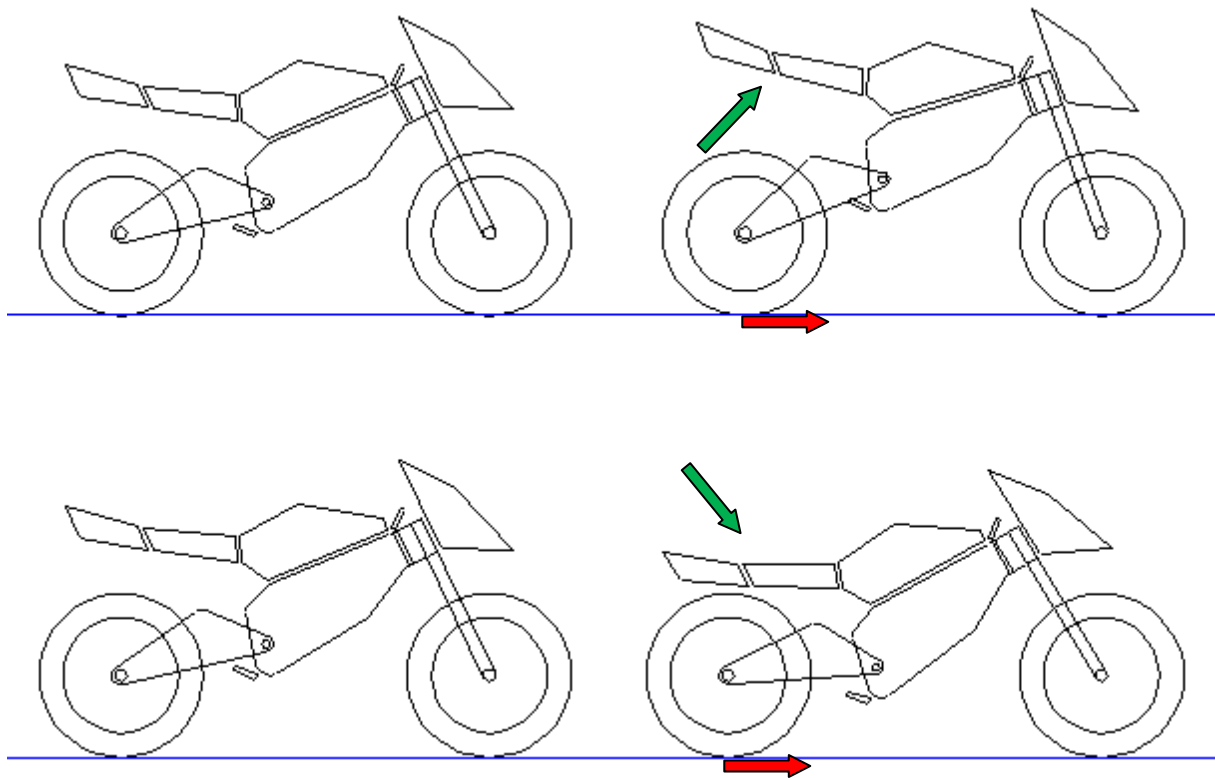
Thanks to the software Suspension Design it is possible to easily study how to modify the position of the swingarm pivot with respect to the front sprocket, to obtain the desired behavior in the acceleration phase.

Wheel Movement
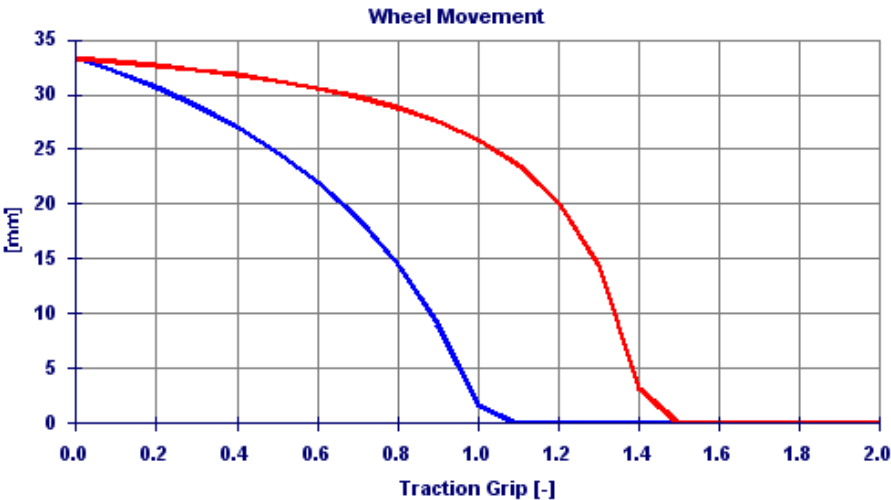
In this example we move from a solution where the rear progressively comes rised, to one where until to a certain level of traction force the balance remains very stable and after comes rised suddenly.

Also from this example we understand how the software Suspension Design can be a fundamental tool for developing and optimizing the characteristics of the motorcycle's rear suspension.