



FULL SUSPENSION-WHAT DOES IT ALL MEAN?

So you're finally convinced that full suspension is here to stay and you're reasonably convinced that most designs on the market work well. You are ready for full suspension! What you may not fully understand is how each different design works and why one design may be better than another for your particular needs. To understand these things, you must first be able to wade through all the acronyms and terms used by the magazines and manufacturers to describe the what, why and how of full suspension. more often than not, these terms are used interchangeably and incorrectly.

The purpose of this article is to give you an accurate explanation of the terms used to describe the functions, attributes and types of full suspension. We will also take a close look at specific designs and give you a guide to use when deciding what type of full suspension frame is best for you.

Fully Active Suspension

The first and most widely used term is "Fully-Active". The term "fully active" refers to any suspension design which does not lock-out. The suspension continues to work over all types of terrain regardless of whether the rider is sitting or standing, pedaling or braking. Fully-Active also means that the suspension has no-effect on your pedaling efforts nor does your pedaling or braking have an effect on the suspension. The term "Semi-Active" can refer to designs which have a split personality. These designs may be active while sitting and then lock-out or become less plush when standing. "In-active", designs lock-out when pedaling. When the force of the pedal stroke is greater than that of the bumps that the rider is encountering, the shock will lock-out rendering the suspension "In-Active"

Bio-Pacing

The term "Bio-Pace" refers to a bobbing feeling the rider experiences on certain full suspension designs. The cause of this feeling is the drivetrain's influence on the rear suspension. The force of pedaling wants to return the rear wheel to its un-suspended position while the terrain wants to activate the suspension. These two opposing forces create what is referred to as "Bio-Pace". This condition is a characteristic of most in-active full suspension designs. Bikes that have a single pivot in line with or above the chainrings exhibit this trait. Most builders of this type of design place the single pivot in-line with the middle chainring to lessen the "Bio-Pace" effect while riding in the middle ring. The higher the pivot, the greater the effect.

Drivetrain Induced Shock Compression

Drivetrain Induced Shock Compression (DISC) is a term that essentially describes the opposite of "Bio-Pace". Instead of locking-out while pedaling, the suspension would be activated by the pedaling torque. This condition exists on the computer screen, but in the real world it has little effect on the ride of most suspension designs. DISC is most commonly confused with an inefficient pedal stroke and hammering out of the saddle, where the weight and force of the rider put added sag into the suspension - Not the torque of the drivetrain. This feeling can even be experienced on unified rear triangle bikes where the drivetrain is completely isolated from the suspension.

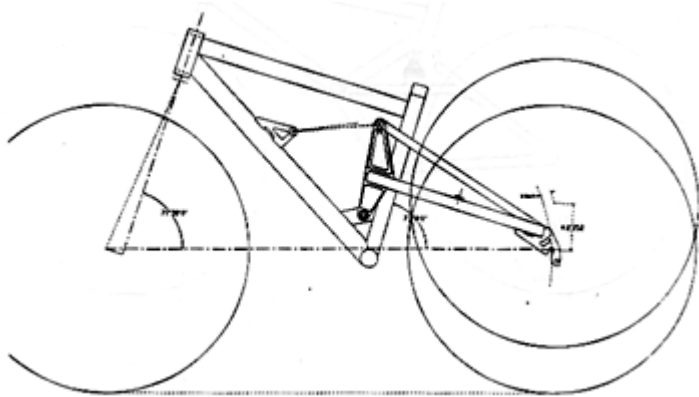
Horst Link

The "Horst Link" is probably the most over used and confused term in the world of full suspension. Most publications call any suspension frame that has a pivot near the rear drop-out a "Horst Link". The Horst-Link actually refers to a pivot that is both in front of and below the rear drop out. This

pivot location allows the rear dropout to pivot forward as the suspension goes through its travel. When the dropout pivots forward, the chainstay length remains the same throughout the suspension's travel. This means that a frame with a properly designed Horst-Link will not "Bio-Pace" or have Drive Train Induced Shock Compression. The frame will be Fully-Active under all conditions. A frame that has the pivot above the rear dropout is not a Horst-Link because the dropout is not able to rotate as the suspension goes through its travel. True Horst-Links were originally used on strut style bikes, but can now be found on many different types of multi-link full suspension designs.

Now that you have become an expert on some of the terms that define the world of full suspension, it's time to break full suspension down into several categories and describe the basic attributes of each design.

HIGH PIVOT DESIGNS

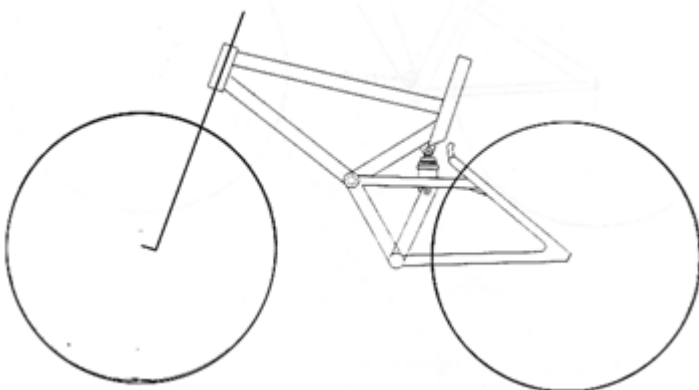


High pivot designs are characterized by a single pivot above or in line with the chainrings. High pivot bikes were the first to become popular and are sometimes referred to as the first generation of full suspension. High pivot designs suffer from Bio-Pace, although most current designs place the pivot as close to the middle chainring as possible to minimize the effect. Many high pivot frames on the market have 4 to 6 inches of travel and most builders that use this design focus on a very stiff frame. These features make high pivot bikes good downhill specific machines.

SOME COMPANIES THAT USE THE HIGH PIVOT DESIGN: CANNONDALE, CONEJO, FOES, MOUNTAIN CYCLE, SANTA CRUZ.

UNIFIED REAR TRIANGLE DESIGNS:

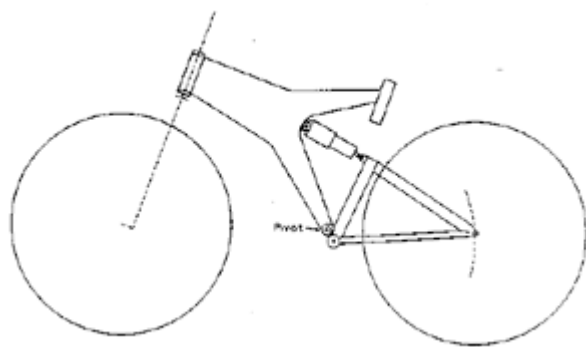
HIGH PIVOT/SWEET SPOT



The basic idea behind all unified rear triangle designs is to isolate the drivetrain from the forces of the suspension. There are two basic types of unifieds: Sweet Spots and low pivots. Sweet Spot designs do a good job of eliminating any pedal or rider induced suspension movement. On Sweet Spot Unifieds, the suspension is fully-active while the rider is seated and becomes less active when the rider stands up. Most builders of unified designs focus their design towards cross-country rather than down hill. On Sweet Spot designs, there is a large change in seat to pedal distance as the suspension goes through its travel. This occurs because the seat and cranks are on separate moving parts of the frame and the pivot is approximately midway between these two points. You will not experience any Bio-pace or DISC on a Sweet Spot unified design.

SOME COMPANIES THAT USE THE UNIFIED SWEET SPOT DESIGN: CATAMOUNT, IBIS, KLIEN, SCHWINN, WTB.

UNIFIED REAR TRIANGLE: LOW PIVOT



Low pivot unified bikes place their pivot closer to the center of the bottom bracket, resulting in a frame that is fully-active all of the time. Low pivot unifieds do not have the large pedal to seat height change that the Sweet Spot unifieds experience because the pivot is so close to the center of the bottom bracket. This low pivot design does not Bio-Pace or experience DISC, but it is much more sensitive to a rider's inefficient pedal stroke. Aside from the high-pivot designs, the low pivot unifieds have a tendency to bob more while pedaling than most other suspension designs on the market.

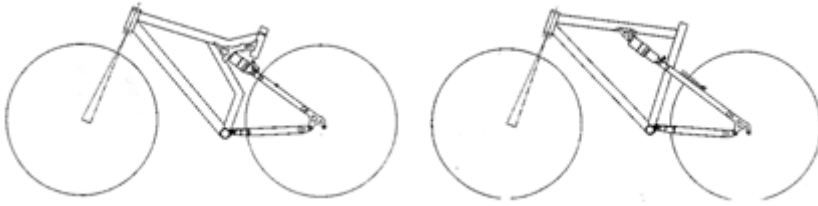
SOME COMPANIES THAT USE THE LOW PIVOT UNIFIED DESIGN: FISHER, TREK, VOODOO.

ISOLATED UNIFIED REAR TRIANGLE

This new style design could also be called second generation unified. Currently, GT is the only company using this design. This modified design places the cranks on the rear swingarm of the bike, just like a low-pivot unified. The difference lies in a second set of bearings at the bottom bracket which allows the cranks to float within the swingarm and follow a different travel path than the rear-end via a link attached to the front triangle. The idea behind their design is to partially eliminate changes in seat-to-pedal distance and the bobbing associated with low pivot unifieds. Although these characteristics are not eliminated, there is a ride improvement over the standard unifieds.

SOME COMPANIES THAT USE THE LOW PIVOT UNIFIED DESIGN: FISHER, TREK, VOODOO.

HORST LINK STRUT DESIGNS AND NON-HORST LINK STRUT DESIGNS.



Frames that incorporate both the strut design and a properly placed Horst Link are among the simplest fully active designs on the market. These designs experience no Bio-Pace or DISC and tend to be some of the lightest full suspension frames available. Strut designs achieve their light weight by using the shock as an integral frame member. The light weight and limited travel characteristics make strut designs ideal designs for cross-country racing. Strut designs that do not use a Horst Link, but place their pivot above the rear dropout, exhibit many of the same positive features as the Horst Link bikes. However, depending on the front pivot location, non- Horst Link designs will exhibit some Bio-Pace or DISC.

SOME COMPANIES THAT USE HORST LINK STRUT DESIGNS: AMP, DEAN, FISHLIPS, INTENSE, MONGOOSE, NORCO, SALSA, TITUS TITANIUM.

SOME COMPANIES THAT USE NON-HORST LINK STRUT DESIGNS: INTENSE, YETI.

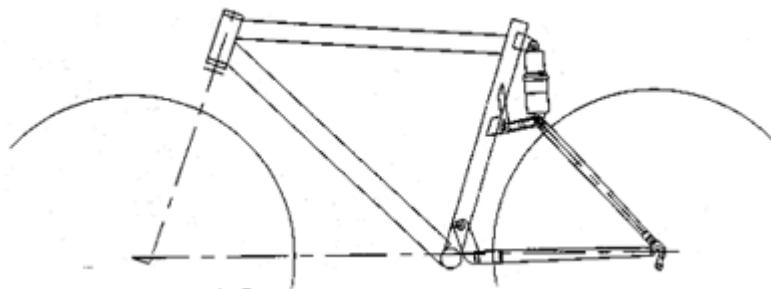
HORST LINK ROCKER AND SWING LINK DESIGNS.



Although this is a very large and diverse category, the use of the Horst Link insures that designs of this type will share some very important features. Like the Strut Bikes, rocker and linkage designs using the Horst Link are fully active and exhibit no Bio Pace or DISC. Frame Builders use both Rockers and Linkages for two reasons. The first is to achieve different ride characteristics at different points in the suspension travel. These traits vary greatly from design to design so there is not one hard and fast rule that can apply to all suspension designs of this type. The second reason is to allow the shock to maximize travel for a given shock stroke. This feature is shared by all rocker and linkage designs. Different manufacturers design these bikes for both cross-country and downhill so it is important to look at the builder's intent when deciding which frame fits your needs best.

COMPANIES THAT USE HORST LINK ROCKER AND SWING LINK DESIGNS: ELLSWORTH, GT, INTENSE, KHS, JAMIS, SPECIALIZED, TURNER, TITUS etc...

OTHER ROCKER AND SWING LINK DESIGNS



Manufacturers of rocker and swing link designs that use a pivot above the rear dropout choose linkage designs for the same two reasons listed above. The big difference with these designs is that the rear dropout is not able to pivot independently as the suspension goes through its travel. Depending on where the front pivot is located, these designs can exhibit traits of either a high pivot frame or a very low pivot design. If the front pivot is in-line with the middle ring or higher, the bike will have some Bio Pace effect and will not be fully active. A frame with a very low front pivot will be fully active but may experience some DISC and be susceptible to bobbing, depending on the type of linkage used up top. Pivots that are placed somewhere between these two points can behave very similar to frames using the Horst Link.

COMPANIES THAT USE ROCKER AND SWING LINK DESIGNS: MANATOU, TOMAC, VENTANA, INTENSE, GIANT.

WHAT ABOUT THE REST?

Yes, there are a few designs that we haven't covered! However, the majority of other suspension frames are variations or hybrids of those designs explained above. When considering different suspension designs, always try to look at the pivot locations and evaluate how the suspension will behave using some of the principles of pivot location and drivetrain torque discussed above.

WHAT DO WE THINK?

Although the purpose of this article is to give you an unbiased education on the basic principles of full suspension, we at **TITUS** definitely have an opinion. We manufacture three different models of fully active suspension frames. Every model incorporates the Horst link and uses either the strut design or a Rocker linkage to handle every riders needs. The strut design achieves the goal of a light weight frame with the minimum amount of pivots while the Rocker equipped bike offers more travel and a super plush and tunable ride. As stated above, frames that use a Horst Link achieve the goal of being fully active all of the time without any effect of pedaling torque on the suspension. The frames are plush, yet feel very light and lively. After looking at the other full suspension frames on the market, **buy a TITUS:** You'll be glad you did!

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