

# [Design of a bicycle frame](https://assignbuster.com/design-of-a-bicycle-frame/)

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Bicycles, whether they be mountain bikes or just ordinary street cycles, play an important role in society, especially In sport and in general means of transportation. The history of bicycles and their contribution to an economical means of transportation goes as far back as the 19th century. Bicycles have progressed and evolved ever since and ever improving with the introduction of spooked wheels, a chain drive connecting a crank with pedals, pneumatic tires and suspension which rough on massive popularity In the latter part of the 19th century.

All of these Innovations, Ironically, actually lead to a rapid decline In the bicycle Industry and this was because early 20th century American automobiles were taking over. Not only was the automobile industry taking over, it was the bicycling craze that brought pneumatic tires, spooked wheels, the manufacturing processes for machining gears and assembling frames that actually paved the way for automobiles to become so cheap and reliable at such a rapid rate.

The next great transportation innovation and evolution - aviation, was in many ways a child of the bicycle industry in the sense that most of the early inventors, pilots (steering an early plane was identical to steering a bicycle by leaning Into turns) and builders were previously a part of the bicycle industry. For most of the 20th century, America was completely fixated on automobiles and aviation.

However, even more ironically, the soaring prices in fuel, an obesity epidemic, as well as more recent manufacturing processes and materials for the automotive and aerospace Industries, paved the way for stronger, faster, lighter and cheaper bicycles. The very Innovations In the automobile and aerospace industries that nearly wiped out the bicycle industry, eventually led to its revitalization and resurrection. The frame is the mall body of the bicycle and Is the framework which all other components are attached.

A modern bicycle Is typically composed of multiple hollow tubes which form together and this basic design hasn't changed much in over a century, however metallurgy, manufacturing techniques, advances in engineering and material science has provided other means to focus on In bicycle frame design. The first bicycles were made of wood. Often bamboo and hickory [1 2] were used instead since these woods have a long grain and can therefore withstand higher stress values than softer woods or woods with a shorter grain.

Modern bicycle materials usually consist of steel, aluminum alloys, or titanium although composites like carbon fiber can be found on higher-end bicycles. Frame materials and shape of the hollow tubes in the framework are topic of intense debate amongst keen cyclists and whilst there are important differences between frame materials and the framework shape these are Just two influences on the weight, strength, stiffness and just the general performance of a bicycle.

Shape of the framework has only Just recently come Into debate, with the production of composite frames allowing alternative designs to the regular " double triangle", " diamond" or cylindrical shaped 1 OFF Materials Steel Frames Steel is the traditional choice for most common bicycle frames and is popular among manufacturers and riders. Steel is strong, durable, very inexpensive and relatively easy to build or repair if need be. Indentations or bending of frames can be easily hammered out and a broken steel frame can be simply re-welded and ridden gain.

However, steel is highly corrosive and can easily rust when exposed to water, air or road salt. This can be simply avoided by coating or double-coating the frame with paint, but scratches can prove costly if left untreated. Theoretically, steel can be immune to fatigue stress as long as the load does not exceed the materials yield strength then microscopic voids and crack won't form internally, which would otherwise lead to failure. Although, weak spots can be formed during the welding process. Steel frames are relatively elastic and can flex a bit under load, at least in imprison to aluminum.

Steel is the heaviest of the above materials by far, at least by volume due to steels density. Manufacturers have discovered construction techniques over the years to deal with this and one of these techniques involves the use of butted tubes. It involves thickening the tube or frame at the ends, rather than the middle. The thick end of a butted tube adds strength where it's most pivotal, whilst the middle bit of the tube is thinner, which reduces the amount of material and in-turn overall weight and volume is reduced. Butting tubes can reduce the eight off steel frame by more than 15%. 6] 2) 3) 4) Aluminum Aluminum is inherently lighter, weaker and less stiff than steel. It is however cheaper than steel and has a much higher strength-to-weight ratio. Aluminum is typically used with large diameter tubes in order to increase stiffness. Aluminum is corrosion resistant, but very susceptible to failure from fatigue. With this susceptibility in mind, most aluminum bicycle frames are designed to be Jarringly stiff in order to compensate and avoid fatigue failure. However, because of this, a lot Carbon Fiber Carbon fiber is the newer composite being used in higher-end bicycles.

Unlike steel or aluminum, carbon is not a metal it's a composite of carbon strands, being the matrix, pressed together in layers with an epoxy glue. The interesting thing about carbon is its ability to be shaped into various aerodynamic forms. Carbon is extremely light and very stiff. In fact, under load, a carbon frame tends to tighten and become more stiff as it flexes. Carbon fiber is also corrosion resistant, but require constant care as a deep scratch or hard bump could seriously compromise the structural integrity of a carbon fiber frame.

Carbon Fiber frames are also by far the most expensive of these bicycle materials, but have the major advantage of being shaped from one large piece, thus eliminating the need of Joining multiple pieces via welding. [2] Forces Static Forces First and foremost the bicycle frame needs to be able to support itself and other components of the bicycle. These are considered static loads or forces as the bicycle is static and not in motion, therefore, without the rider, only gravity is acting on the bicycle.

A bicycle is statically unstable because it only has two contact points with the round and a good base of supports needs at least three contact points with the ground along with a center of gravity above the base of support . With the center of gravity not above the base support comes, dropping of gravitational potential when tipped, acceleration in direction of tip, no return to equilibrium until the vehicle tips over. Dynamic Forces Dynamic forces of a bicycle are those caused by the bicycle being in motion. With this in mind, we need to consider the forces created when the rider pedals.

Even though a bicycle is statically unstable, it is dynamically stable. This is caused from two main features: the bicycle's wheels. When wheels spin, they obtain angular momentum and with the rider, they then obey the principle of conserving angular momentum unless an external torque or twisting force is applied. Otherwise, that momentum and direction of momentum remain constant until static. So, once in motion on a bicycle, the wheels line up and stay like that as long as there's sufficient momentum. This is all made possible with what's known as " trail", which is a product of the bicycles rake and front fork design.

So, a dynamically stable bicycle outsourcers towards motion and rider input is only needed when there is a need to change the motion, not to maintain it! [10] Internal Forces Internal forces within a bicycle and its components are mostly caused by the rider bars and the rear frame, as well as the rider and the rear frame. Friction exits anywhere where parts are in contact with each other and move against each other (drive train, steering mechanism, rear frame). Friction can also be seen in the brakes as well as the suspensions.

External Forces - Gravity: Conclusion Bicycle technology is in constant evolution especially with its high demand in a racial and economical means of transportation. Understanding and mastering the static and dynamic behavior of bicycles, no matter their purpose, has always been a topic of constant research and investigation. With research going into potential new bicycle frame materials, the hot-spot technique will prove vital in predicting the fatigue life of future designs and their success.