

Design Report

Dual suspension frames are purposely used to create a more comfortable ride whilst on rugged terrain. They are advantageous to an off-road rider, over jumps and descending a steep environment. Steel offers easy solutions to repair because of its malleable property it is possible to bend frames back into alignment and repair damage.

This is currently a typical strong bike that can carry one rider and added luggage panniers or racks if necessary. The purpose of the bike is to support touring or a riding adventure that requires long hours in the saddle, the ability to carry items and allow confidence to rely on its durability. All materials will fatigue over time but some faster than others. Steel will rust if not taken care of but is more durable than aluminium over the long term. The area you live and use the bike will have a massive effect in wet, humid climates. Carbon fibre and titanium frames have exceptionally high fatigue rates meaning they will last and last and last.

Which is why I have chosen to manufacture the motor bike frame out of carbon fibre and aluminium for the joining material of other main components, in order to make it a light weight endurance motor bike. Aluminium is incredibly low in density and has the capacity to resist the effects of corrosion. Aluminium and its alloys are essential in the aerospace, transportation and building industries. The use of Carbon Fibre in manufacturing unquestionably changed the industry, the manufacturing process and the appeal to the target market. Its faultless properties make it an ideal first choice for modern day bikes due to its high stiffness to weight ratio, adeptness to customise frame shapes, high resistance to fatigue and the experimentation it allows manufacturers to form any shape and design the need to create. Other materials have difficulties and restricted designs hitches offered when using them, they are problematical to work with and prove to have restricted design capability. Conversely, Carbon fibre is effortlessly mouldable and offers itself with no difficulty to be shaped in practically any way to meet the manufacturers designs and specifications. The primary factor is Carbon's strength-to-weight benefit, as opposed to other materials, during the process of building the frame. The raw material the produces Carbon fibre resembles a strand of wool or string and arrives on a spool. To make it into a useable product the carbon fibre is laid out side by side in parallel lines and then fused with resin in a unidirectional fashion to build the recognisable sizeable sheets of carbon fibre. The manufacturer can then cut them as required to This is then cut to fashion frames and other components.

European supplier Dexcraft Composites states "A component made from standard carbon fibre of the same thickness as an aluminium one will offer 31-percent more rigidity than the aluminium one, and at the same time, weigh 50-percent less and have 60 percent more strength. High modulus carbon can boost those numbers significantly."

The quality and class of the carbon fibre used will affect the final product and its usage. Carbon fibre can be either rigid or robust, but not both. With this in mind, during the design process, engineers will specify where stronger fibres need to be applied to the areas where strength is needed, such as the headtube. This is a point that encounters high stress and the fibres will prevent the frame damaging and fracturing.

The bottom bracket is another example where the frame requires stiffness to enhance power transfer. Top quality frames use high stiffness fibres called 'Ultra High Modulus', although there is no customary name so when one brand uses 'Ultra High Modulus' other brands will use a different term. The only failure of carbon fibre is that it has been known to crack under extreme tension when over tightening bolts or after a substantial impact. Unfortunately this compromises the product's integrity the material will be unstable, dangerous to use and will require repairing or replacing.

The carbon for the frame is layered over an EPS foam mandrel. When all of the carbon is applied to the mandrel, it is then carefully laid into the mould. The two halves are brought together, and it is taken to a heated press. The nylon bladder is pressurized to force the layers of carbon together against the inside of the mould while the press runs through a heating cycle that can take well over an hour. When the mould has cooled sufficiently, it is then hammered and prised apart, if the process is successful a frame is produced that needs just minimal sanding. The moulds will mostly be re used for one to three years.

In order to be appealing motor bike companies, boast about using "aerospace grade metals", actually their alloys will have to obey the quality requirements irrespective of their use, i.e. aircraft or a bike frame. In reality there is no difference in a motorbike made from 'military grade' material and one that isn't. In the process of designing a frame to be stiff enough, it will also have the strength to withstand cycling loads, and resist impact damage. The tougher the material the more punishment it will withstand by absorbing additional energy before failing, in other words it is designed to "fail" by bending instead of breaking. As Carbon offers a lighter weight, longer-lasting, corrosion-free frame, it is the choice of most professional riders wanting a peak performance.

By controlling the geometries and dimensions of the tubing used to build the frame also has a very large influence on ride characteristics. As tubing diameter increases, so does its stiffness. For a given amount of material (and weight), we can increase the diameter of a frame tube but must simultaneously reduce its thickness. Doing this, doubling the diameter results in four times the stiffness. To maintain the same stiffness for a lighter weight, we could use less material in a larger diameter, thinner walled tube. However, there is a limit to how thin tubing walls can be made before they become susceptible to damage, denting and more importantly buckling.

Currently it is found that the industry's carbon frame and component makers do not generate enough waste to make recycling a viable option. Toray, who are one of the world's largest carbon fibre producers, have said that, they have estimated there is 50 million pounds of carbon fibre scrap produce annually, furthermore, 2 million pounds of which is generated in Washington State, where Toray services Boeing's airliner production and aerospace are.

Toray's recycling factory in Port Angeles, Washington, is designed to recapture uncured carbon fibre in quantities that dwarf the cycling industry. The carbon scrap just generated by Boeing and friends next door in Seattle could make 400,000 carbon frames a year. Carbon recycling facilities are established near all of the world's manufacturing centres, but they need large volumes from known sources to produce high-quality products. Due to this recycling issue it would increase the price of the product because although carbon fibre is a wonderful modern material it still has some negatives against its positives. When all points are considered it's still very beneficial to utilise carbon and the main material due to its unbelievable properties. Whilst recycling is environmentally friendly conserving resources is even better, therefore producing goods that have durability and endurance is seen as good sense and by many businesses is considered a long-term investment.

Carbon's disadvantage is that it can be less recyclable, however this is balanced with the fact that a well-made carbon frame and components will offer longevity of use and therefore prolong their performance and appearance for many years. Having a carbon fibre bike, that will last longer than a frame from other materials, means that the owners are even less likely to recycle their frames than those that have purchased an aluminium frame. It has been proven that Carbon bikes are far more resilient and unaffected by fatigue and corrosion. They mostly out-last aluminium and will resell easily and offer a better second hand price. In addition, it is easy to fully repair, to its original strength and integrity, broken or cracked carbon frames, on the contrary it is difficult to weld back most aluminium frames, without reducing them back to bare metal and sending them off to heat treat. The advantage is though that Aluminium can be readily recycled. Ultimately, a carbon bike is suited to be passed on or down to the next generation.

<u>Bill of materials</u>		
PART	MATERIAL	CONSTRUCTION
The main frame	Carbon Fibre	Wrapped around a mould and hardened with an epoxy resin.
Metal joining parts for other components	Aluminium	Holds are drilled into carbon frame and metal parts joined by locking nut and bolt.



Heavy

Bulky

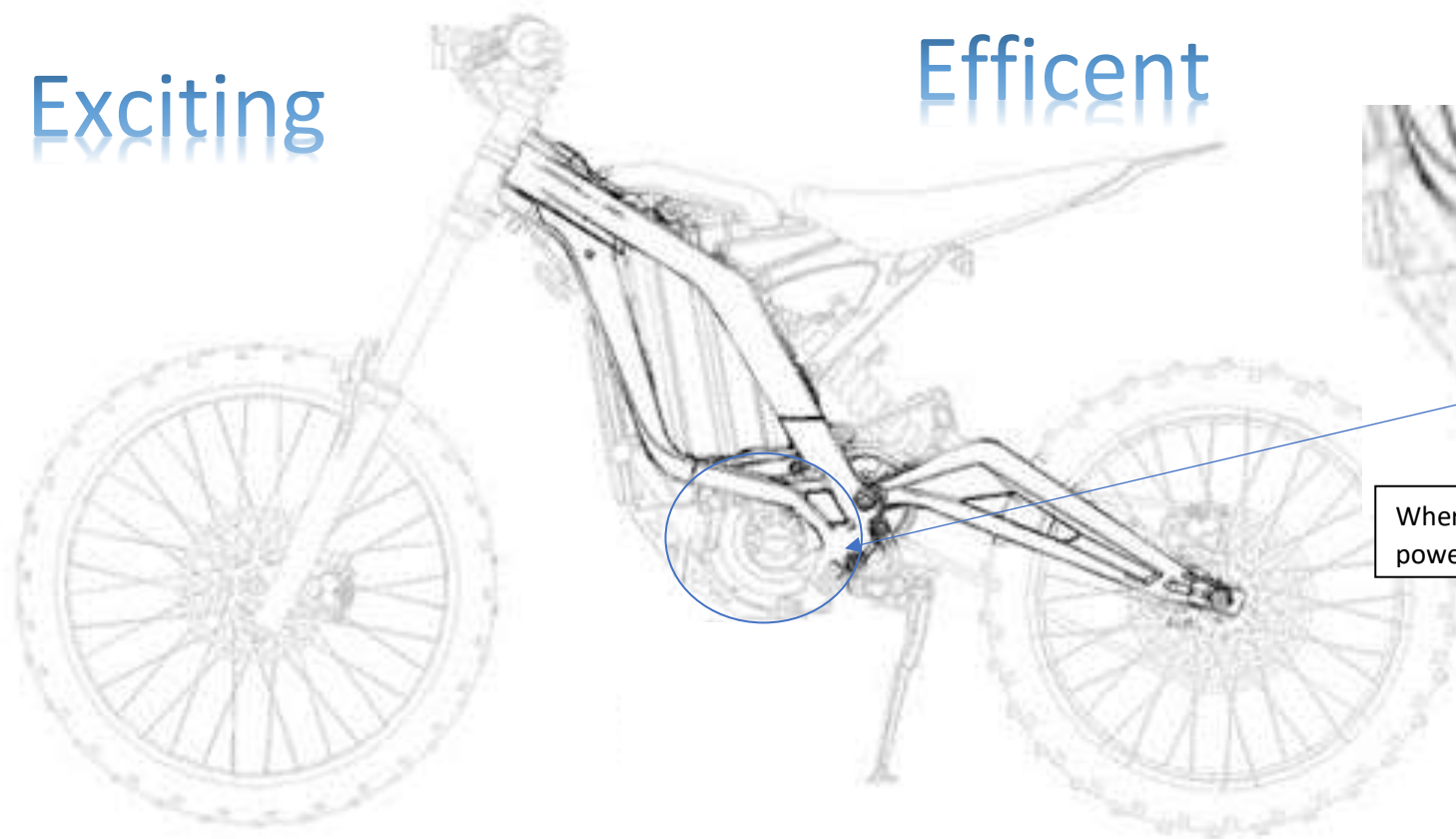
Simplistic Form

Old Fashioned
Design

Modern Design

Exciting

Efficient



Where the DC motor will be located to power the motorbike.

Creative

Product Analysis Poster



This is a bicycle frame made from mild steel. What are the properties of mild steel that have been used beneficially?

Dual suspension mountain bike frame

Toughness. Mild steel will be able to flex slightly to absorb bumps as the bike is ridden

Ductility. Mild steel is quite ductile therefore it can be drawn out into tubes.



Bending strength. tubular form, mild steel has good bending strength.

Can be brazed easily so that it can be fabricated into the frame shape.



This is the raw material, mild steel tubing with connector lugs. The frame would have been brazed together.